

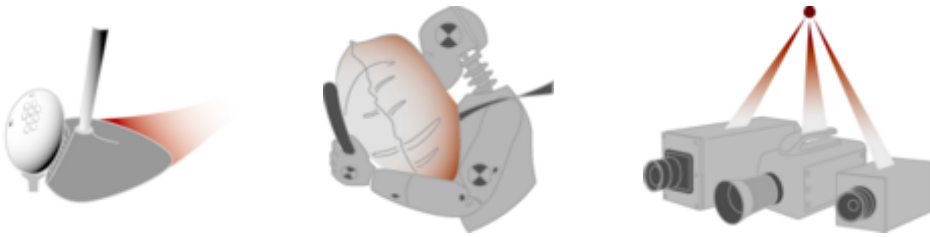


User's guide

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TEMA

Welcome to TEMA!



TEMA is a software package for motion analysis, based on the TrackEye technology from [Image Systems AB](http://www.imagesystems.se).

- [What's New?](#)
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- [Using the Help System](#)
- [System Versions](#)
- [TEMA Viewer](#)

Note: The same information as in this online help system can be found in standalone TEMA manual in .pdf form.

Look in your TEMA installation folder\Help. The software Acrobat Reader from Adobe is required to open this file.

If you have any questions or problems with this software, please [e-mail](#) our technical support.

For additional information about Image Systems AB and our products, please visit our website, www.imagesystems.se

Using the Help System

- The majority of dialogs and windows contain either a Help button, or appropriate options in a Help menu, to enable context-sensitive help to be displayed from the application.
- Context-sensitive help can also be displayed by pressing the <F1> key when the appropriate dialog or window has been selected. This is particularly useful for simple windows that contain only graphical information, i.e. those that do not have buttons or a menu.
- The simplest dialogs do not have a specific help topic, especially if the dialog itself contains its own instructions. If help is required for such dialogs, return to the parent dialog and access help from there.
- Once a help topic has been displayed, you may follow the hyperlinks to associated information.

System Versions

To match different user conditions, TEMA comes in a broad variety of versions.

- The base products are TEMA Motion and TEMA Automotive. There is also the Camera Control version, which is a freestanding product. This can however, be combined with analysis functionality.
- Optional products are [TEMA Arena](#) and [TEMA Gun Scoring](#)
- For users who do not need all 2D functionality, there are pre-set 2D entry configurations with limited functionality. Those are listed below.
- Further customization can be done using in a huge number of different optional functionality.

Available 2D entry configurations

Besides the 3D and 6D options, TEMA 2D is also offered in a number of different entry levels, where your specific application determines the level of TEMA you require. An entry level can over time be updated to a higher level of TEMA. A summary of the functionality is described below.

TEMA Starter 1: Allows tracking of single point with correlation tracker. Possible to plot one point and make table of positions.

TEMA Starter 2: Allows tracking of 5 points with correlation tracker. Possible to plot points and make tables of positions, velocity and acceleration. Some additional scaling functionality.

[TEMA Lite](#): Starter 2 plus quad tracking, X/Y diagrams and export of data. A TEMA Lite user has also possibility to upgrade to the major TEMA options like 3D, 6D etc.

TEMA Player: Image viewer and format conversion. It can view all formats that TEMA can view, but no analysis can be done. There are two versions of this one, Player 1 and 2. Player 2 can

Optional functionality

[3D](#)

[6D](#)

[TEMA Lens calibration](#)

[Airbag Contour Tracker](#)

[Airbag Volume](#)

[MXT Tracker](#)

[TEMA Viewer](#)

[Advanced Viewer](#)

Required configurations

The different TEMA options require different basic functionality and are therefore not available to all configurations of TEMA. Below is a list of which configuration that is required for a certain TEMA option.

| | TEMA Starter I | LITE | TEMA Motion | TEMA Automotive |
|---|----------------|------|-------------|-----------------|
| Options | | | | |
| Dongle licence | | • | • | • |
| Floating license | | • | • | • |
| 3D | | • | • | • |
| 6D | | | • | • |
| MXT tracker | | | | • |
| Airbag Volume | | | | • |
| Lens calibration Image Systems | | | • | • |
| Lens Calibration Aicon | | | • | • |
| Viewer | | | • | • |
| Advanced Viewer | | | • | • |
| 3D with moving cameras | | | • | • |
| Outline tracker, threshold based (TEMA motion option) | | | | |
| Adv. Outline tracker, edge based (TEMA motion option) | | | • | not applicable |

TEMA Camera Control

TEMA [Camera Control](#) is an option to TEMA, the world leading system for advanced motion analysis, and it offers the possibility to control several different brands of high-speed cameras from one single program.

Lite Version

The Lite version contains functionality applicable to a broad range of simpler situations.

The standard Lite version contains the following menu options:

- File
 - New
 - [Camera View](#)
 - [Data File](#)
 - [New Test](#)
 - [Open Test](#)
 - [Save Test](#)
 - [Save Test As](#)
 - [Exit](#)
- Edit
 - [Copy](#)
 - [Delete](#)
 - [Test Description](#)
 - [Time Properties](#)
 - [Scaling/Grid](#) (2D Scaling, coordinate Grids only)
 - [Properties](#)
- View
 - [Zoom In](#)
 - [Zoom Out](#)
 - [Zoom 1:1](#)
 - [Notes](#)
 - [Split View](#)
 - [Show Window](#)
- Camera
 - [Add Point](#)
 - [Add Distance](#)
 - [Add Angle](#)
 - [Goto t0](#)
 - [Set t0](#)
 - [Show Camera View Windows](#)
 - [Show Zoom Windows](#)
 - [Image Enhancement](#)
 - [Select New Image File](#)
 - [Rename View](#)
- Tracking
 - [Enable](#)
 - [Disable](#)
 - [Sleep](#)
 - [Sleep in Selected Interval](#)
- Diagram
 - New
 - [XT Diagram](#)
 - [XY Diagram](#)
 - [Table](#)
 - [Grid](#)
 - [Legends](#)
 - [Legends Settings](#)
 - [Export Data](#)
- Tools
 - [Select](#)

- [Relation](#)
- [Distance](#)
- [Angle](#)
- [Zoom](#)
- [White Balance](#)
- [Toolbars](#)
- [Licence](#)
- [Optimize Display Performance](#)
- [Preferences](#)

Note: Your configuration may differ from the above standard version.

Getting Started

This section outlines the basic steps for each mode of operation, providing links to the detailed instructions for each step.

The TEMA system is capable of operating in the following modes:

- [2D](#)
- [3D](#)
- [6D](#)
- [DIC](#)

Note: 3D, 6D & DIC are optional features.

2D - Getting Started

The following is the list of steps required to set up an image sequence, track it in two dimensions and display the results graphically:

1. [Start up TEMA.](#)
2. [Add a new camera view.](#)
3. [Add some tracking points.](#)
4. [Position the tracking points.](#)
5. [Run the tracking function.](#)
6. Display the results, as required, in:
 - o [An XT Diagram](#);
 - o [A Multi Axis Diagram](#);
 - o [An XY Diagram](#);
 - o [A Time Table](#).
7. [Save the results.](#)

Getting Started - 3D (Optional Feature)

The following is the list of steps required to set up two image sequences from two camera views taken of the same test, track them in three dimensions and display the results graphically.

Note: The original filming must be carried out under the following conditions:

- The two cameras must be positioned far enough apart, compared to the distance to the target to give a significant difference in perspective. The best results are obtained when the two cameras and the centre of the target roughly form an equilateral triangle. If the angle from the target to the cameras is small, poor results are obtained.
- A minimum of four reference points are required for accurate orientation of the cameras.
- The two film sequences must include a significant event that is easily identifiable to enable the two sequences to be synchronised. This can be, for example, the point of impact in a crash test or the momentary illumination of a light source.

1. [Start the TEMA system.](#)
2. [Add the first camera view.](#)
3. [Use the White Balance tool to adjust the displayed colours for the first camera view.](#)
4. Repeat steps 2 and 3 for the second camera view.
5. If you wish to use a different coordinate system, see [Maintaining 3D Coordinate Systems](#).

6. Synchronise the first camera view:

- [Position the displayed sequence at the significant event.](#)
- [Set t0 to this time.](#)
- [Insert reference points from a calibration target.](#)

7. Repeat step 5 for the second camera view.

Note: The reference points for the second camera view are inserted automatically from the same file as was selected for the first camera view.

8. Calibrate the first camera view:

- [Select all the reference points in the camera view.](#)
- [Assign the required tracker to the group of reference points.](#)
- [Position the reference points in the camera view.](#)
- If a point is not visible, [put the tracker to sleep for that point.](#)
- [Set up the orientation of the reference points from the camera view.](#)

9. Repeat step 7 for the second camera view.

If any of the points are visible in one camera view, but not in the other, a [help line](#) is shown in the camera view where the point is not visible. The position of the point lies somewhere along the help line if it is behind a foreground object, or somewhere beyond the end of the help line if it is outside the image area.

[A 3D results node is added to the Test Contents window.](#)

10. At this stage you can [display a table containing the calculated 3D positions](#) of the reference points and compare them with the measured positions specified in the calibration target file.

11. For each camera view, disable the reference points:

- [Select all the reference points in the camera view.](#)
- [Disable the tracker.](#)

12. For each point you wish to track:

- Select the first camera view.
- [Add the point, give it a suitable name and assign the required tracker to it.](#)
- Select the second camera view.
- [Add the point, give it the same name and assign the required tracker to it.](#)
- (Assigning the same name is done by selecting the name from the 'Select from' drop-down list in the Point Setup dialog, or simply by keying the same name.)
- A target point with the same name is automatically added to the 3D results node.

13. [Position the time at t0.](#)

14. [Position each point to be tracked in both camera views.](#)

15. [Position the time to the required start time.](#)

16. [Run the tracking.](#)

17. Display the results, as required, in:

- [An XT Diagram;](#)
- [A Multi Axis Diagram;](#)
- [An XY Diagram;](#)
- [An Advanced Diagram;](#)
- [A Table.](#)

18. [Save the results.](#)

Note: The calibration data is saved with the test set up and results. [It may be imported](#) into a later test to avoid the need to set up the calibration again.

Getting Started - 6DOF (Optional Feature)

The following is the list of steps required to set up an image sequence from a single camera view taken of a target containing a number of tracking points, track them in six degrees of freedom and display the results graphically.

1. [Start up TEMA.](#)
2. [Add the camera view.](#)
3. [Position the time to the required start time.](#)
Note: The position of the target in this image defines the coordinate system.
4. [Insert target points from a target model.](#)
5. [Select all the target points in the camera view.](#)
6. [Assign the required tracker to the group of target points.](#)
7. [Position the target points in the camera view.](#)
8. At this stage you can [display a table containing the calculated 6D positions](#) of the reference points and compare them with the measured positions specified in the calibration target file.
9. [Run the tracking.](#)
10. Select coordinate system for the 6DoF output (Menu 'Camera': '6DoF Coordinate System...')
11. Display the results, as required, in:
 - o [An XT Diagram](#);
 - o [A Multi Axis Diagram](#);
 - o [An XY Diagram](#);
 - o [A Table](#).
11. [Save the results.](#)
Note: The calibration data is saved with the test set up and results. [The calibration data may be imported](#) into a later test to avoid the need to set it up again.

See Also

[6D Calculations](#)

Working with TEMA

Starting up and Closing down

Starting up

Note: If you attempt to start an unlicensed copy of TEMA, the Unlicensed dialog is displayed, which requires you to acquire a licence before continuing. See [Managing Licences](#).

Start the system by:

- Double-clicking on the TEMA application icon in the Programs list in the Windows Start menu.

OR

- Click on the TEMA application icon in the Windows desktop. When TEMA has started, and if a path to the Templates Directory is given in the [Preference Archive/Directories](#), the Select [Template](#) dialog will open. The dialog will list the available Templates in the Templates Directory as set in the [Preference Archive](#). If enabled in the [Preference Archive](#), the <Empty Test> template is available also. This is just an empty test with no setups at all. In this dialog, select the template to load into TEMA. When a template has been loaded, an asterisk in the TEMA title bar will indicate that the test is not saved yet. Note: If no path to the Templates Directory is given, the <Empty Test> template will load by automatically.

OR

- Double-clicking on a TEMA test file in Windows Explorer. In this case the selected test is automatically loaded.

If the XXXX test exists message dialog is displayed, this indicates that TEMA did not close down properly when you last worked with it. Continue by selecting the appropriate button:

- Use Autosave - to continue working with the autosaved test;
- Create new test - to discard the autosaved test and create a new one.

The Autosave feature automatically makes a backup copy of the current test at regular intervals. The latest backup copy is made available after the TEMA system is not closed down properly, typically as a result of a software problem.

Closing down

Close the system by selecting the Exit option from the File menu. If there is unsaved data in the current test, the Unsaved Changes dialog is displayed. This dialog is also displayed if there are unsaved changes when [closing](#), [opening](#) or [starting](#) a test. The dialog offers the following options:

- Save - saves the changes to the current test file. If the file is read-only, this option is disabled.
- Save As - displays the Save As dialog to enable changes to be saved to a different, or new, test file.
- Discard - discards the changes and close the system.
- Cancel - leaves the test open without closing the system.

Optimising Performance

The display of images can be optimised to increase performance. The Display Performance Setup dialog is displayed when the system is upgraded or re-installed. It contains buttons to initiate the performance

test in two modes. When the test has been completed, the Archive window is displayed.

After a hardware upgrade, e.g. the installation of a better graphics card, it may be appropriate to rerun the performance test. You may run the test in either of the modes.

The modes are:

- Run performance test automatically to suggest settings - runs a benchmark test during which various items are displayed. No intervention is required.
- Select display settings manually - enables you to specify which of a number of alternative methods is to be used to optimise the display.

It is recommended that other software is closed down while the tests are being conducted and that no user action is taken.

1. Select the Optimize Display Performance option from the Tools menu in the Archive window. The Display Performance Setup dialog is displayed.
2. To run the test automatically:
 - Select the Run performance test to suggest settings button.
 - The Automatic Display Performance Test dialog is displayed.
 - Select the required Optimization Criteria:
 - Colour most important
 - Grayscale most important
 - Specify the Compatibility Setup.
 - The use of DirectDraw can cause problems on some computers. If this happens, select the Skip DirectDraw Test check box and rerun the test.
 - Select the Test button.
 - When the test is finished a message is displayed, which indicates that the optimization does not take effect until all image windows have been closed and reopened.
 - Select the OK button.
3. To run the test manually:
 - Select the Select display settings manually button.
 - The Manual Display Performance Test dialog is displayed.
 - Select the required display optimisation method:
 - Standard
 - DirectDraw
 - Note: This method causes problems on certain computers. If it does, select a different method.
 - Optimized 1
 - Optimized 2
 - Select the OK button.
 - The selected method is applied, but the optimization does not take effect until all image windows have been closed and reopened.

TEMA Main Window

The [TEMA Main Window](#) is displayed directly when the [system is started](#).

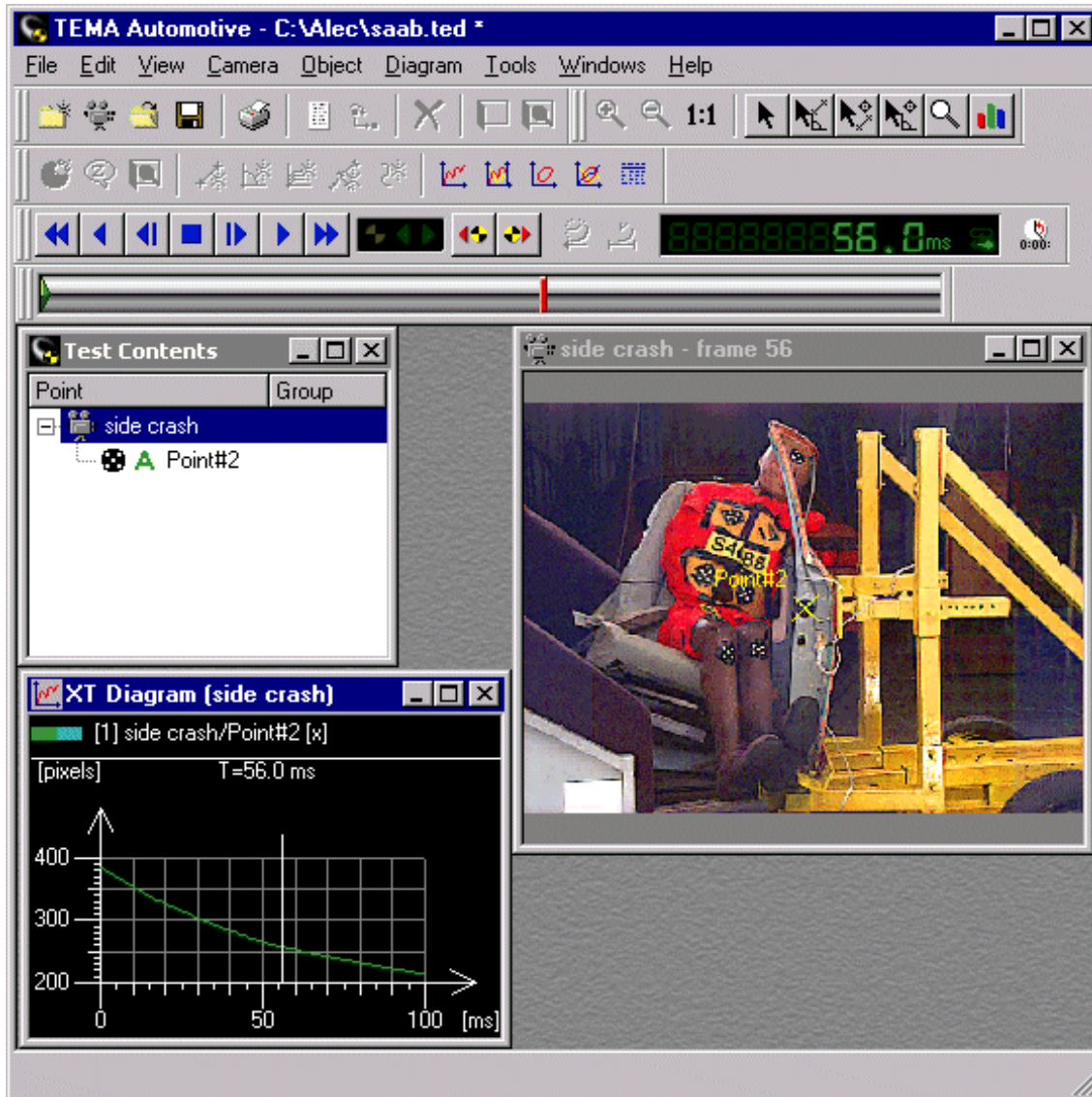
The window contains:

- A [menubar](#);
- Several [toolbars](#);
- A [display area](#);
- A [Test Contents window](#).

In general the appearance of the window and subordinate windows and dialogs reflects the Windows NT/XP style. Specifically:

- Toolbars - Floating toolbars are used throughout the system, which means that you can drag and drop them to any convenient position on the screen.
- Tooltips - Tooltips are displayed for tool buttons and other applicable items.
- An hourglass is displayed during time demanding operations.
- Many items have a pop-up menu displayed via the right mouse button. The options displayed depend on the type of item selected and its context.

TEMA Main Window - Illustration



TEMA Display Area

The TEMA window display area is used to display all the information related to the current test. The information is displayed in subordinate windows that cannot be moved outside the boundaries of this display area.

Note: Dialogs used to set up tests may be moved outside the display area.

Test Contents

The Test Contents window is used to overview all the items included in the current test, such as camera views, target points, diagrams, stick figures, angles etc. In a 3D test, the 3D results are also in the test contents list.

The items in the list are organized in a tree structure that can be expanded (+) and collapsed (-) in the standard manner.

Icons are used to indicate the type of item and its state. For a tracked point, its state in the current image is displayed as a [pair of icons](#).

Displaying an item in the list

Clicking an item in the list will make a [window](#) to appear displaying the marked item (Camera view, point zoom etc).


Multi selecting items in the list

Items can be multi-selected in the Test Contents tree by holding the <Ctrl> key while selecting items in the list.

Multi selecting grouped camera views in the list

Holding the <Alt> key while clicking one camera view in the list will select all other views in the list in the same [group](#). (Camera Views, points etc)

Managing Diagrams via Test Contents

- Deletion of diagram(s):
 - Select or multi select the diagram(s) in the Test Contents tree, right-click and select Delete.
 - OR
 - Select or multi select the diagram(s) in the Test Contents tree and select the  button.
- Show closed or hidden diagram(s):
 - Select or multi select the diagram(s) in the Test Contents tree, right-click and select Show Window.
 - OR
 - Select or multi select the diagram(s) in the Test Contents tree and double-click on the diagram(s).
- Create an editable Diagram Copy:
 - Select the diagram/table in the Test Contents tree, right-click and select Create Diagram Copy.
 - This command creates an editable copy of the existing diagram/table, any changes can be made (via Diagram Properties) without changing the original diagram/table. Valid for XT, Multi Axis, XY, Advanced, 3D, Image Diagram, Time Table and Point Table.
- Create a Time Table with selected data:
 - Select the diagram/table in the Test Contents tree, right-click and select [Copy to Time Table](#).
 - This command creates an editable copy of the existing diagram, any changes can be made (via Diagram Properties) without changing the original diagram/table.

See also...

[Windows](#)

TEMA Menu

The TEMA window menubar contains the following options:

- [File](#) - controls tests, views and printing.
- [Edit](#) - manipulates data and system settings.
- [View](#) - controls the display of windows.
- [Camera](#) - controls the use of the camera.
- [Tracking](#) - controls the tracking function.
- [Diagram](#) - controls the display of diagrams.
- [Tools](#) - controls the use of system tools.
- [Windows](#) - contains a list of open windows.
- [Help](#) - controls access to the help system.

File Menu

The File menu contains the following options:

- New Camera View - Displays the Open Image Sequence dialog to [open an image file](#) as a camera view.
- Add Camera - (Optional Feature) Displays the [Add Camera dialog](#).
- New Data File - Displays the standard Open dialog to [open a fixed format data file](#).
- [New Test](#) - Clears the display area and the Test Contents window ready for a new test.
- [Open Test](#) - Displays the standard Open Dialog to open a previously saved test.
- [Save test](#) - Displays the standard Save dialog to save the current test. (If the test has not been saved previously, the Save As dialog is displayed.)
- [Save Test As](#) - Displays the standard Save As dialog to save the current test under a different name.
- [Create Template](#) (optional) - Displays the Create Template dialog where a Template can be created. Saves the test as a template in the specified [Template directory](#).
- [Manage Templates](#) - Displays the Manage Templates dialog, where the user can manage the User Templates or the Factory Templates.
- [Start Test](#) (optional) - The Start Test Command when working towards a [Test Database](#).
- [Refresh Test](#) (optional) - The Refresh Test Command when working towards a [Test Database](#).
- [End Test](#) (optional) - The End Test Command when working towards a [Test Database](#).
- [Export to Viewer CD](#) - Displays the Export to Viewer CD dialog to export the test to a viewer CD.
- [Import View](#) - Displays the standard Open dialog to import a camera view.
- [Print](#) - Prints the selected displayed image, diagram or table.
- [Print Report](#) - Displays the Print Reprt dialog to print a test report.
- "Test List" - Contains the ten most recently used tests, which may be selected directly to open a test.
- [TEMA Test Database Interface \(optional\)](#)
- [Exit](#) - Closes the system.

Edit Menu

The Edit menu contains the following options:

- Undo - [Cancels the last operation](#).
- Redo - [Restores the last operation that was undone](#).
- Copy - [Copies the selected data to the clipboard](#).
- Paste - [Pastes the selected data into any appropriate application](#).
- Delete - [Deletes the selected item](#).
- Find Image - [Helps to identify images](#).
- Test Description (optional) - [Creates and maintains a description of the test](#).
- Test Data (optional) - [Gun Scoring test Data setup](#).
- Test Sections (optional) - [Test Sections setup](#).
- Test Attributes (optional) - [For setup of additional test information](#).
- Time Properties - Displays the Time Properties dialog to enable you to [set the time properties for the test](#).
- Combined Image Export - Wizard for [exporting a merged external presentation of selected image sequences](#), diagrams etc., in which the user decides and designs the contents and layout.
- Scaling/Coordinate Systems - Displays the [Scaling / Coordinate Systems dialog](#) to enable you to specify [motion planes](#), [coordinate systems](#) and [coordinate grids](#).
- 3D Coordinate Systems (optional) - Displays the [3D Coordinate Systems dialog](#) to enable you to add and maintain 3D Coordinate Systems. This option is only displayed if you have the optional 3D feature installed.
- 3D Interpolation (optional) - Specifies the [3D Interpolation of sleeping points](#) (No interpolation, Linear or Cubic interpolation).
- Area of Interest - [Defines a rectangular area of interest](#) in a camera view that can be used to limit the part of the image used for Image Enhancement and Image Export.
- Default Trackers - A user-defined set of tracker icons shown in the [Default Trackers toolbar](#). The tracker icons can be added, edited, removed or renamed.
- Properties - [Displays the properties of the selected item](#) from the Test Contents window or a Diagram window.

View Menu

The View menu contains the following options:

- Zoom In - [makes the image larger](#).
- Zoom Out - [make the image smaller](#).
- Zoom 1:1 - [returns the image to its normal size](#).
- Split View - [displays multiple images from a camera view](#).
 - Single - the current image is displayed in the normal manner.
 - Multi - the image area is split into a number of rectangles, each showing a different time.
 - Hscroll - as Multi, but the images are displayed in one row that can be scrolled horizontally.
 - Vscroll - as Multi, but the images are displayed in one column that can be scrolled vertically.
 - Showall - displays all images.
 - Setup - customises the split view.
- Show Window - [Displays the selected camera view](#) in the display area.
- Show Zoom Window - [Displays the Zoom window](#) for the selected camera view.
- Image Enhancement - [Adjusts the colour parameters](#) to improve the display of images.
- Time Overview - displays the [Time Overview](#) window.
- Notes - [saves the contents of the status bar in a set of notes](#).

Camera Menu

The Camera menu contains the following options:

- Add Point - [Adds a point to the selected camera view.](#)
- Add Point Generator (Optional) - [Adds a point generator to selected camera view.](#)
- Add Distance - [Adds a distance to the selected camera view.](#)
- Add Angle - [Adds an angle to the selected camera view.](#)
- Add Stick Figure - [Adds a stick figure to the selected camera view.](#)
- Add Contour - [Adds a contour to the selected camera view.](#)
- Add Corridor - [Adds a set of corridors to the selected camera view.](#)
- Add Exclude Rectangle - [Excludes a certain area\(s\)](#) in the image for the tracker.
- Add Exclude Polygon - [Excludes a certain area\(s\)](#) in the image for the tracker.
- Add Body Model (Optional - TEMA Biomechanical System only) - Adds an existing body model.
 - [Import from File](#)
 - [Copy from Other View](#)
- Point Groups
 - Create Point Group - [Creates a point group](#)
 - Import Point Group - [Imports a point group](#)
 - Move Selection to Group - [Adds points to a point group](#)
 - Add Group to Selection - [Adds points to a multiple point groups](#)
 - Remove Selection from Group - [Removes points from a point group](#)
- Goto t0 - [Sets the current time to t0.](#)
- Set t0 - [Sets t0 to the current time.](#)
- Control Time - [Selects the camera view used to control time steps.](#)
- Rename View - [Displays the Rename View dialog.](#)
- Insert Reference Points (3D) - See Insert Target Points below.
- Insert Target Points (6D) - [Inserts reference/target points](#) for setting the orientation of the camera.

Note: This option is only displayed if you have the optional 3D or 6D feature installed. In the 6D option it is called "Insert Target Points".
- Edit Reference Points (3D) - See Edit Target Points below.
- Edit Target Points (6D) - Review the used [reference/target points](#).
- [Lens Calibration](#)
- [Wand Calibration](#)
- [Camera Orientation](#)
 - [Static Camera Orientation](#) (optional: 3D).
 - [Relative Camera Orientation](#) (optional: 3D).
 - [Enter Camera Orientation](#) (optional: 3D or 6D).
 - Reset Camera Orientation - Resets the Camera Orientation if confirmed.
- Import Camera Parameters - [Imports calibration and orientation data](#) from a previous test. This option is only displayed if you have the optional 3D or 6D feature installed.
- [6DoF Coordinate System](#) - Select coordinate system for the 6DoF output, it is either
 - Object coordinate System at t=0
 - Camera Coordinate System
- [Export Images](#) - Exports images:

- [from a single camera view window or zoom window.](#)
- from multiple camera views.

The following options are only displayed if the Camera Control optional feature is included in the system.

- Assign Camera to View - [Relates physical cameras to logical cameras](#) in the test description.
- [Camera Setup Window](#) - Specifies the parameters for the cameras in the test.
- Scan for Cameras - [Scans the available network](#) to identify all the attached cameras.
- Set Black Reference - [Sets a "black area" as a reference point for the cameras](#) in the test.
- Download Images - [Manually downloads images from the cameras](#) in the test.
- Arm - [Activates the cameras](#) in the test.
- [Snapshot Recording](#) - Captures and records short image sequences (similar to Arm command).
- [Redo Auto Download](#) - Performs the Auto Download command, which makes it possible to automatically download the image sequences captured by the camera(s).
- Clear Cameras - [Deletes all the images from all the cameras](#) in the test.
- [Normal Snapshot](#) - Snapshot captured using normal light.
- [Low Light Snapshot](#) - Snapshot captured using low light.

Tracking Menu

The Tracking menu contains the following options:

- Enable - [Enables the tracker](#) for the selected point in the Test Contents window.
- Disable - [Disables the tracker](#) for the selected point in the Test Contents window.
- Sleep - Causes the tracker to [register the selected point as being asleep](#) in the current and successive images.
- Sleep in Selected Interval - [Puts the selected point to sleep in the current image](#).
- Position... - Enables the user to [manually set the pixel coordinates of a tracking point](#).

Diagram Menu

The Diagram menu contains the following options:

- New - Creates new diagrams.
 - XT Diagram - Displays an [XT Diagram](#) - a 2D diagram with time on the x-axis and a component on the y-axis.
 - Multi Axis Diagram - Displays a [Multi Axis Diagram](#) - a 2D diagram with up to four Y axes.
 - XY Diagram - Displays an [XY Diagram](#) - a 2D diagram with component on both axes.
 - Advanced Diagram - Displays an [Advanced Diagram](#) - a complex 2D diagram, i.e. individual components from different sequences can displayed against each other
 - Table - Displays a [Table](#) containing selected data.
- Grid - Toggles the [display of a grid](#) on a diagram.
- Legends - Toggles the [display of legends](#) on a diagram.
- LegendSettings - Specifies the content of the [legend bar](#).
 - Alt Colour - displays the both the legend colour and the alternative legend colour in the legends definition bar.
 - Note: Interpolated points are always displayed in the alternative colour. irrespective of whether the legends are shown or not.
 - Vertical Axis Min - displays in the legend the minimum vertical value, together with the horizontal axis value at which it occurs.
 - Vertical Axis Max - displays in the legend the maximum vertical value, together with the horizontal axis value at which it occurs.
 - Horizontal Axis Value - displays the current horizontal axis value.
 - Vertical Axis Value - displays the current vertical axis value.
- Export Data - [Exports data](#) from a Table.

Tools Menu

The Tools menu contains the following options:

- [Selection](#) - Activates the Selection Tool used for placing points in an image.
- [Distance](#) - Activates the Distance Measurement Tool.
- [Angle](#) - Activates the Angle Measurement Tool.
- [Velocity/Distance](#) - Activates the Velocity/Distance Measurement Tool.
- [Zoom](#) - Activates the Zoom Tool.
- [White Balance](#) - Activates the White Balance Tool.

- [Toolbars](#) - Contains a sub-menu entry for each Toolbar, which is used to toggle the display of the Toolbar.
 - Standard.
 - Tools.
 - Data.
 - Time Panel.
 - Time Slider.

- [Licence](#) - Manages TEMA user licences.
 - [Request](#) - Requests a new licence key.
 - [Install](#) - Installs a licence key.
 - [Transfer](#) - Transfers a licence key.
 - [Connect](#) - Connects to a floating/site licence.
 - [Disconnect](#) - Disconnects to a floating/site licence.

- [Optimize Display Performance](#) - Runs the display performance test.

- [Corridors](#) - Creates and maintains a set of corridors held in an external file.
- [Body Model](#) - (Optional Feature)
- [AICON Lens Calibration](#) - (Optional Feature) Performs AICON lens calibration.
- [Preferences](#) - Maintains Preference Settings.
- [Preference Management \(optional\)](#)

Windows Menu

The Windows menu lists the windows that are currently open. The Windows menu also contains the following options:




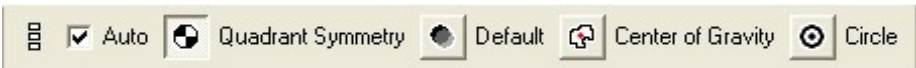

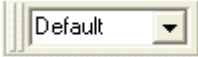




- Cascade - To overlap all currently open windows.
- Tile - To organise all currently open windows side by side.
- Minimize diagram windows - To minimize all diagram windows. This enables more calculation power as the diagrams will be temporarily disconnected.
- Restore diagram - To restore all minimized diagram windows which have been temporarily disconnected.

Help Menu

The Help menu provides information about this version of TEMA and access to the Help contents page. The TEMA Automotive option displays the TEMA Main Window help topic .

TEMA Toolbars

The TEMA window contains the following toolbars:


















- [Standard](#) 
- [Point Control](#) 
- [Tools](#) 
- [Default Tracker Settings](#) 
- [Data](#) 
- [Sections](#) 
- [Time Panel](#) 
- [Time Slider](#) 
- [Camera Control](#) 
- [Test Sequence](#) 

See Also...

[Displaying Toolbars](#)





Standard Toolbar

The Standard toolbar contains the following:

-  - [New Test](#)
-  - [New Camera View](#)
-  - [Add Camera](#) (Optional Feature - Camera Control)
-  - [Assign Camera To View](#) (Optional Feature - Camera Control)
-  - [Open Test](#)
-  - [Undo](#)
-  - [Redo](#)
-  - [Save Test](#)
-  - [Print](#)
-  - [Properties](#)
-  - [Scaling/Coordinate Systems](#)
-  - [Delete Selected Item\(s\)](#)
-  - [Copy Selected Item\(s\)](#)
-  - [Paste](#)
-  - [Open up a window](#)
-  - [Lock/Free Window](#)
-  - [Show Zoom Window](#)
-  - Open [Image Enhancement](#) dialog




Point Control Toolbar

The Point Control toolbar contains the following:

-  - [Enable](#)
-  - [Disable](#)
-  - [Sleep](#)
-  - [Sleep in Selected Interval](#)

Tools Toolbar

The Tools toolbar contains the following:

-  - [Zoom In](#)
-  - [Zoom Out](#)
-  - [Zoom 1:1 \(Normal size\)](#)
-  - [Selection Tool](#)
-  - [Distance Measurement Tool](#)
-  - [Angle Measurement Tool](#)
-  - [Velocity/Distance Measurement Tool](#)
-  - [Zoom Tool](#)
-  - [White Balance Tool](#)

Default Trackers Toolbar

The Default Tracker toolbar contains a user-defined set of trackers.

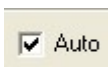
The tracker icons shown in the toolbar can be added, edited, removed or renamed.

When a new point is added to the test, the selection in the toolbar controls the settings of the point.

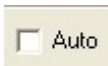
- Default Tracker Toolbar appearance by default.



- Example of Default Tracker Toolbar appearance when different trackers have been added.



- - If the "Auto toggle" is enabled, a left-click in the Camera View window will add and position a new point to the test.

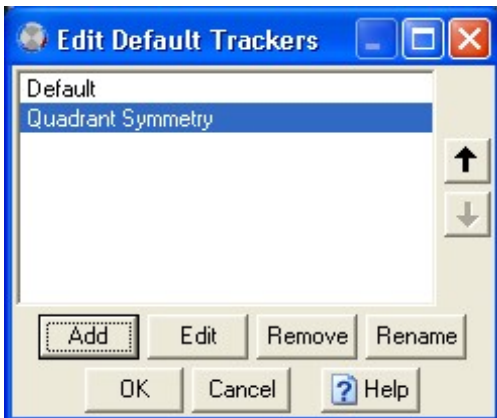


- - If the "Auto toggle" is disabled, the user must first [add a point](#) and then position it to the test.





- - Displays the toolbar vertically or horizontally.

- The content of the Default trackers toolbar can be changed from the Edit Default Trackers dialog by selecting the Default Trackers option from the Edit menu.



- The following changes of the Default Trackers toolbar can be made:
 - Add tracker:
 - Press the Add button and the [Point Setup](#) dialog will open.
 - Specify the properties of the tracker.
 - Press OK button and the tracker icon will be added to the Default Trackers toolbar.
 - Edit tracker:
 - Press the Edit button and the [Point Setup](#) dialog will open.
 - Edit the properties of the tracker.
 - Press OK button and the settings of the tracker icon will be updated.
 - Remove tracker:


















- Highlight the tracker icon name in the Edit Default Trackers dialog and press Remove button.
- Rename tracker:
 - Highlight the tracker icon name in the Edit Default Trackers dialog and retype the name in the Rename dialog.
- Change order of trackers:
 - Highlight the tracker icon name in the Edit Default Trackers dialog and press  or  button.

See Also...

[Definitions of different trackers.](#)









Data Toolbar

The Data toolbar contains the following:



-  - Add a [Point](#)
-  - Add a [Distance](#)
-  - Add an [Angle](#)
-  - Add a [Corridor](#)
-  - Add a [Stick Figure](#)
-  - Add a [Contour](#)
-  - Add [Exclude Rectangle](#)
-  - Add [Exclude Polygon](#)
-  - Add a [XT Diagram](#)
-  - Add a [Multi Axis Diagram](#)
-  - Add a [XY Diagram](#)
-  - Add an [Advanced Diagram](#)
-  - Add a [3D Diagram](#)
-  - Add an [Image Diagram](#)
-  - Add a [Time Table](#)
-  - Add a [Point Table](#)
-  - Add a [Report](#)

Time Panel Toolbar

The Time Panel toolbar contains the following:

-  - rewinds the image sequence.
-  - plays the image sequence backwards.
-  - positions the image sequence one step backwards.
-  - stops the movement of the image sequence.
-  - positions the image sequence one step forwards.
-  - plays the image sequence forwards.
-  - fast forwards the image sequence.
-  - shows the current play/track mode.

Note: In tracking mode, one of the green arrows is also illuminated to indicate the tracking direction:

- Tracking.
- Backward Playing.
- Forward Playing.
-  - tracks backwards.
-  - tracks one frame backwards.
-  - [tracks one frame forwards](#).
-  - [tracks forwards](#).
-  - specifying [Control Time](#).
-  - [sets t0](#).
-  - displays the current time.

Clicking on the green arrow turns the display into a normal text box into which you may key a time value. The current time is set to this time value. This is the equivalent of setting the Goto time in the [Time Properties](#) dialog.

The system can handle time resolution to a level as low as nanoseconds (10⁻⁹). However, the number of significant digits is limited, i.e. resolution to this low level should not be used for absolute times measured from the start of a year, for example.

-  - [sets the current time to t0](#).
-  - opens the [Time Properties](#) dialog (optional).

Time Slider Toolbar

The Time Slider toolbar contains a slider used to move to a particular time in the sequence. It also indicates the time selected when the buttons above it are pressed, including changing the time when the play buttons are used.



Specifically:

- The red line indicates the current time.
- The green diamond indicates t_0 , the reference time.
- The upper, lighter coloured bar indicates the [user defined time interval](#).
- The lower, darker coloured bar indicates the time limits of the available data.
















The slider has a pop-up menu containing the following options:

- View all - when this option is selected, all the data in the test is displayed, otherwise only the selected interval is displayed and the lower bar in the slider is removed.
- Snap to ends - enables the time slider to be set exactly at the end of the time range. This function operates separately for each end of the time range. If you wish to position a time slider close to the end, de-select this toggle.
- Reset user interval - resets the user defined interval to the full available time range. It is equivalent to [selecting the !\[\]\(c6a8736a601a632e2c96605cf66055ed_img.jpg\) button](#) in the Time Properties dialog.
- Time Properties - [displays the Time Properties dialog](#).

Camera Control Toolbar

This toolbar is only displayed if the [Camera Control](#) optional feature is included in the system.

The Camera Control toolbar contains the following:






-  - Enables Camera Control Mode. Live images are sent from the cameras to the program. Parameters can be set for the next recording.
-  - Enables Continuous Live Image. Live images are sent *continuously* from the cameras to the program. This command can only be used when Camera Control Mode  is enabled.
-  - Enables Low Light Setting. Command setting the exposure and frame frequency to low light mode to allow for focus setting etc. in low light conditions. This command can only be used when Camera Control Mode  is enabled.
-  - Take A Snapshot From All Cameras Using Normal Light. Command taking a snapshot from the camera using the recording exposure time. This command can only be used when Camera Control Mode  is enabled.
-  - Low Light Snapshot. Command taking a snapshot from the camera using an exposure time set to low light mode to allow for focus setting etc. in low light conditions.
-  - [Setup Camera](#)
-  - [Scan for Cameras](#)
-  - [Set Black Reference](#)
-  - [Download Images from Camera](#)
-  - [Open Arming Dialog](#). Command opening dialog where all cameras can be armed and triggered.
-  - [Open Snapshot Recording Dialog](#)
-  - [Clear Stored Images from all Cameras](#)

The End

Test Sequence Toolbar

The Test Sequence toolbar is only displayed if the Camera Control (optional feature) is included in the system.

This toolbar includes a selection of commands/functions from the Camera Control toolbar and contains the following:


-  **Start** - Start Test. Command when working towards a [Test Database](#). (Optional Feature - Enterprise Edition).
-  - [Assign Camera To View](#). Command showing the cameras located by the [Camera Scan Function](#).
-  - Enables Camera Control Mode. Live images are sent from the cameras to the program. Parameters can be set for the next recording.
-  - Enables Continuous Live Image. Live images are sent *continuously* from the cameras to the program. This command can only be used when Camera Control Mode  is enabled.
-  **LOW** - Enables Low Light Setting. Command setting the exposure and frame frequency to low light mode to allow for focus setting etc. in low light conditions. This command can only be used when Camera Control Mode  is enabled.
-  **SNAP** - Take A Snapshot From All Cameras Using Normal Light. Command taking a snapshot from the camera using the recording exposure time. This command can only be used when Camera Control Mode  is enabled.
-  **ARM** - [Open Arming Dialog](#). Command opening dialog where all cameras can be armed and triggered.
-  **END** - End Test. Command when working towards a [Test Database](#). (Optional Feature - Enterprise Edition).

Tools

Using the Selection Tool

The Selection tool enables points to be placed in the image and manipulated.


Points may be added to the Test Contents window and defined irrespective of the tracker mode, but they cannot be placed in the image and manipulated unless the Selection tool has been selected.

1. Select the Selection option from the Tools menu.
Alternatively, select the  tool.

Using the Distance Measurement Tool

This tool is used for measuring distances between points in camera views and diagrams.


Note! Not valid for 3D diagrams.

1. Select the Distance option from the Tools menu.
Alternatively click the  tool.
2. Select the camera view or diagram.
3. Position the cursor on a point.
Its X and Y coordinates are shown in the Statusbar.
4. Hold down the left mouse button and drag the pointer to another point on the graph.
A straight line is drawn between the two points.
The Statusbar shows three distance measures between the two points:
 - o distance - diagonal distance;
 - o dx - x-axis distance;
 - o dy - y-axis distance.
5. Release the left mouse button.
The line and distance measures are removed from the display.

Using the Angle Measurement Tool


This tool is used for measuring angles between points in camera views and diagrams.

Note! Not valid for 3D diagrams.

1. Select the Angle option from the Tools menu.
Alternatively click the  tool.
2. Select the camera view or diagram.
3. Position the cursor on a point.
4. Click the left mouse button and drag the pointer to a second point on the graph.
A straight line is drawn between the two points.
5. Click the left mouse button and drag the pointer to a third point on the graph.
A second straight line is drawn between the points two and three.
The angle between the two lines is shown in the Statusbar.
6. Move the mouse outside the selected camera view or diagram.
The lines and angle are removed.

Using the Velocity/Distance Measurement Tool

This tool is used for measuring an average velocity and/or a distance in camera views.


1. Select the Velocity/Distance option from the Tools menu.
Alternatively click the Velocity/Distance Measurement tool .
2. Select the Camera View.
3. Set a scale for the Velocity/Distance Measurement tool in the Camera View:
 - Press the right mouse button and select Scaling.
 - Enter a length in the dialog and select Scale.
 - Select two positions, corresponding to the entered length, in the camera view using the left mouse button.
4. Measure an average velocity:
 - Select a position in the Camera View by pressing the left mouse button
 - Change to a different time, by using the Time Slider or the Time Panel toolbar. (IF NOT - only a distance will be calculated).
 - In the Camera View select the next position by pressing the left mouse button.
 - A straight line is drawn between the two points.
 - The distance and velocity is displayed at the bottom of the Camera View.

Notes:

- *The scale entered above is only used in the Velocity/Distance Measurement tool and only in the Camera View where it was calculated. It is saved with the test and will be used the next time the test is opened.*
- *The scale can be changed at any time by right-clicking in the Camera View and selecting Scaling.*
- *The scale can be removed at any time by right-clicking in the Camera View, selecting Scaling and then Pixel Distance.*

Using the Zoom Tool

This tool is used for controlling the magnification level in diagrams.


1. Select the Zoom option from the Tools menu.
Alternatively click the  tool.
2. Select the required diagram.
3. To increase the magnification, draw a rectangle around the point of interest.
The selected area is expanded to fill the diagram and the axes are adjusted accordingly.
This operation may be repeated as often as required.
4. To return the diagram to its original size, select the Zoom 1:1 option from the View menu.
Alternatively, click the right mouse button and select the Show All option from the pop-up menu.

See Also...

[Using the Zoom Window](#)

Using the White Balance Tool

The White Balance tool is used to adjust the displayed colours relative to a selected colour, i.e. it only operates for colour images.

1. Select the White balance option from the Tools menu.
Alternatively, select the  tool.
When the cursor is placed in the image, the colour at the selected point is displayed in the Statusbar as 'R: 17 G: 19 B: 16', for example.
2. Use the mouse to mark an area in the image that should be light gray.
When the mouse button is released, the colour calibration is performed and the colours in the displayed image are changed.
If the calibration cannot be performed, a message is displayed in the Statusbar to indicate the problem.
3. Repeat the process until you are satisfied with the colour balance.
If the message changes to 'Calibrating Colour Adjustment: , At least one colour channel is saturated', it means that one of the colour channels has reached its limit and the calibration cannot be performed. Choose a different colour on which to base the calibration.
4. Alternatively, you may right click and select a lighting configuration from the pop-up menu, i.e. None, Daylight, Tungsten or Fluorescent. These apply preset calibrations to the image without the need to mark the image. The last option, White Patch, is always disabled and refers to the standard method defined at step 2. It is automatically selected when you mark the image.

See Also...

[Image Enhancement](#)



Windows

Function

Double clicking any item(s) in the test contents list will open up a window displaying the selected item. The item can be a camera view (Sometimes referred to as a Camera View Window) or a point zoom window.

Features

Most windows in TEMA have two main modes; Free and Locked.

- Free  - this mode will make the window interactive. This means that its contents will change depending on what is selected in the test contents tree. If a single tracked point is selected, the window will display a point zoom with that point in the center. If a camera view is selected, the whole tracked image will be displayed instead.
- Locked  - the window will not be affected by the selected items in the test contents tree. This is to be used when the contents of a window are defined and not to be changed depending on what is selected in the test contents tree.

Multi selections

More than one item can be selected and put into one window.

Selecting more than one point in the list will make the window split up and display a point zoom for each point.

Even different kinds of items can be selected and put into the same window: point zooms and camera views can be displayed in one single window at the same time.

Multi selections can be made across the borders of camera views also, allowing the user to put zoom windows of points in different camera views into the same window (This different from [multi selection in image export](#) which will select camera views only even if point are selected also).

Windows with several items displayed

In a window with more than one item displayed, the [Export Images](#) command from the Camera menu will only export the upper left item displayed. Multi image export can only be done from the test contents window (see above). The same goes for image zoom using the zoom buttons   from the tool bar, only the upper left item will be zoomed.

However, at any time, [right clicking](#) any item in the window will of course offer a right click menu valid for this very item.

Setting Up the Test

TEMA tests can be stored as test descriptions in ".ted" files, which makes them available for use in the future.

The File menu contains a series of options to enable you to manage test files. Some of the options are also accessible from the standard toolbar.

Note: If there is any unsaved data when you close a test either explicitly or implicitly, a warning is displayed that asks if you wish to save the data.

The following functions are available:

- [Start a new test](#)
- [Open an existing test](#)
- [Save a test](#)
- [Save a test under a new name](#)
- [Create Template](#)
- [Manage Templates](#)
- [Close a test \(via the Test Contents window\)](#)

Starting a new test

- When the system is started up the Select Template dialog is displayed.
 1. Select a Factory Template or a User Template from the list to load into TEMA as a new test.
 - Factory Templates are templates that are installed by the TEMA installation program .
 - User Templates are templates that are created by the user (with the [Create Templates](#) command). User templates can be renamed and/or removed from the [Manage Templates](#) dialog.

Option: If the Select Template dialog shouldn't appear every time the New Test option is selected, check Don't show this dialog again.

2. Click OK.
 - The new test will now open up as when the template was created.
 - or
 - If <Empty Test> has been selected, an empty test only displaying the Test Contents window with no setups will open.

The test can now be worked with as any TEMA test.

- You may start a new test at any time:

1. Select the New Test option from the File menu. Alternatively, click the  tool.

Notes:

- If there are unsaved changes in the previous test, the [Unsaved Changes](#) dialog is displayed.
- If a path to the Templates Directory is given in the [Preference Archive/Directories](#), the Select [Template](#) dialog will open. The dialog will list the available Templates in the Templates Directory as set in the [Preference Archive](#).
- If enabled in the [Preference Archive](#), the <Empty Test> template is available also. This is just an empty test with no setups at all.

- When a template has been loaded, an asterisk in the TEMA title bar will indicate that the test is not saved yet.
 - If no path to the Templates Directory is given, the <Empty Test> template will load by automatically.
2. Select a Factory Template or a User Template from the list to load into TEMA as a new test.
- Factory Templates are templates that are installed by the TEMA installation program .
 - User Templates are templates that are created by the user (with the [Create Templates](#) command). User templates can be renamed and/or removed from the [Manage Templates](#) dialog.

Option: If the Select Template dialog shouldn't appear every time the New Test option is selected, check Don't show this dialog again.


3. Click OK.
- The new test will now open up as when the template was created.
 - or
 - If <Empty Test> has been selected, an empty test only displaying the Test Contents window with no setups will open.

The test can now be worked with as any TEMA test.


Note: If the system is started by double-clicking a test file in Windows Explorer, that test file is automatically loaded.

Note: If you work with a test planning system via a [Test Database Interface \(optional\)](#), there is a [policy \(optional\)](#) that may restrict the possibilities to open a new test that is not associated with this. This policy is set in the [Test Planning System preference \(optional\)](#). If the policy for this is set to *Warning Every Time*, and the warning that occurred was canceled, the TEMA test selection dialog will require the user to open an existing test or to create a new one from here.

Opening an existing test

1. Select the Open Test option from the File menu.
Alternatively, click the  tool.
If there are unsaved changes in the previous test, the Unsaved Changes dialog is displayed. [Decide what to do about the these changes](#).
A standard Open dialog is displayed.
2. Select the required test. If Cancel is selected here, a redirection will be made to the load Template dialog, like when opening up a [new test](#).
3. Select the Open button.
The selected test is opened in the same condition as when it was saved.
Note: You may also select the required test directly from the File menu if it is in the list of the ten most recently accessed tests.

Saving a test

1. Select the Save Test option from the File menu.
Alternatively, click the  tool.
If the test has been saved previously, it is saved again under the same name.
If the test has not been saved previously, a standard Save as dialog is displayed.
2. Proceed as for saving a test under a new name, see below.

Saving a test under a new name

1. Select the Save Test As option from the File menu.
A standard Save as dialog is displayed with the Save as type preset to '.ted'.
2. Key in or browse for the required File name.
3. Select the Save button.

Create Template

1. Select the Create [Template](#) option from the File menu. The Create Template dialog will open.
2. Key in the Template Name.
3. *Option:* Check Ask for images when loaded if the template should ask for image files next time it is being loaded.
4. Click OK. The Generated Template will now be saved in the Template Directory as set in the [Preference Archive](#).

Note: When opening up a new test, TEMA will look into the same Template directory and suggest any of the Templates there to be loaded as new tests.

Manage Templates

1. Select the Manage Templates option from the File menu. The Manage Templates dialog will open.
2. Select the User Templates tab.
3. *Option:* Rename or delete applicable template(s) in the shown list.
4. *Option:* Check the Add empty test to template list to be able to choose an "<Empty test>" from the template list, otherwise the choice is between already existing User Templates.
5. *Option:* Uncheck Don't ask for a template when creating a new test to be able to select a template from the template list when preparing a New Test next time.
6. Select the Close button.

Note: The Factory Templates can not be renamed or deleted.


Closing a test

1. Select the X button in the Test Contents window.
If there are unsaved changes in the previous test, the Unsaved Changes dialog is displayed.
[Decide what to do about the these changes](#).
The current test is closed.

Note: A new test is not started automatically.

Specifying Camera Views

The New Camera View dialog is displayed when an [image file is opened](#) for a new camera view. It is used to inform the system about the physical aspects of the camera used to produce the view.

1. Key a Name for the new camera view.
2. Use the browse button  to get to the camera view name dialog (optional). This contains a list of view names in the [Preference Camera view list](#) (optional). The names can be used for the new camera view.
Note: Duplicate names are not allowed in the same test.
2. Key the camera Frame Frequency.
3. [Define the Gamma Correction](#).
4. To amend the Camera Parameters:
Note: The Camera Parameters frame is only displayed if you have the optional 3D or 6D feature installed.
 - Select the Define Camera Parameters check box.
 - The remaining fields in the Camera Parameters frame are enabled.
 - The Image Size is fixed and cannot be changed.
 - Select the Camera Type from the drop-down list.
 - Key the Focal Length of the camera lens, selecting the measurement unit from the adjacent drop-down list.
 - Key the Pixel Size, selecting the measurement unit from the adjacent drop-down list.
 - Specify the x and y coordinates of the camera's Optical Center.
1. The Frame Frequency can be set using an entry field. If there is a frame frequency defined in the image file the operator must enable the Override toggle before he can change the frame frequency to some other value. If there is no frame frequency in the image file the Override toggle is selected by default and can not be unchecked by the operator.
5. Select the OK button.
The New Camera View window is closed.
6. When a new camera view is added, a new [locked window](#) will open up displaying the added camera view.

Camera View Window

When a new Image File has been opened, a Window in locked mode is opened displaying the camera view.

Right clicking in this window will offer fast access to a number of functions;

- [Lock/Free Window](#)
- [Camera View Properties](#)
- [Camera View Attributes \(optional\)](#)
- [Camera Orientation](#)
 - [Static Camera Orientation](#) (optional: 3D).
 - [Relative Camera Orientation](#) (optional: 3D).
 - [Enter Camera Orientation](#) (optional: 3D or 6D).
 - Reset Camera Orientation - Resets the Camera Orientation if confirmed.
- [Scaling/Coordinate Systems](#)
- [Geometry \(optional\)](#)
- [3D coordinate systems](#)
- [Airbag volume \(optional\)](#)
- [Show Zoom window](#)
- [Set t0](#)
- [Control time](#)
- [Find Image](#)
- [Tools](#)
- [Image Enhancement](#)
- [Disable Image Enhancement](#)
- [White Balance](#)
- [Zoom in/out](#)
- [Split View](#)
- [Print](#)
- [Copy](#)
- [Paste](#)
- [Export Images](#)
- [Delete](#)
- Add
 - [Point](#)
 - [Point Generator](#)
 - [Distance](#)
 - [Angle](#)
 - [Stick Figure](#)
 - [Contour](#)
 - [Exclude Rectangle](#)
 - [Exclude Polygon](#)
 - [Corridor...](#)
- Exclude By Default
- [Show Disabled Items](#)

Camera View Properties

1. Select the [required camera view](#).
2. Select the Properties option from the Edit menu or via right clicking the camera view window/properties. The Camera View Properties dialog is displayed. This has several tabs, and some are optional. Amend, if required;
 - [Image File](#) properties.
 - [Tracking](#) properties.
 - [Colour/Contrast](#) properties (optional [Image Enhancement](#) feature)
 - [Camera Parameters](#) properties (optional [3D](#) or [6D](#) feature)
 - [Airbag Analysis](#) properties (optional [Airbag](#) tracker feature)
3. Specify the Display Mode by selecting the appropriate radio button:
 - Original Image - displays the original image loaded to the test.
 - Tracking Image - displays the tracked image in the [selected mode](#).
4. Select the OK button.

Airbag Analysis Properties (Optional Feature)

The Airbag Analysis tab in the Camera View Properties dialog is used to specify how the results of an airbag tracking are calculated. It is applicable to both the Airbag tracker and the Advanced Airbag tracker.

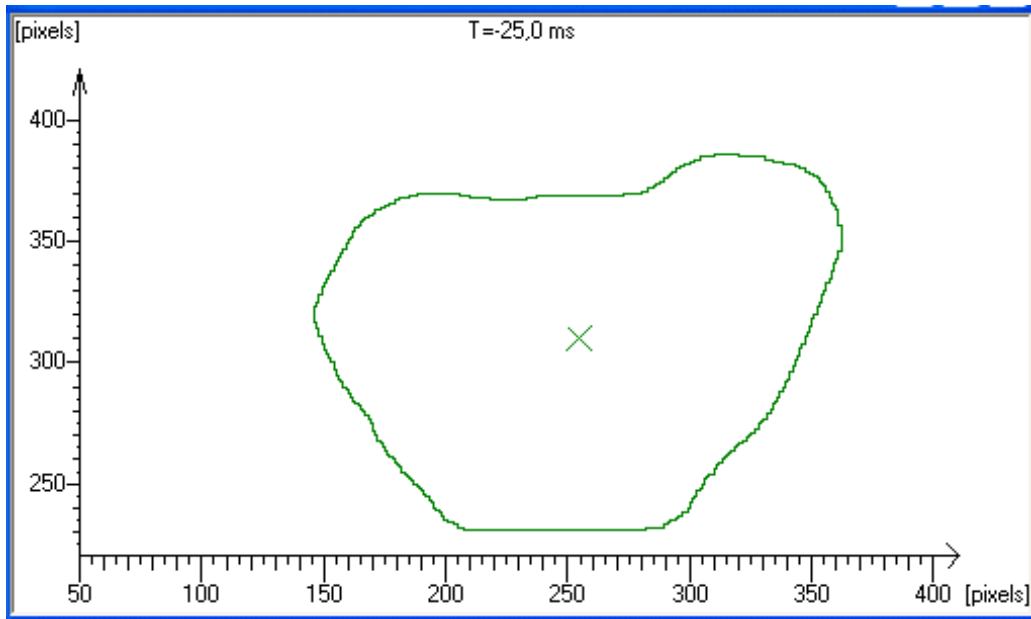
1. Select the required camera view.
2. Select the Properties option from the Edit menu
The Camera View Properties dialog is displayed.
3. Select the Airbag Analysis tab.
4. [Extreme Points](#):
Select the required type of Extreme point analysis:
 - Min/max in coordinate direction - the points with the maximum x or y coordinates.
 - Intersections with coordinate axes - the intersections of the contour with the coordinate axes.
 - Note: For this option to be effective, the coordinate system origin has to be within the airbag.
5. Specify the intersection lines. This is a third way of calculating extreme points for a chain code besides those described above. By selecting intersection lines, TEMA will calculate the extreme points for the intersections between those lines and the chain code. The Add button will make the Add line dialog to appear. In this, start and end points for an intersection line can be selected from the available tracked points in the camera view. While marking an added line, the Edit button will open up the same dialog, making it possible to select new points to define the intersection line.

Note: the results from the airbag tracker analysis can be inserted into a diagram. The results are divided into two groups, curve and visualizer results. Curve results are

- Extreme points coordinates; Right, Left, Up and right. Can be plotted both in XT and XY diagrams.
- [Angle](#) between chaincode major axis and coordinate system x axis. (Can be usefully plotted in XT diagrams only).
- Area of outline tracker as a function of time. Can be plotted in XT diagrams only.
- Circumference of outline tracker as a function of time. Can be plotted in XT diagrams only.
- Volume (Optional Feature): Rotates the airbag contour around an axis and computes the volume of the resulting rotational solid.

Visualizer results

- Visualizer appearance of the outline tracker as a function of time. Can be plotted in XY diagrams only. See illustration of visualizer data inserted into XY diagram below.



See Also...

[Airbag Analysis Calculations](#)

[Inserting results into diagram](#)

[Maintaining Camera View Properties](#)

Camera Parameters (Optional Feature)

When an [image file is opened](#) for a new camera view, the New Camera View dialog is displayed. It is used to inform the system about the physical aspects of the camera used to produce the view. This information can be subsequently maintained via the Camera Parameters tab in the Camera View Properties dialog.

From TEMA version 3.9 camera calibrations can also be exported. This will include camera internal data as well positions/attitude if applicable. The 'Import' button is replaced with one 'Import Parameters' button and one 'Export Parameters' button.

1. Select the required camera view.
2. Select the Properties option from the Edit menu
The Camera View Properties dialog is displayed.
3. Select the Camera Parameters tab.
4. To import a set of camera parameters:
 - Select the Import button.
 - The standard Open dialog is displayed.
 - Select the file containing the required set of parameters. The accepted file formats are [described below](#).
 - Select the Open button.
 - The parameters from the selected file are imported and displayed in the Camera Parameters tab. The Define Camera Parameters check box is automatically selected.
5. Select the Define Camera Parameters check box, if it is not automatically selected.
If this is not done, none of the parameters can be amended.
6. Select the Camera Type from the drop-down list.
7. Specify the Focal Length, selecting the measurement unit from the adjacent drop-down list.
8. Specify the Pixel Size, selecting the measurement unit from the adjacent drop-down list.
9. Specify the Optical Center in terms of x and y coordinates.
10. Key the required Aspect Ratio.
The default value is "1".
11. If you wish to correct the lens distortion:
12. Select the Correct Lens Distortion check box. This prerequisites that a [lens calibration](#) (Planar Target or AICON) has been performed for this sensor.
13. Amend the Distortion Parameters, as required, i.e. x_H , A_1 , B_1 , C_1 , r_0 , y_H , A_2 , B_2 , C_2 and A_3 .
Note: These parameters are the coefficients used by the lens distortion correction algorithm and should not be amended without a thorough knowledge of how the algorithm uses them.
14. If [3D](#) or [6D](#) is about to be calculated, select the [Dynamic Camera Orientation](#) check box if the camera position (s) is not constant during the test.

Accepted file formats

When importing camera parameters from a file, TEMA accepts data from the following calibration software:

- [Planar Target Lens Calibration](#) (*.xml).
- [AICON Lens Calibration](#) (*.ior).
- The Bouguet Lens Calibration toolbox.
This is a third-party program described in the web page http://www.vision.caltech.edu/bouguetj/calib_doc/.

Data from the Bouguet Lens Calibration toolbox are imported as an ASCII text file containing 12 floating-point numbers, one per line. These numbers are the parameters calculated by the Bouguet program:

- Line 1: $fc(1)$
- Line 2: $fc(2)$
- Line 3: $cc(1)$

- Line 4: cc(2)
- Line 5: alpha_c
- Lines 6-10: kc(1) through kc(5)
- Line 11: nx
- Line 12: ny

See Also...

Maintaining [Camera View Properties](#).

Colour/Contrast Properties (Optional Feature)

The Colour/Contrast tab in the Camera View Properties dialog is used to specify the contrast and brightness of the displayed image.

1. Select the required camera view.
2. Select the Properties option from the Edit menu
The Camera View Properties dialog is displayed.
3. Select the Colour / Contrast tab.
4. To amend the Contrast:
 - Key in a new value or adjust it using the slider.
 - Any change made is immediately reflected in the displayed View window in the display area.
 - Select the Reset button to set the values to zero.
 - Select the Revert button to remove the affect of the changes made.
5. Amend the Brightness in the same way.

See Also...

[Maintaining Camera View Properties](#)

Image File Properties

Function

When an [image file is opened](#) for an existing camera view (from the archive or from physical camera connected to the system), the New Image File dialog is displayed.

It is used to inform the system about the physical aspects of the camera used to produce the view. This information can be subsequently maintained via the Image File tab in the Camera View Properties dialog.

In TEMA with Test Sections functionality (optional), this dialog will not only be able to display the properties of the image sequence in the section currently active in test, but for all sections to which the camera view is assigned. In other words, we can enter the image file properties from a camera view in one section in test, select any other section in the properties dialog and view the properties of the image sequence in that section.

Appearance

Basic version

- The basic details of the image file currently in the camera view are listed;
 - File Format - the [format](#) of the image file.
 - Image Mode -
 - Image Size - the size in pixels (x*y) of the image frames.
 - Sequence Size - the number of bytes in the image file.
 - Sequence Length - the number of frames in the sequence.

The Timing section allows you to control how timing information in the image file is used. There are two possible types of timing information that can be available in an image file:

- Frame Frequency is the nominal frequency of the frames in the image file. Note that for some file formats, such as AVI, this frame frequency can sometimes be fixed to 25 or 30 Hz even if the camera recording rate was something different.
- The Frame Zero Time function is connected to the [Set t0](#) function. Set t0 can be a more convenient way of selecting the Frame Zero Time, especially if you know the exact time for some other frame than zero.

Per Frame Time Stamps are available from some high speed cameras. This means that the camera records the exact exposure time for each frame, compared to the hardware trigger pulse. Normally, for a digital camera this is very close to the time that can be calculated using the Frame Zero Time and the Frame Frequency. A notable exception is slave synced Phantom cameras which typically have a notably lower nominal Frame Frequency than the actual frequency seen by the time stamps. This has to do with the mechanism used to synchronize the cameras. For film cameras where the individual frame times are created using TrackEye decoding functions the individual frame times can be substantially different as the camera is actually running at a varying speed.




With Sections (optional)




- The upper part of the dialog contains a list of the [Test Sections](#) to which the camera view is assigned. Each section is listed together with the image file, if any. Marking a section in the list will make its image file properties to be displayed below.
- Below the sections list is the basic details (as in basic version, see above) of the Image file currently assigned to the Selected Section in the sections list above. If no image file is assigned, all fields will be empty here.

- The End Test Export list.



Procedure

No Test Sections

1. Select the required camera view.
2. Select the Properties option from the Edit menu
The Camera View Properties dialog is displayed.
3. Select the Image File tab. Note: the basic details of the image file cannot be amended.
4. To load a new image file into the camera view, click the Load button. This will open up the [Open Image Sequence](#) dialog.
5. To register the fact that you have moved the image file via Explorer, select the Find button. This will open up the [Reselect Image File](#) dialog.
6. To remove any specified image file from the camera view, click Clear.
7. The Use Per Frame Time Stamps toggle allows the operator to select to use individual time stamps for each frame if available. If Per Frame Time Stamps are not available or if the operator selects not to use them the Frame Frequency and Frame Zero Time are used to calculate the time for each frame.
8. The Frame Frequency can be set using an entry field. If there is a frame frequency defined in the image file the operator must enable the Override toggle before he can change the frame frequency to some other value. If there is no frame frequency in the image file the Override toggle is selected by default and can not be unchecked by the operator.
9. The Frame Zero Time can be set using an entry field. If there is a time for frame zero defined in the image file the operator must enable the Override toggle before he can change the frame zero time to some other value. If there is no frame zero time in the image file the Override toggle is selected by default and can not be unchecked by the operator.
10. [Define the Gamma Correction.](#)
7. Specify the InterlaceMode, which controls how the recorded images are presented to the Tracking function:
 - Full Frame - the odd and even lines in the image are presented as a single image.
 - Interlaced Video, Odd Line First - specifies that the half image containing the odd lines is presented before the 'even' half image.
 - Interlaced Video, Even Line First - specifies that the half image containing the even lines is presented before the 'odd' half image.
8. Specify the Image Orientation, i.e. how the image is displayed, by selecting the appropriate button:
 -  - rotates the image in a clockwise direction by 90 degrees. Repeated selection of the button increases the rotation in 90 degree steps. The total rotation with respect to the starting point is displayed beneath the button.
 -  - rotates the image in a counter-clockwise direction by 90 degrees. Repeated selection of the button increases the rotation in 90 degree steps. The total rotation with respect to the starting point is displayed beneath the button.
 -  - the image is mirrored.

- 
- - the orientation of the image is reset to its original position.
- The Revert To/Load Preference Defaults buttons   will be functional if the Camera view is in the [Views](#) (optional) list.

With Test Sections

1. Select the required camera view.
2. Select the Properties option from the Edit menu
The Camera View Properties dialog is displayed.
3. Select the Image File tab. Here is information of the image file in the camera view for the currently active section.
4. In the Relevant [Sections](#) area (optional), a list of the current Sections to which the camera view has been assigned can be seen.
 - Auto.
 - If the check box is checked; the camera view will be assigned to all sections in test at all times. Thus, if a new section is added to the test, this will also be added to this list automatically. No sections can be removed from the list.
 - If the check box is unchecked, any section can be removed from the list using the Remove button. The camera view will then not be assigned to that test section. If in [camera control](#), [download](#) cannot be made for this camera view in that section.
 - If a section in the list has an image file assigned, it cannot be removed. To remove a section with image file from the camera view, click the Clear button in the Selected Section area. The Remove button will then be functional.
 - The Revert To/Load Preference Defaults buttons   (optional) will only be functional if the Camera view is in the [Views](#) list.
5. Selected Sections (optional). This area contains information of the image file in the camera view for the selected section in the section list (see above) as well as the option of reloading a new image file into this section.
 - File Format - the [format](#) of the image file.
 - Image Mode -
 - Image Size - the size in pixels (x*y) of the image frames.
 - Sequence Size - the number of bytes in the image file.
 - Sequence Length - the number of frames in the sequence.
 - Frame Frequency - the frame frequency as set when the camera view was added to the test. The can be amended here.
 - Load - load a new image file to the selected section
 - Find - [Reselect Image File](#)
 - Clear - remove the image file from the selected section.
6. [End Test Exports \(optional\)](#)
Note: If a [Remote Export Server](#) is set up, this will be automatically used for all the End Test Image Exports.

For each section from which an end Test export is to be made, repeat the following steps for each export setting to be added;

- Click the Add button, the Add End Test Exports dialog will appear.
- Select an Image Export setting from the drop box. This contains the whole list of all saved Image Export settings in the preference archive.
- Set an export File Pattern also. This will be the name used on the exported file. Note that the files from the end test export must have unique names. In case a file name is not unique, an error message will appear when the End test Command is given and we will have to reset the exports again, using all unique names.

- Click OK when ready.
 - Edit the entry fields of any End Test Export item by the use of the Edit dialog.
7. [Define the Gamma Correction.](#)
 8. Continue with steps 4-8 above. except the Gamma Correction.

See Also...

[Supported Image Formats](#)

[Maintaining Camera View Properties](#)

Reselect Image File

If you have clicked the Find button in the [Image File Properties](#) dialog, this dialog will open.

Function

With the use of this dialog, a new image file can be selected instead of the one currently used in a camera view.

The need occurs when a test is opened on another workstation where the images are on different locations. To be able to review an image sequence for a camera view, the image file has to be reselected.

Each time a new file has been used as the source for a camera view, this will be added to a reference list for this camera view. This list is displayed in the Reselect dialog.

Selecting amongst the candidates in list

For selecting an image that is correct, TEMA has a way of sorting the image candidates in the list.

The Search New Location is a function that will search a specified location on the network for a file with properties (checksum, file name etc) as close to the original file as possible, using this for the camera view.

However, the user can override this by using the Select Other File function. By the use of this, *any* file can be used in the camera view. It is then up to the user to decide that this is the correct image to use. A case when this is needed is when an image has been modified in an enhancement program and a camera view is to be specified with this image instead of the original.

Appearance

For each file in the list, the following information can be read:

- File name - the name of the file. Most often, the names are the same as the file initially used. It is basically only when the user selects a new file by the Select Other File function (see below) that the filename may be another than the original file.
- Directory - the directory at where the file was located on any workstation when used.
- Available - Offers information of whether the file is currently available on the directory or not (Yes/No).
- Selection - If a file is currently used in the camera view, this will be stated here as *Accepted*. If another file is selected with the Select Other File function, this status will change to *Refused*.

Also, there are additional file information below the file list;

- Image Count - the number of image frames in the image file.
- Skip Count - If the image file has a skip between the images, the length of this will be stated here.
- Start Image - is the selected variant missing some frames in the beginning, compared to the original (yes/No).
- Flip - Is the selected variant flipped compared to the original (yes/No).

- Zoom X - Is the selected variant zoomed in the x direction compared to the original (yes/No).
- Zoom Y - Is the selected variant zoomed in the y direction compared to the original (yes/No).
- Size - Image size in pixels*pixels.
- Size (bytes) - image file size.
- Color Mode
- Color Correction - Is the selected variant color corrected compared to the original (yes/No).(yes/no)
- UniqueID - a checksum based on the images in the file. The value is unique for each file. Should the images have been modified in any way, the checksum will not be the same as the original file.
- File History
 - Origin - when a file is created, maybe via [image export](#) or [download](#) from a camera, the performance will be saved together with the resulting file. This information can be seen here. For files created in TEMA versions where this was not implemented, this column will just state *unknown*.
 - Time - time at when the file was created

Procedure:

Use the buttons below the list, depending on the needs;

1. Search New Location - TEMA will search a directory for a new candidate for the camera view. Specify the directory.
2. Browse for other file - the [Open Image Sequence](#) dialog will open. By the use of this, browse to a new file to use.
3. Remove Selection - Remove the selection from the list.
4. Selected Location - use the marked variant in the list.
5. Accept Any Selection - Load any file. The system will accept any selection made.

Tracking Properties

The Tracking tab in the Camera View Properties dialog is used to specify how points are displayed in a camera view during tracking.

1. Select the required camera view.
2. Select the Properties option from the Edit menu.
The Camera View Properties dialog is displayed.
3. Select the Tracking tab.
4. To amend the Appearance of tracked points in the image, select the appropriate Edit button and select the required colour from the [Colour Editor](#) dialog.

Note: Changing the colour may improve the legibility of the image displayed, or a printed version, depending on the nature of the colour and shading of the image.

- Point Colour - enables the colour of displayed points to be specified.
 - Selected Point - enables the colour of the selected point to be specified.
5. To display point names, select the Show name check box.
 6. If you wish the point names to be displayed on a background colour:
 - Select the Show background check box.
 - Specify the required colour.
 7. To hide non-calculated (not tracked) points, enable the Hide non-calculated points check box.
 8. To specify how the Trace facility is to operate:
 - Select the appropriate radio button:
 - Show before now - Display points before the current point in time;
 - Show after now - Display points after the current point in time;
 - All - Display all points;
 - None - Trace disabled.
 - Key the Trace Length, which defines the number of point positions you wish to display in the current image. This number defines both how many previous and/or following points are displayed relative to the current point.
 9. To specify which images to skip, key the Image Steps in the Image Steps frame.
For example, if "5" is keyed, every fifth image is tracked.
 10. To specify the Default Tracking Image mode for tracking, select the appropriate radio button.
Note that the default set here can be overridden for each point individually in the [point setup](#).
 - Colour - Full colour is displayed.
 - B/W - Gray scale, as defined by the luminance, is displayed.
 - Red - Only the red colour plane is displayed.
 - Green - Only the green colour plane is displayed.
 - Blue - Only the blue colour plane is displayed.
 11. To specify how the system is to [Interpolate Sleeping Points](#), select the appropriate radio button:
 - No Interpolation - Switches off the interpolation function.
 - Linear - Uses a linear function.
 - Cubic - Uses a cubic polynomial. *Note:* If the data is 'noisy', the use of cubic interpolation can lead to unpredictable results. Always check the results by displaying them in a 2D Diagram.

12. To change the Display Mode of the image shown in the Camera View window, select the appropriate radio button:
 - Original Image - The image as stored on disk.
 - Default Tracking Image - The Default Tracking Image mode is applied to the shown image.

See Also...

Maintaining [Camera View Properties](#)

Interpolation of Sleeping Points

Function

When a tracked point is put to sleep for a number of frames there will be a corresponding gap in the output data. TEMA can interpolate (fill in) the data in these gaps, provided there are tracked samples both before and after the gap.

There are two methods of interpolation:

- Linear – TEMA finds a linear function of time (a straight line in an X-T diagram) that connects the last tracked point before the gap with the first tracked point after the gap. The values of this linear function are then used to replace the sleeping data.
- Cubic – As linear, but instead of a linear function a cubic polynomial, that fits the two last points before and the two first points after the gap, is used. Using a cubic function gives a smoother curve than a straight line, but if the data is noisy it can sometimes lead to strange-looking deviations from the expected curve.

It is also possible to turn off interpolation and leave the gaps in the data unfilled.

When displayed in a diagram, interpolated data will be indicated with a contrasting line colour from the rest of the curve.

Procedure

There are two places in TEMA where interpolation is performed:

- Directly after tracking:
 - Before any other operation (except the optional correction for lens distortion) is performed on the tracked data, sleeping data is interpolated.
 - 2D angles and distances, as well as velocities and accelerations, are then calculated using the interpolated data.
 - The settings for this interpolation function are available on the [Tracking](#) tab in the Camera View Properties dialog.
- After 3D positions are calculated (optional feature):
 - The 3D module does not operate on interpolated input data. The reason for this is that interpolation introduces errors in the data (if a point was put to sleep because it was not visible, its true position is unknown; interpolating the gap in the data is just a way of guessing where it was) which will be magnified by the 3D process and may lead to unpredictable results.
 - Instead TEMA interpolates gaps in the 3D data as a separate step.
 - The settings for this interpolation are available by:
 - Right-clicking on 3D Results in the [Test Contents](#).
 - or
 - Selecting 3D Interpolation in the [Edit menu](#).

See Also...

Maintaining [Tracking Properties](#).

Camera View Attributes

Function

The camera view attributes are additional information that can be assigned a [camera view](#), focal length etc. Camera view specific additional information. The attributes are all created in Preferences/ [Attributes](#).

Note: Updated Camera View Attributes will affect new tests only. Neither the currently opened nor any other existing tests are affected.


When selected from the camera view right click menu, the Camera View Attributes dialog will open. This presents the present camera view attributes in the preference list. After each attribute is a entry field in which any information about the camera view can be added.

See also...

[Test Attributes](#)

Opening Image Sequences

Procedure

1. To open an image sequence for a new camera view:
 - Select the New Camera View option from the File menu.
alternatively
 - Click the  tool.
The Open Image Sequence dialog is displayed.

or

To change to a different image file for the same camera view:

- Select Properties from the Edit menu and press Load button in the Camera View Properties dialog.
alternatively
 - Select Camera View Properties by right-clicking and press Load button in the Camera View Properties dialog.
The Open Image Sequence dialog is displayed.
2. From the top left frame, select the drive and directory that contains the required image sequence. The selected image sequence source is shown in the Directory field and the details of the image sequences in the folder are displayed in the Sequence list.

If the required directory is on another machine in the network:

- Select the Network button.
 - The standard Map Network Drive dialog is displayed.
 - Browse for the required computer/directory.
 - Select the OK button.
 - The selected computer/directory is assigned a drive letter and added to the list of drives.
3. Select the Sequence you wish to open.
The first image in the selected sequence is displayed in the Preview frame.
Note: The list can be sorted on any column by clicking the column header with the left mouse button. Right clicking the column header displays the [Column Setup dialog](#), which is used to specify the data to be displayed.
4. While having an image file marked in the Sequence list, there are four buttons activated above the list:
 - Network... - Click this if the required directory is on another machine in the network. For further details see paragraph 2 above.
 - Fileformat Info - Click this to get information of workstation where the file was created, operator, time and source file.
 - Delete Images - Click this to delete the image sequence marked.
 - Check Signature (optional) - If having a [Digital Signature](#), this can be reviewed here before using the image file.
5. Below the Sequence list the Refresh button is activated. This button enables to make sure that the content in the Sequence list is valid.
6. To select the marked image file, click the OK button. Note: If the image file is not found at the registered location when TEMA attempts to open it, but is found at another defined Image Location, the [Image File Not Found](#) dialog will appear.

For a new camera view, the New Camera View window is displayed.

- [Specify the camera view parameters.](#)
- The new camera view is displayed in a separate View window within the display area.
- A camera icon and the name of the camera view are added to the Points List window.

For an existing camera view, the New Image File dialog is displayed.

- [Specify the image file parameters.](#)
- The selected image file replaces the previous one in the camera view.

See also...

[Supported Image Formats](#)

Image File Not Found

Function

When an image file that is used in a TEMA test is deleted, moved or renamed outside TEMA, it will not be found when opening the test again.

In such situation, the Image File Not Found dialog will open. This enables you to cancel the use of the file or to re-select the file at its new destination or with its new name.

Appearance

- Search - if the image file has been moved from its original location, relocate it with help of the The Browse for Folder dialog.
- Select - if the image file has been renamed, re-select it with its new name with help of the [Open Image Sequence](#) dialog.
- Cancel - cancel the use of the file in the test.
- Help - takes you to this help page.

Specifying Image File Parameters

When changing the image sequence in a camera view, most of the defined parameters apply, e.g. those applying to the camera. This dialog is used to specify the few parameters applying to the image sequence and is displayed automatically after the new image file has been selected.

1. Amend the Name, if required.
Note: Duplicate names are not allowed in the same test.
2. Key the camera Frame Frequency.
3. [Define the Gamma Correction](#).
4. Select the OK button.
The Select New Image File dialog is closed.

Templates

Function

A Template is a generic definition of a Test, but with no data or pointers to images. When a template is created, the procedure is saving the test setup, but the actual data is removed from this.

A template is stored on the workstation as a file. At any time, a template can be opened in TEMA again. It will then open up as a copy of the test used that was used to create the template, but with no data or images. New data and images can now be applied instantly, and all camera views, diagrams etc will update with this data.

Using templates is a very time efficient way of working if a number of specific test setups are often used. Those typical tests could then be saved as templates, working as model when the use of a specific test type arises.

Types of usage

The templates and tests can be used in two main ways.

From Test to Template

An existing Test can be used as a model when creating a template. The test first opened in TEMA. You may then amend the test as desired and create a template from it by using the *Create Template* command. This will generate a copy of the test but without the associations to the data used in this.

Note: A Template is a .ted file, just like any other TEMA test, even if it does not contain any data. When creating a template, this kind of special .ted file will be saved in the *Templates* directory as specified in the [Preference Archive](#). It is no actual difference between what is called a template and a TEMA test saved without any data. The difference is the way of usage. A .ted file stored in the Templates Directory will be treated as a template; it may be loaded into TEMA with the File/New Test command.

Note 2: A general template does not contain any tracked data nor references to any images used in a test. However, in the File/Create New Template dialog, there is a check box saying *Wipe Images and Data*. Having this unclicked, will result in the creation of a template with tracked data and images.

From Template to Test

An existing template can be used as a model when creating a test. The template is first opened in TEMA with the new test command. The command will lead to an open Template dialog where all templates are listed. From this list, the desired template can be selected and opened in TEMA. When opened, it can be considered a test but with no data yet inserted. You may then amend the template as desired and add data. The "Template" (it may now contain data) can then be saved either as a test OR as a Template. The first will generate a regular test and the latter a copy of the Template but with no data associated (see above).

When opening up a new test in TEMA, initially a template is always opened. Opening a blank new test, is with no setups made, is just loading a special case of templates, called <Empty Test> in the template list. The existence of this can be determined in the preference archive/directories.

Accessed via...

File/Create Template
File/New Test.

See also...

[Setting Up the Test.](#)

Test Sections (optional)

Function

In many applications, a static (non-moving) camera is used for shooting multiple sequences during the same test; calibration sequence and additional test sequences.

In such applications, in TEMA, we might want to track a number of reference points in the camera view, calibrating the camera and then use this calibrated camera when tracking in a subsequent test sequence.

To make this simple, TEMA has a user interface that allows the use of several image sequences in one camera view.

Instead of just add a camera view to a test, a Section is added to the test. A Section is an item that can be specified with several image sequences and assigning them all to a camera view.

Several sections can be added to a test.

Multi/Single sections

There are two different types of Test Sections; Multi and Single Test sections.

- A Multi Section handles stored images on the RAM memory of a camera. The download commands will capture such data and download to the specified download directories.
- A Single Section operates on live images only. Having a single section active, when in Camera Control Mode, the [Arm](#) command, that captured stored images, cannot be performed. Instead, the [Single Frame Capture](#) function will be available, that captures a live snapshot from all cameras in the test. Typically, we want to capture a reference board, using one frame only. After download, a single section in store mode will delimit the time panel to one frame only (the first frame), even if the downloaded sequences in the camera view(s) have several frames. Using a single section, there is a live download function also, that will capture a live snapshot from one camera at a time.



Appearance

For each section in the list, the following information can be read:

- Section Name, as given in the Add Section dialog.
- Single status enabled/disabled, see below.
- Download 1. Default File Pattern for [Download](#) from camera, download [directory 1](#). The filename will appear in the [Camera Setup window](#). Editable enter field.
- Download 2. Default File Pattern for Download from camera, download [directory 2](#). The filename will appear in the [Camera Setup window](#). Editable enter field.
- Export. The default name for the exported file when entering the [Image Export](#) dialog. Editable enter field.

Procedure

1. Select Edit/Test Sections. The Sections Setup Dialog will appear. As can be seen in the sections list, there is one section present from start. This is the Default section. Due to system design, at least one section has to be present at all times. Therefore, this cannot be removed before we have added one additional section to the test.
2. To Add an Additional test section to the test, click the Add button. The Add Section interface will appear.

3. Give the Section a suitable Name.
4. If the Single check box is enabled, this section will be a single section.
5. The Download File pattern contains the filename patterns from the Preference Archive/Directories if present, for the dual download destinations. Override by typing something else in the enter fields.
6. Enter an Export File pattern to be used as name of exported file when performing an Image Export. The built in variable *\$VIEWNAME\$* will use the view name automatically.
7. The Default section can now be removed from the test by selecting it in the sections list and clicking Remove.
8. The fields for Download 1 & 2 and Export can be amended in the list. Click the item and re-type. Click outside the enter field when ready.
9. Change the order of the sections in the list. Mark an item and click the down arrow buttons   to move it in the list. The same order as in the list will be used in the Sections tool bar in the main window.
10. Edit the entry fields of any Section by the use of the Edit dialog.
11. Click the OK button when ready.
12. In the Tool bar, the added sections can now be selected from the drop box. The currently displayed section is selected.
13. If a camera view is added to the test, the image file will be associated to the selected section. If a live camera is added to the test, the downloads from this will be done with the filename patterns as set for the selected section. Thus, if several sections are available and another one is selected, the camera view will display another image sequence.
14. If track points are added to the camera view in the current section, those will be present for the selected section only. Thus, if several sections are available and another one is selected, the point list below the camera view will change to match the points added to the camera view in the other section.
15. If the camera view properties are entered for a camera view, and select [Image File Properties](#), we can manage the sections at where the image file is used.

See also...

[Arena test](#)
[Point Generator](#)

Specifying the Gamma Correction

An image sequence that you use may or may not have been gamma corrected. If it has been corrected, the correction factor may or may not have been stored in the file.

When an image sequence is selected, if there is a gamma correction factor in the file, it is displayed in the appropriate dialog, i.e.

- [New Camera View](#);
- [Select New Image File](#);
- [Camera View Properties](#).

If the value is not in the file, the default value is assumed, i.e. 1.8.

The general preferences contain a [preferred gamma correction](#) which is set to the value most suitable for your display, the default value being 1.8.

In any of the above dialogs:

- If you do not select the Define File Gamma checkbox, the displayed value is assumed to apply to the file. This level of correction is removed and the preferred level applied.
- If you do select the Define File Gamma checkbox and key a value, the keyed value is assumed to apply to the file. This level of correction is removed and the preferred level applied.

Opening Data Files


Function

This function enables to use data from a number of fixed format file types, which the system recognises automatically without the need to specify the format. The format file types are:

- Files based on the ISO:13499 standard.
- A subset of the formats produced by the DIAdem software.
- HDF (Hierarchical Data Format).
- Altair Binary Format.
- CSV, comma-separated values, see example below.
- Tab-separated values, see example below.

Procedure

To use this function:

1. Select the New Data File option from the File menu.
The standard Open Data File dialog displayed.
2. Browse for the required file.
3. Select the  button.

For most file formats, the Select Columns dialog is displayed. It shows the columns available in the selected file. All columns are selected by default. If not all columns are required:

- Select the required columns using the available buttons:
 - Mark All - selects all columns.
 - Unmark All - unselects all columns.
 - Mark Selected - selects all the columns you have marked using the mouse and the <shift> and <ctrl> keys in the standard Windows manner.
 - Unmark Selected - unselects all the columns you have marked using the mouse and the <shift> and <ctrl> keys in the standard Windows manner.
 - Individual columns may be selected by clicking the appropriate check box.
- When you have set the required columns, select the OK button.

For CSV- and Tab-separated values: A data file with signals or "curves" as columns in a multi-column sheet, the files can probably be imported in TEMA, either directly or by making some minor changes. Any file extension can be used (.txt, .dat etc.). See examples below.

4. The selected file is imported.
Note. If the Unit column contains a value, i.e. a measurement unit, that the system does not recognise, a warning is displayed indicating that the data will be imported as a scalar value. A file icon, the file name and the list of selected columns are added to the Test Contents window.

Examples

Both files below will result in three sequences in TEMA named a, b and c.

Example 1:

t,a,b,c

ms,m,m/s,G
1,5,7,9
2,6.1,7.2,9.3
3,7.2,8.3,10.2
4,7.2,8.3,10.2
5,7.2,8.3,10.2
6,7.2,8.3,10.2
7,7.2,8.3,10.2
8,7.2,8.3,10.2
9,7.2,8.3,10.2
10,7.2,8.3,10.2
...

Rules:

- The first row is the name of each "signal" or "curve".
- The second row is the unit for each column.
- The first column must be the time base (sample time for each row).
- Note! Each value is separated with a tab or a comma.




Importing Camera Views

This function is used to import into the current test a camera view held in an external ".ted" file, i.e. from a previously saved test.

1. Select the Import View option from the File menu.
The standard Open dialog is displayed.
2. Select the required camera view.
3. Select the Open button.
The Import View window is displayed, showing all the camera views in the selected test.
4. Select the required camera view.
5. Select the OK button.
6. The selected camera view is displayed in a separate View window within the display area.
A camera view icon and the name of the camera view are added to the Test Contents window.





Setting Time Properties

This function is used to specify how time is handled during the test.

1. Select the Time Properties option from the Edit menu.
2. To set the User Defined Interval:
Note: This function is used to limit the images from a sequence used for tracking and analysis to a specific time range.
 - Key the required User defined start time frame.
 - Alternatively, select the  button to set the start time to the current time.
 - Key the required User defined stop time frame.
 - Alternatively, select the  button to set the stop time to the current time.
 - You may reset the start and stop times to cover the full range by selecting the  button.
3. To position at a particular point in time:
 - Key in the required Goto time.
 - Select the Go button.
4. To specify the Animation Speed:
Note: The Animation speed specifies the speed at which the time panel operates in relation to the test time, i.e. how many seconds of test time relate to one second of analysis time.
 - Select the Use Animation Speed checkbox.
 - Key the required speed in the Animation Speed field.
 - The value is specified in units of test time per unit of analysis time, i.e. real time.
5. To set the Time Run Mode, select the appropriate checkboxes:
 - If Normal is specified, the sequence stops when the end is reached.
 - If Auto Reverse is specified, the sequence is played in reverse, then forwards again until the stop button is selected.
 - If Circular is specified, the sequence is repeatedly played from the beginning until the stop button is selected.
6. Select the OK button.

Setting up List Columns

The Column Setup dialog is used to specify the columns to be displayed in a list view and to specify the sort sequence of the items in the list.

1. Right click a column header in left or right side of the window/dialog, as appropriate. The Column Setup dialog is displayed, showing the columns currently displayed and those available for display.
2. To make a column visible, select it in the Invisible columns list and click the  button.
3. To make a column invisible, select it in the Visible columns list and click the  button.
4. To move a visible column to the right, select it in the Visible columns list and click the  button.
5. To move a visible column to the left, select it in the Visible columns list and click the  button.
6. To specify the sort sequence:
 - o Select the Sorting checkbox.
 - o Select the sort key from the Sort by drop-down list.
 - o Specify the sort sequence by selecting (for ascending) or de-selecting (for descending) the Ascending checkbox.
7. Select the OK button.

Creating and Maintaining a Test Description

A test description is a free text entry that is used to provide a brief description of the associated test. It can subsequently be included in [print reports](#) to describe the context of the test results.

1. Select the Test Description option from the Edit menu.
The Test Description dialog is displayed.
2. Key in or amend the free text description of the test.
3. Select the OK button.

Lens Calibration

Every lens has an inbuilt distortion to some degree. In order to obtain accurate results from the system it is necessary to perform a camera lens calibration on a regular basis. This is achieved by comparing the predicted positions of the points on a fixed target with the actual measured positions and calculating the deviation. The results of each calibration may be stored as xml files and used later to compensate for lens distortion by using the lens distortion correction function.

Lens calibration in TEMA can be done in three ways;

- [AICON Lens Calibration](#)
- [3D Target Lens Calibration](#)
- [Planar Target Lens Calibration](#)

AICON Lens Calibration (optional)

Function


The AICON calibration method is a separate software from AICON 3D Systems GmbH in Germany, which can be integrated to TEMA. For the camera lens combination it calculates internal parameters together with a transfer function to adjust for lens distortion. The method uses a dedicated physical calibration board on which all markers have a very accurately measured 3D position (x, y & z), which automatically are identified by the software module.

The AICON lens calibration is a three step process:

- [Create a template.](#)
The camera template has to be created in AICON *once only* for each *new* camera, and this has to be performed before calibrating the camera.
- [Calibrate a camera.](#)
- [Inspect calibration result.](#)

Procedure

Creating a Template

1. Select the AICON Lens Calibration option from the Tools menu.
Note: Alternatively, you can perform the calibration from outside TEMA by starting the application "dpa_calib10".
The AICON Lens Calibration dialog is displayed.
2. Select the Calibrate button.
The New calibration - Selection of template dialog is displayed.
3. To calibrate a new camera, double-click on "New template".
The New template- Select camera dialog is displayed.
4. Select .
The Create new camera dialog is displayed.
5. [Specify the camera details.](#)
Note: The Name, Resolution, Sensor size and nominal Principal point are the minimum requirement.
6. Select the Save button.
The Create new camera dialog is removed and the New template- Select camera dialog is redisplayed.
7. Select the OK button.
The New template- Insert cameras dialog is displayed.
8. Select the Next button.
The New template- add reference information dialog is displayed.
9. Select the Next button.
The New template- Parameter dialog is displayed.
10. Check the settings displayed and amend them if necessary.
For the supplied calibration board, the default settings should be used, i.e.
 - Type of coded targets - 12 bits.
 - white target.
 - Index values - from = 2, to = 147.
 - Allow very small targets? - select this check box if the camera has low resolution.
11. Select the Next button.
The New template- Calibration settings dialog is displayed.
12. Select the Next button.
The New template- Summary of parameters dialog is displayed.
13. Check the settings.

If necessary, use the Back button and amend the settings.

14. Select the Finish button.
The New calibration - Selection of template dialog is redisplayed with the new template added with the name "Unnamed".
15. Amend the name to reflect the type of the camera.

Calibrating a Camera

1. Double-click the required template in the New calibration - Selection of template dialog.
The New calibration - Enter information dialog is displayed.
2. Key the Project name.
This is a unique name that will be used to identify this particular calibration.
3. Amend the Project path, if necessary.
This is the directory where intermediate calibration files are stored. The default value created by the program can be used.
Note: When a name is keyed, the path is automatically extended.
4. Make sure that the Image selection and calibration check boxes in the Start automatically frame are selected.
5. Select the Next button.
If the specified directory does not exist, a warning is displayed.
6. Select the Yes button to create the directory.
The New calibration - Calibration settings dialog is displayed. This contains a series of value and check box pairs. A selected check box indicates that the corresponding parameter is to be calibrated and the value used as an approximate starting point.
7. Select the required check boxes and amend the values if necessary.
It is allowable to give a zero starting value for all parameters except the Focal length and the Principal point.
8. Select the Next button.
9. The New calibration - Summary of parameters dialog is displayed.
10. Check the settings.
If necessary, use the Back button and amend the settings.
11. Select the Finish button.
The Choose images dialog is displayed.
12. Select the Select images button.
The standard Open dialog is displayed.
13. Select one or more image files.
The image files should be in Windows bitmap format (.bmp) or in uncompressed TIFF format (.tif). They should be pictures of the calibration board from different angles and with different camera orientations, taken with the same focus settings and at approximately the same camera-object distance as for the intended use of the camera.
14. Select the OK button.
The Measurement dialog, containing a progress indicator, is displayed and the calibration proceeds automatically. When finished, the ALCON Lens Calibration dialog is displayed and contains a summary of the calibrated parameters.
Note; If the calibration fails, select the Details button in the Measurement dialog to determine the reason for the failure.

Results

15. Select the View Results button.
The Results dialog is displayed where you can review the calibration and check the results. There are three tabs in the dialog:
 - Measurement - this shows the measurements of points in the images. Selecting the Info ("i") button next to an image name displays the Image measurement information dialog (Image tab) showing the point identification graphically in the image. Selecting the Grid tab displays the measured image coordinates with error estimates associated with the point identification.
 - Pre-orientation - this shows the 6DOF of the camera relative to the board in each image. Selecting the Info ("i") button displays a schematic picture of the camera's orientation.
 - Calibration - this shows the calibrated parameters. Selecting the Info ("i") button and then

- selecting the Grid tab displays the estimated standard deviations of each parameter
16. When satisfied with the results, select the OK button.
 17. Select the Save Results button in the AICON Lens Calibration dialog.
The Save as dialog is displayed.
 18. Save the calibration results as a text file with the extension ".ior".
 19. Select the Close button.

Create New Camera Dialog

The Create New Camera dialog contains the following information:

- Name - the name to be assigned in the system to the camera.
- Camera values
 - Resolution (Pixel) - the size of the image in pixels, e.g. 1600*1200.
 - Sensor size (mm) - the actual size of the sensor.
 - If this is not known, choose a reasonable nominal value for the size of one pixel and multiply the resolution by this value. In the above example, a nominal pixel size of 5 μm is chosen, the computed sensor size is 8*6 mm.
 - Note: The result of guessing the pixel size and sensor size in this way is that the calibrated focal length differs from the real focal length. This is perfectly normal and works since the quantity that is important in photogrammetry is actually the ratio (focal length) : (pixel size).
 - Focal length (MM) - this is used as a starting value for the calibration.
- Distortion parameters
 - Principal point (mm) - In unknown, enter half the values for the sensor size, i.e. the coordinates of the centre of the image.
 - Radial-symmetric - These fields and check boxes determine which parameters are calibrated by default and specify their default values. You do not need to change these fields.
 - Asymmetric - These fields and check boxes determine which parameters are calibrated by default and specify their default values. You do not need to change these fields.
- Import - Button used to import a camera specification from an external file.
- Save - Button used to save the camera specification and return to the New template - Select camera dialog.
- Cancel - Button used to cancel the setup.

3D Target Lens Calibration (optional)

Function

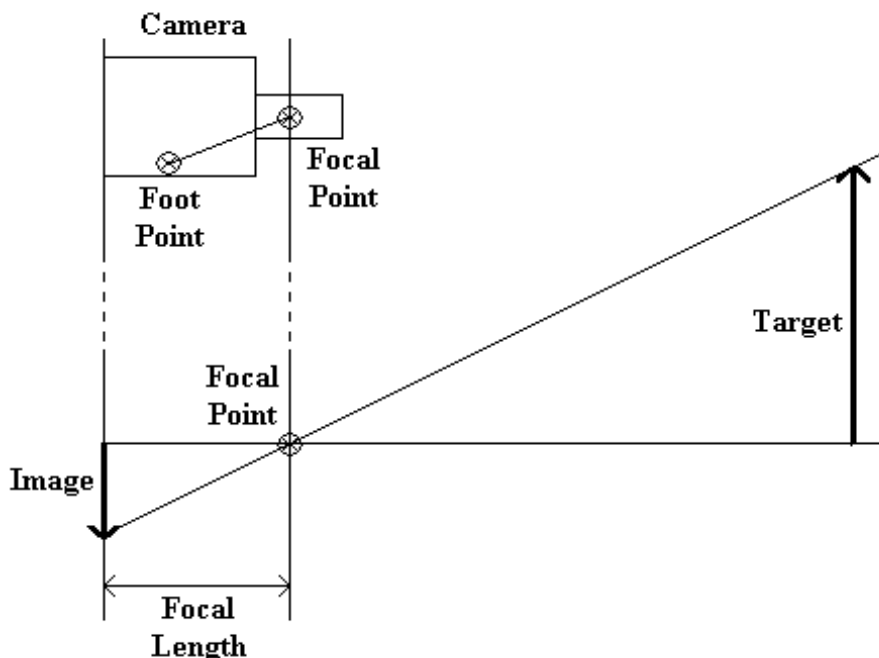
The TEMA Lens calibration process involves the following major steps:

- Record an image sequence containing the target using the camera/lens combination you wish to calibrate and save it as an image file on the workstation. The target should be stationary during this process and placed so that it fills the image. The calibration may be done from a single image but better results are obtained from a sequence because the results from each image are averaged.
- Define a TEMA test which carries out a normal automatic 2D Tracking on the camera view. The target points are included in the Tracking by means of Reference Points. The tracked sequence is then fed into a Lens Calibration function. The calibration function compares the tracked coordinates against the measured known positions as stored in the Archive.
- Carry out the calibration and store the results on an external XML file. The file can then be imported into the sensor when used in any test, making lens distortion compensation possible.

The calibration reference points (target)

The calibration process requires specific Reference points (target) to be constructed and modeled accurately in the system. The target must have at least 15 points if you wish to include lens distortion in the calibration and at least 5 points if you wish to calibrate only for focal length, principal point and aspect ratio. The points must not all be in the same plane otherwise the calibration function is not able to make the necessary depth calculations. The x, y, z coordinates of the target points are measured to sub-millimeter accuracy.

If the camera's foot point is known, its position may be specified and used as input to the calibration.



Procedure

1. Input the camera view with the calibration target visible via the Add New Camera View function.
2. Insert the required Calibration Reference Points via the Camera/[Insert Reference Points](#).
3. Track each of the reference points through the calibration sequence.

4. When finished tracking, select the Camera/Lens Calibration option from the menu bar. The Lens Calibration dialog will appear.
5. Specify the Reference points to use in the calibration by clicking in the list.
6. Specify the Distortion Model. The Radial model has increasing distortion with increasing lens radius. The Polynomial model sets up polynomials in the X and Y directions to model the distortion. Which one of the models to use is a matter of opinion, but most often the Radial model is the best choice.
7. Specify the camera axis, x, y or z.
8. Check the Distance To Target Known check box if this is true. This will allow the distance to be typed in the entry field below.
9. Enter the Known Parameters.
10. When finished, select the Calibrate button.
The calibration is performed and displayed in the Calibration Results dialog.

Results

11. See [Reviewing the results](#) for an explanation of how to interpret the results.
12. Select the Save button to save the results as xml file. Such can be imported into any TEMA test using the this sensor. This is done in the [Camera View Properties](#) dialog.
13. Select the Close button.

Reviewing the results from the 3D target lens calibration

The results of each calibration must be checked, especially if you choose to save them in the Archive because they are then available to be used for compensating for camera performance in other tracked sequences.

The Calibration Results dialog shows the results of the calibration under the following headings:

- Camera Position
- Camera Orientation
- Internal Camera Parameters
- Foot Point Offset (This result is only displayed if the camera has been calibrated for foot point offset.)
- Residual
- Distortion (This result is only displayed if the camera has been calibrated for lens distortion.)

As well as assessing the results of an individual calibration it is advisable to compare the results against previous calibrations to identify any major changes which may need to be addressed.

Camera Position

This displays the calibrated position of the camera's optical centre (focal point). A deviation of a few centimetres in any direction is acceptable, especially since the optical centre is not usually marked. This information is not stored in the Archive because it is not used for correction.

Camera Orientation

This displays the angles giving the camera's orientation relative to the coordinate axis. This information is not stored in the Archive because it is not used for correction.

Internal Camera Parameters

The following internal parameters are displayed:

- Focal length - The focal length is measured in pixels (which may vary in size from installation to installation).
- Note: There are different definitions of focal length which means the measured value may differ from the value specified by the lens manufacturer.
- Principal point - The x and y coordinates of the principal point should normally be close to the centre of the image.
- Aspect ratio - This is normally "1" for most cameras and should be within 1% of the expected aspect ratio.

Foot Point Offset

The position of the focal point is difficult to identify on a camera. To overcome this, a foot point is specified at an easily identifiable position on the camera. The foot point offset is the angular vector from the foot point to the focal point. It is used to calculate the focal point from the foot point.

Residual

This is a measure of how well the predicted image matches the measured image. The smaller the figure, the better the match. The range of acceptable values varies depending on the number of reference points and the camera resolution.

Distortion

This is a measure of the distortion of the shape of the target attributable to the camera lens. It is defined as the maximum distance (in pixels) between a calibration point's image before and after correction.

Selecting the View Distortion Coefficients button displays the Distortion Coefficients dialog which contains the 30 coefficients (15 for the X dimension and 15 for the Y dimension) use in the calibration calculations.

Planar Target Lens Calibration

Function

For a chosen camera and lens combination this lens calibration method calculates the camera internal parameters together with a transfer function to adjust for lens distortion. The method requires a dedicated physical calibration target (e.g. physical calibration board or a printed version of the board) together with a set of images of the target. The calibration images can either be separate snapshots or parts of a longer image sequence captured by either a still camera or a video camera.

Procedure

The lens calibration is a seven-step process:

1. [Recommendations for calibration target \(printed version\)](#)
2. [Recommendations for image capture](#)
3. [Recommendations for camera setup](#)
4. [Image capture of calibration target](#)
5. [Download of images](#)
6. [Calibration of camera](#)
7. [Inspection of result](#)

1. Recommendations for Calibration Target (printed version)

When using a calibration target consisting of a printed version of the physical calibration board, please follow instructions how to print your own calibration board:

- Print the calibration target on paper size A1 (594 x 841 mm) or A2 (420 x 594 mm) depending on the camera field of view.
- The accuracy of the squares should be at least 0,3 mm for a paper size of A1.
- Use a printer that keeps the aspect ratio of the squares.
- It is important to keep the printed calibration target flat when sticking it to a hard surface.

2. Recommendations for Image Capture

In order to determine the camera parameters, the camera that has to be calibrated needs to capture images of the calibration target. Please pay attention to the following:

- Calibration target size. (See chapter 2.1)
- Filling the format. (See chapter 2.2)
- Calibration target placement. (See chapter 2.3)
- Set of calibration images. (See chapter 2.4)

2.1 Calibration Target Size

The camera focus should be the same as when the camera is used after calibration. This puts constraints on the distance between the camera and the calibration target, which means that it is not possible to have full control over how large the target will appear in the image. The limits on the apparent size of the calibration target are:

- All four reference points (the four round target markers) must be visible in all calibration images.
- The reference points should not be less than six pixels across in any image.

2.2 Filling the Format

- The image sequence of the calibration target needs to be as *format filling* (i.e. image filling) as possible. This is necessary to determine the distortion for the entire image format.
- The format filling does not necessarily have to be in one single image. Depending on the focal length and the environmental conditions more images might be necessary.
- It is important that, in the total of the images, the format is well used.

2.3 Calibration Target Placement

- In order to achieve a precise determination of the principal point, it is useful to perform a rotation of the calibration target around the camera axis (*swing*). The best result is achieved, if a 90° rotation as well as a 180° degree rotation is performed.
- A tipping over of the calibration target relatively to the camera causes the capturing of *sloped images*. These sloped images are necessary to determine the focal length.

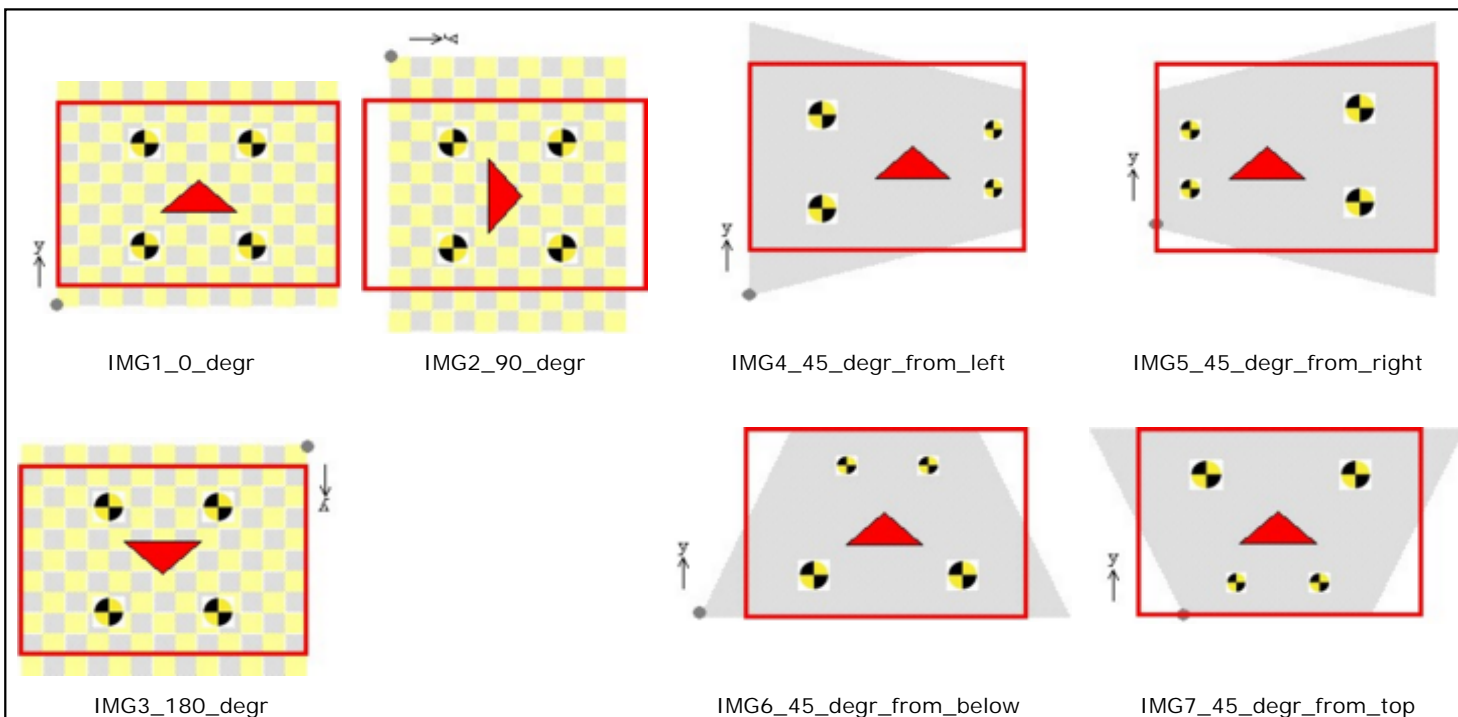
2.4 Set of Calibration Images

A recommended set of calibration images are described and shown below:

- Images 1-3: Different swings between camera and calibration target.
- Images 4-7: Sloped images with different angles between the camera and the calibration target. Recommended slope is approximately 45°.
- Images 1, 2, 3, 4, and 5 described are an absolute minimum. The accuracy of the calibration generally improves if more images are added, up to a maximum of about 20 images.

It is important that the reference points (target markers) on the calibration target are close to the edge of the image. It does not matter if some parts of the target are out of the image view.

For more information about *Recommendations for image capture* see [More about...](#)



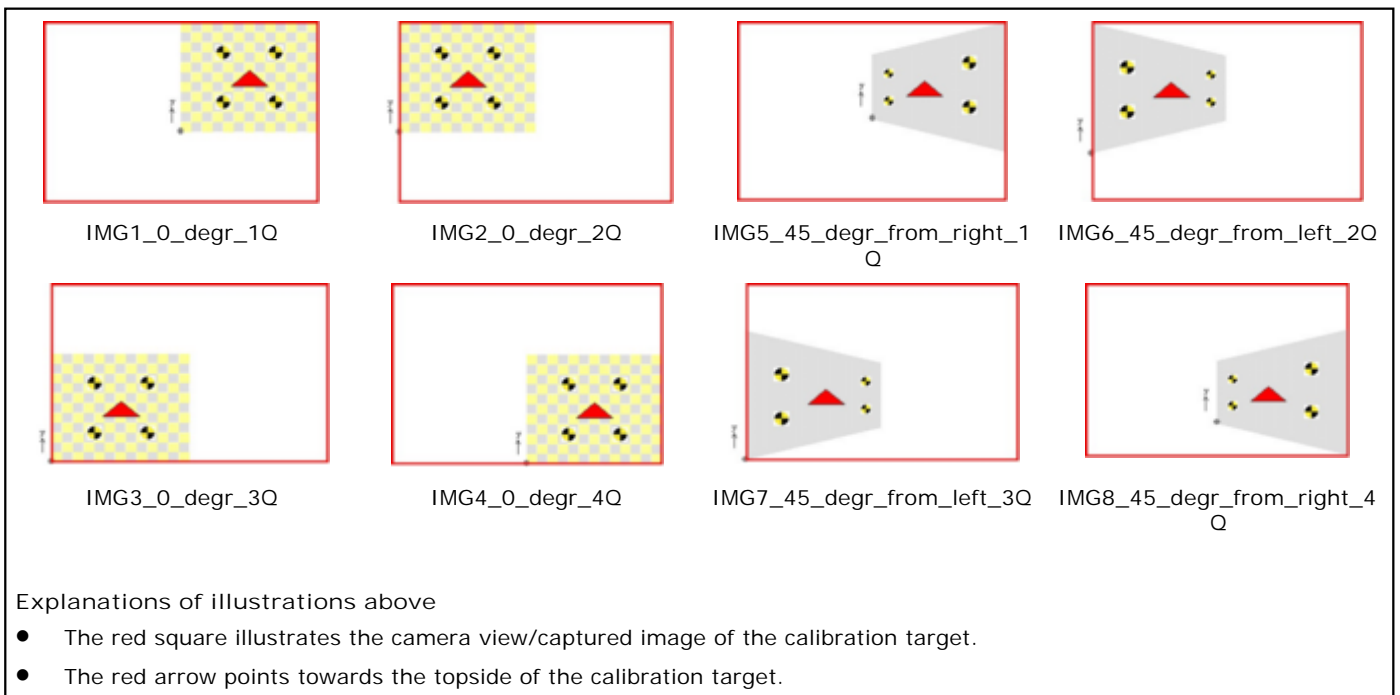
Explanations of illustrations above

- The red square illustrates the camera view/captured image of the calibration target.

- The red arrow points towards the topside of the calibration target.

When the calibration target *does not fill the entire image* a recommended set of calibration images are described and shown below:

- *Images 1-4:* The calibration target fills less than half the image frame. When capturing images of the target in each of the four quadrants of the frame, they fill the entire format together.
- *Images 5-8:* Sloped images. The target fills less than half the image frame. When capturing images of the target in each of the four quadrants of the frame, they fill the entire format together. Recommended slope is approximately 45°.
- *Corresponding images* to those described above (and shown below) can be captured but with different swing and slope.



3. Recommendations for Camera Setup

3.1 Camera Settings

A very important fact is that the camera parameters change when the focus setting and/or the zoom setting of the lens is changed. This means that:

- *All calibration images must be captured with the same focus setting and the same zoom setting.*
- The calibration results are *only valid for a unique camera setting.*
- Use manual focus. Do *not use auto focus.*
- Use a small aperture (f-stop) and possibly long exposure time. The aperture can be changed after calibration if desired.

3.2 Camera Placement

- To reduce the risk for motion blur it is recommended to mount the camera on a tripod when capturing the calibration images.
- As described above the calibration images should be captured from different directions relative to the calibration target. When describing this it is assumed that the target is in a fixed

position and the camera is moved around. This is often inconvenient or even impossible. In such cases keep the camera fixed and move the calibration target instead.

- Use the same distance for capturing images, either by using a fixed position of the calibration target and moving the camera or a by using a fixed position of the camera and moving the calibration target.

3.3 Lighting

- Good and uniform lighting is important to get sharp images that produce accurate calibration results.
- Take care to avoid reflections in the surface of the calibration target, since this may make it hard to find the reference points (target markers).

For more information about *Recommendations for camera setup* see [More about...](#)

4. Image Capture of Calibration Target

When the recommendations for image capture and camera settings respectively have been acquired, the image sequence of the calibration target can be captured.

1. Place the calibration target in front of the camera.
2. Capture an image sequence of the calibration target from different angles according to above recommendations.
 - It is recommended to capture snapshots rather than a continuous movie, because it makes the calibration process easier.
 - Use the same distance for capturing images.
 - Use a fixed position of the calibration target and move the camera
OR
Use a fixed position of the camera and move the calibration target.

5. Download of Images

- When downloading images from the camera it is vital that the images appear as "seen by the camera", e.g. for a swing 180° image it really should be up-side-down. Do not use the option to rotate the images so they appear right side up.
- TEMA requires the calibration images to be a part of a film sequence. This sequence may also contain any number of images that will not be used for the calibration.
- There are two ways that the images can be organized when downloaded from the camera, as separate snapshots or as a continuous movie.

5.1 Separate snapshots

- Each calibration image will be stored as a separate file.
- Before loading these images into TEMA, make sure that the file names conform to the following rules:
 - All file names should start with the same string of characters. This string is the name of the image sequence that is seen inside TEMA.
 - Following the name string should be consecutive numbers with the same number of digits. These numbers are the frame numbers of the images within the sequence.
 - Following the digits is the usual file name extension, e.g. ".jpg" for JPEG images.
 - As an example, if we have ten image files named calib0001.jpg, calib0002.jpg, calib0003.jpg and so on up to calib0010.jpg. TEMA will read them as one sequence called "calib".

5.2 Continuous movie

- The calibration images are part of a continuous movie sequence and will either be stored as one big file (e.g. AVI file) or as a set of separate files with a naming convention as described above. In both cases they can be loaded directly into TEMA.
- Such a sequence will probably contain a lot of "intermediate" images that not will be used (typically is that the calibration target is moving between different positions in the image frame).
- TEMA will let you skip the intermediate images and only use the images that are part of the calibration set.

6. Calibration of Camera

1. Create a camera view and open an image sequence.

- Select the New Camera View option from the File menu. The [Open Image Sequence](#) dialog will appear.
- Select the image file of the calibration target and press the OK button. The New Camera View dialog will appear.
- Do not enter any camera parameters in the New Camera View dialog. Do not enter any frame frequency either, since it is not used by the calibration.
- Press OK button. The program automatically highlights the image file of the calibration target in the [Test Contents](#) dialog and a camera view of the calibration target is shown.

2. Start the Lens calibration wizard.

- Select the Planar Target Lens Calibration option from the Camera menu. The [Lens Calibration Wizard](#) dialog will appear. The [Status](#) section in Lens Calibration Wizard dialog will communicate the necessary steps to complete the calibration.

3. Some inputs need to be made before proceeding with the calibration.

- Set Calibration input data of the camera.
 - If known, enter Physical Pixel Size (value and unit) of applicable camera in the Calibration input section.
OR
Check Unknown in the Calibration input section
- Set Calibrated Parameters of the camera.
 - Influence which parameters will be calibrated by checking Calibrate Tangential Parameters or Calibrate A3.
 - This is an advanced feature. In most cases both check boxes can be left unchecked. For more information, please see the [Lens Distortion Model](#).

4. Create a Reference model of the calibration target.

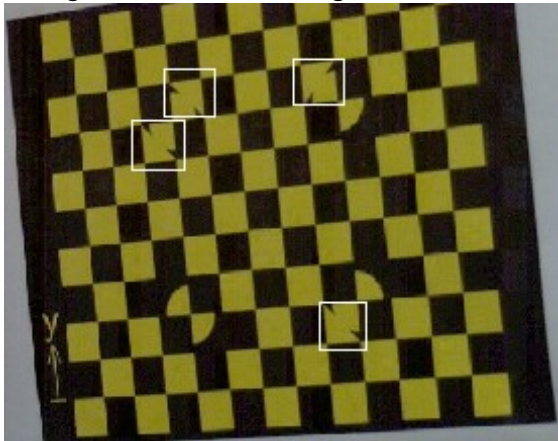
- Generate a Reference model.
 - Mark Generate in the Reference model section and modify the Size of squares (value and unit of one calibration target square).
 - Press Generate button to generate tracking points of the calibration target.
 - The accuracy in the "size of squares" will not affect the accuracy of the calibration. It will only affect the intermediate results, which are the camera positions in each frame.

OR

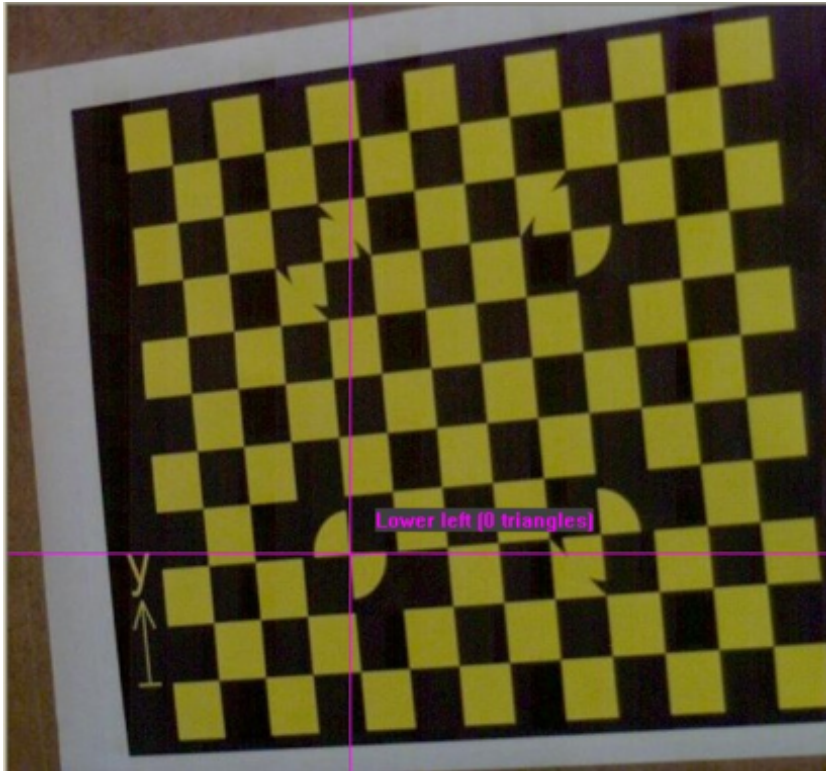
- Import a Reference model. This option is *only* relevant for users having an already created target model of the calibration target.
 - Mark Import from file in the Reference model section and press the Import button.
 - Select applicable Target file (.trg) and press Open button.

5. Position tracking points on the calibration target.

- The calibration process requires four tracking points to be pointed out on each frame. TEMA will automatically name these tracking points when moving the cursor towards the reference points (target markers) in the image of the calibration target by: Lower left, Lower right, Upper right and Upper left tracking point.
 - *Note!* The names "Lower left", "Lower right", "Upper right" and "Upper left" refer to positions of the four reference points when the calibration target is turned right-side-up. These names will be kept even though the calibration target has been turned 90° or 180°.
 - *Note!* Three of the reference points are also identifiable by having yellow identification triangles, marked in image below.



- *Note!* It is important to position the tracking points (Lower left, Lower right, Upper right and Upper left) correctly, even though the calibration target has been turned 90° or 180°.
 - *Note!* If the positioning of tracking points gets wrong, press Clear frame button or Clear all frames button.
- Place the first tracking point Lower left with the cursor in the reference point at position "Lower Left".



- During the calibration process the Status section in [Lens Calibration Wizard](#) dialog will communicate next step, e.g. "Processing frame..." followed "OK. Goto next frame."
- Place the second tracking point Lower right with the cursor in the reference point at position "Lower right".
- Place the third tracking point Upper right with the cursor in the reference point at position "Upper right".
- Finally place the fourth tracking point Upper left with the cursor in the reference point at position "Upper left".
- Wait a while for the TEMA system to find the remaining tracking points.
- Inspect the tracking result. If one or more tracking points are wrongly detected, then clear the frame to stop it from affecting the calibration, by pressing Clear frame button.
- Goto next frame by pressing Play button and Stop button OR alternatively Step forward button in the Time section.
- Position the four (4) tracking points as before: Lower left, Lower right, Upper right and Upper left.
- Repeat this procedure until at least five (5) frames of the calibration target have been marked with tracking points. The Status section in [Lens Calibration Wizard](#) dialog will communicate next step.

7. Inspection of Results

1. View Calibration result.

- When satisfied with the result of positioning tracking points, continue by pressing Next button.
- The calibration result will appear in the in [Lens Calibration Wizard](#) dialog.

Lens Calibration Wizard - Calibration results

Images

| Frame # | Time Sta... | Points | Mean Res... | Max Resi... | Worst Point |
|---------|-------------|--------|-------------|-------------|-------------|
| 0 | 836,0 | 96 | 0,41 | 1,22 | L6 |
| 31 | 867,0 | 96 | 0,49 | 1,55 | L6 |
| 49 | 885,0 | 96 | 0,52 | 1,54 | L6 |
| 67 | 903,0 | 96 | 0,52 | 1,52 | L6 |

Calibration Status
Calibration Successful

Calibrated Parameters

| Parameter | Value | Accuracy | Unit |
|-------------------|-----------|-----------|--------|
| f | 2905,74 | 33,72 | pixels |
| f (length units) | 29,057 | 0,33717 | mm |
| Principal point x | 480,16 | 52,15 | pixels |
| Principal point y | 483,55 | 44,57 | pixels |
| Aspect ratio | 1,0024 | 0,0064360 | |
| R0 | 2810,63 | 0,00 | pixels |
| A1 | -0,085580 | 0,097104 | |
| A2 | -4,8563 | 3,5470 | |
| A3 | 0,00000 | 0,00000 | |
| B1 | 0,00000 | 0,00000 | |
| B2 | 0,00000 | 0,00000 | |

Residuals

Mean Residual = 0,49 pixels Max Residual = 1,55 pixels
Standard Deviation = 0,34 pixels

Distortion Table

- View the calibration result and analyse the Mean Residuals and Max Residuals.
 - By selecting a Frame# (row) in the Image section the Worst Point will be shown in red colour in the image to the right.

2. Save calibration result.

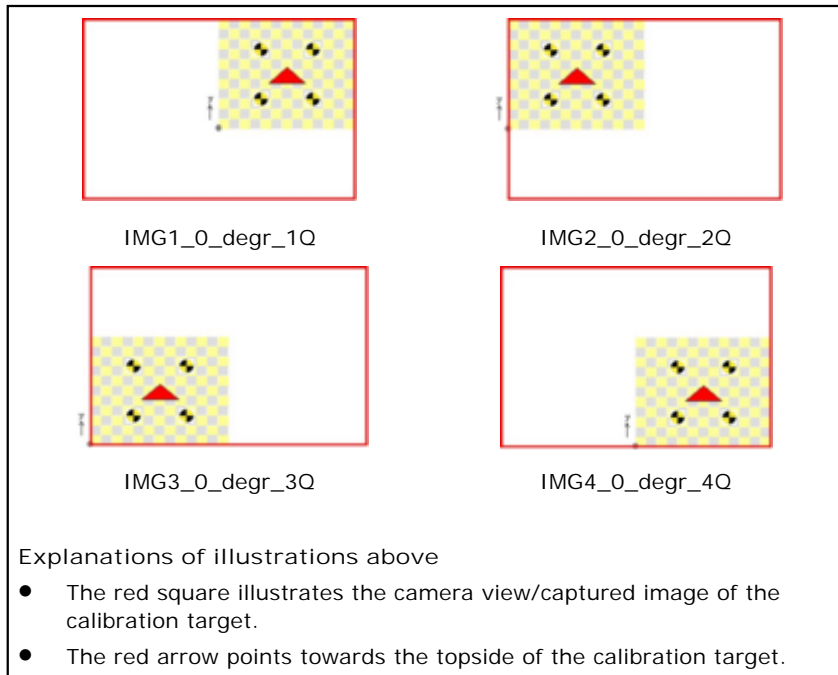
- When satisfied with the calibration result press the OK button and save the result as an XML file (.xml).

More about Image Capture and Camera Setup...

The information below is presented in the same order as it appears in the Planar Target Lens Calibration chapters above.

Format filling

There should be calibration points (target pattern) in all parts of the image frame in at least one image. This does not mean that the calibration target must fill the entire format in any single image, but that the target can be moved between images so that it fills the format when the images are viewed together. See illustration below.



Calibration target placement

To describe the orientation of the camera relative to the target the terms swing and slope are used.

- Swing is a rotation of the camera around the optical axis (or the equivalent rotation of the calibration target). Swing 0° means that the calibration target appears right side up, while swing 90° means that it appears standing on edge, and swing 180° shows it up-side-down.
- Slope is the angle between the camera's sensor plane and the surface of the target. A slope of 0° means that the image is taken head-on (that is, the angle between the optical axis of the lens and the target is 90°).

Number of calibration images

- It is not recommended to use at least five (5) images as an absolute minimum.
- It is not recommended to use more than 20 images since it will lead to long processing times and may also lead to decreased accuracy due to accumulation of rounding errors.

Focus

- If the camera has different focus for the different calibration images the calibration results will be of poor quality, and the calibration algorithm may not even be able to find a solution.
- For an auto focus camera the requirement for a fixed focus setting can lead to problems. The auto

focus should be turned off and the camera manually focused at the distance it will be used. If auto focus cannot be turned off all the calibration images must be captured at the same distance from the calibration target.

Zoom

Changing the zoom setting of a zoom lens not only changes the focal length (which determines the image scale) but also all other lens parameters.

Aperture (f-stop)

- The lens aperture (f-stop setting) only has a small effect on the lens parameters. A smaller aperture (high f-stop number) leads to a larger depth of focus (the range of distances at which the lens will produce sharp images).
- Using a small aperture as recommended above often means that a long exposure time should be used, which increases the risk for motion blur. Mounting the camera on a tripod could prevent this.

Lighting

With a still camera a flash can be used, provided it does not give reflections in the calibration target (which is often the case if the flash is mounted close to the lens).

Lens Distortion Model

Abstract

Below follows a description of the Lens Distortion Model used in TEMA's Planar target lens calibration.

Distortion Model

Let (x, y) be the *uncorrected* pixel coordinates. These coordinates refer directly to the image and are the output of the various tracking algorithms.

The distortion correction produces corrected pixel coordinates (x', y') which are an approximation to what an "ideal" camera would see.

The correction algorithm works with normalized coordinates (X, Y) and (X', Y') given by

$$X = \frac{x - x_0}{R_0}, \quad Y = \frac{y - y_0}{R_0}$$

$$X' = \frac{x' - x_0}{R_0}, \quad Y' = \frac{y' - y_0}{R_0}$$

where (x_0, y_0) is the principal point and R_0 is a scale factor that is chosen by the calibration algorithm.

The relation between corrected and uncorrected coordinates is given by the equations

$$X = X' + dX$$

$$Y = Y' + dY$$

where

$$dX = \frac{X'}{r} dr + 2B_1 X' Y' + B_2 (r^2 + 2X'^2)$$

$$dY = \frac{Y'}{r} dr + 2B_2 X' Y' + B_1 (r^2 + 2Y'^2)$$

$$dr = A_1 r^3 + A_2 r^5 + A_3 r^7$$

and $r = \sqrt{X'^2 + Y'^2}$ is the distance from the principal point.

Note that the equations above tell how to compute the uncorrected coordinates if the corrected coordinates are known — dX and dY are given as functions of the corrected coordinates X' and Y' . Usually the situation is the opposite: the uncorrected coordinates (the output of our trackers) are known and compensation for distortion is wanted. TEMA implements an iterative procedure to solve the equations in this case.

Description of the Parameters

In the formulas above, the term dr depends only on the distance from the principal point. It is radially symmetric around the optical axis and is therefore called the *radial distortion*.

The radial distortion term describes the fact that the image scale varies slightly with the angle between

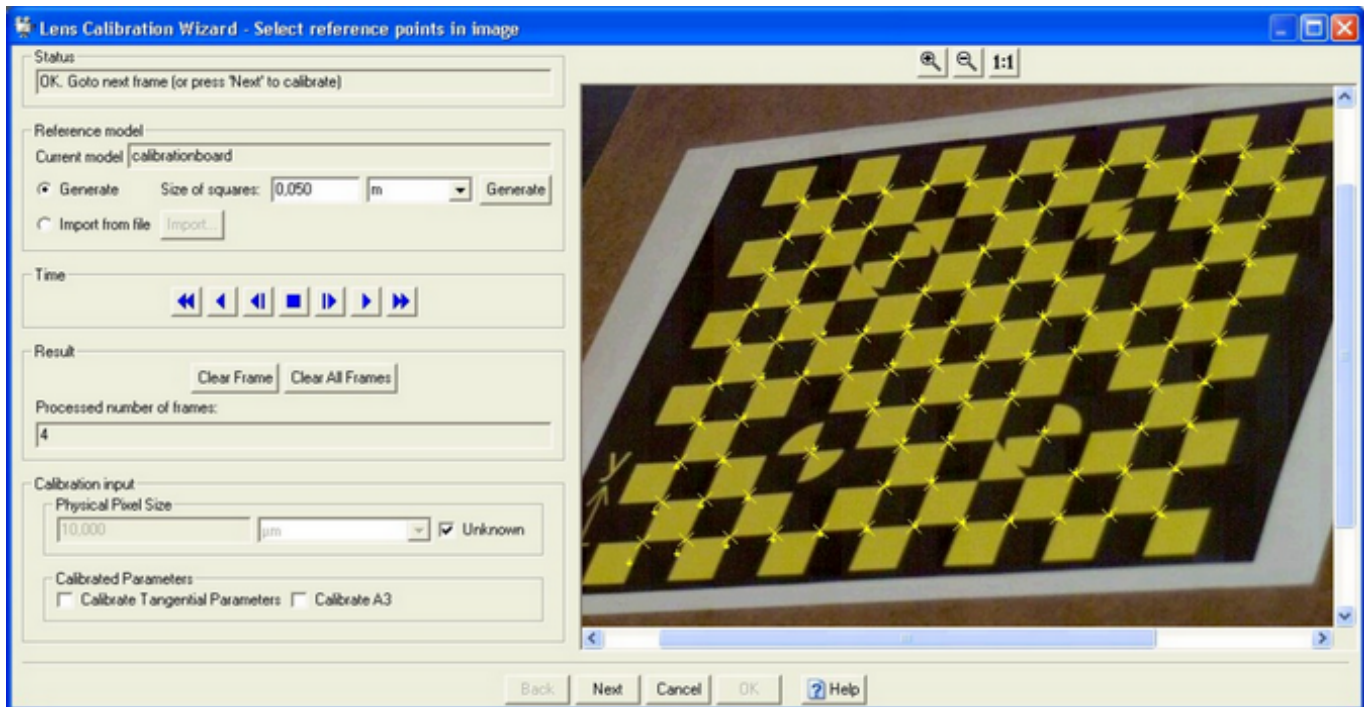
the incoming ray of light and the optical axis (in an ideal camera the scale is constant over the entire image). This is usually the dominant part of the distortion.

For most lenses the radial distortion varies quite slowly with r , and it can be accurately approximated with just the first two terms of the polynomial.

The terms involving the coefficients B_1 and B_2 are called *tangential distortion*. Tangential distortion is caused by the lens elements not being perfectly aligned, which causes the lens system not to be radially symmetric. The tangential distortion is usually much smaller than the radial distortion. In many cases the tangential coefficients B_1 and B_2 can be set to zero without affecting the accuracy of the result.

Lens Calibration Wizard dialogs

The different sections of the Lens Calibration Wizard dialogs will be explained below.



Status

This section communicates next step in the calibration process.

Reference model

This section generates or imports a reference model of the calibration target, consisting of the coordinates of all tracking points.

- Current model - given name of reference model when importing a file.
- Current model - "calibrationboard" when generating a reference model.
- Size of square - value and unit of one calibration target square.

Time section

See [Time Panel Toolbar](#).

Result section

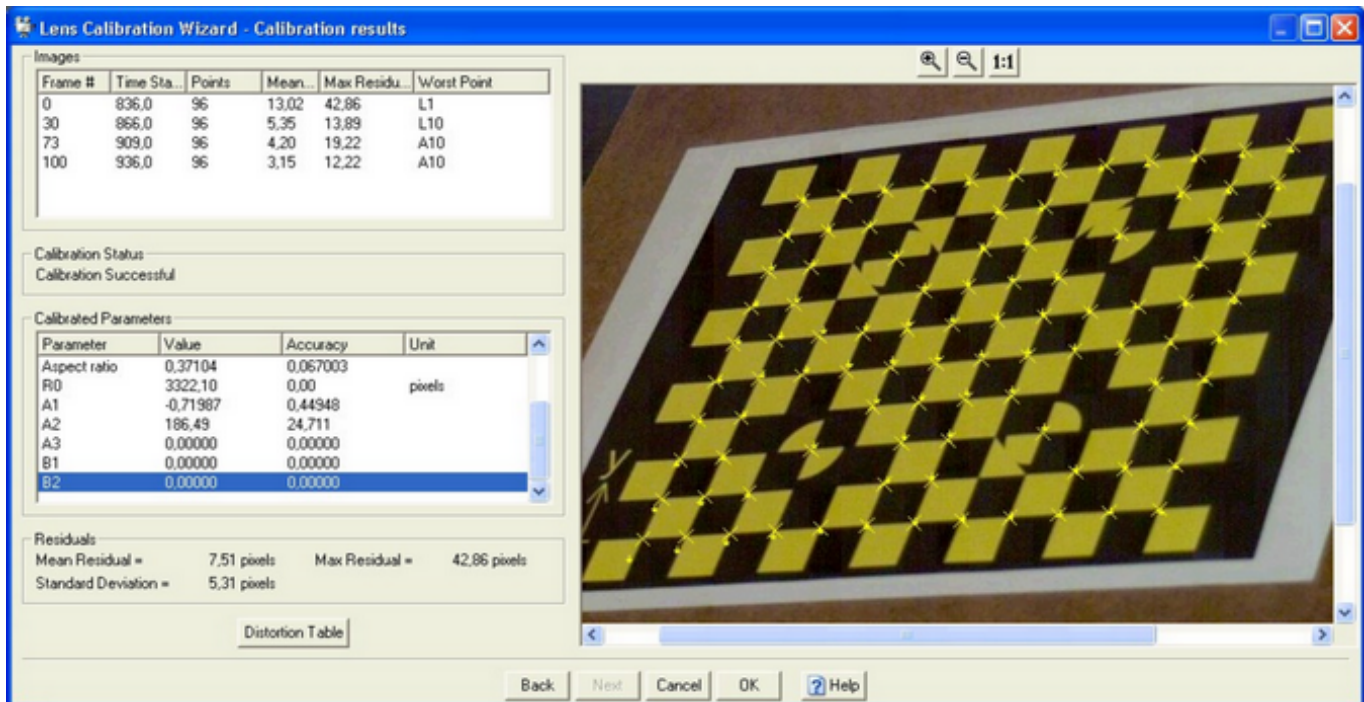
This section erases tracking points.

- Clear Frame – erases all tracking points in one frame.
- Clear All Frames - erases all tracking points in all frames.

Calibration input

- Physical Pixel Size
 - Enter the size of a pixel on the camera sensor, if known. This value is only used to convert the calibrated focal length to a "real world" measurement. Internally TEMA measures the focal length as a number of pixels (this is logical when tracking all measurements in pixels).

- If the pixel size is known this number can be converted to a focal length, which can be compared to the number specified for the lens.
- If the pixel size is unknown check the check box Unknown. Then TEMA will not display the focal length but will otherwise work as usual.
- Calibrated Parameters
 - Influence which parameters to be calibrated by the wizard. This is an advanced feature. In most cases both check boxes can be left unchecked.



Images

This section gives information of processed images.

- Frame # - number of frame or image.
- Time Stamp - time of frame.
- Points – no of tracking points in a frame.
- Mean Residuals (pixels) – mean difference between tracked points and reference model points.
- Max Residuals (pixels) – maximum difference between tracked points and reference model points.
- Worst Point – coordinate of the worst point (also marked red in image).

Calibrated Parameters

This section shows the result from all calibration images.

Distortion Table

This Distortion Table button gives a Calibrated Distortion table, which shows the radial distortion component for different values of the distance R from the principal point.

Wand Calibration

Function

TEMA Wand Calibration is a calibration tool for 3D motion analysis of high-speed tests.

To perform a 3D analyze the camera parameters (positions, attitudes and focal length) have to be known. The Wand Calibration tool will simplify the calibration work flow and determine these parameters.

Two active markers (LED light bulbs) on a rigid wand are tracked in an image sequence where the wand is moved around in a measurement volume. The tracked markers are used to perform a relative orientation on the observing cameras. The distance between the markers is used for scale.

The use of Wand Calibration will increase the accuracy and ensure that the results acquired from the analysis are accurate enough to draw the correct conclusions.



Prerequisites:

- The length of each wand is unique and has to be known before calibration (distance between the markers), see wand calibration specification from Image System.
- At least two (2) cameras are required to perform the Wand Calibration and test.
- Activating the wand after image recording has started will ensure the synchronization of the cameras.
- Approx. 1000 images are recommended for wand calibration of cameras.

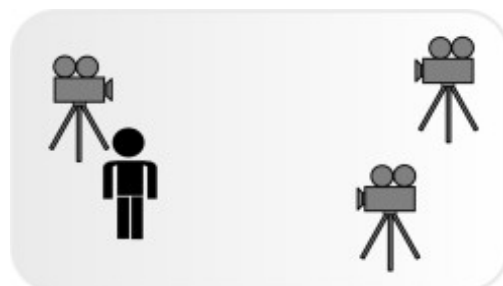
Procedure

The Wand Calibration is a six-step process:

1. [Camera setup and recommendations.](#)
2. [Image capture for calibration and recommendations.](#)
3. [Image capture of test.](#)
4. [Down load of images.](#)
5. [Wand calibration of cameras in TEMA 3D \(Wizard\).](#)
6. [Analysis of test in TEMA 3D.](#)

1. Camera Setup and Recommendations

- Position the cameras for the test and set the final zoom, focus and aperture according to recommendations below.



Camera Placement Recommendations:

- To reduce the risk for motion blur it is recommended to mount the camera on a tripod when capturing the calibration images.
- Place the cameras to cover required measurement volume.
 - The side of a typical measurement volumes are 1-5 m.
 - Each part of the measurement volume must be covered by at least two (2) cameras.
 - More than two cameras can cover a part of the measurement volume; the usage of more cameras will increase the accuracy of the markers and decrease the possibility of obstructed camera views.
 - The accuracy of the analysis depends on the geometry between the points and the observing cameras; 90° angles are optimal, $30^\circ - 150^\circ$ angles are acceptable.

Camera Settings Recommendations:

A very important fact is that the camera parameters change when the focus setting and/or the zoom setting of the lens is changed. This means that:

- All calibration images must be captured with the same focus setting and the same zoom setting.
- The calibration results are only valid for a unique camera setting.
- Use manual focus. Do NOT use auto focus.
- Use regular room lighting.
- Perform the camera settings by using live images. The objective is to capture a 1000-image sequence of the wand which is synchronized, well focused, has maximal contrast relative the background and a motion blur < 1 mm.
 - Set focus and aperture so that the complete measurement volume is in focus.
 - Set the exposure time to enable good contrast of the markers and distinguished black-and-white fields if the wand.
 - Set the exposure time to $< 333 \mu\text{s}$ to guarantee a motion blur < 1 mm of the wand is moved 3 m/s.
 - Set the frame rate to 25-30 frames/s.
- Take notes of the camera settings for reuse in future tests.

2. Image Capture for Calibration and Recommendations

The objective of the image capture is that when all images are viewed as overlaid images, the points should cover the entire measurement volume.

- Place the operator holding the wand inside the measurement volume.
- Start the image capture.
- Activate the wand and move it inside the entire measurement volume according to recommendations below.
- Start a synchronized recording of the wand from all cameras according to recommendations above (chapter 1).

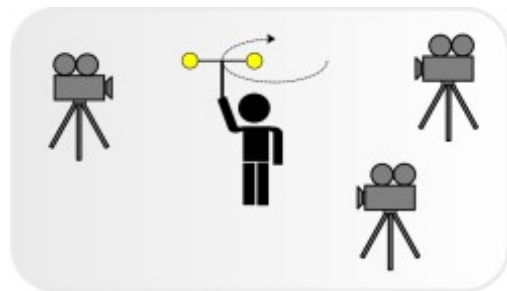


Image Capture Recommendations:

- Move the wand so that the markers are visible to the cameras as much as possible.
- Move the wand smoothly in the entire measurement volume, so it spends the same time in each part of the volume.
- Capture approx. 1000 images. 300 images is a minimum.
Note: An image will only be usable if at least two cameras view both markers.

3. Image Capture of Test

- Set the final frame rate and exposure time for the test.
- The wand calibration is unique for each camera. Do NOT change camera positions, zoom, focus or aperture.
- Set applicable exposure time and frame rate due to test requirements.
- Perform the test and make a synchronized recording from all cameras.



4. Down Load of Images

- The calibration images are part of a continuous movie sequence and will either be stored as one big file (e.g. AVI file) or as a set of separate files. In both cases they can be loaded directly into TEMA.

5. Wand Calibration of Cameras in TEMA 3D (Wizard)




- Use TEMA 3D and the calibration images to calibrate the system via the Wand Calibration wizard (described below).

All necessary parameters will be calibrated and the process is 100 % automatic.



1. Create at least two camera views and open the image sequences.
 - Select the New Camera View option from the File menu. The [Open Image Sequence](#) dialog will appear.
 - Select the applicable image files of the wand and press the OK button. The New Camera View dialog will appear.
 - If the focal length and pixel size are known, it is recommended to enter these values for applicable cameras.
Note: The pixel size will be given automatically if Camera Type is selected.
 - Press the OK button. The program automatically highlights the image file of the wand in the [Test Contents](#) dialog and the selected number of camera views of the wand are shown.
 - For each of the used image sequences, set t0 at the exact time when the wand is being activated. This is to ensure the synchronization of the camera views.
2. Start the Wand Calibration wizard.
 - Select the Wand Calibration option from the Camera menu. The Wand Calibration Wizard dialog will appear. The Status section in the Wand Calibration Wizard dialog will communicate the necessary steps to complete the calibration.
 - Step 1 - Basic Setup :
 - Select which Views to Calibrate . All views are selected by default.
 - Select Primary (origin of coordinates) from the drop-down list.
 - Enter the Wand Length (value and unit), e.g. 0.601 m. See [Prerequisites](#) above.
 - Select the Calibration Time Interval in which the wand is active;
 - Select All Times .
 - OR
 - Enter values/units manually.

OR

- Use the Set to current time , Set to start of time interval  or Set to end of time interval  buttons.

- Press the Next button to continue.

○ Step 2 - Calibration Points:

- Select how the wizard will find the points; Automatic or Manual.
 - If the Automatic option is selected:
 - Then press the Go button to find the points.
 - When the tracking is completed press the Next button to perform the Wand Calibration and wait while it is in progress. Data will be created for camera position, orientation and focal length.
 - If the Manual option is selected (adequate when automatic tracking is difficult or when the wand is not supplied by Image Systems AB) the following is required:
 - Previously tracked points.
 - At least two (2) points per camera view.
 - The names of the tracked points have to be the same in all camera views.
 - Selection of points in the drop-down lists.

Then press the Next button to perform the wand calibration and wait while it is in progress. Data will be created for camera position, orientation and focal length.

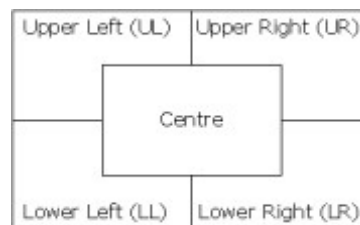
Note: The Residual measures how well TEMAs adjusting the parameters to the measurement data. the residual decreases during calibration process.

- Press the Back button to perform necessary changes in step 1.
- Press the Close button to close the wand calibration process. It can later be reopened.
- If any error messages are received, please follow the instructions shown in the Status message field.
- If the calibration has succeeded, see step 3 below.

○ Step 3 - Calibration Results:

- The Calibration results include:
 - The individual Camera Parameters (orientation and focal length), presented in separate tabs.
 - The quality measurement Overall Results (Mean 3D Error) is presented below the camera parameters.
 - Mean 3D Error is the estimated average 3D error in the final result, if this calibration is used in 3D tests with markers and high quality images. It is based on the average 3D parallax and the tracking accuracy of the Circle tracker.
 - More detailed calibration results are available by pressing the More button.

- Points Per Image Section displays the number of used point observations in each section of the image; Centre, Upper Left, Upper Right, Lower left and Lower Right.



- Max Parallax - The parallax is defined as the "miss distance" between the lines of sight from each camera to the point.
- Mean Wand Length Deviation gives the mean deviation of the wand length computed at each time.
- Max Wand Length Deviation gives the max deviation of the wand length computed at each time.
- The Status message indicating the status of the Wand Calibration:
 - Calibration successfully completed.

- Calibration failed.
 - Calibration completed with warnings.
 - Review the results and press the OK button to accept the results.
 - Press the Close button to close and reject the results. The calibration can later be resumed.
- Note: If needed the markers of the wand can be tracked as usual. This handles the cases where the calibration images have to low contrast to be calibrated automatically and those cases when the user has constructed his own wand.*

6. Analysis of Test in TEMA 3D

- Use TEMA 3D and the test images to analyse the points of interest in the test images.

3D results are computed for each point that is tracked in two or more calibrated cameras.

Note: The calibration can be reused in future tests as long as the camera setup is identical.



- Open a new test.
- Import the images captured during test.
- Import the previously performed calibration results from the calibration test (.ted-file).
- Define a 3D coordinate system by using the markers in the test images.
- Track the points to be analyzed.
- The 3D result is automatically calculated for all points that have been tracked and are named the same in two or more camera views.
- Save the test as a TEMA test (.ted-file).
- From version 3.9 calibration parameters can be save to an *.XML file. This file can be later be imported in 'Camera View Properties'.

Test Database Interface (optional)

Function

TEMA provides a possibility to interact with an external test database. This enables automatic setup of TEMA tests according to information in the test database.

Appearance

The test database interface is reached from the File menu.

Export xml file

-- This is just for testing --

The function is reached by <Alt> + <Shift> + T.

Export a TEMA test into a xml format file. In General, a xml file is just a text file and contains no data. A TEMA xml file, resulting from a xml export of a test, contains information of how the test was set up. The specific xml layout of the file makes it possible for TEMA to re-import it and re-create the test. This prerequisites that the data produced and images used in the exported test is still on the same locations as when the export was done. Some fields in a xml file can be edited, using any text editor, making adjustments in a test before importing.

The test database interface can import xml files whose information is determined by

Import xml file

Start Test

Enter a new Test specification and load the specified test from the Test Database into TEMA.

Unknown View Names

If the Start Test Command is about to load a test from an xml file containing one or more camera view names not present in the list of known views in the preference archive, the Unknown View Name dialog will appear. This contains the whole view list.

The user can now select whether to add the view name into the views list or not.

Add View - adds the unknown view name to the view list in the preference archive.

Don't Add - the view will be used in test but the view name will not be added to the view list in the preference archive

Refresh Test

Reload updated Test Database information into an ongoing TEMA test using the Test Specification already given at Start Test. This is useful if errors are found in the Test Database after the test has been started in TEMA. Just correct the errors and refresh TEMA.

End Test

Store final information back to the Test Database using the Test Specification already given at Start Test. When this is done, the test will be closed and a new test can be opened. [Policies](#) can be set to specify the Program actions at End Test.

End Test Exports

The End Test command can be combined with automatic [Image Exports](#) to be carried out at End Test. In the [Image Export](#) Dialog, we can make [Image Export Settings](#) (different image formats, overlays, ranges etc) and save those in the [preference archive](#) under different names. The functionality allows any number of end test exports to be performed automatically. The command works on three levels in the test and the number of combinations can therefore be huge;

- For each [camera view](#) i test
- For each Test [section](#) in test
- For each [image export setting in preference archive](#).

If a [Remote Export Server](#) is set up, this will be automatically used for the End Test Image Exports.

See also...

Preferences/[Test Database Interface setup](#)


Controlling Time

Specifying Control Time

You may insert several camera views into a test, each of which has a different timescale. Consequently, the diagrams generated from these camera views also have different timescales.

You may specify which camera view timescale should be used to control the stepping of time via the time panel and time slider. Camera views and associated diagrams that have no sample matching the current time use the sample closest in time as its current sample.

1. Select the camera view that is to be used to control the stepping of time.
2. Select the Control Time option from the Camera menu.

The  icon is displayed adjacent to the name of the selected camera view and the Control Time option is disabled for this camera view.

Time Overview

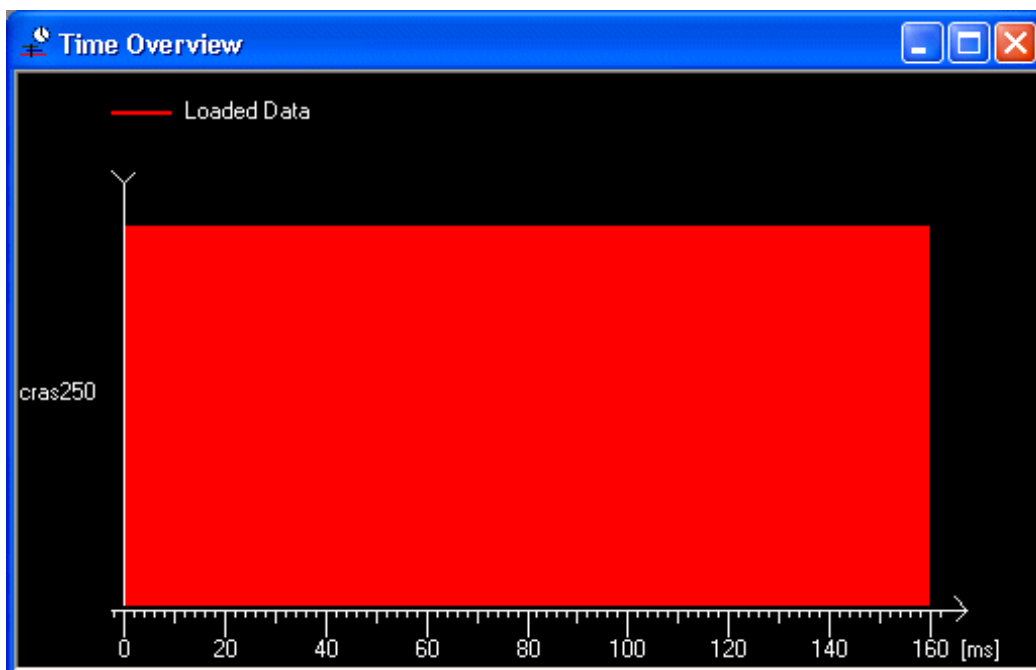
The Time Overview window is used to display graphically the status of the data in the test.

It is most useful in conjunction with the system when the Camera Control optional feature is available. However, it can be used in the Standard system.

To display the Time Overview window, select  Time Overview from the View menu.

Standard System

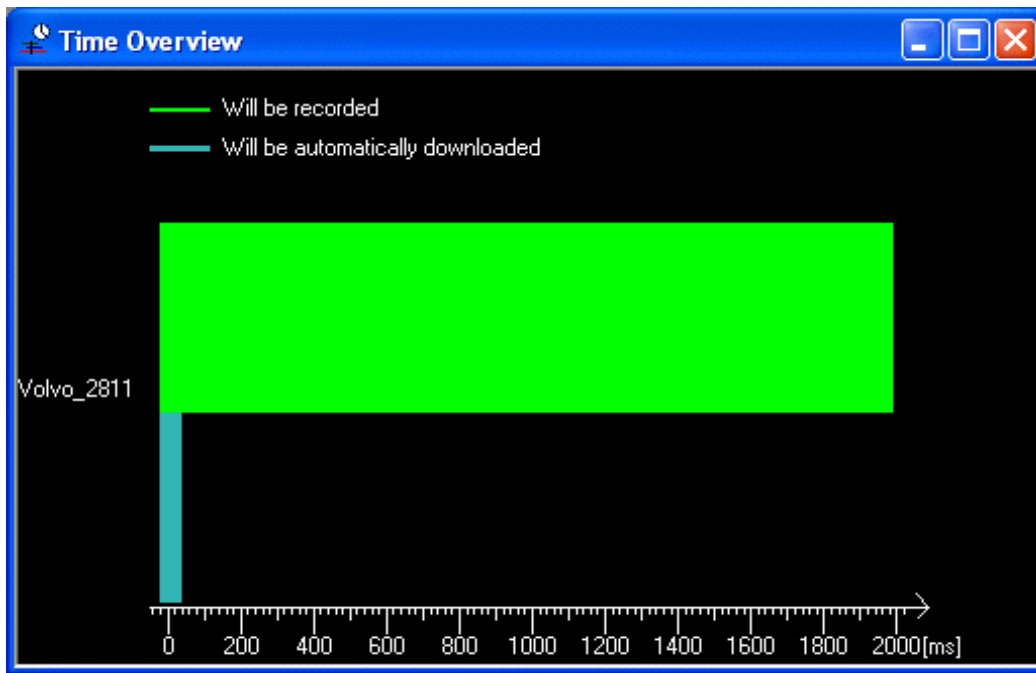
The time span of the loaded data is displayed.



Camera Control System

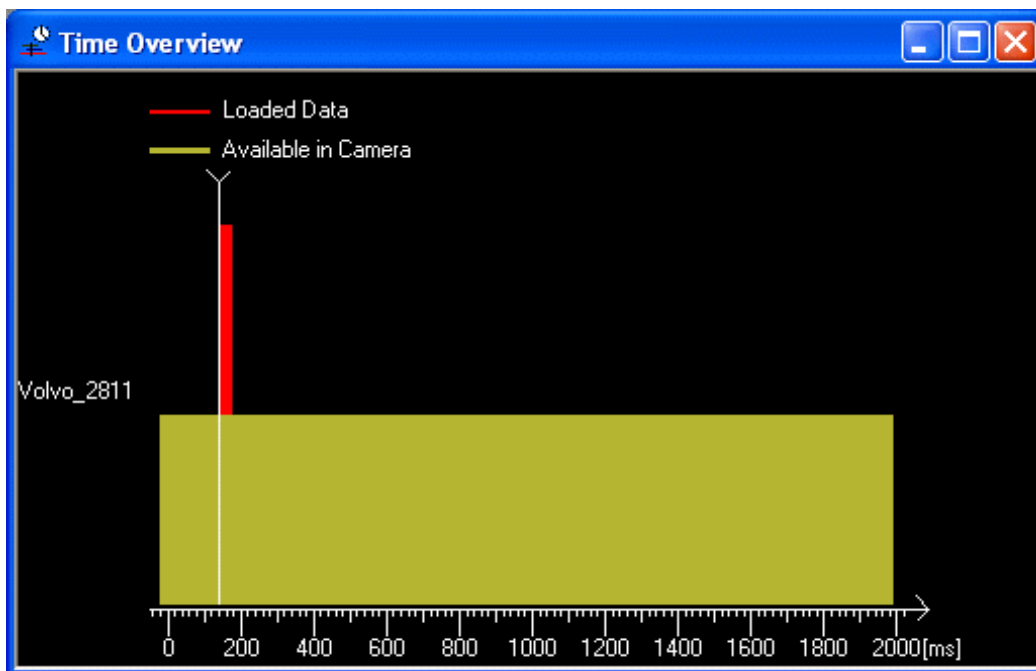
In Live Digital mode, the time span of the data that can be recorded is displayed, together with the time span of the data that has been specified to be automatically downloaded.

Note: In the following example, a pre-trigger frame count of 10 frames was specified. This is translated to a pre-trigger time and is indicated in the display by the time spans starting before the zero time.



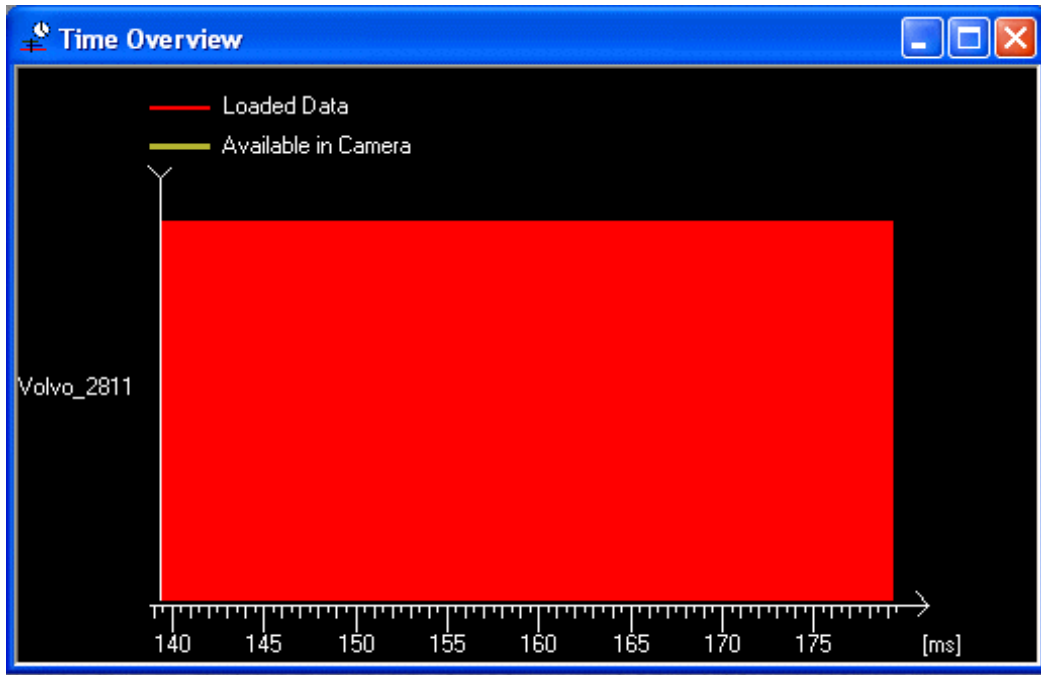
In TEMA mode, the time span of the available data in the camera is displayed, together with the time span of the data already downloaded to the system.

In the following example, the time span for the 20 frames already automatically downloaded is shown.





The following illustration shows the same situation, but after the Clear Cameras command has been executed.

Note: The timescale axis is automatically adjusted to reflect the data to be displayed.



Setting t0

1. Use the [Time Panel toolbar](#) or the [Time Slider](#) toolbar to set the current time to a particular point of interest in the image sequence.
This time is typically at a readily identifiable event in the sequence such as the point of impact in a crash test or a calibration light being extinguished. It is used as a reference time during the test and the subsequent analysis. It is referred to as "t0".
2. Click the  button.
t0 is set to the current time, which is indicated by the red line being positioned over the green diamond on the time slider, i.e. .


Alternatively:


- Select the Set t0 option from the Camera menu.
- The Enter New Time dialog is displayed.
- Key the New time for current frame.
- Select the required unit from the adjacent list.
- Select the OK button.

Setting the Current Time to t0

Using the system results in the current time being moved to different times in the test. You may reset the current time to t0, the [defined reference time](#) for the test:

1. Select the Goto t0 option from the Camera menu.

Alternatively, click the  button.

The current time is set to t0, which is indicated by the red line being positioned over the green diamond on the time slider, i.e. .

Tracking

Setting up and Running Tracking

The system contains the following facilities for specifying points to be tracked:

- Controlling the tracker:
 - [Disabling the tracking function for a point in a sequence.](#)
 - [Enabling the tracking function for a point in a sequence.](#)
 - [Putting a point to sleep in a sequence.](#)
 - [Waking up a sleeping point.](#)
- Controlling a point:
 - Advanced facilities for controlling the tracking of a point via the [Point setup dialog.](#)
 - [Putting a point to sleep on an image.](#)
 - Using the [Zoom function](#) to position a point.

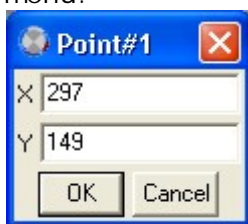
Note: You may find it convenient to select several points at the same time to specify or amend their common properties. The <shift> and <control> keys may be used in the standard manner to select multiple points.


Specifying a point for tracking

1. Select the  button.

The first point, Point#1 is added to the Test Contents window. The  icon indicates that the tracker is enabled for the point, but that its position in the image has not been registered.

2. Select the Properties option from the Edit menu to:
 - [Change the name of the point.](#)
 - [Specify the tracker algorithm](#) if you wish to change the default.
3. Position the mouse pointer where you want to place the point in the displayed image.
4. Click with the left mouse button.
The point is placed in the image with its position indicated by a cross.
5. You may move the point
 - by using Drag and Drop.
 - OR
 - by positioning the point more accurately using the [Point Zoom window.](#)
 - OR
 - by manually set the pixel coordinates by selecting Position... option from the Tracking menu.



The  icon indicates that the tracker is enabled for the point and its position in the image has

been registered.

6. Repeat the above steps to specify any other points that you wish to track automatically.
Note: As soon as a new point is added it becomes current and the previous point changes colour.
You are now ready to [run tracking](#).

Managing Tracked Points

TEMA contains a number of functions to enable you to manage tracking points:

- [Add a Point.](#)
- [Add a Duplicate Point.](#)
- [Copy a Tracker Setup.](#)
- [Enable the Tracker for a Point.](#)
- [Disable the Tracker for a Point.](#)
- [Register a Point as being Asleep.](#)
- [Put a Point to Sleep in the Selected Interval.](#)
- [Unregister a Point in the Selected Interval.](#)
- [Wake a Point in the Selected Interval.](#)
- [Zoom a Point.](#)

The following descriptions refer to a single point. However, you may select several points using the <Shift> and <Ctrl> keys where appropriate. In these circumstances any action which operates on the 'current point' assumes that the first point in the list is current.

- Right clicking a point in the camera view window offers fast access to a number of functions.
 - [Point setup](#)
 - [Copy setup from point](#)
 - [Show Point Zoom](#)
 - [Sleep In Selected Intervals](#)
 - [Unregister in selected interval](#)
 - [Wake up point](#)
 - [Recalculate All](#) (only valid for virtual points)
 - [Suggest Point Position](#)
 - [Auto find similar](#)
 - Delete Point
 - [Duplicate Point](#)
 - [Enable Point for tracking](#)
 - [Disable Point for tracking](#)
 - [Sleep](#)
- Selecting a point in the Test Contents tree will make the right-click menu to contain some more options. Those are merely options useable when making multi-selections of points. Multi selection is possible in the list but not in a camera view.
 - [Point Groups](#)

Note; when clicking on a point in the camera view, the point will not be selected in the list in [test contents](#) tree. The items highlighted in the list will remain in that status no matter which point is clicked in the camera view. This is to avoid open point windows with multiselected points not to change their contents at all times a point is selected in a camera view.

Point Display




The current status of each point is defined by two icons. The position of a point displayed in the current image is indicated by one of several markers.

First Icon

The first icon indicates the tracker assigned to the selected point:









Each of the tracker icons may be displayed in three forms depending on the tracker state. The following show the variations as applied to the Airbag tracker:


-  - indicates that the tracker is enabled and the selected point is tracked in the current and subsequent images until the tracker status is changed;
-  - indicates that the tracker is disabled and the selected point is not tracked in the current and subsequent images until the tracker status is changed;
-  - indicates that the tracker marks the selected point as being asleep in the current and subsequent images until the tracker status is changed.


Second Icon


The second icon indicates the status of the point in the current image. It may take the following values:

-  - indicates that the position of the point has not been defined.
-  - indicates that the point has a valid position set automatically by the tracker.
-  - indicates that the point has a valid position set manually by the user.
-  - indicates that the point is asleep in the current image.
-  - indicates that the point is being tracked but that its position has been lost for one of several reasons:
 - it has moved outside the tracked area of the image;
 - it is hidden;
 - its movement is too erratic to track automatically;
 - the image quality is not good enough.
-  - indicates that the point has a valid position set automatically by the tracker by calculation from its group membership rather than by measurement.

Each of the point status icons may be displayed in two forms depending on whether the point is a member of a point group or not, a red dot will be added if the point is in a group:

 - indicates that the point is not in a group;

 - red dot indicates that the point is in a group.

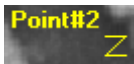
+  - red dot and + sign indicate that the point belongs to multiple groups.

Point Display

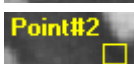
A point displayed in the current image may be marked by one of the following indicators:



- tracked position;



- last known position of a sleeping point;



- last known position of a non-registered point;



- last known position of a lost point.

Adding a Point

1. Select the required camera view.
2. Add a point by:
 - o Selecting the Add Point option from the Camera menu.

OR

- o Selecting the  tool.

A new point is added to the Test Contents window and made available for tracking.

The settings of the point is controlled by the current selection in the [Default Trackers](#) toolbar.

3. Change the default name of the point by clicking on the point name twice (not a double-click) and keying the required name.
4. Double-click on the point.
The Point Setup dialog is displayed.
5. [Specify the properties of the point](#).

The Default Tracker Toolbar contains a user-defined set of trackers.

Adding a Duplicate Point


1. Select the required camera view.
2. Right-click the point to be duplicated in the Test Contents window.
3. Select the Duplicate option from the pop-up menu.
A new point is added to the Test Contents window and made available for tracking.
4. Change the default name by clicking on the point name twice (not a double-click) and keying the required name.
5. Double-click on the point and [amend the properties of the point](#), if required.

Copying a Tracker Setup

1. Right-click the point in the Test Contents window that you wish to set up.
2. Select the Copy Setup from Point button.
The Copy Tracker From Point dialog is displayed.
3. Select the point whose tracker setup is to be copied.
4. Select the OK button.
5. Double-click on the point and [amend the properties of the point](#), if required.


Enabling the Tracker for a Point

1. Select the required camera view.
2. Select the required point.

3. Select the Enable option from the Object menu.
The tracking function is enabled for the selected point. This state is indicated by a plain tracker icon, e.g.  for the Airbag tracker. This is the default state of all points.

Disabling the Tracker for a Point


1. Select the required camera view.
2. Select the required point.
3. Select the Disable option from the Object menu.
The tracking function is disabled for the selected point. This state is indicated by a crossed tracker


icon, e.g.  for the Airbag tracker.

If the sequence is re-tracked, any previous information about disabled points is retained, rather than being deleted. This facility is useful if one of the points to be tracked is not straight forward, e.g. it moves erratically from one image to the next. The other points may be tracked automatically while the one point is disabled. This point may then be enabled and tracked manually or semi automatically.


Registering a Point as being Asleep

1. Select the required camera view.
2. Select the required point.
3. Select the Sleep option from the Object menu.
The tracker registers the selected point in the current and successive images as being asleep and

is indicated by two icons, e.g.  for the Airbag tracker. The first icon indicates that the tracker is asleep, while the second indicates that the point is asleep in the current image. The tracker continues to register the selected point in successive images as being asleep until the tracker is enabled or disabled for the selected point.


- o If you wish to mark the position of the selected point in a later image, select the point in the list and mark the position in the image. The icons change to . The second icon indicates that the point has been placed manually. The first icon indicates that the tracker has been automatically enabled. If you do not want the tracking to continue automatically, move to the next image and select the Sleep option from the Object menu. The icons change to



- o If you wish to disable the tracker, move to the next image and select the Disable option from the Object menu. The icons change to .

Putting a Point to Sleep in the [Selected Interval](#)


1. Select the required camera view.
2. Select the required point.
3. Select the Sleep in Selected Interval option from the Object menu.

Alternatively, click the  tool.

The selected point in the current image is marked as being asleep, i.e. the point exists but is hidden and consequently cannot be assigned coordinates. This is indicated by two icons, e.g.





for the Airbag tracker. If you wish to wake up the point, this may be achieved by using

the mouse to position the point in the image and is indicated by the icons changing to .

Unregistering a Point in the [Selected Interval](#)

1. Select the required camera view.
2. Right-click the required point.
3. Select the Unregister in Selected Interval option from the pop-up menu.

The selected point in the current image is marked as being unregistered, i.e. the point exists but is not assigned coordinates. This is indicated by two icons, e.g.  for the Airbag tracker. If possible, you may position the point using the mouse. When positioned in the image, this is


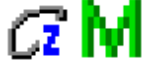
indicated by the icons changing to .


Note: For Virtual Points see also the alternative function [Recalculate All](#).

Waking a Point in the [Selected Interval](#)

1. Select the required camera view.
2. Right-click the required point.
3. Select the Wake in Selected Interval option from the pop-up menu.

The selected point in the current image is marked as being manually positioned at its "lost"

position. This is indicated by the icons changing from  to .

Reposition the point at the correct position. This is indicated by the icons changing from 

 to .

Selected interval

The Selected Interval can be set from the time panel slider or from a text table in a test. Using the time panel slider, a time interval can be defined by holding the <Shift> key while dragging the slider between the first and the last sample in the interval. The selected interval will be enlightened.

Using a text table, the same procedure is used; the interval is marked by holding the <Shift> key. The selected time interval will now be enlightened in the time panel also.

The selected time interval will now be used when selecting *Putting a Point to Sleep*, *Unregistering a Point* or *Waking a Point* in the Selected Interval.




| 1 | CS1:1 | CS1:2 |
|--------------|---|---|
| Time [ms] | Default/Point#1 : Up x[pixels] Camera2_test01 | Default/Point# y[pixels] Camera2_te |
| 2.0 | 259.00 | 204.00 |
| 3.0 | 262.00 | 224.00 |
| 4.0 | 259.00 | 238.00 |
| 5.0 | 249.00 | 249.00 |
| 6.0 | 246.00 | 261.00 |
| 7.0 | 253.00 | 272.00 |
| 8.0 | 245.00 | 282.00 |
| 9.0 | 244.00 | 296.00 |
| 10.0 | 238.00 | 310.00 |
| 11.0 | 236.00 | 312.00 |
| 12.0 | 236.00 | 312.00 |
| 13.0 | 232.00 | |
| 14.0 | 247.00 | |
| 15.0 | 248.00 | |
| 16.0 | 254.00 | |
| 17.0 | 244.00 | |
| 18.0 | | |

Zooming a Point

1. Open up an empty window or have a present window [open](#).
2. Select the point in the test contents tree. The Window will now display the point zoom with the point always in the centre.

OR

3. Select the Show Window option from the View menu.

Alternatively, click the  tool.

The Point Zoom window is displayed, showing part of the image around the point to enable the image detail to be studied.

Each selected point is displayed in its own frame in the window. This enables points to be placed more accurately by selecting their positions in the Point Zoom window, rather than in the displayed image. When a point is moved in the Point Zoom window, the dialog is refreshed so that the point remains at its centre of its particular frame.

Note: Using the left mouse button in the Point Zoom window or the View window repositions the point in both places.

Suggest Point Position

This function predicts and suggests positions of reference points.

1. In a camera view, select Camera/Insert Reference Points.
2. Select the correct tracker algorithm for all selected points.
3. Insert a few points accurately (at least three), advisably spread both in horizontal and vertical direction in the total image. *Note:* The more accurately the points are manually positioned, the better the suggested position of the other points will be. You may then adjust the position of any point manually, or select one or more points and get their suggested position relative to the rest of

the points by re-selecting the tool.

4. To get suggested positions for the remaining points:
 - Mark any point in the point list.
 - Right-click the point list and select the Suggest Point Position function.
 - The Suggest Point Position dialog will appear.
5. The following options are available in the Suggest Point Position dialog:
 - Click the Use colour Edit button to edit the colours of the points in the camera view.
 - Click the OK button to show/register the suggested points in the camera view.
 - Click the Cancel button to cancel the suggestion of point positions.

Autofind similar points

Function

Autofind is functionality for automatic detection of tracking points in images. This can be done in the current frame or in each frame during tracking. In a case where there are many similar points to be tracked (for example when tracking a calibration board) the operator just has to set the tracker to match one of these points and then leave the rest of the points to the autofind similar functionality.

Currently Autofind is implemented for Quad-, MXT- and centre-of-gravity (COG) trackers

Autofind uses a tracking point as a template to find similar points. By choosing a point tracking attributes (e.g. tracker type, template size, tolerance) you can define the type of points that Autofind will find. Autofind returns a list of point candidates, paired up with quality estimates. The quality estimate ranges from 0 (poor) to 1 (perfect).

Procedure

Autofind in current frame

1. Insert a point (template point) in the image
2. Right-click the point in the test contents list or in the camera view and choose Autofind Similar points. The Autofind points dialog will appear. This shows a list of the Autofind points. These are the suggested positions suitable for tracking with the tracker of the original point. The user can select which ones to really create trackers for by clicking in the list. Hitting the Add button moves the selected point(s) to the list of tracked points, while Add all adds all points directly.
3. Click Add or Add all. The default point name field controls the name that a point receives when adding.
4. The list can be sorted on the different columns which simplifies the selection process.
5. Drag the Tolerance slider below the list OR type a value manually. The slider thresholds the content of the listbox.
6. Set the Point-pair distance. A distance threshold that removes points that are too close to existing track points or points with higher quality among the current Autofind points. The unit of this threshold is pixels.
7. Select Visualization type, box or ID number.
8. All points in the Autofind list are shown as small squares or ID numbers in the tracking window, the selected ones in red and the remaining ones in yellow. The visualization radio buttons select whether the tracking window shows IDs or boxes at the point coordinates.

Autofind during tracking

1. Insert a point in the camera view
2. Go to the point setup for the point.
3. Set tracker to Quad-, MXT- or centre-of-gravity (COG) tracker.
4. Enable the toggle Autofind similar points. Autofind will now be performed in each frame during tracking.

Examples of use

Say you wish to automatically find small dark dots on a white background in a single frame. Do this by adding a point to a target, place it on one of the dots, enter its point setup and adjust the thresholds. Then leave the point setup and access the

autofind points dialog as described above.

Point Setup

Starting from version 3.9 the point setup is a window

- dynamically reflecting selections in 'Test Contents'
- reacting on test time changes
- and does not have to be closed

Features and setup functions in general remain the same. Changes are activated via an 'Apply' button.

1. Select either a single point or a group of points using the standard Windows mouse and keyboard combinations, i.e. the <Shift> key for a block selection and the <Ctrl> key for a non-contiguous selection.
2. Change the properties of the point/points in the Point Setup dialog which is displayed by:
 - Selecting the Properties option from the Edit menu.OR
 - Double-clicking on the point in the Test Contents window.OR
 - Clicking on the Add or Edit button in the [Edit Default Trackers](#) dialog.The Point Setup dialog is used to define how the tracking is carried out for a selected point. Any property change made applies "from now on", i.e. tracking may be temporarily stopped and the definition of a point changed before continuing. The information you specify applies to all the selected points.
3. Key in or amend the Point name.

The system gives a new point a name from the range 'Point#1', 'Point#2', etc. You may use these default names or key in a more meaningful name.

If multiple points have been selected, the field is disabled and individual names cannot be changed.

You may also change the name of a point directly by selecting it in the Test Contents window and amending the name.
4. If this is the setup of a [Point Generator](#), the Generated name prefix can be set here also. For example, if the generated name is set to "Point", the names of the *n* points generated from the point generator will be *Point1...Pointn*.
5. For the optional 3D feature, select the required point name from the Select from drop-down list. The drop-down list contains the names of all the points defined for all the camera views in a 3D test. Selecting a name from the list changes the original name of the point to the selected name. This enables you to assign the same name to the same point in all the camera views in which it appears, thus allowing 3D point calculations to be made.
6. Image Mode - override the default image mode as set in the [Tracking setup](#). Note that the tracking can be done on enhanced images also.
7. Specify the display of tracker visualizer (tracker appearance) data in the Show Tracker .
 - Animate - Enabled will draw visualizer data in real time as the current time moves in test.
 - Show - specifies the appearance of visualizer data in camera view window. Select With Skip (enter interval value) or use any of the preset interval settings; At current time, All, Dense, Normal or Sparse.
 - Specify the visualizer color also.

8. Key the Accept lost points for xxx frames value.
This specifies in how many consecutive images a lost point should be treated automatically as being asleep. If the point is lost in any subsequent consecutive image it is treated as lost. The default setting is '0' which means that any point that cannot be positioned is reported as lost. If you set this field to the value '2', the tracker puts the point to sleep in the first two consecutive images where it is lost and does not report it as being lost. If the point is also lost in the next image, it is reported as being lost.
9. If the point is a member of a point group, select the Use Group to calculate lost points check box if the point position is to be calculated from the group definition when lost during tracking.
10. If you do not want Frame to frame prediction de-select the check box.
Using Frame to frame prediction mode is the default and means that the tracking function takes into account the previous positions of the point when tracking its next position. De-selecting Frame to frame prediction mode should be used in circumstances where the movement of the point as seen in the image is erratic.
11. Select the required Tracking method button.
The layout and contents of the dialog are amended to reflect the selection made.
12. Specify the tracking parameters for the selected point(s).
 - [Correlation](#) - looks in each successive image for the area contained within the correlation template. This method is applicable to most cases.
 - [Quadrant Symmetry](#) - finds the symmetry center of the image within the search area and is applicable to Patrick targets, chessboard squares, etc.
 - [Circular Symmetry](#) - finds the symmetry center of the image within the search area and is applicable to concentric circles, spokes on a bicycle wheel or combinations thereof.
 - [Centre of Gravity](#) - tracks a regular, roughly circular shaped object that does not change size and shape during the tracking process.
 - [Circle \(optional\)](#) - tracks circular objects even if part of the object is obscured.
 - [Airbag](#) (Optional Feature) - tracks the outline of an irregular shaped object that may change size and shape during the tracking process.
 - [Advanced Airbag](#) (Only available with the Airbag Optional Feature) - tracks the outline of an irregular shaped object that may change size and shape during the tracking process. It uses a different method from the Airbag tracker in order to track the outline.
 - [MXT Target](#) (Optional Feature) - finds the symmetry centre of the image within the search area and is applicable to MXT targets with either four or five outer white dots on a black circular background.
 - [Virtual](#) - specifies that the point is virtual, i.e. its position in successive images is calculated from the positions of the other points in its [point group](#), rather than by measurement. There is no setup procedure.
 - [Constant](#) - specifies a fixed point in the image that can subsequently be used as a reference point for analysis and display.
 - [Corner Contour](#) - tracks the curvature of edges, e.g. corners in any shape.
 - The choice of which method to use depends on the nature of the target and the measurements you wish to make. The following points should be taken into consideration:
 - The Airbag, Quadrant Symmetry and MXT Target methods should be used to track their intended targets.
 - The Advanced Airbag method should be used when the background is not clearly distinguished from the airbag. If the background is clearly distinguished, the Airbag method should be used because it operates faster and produces a result of the same accuracy as the advanced method.
 - The Circular Symmetry method should be used for circular or almost circular targets. It is not so good for elliptical targets. For these use the Centre of Gravity method.
 - The Centre of Gravity method should be used for a well-defined target with a good contrast against the background.
 - The Correlation method is generally effective in most cases.
 - The Virtual method is used when the point is not to be tracked at all. Its position is always

calculated from its membership of a point group. When this option is selected, the Setup button is disabled.

13. If you wish the settings you have made to be the default for points added in the future, select the Save as default button. These will then be added to the [Default Trackers](#) toolbar.



Note: This new default is also applied to new camera views and new tests.

Note: The setup of existing points is not affected, even those still at the original default.

14. Select the OK button.






Running Tracking

These instructions assume that the first image in the sequence is displayed and the points to be tracked have been specified.

1. Click on:
 - the  button (track forward).
 - or
 - the  button (tracks one frame forwards).

While the tracking function plays through the image sequence, the message "Tracking in progress" is displayed in the Statusbar.

For each image it calculates the position of each point and marks it in the image with a cross. When it is finished, the last image in the sequence remains on the display.

2. If the tracking function is unable to position a point in an image, the message "<point name> is lost" is displayed and you may position the point using the mouse.
Note: If the lost point is not visible in the View window, make sure that the whole of the camera view is visible.
3. You may stop the tracking function at any time by clicking the  button and continue from that point later by clicking:
 - the  button.
 - or
 - the  button.
4. To view the results:
 - Click on  button (sequence rewind).
 - Click on the  button repeatedly (step forward through the sequence).
5. You may now [save the results](#) at this point, if you wish, especially if the tracking has taken a long time.

Displaying a Split View

The split view function is used to control how camera view images are displayed. The default is to display one image at a time, but you can specify that any number of images are displayed at the same time.

1. Select the camera view for which you wish to display a split view.
2. Select the Split View option in the View menu.
3. Select the required type of view from the Split View sub-menu.
 - Single - The current image is displayed in the normal manner.
 - Multi - The image area is split into a number of rectangles, each showing a different time. The default is to show five images centred on the current time.
 - HScroll - As Multi, but the images are displayed in one row that can be scrolled horizontally.
 - VScroll - As Multi, but the images are displayed in one column that can be scrolled vertically.
4. If you wish to display all images, select the Showall option from the Split View sub-menu. This option can be selected in conjunction with any of the first four options. In Multi mode, the system skips images in order avoid a too small grid. The first, last and current images are always displayed.
5. If you wish to customise the split view, select the Setup option from the Split View sub-menu.
 - Key the Count, i.e. the number of images to be displayed when Showall is not selected.
 - Key the Skip, i.e. the number of images to be skipped between successive displayed images in HScroll and VScroll modes.
 - Key the Min Size (%), i.e. the minimum percentage of the original image size to be displayed in Multi mode.

Exclude Area (Rectangle or Polygon)

Function

In order to make the tracking procedure efficient, certain areas in the image can be excluded for the tracker, becoming "forbidden" areas.


This is useful when tracking one point that has a similar pattern very close. Without any exclude area, there is a risk that the point is lost as the tracker starts to track the similar pattern next to the point. Adding an exclude area will remove that risk, easing the tracking procedure.

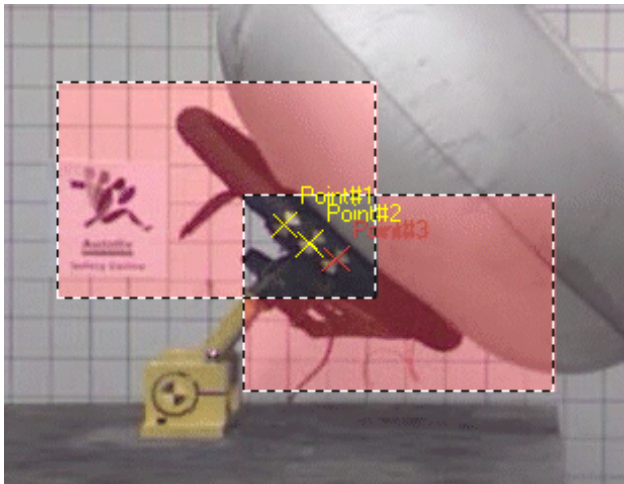
Another way of usage is when using the COG, the outline or the advanced outline tracker when tracking e.g. an airbag. Adding exclude areas next to the outline tracker in such cases will align the tracker to the exclude area side facing the tracker. This will make an exact tracking of the airbag, without the tracker spilling out outside the airbag.


Procedure

In General

The exclude rectangle function is reached from the menu bar; Camera/Add Exclude Rectangle.

Selecting this will add a red square to the image and an  icon in the point list. This is the exclude area. The size of this can be amended to match the area not to be tracked. Adding an exclude area that intersects with a previous one will result in a double negation; the area enclosed by two exclude areas will be a non-exclude area, see illustration below.



The exclude polygon function is reached from the menu bar; Camera/Add Exclude Polygon. This will add an exclude area which shape is set by the user. A  icon will also be added to the tracker window tree structure. When selected; a mouse click will result in a sort of draw tool. The subsequent clicks will result in the sides of the exclude polygon. Any number of sides can be added to this. To finish the shape of the polygon, just drag the mouse pointer from the tracking area. The finished polygon will be highlighted in the exclude transparent red. The exclude polygon can now be reshaped to fit any condition; all of the corners points between the polygon sides can be dragged. Just hold the left mouse button and drag. The illustration below shows an exclude polygon.



Besides the user defined shape, the properties of the exclude polygon are the same as those of the exclude rectangle described above.

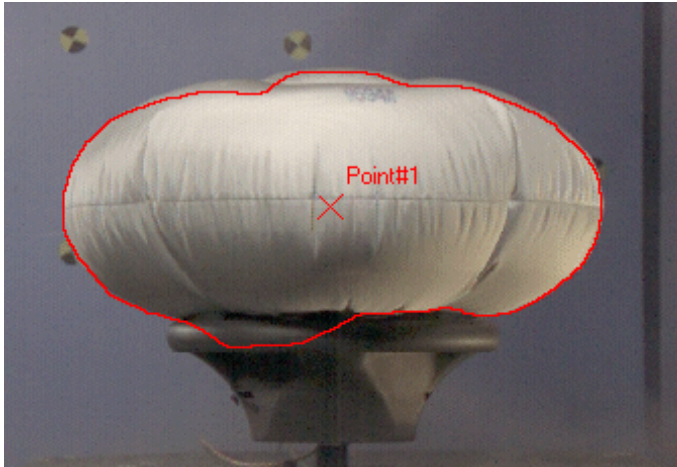
The option exclude by default encloses the whole image in an exclude area. Like this, nothing in the image can be tracked. By using the double negation nature of the exclude areas (see above), adding an exclude area in this mode will result in a small non-excluded area that *can* be tracked, see illustration below.



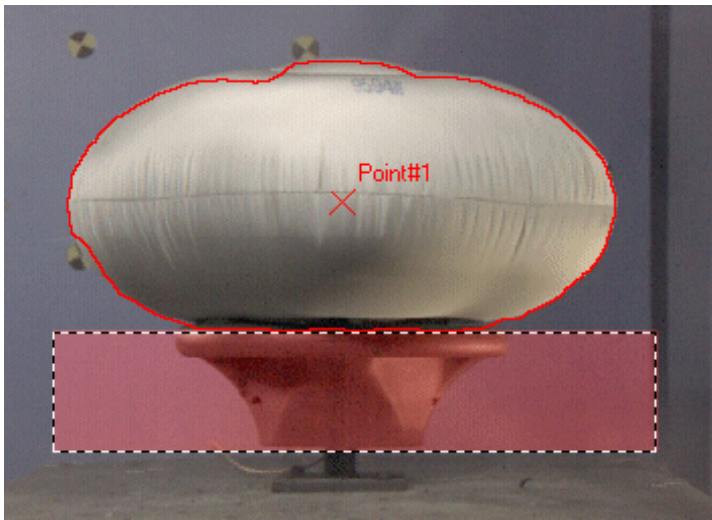
In this way, the areas that are to be tracked and those that are not can be customized to match almost any situation.

Airbag tracker

The illustrations below aim to describe the differences when using an outline tracker without and with an exclude area next to the tracker.



Above; no exclude area added. The outline tracker tends to spill out below the airbag.



The outline tracker aligned to an exclude area.

Point Generator

Function

In some applications, like in [Gun Scoring](#) tests, we might want to track points that are not visible in the start frame, but that appears by chance in subsequent images. The point generator makes this convenient.

The Point Generator is the [Auto find Similar Points](#) functionality, but works over a whole sequence, consisting of many frames.

Using the [point setup](#) interface, a point-model is set up in one frame where an area with desired appearance is visible. When tracking the sequence, the point generator will then generate tracking points for all areas, or spots, where a similar pattern appears. After being applied, those points are then tracked throughout the sequence.

Procedure

1. Step to the frame at where one spot with the desired pattern is visible.
2. Mark the camera view in the test contents list.
3. Select Camera/Add Point Generator option. The Point Generator item will be added to the test contents list like a point sorted below the camera view.
4. Double Click the point generator item OR right click it and select Point Setup. The Point Setup dialog will appear.
5. Apply the point generator to the pattern to track.
6. Set up the point generator using the [point setup](#) interface.
7. Track through the sequence.

See also...

[Exclude areas](#)

[Running Tracking](#)

Angles/Distances


Maintaining Distances

A distance is defined as the length of a straight line between two specified points in a camera view. During tracking the length of the line is determined for each tracked image and can be manipulated and displayed in the same way as a tracked point.

You may:

- [Add a distance.](#)
- [Maintain the properties of a distance.](#)

Adding a Distance

1. Select the required camera view.
2. Select the Add Distance option from the Camera menu.
Alternatively, click the  tool.
The new distance is added to the Test Contents window with a default name and no definition.
3. To define the distance in an image:
 - Select the distance in the Test Contents window.
 - Click on the first point and drag the mouse to the second point.
 - When the mouse button is released, the distance is displayed in the image as a straight line with an arrow pointing from the first point to the second.
4. Amend the distance properties, as defined below.

Maintaining Distance Properties

1. Select the required distance in the Test Contents dialog.
2. Select the Properties option from the Edit menu.
The 2D Distance Setup dialog is displayed.
3. Amend the Name of the distance.
4. Select Point 1 from the adjacent drop-down list.
5. Select Point 2 from the adjacent drop-down list.
6. Select the OK button.

The End

Maintaining Angles

An angle can be specified between two or four points.
The definition of the angles can be seen in the angle setup dialog.


During tracking the size of the angle is determined for each tracked image and can be manipulated and displayed in the same way as a tracked point.

You may:

- [Add an angle.](#)
- [Maintain the properties of an angle.](#)

Procedure

Adding a new angle

1. Select the required camera view.
2. Select the Add Angle option from the Camera menu.
Alternatively, click the  tool.
The new angle is added to the Test Contents window with a default name and no definition.
3. To define the angle in an image:
 - Select the angle in the Test Contents window.
 - Click on the first point and drag the mouse to the second point.
 - When the mouse button is released, the first angle line is displayed in the image.
 - For a 2-point angle, drag the mouse to the second point.
 - For a 3-point angle, click on the second point and drag the mouse to the third point.
 - When the mouse button is released, the second angle line is displayed in the image and the angle is indicated by an arc.
 - For a 4-point angle, click on the third point and drag the mouse to the fourth point.
 - When the mouse button is released, the second angle line is displayed in the image and the angle is indicated by an arc.
4. Amend the angle properties, as defined below.

Maintaining Angle Properties

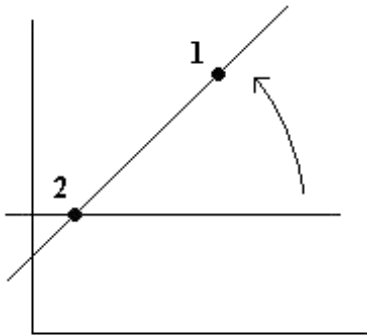
1. Select the required angle in the Test Contents dialog.
2. Select the Properties option from the Edit menu.
The Angle Setup dialog is displayed.
3. Amend the Name of the angle.
4. Select the 2-point, 3-Point or 4-Point radio button, depending on the type of angle required.
5. Select Point# 1 from the adjacent drop-down list.
6. Select Point# 2 from the adjacent drop-down list.
7. Select Point# 3 from the adjacent drop-down list.
8. For a 4-Point angle, select Point# 4 from the adjacent drop-down list.
9. Select the OK button.

Note: The drop-down lists contain a NONE option. If this is selected, the system assumes the point to be further along the x-axis from the previous point. In this way 2-Point and 1-point angles may be defined. A 2-Point angle is one where only two points are defined as not NONE. A 1-Point angle is one where only one point is defined as not NONE.

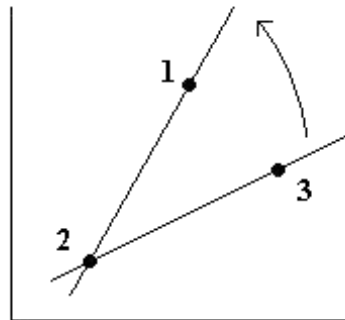
See Also...

[Angle Definitions](#)

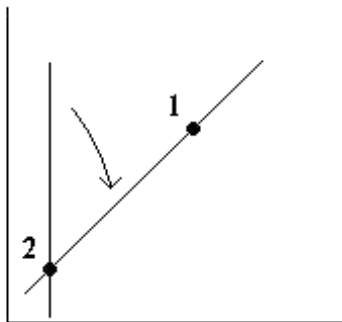
Angle Definitions



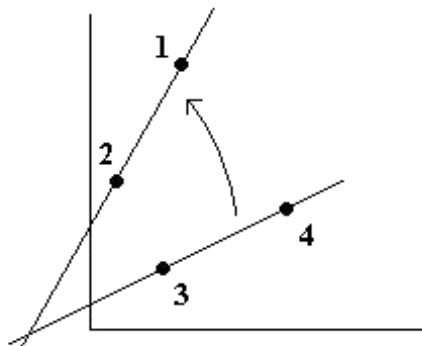
2 - point (x - ref.)



3 - point (x and y ref.)



2 - point (y - ref.)



4 - point (x and y ref.)

Note: All angles are measured in the anti-clockwise direction. This means that all the above angles are positive except the 2 - point (y - ref.).

2-Point angle

The 2 point angle is the angle between the line through the two points and the positive axis direction. It is computed as the angle for the vector from point 2 to point 1.

3-Point angle

The 3 point angle is only defined for positions. It is calculated as the angle between the displacement vectors from point 2 to points 1 and 3.

4-Point angle

The 4 point angle is only defined for positions. It is calculated as the angle between the displacement vector from point 2 to point 1 and that from point 3 to point 4.

Corridors/Stick Figures/Body Models

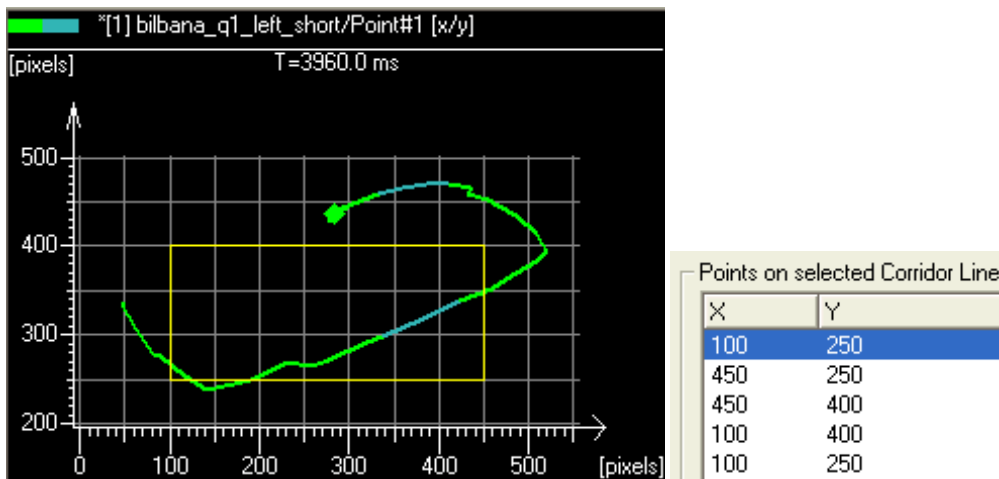
Corridors

Function

Corridors are used to define limits that can be drawn on a diagram or a camera view. They are used to indicate graphically the position of a particular test condition limit. If a diagram line or an item in a camera view crosses the corridor line, then the limit has been exceeded.

Appearance

Corridors can be specified as any shape that can be drawn as a series of straight lines. Enclosed shapes, such as the one shown below, are defined by specifying the "starting point" twice.



Corridors are displayed in the Diagram Corridors window, which is used to:

- [Create corridors](#)
- [Amend corridors](#);

It contains the following information:

Menu Bar

The Menu bar contains the following options: File - manages corridors: New - creates a new set of diagram corridors. Open - opens an existing set of diagram corridors. Save - saves the currently open set of diagram corridors. Save As - saves the diagram corridors under a new name and makes the new set of diagram corridors current. Close Window - closes the Diagram Corridors window. Window - lists the windows that are currently open. Help - provides information about this version of TrackEye and access to the Help contents page. The Diagram Corridors option displays this Help topic.

Dimensions

The Dimensions frame contains the following for both the X and Y dimensions: Dimension - a list of the available dimensions.

Note: The default is "dimensionless" which means that dimension is used to display a scalar quantity.

Unit - the list of available units applicable to the selected dimension.

Lines

The Lines frame contains a list of the lines defining the set of diagram corridors, together with Add Line and Remove Line buttons.

Selected Line

The Selected line frame contains a list of the points for the selected line in terms of X and Y coordinates, together with Add Point, Insert Point and Remove Point buttons.

Procedure

To create a set of corridors:

1. Select the Corridors option from the Tools menu.
The Diagram Corridors window is displayed, containing one diagram corridor line comprising two points.
2. For each of the dimensions X and Y:
 - Select the required Dimension from the list of available dimensions.
 - Select the required Unit from the list of available units applicable to the selected dimension.
3. At the diagram corridor line level, you may:
 - Add a new line:
 - Select the Add Line button.
 - A new line is added to the Lines list with a default name and two default points.
 - Select the default line name and edit the name, if required.
 - [Define the points for the line.](#)
 - Edit a line:
 - Select the required line in the Lines list.
 - Click the line name twice and edit the name, if required.
 - [Define the points for the line.](#)
 - Remove a line:
 - Select the required line in the Lines list.
 - Select the Remove Line button.
 - The selected line is removed.
4. At the point level for a Selected line, you may:
 - Add a new point:
 - Select the Add Point button.
 - A new point is added to the end of the Selected line list with its X and Y coordinates set to '0'.
 - Select the X coordinate and key the required value.
 - Select the Y coordinate and key the required value.
 - Insert a new point:
 - Select the point above which the new point is to be inserted.
 - Select the Insert Point button.
 - A new point is added above the selected point in the Selected line list with its X and Y coordinates set to '0'.
 - Select the X coordinate and key the required value.
 - Select the Y coordinate and key the required value.
 - Edit a point:
 - Select the required point in the Selected line list.
 - Select the X coordinate and key the required value.
 - Select the Y coordinate and key the required value.
 - Remove a point:
 - Select the required point in the Selected line list.
 - Select the Remove Point button.
 - The selected point is removed.

5. Select the Save option from the File menu.
The standard Save as dialog is displayed.
6. Browse for the required folder.
7. Key the file name.
The file type is pre-set to "XML".
8. Select the Save button.
The corridors are saved in the specified file and the name of the window is appended with the full path to the file. The corridors can be [amended](#) if required.

To amend a set of corridors:

1. Select the Corridors option from the Tools menu.
The Diagram Corridors window is displayed, containing one diagram corridor line comprising two points.
2. Select the Open option from the File menu.
The standard Open dialog is displayed.
3. Browse for the required set of corridors.
4. Select the Open button.
The selected corridors are displayed in the Diagram Corridors window.
5. You may:
 - o [amend the dimensions and units](#);
 - o [maintain lines](#);
 - o [maintain points](#).
6. When the required diagram corridors have been amended:
 - o To save the set of diagram corridors under the original name, select the Save option from the File menu;
 - o or
 - o To save the set of diagram corridors under a different name:
 - o Select the Save As option .
 - o [Save the set of diagram corridors](#).

Add a Corridor

1. Select the required camera view in the Points List window.
2. Select the Add Corridor option from the Camera menu.
Alternatively, select the Add Corridor button in the following Diagram Properties dialogs:
 - o [XT](#)
 - o [Multi Axis](#)
 - o [XY](#)
 - o [Advanced](#)
4. The Open File dialog is displayed.
Note: Only corridors matching the dimensions of the displayed image/diagram are presented for selection.
3. Select the required set of corridors.
This is done by browsing in the folder structure in the top left frame and selecting the required corridors file in the top right frame. The selected Directory and Filename are displayed.
If the required folder is on a network drive not shown in the top left frame, select the Network button and map it via the standard Map Network Drive dialog.
4. Select the OK button.
The selected corridors are displayed in the image and a Corridor node is added to the Test Contents window. This enables the corridor to be removed, if required.

Stick Figures

A stick figure is a line drawing superimposed on a camera view. The lines are drawn between pairs of points added to the camera view. Any number of lines may be drawn.


Stick figures are automatically tracked when the points used to draw them are tracked. A typical use of a stick figure is to draw an approximate skeletal structure of a dummy in a crash test. Displaying the stick figure in a diagram adds to the ease of interpretation of the results.

You may:

- [Add a stick figure.](#)
- [Maintain the properties of a stick figure.](#)
- [Amend a stick figure using the Relation tool.](#)

Adding a Stick Figure

1. Select the required camera view.
2. Select the Add Stick Figure option from the Camera menu.

Alternatively, click the  tool.


The new stick figure is added to the Test Contents window with a default name and no definition.

3. Define the stick figure in the image by amending its properties, as defined below.

Maintaining Stick Figure Properties

1. Select the required stick figure in the Properties List dialog.
2. Click the required stick figure again.
3. Amend the Name of the stick figure.
4. Select the Properties option from the Edit menu.
The Stick Figure dialog is displayed.
5. To add a selection:
 - Select a point in the left point list.
 - Select a point in the right point list.
 - Select the Add button.
 - The selection is added to the From - To list.
6. To remove a selection:
 - Select it in the From - To list.
 - Select the Remove button.
7. When all the required selections have been made, select the OK button.
The specified stick figure is displayed in the camera view.

Amending a Stick Figure using the Relation Tool

1. Select the required angle in the camera view.
2. Select the Relation option from the Tools menu.
Alternatively, click the  tool.
3. To add a new line, select the first point on the line and drag it to the second point.
4. To remove a line:
 - Right-click the line.
 - Select the Remove Line option from the pop-up menu.
 - The line is removed.
5. Repeat the process as required.

Body Models (optional)

Function

A Body Model consists of a set of segments where each segment is defined as the line between two tracked points. Each segment can be assigned a mass and a centre of gravity.

Body models are automatically tracked when the points used to draw them are tracked. Displaying the body model in a diagram adds to the ease of interpretation of the results.

If 3D positions have been calculated for each point in the model, the 3D position of each segment's centre of gravity as well as that of the centre of gravity of the whole model is also calculated. A centre of gravity (COG) entry is added to the Test Contents window for each segment of the body model and an additional one for the whole body model. These entries can be selected for inclusion in diagrams.

Body models can be created and edited within TEMA and exported to/imported from ASCII files.

You may:

- Use the body model tool to:
 - [Create a body model.](#)
 - [Maintain a body model.](#)
- Add a body model by:
 - [Importing from a file.](#)
 - [Copying from another view.](#)

Procedure

Creating a Body Model

1. Select the Body Model option from the Tools menu.
The Body Model dialog is displayed.
2. [Create the points.](#)
3. [Create the body model from the points.](#)
4. Select the Save or Save as option from the File menu.
The standard Save as dialog is displayed.
5. Save the body model at an appropriate location.
Note: the body model is saved in a .trg file.
6. If you wish to create another body model, select the New option from the File menu and repeat the above procedure

Creating the Points

To add a point:

1. Select the Add button in the Points list.
A new point is added to the Points list.
2. Select the point.
3. Key in a suitable name

To remove a point:

1. Select the point.
2. Select the Remove button in the Points list.
The selected point is removed from the Points list.

Creating the Body Model from the Points

To add a segment:

1. Select a point in the left side of the Body Model frame.

Note: The next point in the right side is automatically selected.

2. Select a different point in the right side of the Body Model frame, if necessary.
3. Select the Add button in the Body Model frame.
A new segment is added to the Body Model frame. It is given:
 - o a default Name consisting of the two point names separated by a hyphen, e.g. "Foot - Ankle".
 - o a default Mass of "0".
 - o a default COG (centre of gravity) of "0.5", i.e. halfway from the first point to the second.
4. To change the name, select the segment Name and key the required name.
5. To change the mass, select the segment Mass and key the required value.
6. To change the centre of gravity, select the segment COG and key the required value.

To remove a segment:

1. Select the segment.
2. Select the Remove button in the Body Model frame.
The selected segment is removed from the Body Model frame.

Maintaining a Body Model

1. Select the Body Model option from the Tools menu.
The Body Model dialog is displayed.
2. Select the Open option from the File menu.
The standard Open dialog is displayed.
3. Browse for the required .trg file and open it.
The selected body model is displayed.
4. Maintain the body model as described in:
 - o [Creating the Points.](#)
 - o [Creating the Body Model from the Points.](#)
5. Select the Save option from the File menu.
The amended body model is saved under the same name.
Note: Use Save as to save under a different name.
6. Select the Close option to close the Body Model dialog.

Importing a Body Model from a File

1. Select the camera view to which the body model is to be assigned.
2. Select the Add Body Model option from the Camera menu.
3. Select the Import from File option from the Add Body Model sub-menu.
The standard Open dialog is displayed.
4. Browse for the required .trg file and open it.
The points from the selected body model are displayed in the Test Contents window under the selected camera view. The file name is used as the name of the point Group.

Copying a Body Model from Another View

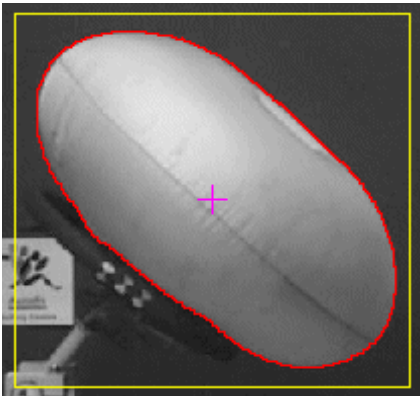
1. Select the camera view to which the body model is to be assigned.
2. Select the Add Body Model option from the Camera menu.
3. Select the Copy from Other View option from the Add Body Model sub-menu.
The Select Model dialog is displayed.
4. Select the required body model from the list of those already in the test.
5. Select the Copy button.
The points from the selected body model are displayed in the Test Contents window under the selected camera view. The file name is used as the name of the point Group.

Trackers


Algorithms

Setting up the Airbag Tracker (Optional Feature)

The Airbag Tracker Setup dialog is used to 'tune' the Airbag tracking function which tracks an irregular shaped object that may change size and shape during the tracking process. A prime example is a vehicle airbag whose shape may be defined by the setup function in the last image in the sequence when it is fully expanded. It may then be tracked forwards from the first image in which it appears.



For a tracked image, the edge coordinates of the airbag can be displayed in the Statusbar (in the grid coordinate system). This is achieved by moving the cursor to the required point on the red outline. The

cursor changes to  and the coordinates are displayed:

On contour point x: 109.00 pixels y: 105.00 pixels

The [analysis to be performed on the airbag](#) after tracking can also be specified.

The Airbag Tracker Setup dialog contains the following fields:

- Zoom- enables the magnification of the displayed image to be controlled directly from within the dialog.
- Image - this shows the Search Area size (yellow rectangle) and the centre of the target (purple cross). The Search Area is updated automatically when the corresponding parameters are changed. The centre of the target is moved by clicking at the centre of the Search Area and dragging it to the appropriate point. The Search Area is automatically repositioned around the new target centre. It also incorporates a zoom function to enable you to control the magnification of the image.
- Search Area - this is the area around the point in the previous image in which the tracker looks when trying to position the point in the current image.
 - Size (X) - the width of the Search Area.
 - Size (Y) - the height of the Search Area.
 - You may specify the Search Area by keying in the width and height, or by drawing it directly with the mouse. Note: The mouse should be positioned at the centre of the point when you start to draw the Search Area.
- Accept search area edge hits - If this checkbox is not selected, when part of the target moves outside the search area, the target is lost. If this checkbox is selected, when part of the target moves outside the search area, that part of the target inside the search area is treated as a hit.

- Object Thresholds - these tools are used to define the shape of the object which is to be tracked.
 - Min - The minimum threshold may be adjusted by keying in a value or dragging the slider to an appropriate position.
 - Max - The maximum threshold may be adjusted by keying in a value or dragging the slider to an appropriate position.
 - The two threshold tools are used in combination to adjust the threshold range of the object within the full value range of 0 to 255. This enables the object which is to be tracked to be defined distinctly in contrast to the background. The outline of the target is shown in red. See [Adjusting the Threshold Levels](#). Threshold range may be further adjusted, if required.
- Subtract/Remove Background Image - subtracts/removes(improved algorithm) the selected image from each image in the sequence, thus removing extraneous parts of the image that could interfere with the tracking process.
Disadvantage: When the background is not a plain colour, the pattern the background has will be superimposed on the foreground object.

Removal settings - Checkbox to activate improved background removal algorithm.

The result of the image subtraction is passed through a median filter to remove noise and small artifacts. Then a **threshold** is applied to the median filter to produce a binary image. This binary image is then used to mask out the background.


The algorithm only works for a static camera as the background has to be at the same position in the reference image as in the processed image for the first subtraction to give a reasonable result. In some tests the camera will invariably have minute changes in attitude and/or position or display aliasing effects. To cope with this a parameter called "**wiggle**" is introduced. Wiggle basically moves the reference image around by an integer number of "wiggle" pixels in each direction in an effort to find the smallest difference from the background. The wiggle parameter increases the runtime of the algorithm as $wiggle^2$ so small values are recommended. Typically values 0-2 are used.

Remove background - check to activate An improved background removal feature will remove the static background without superimposing any pattern from the background on the foreground objects.

Threshold - The threshold value that is applied to create the binary image described in the algorithm. This should be as low as possible without introducing unwanted artifacts. Values around 5-20 are typically good depending on the image quality.

Filter size - The size of the median kernel that is used to remove artifacts and noise. Only odd values are ever used, if you specify an even value the next larger odd size will be used. Typical values are 2-20.

Wiggle - The number of integer pixels to "wiggle" the reference image around to find the lowest difference to the background before performing filtering and applying threshold.

- None - no image subtraction.
 - First image - subtract the first image from each image.
 - Image at time - subtract the specified image from each image. The image is specified by keying the time or by positioning at the required image and selecting the  button, i.e. current time.
- Pre Filtering - this feature applies a filter to the image to produce a smoother definition before the selected threshold range is applied.
 - Filter type - The following filter types are available:
 - Gaussian - A Gaussian smoothing pre-filter is applied. (In earlier versions of the system this filter was referred to as 'Blur').

- Median - A Median smoothing pre-filter is applied.
- None - No pre-filtering to be applied.
- Filter size - specifies the size in terms of pixels of the filter to be applied. The size is set to 3, 5, 7 or 9 by selecting the appropriate radio button.

See Also...

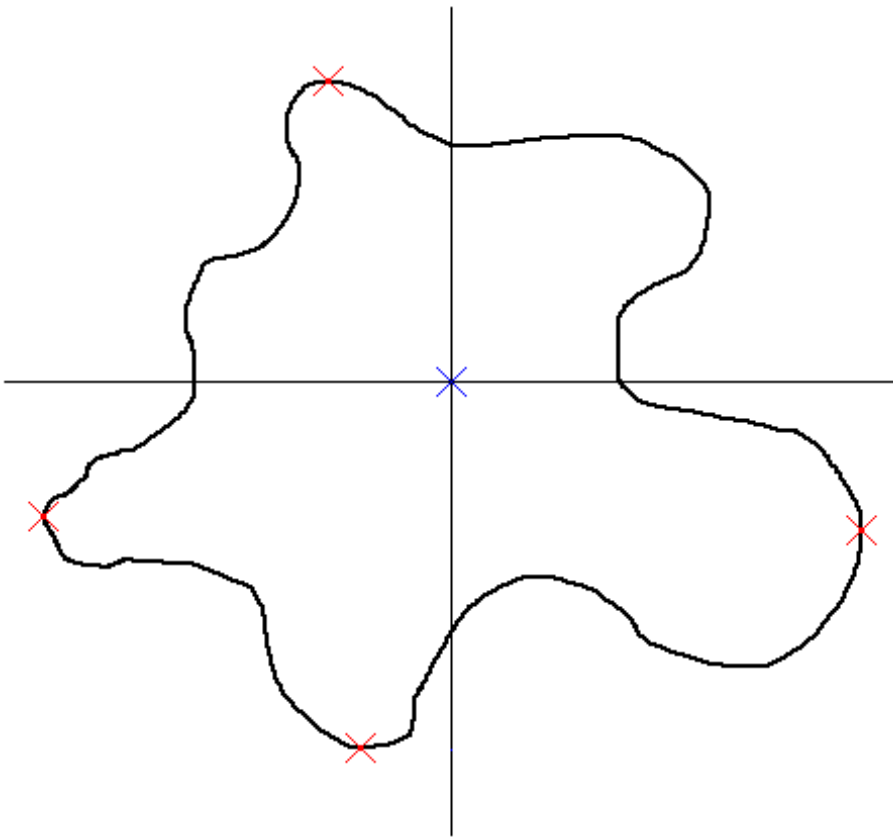
[Exclude area](#)

[Point Setup dialog](#)

Airbag Analysis Calculations (Optional Feature)

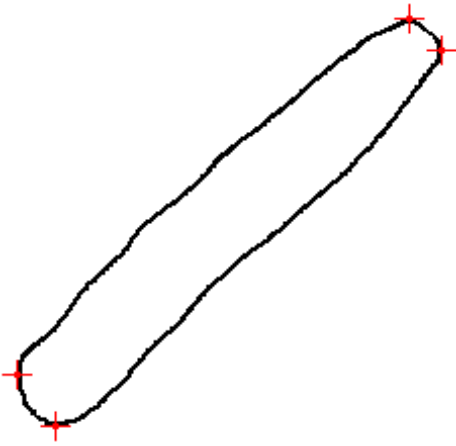
The Outline is a composite data type that represents the shape of an image object and is produced as output from the outline tracker. The Outline always forms a closed loop, as seen in the diagram below. The Outline Analysis node provides the necessary tools to calculate the extreme points in different directions for the shape, shown as red crosses in the diagram. The analysis function also calculates the orientation of the shape, defined as the angle, θ , between its major axis and the x axis. (Note: The major axis is defined mathematically as the "principal axis of inertia" and is calculated from the second moments of the shape.)

Note: The following diagram assumes a zero reference angle implying that the extreme points are calculated in the four directions given by the positive and negative x and y axis of the image coordinate system.

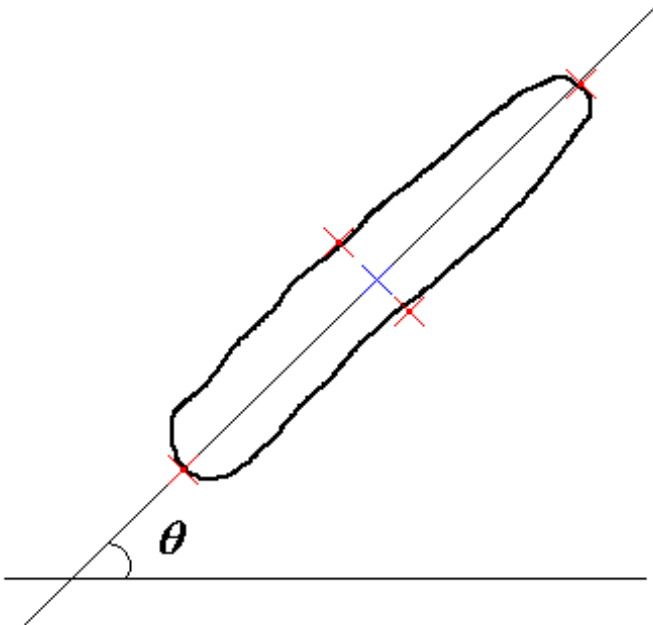


By applying a non-zero reference angle the extreme values can be calculated in other directions as well. The reference angle is defined as the rotation of the four measurement directions relative to the fixed image coordinate system. Positive angles rotate the measurement directions in an anti-clockwise direction. This becomes very powerful when the object orientation is used as reference angle. It gives the extreme points in the objects own direction.

In the following diagram, the extreme values are calculated in the image coordinate system.



In the following diagram, the measurement directions have been rotated by a positive angle (θ) gained from the object orientation calculation. The extreme values are then calculated into the "new" direction.



Airbag Volume analysis

Function

The airbag volume analysis function can calculate the volume of an object. The analysis is based on the results of outline trackers in several calibrated camera views. As the name of the function implies, the function can be used for time-varying volumes as well, such as airbags. The final result is a 3D volume sequence that can be used in diagrams and tables.

Procedure

To make an volume analysis, the cameras used must be [calibrated](#). The more cameras used in the analysis, the better the result. Three cameras is adequate and is recommended.

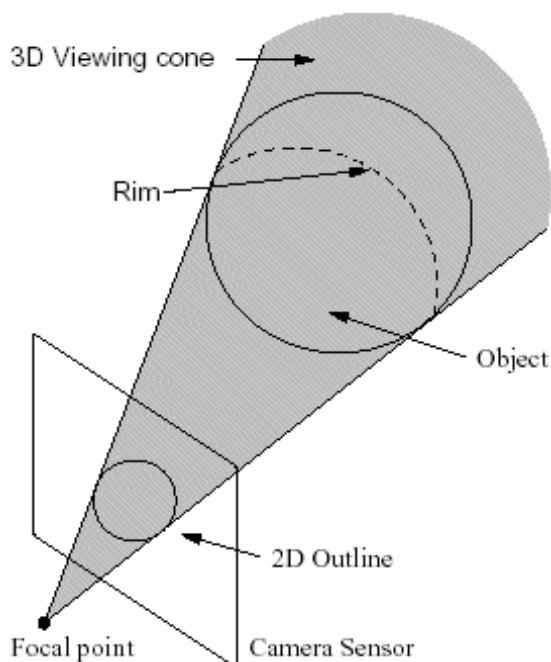
The basic algorithm of the volume analysis function is;

1. produce a 3D model of the real object based on outline trackers in different camera views using calibrated cameras.
2. calculate the volume of the 3D model.
3. compensate for estimated over approximation of volume - the volume calibration.

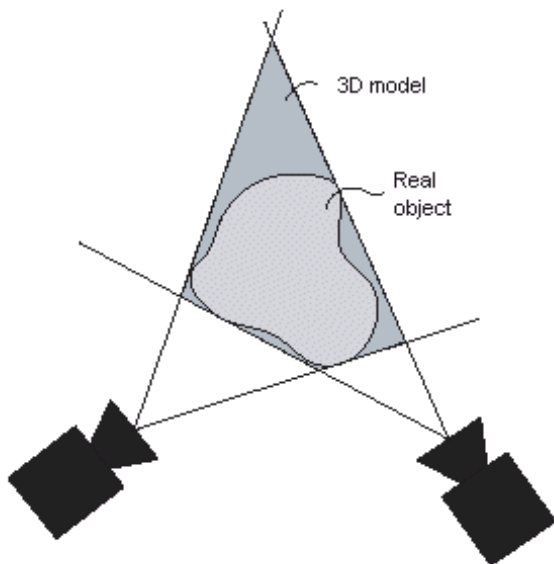
The 3D model

The viewing cone

To describe the 3D model we have to use the so called "3D Viewing cone". This is an imaginary 3D cone which has its apex in the camera's focal point. The base of the viewing cone has the shape of the outline as seen by the camera. The illustration below aims to describe this.



The 3D model is produced by using the view cones from all cameras in the test. The intersection defines the 3D model. The illustration below aims to show this.



The volume calibration

The volume calibration is used for solving step three in the volume analysis algorithm; revealing the relation between the 3D model volume and the real object volume.

The 3D model is always an overestimation of the real object volume. This is due to 'dead angles' between the camera views. The illustration above shows the situation.

The dark areas in the illustration of the 3D model above cannot be seen from any camera view. Nevertheless those areas will be contained in the 3D model and its volume. The overestimation of the 3D model volume is also due to the incapability of the volume analysis algorithm to handle cavities.

In order to calculate the real object volume, this overestimation must be estimated. The process of doing that is what we call the volume calibration.

There are two procedures for doing this, called Fitted Sphere and Actual Current Volume. Both methods are based on the same basic idea.

Fitted sphere

This algorithm uses the same image sequence that is used for the 3D model.

In order to estimate the volume overestimation, a sphere is superimposed onto each camera view. The radius of the sphere is set to match the object as much as possible. The sphere is the volume reference. In each camera view, an outline tracker is added to the sphere. Those two steps are totally transparent to the user. Using the same procedure as when computing the 3D model, the volume of the sphere is calculated. With both the true sphere's volume and the computed 3D model's volume known, the ratio of over-estimation is extracted. The same ratio (roughly) exists between an inflated airbag and its 3D model, so using this ratio, the real object volume can now be calculated.

Actual Current Volume

Instead of using a fitted sphere as reference, an actual real world model of the object (with known volume) is used. The model is placed in the camera setup and filmed. The object is then tracked in each camera view and its volume is calculated by the volume analysis function as above. The difference between the real known volume and the calculated one is the overestimation. Just like in the fitted sphere algorithm above, the ratio between the volumes is calculated and then used when calculating the real object volume later on.

Time-varying volumes

In the case of time varying volumes (airbags) the volume relation as calculated in one frame can be used

in the whole sequence, resulting in a value of the real object volume that is fine. In the airbag case, making the volume in the last image frame (when the bag is fully inflated) is best in most cases. This gives an overall accuracy that is good. Should better accuracy be needed in the frames at when the airbag is poorly inflated, better result is obtained if the volume calibration is done earlier in the sequence.

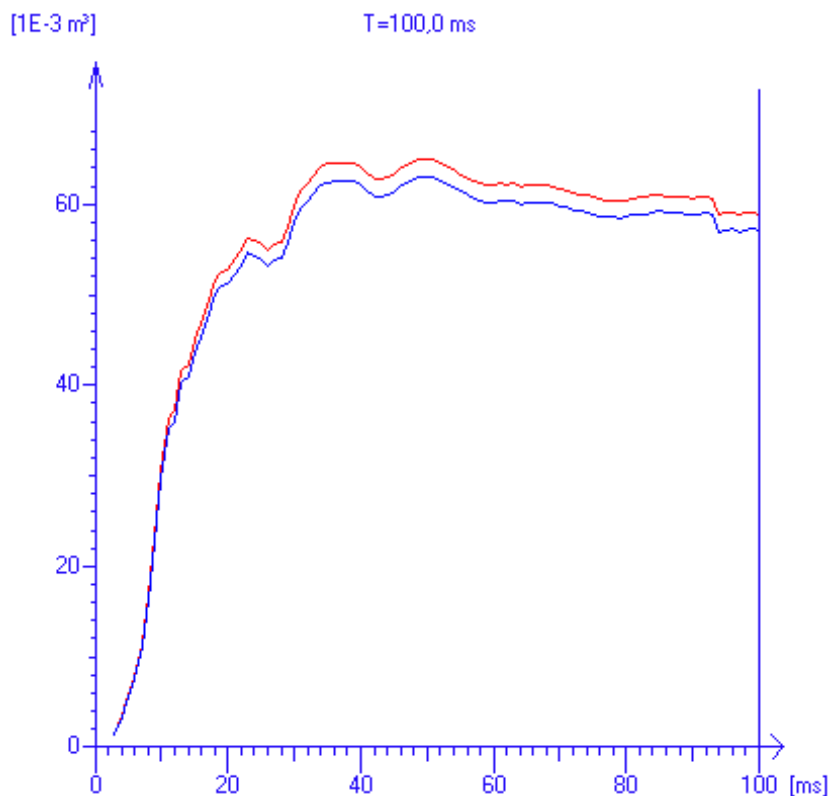
The importance of keeping the camera setup

When one volume calibration has been done, this can be used for several tests in the same camera setup. It is important to keep the cameras at the exact positions at where they were calibrated (3D Static Camera orientation) in all tests using that volume calibration. This is as each volume calibration is unique for each camera setup.

Calculating Real object volume

When a volume calibration has been done, a volume sequence will be produced when the object is tracked in each camera view using the outline tracker. As the 3D model volume is used for each new object volume value, a model volume sequence will be produced also. This is called Model Volume while the real object volume sequence is called just Volume. Both sequences can be used in diagrams and tables in TEMA.

The illustration below shows those two sequences inserted in a XT diagram. Here, the overestimation can be seen; the Model Volume sequence (red plot) is a bit dislocated upwards compared to the Volume sequence (blue plot).



Procedure

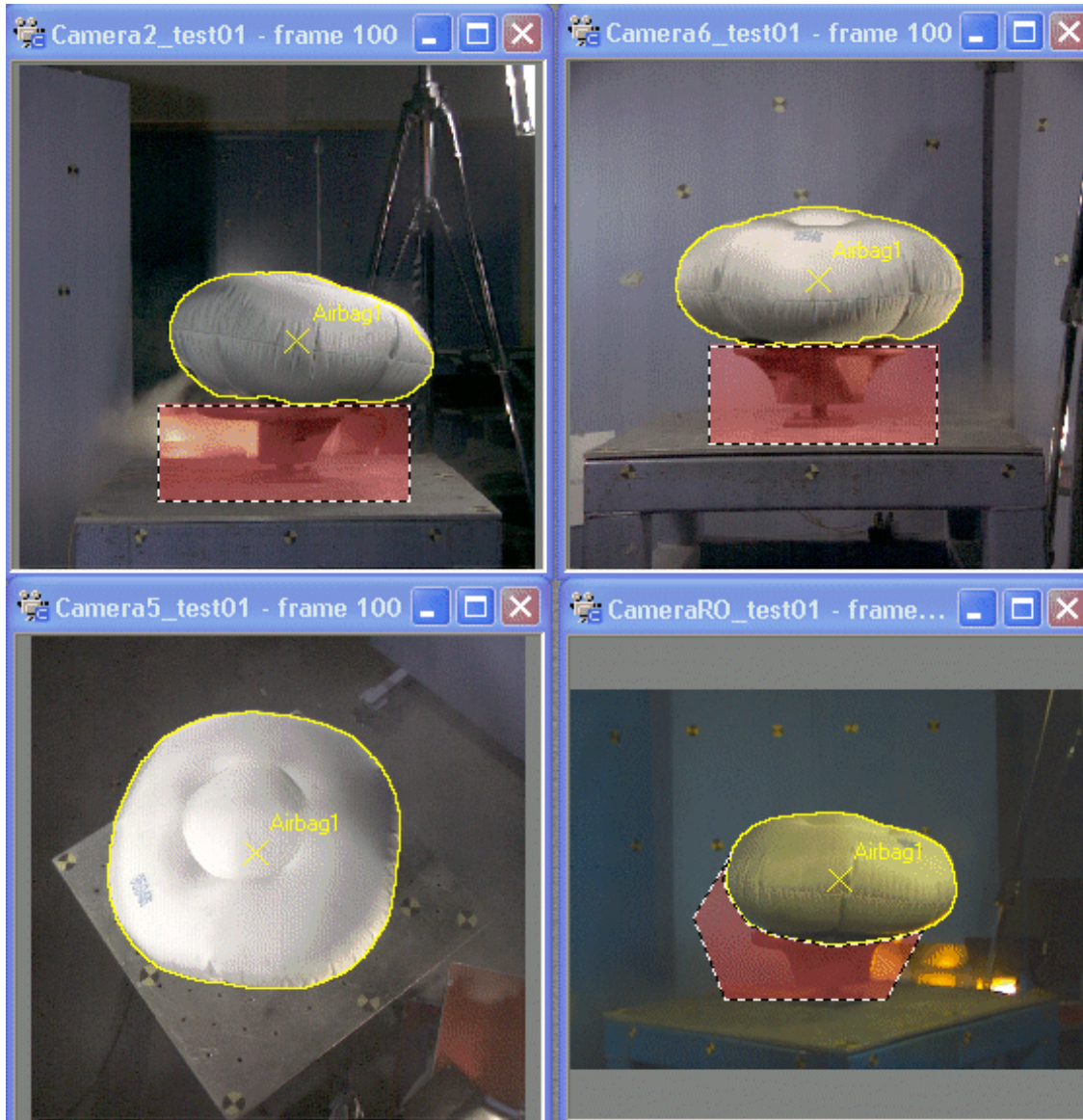
The test description prerequisites [calibrated](#) cameras and a TEMA configuration with airbag analysis configuration. The calibration data from the test where the cameras were calibrated has to be imported into the volume analysis test. This is done for each camera in test by;

1. Mark the camera view in the test contents tree and select Camera/Import Calibration from the menu bar.
2. Browse to the TEMA test where the calibration was done. Click OK.

3. In the Import Calibration dialog, select the corresponding calibration for each camera. Click OK.

Volume Calibration with Fitted Sphere

1. Add camera views of real object sequence into test.
2. Step to the image frame displaying the object having the shape at which the highest accuracy is desired. Typical for airbag; select the last image where the airbag is fully inflated.
3. Add point for tracking into each camera view. Be sure to use the same point name in each camera view.
4. Select tracker type [Outline](#) (Airbag and Advanced Airbag) tracker. The illustration below shows airbag trackers added on four camera views in an airbag test. The [exclude areas](#) are used to support the outline trackers



5. In the test contents window, a 3D data will appear. Right click on the 3D Results and selecting Airbag Volume or selecting Edit/Airbag Volume will make the Airbag Volume Calculation window to appear.
6. Select Fitted Sphere and press OK. The volume calibration is now ready.
7. Continue to track the object using the same outline tracker. For an airbag, begin when the airbag is fully inflated and track backwards.
8. Volume data will now be produced. This can be inserted into diagrams and tables.

Volume Calibration with Actual Current Volume

1. Add camera views of model into test.
2. Add point for tracking into each camera view. Be sure to use the same point name in each camera view.
3. Select tracker type [Outline](#) (Airbag and Advanced Airbag) tracker.
4. In the test contents window, a 3D data will appear. Right click on the 3D Results and selecting Airbag Volume or selecting Edit/Airbag Volume will make the Airbag Volume Calculation window to appear.
5. Select Actual Current Volume and press OK. The volume calibration is now ready.
6. Start a new test and add camera views of the real object. Use the same calibrated cameras.
7. Add point for tracking into each camera view. Be sure to use the same point name in each camera view.
8. Select tracker type [Outline](#) (Airbag and Advanced Airbag) tracker.
9. Track the object using the same outline tracker. For an airbag, begin when the airbag is fully inflated and track backwards.
10. Volume data will now be produced. This can be inserted into diagrams and tables.

Note: The airbag can be inserted as a Vizualizer in a 3D-diagram.

See Also...

[Exclude area](#)

[Point Setup dialog](#)

Setting up the Advanced Airbag Tracker (Optional Feature)

Note: The Advanced Airbag Tracker is available only if the optional Airbag Tracking functionality is included in your TEMA system.

The Advanced Airbag Tracker differs from the standard Airbag Tracker in that it uses edge detection together with a contour model instead of intensity thresholds.

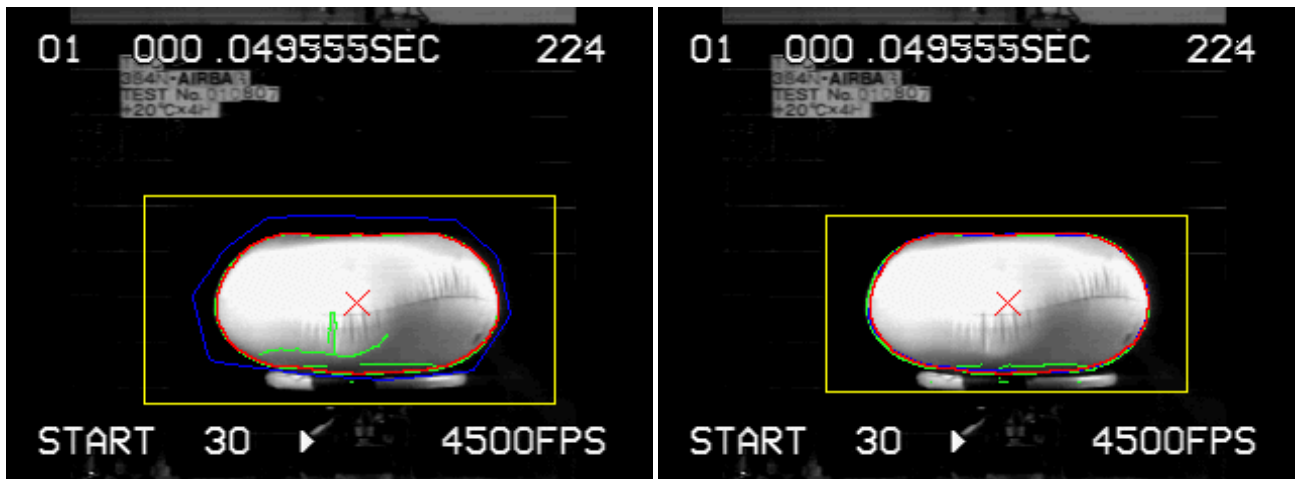
The Advanced Airbag Tracker Setup dialog is used to 'tune' the Advanced Airbag tracking function which tracks an irregularly shaped object that may change size and shape during the tracking process. A prime example is a vehicle airbag whose shape may be defined by the setup function in the last image in the sequence when it is fully expanded. It may then be tracked forwards from the first image in which it appears.

When the "Airbag point" has been added to the image and the Advanced Airbag Tracker assigned to it in the Point setup dialog, the green lines show the initial, automatic calculation of the target. A closed boundary line (purple) can be drawn around the actual target using the mouse in order to limit the target area. This is done by left-clicking at a convenient start point and moving the mouse to the next point. This action is repeated until an enclosed polygon has been drawn.

Note: If the image in the Point Setup dialog is too small to draw the polygon accurately, the dialog can be closed and the polygon drawn in the Main window image. The Point Setup dialog can then be reopened.

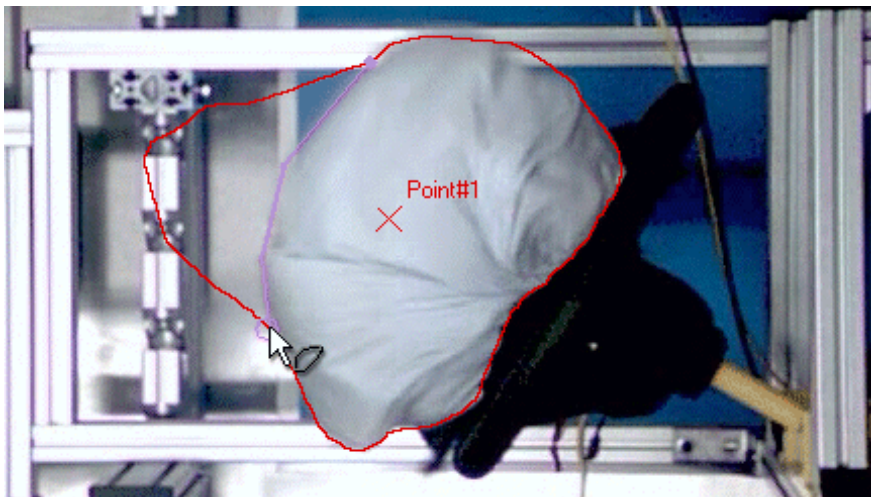
When the polygon has been completed, the position of the "Airbag point" is recalculated (red) only within the search area (yellow rectangle). The boundary of the polygon entered by the user is displayed in blue.






Since feedback is very important in order to obtain a feel for what changing a parameter actually does, the feature detection (and optionally the contour) is recalculated live when the user changes a parameter. To provide a good sense of how well edges are detected, the detected edges are displayed overlaid on the image.

During tracking, the user can stop at any time if the contour gets stuck on false features and correct it. When the user has edited the contour, tracking is done again for the current frame with the edited contour as initial data. If the user wants to override this behaviour and draw the contour manually without re-tracking, this can be done by holding the ALT key while editing.



For a tracked image, the edge coordinates of the airbag can be displayed in the Statusbar (in the grid coordinate system). This is achieved by moving the cursor to the required point on the red outline. The


cursor changes to  and the coordinates are displayed:

On contour point x: 109.00 pixels y: 105.00 pixels

The analysis to be performed on the airbag after tracking can also be specified.

The Advanced Airbag Tracker Setup dialog contains the following fields:

- Zoom- enables the magnification of the displayed image to be controlled directly from within the dialog.
- Image - shows the Search Area size (yellow rectangle). The other coloured lines are described above.
- Edge Detection - specifies how the edges of the target are determined.

- Image Blur - the standard deviation σ used for the Gaussian filter kernels in the edge detector. The higher the value, the more noise is filtered out at the expense of good localisation of the edge. Key in value or use the slider. Slider spans between None and Blur (max value).
- Edge Threshold - corresponds to the ratio of edge pixels / non-edge pixels. It controls the number of pixels considered as an edge. Key in value or use the slider. Slider spans between Strict (value zero) and Lenient (max value).
- Remove Background Edges - subtracts the detected edges in the selected image from each image in the sequence, thus removing extraneous parts of the image that could interfere with the tracking process.
 - No - no image subtraction.
 - First image - subtract the first image from each image.
 - Image at time - subtract the specified image from each image. The image is specified either by keying the time or by positioning at the required image and selecting the  button, i.e. current time.
- Remove Inner Edges - checkbox used to specify whether to keep only the outermost edge segments. Any edge segment that cannot "see" the edges of the search area in all four directions (due to being hidden behind another detected edge) will be removed when enabled.
- Contour Generation - used to specify how the shape of the object is calculated and viewed.
 - Contour Smoothing - the higher the value, the less jagged the contour at the expense of not being able to retain sharp corners. Key in value or use slider. Slider spans between None and Smooth (max value).
 - View Contour - checkbox used to specify whether the contour is displayed. The contour often obscures the detected edges. The user can hide the contour to obtain a better view of the edges.

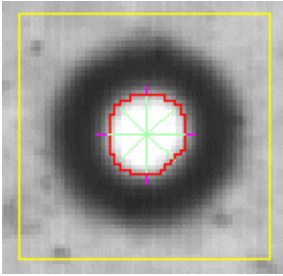
See Also...

[Point Setup dialog](#)

[Exclude areas](#)

Setting up the Centre of Gravity Tracker

The Centre of Gravity Tracker Setup dialog is used to 'tune' the Centre of Gravity tracking function which tracks an object that does not change size and shape during the tracking process.



The Object target is bounded by the red outline, which is created by adjusting the maximum and minimum threshold values.

The Search Area in which the search is conducted is enclosed by the yellow square.

A prime example of its use is the tracking of a calibration target which consists of a dark circle on a light background, or vice versa.

For help on how to use the Threshold slider, see [Adjusting the Threshold Levels](#).

The Centre of Gravity Tracker Setup dialog contains the following fields:

- Zoom- Enables the magnification of the displayed image to be controlled directly from within the dialog.
- Image - This shows the Search Area size (yellow rectangle) and the centre of the target (green and/or purple star, depending on its size in relation to the Search Area). The Search Area is updated automatically when the corresponding parameters are changed. The centre of the target is moved by clicking at the centre of the Search Area and dragging it to the appropriate point. The Search Area is automatically repositioned around the new target centre. It also incorporates a zoom function to enable you to control the magnification of the image.
- Search Area - This is the yellow area around the point in the previous image in which the tracker looks when trying to position the point in the current image.
 - Size (X) - The half width of the Search Area.
 - Size (Y) - The half height of the Search Area.
 - You may specify the Search Area by keying in the width and height, or by drawing it directly with the mouse.
- Object Thresholds - these fields are used to define the object which is to be tracked.
 - Min - The minimum threshold may be adjusted by keying in a value or dragging the slider to an appropriate position.
 - Max - The maximum threshold may be adjusted by keying in a value or dragging the slider to an appropriate position.
 - The two threshold tools are used in combination to adjust the threshold range of the object within the full value range of 0 to 255. This enables the object which is to be tracked to be defined distinctly in contrast to the background. The outline of the target is shown in red.
 - Slider - Used to set the minimum and maximum thresholds.
 - Automatic Detect - Determines the object radius by adjusting its gray scale threshold values. It starts from the centre cross in the red search area created and searches radially outwards until desired object radius is obtained.
 - Object radius - Used to decide the proper gray scale threshold. This should be adjusted so that it is slightly smaller than the size of the target to be tracked.
 - Bright object - Used to automatically find the threshold settings by detecting a bright

object with darker surroundings. Position the centre cross in the centre of the object and make sure the search area encloses the object. Pressing the button will then make the object thresholds to be set at reasonable start values. Amend those if needed by dragging the slider.

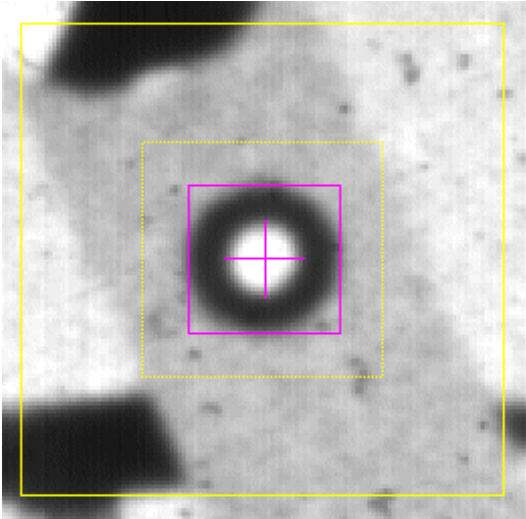
- Dark object - Same as above but for a dark object with light surroundings.

See Also...

[Point Setup dialog](#)

Setting up the Circular Symmetry Tracker

The Circular Symmetry Tracker Setup dialog is used to 'tune' the Circular Symmetry tracking function which looks in each successive image for the circular target contained within the target square, i.e. the purple Template, when the Tracker is set up.



The Search Area in which the search is conducted is enclosed by the outer yellow square. Optionally, after the second image the search may be restricted to the inner yellow square, which is a quarter of the size of the outer square. This option works best when the target does not move erratically after the initial move in the second image.

Under normal circumstances there is no need to change the default settings, except:

- Search Area - you may need to increase this if the movement of a point between successive images is erratic, i.e. if its predicted position lies outside the Search Area.
- Note: If the Search Area is too large, the tracking function takes longer and may become confused with extraneous 'noise'.
- Object size - you may need to increase this because the object radius has to be bigger than the radius of the point, since you are tracking the edge of the point.

The Circular Symmetry Tracker Setup dialog contains the following fields:

- Zoom- enables the magnification of the displayed image to be controlled directly from within the dialog.
- Image - this shows the Search Area size (yellow rectangle) and the Target size (purple rectangle). Both of these are updated automatically when the corresponding parameters are changed.
- Template - this is the definition, i.e. size and shape of the target that the tracker uses.
 - Object size - this is used by the tracking filter to reduce the radius of the tracked target, i.e. a smaller area is used to track the target.
- Search Area - this is the area around the point in the previous image in which the tracker looks when trying to position the point in the current image.
 - Size (X) - the width of the Search Area.
 - Size (Y) - the height of the Search Area.
 - Reduce After 2nd Image - check box used to specify that the size of the Search Area is to be reduced when a prediction can be calculated thereby increasing speed. Select this option if prediction can be used.
- Pull point to straight path - When moving from image to image during tracking, there may be several potential matches within the Search Area. The greater the physical mass of the target

being tracked, the less likely it is to make erratic changes in position from frame to frame. The more the slider is moved to the right, the more the tracker is biased towards accepting matches closer to the position in the previous image even though there are better matches further away.

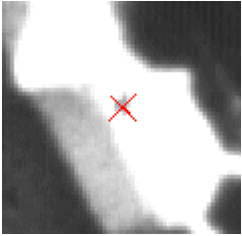
- Tracker Tolerance - slider used to set the tolerance level used when the tracker is predicting the position of a point. Set a higher value to increase the tolerance, e.g. in a situation where the tracker is producing accurate results, but the 'noise' level in the images causes them to be rejected because they are outside the default tolerance.

See Also...

[Point Setup dialog](#)

Setting up the Constant Tracker

The Constant Tracker Setup dialog is used to place and retain a point at a fixed position in successive images. It is typically used as a reference point for subsequent analysis. It is marked in the image as a red cross.



The Constant Tracker Setup dialog contains the following fields:

- Zoom- enables the magnification of the displayed image to be controlled directly from within the dialog.
- Image - this shows the Search Area size (yellow rectangle) and the Target size (purple rectangle). Both of these are updated automatically when the corresponding parameters are changed. It also incorporates a zoom function to enable you to control the magnification of the image.
- Point Position - the position may be specified by drag and drop or by keying the X and Y coordinates:

See Also...

[Point Setup dialog](#)

Setting Up the Advanced Circle Tracker


The Advanced Circle Tracker (*beta*) Setup dialog is an experimental development of the Circle Tracker, including more advanced settings and controls.

The standard cursor is replaced by a circle shaped cursor. The size of this circle is adjusted using the mouse scroll wheel.

Data sequences generated from this tracker are:

- coordinates
- circumference
- area
- (rotational) volume

The Advanced Airbag Tracker Setup dialog contains the following fields:

- Edge Detection - specifies how the edges of the target are determined.
 - Image Blur - the standard deviation s used for the Gaussian filter kernels in the edge detector. The higher the value, the more noise is filtered out at the expense of good localisation of the edge. Key in value or use the slider. Slider spans between None and Blur (max value).
 - Edge Threshold - corresponds to the ratio of edge pixels / non-edge pixels. It controls the number of pixels considered as an edge. Key in value or use the slider. Slider spans between Strict (value zero) and Lenient (max value).
- Remove Background Edges - subtracts the detected edges in the selected image from each image in the sequence, thus removing extraneous parts of the image that could interfere with the tracking process.
 - No - no image subtraction.
 - First image - subtract the first image from each image.
 - Image at time - subtract the specified image from each image. The image is specified either by keying the time or by positioning at the required image and selecting the  button, i.e. current time.
- Remove Inner Edges - checkbox used to specify whether to keep only the outermost edge segments. Any edge segment that cannot "see" the edges of the search area in all four directions (due to being hidden behind another detected edge) will be removed when enabled.
- Contour Generation - used to specify how the shape of the object is calculated and viewed.
 - Contour Smoothing - the higher the value, the less jagged the contour at the expense of not being able to retain sharp corners. Key in value or use slider. Slider spans between None and Smooth (max value).
 - View Contour - checkbox used to specify whether the contour is displayed. The contour often obscures the detected edges. The user can hide the contour to obtain a better view of the edges.
- Radius - using radius to add to tracking control capabilities.
 - Current radius - the higher the value, the less jagged the contour at the expense of not being able to retain
 - Limit radius change - Check to activate limits of radius change going from one image to the next
 - Max difference/frame - Maximum allowed difference in pixels
 - Current radius - Tolerance for radius detected

See Also...

[Point Setup dialog](#)

[Exclude areas](#)

Setting up the Correlation Tracker

The Correlation Tracker Setup dialog is used to 'tune' the Correlation tracking function which looks in each successive image for the part of the image contained within the correlation circle, i.e. the purple Template, when the Tracker is set up.



The Search Area in which the search is conducted is enclosed by the outer yellow square. Optionally, after the second image the search may be restricted to the inner yellow square, which is a quarter of the size of the outer square. This option works best when the target does not move erratically after the initial move in the second image.

For the best results, the area within the circle should contain a well defined object.

Under normal circumstances there is no need to change the default settings, except:

- Search Area - you may need to increase this if the movement of a point between successive images is erratic, i.e. if its predicted position lies outside the Search Area.
- Note: If the Search Area is too large, the tracking function takes longer and may become confused with extraneous 'noise'.
- Total Size - you may need to increase the size slightly when using high resolution film, or decrease it slightly when using video tape, in order to match the size of the object being tracked.

The Correlation Tracker Setup dialog contains the following fields:

- Zoom- enables the magnification of the displayed image to be controlled directly from within the dialog.
- Image - this shows the Search Area size (yellow rectangle) and the Target size (purple rectangle). Both of these are updated automatically when the corresponding parameters are changed. It also incorporates a zoom function to enable you to control the magnification of the image.
- Template - this is the definition, i.e. size and shape of the target that the tracker uses.
 - Core Size - the tracking function looks at all pixels within the Core Radius.
 - Total Size - the tracking function looks at only some of the pixels within the Total Radius.
 - Update Factor - the tracking function updates the template by taking into account how it appeared in the previous image. A '0' value means that no account is taken, while a '1' value means that the template is completely updated. If the value is set too high, it may cause drifting of the point's position, so a low value is recommended.
 - Circle - uses a circular template.
 - Square - uses a square template.
 - Cross - uses a cross shaped template.
- Search Area - this is the area around the point in the previous image in which the tracker looks when trying to position the point in the current image.
 - Size (X) - the half width of the Search Area.
 - Size (Y) - the half height of the Search Area.
 - Reduce After 2nd Image - check box used to specify that the size of the Search Area is to be reduced when a prediction can be calculated thereby increasing speed. Select this option if prediction can be used.
- Filtering - when the Use Sobel filter checkbox is selected, the images are pre-processed using a Sobel filter.

- Pull point to straight path - When moving from image to image during tracking, there may be several potential matches within the Search Area. The greater the physical mass of the target being tracked, the less likely it is to make erratic changes in position from frame to frame. The more the slider is moved to the right, the more the tracker is biased towards accepting matches closer to the position in the previous image even though there are better matches further away.
- Tracker Tolerance - slider used to set the tolerance level used when the tracker is predicting the position of a point. The tolerance is a threshold that defines if a point is to be considered lost or not. Set a higher value to increase the tolerance, e.g. in a situation where the tracker is producing accurate results, but the 'noise' level in the images causes them to be rejected because they are outside the default tolerance.

See Also...

[Point Setup dialog](#)

Setting up the Corner Contour Tracker

The Corner Contour Tracker can detect edges and find corners along these edges. One corner will be selected as the track point. The tracking algorithm is as follows:

1. Edges are detected using a Canny algorithm (background edges can be removed). Detected edges are visualized as green lines in the Point setup dialog. If the number of pixels in the edges are greater than 15% of the total amount of pixels in the search area then the text 15% will appear in the point setup dialog and the settings for the edge detection will have to be edited (for instance by moving the *Edge Threshold* towards *Strict*, see below).
2. Endpoints for all edge lines are extracted. If an edge intersects another edge, pixels are removed at the intersection until all lines have exactly two endpoints. These endpoints can be connected again in the third step. Endpoints are visualized as blue pixels in the Point setup dialog.
3. Endpoints that are close to each other are mapped as connected. An endpoint can be connected to more than one other endpoint. However, if a line does not have an endpoint, if two lines are connected at both ends, or if several lines are connected without leaving any endpoint free then no corners will be detected in the following steps. The pixels connecting one endpoint to the next are visualized as red pixels in the Point setup dialog.
4. Lines, beginning at one unconnected endpoint to another unconnected endpoint, are extracted. If the lines are extracted along a path where more than two endpoints are connected several lines are extracted.
5. The best corner on each line is extracted. Two different methods can be used for extracting the best corner of the line. In the first method a line segment is moved along the line, one pixel at a time, and the point with the largest perpendicular distance to the line between the segment endpoints will be the position of the best corner for the line (the segment corresponding to this point is the *best corner segment*). This method is always used for the first image when tracking is started. In the second method the line segment is correlated against the segment selected as the *best corner segment* for the first image when tracking is started. The best corner on each line are visualized with blue crosses in the Point setup dialog.
6. The corners from each line is finally compared to each other and the best of these corners are selected. The selected corner is visualized with a red cross in the Point setup dialog.

The Corner Contour Tracker dialog contains the following fields:

- Edge Detection
 - Image Blur - The higher the value, the more noise is filtered out at the expense of good localization of the edge. Set slider between Strict and Lenient or type value.
 - Edge Threshold - corresponds to the ratio of edge pixels / non-edge pixels. It controls the number of pixels considered as an edge. The higher the value, the more edges are detected. Set slider between Strict and Lenient or type value.
 - Remove Background Edges - remove edges found in both the current image and the background image, thus removing extraneous parts of the image that could interfere with the tracking process.
 - No - no background image is used.
 - First image – the background image is the first image in the sequence.
 - Last->First image – the last image in the image sequence is used for the first half of the sequence and the first image is used for the second half of the sequence.
- Corner Detection
 - Segment length – length of the segment that is moved along the edge in step 5

- above. If the edge is shorter than the segment length then that edge will be ignored. A too short segment length will make it difficult to detect round edges.
- Max Gap – determines if endpoints should be connected in step 3 above. (See also *Pull point to straight path*, below).
 - Best corner mode
 - Sharpest corner – the best corner for a line (step 5 above) is the sharpest corner.
 - Similar shape – the sharpest corner will be selected, in step 5 above, for the first image when tracking starts. Edges in following images will be compared to this edge.
 - Search Area - set the size of the search area (yellow square). The square can also be resized using the mouse.
 - Size (X) - the width of the Search Area.
 - Size (Y) - the height of the Search Area.
 - [Pull point to straight path](#) - tracking prediction. Will also affect the allowed size of the gap between endpoints for connection in step 3 above. The accepted gap will scale with the distance to the predicted track position; Max Gap will be used at zero distance and [Pull point to straight path](#)/100 * Max Gap will be used at the edge of the search area.
 - [Tracker Tolerance](#) - Set slider between Strict and Lenient or type value.
 - [Accuracy](#)

Accessed via...

Tracking window/Point menu/Point Setup option/ Point setup dialog /CornerContour button.

Setting up the Intersection Tracker (optional)

Function

The Intersection Tracker Setup dialog is used to 'tune' the Intersection tracking function. Basically, this works in three steps.

1. First, it will look for edge pixels. Such are pixels in the border between a darker and lighter area in an image. In the most lenient case, all pixels in an image can be considered as edge pixels in some way. Therefore, some limitations in the definition of the edge pixels has been done in order to obtain a useable result. The result can be tuned further by adjusting the settable parameters in the tracker setup. The Search Area in which the search is conducted is enclosed by the outer yellow square. Detected edge pixels are visualized by green lines.
2. Second, when the edges in the search area has been detected, the tracker will search for edge sections that can be fitted to a straight line. The minimum length of the fitting is settable. The value will be visualized by the size of the purple square; the length of any of its sides is equal to the minimum line length. When the fitting has been done, the result is visualized by blue lines superposed on the detected edges.
3. Finally, the tracker will detect intersections between the straight line fittings within the search area. The intersection found nearest to the center of the search area (The yellow cross) will be the default candidate for the point to track. The point is visualized by the red cross.

Appearance

The Intersection Tracker Setup dialog contains the following fields:

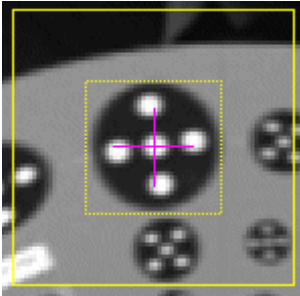
- Edge Detection
 - Image Blur - The higher the value, the more noise is filtered out at the expense of good localization of the edge. Set slider between Strict and Lenient or type value.
 - Edge Threshold - corresponds to the ratio of edge pixels / non-edge pixels. It controls the number of pixels considered as an edge. The higher the value, the more edges are detected. Set slider between Strict and Lenient or type value.
- Line Detection
 - Min Length - Set the minimum length of lines to be detected. This will set the size of the purple circle as well.
 - Max Gap - set the maximum accepted gap when calculating a straight line fitting. The feature is to be used in cases when the shapes of an edge sections is mostly straight but has delimited deviations from the "straight line pattern". With no Gaps allowed, the line fitting will be done on the straight segments only, often resulting in lots of short line fittings. Too short line fittings may result in important trends being missed. However, defining Gaps with the size of the deviations will result in straight line fittings performed over edge segments that includes even great deviations from any straight line pattern, thus containing trends in the shapes of the edges.
- Search Area - set the size of the search area (yellow square). The square can also be resized using the mouse.
 - Size (X) - the width of the Search Area.

- Size (Y) - the height of the Search Area.
- Pull point to straight path - When moving from image to image during tracking, there may be several potential matches within the Search Area. The greater the physical mass of the target being tracked, the less likely it is to make erratic changes in position from frame to frame. The more the slider is moved to the right, the more the tracker is biased towards accepting matches closer to the position in the previous image even though there are better matches further away.
- Tracker Tolerance - slider used to set the tolerance level used when the tracker is predicting the position of a point. Set a higher value to increase the tolerance, e.g. in a situation where the tracker is producing accurate results, but the 'noise' level in the images causes them to be rejected because they are outside the default tolerance.

Note: Validity check is done on all typed values.

Setting up the MXT Tracker (Optional Feature)

The MXT Tracker Setup dialog is used to 'tune' the MXT Target tracking function which looks in each successive image for the MXT target centred by the purple cross Template, when the Tracker is set up.



The Search Area in which the search is conducted is enclosed by the outer yellow square. Optionally, after the second image the search may be restricted to the inner yellow square, which is a quarter of the size of the outer square. This option works best when the target does not move erratically after the initial move in the second image.

Under normal circumstances there is no need to change the default settings, except:

- Search Area - you may need to increase this if the movement of a point between successive images is erratic, i.e. if its predicted position lies outside the Search Area.
- Note: If the Search Area is too large, the tracking function takes longer and may become confused with extraneous 'noise'.
- Object size - you may need to adjust this because the object radius should be smaller than the object. In this case, you are tracking the centre cross of the marker to avoid noise from the outer edge.

The MXT Tracker Setup dialog contains the following fields:

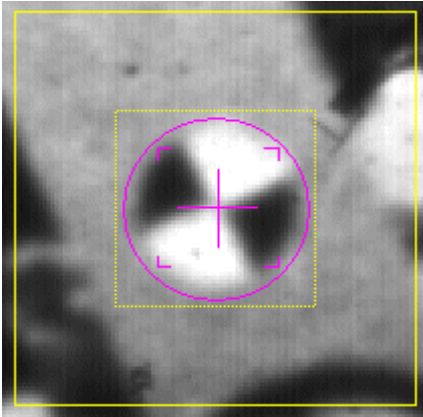
- Zoom- enables the magnification of the displayed image to be controlled directly from within the dialog.
- Image - this shows the Search Area size (yellow rectangle) and the Target size (purple rectangle). Both of these are updated automatically when the corresponding parameters are changed.
- Search Area - this is the area around the point in the previous image in which the tracker looks when trying to position the point in the current image.
 - Size (X) - the width of the Search Area.
 - Size (Y) - the height of the Search Area.
 - Reduce After 2nd Image - check box used to specify that the size of the Search Area is to be reduced when a prediction can be calculated thereby increasing speed. Select this option if prediction can be used.
- Version - the version of the tracker installed with your system is displayed. This information is useful if a problem is reported or an explanation requested.
- Target type - this is the type of target selected from the drop-down list. The options are:
 - Type 1 (1+4 dots) - black circular target with a centre and four outer white dots;
 - Type 2 (1+5 dots) - black circular target with a centre and five outer white dots.
- TrackerTolerance - slider used to set the tolerance level used when the tracker is predicting the position of a point. Adjusting the slider position automatically updates the % figure displayed, and vice versa. Set a higher value to increase the tolerance, e.g. in a situation where the tracker is producing accurate results, but the 'noise' level in the images causes them to be rejected because they are outside the default tolerance.

See Also...

[Point Setup dialog](#)

Setting up the Advanced Circle Tracker

The Quadrant Symmetry Tracker Setup dialog is used to 'tune' the Quadrant Symmetry tracking function which looks in each successive image for the quadrant contained within corner markers in the quadrant circle, i.e. the purple Template, when the Tracker is set up.



The Search Area in which the search is conducted is enclosed by the outer yellow square. Optionally, after the second image the search may be restricted to the inner yellow square, which is a quarter of the size of the outer square. This option works best when the target does not move erratically after the initial move in the second image.

Under normal circumstances there is no need to change the default settings, except:

- Search Area - you may need to increase this if the movement of a point between successive images is erratic, i.e. if its predicted position lies outside the Search Area.
- Note: If the Search Area is too large, the tracking function takes longer and may become confused with extraneous 'noise'.
- Object size - you may need to adjust this because the object radius should be smaller than the object. In this case, you are tracking the centre cross of the marker to avoid noise from the outer edge.

The Quadrant Symmetry Tracker Setup dialog contains the following fields:

- Zoom- enables the magnification of the displayed image to be controlled directly from within the dialog.
- Image - this shows the Search Area size (yellow rectangle) and the Target size (purple rectangle). Both of these are updated automatically when the corresponding parameters are changed.
- Template - this is the definition, i.e. size and shape of the target that the tracker uses.
 - Object size - this is used by the tracking filter to reduce the radius of the tracked target, i.e. a smaller area is used to track the target.
- Search Area - this is the area around the point in the previous image in which the tracker looks when trying to position the point in the current image.
 - Size (X) - the width of the Search Area.
 - Size (Y) - the height of the Search Area.
 - Reduce After 2nd Image - check box used to specify that the size of the Search Area is to be reduced when a prediction can be calculated thereby increasing speed. Select this option if prediction can be used.
- Pull point to straight path - When moving from image to image during tracking, there may be several potential matches within the Search Area. The greater the physical mass of the target being tracked, the less likely it is to make erratic changes in position from frame to frame. The more the slider is moved to the right, the more the tracker is biased towards accepting matches closer to the position in the previous image even though there are better matches further away.

- TrackerTolerance - slider used to set the tolerance level used when the tracker is predicting the position of a point. Set a higher value to increase the tolerance, e.g. in a situation where the tracker is producing accurate results, but the 'noise' level in the images causes them to be rejected because they are outside the default tolerance.

See Also...

[Point Setup dialog](#)

Setting up the Circle Tracker (Optional)

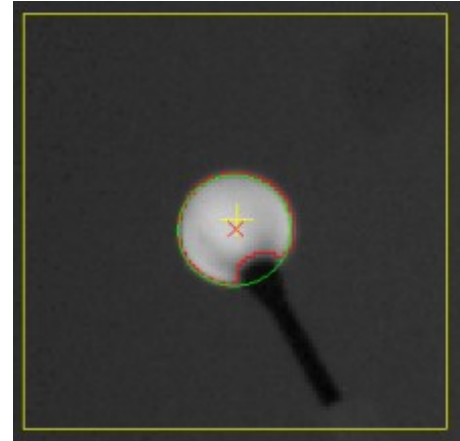
The Circle Tracker Setup dialog is used to 'tune' the Circle tracking function which tracks circular objects.

The tracker can track circular objects even if part of the object is obscured, see image to the right.

Data sequences generated from this tracker are:

- coordinates
- radius
- (tracked) area

Thresholds are used to define the object. The Object target is bounded by one red and one green outline. The red outline is the result of the threshold operation and the green outline is the corresponding circle.



The Search Area in which the search is conducted is enclosed by the yellow square.

A prime example of its use is the tracking of the Image System Wand for Wand Calibration (a calibration target which consists of two light circles on a dark background).

The Circle Tracker Setup dialog contains the following fields:

- Zoom - Enables the magnification of the displayed image to be controlled directly from within the dialog.
- Image - This shows the Search Area size (yellow rectangle) and the centre of the target. The Search Area is updated automatically when the corresponding parameters are changed. The centre of the target is moved by clicking at the centre of the Search Area and dragging it to the appropriate point. The Search Area is automatically repositioned around the new target centre. It also incorporates a zoom function to enable you to control the magnification of the image.
- Search Area - This is the yellow area around the point in the previous image in which the tracker looks when trying to position the point in the current image. You may specify the Search Area by keying in the width and height, or by drawing it directly with the mouse.
 - Size (X) - The half width of the Search Area.
 - Size (Y) - The half height of the Search Area.
- Thresholds are used to define the object.

When Object Contrast is set to:

 - Bright (dynamic) or Dark (dynamic), threshold levels are set automatically in every frame of the image sequence.
OR
 - Manual (static), the user has to provide static threshold levels to define the object.
 - Min - The minimum threshold may be adjusted by keying in a value or dragging the slider to an appropriate position.
 - Max - The maximum threshold may be adjusted by keying in a value or dragging the slider to an appropriate position.
 - Slider - Used to set the minimum and maximum thresholds. For help on how to use the Threshold slider, see [Adjusting the Threshold Levels](#).
- Tracker Tolerance - Is used to control how circular the (non obscured part of the) object has to be and how much the radius of the circle can deviate from one image to the next without losing track.

See Also...

[Point Setup dialog](#)

Adjusting the Threshold Levels

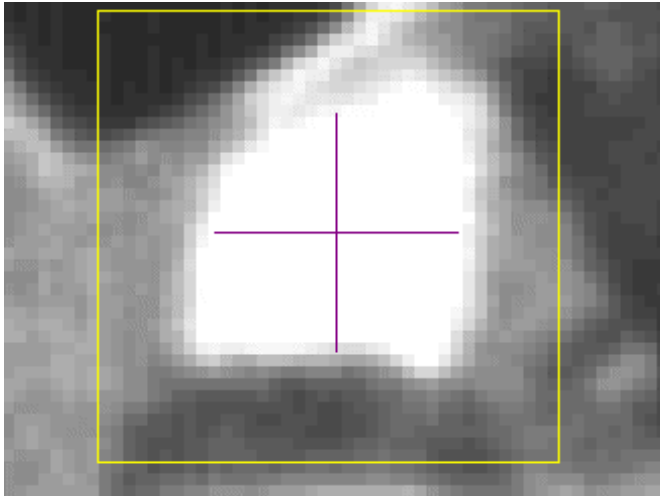
Several of the tracker setup dialogs contain threshold levels. These can be adjusted using the following procedure.

The minimum and maximum threshold levels define the pixel intensity interval within which the object is expected to be found. Pixels with intensities outside this interval are treated as background pixels and are excluded from consideration.

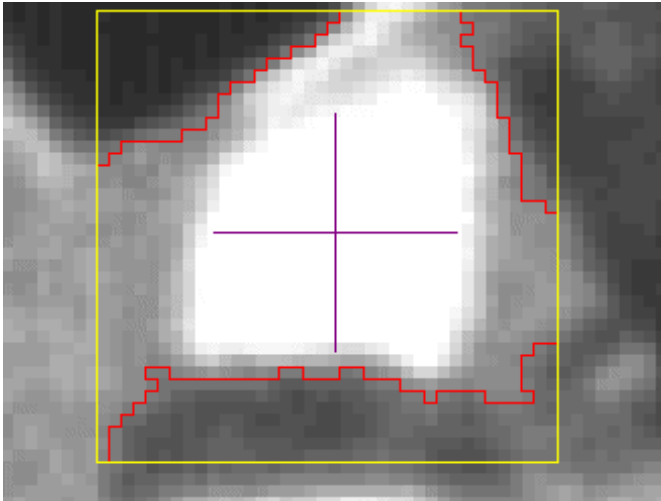
Note: High pixel intensity values give a bright pixel and low intensities give dark pixels.

Setting threshold levels to produce a good definition of the target is sometimes not straightforward, especially if the contrast between the target and its background is not sharply defined. Using the following procedure normally produces good results, especially if the target is well-separated from the background:

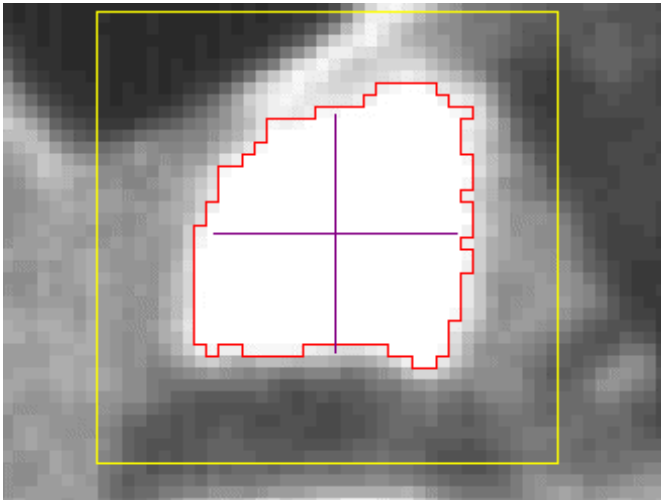
1. Place the purple cross at the centre of the required target object.
2. Adjust the Search Area using the mouse so that it is as small as possible, but covers the whole object and has some overlap.
3. Set the Min threshold to 0 and the Max threshold to 255, i.e. the whole range is included. This results in an outline as big as the Search Area. However, it is not visible because the red outline is exactly behind the yellow Search Area.
4. For a bright object on a dark background:
 - Leave the Max threshold at 255.
 - Click the left red marker (minimum threshold) on the slider repeatedly until the object is well-targeted, i.e. the outline has shrunk and formed tightly around the object.
 - Adjust the right red marker (maximum threshold) on the slider if necessary.



○



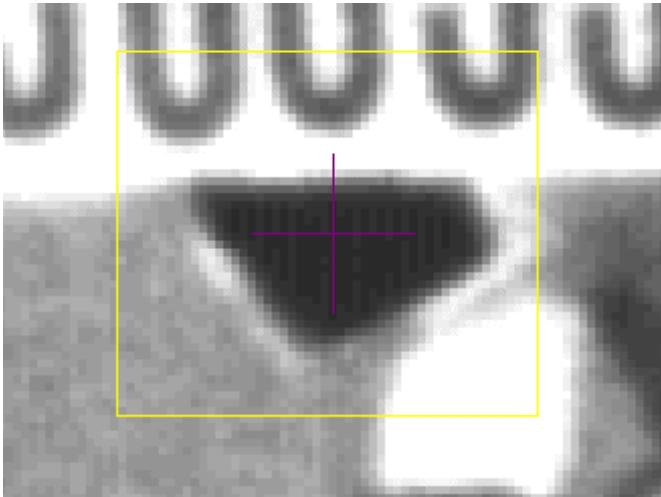
○



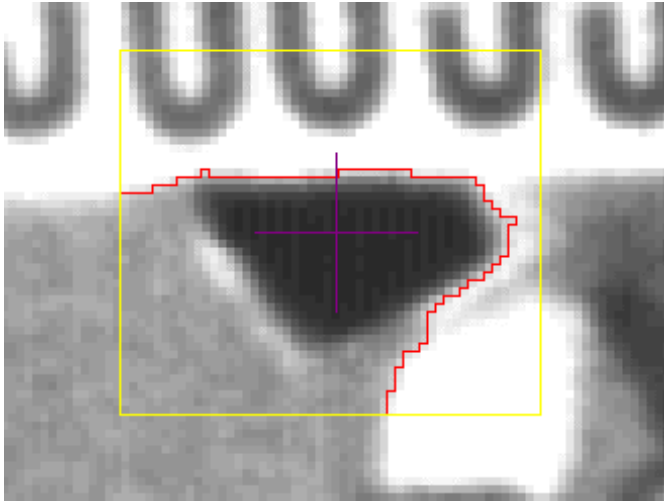
○

5. For a dark object on a bright background:

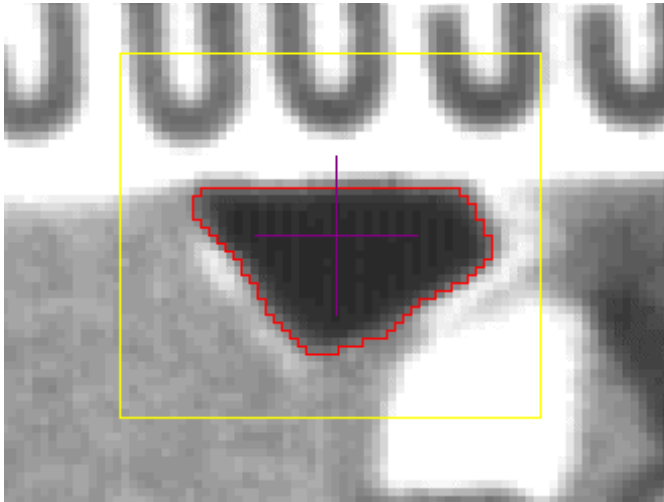
- Leave the Min threshold at 0.
- Click the right red marker (maximum threshold) on the slider repeatedly until the object is well-targeted, i.e. the outline has shrunk and formed tightly around the object.
- Adjust the left red marker (minimum threshold) on the slider if necessary.



○



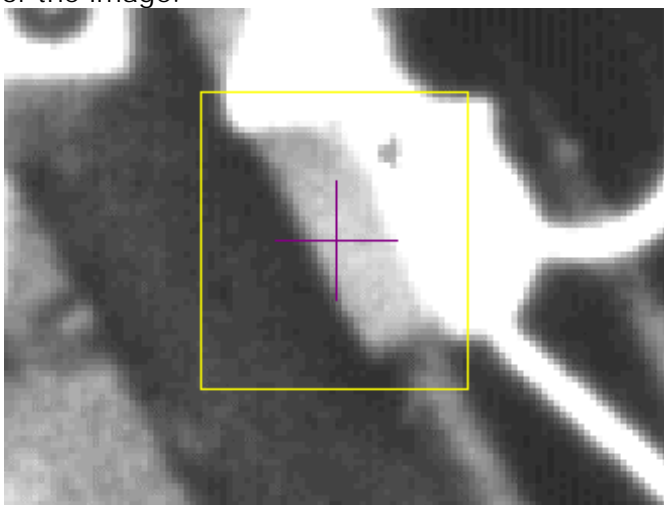
○



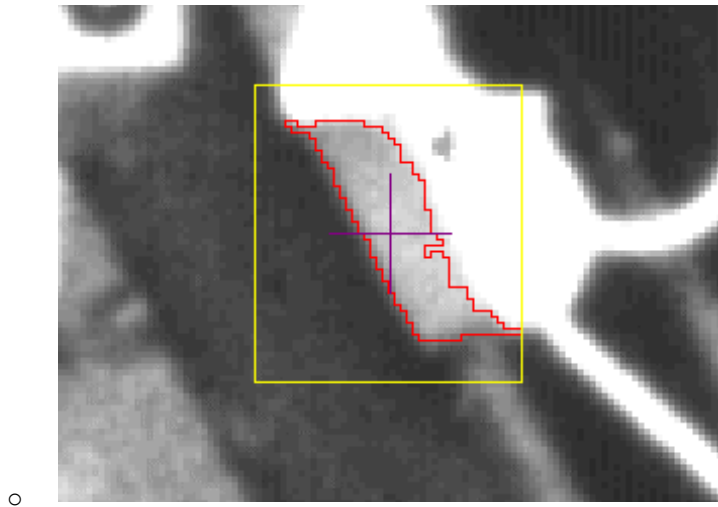
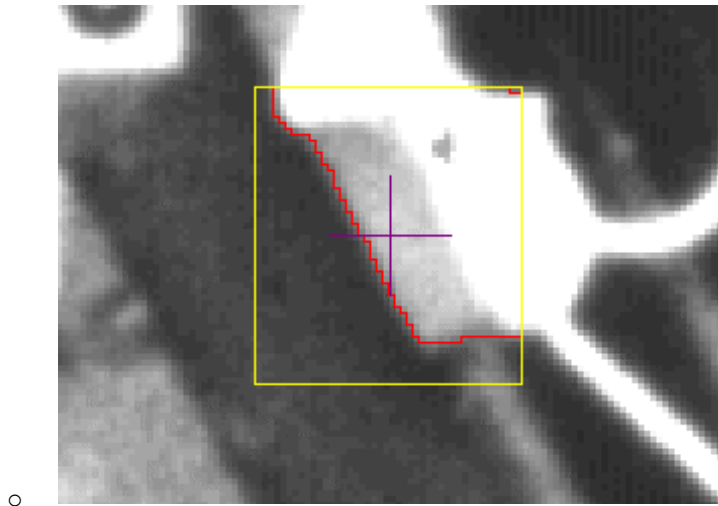
○

6. For a gray object on a mixed bright/dark background:

- Leave the Max threshold at 0.
- Click the left red marker (minimum threshold) on the slider repeatedly until the object is well-targeted against the dark background.
- Leave the Min threshold at its current setting.
- Click the right red marker (maximum threshold) on the slider repeatedly until the object is well-targeted against the dark background.
- Note: The Max threshold could be adjusted before the Min threshold, depending on the nature of the image.



○



Groups, Contours and Virtual Points (Optional Feature)

Consider a typical vehicle crash test involving a dummy and an airbag. As the test proceeds, the airbag expands and progressively obscures the dummy's head and the tracking points marked on it. To obtain the best results from such a test, it is important to identify the position of all the tracked points in each successive image. The usefulness of the test is also improved if the position of the dummy's facial outline is known, even when it is obscured. This enables, for example, an assessment of how close the face came to a solid part of the vehicle.

This type of test and analysis is achieved using the functionality associated with groups, contours and virtual points.

Groups

A group is a set of at least two points that is assigned a group name. If a larger number of points is defined in a group, the tracking process is more robust because accurate results can be obtained when some of the points are obscured and their positions cannot be measured. The points in a group should be marked on a part of the image that is reasonably rigid, e.g. the head of a dummy. The less relative movement there is between the group points during the test, the more accurate and practical are the results. It is possible to include any points in a group, e.g. some on the dummy and some on the vehicle, but the results are both less accurate and less meaningful. As many groups may be defined in a camera view as required, but a point may belong to only one group at a time. See [Maintaining Groups](#).

Note: A contour can be selected as if it were a point and assigned to a group.

Contours

A contour is an outline drawn on an image as a series of straight lines. The more lines there are and the shorter they are, the more accurate is the representation of a physical aspect in the image, e.g. an outline of the face on a crash dummy. The contour should be drawn on a part of the image that is reasonably rigid, e.g. the face of a dummy, for the same reasons given for groups. For the best results, the contour should stand out visibly against its background, e.g. a light facial outline against a dark background. The contour must be drawn as a single line, but may be as complex as required to meet the requirement. It can contain closed loops which are created by returning to an earlier point for the second time, or by retracing line segments. The basic rule is that all the points on the contour must be linked together by a single unbroken line, although points and line segments may be reused as often as required. Each contour is associated with a point group and its position in successive images is determined relative to the positions of the points in the group. As many contours may be defined in a camera view as required. See [Maintaining Contours](#).

Virtual Points

A virtual point is one whose position is calculated from the known position of other points in the image, rather than by measurement. Virtual points are used in two distinct situations. If the position of a point cannot be measured by the tracking algorithm, for example because the point is obscured by an airbag, it is deemed to be lost and its position may be calculated. Alternatively, a point may be specified as being always virtual, i.e. its position is always calculated. An example when this feature is useful is where a coordinate system is based on a particular point which is not visible in all images. See [Maintaining Virtual Points](#).

Tracking

When tracking using groups, contours and virtual points, an ideal set of conditions, i.e. as described above, leads to the best results. The further from this ideal, the less accurate are the results. There is no

sudden cut-off beyond which groups, contours and virtual points should not be used.

Point Group Tracking

The points in a point group are tracked in the same way as if they were individual points not in a group.

Virtual Point Tracking

Virtual points are not tracked because a tracking algorithm is not associated with them. If a point is specified as being always virtual, rather than just when lost, its position is always calculated from the measured positions of the other points in its group.

Contour Tracking

There are three ways in which a contour can be used in tracking:

1. As a drawing tool
2. As a tracked object
3. As a virtual object

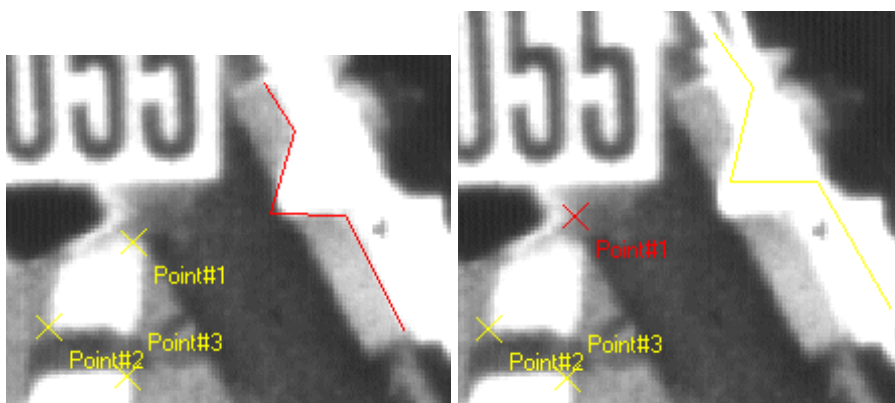
See [Using Contours](#)

Amending the Point Group

When a contour is drawn, its position is calculated by transformation with respect to the associated point group. The positions of the points in the group when it is established are stored as a two dimensional model which is used as the basis for all transformations used to calculate the position and shape of the associated contour. The definition of the two dimensional model is not changed during tracking. However, if the definition of the point group is changed, the two dimensional model is changed and this may affect the position and shape of the associated contour, i.e.

- Changing the position of an existing point in the group changes the position of the contour.
- Adding a new point to the group does not change the position of the contour.
- Note: If the point is positioned in an image other than that in which the two dimensional model was established, a reverse transformation is made to calculate the position it would have had in the first image. It is this position that is added to the two dimensional model.
- Removing a point from the group changes the position of the contour.
- Note: At least two points must remain in the group, otherwise there is insufficient information to make positional calculations.

The following example shows the effect on the position of a contour of moving a point in the associated group.



Maintaining Point Group Properties

A point group is a set of at least two points assigned a group name. A point can belong to one or more point groups. As many point groups as required may be set up.

Note: A contour can be selected as if it were a point and assigned to a group.

Point groups are used in conjunction with contours and virtual points. See [Groups, Contours and Virtual Points](#).

You may:

- [Create a point group](#)
- [Import a point group](#)
- [Add points to a point group \(Move Selection to Group\)](#)
- [Add points to multiple point groups \(Add Group to Selection\)](#)
- [Remove points from a point group](#)

Note: Above options are available either from Camera menu/Point Groups or by right-clicking in the Test Contents window.



Creating a Point Group

1. Select the required camera view.
2. Select at least one point in the Test Contents window whose position is marked in the current image.
3. Select the Point Groups option from the Camera menu.
4. Select the Create Point Group option from the Point Groups menu.
The Add Point Group dialog is displayed.

Note: If only one point is selected, an error message is displayed.


Note: If any of the points is not marked in the current image, an error message is displayed.

5. Key the Point Group Name.
6. Select the OK button.
The point group is created and its name is automatically displayed in the Test Contents window. If this is the first group to be created, the Group column is automatically added to the Test Contents window.

In the Test Contents window, the icon for each of the points in the group is changed from  to .

Importing a Point Group

1. Select the required camera view.
2. Select the Point Groups option from the Camera menu.
3. Select the Import Point Group option from the Camera menu.
The standard Open dialog is displayed.
4. Browse for the required [point group file](#).
5. Select the Open button.



The points in the group are added to the selected camera view. The default Correlation tracker is assigned to them and they are marked as "unregistered". A red dot indicates that they are part of a point group, i.e. .

Adding Points to a Point Group (Move Selection to Group)

1. Select the required camera view.
2. Select the points in the Test Contents window to be added to the group.
3. Select the Point Groups option from the Camera menu.
4. Select the Move Selection to Group option from the Point Groups menu.
The Select Group dialog is displayed.


Note: If any of the points is not marked in the current image, an error message is displayed.

5. Select the required group from the list of those available.
6. Select the OK button.
The selected points are added to the point group.

In the Test Contents window, the icon for each of the points in the group is changed from  to .

Adding Point(s) to Multiple Point Groups (Add Group to Selection)

1. Select the required camera view.
2. Select the point(s) in the Test Contents window to be added to another group.
3. Select the Point Groups option from the Camera menu.
4. Select the Add Group to Selection option from the Point Groups menu.
The Select Group dialog is displayed.
Note: If any of the points is not marked in the current image, an error message is displayed.
5. Select the required group from the list of those available.
6. Select the OK button.
The selected point(s) are added to the multiple point group.

In the Test Contents window a point belonging to multiple groups are listed several times, one time for each group it belongs to. The icons for these points will have a + sign in front of the icon indicating the status of the point .

Note: Virtual points can only belong to one point group.

Removing Points from a Point Group

1. Select the required camera view.
2. Select the points in the Test Contents window to be removed from the group.
3. Select the Point Groups option from the Camera menu.
4. Select the Remove Selection from Group option from the Point Groups menu.
The selected points are removed from the point group, but not from the Test Contents window.
Note: A confirmation message is not displayed. However, points removed unintentionally may be easily added back into the group.

Point Group Files

Point Groups can be imported from external ".grp" files. These files are text files that can be created with any suitable text editor. Each file contains a line for each point in the group. Each line contains three fields, i.e. point name, x coordinate, y coordinate. The fields are separated by a space character. The point name must be consistent with the point naming standards and the coordinates are given in pixels. An example of a point group file is shown below:

```
Point#A 10 20
Point#B 20 30
Point#C 30 40
```


Using Contours (Optional Feature)

There are three primary ways of using the tracking function in relation to targets, contours and virtual points:

1. [As a drawing tool](#)
The contour function is used as a drawing tool to position the contour in each successive image.
2. [As a tracked object](#)
A contour can be tracked directly as a separate item in the same way as individual points are tracked. In this case its position is determined directly from the image by the tracker. The positions of virtual points can be calculated from their relationship to the contour.
3. [As a virtual object](#)
A contour can be treated as virtual, i.e. similar to a virtual point. Its position in successive tracked images is calculated by transformation from the positions of the points in its associated target.

See Also...



[Groups, Contours and Virtual Points](#)



[Maintaining Contour Properties](#)

Contour as a Manual Drawing Tool (Optional Feature)

In this mode a contour is drawn in the image and is tracked as if it were a point.

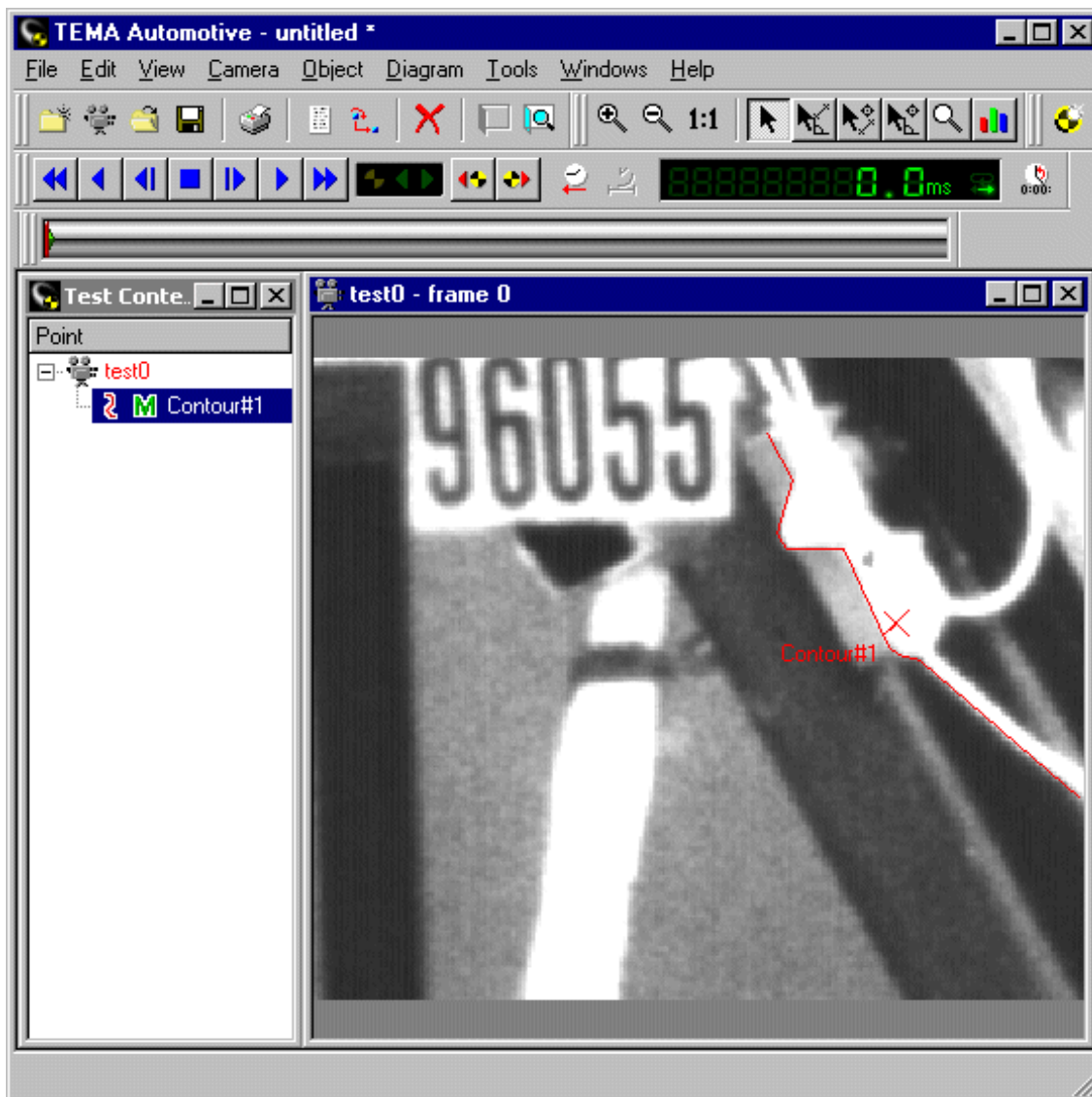
It is recommended to track the contour by using the "step track" functions from the Time Panel toolbar:

-  - tracks one frame backwards.
-  - tracks one frame forwards.

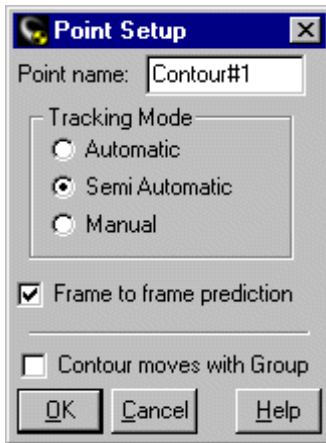
Note: Tracking by using the  or  button should not be used because it is not effective. No opportunity is given to ensure that the contour is positioned correctly in each successive image.

The following illustrations show some of the features of this mode of operation:

1. [Add a Contour](#) to the Default target.
2. [Draw the Contour](#) in the first image.

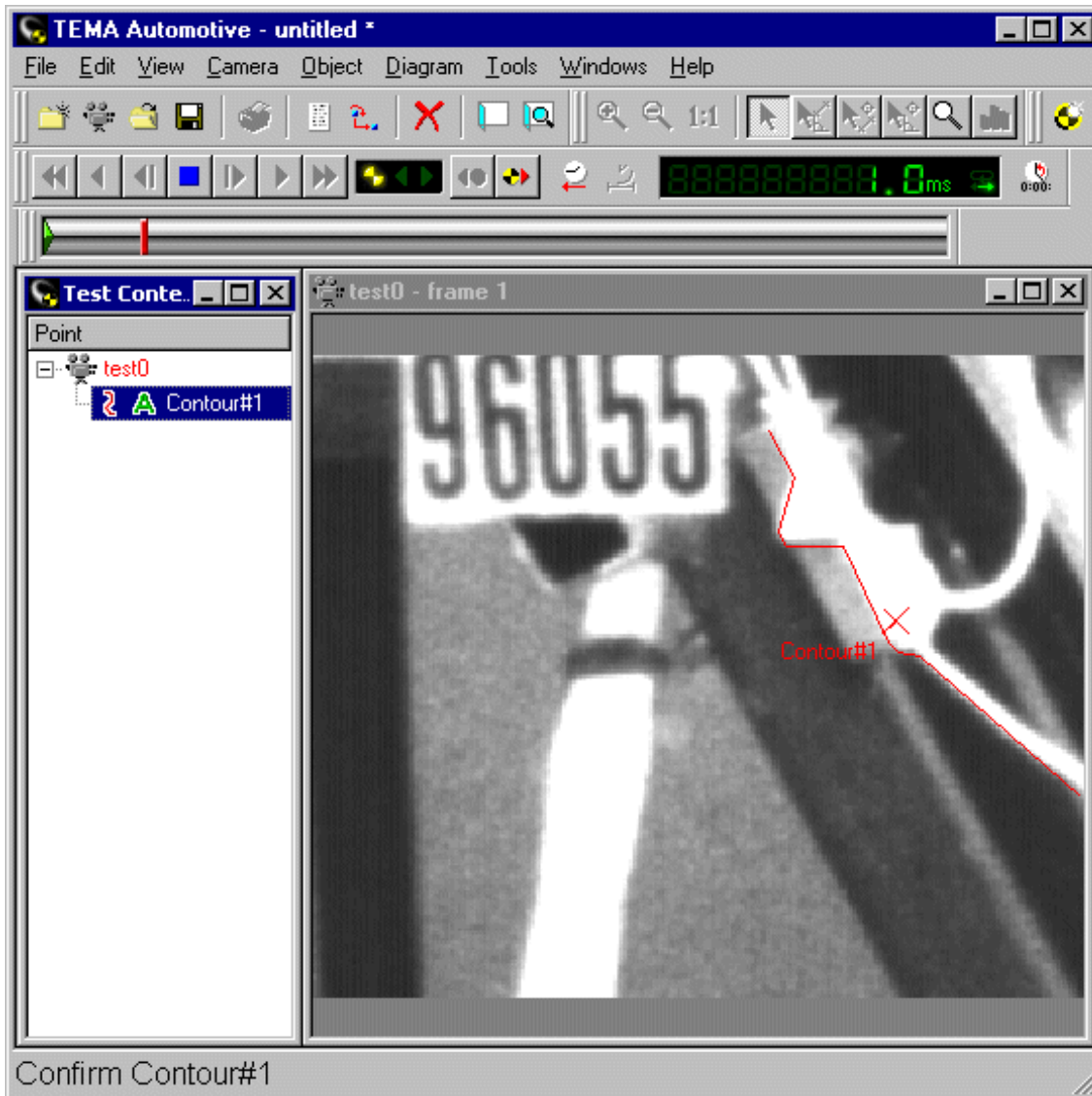


3. Double-click on the Contour in the Test Contents window.
4. Select Semi Automatic in the Contour [Point Setup dialog](#).

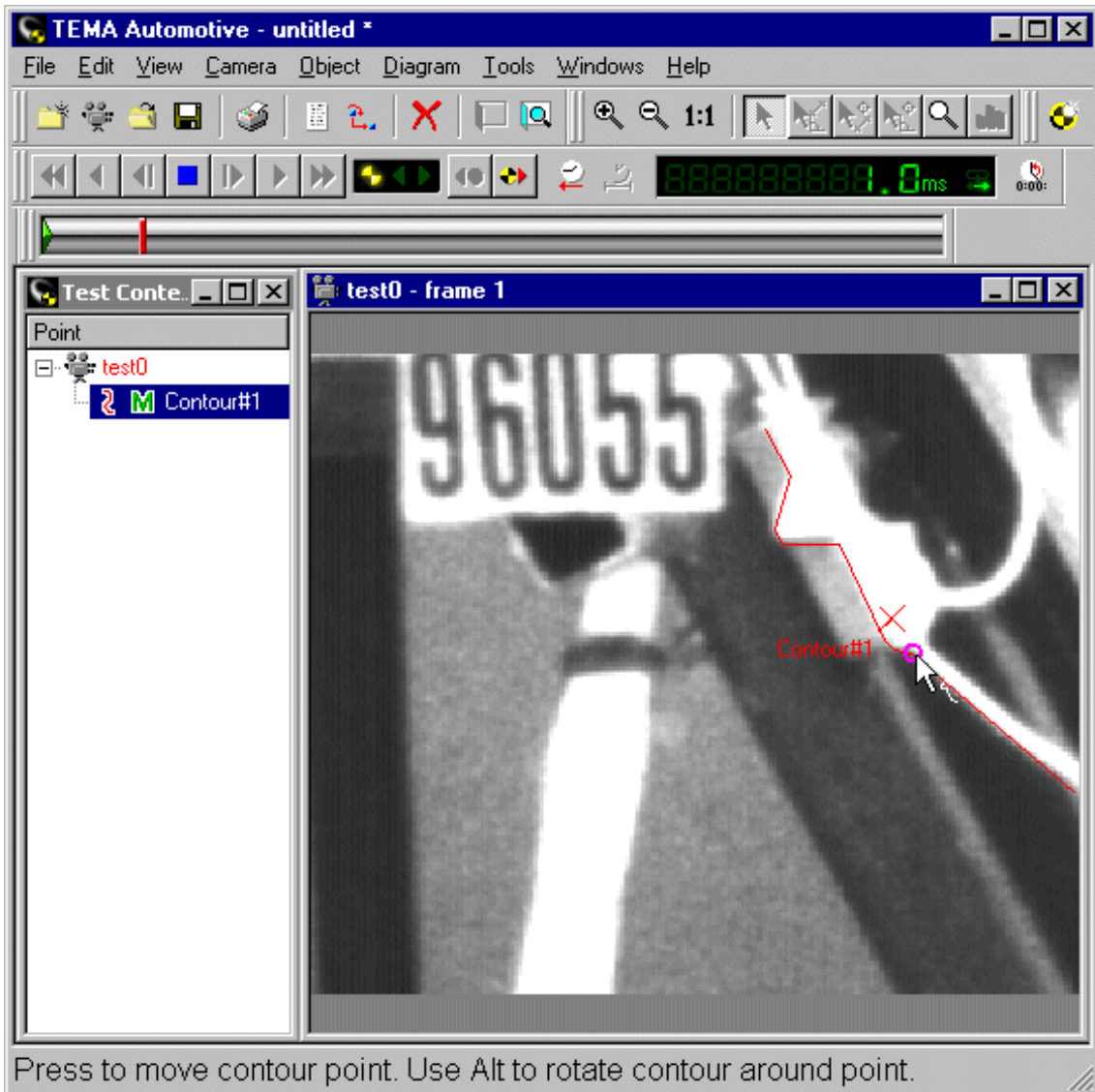


Note: The Contour moves with Group feature is not relevant in this mode.

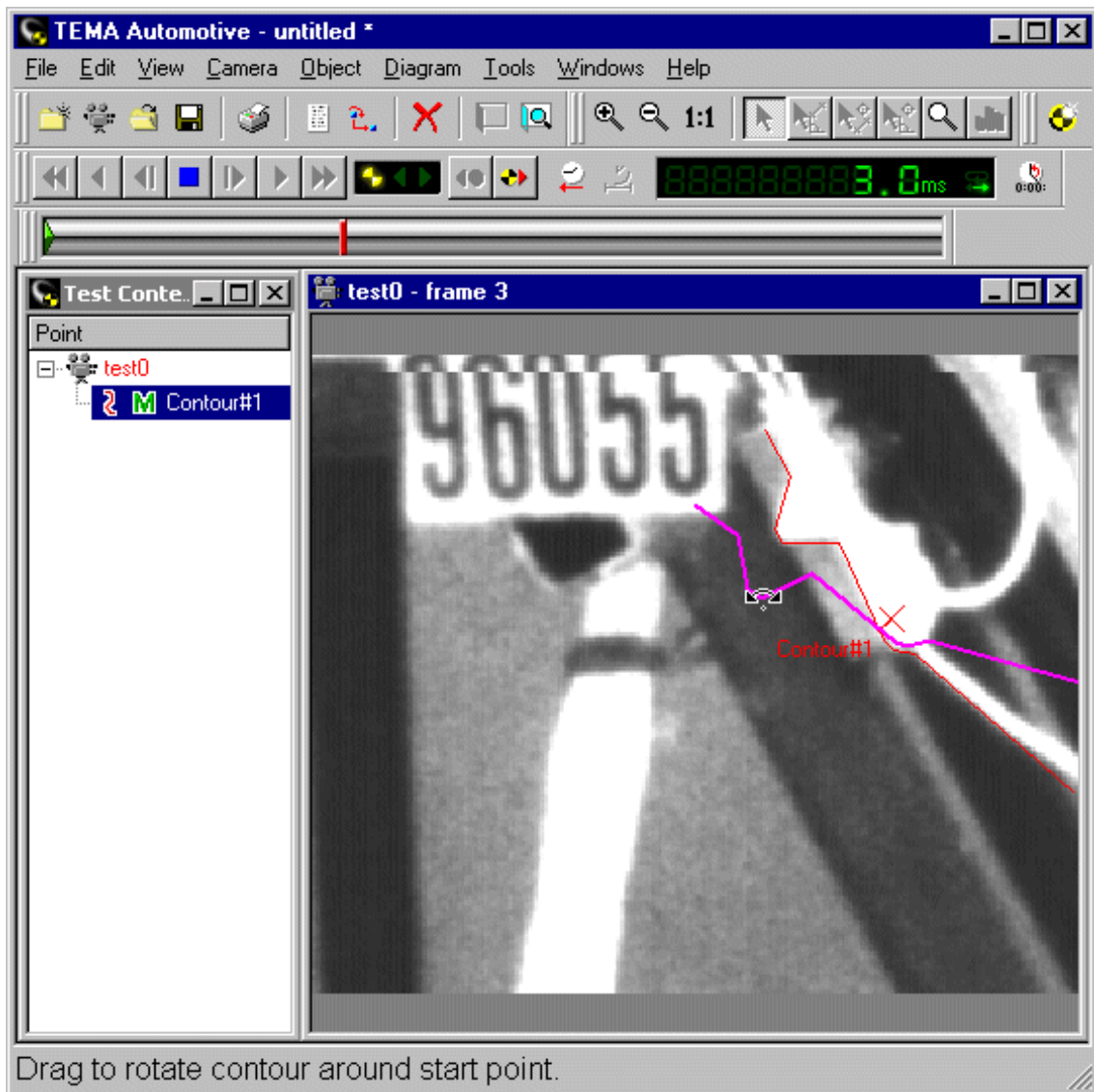
5. Select the OK button.
6. Start the tracking by selecting  in the Time Panel.
You are asked to confirm the Contour position in the next image.



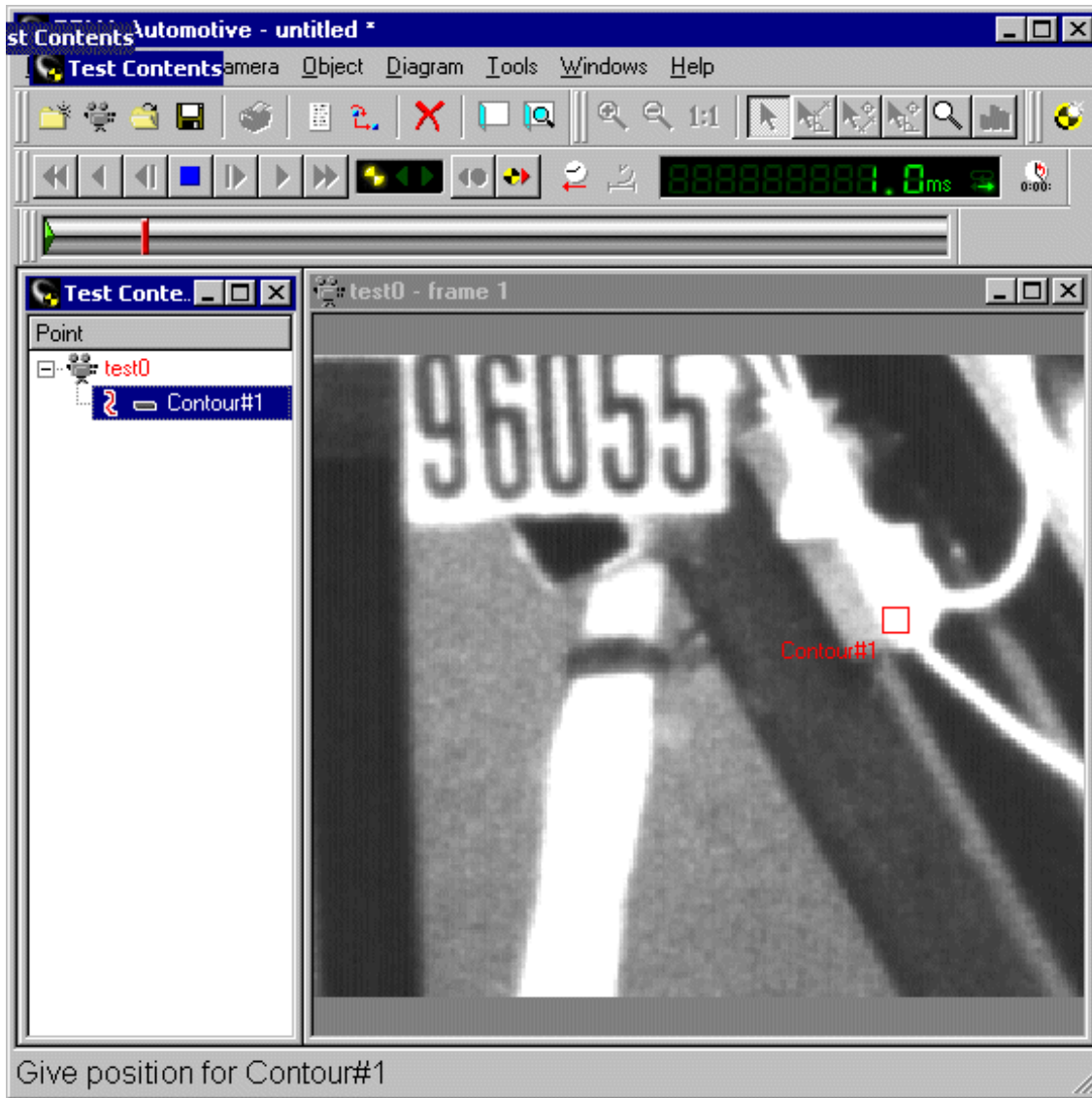
7. You may:
 - o Adjust the Contour shape or position using the normal [contour tools](#).



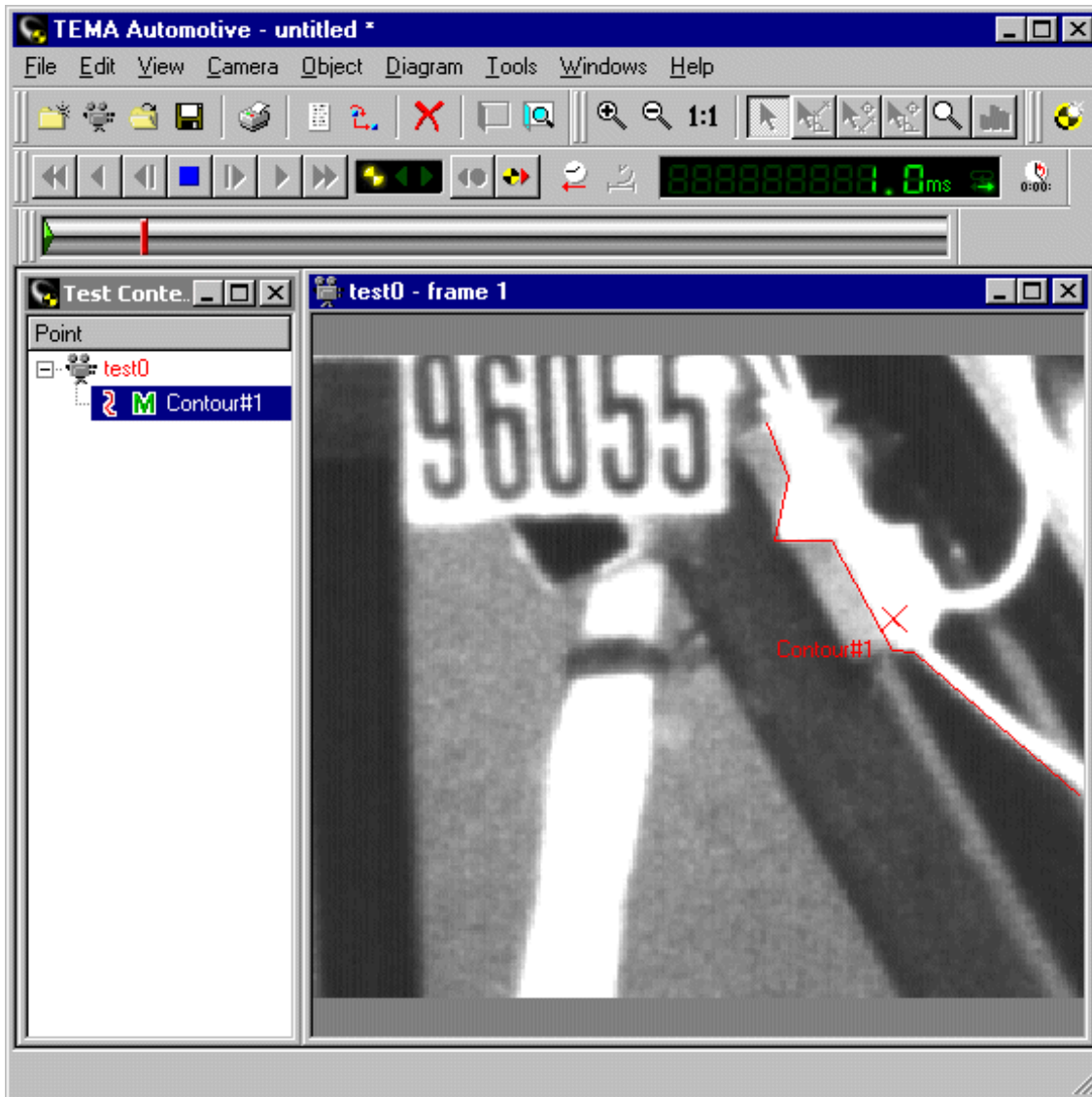
- Rotate the Contour using the [rotation tool](#).



8. Repeat the above steps for each successive image.
Note: If the Contour is being tracked in Manual mode, it is lost in each successive image.



It then has to be [redrawn](#) each time.

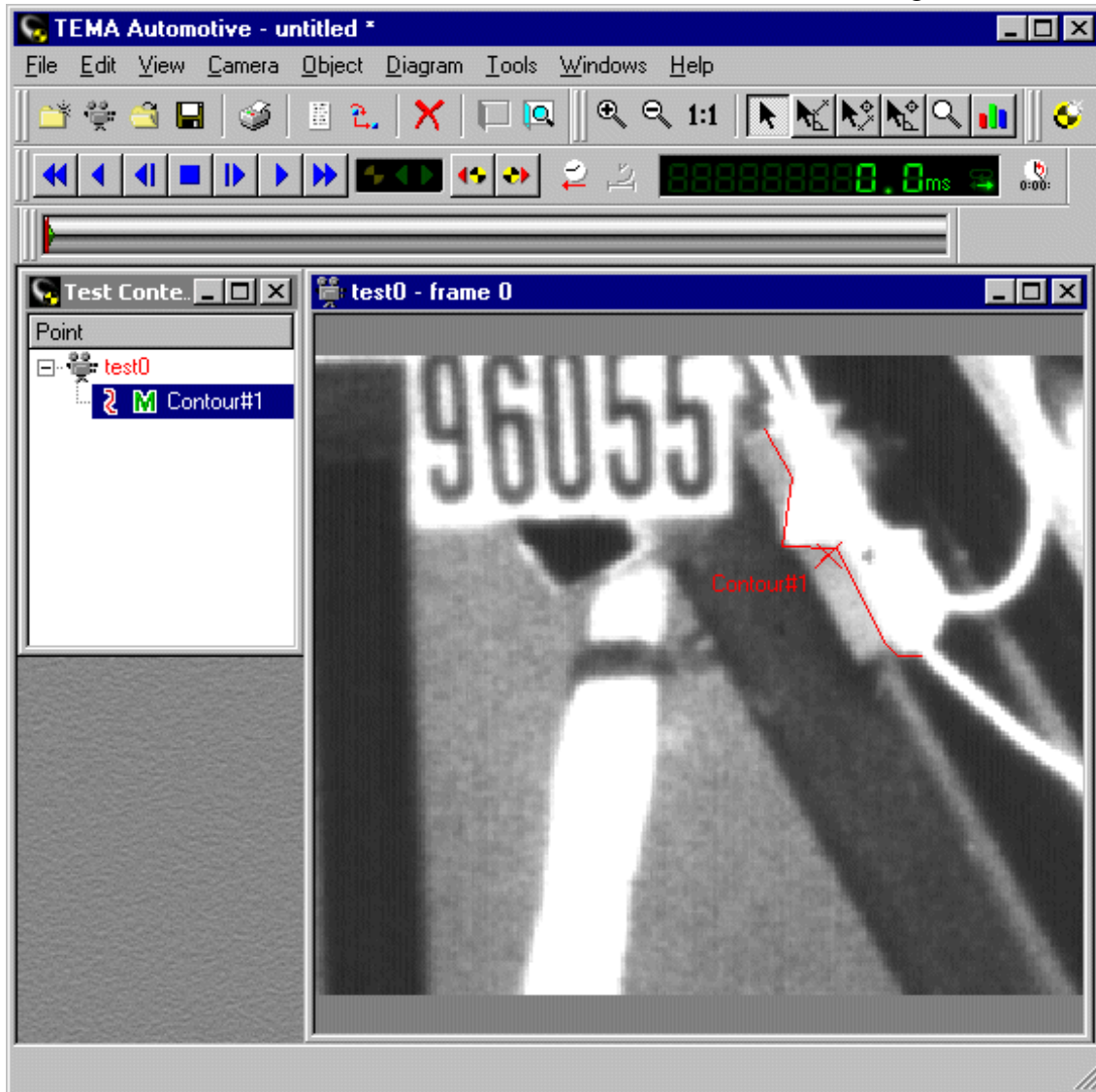


Virtual Point from Contour Position (Optional Feature)

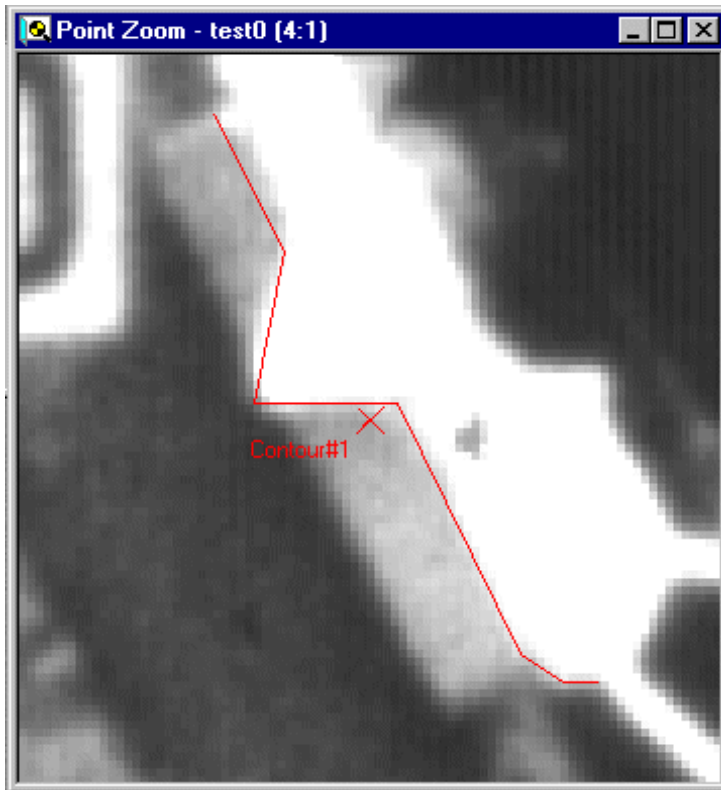
In this mode a contour is drawn in the image, together with a point. The point is treated as if it were virtual when the contour is tracked. The position of the contour in successive images is located by the tracker and adjusted manually, while the position of the point is calculated by the tracker from the point position.

The following illustrations show some of the features of this mode of operation:

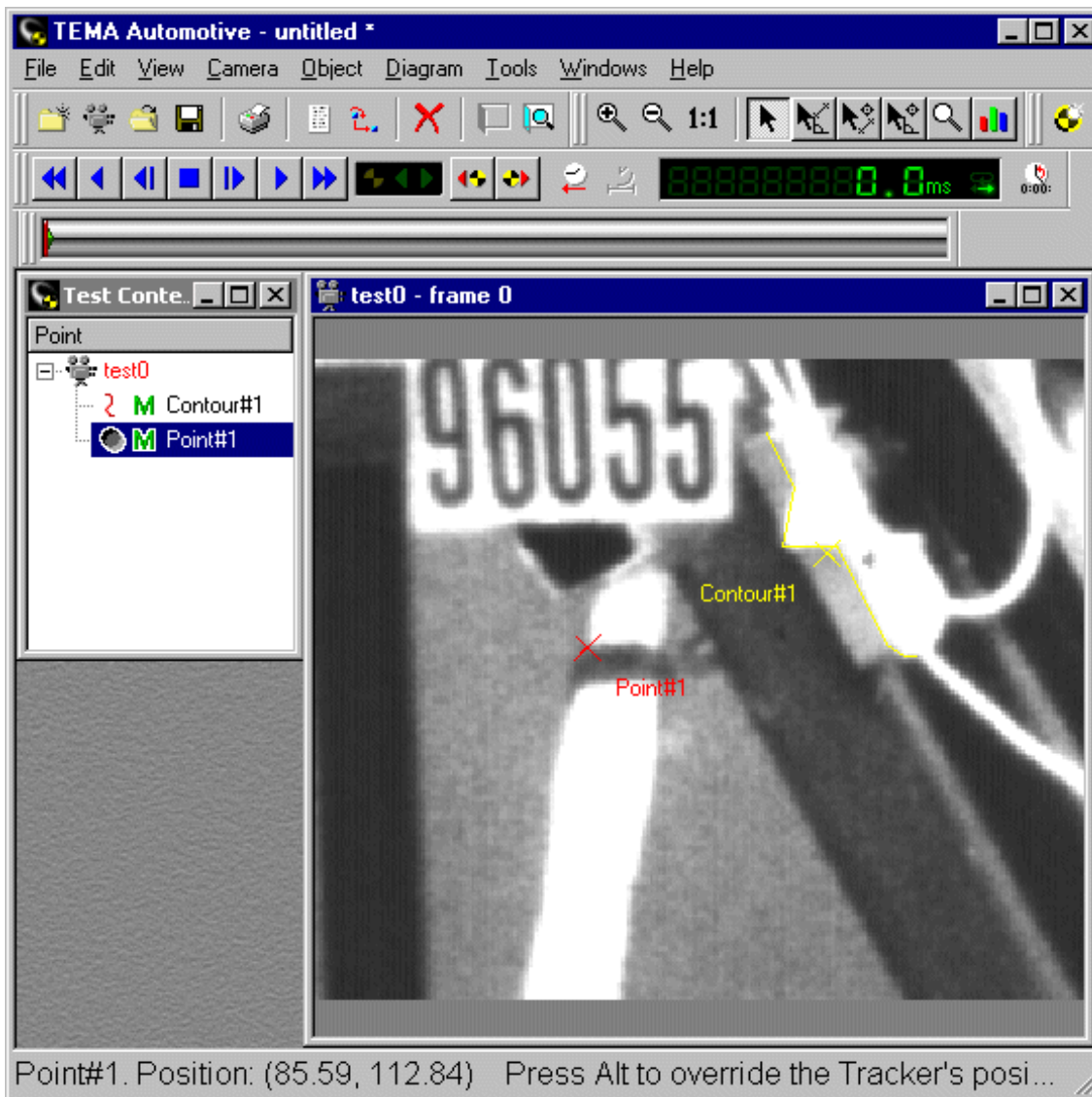
1. [Add a Contour](#) to the **Test Contents** window and [draw it](#) in the first image.



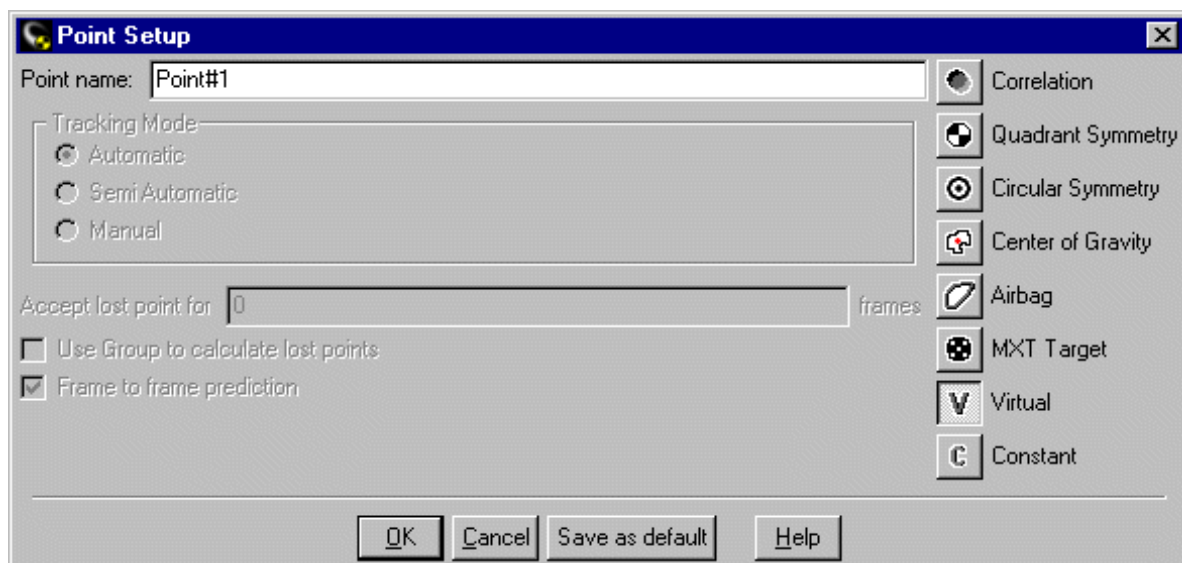
This may be achieved more accurately via a [Zoom](#) window.



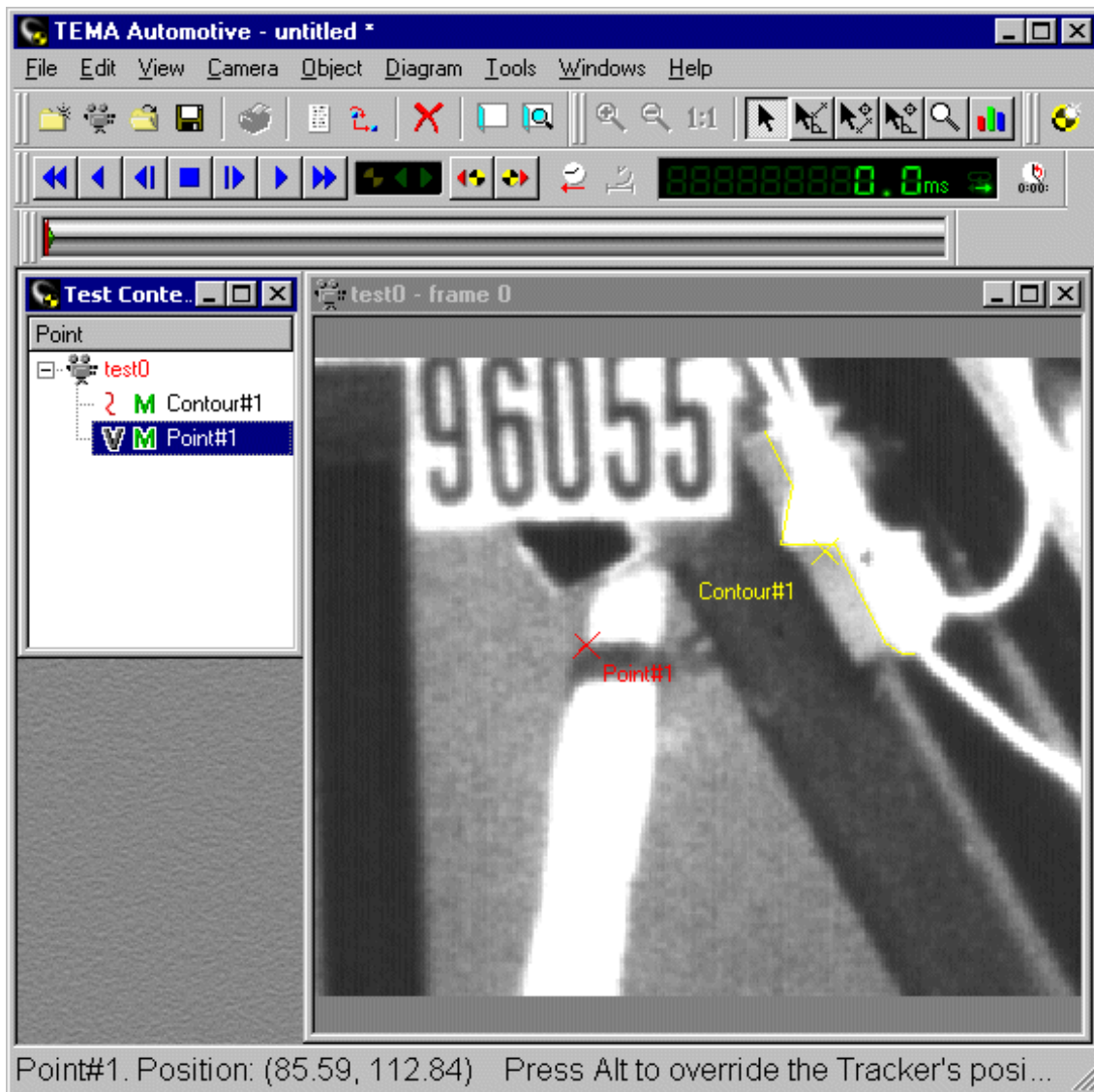
2. [Add a Point](#) to the **Test Contents** window and mark its position in the first image.



3. Double-click on the Point in the **Test Contents** window and select the **Virtual Tracker** in the [Point Setup](#) dialog.





The Point is now shown in the **Test Contents** window as being [Virtual](#).

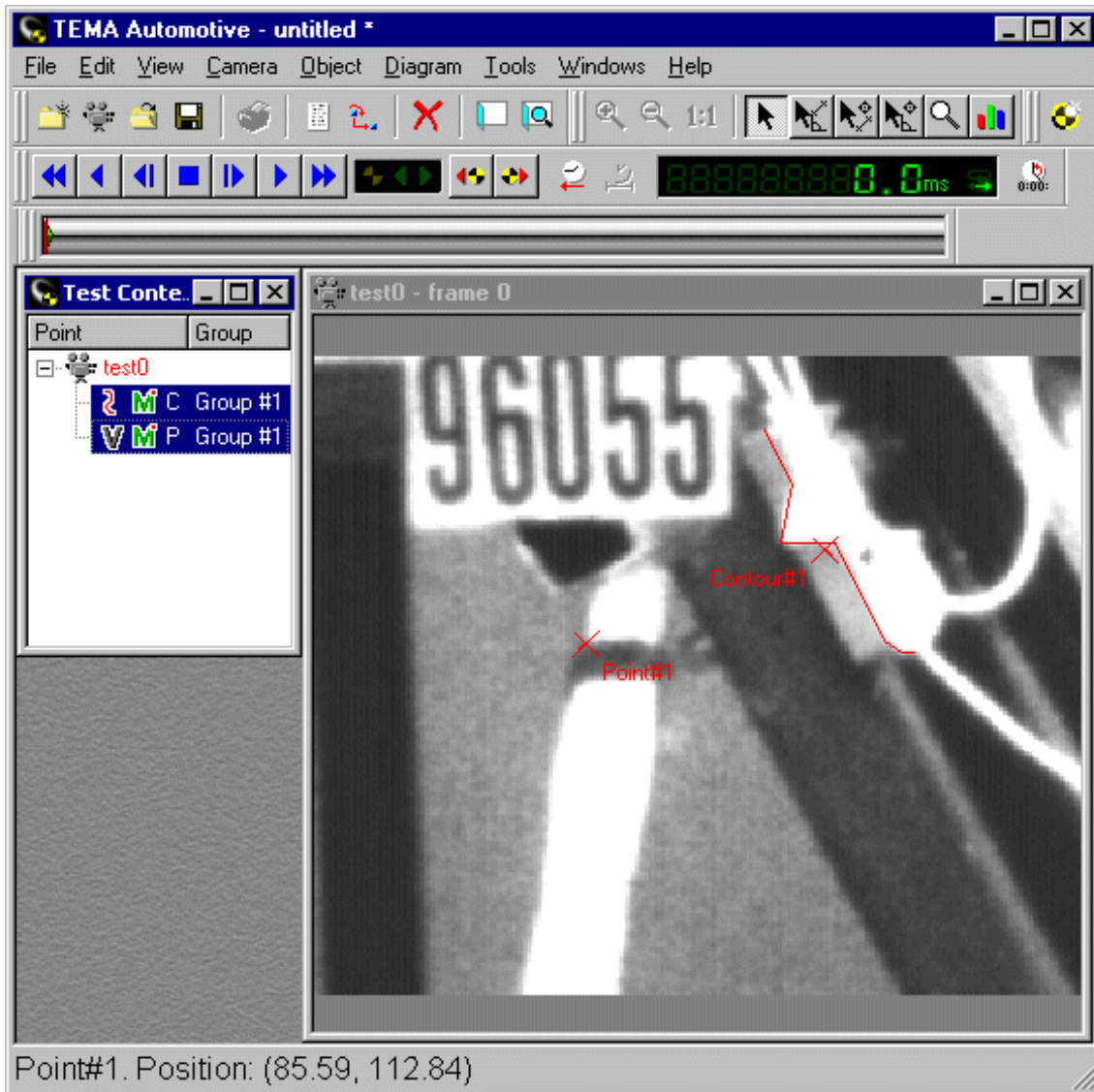



4. Select the Point and the Contour in the **Test Contents** window.
5. Select the **Point Groups** option from the **Camera** menu.
6. Select the **Create Point Group** option from the **Point Groups** menu.
The **Add Point Group** dialog is displayed.

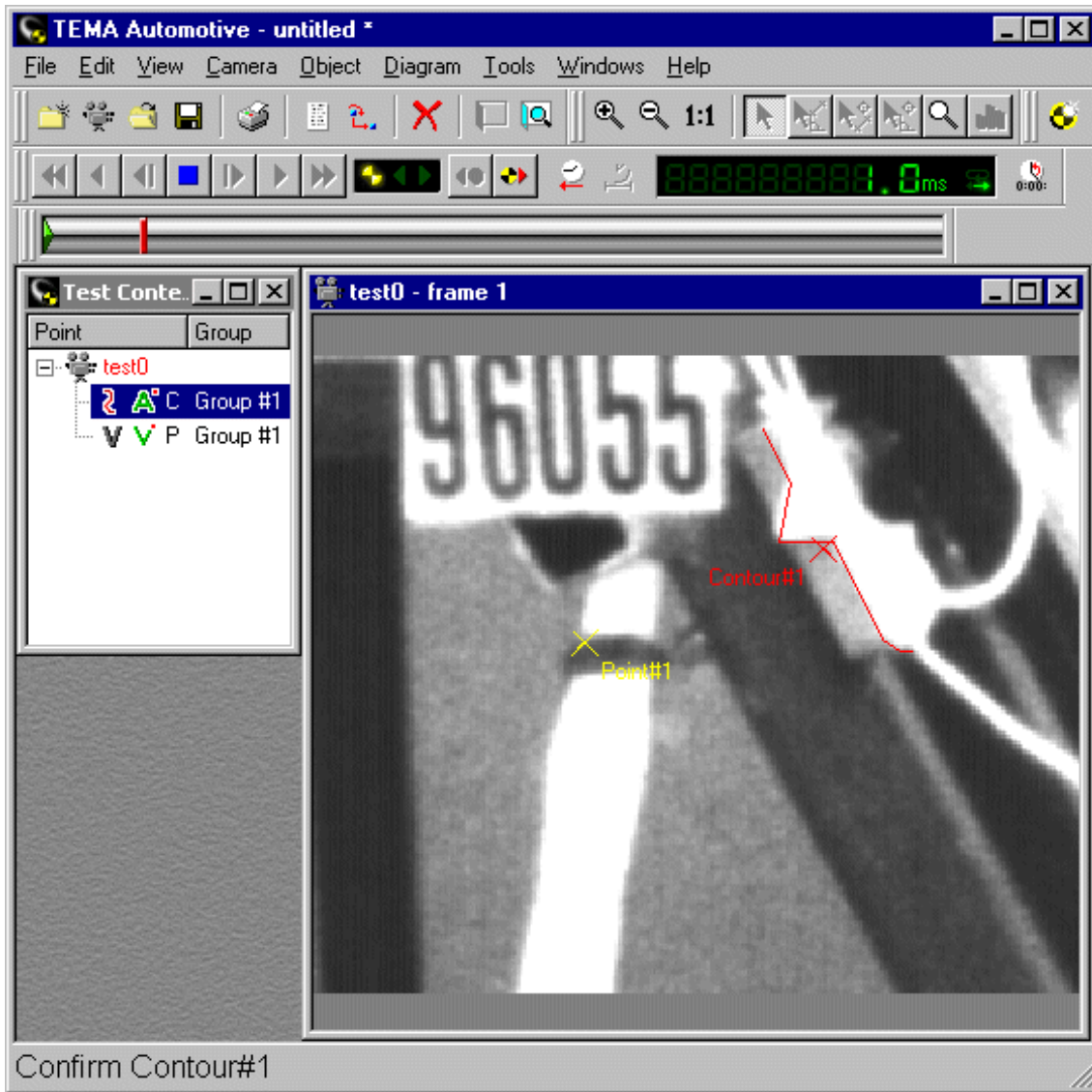


7. Select the **OK** button.

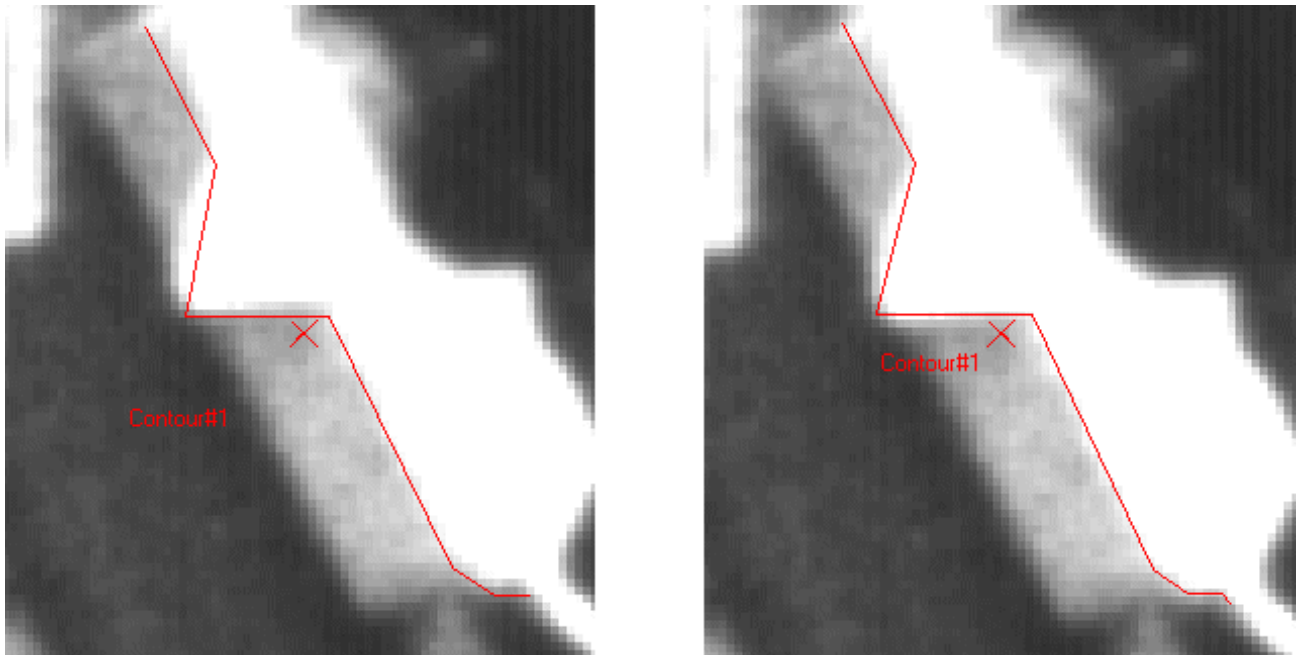
The  icon for the Point and the Contour is changed to  to indicate that they are in the 2D model.



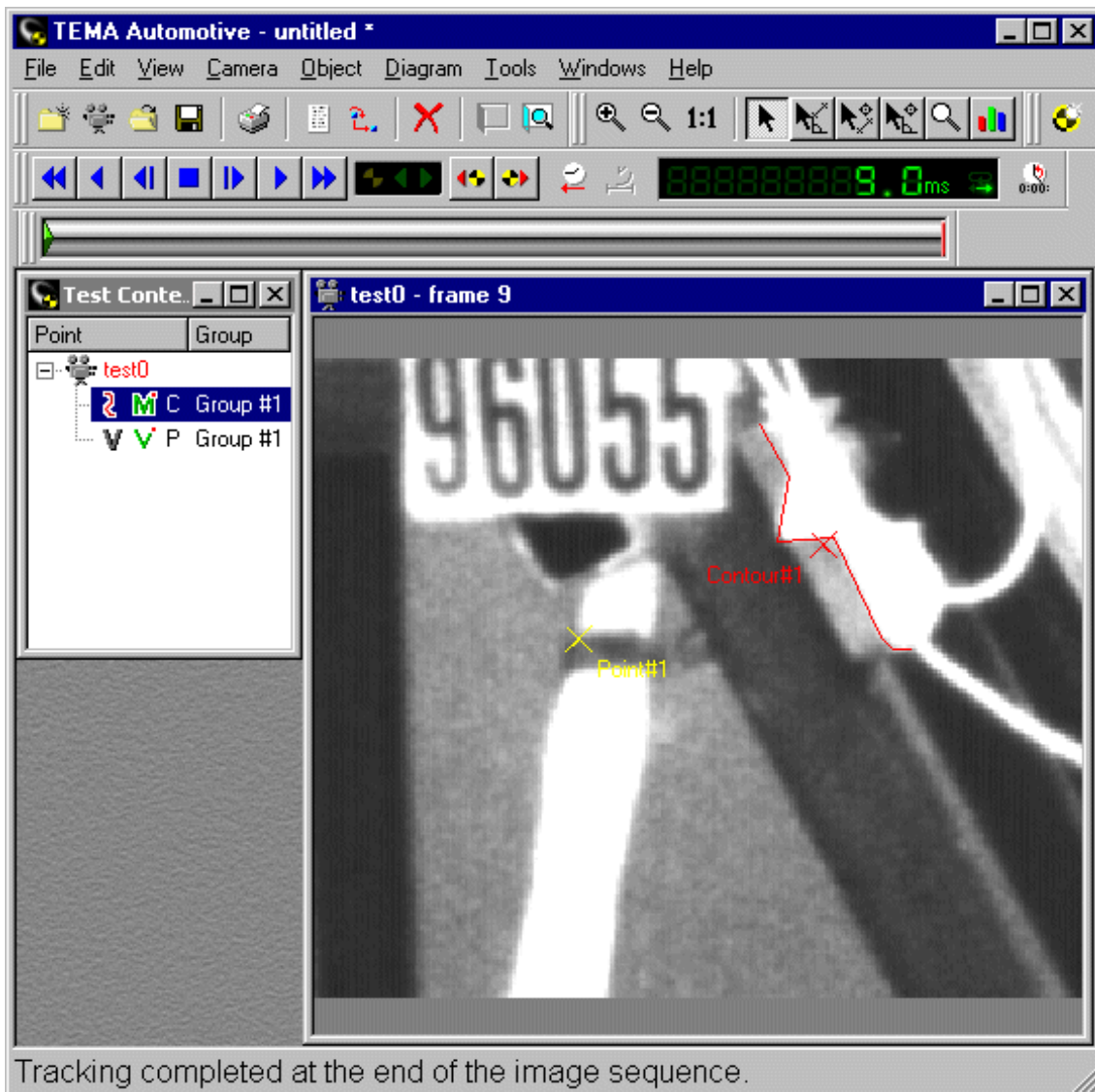
8. Start the tracking by selecting  in the **Time Panel**.
The tracker asks for confirmation of the Contour in the next image because it is being tracked in Semi-automatic mode, by default.



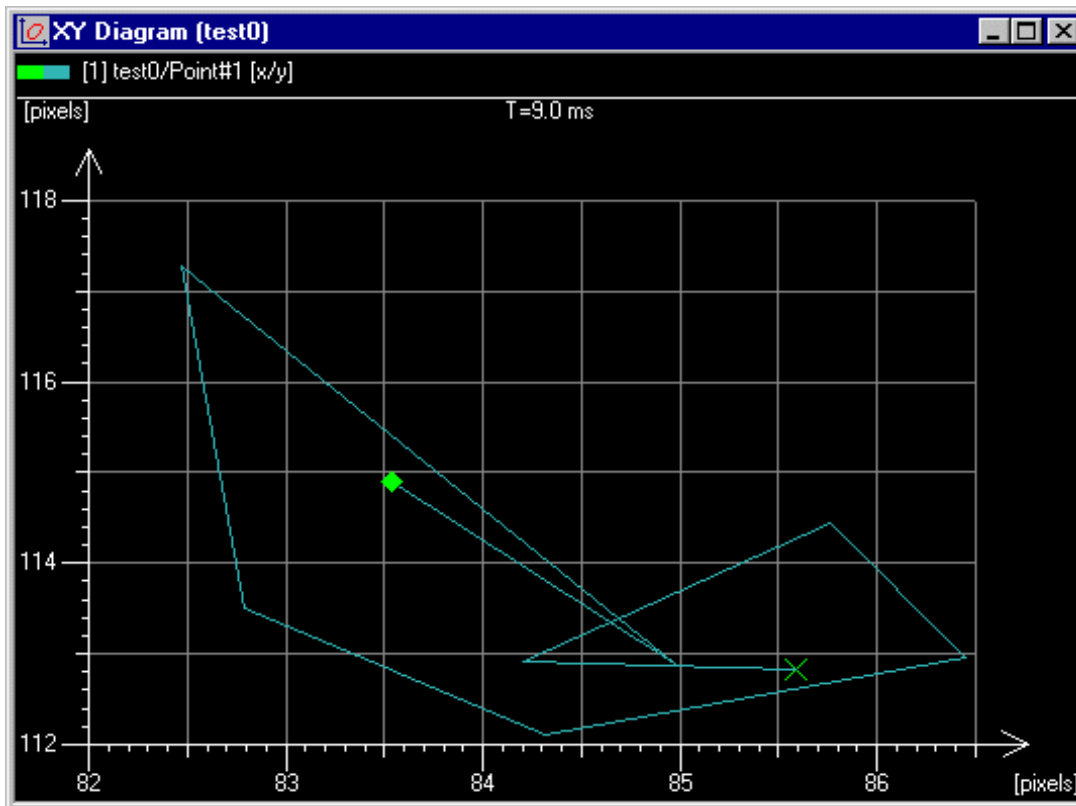
9. Adjust the position and shape of the Contour in the image. This is best done via a [Zoom](#) window.



10. Repeat the above steps for each image in the sequence until the tracking has finished.



11. Display an [XY Diagram](#).
12. In the [XY Diagram](#) dialog, select only the Point for display.
This shows that the calculation of the Virtual Point position has been accurate.

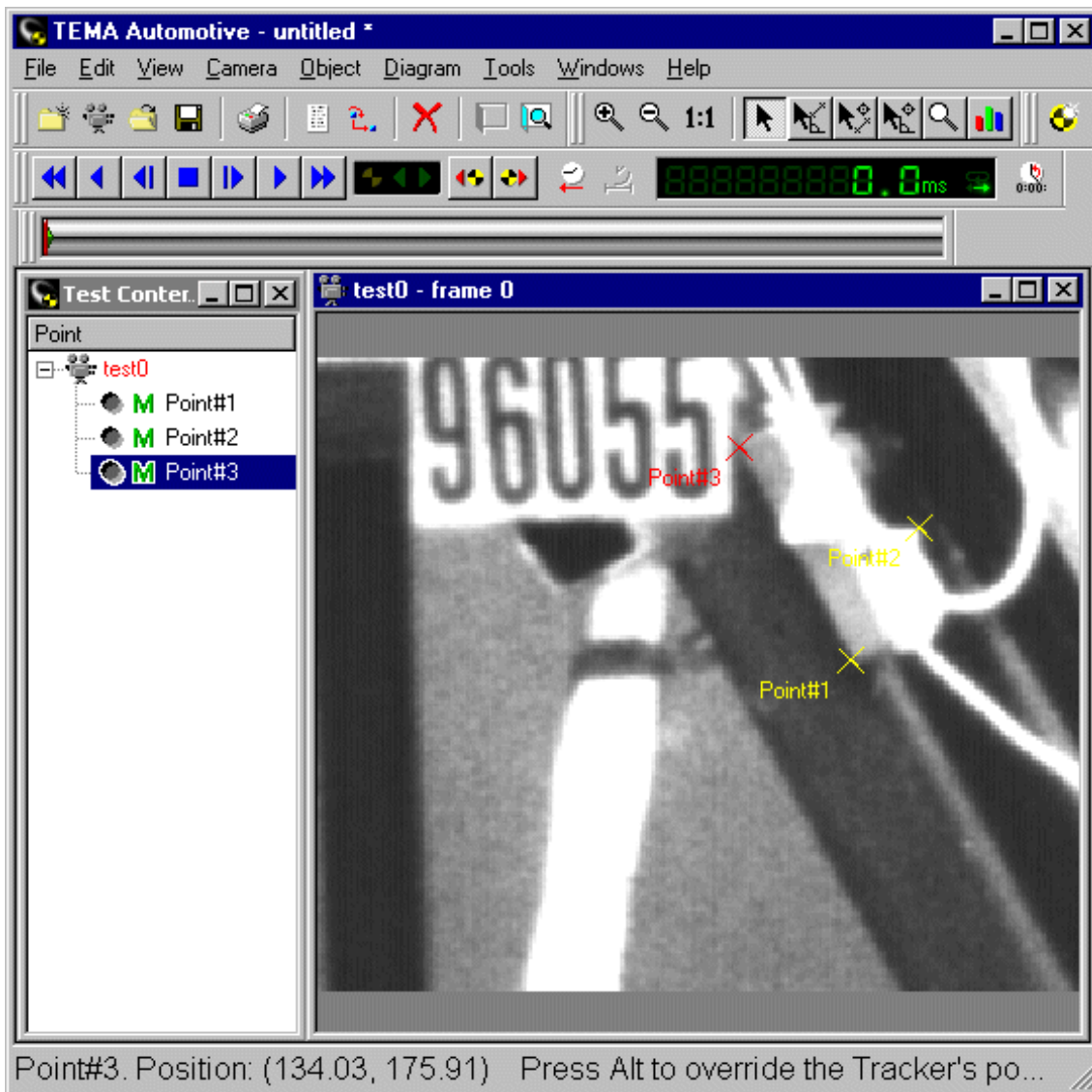



Virtual Contour from Point Position (Optional Feature)

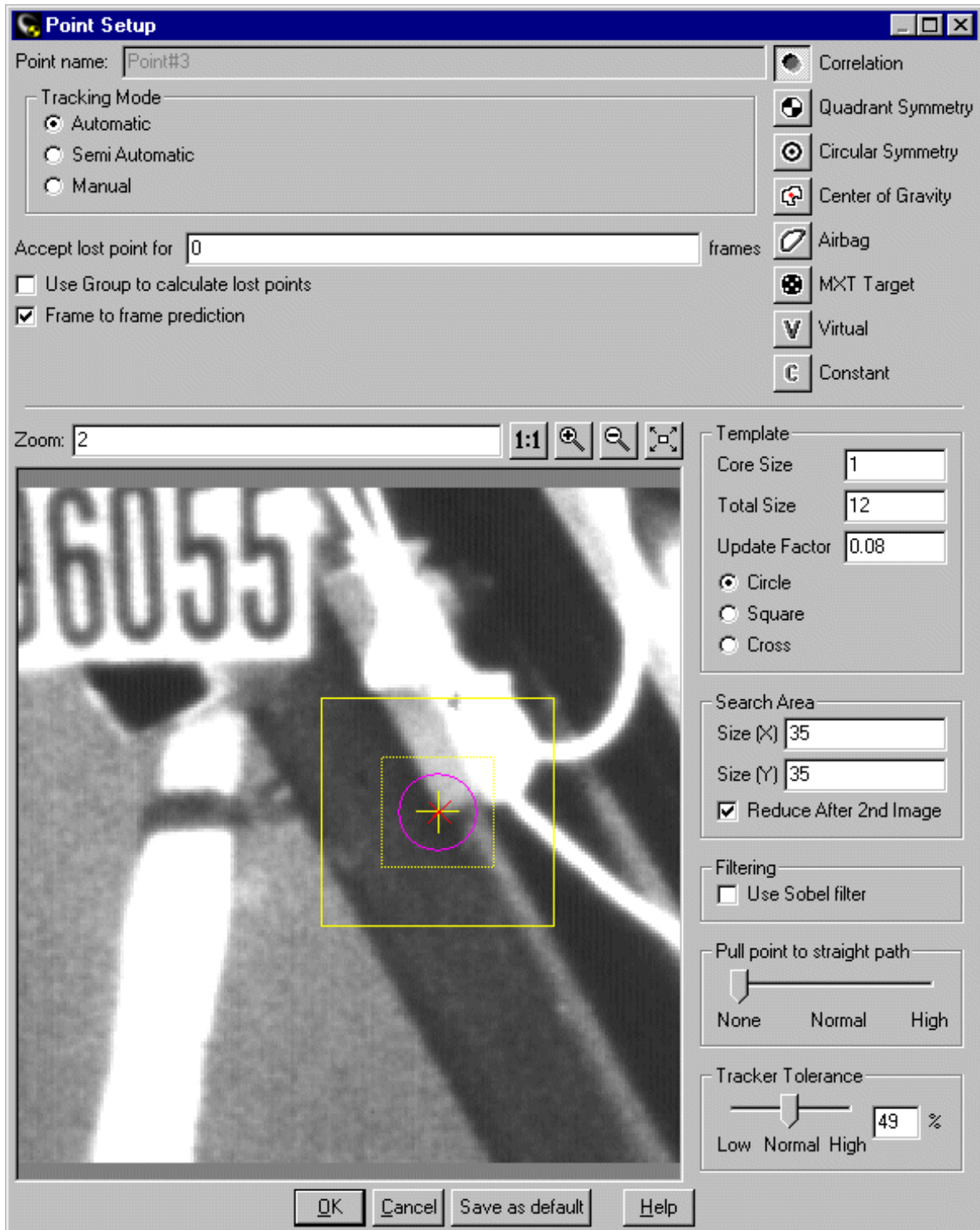
In this mode some points are placed in the image, together with a contour. The contour is drawn in the image and treated as if it were virtual when the points are tracked. The positions of the points in successive images are located by the tracker, while the position of the contour is calculated by the tracker from the point positions.

The following illustrations show some of the features of this mode of operation:

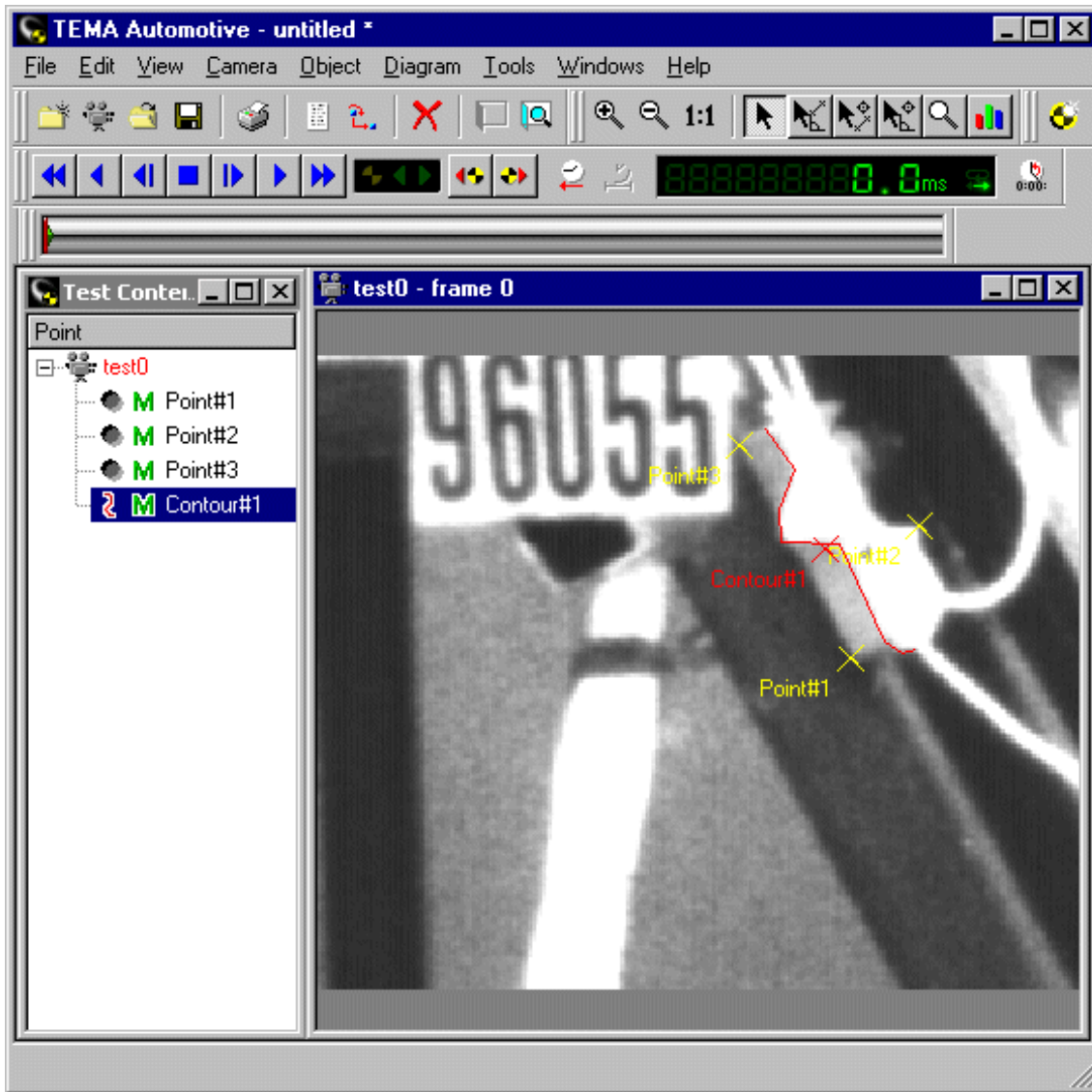
1. [Add three points](#) to the Test Contents window and position them in the first image.



2. Select the three point and then the  tool. In this case no changes are required in the Point Setup dialog because the points are set to use [Automatic tracking](#) by default.





3. [Add a Contour](#) to the Test Contents window.
4. [Draw the Contour](#) in the first image.

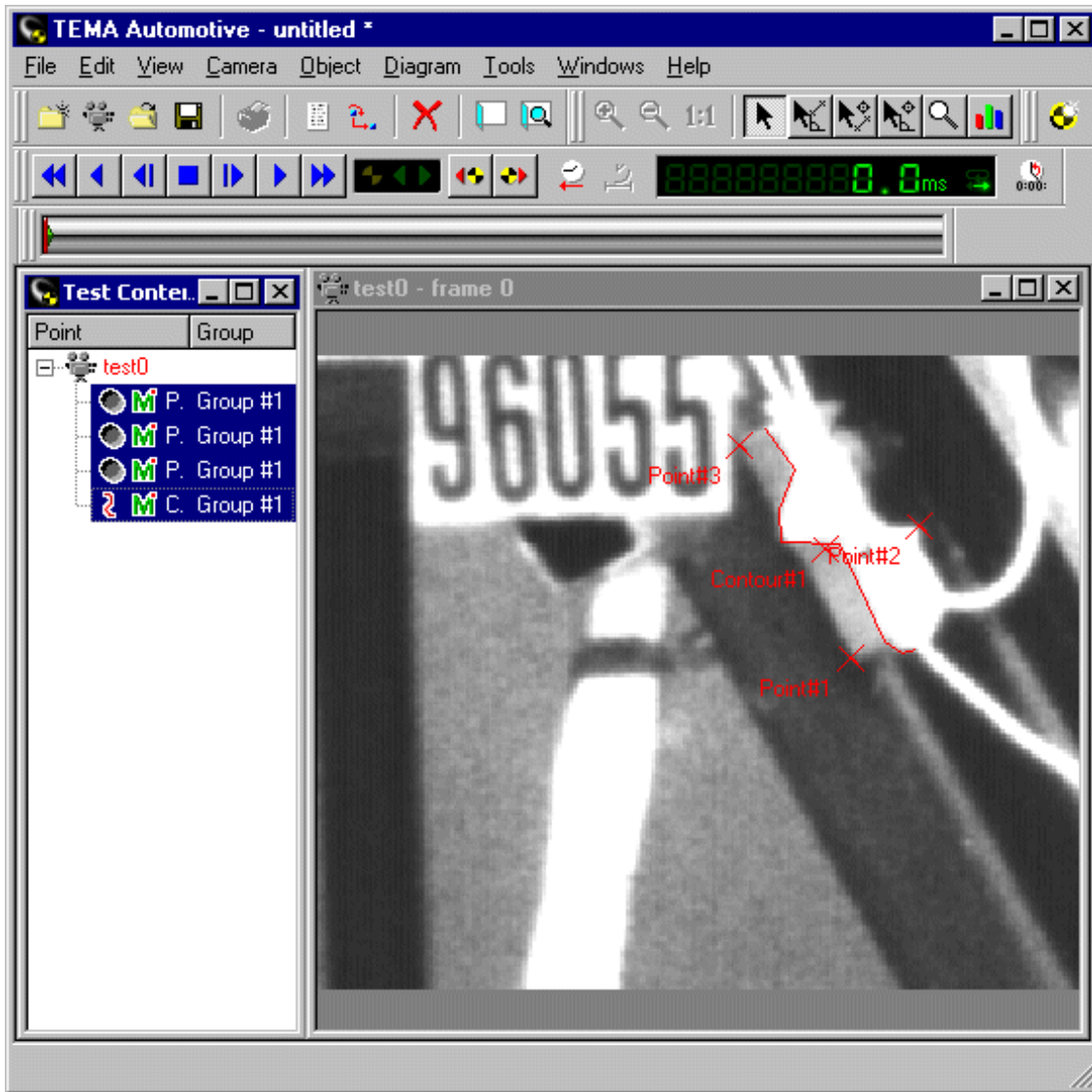


5. Select the Points and the Contour in the Test Contents window.
6. Select the Point Groups option from the Camera menu.
7. Select the Create Point Group option from the Point Groups menu.
The Add Point Group dialog is displayed.

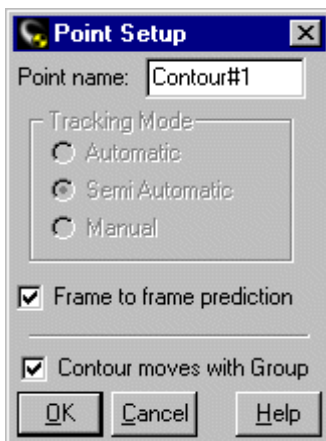


8. Select the OK button.

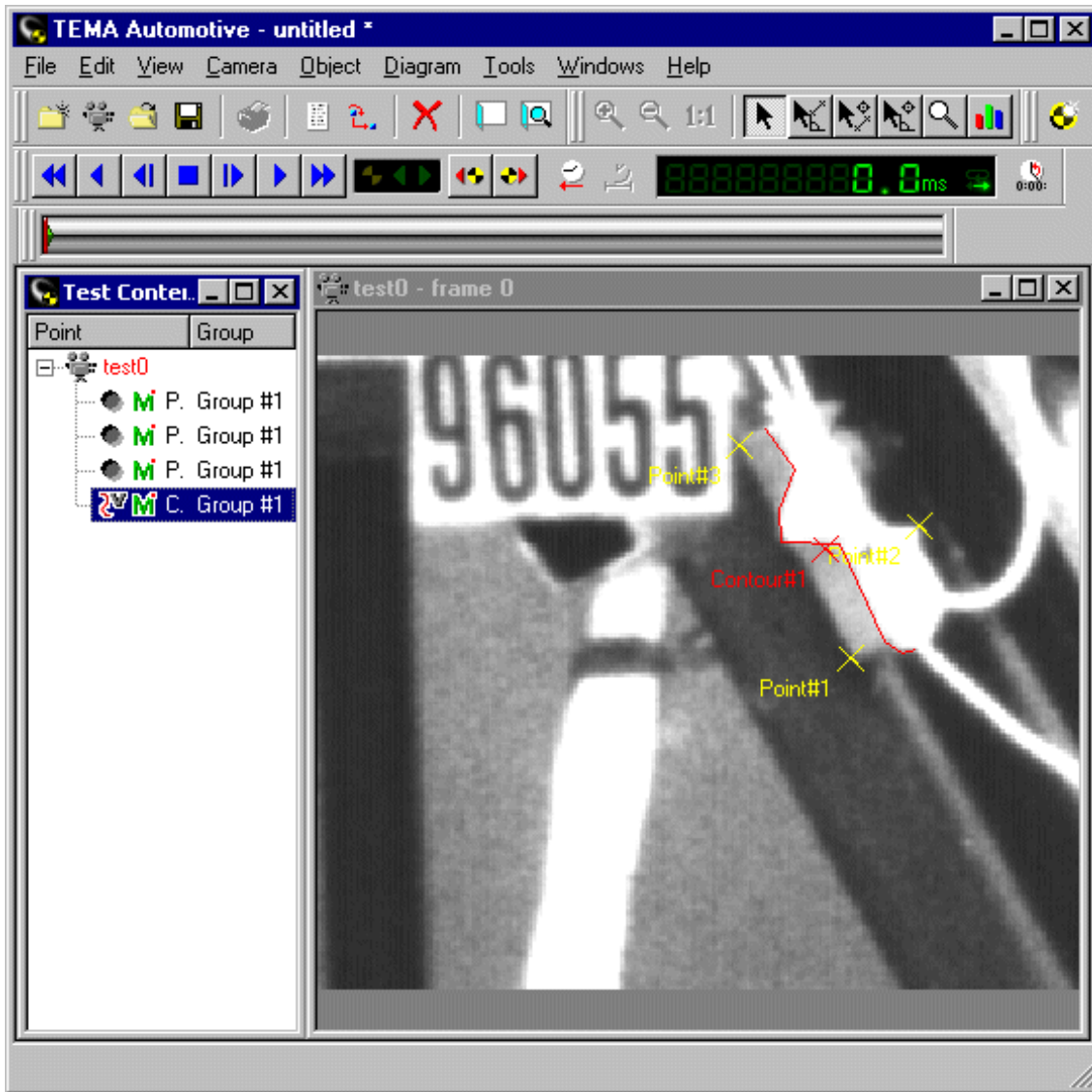
The  icon for the Point and the Contour is changed to  to indicate that they are in the 2D model.



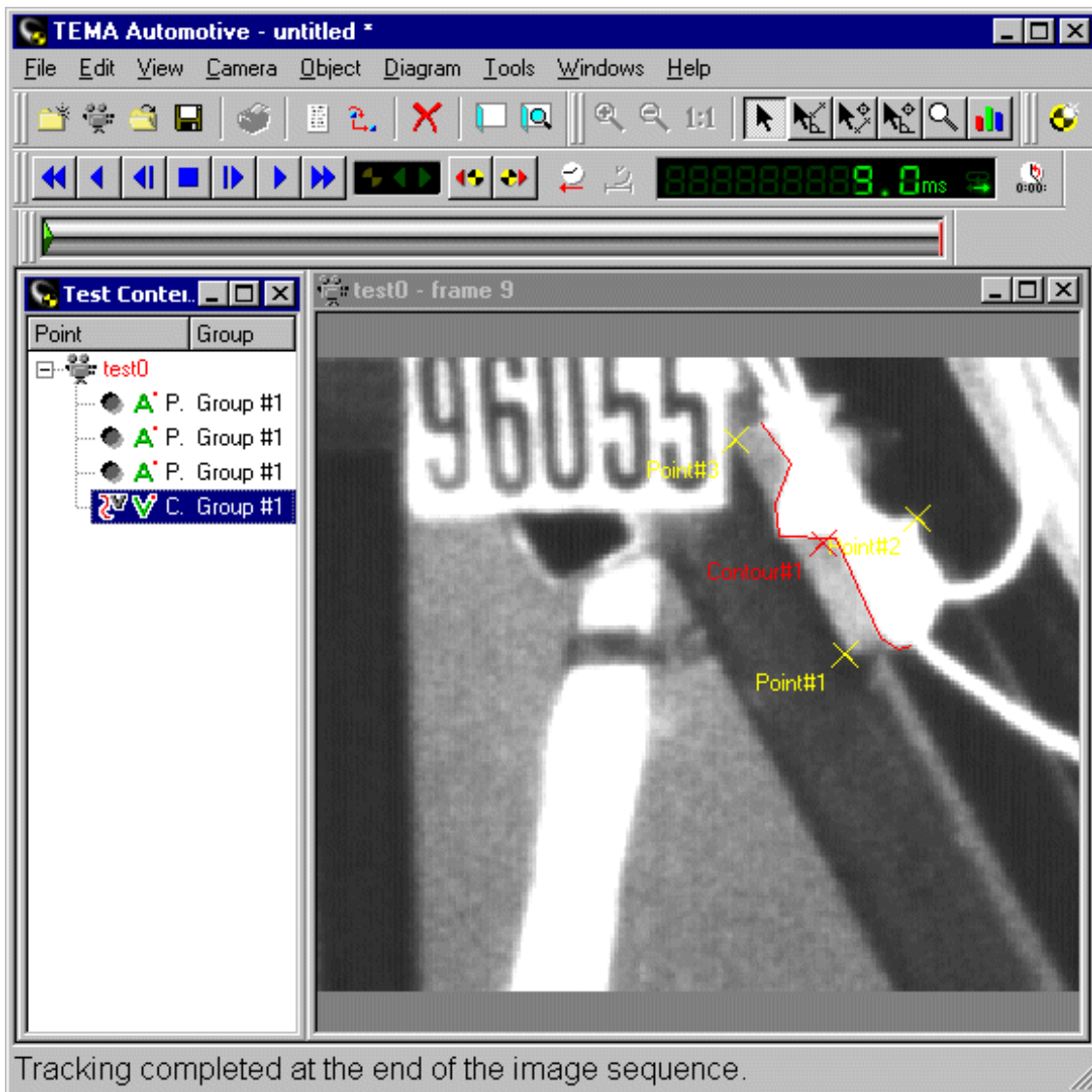
9. Double-click the Contour in the Test Contents window.
10. Select the Contour moves with Target checkbox in the Contour [Point Setup dialog](#).



11. Select the OK button.
This marks the Contour node as being [Virtual](#).

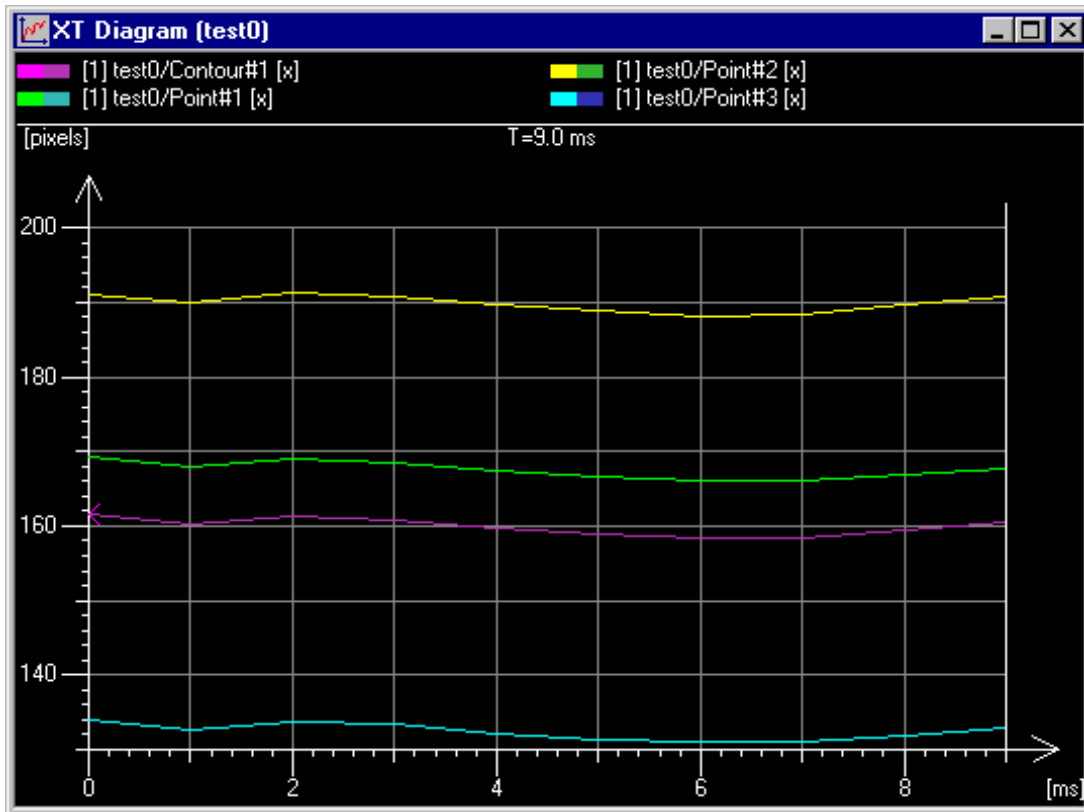


12. Start the tracking by selecting  in the Time Panel.
The tracking proceeds to completion because Automatic mode was selected for all the points.



The position of the Contour in successive frames is calculated from the Point positions. Because, in this example, the three Points and the Contour are on the same rigid structure, the Contour position is calculated exactly.

13. Display an [XT Diagram](#).
14. In the [XT Diagram](#) dialog, select the Points and Contour for display.
This shows that the relative positions of the Points and Contour remain the same.



Maintaining Contour Properties (Optional Feature)

A contour is a named outline drawn on an image as a series of straight lines. It is associated with a [point group](#).

Contours are used primarily to improve the visibility of the displayed images. However, they are in conjunction with point groups and virtual points. See [Groups, Contours and Virtual Points](#). Specifically, a contour can be used in the calculation of the positions of virtual points. Alternatively, a contour can be defined as virtual and its position calculated from the positions of real points. During tracking, the size and angle of the contour are calculated, as well as its position, and are made available for subsequent analysis and presentation.

There are two modes of operation when manipulating contours:

- Draw mode operates by left-clicking the last point in a contour and releasing the mouse button. It is used to draw the basic shape of the contour.
- Drag mode operates by left-clicking any point or line in a contour and dragging it to a new position before releasing the mouse button. It is used to:
 - move the position of a point;
 - add a point to the middle of a contour;
 - delete a line or group of lines.

You may:

- [Create a contour](#).
- [Draw a basic contour line](#).
- [Reposition a point](#).
- [Add a point to the end of a contour](#).
- [Add a point to the middle of a contour](#).
- [Remove a point](#).
- [Create a loop](#).
- [Rotate a contour](#).
- Use the pop-up menu:
- Note: The pop-up menu is available from the contour in the Test Contents and in the image.
 - [Delete the contour from the Test Contents window](#).
 - [Control the display of the contour](#).
 - [Clear the contour from the image](#).
 - [Undo the last operation](#).


Creating a Contour

1. Select the required camera view.
Select the Add Contour option from the Camera menu.
2. The contour is added to the Test Contents window with a default name.
Note: The contour is not displayed in the image because it has not yet been drawn. So far, all that has been done is to define the contour name and associate it with a point group.
3. Double-click the contour in the Test Contents window.
The Point Setup dialog is displayed for the contour.
4. Amend the Point name, if required.
5. Specify the Frame to frame prediction - Using Frame to frame prediction mode is the default and means that the tracking function takes into account the previous positions of the point when tracking its next position. De-selecting Frame to frame prediction mode should be used in circumstances where the movement of the point as seen in the image is erratic.
6. If you wish the contour and the target to be moved together, i.e. to maintain the same relative positions, select the Contour moves with Target checkbox.
7. Select the OK button.
The Point Setup dialog is removed from the display.

8. Select the contour and change its name, if required.
9. Draw the contour, see below.

Drawing a Basic Contour Line

1. Select the required camera view.
2. Select the required contour in the Test Contents window.

When a contour is selected, the cursor changes to .

3. Left-click the first point in the contour.
4. Release the mouse button.
5. Move the cursor to the next point, left-click and release.
The contour is drawn as each point is specified.
6. Repeat the above step until the last point is placed.
7. Double-click the last point to complete the contour and disable the drawing tool. The select tool will then be active at once.

Note: It is best, if possible, to avoid having tracking points and contour line points too close together because it makes point selection a little difficult.

Repositioning a Point

1. Select the required camera view.
2. Select the required contour in the Test Contents window.
3. Place the cursor at the point to be moved.
A circle is displayed around the point to confirm that it may be selected.
4. Left-click the point and drag it to the required position.
5. Release the mouse button.

Adding a Point to the End of a Contour

1. Select the required camera view.
2. Select the required contour in the Test Contents window.
3. Place the cursor at the required end point.
A square is displayed around the point to confirm that it may be selected.
4. Left-click the point and release the mouse button.
5. Proceed as defined in [Drawing a Basic Contour Line](#).

Adding a Point to the Middle of a Contour


1. Select the required camera view.
2. Select the required contour in the Test Contents window.
3. Place the cursor at the line joining the points between which the new point is to be added.
The line changes colour to confirm that it may be selected.
4. Left-click the line and drag the selected point to the required position for the new point.
5. Release the mouse button.
The new point is positioned, the old line is removed and two new lines are drawn to connect the new point to the contour.

Removing a Point

1. Select the required camera view.
2. Select the required contour in the Test Contents window.
3. Place the cursor at the point to be removed.
A circle or square is displayed around the point, depending on its position in the contour, to confirm that it may be selected.
4. Left-click the point and drag it to the next or previous point on the contour, as appropriate.
5. Release the mouse button.
The selected point is removed and the line segments readjusted.
Note: If the selected point is moved to a point several segments away, all the intervening points are removed and replaced by a single segment between the two selected points.

Rotating a Contour

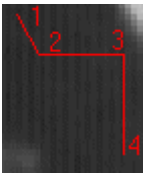
1. Hold down the <Alt> key.

2. Move the mouse to the cross indicating the contour in the image.
The cursor changes to .
3. Press and hold the left mouse button.
4. Move the cursor slowly a little way from the start point.
5. Move the mouse in a clockwise or anti-clockwise direction to rotate the contour to the required position.
During this movement both the old and new positions are shown in the image in different colours.
6. Release the mouse button.
The old contour position is removed and the new one is shown in the original contour colour.

Creating a Loop

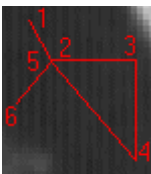
If you require a contour to contain loops, it is best to plan the sequence in which the contour points are drawn because a contour must be a single continuous line. Loops are created by revisiting previous points and retracing previous line segments. The sequence should endeavour to minimise the amount of retracing.

It is assumed that a contour line is being drawn.



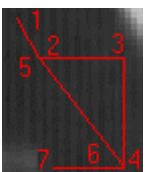
To create a loop by returning to a previous point:

1. Place the cursor at the required end point.
A square is displayed around the point to confirm that it may be selected.
2. Left-click the point and release the mouse button.
3. Move the cursor to the required previous point to create the loop, left-click and release.
4. Proceed as defined in [Drawing a Basic Contour Line](#).
5. Left-click the end point.



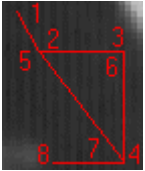
To create a loop by returning to a previous point and then retracing the previous line segment:

1. Place the cursor at the required end point.
A square is displayed around the point to confirm that it may be selected.
2. Left-click the point and release the mouse button.
3. Move the cursor to the required previous point to create the loop, left-click and release.
4. While still in draw mode, move the cursor back to the end point, left-click and release.
5. Proceed as defined in [Drawing a Basic Contour Line](#).
6. Left-click the end point.



Note: If step 4 is performed in drag mode, rather than draw mode, the line just drawn is removed rather than retraced. It is possible to return to the original end point in drag mode, but it has to be done via a different route, as shown below.

1. Place the cursor at the required end point.
A square is displayed around the point to confirm that it may be selected.
2. Left-click the point and release the mouse button.
3. Move the cursor to the required previous point to create the loop, left-click and release.
4. Left-click the current point and drag the cursor along a previously drawn line segment, left-click and release.
5. Repeat the previous step until the starting point in step 1 is reached.
6. Proceed as defined in [Drawing a Basic Contour Line](#).
7. Left-click the end point.



Note: Having retraced a line segment, there are two superimposed lines joining the two points. You may drag either, or both in turn, to a new position, as described in [Adding a Point to the Middle of a Contour](#), thus creating another closed loop. In the above example this may be done between points 2/5 and 3/6, and points 3/6 and 4/7.

Deleting the Contour from the Test Contents Window

1. Right-click on the contour.
A pop-up menu is displayed.
2. Select the Delete option.
A warning message is displayed requesting confirmation.
3. Select the OK button:
The contour is removed from the image and deleted from the Test Contents window.

Controlling the Display of the Contour

1. Right-click on the contour.
A pop-up menu is displayed.
2. Select the Enable option to display the contour in the image.
3. Select the Disable option to remove the contour in the image.
Note: The contour is not deleted from the Test Contents window. Also, the contour definition, i.e. the list of points, is retained.

Clearing the Contour from the Image

1. Right-click on the contour.
A pop-up menu is displayed.
2. Select the Clear option to display the contour in the image.
Note: The contour is not deleted from the Test Contents window, but the contour definition, i.e. the list of points, is discarded. This enables the contour to be redrawn.

Undoing the Last Operation

1. Right-click on the contour.
A pop-up menu is displayed.
2. Select the Undo Last option to display the contour in the image.
The effect of the last operation on the contour is removed.
Note: The undo operation is not recursive, i.e. only the position previous to the last operation is retained.

Maintaining Virtual Point Properties (Optional Feature)

- A Virtual Point is one which position is calculated from the known position of other points in the image, rather than by measurement.
- It is typically associated with a [Point Group](#).
- During tracking, the position of the Virtual Point is calculated from the known positions of the other points in the group.
- If the Virtual Point is added after tracking or the Virtual Point has been moved, it can be recalculated by:
 - Right-clicking on the Virtual Point in the point list and selecting Recalculate All.
 - OR
 - Right-clicking on the Virtual Point in the Camera View window and selecting Recalculate All.
- You may specify a Virtual Point as not being part of a point group, but its position must be specified manually in each tracked image.
- Virtual Points are used in conjunction with contours and point groups. See [Groups, Contours and Virtual Points](#).

Specifying a Virtual Point

It is assumed that a point group has been established into which the virtual point is to be placed.

1. [Add a new point to the Test Contents](#).
2. [Specify the properties of the new point](#), setting the Tracking method to "Virtual".
3. [Mark the position of the new point in the first image to be tracked](#).
4. [Add the new point to the appropriate point group](#).

See Also...

[Point Setup dialog](#)

Presentation



Specifying an XT Diagram

Function

XT diagrams are used to plot a physical distance, speed or acceleration against time. Although it is referred to as an XT diagram, either the x or y dimension can be plotted. In addition, "absolute pixel coordinate/speed/acceleration" can be selected, which plots the hypotenuse from the origin to the point

(x,y), i.e. $\sqrt{(x^2 + y^2)}$.

Procedure

1. To setup the diagram:
 - Select the New/ XT Diagram option from the Diagram menu.
 - OR
 - Click the  tool in the toolbar.

The XT Diagram is displayed.

2. To open the diagram properties dialog:
 - Select the Properties option from the Edit menu.
 - OR
 - Right-click in the diagram and select the Properties option from the pop-up menu.

The XT Diagram Properties dialog is displayed.

The items from the Test Contents window that can be presented in an XT diagram are displayed in a similar structure in the Data Selection list. The items in the Data Selection list can be sorted by Name or Group.

3. Set the diagram properties according to the preferences described below:
 - Open the diagram properties dialog, if not already open.
 - Select appropriate tab (Curves, Text Boxes) or Properties.
 - Set the appropriate diagram properties, the changes will be implemented directly in the diagram.
 - Click the OK button when ready.

Note, an error message telling what is wrong will appear in the diagram if it has been incorrectly specified.

Diagram Properties dialog - Curves tab

4. To add data to the diagram:
 - Optional: The [Section](#) drop box is where you select from which section to add data into diagram. The list in the Data Selection frame will display the data from the selected section only. To be able to add data from any section in test, select <Any> in the section drop box.

Then all data in test will be present in the data selection frame at the same time.

- Select the desired item in the Data Selection frame.
- Select the Add button. The item is transferred to the list of selected items in the Curves frame.

OR

- Enable the Auto Select check box. Then all available data will be added to the diagram at once. The Auto Select function will be disabled automatically if any data is added or removed from the Column list in the Properties dialog.

OR

- Use "Drag-and-drop" (without opening the Properties dialog) simply by dragging the items from the Test Contents window and dropping them in the diagram. It is possible to add points, distances, angles and stick figures to diagram.

5. To remove data from the diagram:

- Select the Remove button.

OR

- Right-click the item and select Remove Selected

The item is transferred to the Data Selection frame.

6. To change colour of any added curve item:

- Right-click the Colour or Alt Colour (representing interpolated points) and select the required colour from the list displayed.

7. To turn on and off the display of the curve before and/or after the current time:

Note: The default is to display for the whole time range.

- To plot the curve before the current time, enable the Show before Now Check box.
- To plot the curve after the current time, enable the Show After Now Check box.

Note: De-selecting both check boxes displays only for the current time. Adjusting the current time with the slider moves these points around the screen.

8. To display Accuracy (if any) of the data selected into the diagram :

- Enable the [Show Accuracy](#) check box.

9. To specify the diagram type:

- Select the required type from the Plot drop-down list.

10. To specify the Plot component:

- Select the required component from the Plot component drop-down list.

Note: The list contains an 'abs. xxxx' option, depending on the nature of the selected item , to enable you to plot its absolute value.

11. To specify the Coordinate system:

- Select the required system from the drop-down list.

The default is the image coordinate system, which has the origin at the lower left corner of the used image. If more than this coordinate system has been set up in the [Scaling/Coordinate Systems setup](#), such can also be used here.

The XT diagram will present the data according to the set coordinate system at all times.

12. To compare two or more curves displayed in the same diagram:


- Enable the Compare Curves check box.
 - Key the required comparison Time, acknowledging the appropriate unit.
- OR
- Select the  button to set the time to t0.
 - Key the required comparison Y value.
 - The curves are adjusted so that they all use the specified Time and Y values as the origin.

Diagram Properties dialog - Text Boxes tab

13. To insert a Text Box into the diagram:

- Click the Add button to get to the [Text Box setup dialog](#).
- When a text box is inserted in the list;
 - Right clicking in the Name column will present a small right click menu from which the properties dialog can be reached or the text box removed.
 - Right clicking in the Colour column will make it possible to change the text colour.
 - Right clicking in the Background column will make it possible to change the background colour.
 - Right clicking in the Border column will make it possible to change the text box border colour.
- Delete a Text box from the list by marking in the list and click Remove.

Diagram Properties dialog - Properties

14. To specify the axes properties:

- Select the Axes button.
- Key appropriate [axes properties](#).

15. To specify the filter properties:

- Select the Filter button.
- Key appropriate [filter properties](#).

16. To specify the general properties:

- Select the General button.
- Key appropriate [general properties](#).

17. To add a corridor from an external file:

- Select the Add Corridor button.

18. To specify corridors known to the system:

- Select the [Corridors](#) button.

Right Click Menu

Note, right clicking the XT diagram will offer fast access to a number of functions:

- [Properties](#)
- [Zoom tool](#)
- [Selection Tool](#)
- [Distance Measurement tool](#)
- [Angle Measurement tool](#)
- Show all - will display the diagram in zoom 1:1.
- [Grid](#)
- [Legends](#)
- [Legends Settings](#)
- [Export Images](#)
- [Print](#) - Prints the diagram.
- [Copy](#) - Copies the diagram to the clipboard.
- [Paste](#) - Pastes the selected data into any appropriate application.
- Create Diagram Copy - Creates an editable copy of the existing diagram, any changes as described above can be made without changing the original diagram.
- [Copy to Time Table](#) - Creates a copy of the contents of the current diagram, showing selected data in table form.

See also..

[Multi Axis Diagram](#)

[XY Diagram](#)

[Advanced Diagram](#)

[3D Diagram](#)

[Image Diagram](#)

[Frequency Analysis Diagram](#)

[Managing Diagrams via Test Contents](#)



Multi Axis Diagram

Function

Multi Axis diagrams are similar to [XT diagrams](#) except that up to four different Y axes can be selected, i. e. up to four different plots can be displayed in the same diagram. For example, the x, y and "absolute pixel coordinate" values can be displayed in the same diagram.

Procedure

1. To setup the diagram:

- Select the New/ Multi Axis Diagram option from the Diagram menu.
- OR
- Click the  tool in the toolbar.

The Multi Axis Diagram is displayed.

2. To open the diagram properties dialog:

- Select the Properties option from the Edit menu.
- OR
- Right-click in the diagram and select the Properties option from the pop-up menu.

The Multi Axis Diagram Properties dialog is displayed.

The items from the Test Contents window that can be presented in an Multi Axis diagram are displayed in a similar structure in the Data Selection list. The items in the Data Selection list can be sorted by Name or Group.

Note. This dialog is the same as the XT Diagram equivalent except that the Curves frame contains four tabs, one for each of the possible Y axes. Each tab contains the same information as the Curves frame in the XT Diagram equivalent.

3. Set the diagram properties according to the preferences described below:

- Open the diagram properties dialog, if not already open.
- Select appropriate tab (Curves, Text Boxes) or Properties.
- For each required Y axis, select the appropriate Y-Axis tab.
- Set the appropriate diagram properties, the changes will be implemented directly in the diagram.
- Click the OK button when ready.

Note, an error message telling what is wrong will appear in the diagram if it has been incorrectly specified.

Diagram Properties dialog - Curves tab

4. To add data to the diagram:

- Optional: The [Section](#) drop box is where you select from which section to add data into diagram. The list in the Data Selection frame will display the data from the selected section only. To be able to add data from any section in test, select <Any> in the section drop box. Then all data in test will be present in the data selection frame at the same time.

- Select the item in the Data Selection frame.
 - Select the Add button. The item is transferred to the list of selected items in the Curves frame.
- OR
- Enable the Auto Select check box. Then all available data will be added to the diagram at once. The Auto Select function will be disabled automatically if any data is added or removed from the Column list in the Properties dialog.
- OR
- Use "Drag-and-drop" (without opening the Properties dialog) simply by dragging the items from the Test Contents window and dropping them in the diagram. It is possible to add points, distances, angles and stick figures to diagram.

5. To remove an item from the diagram:

- Select the Remove button.
- OR
- Right-click the item and select Remove Selected.

The item is transferred to the Data Selection frame.

6. To change colour of any added curve item:

- Right-click the Colour or Alt Colour (representing interpolated points) and select the required colour from the list displayed.

7. To turn on and off the display of the curve before and/or after the current time:

Note: The default is to display for the whole time range.

- To plot the curve before the current time, enable the Show before Now Check box.
- To plot the curve after the current time, enable the Show After Now Check box.

Note: De-selecting both check boxes displays only for the current time. Adjusting the current time with the slider moves these points around the screen.

8. To display Accuracy (if any) of the data selected into the diagram :

- Enable the [Show Accuracy](#) check box.

9. To specify the diagram type:

- Select the required type from the Plot drop-down list.

10. To specify the Plot component:

- Select the required component from the Plot component drop-down list.

Note: The list contains an 'abs. xxxx' option, depending on the nature of the selected item , to enable you to plot its [absolute value](#).

11. To specify the Coordinate system:

- Select the required system from the drop-down list.

The default is the image coordinate system, which has the origin at the lower left corner of the used image. If more than this coordinate system has been set up in the [Scaling/Coordinate Systems setup](#), such can also be used here.

The XT diagram will present the data according to the set c oordinate system at all times.

12. To compare two or more curves displayed in the same diagram:


- Enable the Compare Curves check box.
 - Key the required comparison Time, acknowledging the appropriate unit.
- OR
- Select the  button to set the time to t0.
 - Key the required comparison Y value.
 - The curves are adjusted so that they all use the specified Time and Y values as the origin.

Diagram Properties dialog - Text Boxes tab

13. To insert a Text Box into the diagram:

- Click the Add button to get to the [Text Box setup dialog](#).
- When a text box is inserted in the list;
 - Right clicking in the Name column will present a small right click menu from which the properties dialog can be reached or the text box removed.
 - Right clicking in the Colour column will make it possible to change the text colour.
 - Right clicking in the Background column will make it possible to change the background colour.
 - Right clicking in the Border column will make it possible to change the text box border colour.
- Delete a Text box from the list by marking in the list and click Remove.

Diagram Properties dialog - Properties

14. To specify the axes properties:

- Select the Axes button.
- Key appropriate [axes properties](#).

15. To specify the filter properties:

- Select the Filter button.
- Key appropriate [filter properties](#).

16. To specify the general properties:

- Select the General button.
- Key appropriate [general properties](#).

17. To add a corridor from an external file:

- Select the Add Corridor button.

18. To specify corridors known to the system:

- Select the [Corridors](#) button.

Right Click Menu

Note, right clicking the Multi Axis Diagram will offer fast access to a number of functions:

- [Properties](#)
- [Zoom tool](#)
- [Selection Tool](#)
- [Distance Measurement tool](#)
- [Angle Measurement tool](#)
- Show all - will display the diagram in zoom 1:1.
- [Grid](#)
- [Legends](#)
- [Legends Settings](#)
- [Export Images](#)
- [Print](#) - Prints the diagram.
- [Copy](#) - Copies the diagram to the clipboard.
- [Paste](#) - Pastes the selected data into any appropriate application.
- Create Diagram Copy - Creates an editable copy of the existing diagram, any changes as described above can be made without changing the original diagram.
- [Copy to Time Table](#) - Creates a copy of the contents of the current diagram, showing selected data in table form.

See also..

[XT Diagram](#)

[XY Diagram](#)

[Advanced Diagram](#)

[3D Diagram](#)

[Image Diagram](#)

[Frequency Analysis Diagram](#)



[Managing Diagrams via Test Contents](#)

Specifying an XY Diagram

Function

XY diagrams are similar to [XT diagrams](#) except that time is not used as the default dimension on the x-axis, i.e. the x-axis can be specified in the same way as the y-axis in XT diagram. For example, for a point or group of points, the x-direction acceleration can be plotted against the y-direction acceleration. The results from an [airbag \(outline\) tracker](#) can also be displayed here.

Procedure

1. To setup the diagram:
 - Select the New/ XY Diagram option from the Diagram menu.
 - OR
 - Click the  tool in the toolbar.

The XY Diagram is displayed.

2. To open the diagram properties dialog:
 - Select the Properties option from the Edit menu.
 - OR
 - Right-click in the diagram and select the Properties option from the pop-up menu.

The XY Diagram Properties dialog is displayed.

The items from the Test Contents window that can be presented in an XY diagram are displayed in a similar structure in the Data Selection list. The items in the Data Selection list can be sorted by Name or Group.

3. Set the diagram properties according to the preferences described below:
 - Open the diagram properties dialog, if not already open.
 - Select appropriate tab (Curves, Visualizers, Text Boxes) or Properties.
 - Set the appropriate diagram properties, the changes will be implemented directly in the diagram.
 - Click the OK button when ready.

Note: an error message telling what is wrong will appear in the diagram if it has been incorrectly specified.

Diagram Properties dialog - Curves tab

4. To add data to the diagram:
 - Optional: The [Section](#) drop box is where you select from which section to add data into diagram. The list in the Data Selection frame will display the data from the selected section only. To be able to add data from any section in test, select <Any> in the section drop box. Then all data in test will be present in the data selection frame at the same time.
 - Select the item in the Data Selection frame.
 - Select the Add button. The item is transferred to the list of selected items in the Curves frame.

OR

- Enable the Auto Select check box. Then all available data will be added to the diagram at once. The Auto Select function will be disabled automatically if any data is added or removed from the Column list in the Properties dialog.

OR

- Use "Drag-and-drop" (without opening the Properties dialog) simply by dragging the items from the Test Contents window and dropping them in the diagram. It is possible to add points, distances, angles and stick figures to diagram.

5. To remove data from the diagram:

- Select the Remove button.

OR

- Right-click the item and select Remove Selected.

The item is transferred to the Data Selection frame.

6. To change colour of any added curve item:

- Right-click the Colour or Alt Colour (representing interpolated points) and select the required colour from the list displayed.

7. To turn on and off the display of the curve before and/or after the current time:

Note: The default is to display for the whole time range.

- To plot the curve before the current time, enable the Show before Now Check box.
- To plot the curve after the current time, enable the Show After Now Check box.

Note: De-selecting both check boxes displays only for the current time. Adjusting the current time with the slider moves these points around the screen.

8. To display Accuracy (if any) of the data selected into the diagram :

- Enable the [Show Accuracy](#) check box.

9. To specify the type of data to be displayed on the x axis:

- Select the required type from the X list.

Note: This selection automatically changes the entries in the X comp list.

10. To specify the type of data to be displayed on the y axis:

- Select the required type from the Y list.

Note: This selection can automatically change the entries in the Y comp list.

11. To specify the Coordinate system:

- Select the required system from the drop-down list.

The default is the image coordinate system, which has the origin at the lower left corner of the used image. If more than this coordinate system has been set up in the [Scaling/Coordinate Systems setup](#), such can also be used here.

The XY diagram will present the data according to the set c coordinate system at all times.

Diagram Properties dialog - Visualizers tab

12. Select the [Visualizers](#) tab to display the appearance of the [airbag tracker](#).
13. Repeat the same procedure as for the Curves tab.

The differences are:

- The Alt Colour column does not apply.
- The Filter column does not apply.
- The Accuracy does not apply.
- The X and Y lists are not displayed.
- The frame frequency may be specified in several ways in order to select which time frames are displayed. The options are:
 - "With Skip" - displays frames at the specified interval.
 - "At current time" - displays frames at current time.
 - "All" - displays all frames.
 - "Dense" - displays a high density of frames, based on position density not time.
 - "Normal" - displays a medium density of frames, based on position density not time.
 - "Sparse" - displays a low density of frames, based on position density not time.

14. To specify the selected X component:

- Select the required component from the X comp list.

15. To specify the selected Y component:

- Select the required component from the Y comp list.

Diagram Properties dialog - Text Boxes tab

16. To insert a Text Box into the diagram:

- Click the Add button to get to the [Text Box setup dialog](#).
- When a text box is inserted in the list;
 - Right clicking in the Name column will present a small right click menu from which the properties dialog can be reached or the text box removed.
 - Right clicking in the Colour column will make it possible to change the text colour.
 - Right clicking in the Background column will make it possible to change the background colour.
 - Right clicking in the Border column will make it possible to change the text box border colour.
- Delete a Text box from the list by marking in the list and click Remove.

Diagram Properties dialog - Properties

17. To specify the axes properties:

- Select the Axes button.
- Key appropriate [axes properties](#).

18. To specify the filter properties:

- Select the Filter button.
- Key appropriate [filter properties](#).

19. To specify the general properties:

- Select the General button.

- Key appropriate [general properties](#).
20. To add a corridor from an external file:
- Select the Add Corridor button.
21. To specify corridors known to the system:
- Select the [Corridors](#) button.

Right Click Menu

Note, right clicking the XY diagram will offer fast access to a number of functions:

- [Properties](#)
- [Zoom tool](#)
- [Selection Tool](#)
- [Distance Measurement tool](#)
- [Angle Measurement tool](#)
- Show all - will display the diagram in zoom 1:1.
- [Grid](#)
- [Legends](#)
- [Legends Settings](#)
- [Export Images](#)
- [Print](#) - Prints the diagram.
- [Copy](#) - Copies the diagram to the clipboard.
- [Paste](#) - Pastes the selected data into any appropriate application.
- Create Diagram Copy - Creates an editable copy of the existing diagram, any changes as described above can be made without changing the original diagram.
- [Copy to Time Table](#) - Creates a copy of the contents of the current diagram, showing selected data in table form.

See also..



- [XT Diagram](#)
- [Multi Axis Diagram](#)
- [Advanced Diagram](#)
- [3D Diagram](#)
- [Image Diagram](#)
- [Frequency Analysis Diagram](#)
- [Managing Diagrams via Test Contents](#)

Specifying an Advanced Diagram

Function

Advanced diagrams are similar to [XY diagrams](#) except that data from different sequences can be plotted in the same diagram.

Procedure

1. To setup the diagram:
 - Select the New/ Advanced Diagram option from the Diagram menu.
 - OR
 - Click the  tool in the toolbar.

The Advanced Diagram is displayed.

2. To open the diagram properties dialog:
 - Select the Properties option from the Edit menu.
 - OR
 - Right-click in the diagram and select the Properties option from the pop-up menu.

The Advanced Diagram Properties dialog is displayed.

The items from the Test Contents window that can be presented in an Advanced diagram are displayed in a similar structure in the Data Selection list. The items in the Data Selection list can be sorted by Name or Group.

3. Set the diagram properties according to the preferences described below:
 - Open the diagram properties dialog, if not already open.
 - Select appropriate tab (Curves, Text Boxes) or Properties.
 - Set the appropriate diagram properties, the changes will be implemented directly in the diagram.
 - Click the OK button when ready.

Note: an error message telling what is wrong will appear in the diagram if it has been incorrectly specified.

Diagram Properties dialog - Curves tab

4. To add data to the diagram:
 - Optional: The [Section](#) drop box is where you select from which section to add data into diagram. The list in the Data Selection frame will display the data from the selected section only. To be able to add data from any section in test, select <Any> in the section drop box. Then all data in test will be present in the data selection frame at the same time.
 - Select the item in the Data Selection frame.
 - Select the Add button. The item is transferred to the list of selected items in the Plot frame.
 - OR
 - Use "Drag-and-drop" (without opening the Properties dialog) simply by dragging the items from the Test Contents window and dropping them in the diagram. It is possible to add

points, distances, angles and stick figures to diagram.

5. To remove data from the diagram:

- Select the Remove button.

OR

- Right-click the item and select Remove Selected.

The item is transferred to the Data Selection frame.

6. To change colour of any added curve item:

- Right-click the Colour or Alt Colour (representing interpolated points) and select the required colour from the list displayed.

7. To turn on and off the display of the curve before and/or after the current time:

Note: The default is to display for the whole time range.

- To plot the curve before the current time, enable the Show before Now Check box.
- To plot the curve after the current time, enable the Show After Now Check box.

Note: De-selecting both check boxes displays only for the current time. Adjusting the current time with the slider moves these points around the screen.

8. To display Accuracy (if any) of the data selected into the diagram :

- Enable the [Show Accuracy](#) check box.

9. To specify the diagram components:

- Amend the entries in the Plot frame.

Note: Certain amendments that you might make may prevent particular items from being displayed in the diagram. A typical example of this is when the selected X Plot or Y Plot entry for an item, e.g. acceleration, does not apply to another item, e.g. if velocity has been selected for it. Items that can be displayed automatically are indicated with by a green tick in the OK column, whereas those that cannot are indicated with by a red cross.

- The Plot table has the following columns that may be amended as follows:

- OK - Right-click and select:

- Draw - to force the selected item to be drawn in the diagram when it normally would not be displayed. The axis is amended accordingly.
- Remove selected - to remove the item from the diagram.

- X View - Right-click and select:

- Draw - to force the selected item to be drawn in the diagram when it normally would not be displayed. The axis is amended accordingly.
- Remove selected - to remove the item from the diagram.

- X Point - Right-click and select:

- Select Point to display the Select X Point dialog from which another item can be selected from the Test Contents window.

- X Plot - Right-click and select the plot from the list:

- e.g. pixel coordinates.
- e.g. pixel velocity.
- e.g. pixel acceleration.

- X Comp - Right-click and select the component from the list:

- e.g. x.

- e.g. y.
- Note.* The list contains an 'abs. xxxx' option, depending on the nature of the selected item, to enable you to plot its [absolute value](#).
- Y View - Right-click and select:
 - Draw - to force the selected item to be drawn in the diagram when it normally would not be displayed. The axis is amended accordingly.
 - Remove selected - to remove the item from the diagram.
- Y Point - Right-click and select:
 - Select Point to display the Select Y Point dialog from which another item can be selected from the Test Contents window.
- Y Plot - Right-click and select the plot from the list:
 - e.g. 2D pixel coordinates.
 - e.g. pixel velocity.
 - e.g. pixel acceleration.
- Y Comp - Right-click and select the component from the list:
 - e.g. x.
 - e.g. y.*Note.* The list contains an 'abs. xxxx' option, depending on the nature of the selected item, to enable you to plot its [absolute value](#).
- Colour - Right-click and select the required colour from the list displayed.
- Alt Colour - Right-click and select the required colour from the list displayed.
- Filter - Select the check box to apply the selected filter to this item .

10. To specify the Coordinate system:

- Select the required system from the drop-down list.

The default is the image coordinate system, which has the origin at the lower left corner of the used image. If more than this coordinate system has been set up in the [Scaling/Coordinate Systems setup](#), such can also be used here.

The Advanced diagram will present the data according to the set coordinate system at all times.

Diagram Properties dialog - Text Boxes tab

11. To insert a Text Box into the diagram :

- Click the Add button to get to the [Text Box setup dialog](#).
- When a text box is inserted in the list;
 - Right clicking in the Name column will present a small right click menu from which the properties dialog can be reached or the text box removed.
 - Right clicking in the Colour column will make it possible to change the text colour.
 - Right clicking in the Background column will make it possible to change the background colour.
 - Right clicking in the Border column will make it possible to change the text box border colour.
- Delete a Text box from the list by marking in the list and click Remove.

Diagram Properties dialog - Properties

12. To specify the axes properties:

- Select the Axes button.
- Key appropriate [axes properties](#).

13. To specify the filter properties:
 - Select the Filter button.
 - Key appropriate [filter properties](#).
14. To specify the general properties:
 - Select the General button.
 - Key appropriate [general properties](#).
15. To add a corridor from an external file:
 - Select the Add Corridor button.
16. To specify corridors known to the system:
 - Select the [Corridors](#) button.

Right Click Menu

Note, right clicking the Advanced diagram will offer fast access to a number of functions:

- [Properties](#)
- [Zoom tool](#)
- [Selection Tool](#)
- [Distance Measurement tool](#)
- [Angle Measurement tool](#)
- Show all - will display the diagram in zoom 1:1.
- [Grid](#)
- [Legends](#)
- [Legends Settings](#)
- [Export Images](#)
- [Print](#) - Prints the diagram.
- [Copy](#) - Copies the diagram to the clipboard.
- [Paste](#) - Pastes the selected data into any appropriate application.
- Create Diagram Copy - Creates an editable copy of the existing diagram, any changes as described above can be made without changing the original diagram.
- [Copy to Time Table](#) - Creates a copy of the contents of the current diagram, showing selected data in table form.

See also..

[XT Diagram](#)

[Multi Axis Diagram](#)

[XY Diagram](#)

[3D Diagram](#)

[Image Diagram](#)

[Frequency Analysis Diagram](#)

[Managing Diagrams via Test Contents](#)



3D Diagram

Function

3D diagrams are used to display [3D](#) data in a rotatable 3 axis diagram.

Procedure

1. To setup the diagram:

- Select the New/ 3D Diagram option from the Diagram menu.
OR
- Click the  tool in the toolbar.

The 3D Diagram is displayed.

2. To open the diagram properties dialog:

- Select the Properties option from the Edit menu.
OR
- Right-click in the diagram and select the Properties option from the pop-up menu.

The 3D Diagram Properties dialog is displayed.

The items from the Test Contents window that can be presented in an 3D diagram are displayed in a similar structure in the Data Selection list. The items in the Data Selection list can be sorted by Name or Group.

3. Set the diagram properties according to the preferences described below:

- Open the diagram properties dialog, if not already open.
- Select appropriate tab (Curves, Visualizers, Text Boxes) or Properties.
- Set the appropriate diagram properties, the changes will be implemented directly in the diagram.
- Click the OK button when ready.

Note, an error message telling what is wrong will appear in the diagram if it has been incorrectly specified.

Diagram Properties dialog - Curves tab

4. To add data to the diagram:

- Optional: The [Section](#) drop box is where you select from which section to add data into diagram. The list in the Data Selection frame will display the data from the selected section only. To be able to add data from any section in test, select <Any> in the section drop box. Then all data in test will be present in the data selection frame at the same time.
- Select the desired item in the Data Selection frame.
- Select the Add button. The item is transferred to the list of selected items in the Curves frame.
OR
- Enable the Auto Select check box. Then all available data will be added to the diagram at once. The Auto Select function will be disabled automatically if any data is added or removed

from the Column list in the Properties dialog.

OR

- Use "Drag-and-drop" (without opening the Properties dialog) simply by dragging the items from the Test Contents window and dropping them in the diagram. It is possible to add points, distances, angles and stick figures to diagram.

5. To remove data from the diagram:

- Select the Remove button.

OR

- Right-click the item and select Remove Selected.

The item is transferred to the Data Selection frame.

6. To change colour of any added curve item:

- Right-click the Colour or Alt Colour (representing interpolated points) and select the required colour from the list displayed.

7. To turn on and off the display of the curve before and/or after the current time:

Note: The default is to display for the whole time range.

- To plot the curve before the current time, enable the Show before Now Check box.
- To plot the curve after the current time, enable the Show After Now Check box.

Note: De-selecting both check boxes displays only for the current time. Adjusting the current time with the slider moves these points around the screen.

8. To display Accuracy (if any) of the data selected into the diagram :

- Enable the [Show Accuracy](#) check box.

In 3D, this will be shown as spheres.

9. To specify the Coordinate system:

- Select the required system from the drop-down list.

The default is the image coordinate system, which has the origin at the lower left corner of the used image. If more than this coordinate system has been set up in the Scaling/Coordinate Systems setup, such can also be used here.

The 3D diagram will present the data according to the set coordinate system at all times.

Diagram Properties dialog - Visualizers tab

10. Select the Visualizers tab to display the appearance of the stick figures, distances, angles and axes in the 3D diagram.

11. Repeat the same procedure as for the Curves tab.

The differences are:

- The Alt Colour column does not apply.
- The Filter column does not apply.
- The Accuracy does not apply.
- The frame frequency may be specified in several ways in order to select which time frames are displayed. The options are:
 - "With Skip" - displays frames at the specified interval.
 - "At current time" - displays frames at current time.

- "All" - displays all frames.
- "Dense" - displays a high density of frames, based on position density not time.
- "Normal" - displays a medium density of frames, based on position density not time.
- "Sparse" - displays a low density of frames, based on position density not time.

Diagram Properties dialog - Text Boxes tab

12. To insert a Text Box into the diagram :

- Click the Add button to get to the Text Box setup dialog.
- When a text box is inserted in the list;
 - Right clicking in the Name column will present a small right click menu from which the properties dialog can be reached or the text box removed.
 - Right clicking in the Colour column will make it possible to change the text colour.
 - Right clicking in the Background column will make it possible to change the background colour.
 - Right clicking in the Border column will make it possible to change the text box border colour.
- Delete a Text box from the list by marking in the list and click Remove.

Diagram Properties dialog - Properties

13. To specify the axes properties:

- Select the Axes button.
- Key appropriate axes properties.

14. To specify the filter properties:

- Select the Filter button.
- Key appropriate filter properties.

15. To specify the general properties:

- Select the General button.
- Key appropriate general properties.

Rotation tool / Select tool

When the 3D diagram is set up;

16. Dragging the mouse pointer over the 3D diagram area, will activate the rotate tool. With the use of this, the 3D diagram can be rotated and viewed from any desired angle. Holding the left mouse button while dragging will enable the tool. To rotate the camera around its horizontal- and up vector, drag the mouse while holding the left mouse button. To rotate the camera around its forward (principal) vector, hold shift while rotating.
17. The mouse scroll wheel is used to zoom in and out in diagram.
When the select tool is active, double clicking a curve will make the 3D box to enclose only the part of the curve(s) visible in the current zoom view. To get back to normal mode, right click the diagram and select Show All.
18. When middle mouse button or when left mouse button and ctrl is pressed at the same time the panning tool is activated enabling the user to move the position of the diagram in the window and can also be used if the user wants to zoom in on different parts of the diagram. Panning will be restored to its original position when zoom in/out using right click or normal menu or toolbar

item, or when Go to Default, X-Y, ...

19. Position the pointer on or close to a plotted curve to make the Rotate tool automatically change to the [Select Tool](#) in order to display the curve coordinates. At any time, the pointer can be moved away from the curve to reactivate the rotate tool again.
20. When the select tool is active, double clicking a curve will make the 3D box to enclose only the part of the curve(s) visible in the current zoom view. To get back to normal mode, right click the diagram and select Show All.

Right Click Menu

Note, right clicking the 3D diagram will offer fast access to a number of functions:

- [Properties](#) - Goes to the diagram setup.
- Show All - Puts the zoom mode back in normal view in order to show all data in diagram .
- Camera - Presets perspectives for reviewing data in diagram a suitable overview perspective (Default) or any of the base planes:
 - Go to Default.
 - Go to X-Y Plane.
 - Go to X-Z Plane.
 - Go to Y-Z Plane.
- Curtains - It is possible to draw curtains to the plotted curves in the 3D diagram .
- Curtain settings - To orient the curtain, a Curtain Plane has to be defined. The curtain is an orthogonal projection on the defined curtain plane. This feature is an excellent tool for reading the diagram axes without having to use the rotation tool. Therefore, it should always be enabled on printouts and screen shots.
- Arrow Settings
 - Show - Shows or hides the x-,y- and z-axis.
 - Colour - To change the colour of the x-,y- and z-axis.
- [Grid](#)
- [Legends](#)
- [Legends Settings](#)
- [Export Images](#)
- [Print](#) - Prints the diagram.
- [Copy](#) - Copies the diagram to the clipboard.
- [Paste](#) - Pastes the selected data into any appropriate application.
- Create Diagram Copy - Creates an editable copy of the existing diagram, any changes as described above can be made without changing the original diagram.
- [Copy to Time Table](#) - Creates a copy of the contents of the current diagram , showing selected data in table form.

See also..

[XT Diagram](#)

[Multi Axis Diagram](#)

[XY Diagram](#)

[Advanced Diagram](#)

[Image Diagram](#)

[Frequency Analysis Diagram](#)

[Managing Diagrams via Test Contents](#)



Image Diagram

Function

Image diagrams in TEMA are a mixture between XY and camera view windows - a plotted curve can be superimposed on the image. Using [Image Merge](#), several image sequences can be displayed in one image diagram simultaneously.

Procedure

1. To setup the diagram:

- Select the New/  Image Diagram option from the Diagram menu.
OR
- Click the  tool in the toolbar.

The Image Diagram is displayed.

2. To open the diagram properties dialog:

- Select the Properties option from the Edit menu.
OR
- Right-click in the diagram and select the Properties option from the pop-up menu.

The Image Diagram Properties dialog is displayed.

The camera views from the Test Contents are listed in the Data Selection list together with the corresponding image sequences. The items in the Data Selection list can be sorted by Name or Group.

3. Set the diagram properties according to the preferences described below:

- Open the diagram properties dialog, if not already open.
- Select appropriate tab (Images, Curves, Visualizers, Text Boxes) or Properties.
- Set the appropriate diagram properties, the changes will be implemented directly in the diagram.
Note, an error message telling what is wrong will appear in the diagram if it has been incorrectly specified.

4. To specify the Coordinate system:

- Select the required system from the drop-down list.

The default is the image coordinate system, which has the origin at the lower left corner of the used image. If more than this coordinate system has been set up in the [Scaling/Coordinate Systems setup](#), such can also be used here.

The Image diagram will present the data according to the set coordinate system at all times.

5. To correct for image distortion (Optional):

- Enable Lens Correction.
Note, only possible if the Camera Parameter Correct Lens Distortion is enabled in the camera View Properties.

- Enable Inscribed, to inscribe/circumscribe the image.
6. Click the OK button when ready.

Diagram Properties dialog - Images tab

7. To add an Image sequence to the diagram:
- Select the item in the Data Selection frame.
 - Select the Add button.
 - The image is transferred to the list of selected items in the Images frame. At the same time, the first sample of the image sequence can be seen in the image diagram window.
8. To display a [merged image](#), i.e two image sequences displayed in the diagram:
- Repeat the procedure "To add an Image sequence".
 - Click the [Align](#) button.
9. To remove an Image sequence from the diagram:
- Select the Remove button.
- OR
- Right-click the item and select Remove Selected.

The item is transferred to the Data Selection frame.

Diagram Properties dialog - Curves tab

10. To add a Curve, superimposed on the image:
- Optional: The [Section](#) drop box is where you select from which section to add data into diagram. The list in the Data Selection frame will display the data from the selected section only. To be able to add data from any section in test, select <Any> in the section drop box. Then all data in test will be present in the data selection frame at the same time.
 - Select the item in the Data Selection frame.
 - Select the Add button. The item is transferred to the list of selected items in the Curves frame.
- OR
- Enable the Auto Select check box. Then all available data will be added to the diagram at once. The Auto Select function will be disabled automatically if any data is added or removed from the Column list in the Properties dialog.
- OR
- Use "Drag-and-drop" (without opening the Properties dialog) simply by dragging the items from the Test Contents window and dropping them in the diagram. It is possible to add points, distances, angles and stick figures to diagram.
11. To remove data from the diagram:
- Select the Remove button.
- OR
- Right-click the item and select Remove Selected.

The item is transferred to the Data Selection frame.

12. To change colour of any added curve item:

- Right-click the Colour or Alt Colour (representing interpolated points) and select the required colour from the list displayed.
13. To turn on and off the display of the curve before and/or after the current time:
Note. The default is to display for the whole time range.
- To plot the curve before the current time, enable the Show before Now Check box.
 - To plot the curve after the current time, enable the Show After Now Check box.
- Note.* De-selecting both check boxes displays only for the current time. Adjusting the current time with the slider moves these points around the screen.
14. To display Accuracy (if any) of the data selected into the diagram :
- Enable the [Show Accuracy](#) check box.

Diagram Properties dialog - Visualizers tab

15. Select the Visualizers tab to display the appearance of Visualizers (for example the [airbag_tracker](#)).
16. Repeat the same procedure as for the Curves tab.

The differences are:

- The Alt Colour column does not apply.
- The Filter column does not apply.
- The Accuracy does not apply.
- The frame frequency may be specified in several ways in order to select which time frames are displayed. The options are:
 - "With Skip" - displays frames at the specified interval.
 - "At current time" - displays frames at current time.
 - "All" - displays all frames.
 - "Dense" - displays a high density of frames, based on position density not time.
 - "Normal" - displays a medium density of frames, based on position density not time.
 - "Sparse" - displays a low density of frames, based on position density not time.

Diagram Properties dialog - Text Boxes tab

17. To insert a Text Box into the diagram :
- Click the Add button to get to the [Text Box setup dialog](#).
 - When a text box is inserted in the list;
 - Right clicking in the Name column will present a small right click menu from which the properties dialog can be reached or the text box removed.
 - Right clicking in the Colour column will make it possible to change the text colour.
 - Right clicking in the Background column will make it possible to change the background colour.
 - Right clicking in the Border column will make it possible to change the text box border colour.
 - Delete a Text box from the list by marking in the list and click Remove.

Diagram Properties dialog - Properties

18. To specify the axes properties:
- Select the Axes button.

- Key appropriate [axes properties](#).
19. To specify the filter properties:
- Select the Filter button.
 - Key appropriate [filter properties](#).
20. To specify the general properties:
- Select the General button.
 - Key appropriate [general properties](#).
21. To add a corridor from an external file:
- Select the Add Corridor button.
22. To specify corridors known to the system:
- Select the [Corridors](#) button.
23. To merge images in the diagram:
- Click the [Align](#) button.

Right Click Menu

Note, right clicking the Image diagram will offer fast access to a number of functions besides the Properties described above;

- [Properties](#)
- [Zoom tool](#)
- [Selection Tool](#)
- [Distance Measurement tool](#)
- [Angle Measurement tool](#)
- Show all - will display the diagram in zoom 1:1.
- [Legends](#)
- [Legends Settings](#)
- [Export Images](#)
- [Print](#) - Prints the diagram.
- [Copy](#) - Copies the diagram to the clipboard.
- [Paste](#) - Pastes the selected data into any appropriate application.
- Create Diagram Copy - Creates an editable copy of the existing diagram, any changes as described above can be made without changing the original diagram.
- [Copy to Time Table](#) - Creates a copy of the contents of the current diagram, showing selected data in table form.

See also..

[XT Diagram](#)
[Multi Axis Diagram](#)
[XY Diagram](#)
[Advanced Diagram](#)
[3D Diagram](#)

[Frequency Analysis Diagram](#)
[Managing Diagrams via Test Contents](#)

Image Merge

Function

The function enables simultaneous display of two image sequences in the same [image diagram](#). This prerequisites that a 2D coordinate transformation is done.

By a graphical [Align](#) interface, this is easily done. By the help of this, an image sequence is oriented and scaled versus another.

In the image diagram, the image merging can be displayed in three ways;

- **Overlay** - added images are placed on top of each other and are non-transparent. The order of the images is defined when adding the images into diagram.
- **Blend** - the added images are blended into each other, resulting in a mixture of the images in diagram. Every pixel in the resulting image is an average of the two contained images.
- **Interlace** - the added images are interlaced into each other. The (horizontal) scan lines in each contained image are mixed subsequently. Thus, the resulting image has its scan lines as taken from the contained images in order.

After the image merging, tracked points in any of the image sequences can be superimposed on the merged image in diagram.

Procedure

The following prerequisites that steps 1-3 in [the image diagram setup](#) have been completed.

1. Add a second image sequence into the image diagram. This will make the Align button to the right to be enlighten. Below the list of added image sequences is the [Coordinate System](#) combo box. This will tell which coordinate system that is used. This is always that of the first image in the images list. Thus, the second image will be oriented in this also. To change the coordinate system to that of the second image sequence, remove both sequences and add them again in reverse order (double click in left list will add a sequence to diagram).
2. Click the Align button. This will make the [Aligned Coordinate Systems](#) dialog to appear. In this, define the coordinate system transformation for the desired orientation of the images to merge.
3. In the list of image sequences, right click the second image sequence and select Properties. This will make the Image Merge Properties dialog to appear. In this, select the merge method; Overlay, Blend or Interlace (as described above). The selected method will be stated in the images list.
4. Set Image Tint to use a color marking; values below zero will mark any field in primary image that is darker than the second with a yellow color and blue color for fields lighter. Values above zero will result in the opposite colors. The tint color marking will be active even though Overlay merge (non transparent images) is used. The tint value will be stated in the images list also.
5. If desired, [add tracker data](#) (if any) just like in any image diagram, click the curves tab and add curves.

See also..

[Image Diagram](#)
[Scaling and Coordinate Systems](#)

Specifying an Frequency Analysis Diagram

Function

The Frequency Analysis function analyzes a signal (such as tracked coordinates, a computed angle, or imported measurement data) and plots a curve that shows the signal's relative strength at different frequencies. This curve is called an amplitude spectrum. For multi-dimensional data (such as position coordinates) a separate spectrum is calculated for each component, as well as for the absolute value of the quantity.



The frequency analysis function appears as a special kind of diagram called a Frequency Analysis diagram. Such diagrams can be added from the Diagram menu in the main window, or by pressing a button on the Data toolbar. Adding a new Frequency Analysis diagram will open a new, empty diagram.

The setup dialog for the Frequency Analysis diagram is very similar to that of the XT or XY diagrams, with the following differences:

- * The X axis will always display frequency so there is no choice of X component.
- * The checkboxes for "show before now" and "show after now" are absent as the spectrum is always computed for the entire time span of the data.
- * It is possible to mix different kinds of data in a more flexible way than for the other diagrams. For example, you can show the spectrum of an angle and a position in the same diagram.

Note: The spectrum will never contain any frequency higher than half the sampling frequency of the input data. For example, if the image frequency is 1000 Hz, the spectrum ends at 500 Hz. This is a fundamental mathematical property of sampled signals known as the sampling theorem (see any textbook on signals processing, or Wikipedia).

Procedure

4. To setup the diagram:
 - Select the New/  Frequency Analysis Diagram option from the Diagram menu.
OR
 - Click the  tool in the toolbar.

The Frequency Analysis Diagram is displayed.

2. To open the diagram properties dialog:
 - Select the Properties option from the Edit menu.
OR

- Right-click in the diagram and select the Properties option from the pop-up menu.

The Frequency Analysis Diagram Properties dialog is displayed.

The items from the Test Contents window that can be presented in an Frequency Analysis diagram are displayed in a similar structure in the Data Selection list. The items in the Data Selection list can be sorted by Name or Group.

3. Set the diagram properties according to the preferences described below:

- Open the diagram properties dialog, if not already open.
- Select appropriate tab (Curves, Text Boxes) or Properties.
- Set the appropriate diagram properties, the changes will be implemented directly in the diagram.
- Click the OK button when ready.

Note, an error message telling what is wrong will appear in the diagram if it has been incorrectly specified.

Diagram Properties dialog - Curves tab

4. To add data to the diagram:

- Optional: The [Section](#) drop box is where you select from which section to add data into diagram. The list in the Data Selection frame will display the data from the selected section only. To be able to add data from any section in test, select <Any> in the section drop box. Then all data in test will be present in the data selection frame at the same time.

- Select the desired item in the Data Selection frame.
- Select the Add button. The item is transferred to the list of selected items in the Curves frame.

OR

- Enable the Auto Select check box. Then all available data will be added to the diagram at once. The Auto Select function will be disabled automatically if any data is added or removed from the Column list in the Properties dialog.

OR

- Use "Drag-and-drop" (without opening the Properties dialog) simply by dragging the items from the Test Contents window and dropping them in the diagram. It is possible to add points, distances, angles and stick figures to diagram.

5. To remove data from the diagram:

- Select the Remove button.

OR

- Right-click the item and select Remove Selected

The item is transferred to the Data Selection frame.

6. To change colour of any added curve item:

- Right-click the Colour or Alt Colour (representing interpolated points) and select the required colour from the list displayed.

7. To turn on and off the display of the curve before and/or after the current time:

Note. The default is to display for the whole time range.

- To plot the curve before the current time, enable the Show before Now Check box.
- To plot the curve after the current time, enable the Show After Now Check box.

Note. De-selecting both check boxes displays only for the current time. Adjusting the current time with the slider moves these points around the screen.

8. To specify the diagram type:

- Select the required type from the Plot drop-down list.

9. To specify the Plot component:

- Select the required component from the Plot component drop-down list.

Note. The list contains an 'abs. xxxx' option, depending on the nature of the selected item, to enable you to plot its absolute value.

10. To compare two or more curves displayed in the same diagram:


- Enable the Compare Curves check box.
 - Key the required comparison Time, acknowledging the appropriate unit.
- OR
- Select the  button to set the time to t0.
 - Key the required comparison Y value.
 - The curves are adjusted so that they all use the specified Time and Y values as the origin.

Diagram Properties dialog - Text Boxes tab

11. To insert a Text Box into the diagram:

- Click the Add button to get to the [Text Box setup dialog](#).
- When a text box is inserted in the list;
 - Right clicking in the Name column will present a small right click menu from which the properties dialog can be reached or the text box removed.
 - Right clicking in the Colour column will make it possible to change the text colour.
 - Right clicking in the Background column will make it possible to change the background colour.
 - Right clicking in the Border column will make it possible to change the text box border colour.
- Delete a Text box from the list by marking in the list and click Remove.

Diagram Properties dialog - Properties

12. To specify the axes properties:

- Select the Axes button.
- Key appropriate [axes properties](#).

13. To specify the filter properties:

- Select the Filter button.
- Key appropriate [filter properties](#).

14. To specify the general properties:

- Select the General button.
- Key appropriate [general properties](#).

15. To add a corridor from an external file:
 - Select the Add Corridor button.
16. To specify corridors known to the system:
 - Select the [Corridors](#) button.

Right Click Menu

Note, right clicking the Frequency Analysis diagram will offer fast access to a number of functions:

- [Properties](#)
- [Zoom tool](#)
- [Selection Tool](#)
- [Distance Measurement tool](#)
- [Angle Measurement tool](#)
- Show all - will display the diagram in zoom 1:1.
- [Grid](#)
- [Legends](#)
- [Legends Settings](#)
- [Export Images](#)
- [Print](#) - Prints the diagram.
- [Copy](#) - Copies the diagram to the clipboard.
- [Paste](#) - Pastes the selected data into any appropriate application.
- Create Diagram Copy - Creates an editable copy of the existing diagram, any changes as described above can be made without changing the original diagram.

See also..

- [Multi Axis Diagram](#)
- [XY Diagram](#)
- [Advanced Diagram](#)
- [3D Diagram](#)
- [Image Diagram](#)
- [Managing Diagrams via Test Contents](#)

Time Table

Function

Time Tables are used to display results numerically, typically in support of a graphical diagram or when the data is to be exported to another system for storage or further analysis.



Procedure

To match the way different users work, the Time Table has two different setups:

- Simple
- Advanced

The setup is selected by using the tabs in upper left corner of the table setup .

1. To setup the table:

- Select the New/ Time Table option from the Diagram menu.
- OR
- Click the  tool in the toolbar.

The Time Table is displayed.

2. To open the table properties dialog:

- Select the Properties option from the Edit menu.
- OR
- Right-click in the table and select the Properties option from the pop-up menu.

The Time Table Properties dialog is displayed.

3. Set the table properties according to the preferences described below:

- Open the table properties dialog, if not already open.
- Select appropriate tab (Simple, Advanced) or Properties.
In the Advanced tab the items in the Data Selection list can be sorted by Name, Group, Data Type, Coordinate System or Attributes.
- Set the appropriate table properties, the changes will be implemented directly in the table.
- Click the OK button when ready.

Note, an error message telling what is wrong will appear in the table if it has been incorrectly specified.

Table Properties dialog - Simple Setup tab

4. Select the Point(s) to add to the Columns list.

Note, that multi selections can be done here, selecting points from different trackers. Any subsequent specification done will affect the whole selection.

5. Specify what type of Attributes to use for the selected point.

The range of attributes will depend on the type of point selected, thus, the list will update to match the range of the selection made in the point list.

Note: If a multi selection has been done, including points from different trackers, the attribute list will list all available attributes from all selected points. It is therefore important to know what types of unique data that comes out from the different trackers.

6. Specify also the Time Derivative of the selection.

The derivatives will be applied on all selected attributes for each point.

7. Specify the Coordinate System to be used when presenting the data selection.

- Select from the drop-down list.

If more than one system is available in the test, the option All will present the specified data for each coordinate system in the test.

8. Select the desired Function which will be applied on the data before presentation:

- At Current time will pass the data untouched.
- The max and min functions will however calculate the extreme values of a sequence before presentation. Thus, the use of any of those two functions will result in a presentation of data that is unaffected by the current time. This as it is just one value for all times in a sequence.

9. To add data to the table (there are several alternatives):

- Click the ➡ button (Add button) to insert the data selection in the Columns list.

OR

- If a row in the Columns list is marked and the Add Similar button is clicked, all the available similar data (same point type from the Points list, as in the selected row) that can be specified from the point list will be added to the list automatically.

OR

- If at least one data is available in the Columns list, enable the Auto Select check box. Then all available similar data will be added continuously to the list/table. The Auto Select function will be disabled automatically if any data is added or removed from the Columns list in the Properties dialog.

10. To change the order of the added items in the list:

- Mark an item and move up and down using the up and down buttons ⬇ ⬆.

11. To remove an item from the table:

- Select the item in the Columns list.
- Select the ← button (Remove button).

12. To display Accuracy (if any) of the data selected into the table:

- Enable the [Show Accuracy](#) check box.

Table Properties dialog - Advanced Setup tab

13. To specify the items displayed in the Data Selection frame:

- Select the Filtered check box to display filtered items only, otherwise only non-filtered items are shown.
- Select the Absolute Value check box to display absolute value items only, otherwise only non-absolute value items are shown.

Note: Selecting both check boxes displays only filtered, absolute value items. Selecting neither check box displays only non-filtered, non-absolute value items.

14. To limit the items shown to a specific Coordinate System:

- Select the required system from the list. The default is to show items from all systems.

15. To add *an item* to the table:

- Expand the appropriate part of the Data Selection frame.
- Select the required item.
- Select the Add button.
- The item is transferred to the list of selected items in the Data frame.

Note: The first selected item determines the sample rate for the table. If data from two camera views with very different sample rates is to be displayed, care should be taken in the selection of the first camera view, although the system does take steps automatically to compensate for the difference. If the first camera view is subsequently removed, the sample rate is recalculated.


16. To add *all* items of the same data type:

- Expand the appropriate part of the Data Selection frame.
- Select the required item.
- Select the Add Similar button. All items with the same data type as the first selected is transferred to the list of selected items in the Data frame.

OR

- Select the Auto Select button. All items with the same data type as the first selected is transferred to the list of selected items in the Data frame continuously during the test. The Auto Select function will be disabled automatically if any data is added or removed from the Columns list in the Properties dialog.

17. To remove an item from the table:

- Select the item in the Columns list.
- Select the  button (Remove button).

The item is transferred to the Data Selection frame.

18. To display Accuracy (if any) of the data selected into the table:

- Enable the [Show Accuracy](#) check box.

Table Properties dialog - Properties

19. To specify the filter properties:

- Select the Filter button.
- Key appropriate [filter properties](#).

20. To specify the general properties:

- Select the General button.
- Key appropriate [general properties](#).

Sorting in Time tables

By clicking on the header of a column in the table (text diagram), the rows are sorted in increasing/decreasing order according to that column.

Right Click Menu

Note, right clicking the Time table will offer fast access to a number of functions besides the Properties described above;

- [Properties](#)
- [Print](#) - Prints the table.
- [Copy all](#) - Copies complete table to the clipboard.
- [Copy selection](#) - Copies selection of the table to the clipboard.
- [Export...](#)
- [Paste](#) - Pastes the selected data into any appropriate application.
- Create Diagram Copy - Creates an editable copy of the existing Time table, any changes as described above can be made without changing the original Time table.

See also...

[Point Table](#)

[String Expression Wizard](#)

[Managing Diagrams via Test Contents](#)

Amending Table General Settings

1. Select the General button in the Table Properties dialog.
The General Settings dialog is displayed.
2. To amend the default table title, key in a new Title.
3. To amend the data format, select the required Format from the list.
4. To specify the decimal character, select the required Decimal Point from the list.
5. Select the OK button.
The dialog is closed and the changes made are reflected in the table.

Point Table

Function

Point Tables are used to display results per point numerically. Typically in support of a graphical diagram or when the data is to be exported to another system for storage or further analysis.

Appearance

The Data selection area is divided into Rows and Columns, which mirrors the procedure of populating the point table.

- Each selected point will define one row in the point table. Therefore, the points are sorted under Rows. (Compare this with the time table where one frame will define one table row.)
- Each selected attribute, function or other will define one column in the point table. For each selected Point, the following information can be listed in columns:
 - View - The view in which the tracking for the selected point was made.
 - Attributes - The selected Attribute.
 - Time Derivatives - Sets time derivative.
 - Coordinate System - The selected coordinate system.
 - Function - The used function on the data.
 - Components - The selected components.



Procedure

The whole idea of the Point Table setup procedure builds upon populating a table in two steps:

- Rows first
- Then columns to affect all rows

By using the Data Selector approach.

2. To setup the table:

- Select the New  Point Table option from the Diagram menu.
OR
- Click the  tool in the tool bar.

The Point Table is displayed.

2. To open the table properties dialog:

- Select the Properties option from the Edit menu.
OR
- Right-click in the diagram and select the Properties option from the pop-up menu.

The Point Table Properties dialog is opened.

3. Set the table properties according to the preferences described below:

- Open the table properties dialog, if not already open.
- Set the appropriate table properties (Rows, Columns), the changes will be implemented directly in the table.
- Click the OK button when ready. The selected data in the column list will now be displayed in the presentation function.

Note, an error message telling what is wrong will appear in the table if it has been incorrectly specified.

Table Properties dialog - Rows





4. First, define the points to be included in the table.
 - Select the point(s) in the Available Points field (multi select by holding the <Ctrl> key while selecting items).
5. To add data to the table:
 - Click the  button (Insert points button) to insert the selected point into the Selected Points list.
6. To change the order of the rows (points) in the table:
 - Mark an item and move up and down using the up and down buttons  .
7. To remove an item from the table:
 - Select the item in the list.
 - Select the  button (Remove button).

Table Properties dialog - Columns

8. Select the Point(s) that are to be further presented than just the basic appearance as done when specifying the rows above.

Note that multi selections can be done here, selecting points from different trackers.

9. Specify what type of Attributes to use for the selected point.

The range of attributes will depend on the type of point selected, thus, the list will update to match the range of the selection made in the point list.

Note If a multi selection has been done, including points from different trackers, the attribute list will list all available attributes from all selected points. It is therefore important to know what types of unique data that comes out from the different trackers.

3. Specify also the Time Derivative of the selection.

The derivatives will be applied on all selected attributes for each point.

4. Specify the Coordinate System to be used when presenting the data selection.

- Select from the drop down list.

If more than one system is available in the test, the option All will present the specified data for each coordinate system in the test.

5. Select the desired Function which will be applied on the data before presentation:
 - At Current time will pass the data untouched.
 - The max and min functions will however calculate the extreme values of a sequence before presentation. Thus, the use any of those two functions will result in the presentation of data that is unaffected by the current time. This as it is just one value for all times in a sequence.
6. To add data to the table:
 - Click the ➡ button (Add button) to insert the data selection in the Column list.
7. To change the order of the added items in the list:
 - Mark an item and move up and down using the up and down buttons ⬇ ⬆.
8. To remove any data from the table:
 - Select the item in the Column list.
 - Select the ⬅ button (Remove button).
9. If a row in the column list is marked and the Add Similar button is clicked, all the available similar data (same point type from the Points list, as in the selected row) that can be specified from the point list will be added to the list automatically.
10. To display Accuracy (if any) of the data selected into the table:
 - Enable the [Show Accuracy](#) check box.

Table Properties dialog - Properties

11. To specify the filter properties:
 - Select the Filter button.
 - Key appropriate [filter properties](#).
12. To specify the general properties:
 - Select the General button.
 - Key appropriate [general properties](#).

Right Click Menu

Note, right clicking the Point table will offer fast access to a number of functions besides the Properties described above;

- [Properties](#)
- [Print](#) - Prints the table.
- [Copy all](#) - Copies complete table to the clipboard.
- [Copy selection](#) - Copies selection of the table to the clipboard.
- [Export...](#)
- Create Diagram Copy - Creates an editable copy of the existing Point table, any changes as described above can be made without changing the original Point table.

See also...

[Time Table](#)

[Managing Diagrams via Test Contents](#)



Report (optional)

Function

The Report function is used to gather data from a test into a single output.

Procedure

1. To setup the table:


- Select New /  Report from the Diagram menu.
- OR
- Click  tool in the toolbar.

The Report window is displayed.

2. To add data to the report:

- Items such as [XT](#), [Multi Axis](#), [XY](#), [Advanced 3D](#) and [Image diagrams](#) and [Test Summaries](#) can be added to the report.
- Clicking on their corresponding icon in the top of the window.

3. To edit any added item (To open the diagram properties dialog):

- Mark the item in the report item list.
 - Click the Report setup button .
- OR
- Right-click on it and selecting Setup.

The diagram setups function as their standard-test counterparts.

OR

- Right-click in the diagram and select the Properties option from the pop-up menu.

4. To display *an* item:

- Click on it in the list.



5. To display *several* items simultaneously:

- Use multi-select in the list (pressing the <ctrl> key while clicking).


6. To browse through the report:

- Use the arrows   to the right.

OR

- Click on the desired report items and use the double-arrow keys   to go quickly to the top or bottom of the list.

7. To remove any item from the report:

- Select the item and click the  button (Delete button).

8. To print the report:

- Click on  button (Print button).

Note, an error message telling what is wrong will appear in the diagram if it has been incorrectly specified.

Right Click Menu

Note, right clicking the Report will offer fast access to a number of functions:


- [Properties](#)
- [Zoom tool](#)
- [Selection Tool](#)
- [Distance Measurement tool](#)
- [Angle Measurement tool](#)
- Show all - will display the diagram in zoom 1:1.
- [Grid](#)
- [Legends](#)
- [Legends Settings](#)
- [Export Images](#)
- [Print](#) - Prints the diagram.
- [Copy](#) - Copies the diagram to the clipboard.
- [Paste](#) - Pastes the selected data into any appropriate application.

Test Summary

Function

A Test Summary is a framework that enables a [Text Box](#) to be inserted by itself in a report. As any text box, it can contain any text and suits fine using [Built-in Variables](#) to create customized tables.

Procedure

1. In the [report](#), click the  tool.
An empty Test Summary is Added to the report displayed.
2. Right Click the Test Summary in the list and select Setup. The Test Summary setup opens.
3. Set up the Test summary [Text Box](#).
4. The contents in the Test Summary can be exported to excel. Right click and select Export. Select .xls format.

Tabbing in text box/xls file

To make tabs in the text, (using the syntax `$!/$`) to match columns in the exported excel, use space between the '\t' patterns. For example, if we need one empty columns between two columns with values in the exported xls file, type '\t \t' between the values. Please look at the following exam ple:

Syntax in Test Summary text box:

```
Value 1\t \tValue 2
Value3\t \tValue4
```

```
Value5\tValue6
Value7\tValue8
```

Appearance in excel:

| | A | B | C |
|---|---------|--------|---------|
| 1 | Value 1 | | Value 2 |
| 2 | Value3 | | Value4 |
| 3 | | | |
| 4 | Value5 | Value6 | |
| 5 | Value7 | Value8 | |

See also...

Absolute Value / Vector Length

If you choose to plot an absolute value in a diagram, a function is used to calculate the length of a vector, i.e. its absolute value.

The function calculates the length of vectors or the absolute value of scalars, i.e. it removes the direction component of a distance, a velocity or an acceleration.

The length of a vector is a scalar quantity of the same dimension as the vector's components. For positions, the function calculates the distance from the origin.

In the case of:

- distance, which has length and direction components, the length is calculated.
- velocity, which has speed and direction components, the speed is calculated.
- acceleration, which has acceleration and direction components, the acceleration is calculated.

Amending Diagram Axes

1. Select the Axes button in the Diagram Properties dialog. The Axis Properties dialog is displayed.
2. For each axis in diagram you can:
 - Select the required unit from the drop-down list. For a Multi Axis diagram, a selection is made for each of the Y axes individually.
 - Scale automatically, select the Auto Scale check box.
 - Scale manually:
 - De-select the Auto Scale check box.
 - The Scale fields are enabled and contain the current corridors of the axes.
 - Key in the lower and upper bounds
3. For an [XY diagram](#) or [3D diagram](#) select the Keep Aspect Ratio check box if you want the aspect ration to be preserved. For a [Multi Axis](#) or [Advanced diagram](#), select the Align Axes at Value check box and key the required value. This aligns all the Y axes at the specified value.
4. Select the OK button. The dialog is closed and the changes made are reflected in the diagram.

See also...

[3D Diagram](#)

Diagram Filters

1. Select the Filter Properties button in a Diagram Properties dialog. The Filter Properties dialog is displayed.
2. Select the Filter Type from the drop-down list:

[FIR](#)

- FIR applies a variable length low-pass filter, i.e. a filter which removes high frequency noise and makes the data look smoother. All physical data is processed, except images and calibration sequences. For vector data each component is filtered.
- A Filter Factor of '0' specifies no filtering, while '100' specifies maximum filtering.

CFC

- CFC applies a fourth order phaseless Butterworth filter. All physical data is processed, except images and calibration sequences. For vector data each component is filtered. The filter is a non-causal IIR (Infinite Impulse response) filter, i.e. a change in any input sample affects the entire output. Invalid input samples are interpolated and the corresponding output samples are marked as invalid. Input data is re-sampled to an equidistant timebase.
- The CFC parameter determines the cut-off frequency of the filter.
- For large CFC values, the cut-off frequency is larger than the Nyquist limit (the highest frequency that can be represented at a given sampling frequency). In this case, the filter just lets through its input signal, which complies with the SAE J211/1 specification.
- The specified CFC value determines the cut-off frequency which is the highest frequency in the input signal that is passed to the output. It should be set well above the highest signal frequency, otherwise part of the signal is filtered out as well as the noise.
- The CFC filter does not compute any accuracy estimate for its output data. This means that when the CFC filter is active no accuracy data will be displayed if you select [Show Accuracy](#) in the diagram setup.

Spline

- Spline applies a spline smoothing filter. All physical data is processed, except images and calibration sequences. For vector data each component is filtered.
- The filter algorithm fits a spline curve to each component of the data. A spline curve is a curve that is constructed from multiple n -th degree polynomials (one polynomial for each pair of consecutive data points) so that the $n-1$ first derivatives are continuous. The fit is optimized to make the curve as smooth as possible without losing information. The algorithm used is known as GCV optimization.
- The settings control the degree of the polynomials:
 - Cubic: Polynomials of degree 3.
 - Quintic: Polynomials of degree 5.
 - Heptic: Polynomials of degree 7.
- The Spline filter does not compute any accuracy estimate for its output data. This means that when the Spline filter is active no accuracy data will be displayed if you select [Show Accuracy](#) in the diagram setup.

3. For an FIR filter, drag the Filter Factor slider to the required filter value.
4. For an CFC filter, key in the required CFC value.
5. Select a Spline filter by either checking the Cubic, Quintic or Heptic filter.
6. If you wish to set the filter definition as the default, select the Set As Default button.
Note. This sets a single default, not a default for each type of filter.
7. Select the OK button.

Filter Algorithms

FIR Filter

TEMA's FIR (Finite Response Filter) filter is a low-pass filter with a single parameter, the "filter factor", which is a dimensionless number between 0 and 100, where a higher filter factor means harder filtering. Instead of the user specifying the length of the filter, the filter half-length n varies from 1 to 10 depending on how many valid samples surround the current sample.

The filter algorithm is a Hamming low-pass filter, with the coefficients

$$c_j = \frac{w_j h_j}{\sum_{k=-n}^n w_k h_k}, \quad j = -n..n$$

where n is the half-length of the filter and

$$w_k = 0.54 - 0.46 \cos \frac{2\pi(k+n+\frac{1}{2})}{2n+1}$$

and

$$h_k = \begin{cases} \frac{\sin(2\pi f_0 T k)}{\pi k}, & k \neq 0 \\ 2f_0 T, & k = 0 \end{cases}$$

with T being the sampling interval of the input.

The cutoff frequency f_0 is given by the filter factor F according to the formula

$$f_0 = \frac{1}{T} \frac{101 - F}{202}$$

Note that a filter factor of 0 corresponds to

$$f_0 = \frac{1}{2T}$$

i.e. the Nyquist limit (the maximum frequency that can be represented with the sampling interval T). If we insert this value in the formula for the filter coefficients, we get

$$h_k = \begin{cases} \frac{\sin(\pi k)}{\pi k}, & k \neq 0 \\ 1, & k = 0 \end{cases}$$

that is, all the filter coefficients except h_0 will be zero and the filter will just pass its input through unchanged.

Speed and acceleration filter algorithms

TEMA's speed and acceleration filters (also FIR filters) algorithms computes speed and acceleration from tracking data. These algorithms require that the input is equidistantly sampled, i.e. that the time interval between consecutive samples is the same throughout the sequence.

If the input sequence doesn't satisfy this requirement it is re sampled by interpolating its values at equidistantly spaced times.

The filter algorithms can be described by the following formula:

$$y_i = \sum_{j=-n}^n c_j x_{i+j}$$

where x_j are the samples of the input sequence (after re sampling) and y_i are the samples of the output sequence. When the data has more than one component this formula is applied independently to each component.

The numbers c_j are called the *filter coefficients*, and the integer n is called the filter's *half length*. There are $2n + 1$ filter coefficients.

In general, the greater the half length, the less sensitive the filter is to noise in the input data (because it uses more data points for its computation, and random noise will average out between these points).

However, a longer filter will leave longer gaps at the ends of the output: the formula above can only be applied if there are n input samples both before or after the sample being calculated. To reduce these gaps, TEMA has an option to reduce the filter length at the ends of the input sequence.

Speed Filters

Filter coefficients

The filters used to compute speeds and velocities have filter coefficients given by

$$c_j = \frac{1}{T} \frac{3j}{n(n+1)(2n+1)}, \quad -n \leq j \leq n$$

where T is the sampling interval of the input sequence (i.e. the time between consecutive samples).

This formula can be derived by least-squares fitting a quadratic equation to the $2n+1$ input points and then taking the derivative of the fitted function.

The above coefficients make the filters *anti symmetric*: they extend n samples both before and after the current sample and $c_{-j} = -c_j$. This ensures that the filter is *causal*, i.e. that data is not moved in time.

Short-sequence filter

The user also has an option to reduce the filter length even further at the ends of the sequences, down to

a two-point filter. The formulas used for this "short-sequence filter" are

$$y_i = \frac{x_{i+1} - x_i}{T} \quad \text{or} \quad y_i = \frac{x_i - x_{i-1}}{T}$$

depending on at which end of the input sequence we are. This means that there will be an output sample for every valid input sample, which is important in some applications.

Since only two input points are used, these formulas are very noise-sensitive – a small error in one input sample will give a large error in the speed. Also, these formulas are not anti symmetric, so the filter will not be causal (the calculated speed is really the speed at the time halfway between the input samples).

The use of this option is recommended *only* if it is very important that there be no gaps at the ends of the speed sequence.

Mean velocity from t_0

TEMA also has a special option to calculate velocities as the mean velocity from time zero rather than as the instantaneous velocity. When this option is selected, the above filters are not used at all. Instead the speed at time t is calculated simply as the displacement from time zero to time t , divided by t .

This option is, obviously, only suitable for applications where the tracked objects are moving with constant velocity.

Acceleration Filters

TEMA computes accelerations with the same type of filters as it uses for speeds. The only difference is that the filter coefficients will be symmetric rather than anti symmetric (this is a mathematical consequence of the fact that we are differentiating twice).

The system implements two filters of different half-length:

$n = 2$, coefficients;

$$\frac{1}{7T}(2, -1, -2, -1, 2)$$

and $n = 4$, coefficients;

$$\frac{1}{100T}(4, 4, 1, -4, -10, -4, 1, 4, 4)$$

These filter coefficients can be derived by applying the 3- and 5-point velocity filters twice in succession.





Normally, the 9-point ($n = 4$) filter is used. If the user selects the "reduce filter length at ends" option, the 5-point filter will be used at the ends of the input sequence.

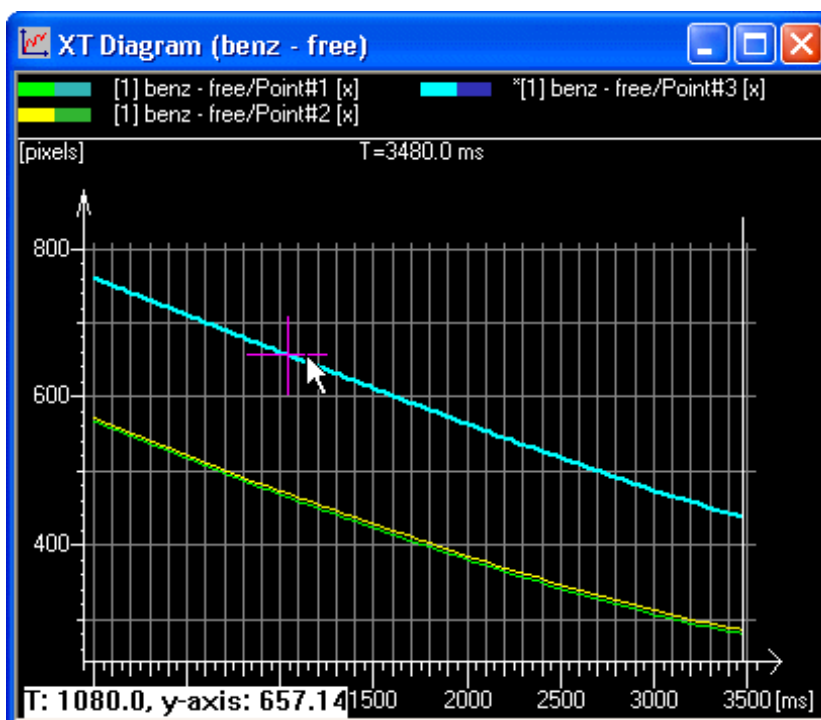
See also...

[Diagram Filters](#)

Manipulating Diagrams and Tables

When a diagram or table has been displayed in its own window, there are a number of functions you may perform:

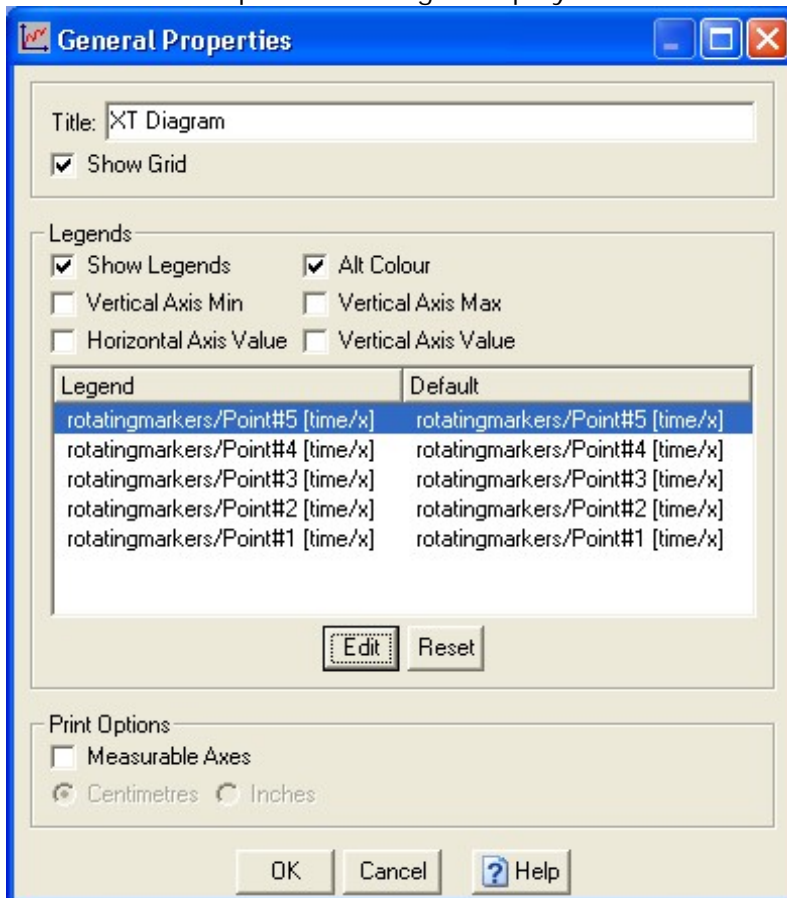
1. Double-click on the diagram/table Titlebar, or select the  button to expand the diagram/table to fill the whole of the display area.
Selecting the  button returns the display area to its original condition.
2. To minimise the diagram/table, select the  button.
3. To save the diagram/table, select the Save Test or Save Test As option from the File menu.
4. To close the diagram/table, select the  button.
Note: If you have not saved the diagram/table as part of the test, IT IS LOST.
5. For a diagram only:
 - To remove the grid, select the Grid option from the Diagram menu.
 - Re-selection redisplay the grid.
 - To remove the legends, select the Legends option from the Diagram menu.
 - Re-selection redisplay the legends.
 - Specify the [Legend Settings](#).
 - To display curve coordinates:
 - Click on the curve whose coordinates are to be displayed.
 - The selected curve is displayed in bold and an asterisk is added to the curve's legend.
 - Move the mouse to a point of interest on the selected curve.
 - A purple cross is displayed to indicate the current point selected with the mouse.
 - The coordinates of the current point (the closest actual sample value) are displayed in the bottom left corner of the diagram.



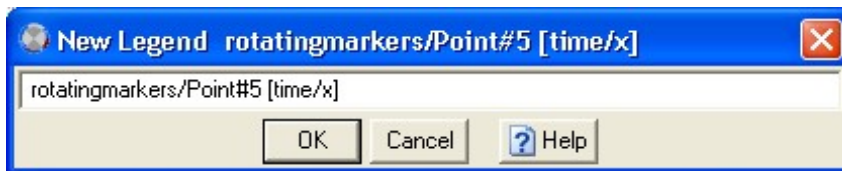
- Note: The values are also displayed in the Statusbar and can be saved to [Notes](#).

Diagram General Properties

1. Select the General button in the XT (or XY, or Multi Axis) Diagram Properties dialog. The General Properties dialog is displayed.



2. To edit the default diagram title, type a new Title.
3. To remove the default grid, uncheck the Show Grid check box.
4. To specify the legend:
 - Select the required check boxes (check or uncheck).
 - The specified legend is displayed in the frame below the check boxes.
 - Show Legends - Displays the legends in the diagram .
 - Alt Colour - displays both the legend colour and the alternative legend colour in the legends definition bar.
 - Note: Interpolated points are always displayed in the alternative colour, irrespective of whether the legends are shown or not.
 - Vertical Axis Min - displays in the legend the minimum vertical value, together with the horizontal axis value at which it occurs.
 - Vertical Axis Max - displays in the legend the maximum vertical value, together with the horizontal axis value at which it occurs.
 - Horizontal Axis Value - displays the current horizontal axis value.
 - Vertical Axis Value - displays the current vertical axis value.
 - To edit the legend for a specific point:
 - Mark applicable point in the Legend list.
 - Select Edit button.
 - Type the new Legend name in the New legend dialog.



- Select OK button.
 - The new Legend name is shown in the left column (Legend) and the old Legend name is shown in the right column (Default).
 - To reset changed Legend name:
 - Mark applicable point in the Legend list.
 - Select Reset button.
 - The Legend will be changed back to default Legend name.
 - 5. To remove the default legends, uncheck the Show Legends checkbox.
 - 6. To specify the Print Options:
 - Select the Measurable Axes.
 - Select the appropriate radio button, i.e. Centimetres or Inches.
 - 7. Select the OK button.
- The dialog is closed and the changes made are reflected in the diagram.

Diagram Corridors

1. Select the Corridors button in the XT (or XY, or Multi Axis) Diagram Properties dialog. The Diagram Corridors dialog is displayed.
2. To add a diagram corridor:
 - Right-click the Colour and select the required colour from the list.
 - Select the diagram corridor in the list.
 - Select the Add button.
3. To remove a diagram corridor:
 - Select the diagram corridor in the list.
 - Select the Remove button.
4. Select the Close button.

See Also...

[Maintaining Corridors](#)

Accuracy Settings

Function

The Accuracy of displayed data in any diagram or table can be plotted in the same diagram/table.

Procedure

To show the Accuracy of displayed data:

1. Open the Properties dialog of applicable diagram/table, either by
 - right-clicking the diagram/table.
 - OR
 - selecting Properties from the Edit menu.
2. Enable the Accuracy to be displayed by checking the Show Accuracy check box.
3. For diagrams, the Accuracy is shown as a σ -factor times the standard deviation (σ).
Set the size of the σ -factor by selecting desired value from the Std Dev. drop down list.
 - In a XT diagram, the Accuracy will appear as error bars (vertical lines) on the curve. The length of each bar will match the value of the standard deviation times the σ -factor.
 - For a Multi Axis diagram, same appearance as for a XT diagram.
 - In a XY diagram, the Accuracy will appear as ellipses on the curve. The size of the ellipses will match the value of the standard deviation times the σ -factor.
 - For an Advanced diagram, same appearance as for a XY diagram.
 - In a 3D diagram, the Accuracy will appear as ellipsoids on the curve. The size of the ellipsoids will match the value of the standard deviation times the σ -factor.
 - For an Image diagram, same appearance as for a XY diagram.

OR

For tables, the Accuracy is shown as the standard deviation (σ).

- In a Time table, the Accuracy will appear numerically in the table.
 - For a Point table, the Accuracy will appear numerically in the table.
4. For diagrams, set the intervals for the appearance of the accuracy plots (lines, rings or ellipsoids, depending on diagram type). The Skip value entered will be the amount of time samples between the accuracy plots in diagram.

Text Boxes

Function

Text boxes in TEMA are what the name implies; boxes where text can be inserted. Such boxes can be inserted into all TEMA diagrams as well as overlays in the [Image Export](#). The text box is also a place where expressions can be inserted and used.


Appearance

Depending on from where in TEMA the text box dialog has been entered, diagram (XT, XY, Multi Axes, Advanced diagrams) setups or [Image Export](#) the exact appearance varies slightly. The deviations are described in each corresponding help section. The common features regarding text boxes however, are those listed below.

- Text - this section contains settings for the text message in the text box.
 - Alignment sets the text alignment within the text box. This can be changed later in the Overlays tab in the image export dialog.
 - Color - set the color of the text.
 - Font - set the font of the text. Select the appropriate font, style and size.

Procedure

Depending on from where in TEMA the text box dialog is entered, the procedure of setting this up varies slightly.

1. Type the Text Box message.
2. Use [expressions](#) if needed, either typed manually or with the use of the [String Expression Wizard](#) .
3. To create tabs in the text, use the syntax *\$!t\$*.
4. Specify the Alignment, Text Color and Font.
5. Click OK when ready to insert the created Text Box in Diagram or export window.

See also...

[Text Box in XT Diagram](#)

[Text Box in Multi Axis Diagram](#)

[Text Box in XY Diagram](#)

[Text Box in 3D Diagram](#)

[Text Box in Image Diagram](#)

[Text Box in Advanced Diagram](#)

[Text Summary](#)

Copy to Time Table


The Copy to Time Table function creates a Time Table that displays the same data as an existing X T, Multi-axis, XY, Advanced XY or 3D diagram. For multi-dimensional data the Time Table will show all the data components, even if only one component is displayed in the original diagram.

The function is not available for Time Tables, Point Tables or Frequency Analysis diagrams.

It can be accessed from the Diagram menu in the main window, from the right-click menu in a diagram of the relevant types, or from the right-click menu in the Test Contents window (provided one or more diagrams are selected).

Scaling and Coordinate Systems

The scaling and coordinate system functions enable measurements and calculations to be made more accurately by relating parts of the image to their corresponding features in the real world.

1. Select the required camera view.
2. Specify points/reference points in applicable image sequence.
Minimum number of points are for:
 - Single Parallel: 2.
 - Multiple Parallel: 2 or 0.
 - Skewed: 2.
 - 4 Points: 4.
3. Select the Scaling/Coordinate Systems option:
 - from the Edit menu.
 - OR
 - by right-clicking in the Camera View.
 - OR
 - by clicking the  tool.


The Scaling/Coordinate Systems dialog is displayed.

Note: If a camera view has not been selected, the message "No active Camera View found" is displayed in the Status bar and the dialog is not displayed.

4. [Set up Motion Planes.](#)
5. [Specify Coordinate Systems.](#)
6. [Specify Coordinate Grids.](#)
7. Select the OK button.

Motion Planes

1. Select the Scaling/Coordinate Systems option:

- from the Edit menu.
- OR
- by right-clicking in the Camera View.
- OR
- by clicking the  tool.

The Scaling/Coordinate Systems dialog is displayed.

2. Specify points/reference points in applicable image sequence.

Minimum number of points are for:

- Single Parallel: 2.
- Multiple Parallel: 2 or 0.
- Skewed: 2.
- 4 Points: 4.


3. Select the Motion Planes tab.

4. Select Mode:

- Disabled - Motion Planes calculation disabled.
- [Single Parallel](#) - Only scaling
(useful when the motion plane and image plane are parallel).
- [Multiple Parallel](#) - Scaling and compensation for offset
(useful for more than one motion plane and when these are parallel to the image plane).
- [Skewed](#) - Scaling and compensation for offset and skew of motion plane(s)
(useful when the motion plane and image plane are skewed and NOT parallel to each other).
- [4 Points](#) - Scaling and compensation for offset and skew of motion plane(s)
(useful when relative positions of 4 reference points are known).

Single Parallel Mode

5. Select Time Mode and set the Scale:


- For Dynamic Time Mode:
Note: If Dynamic mode is selected, a reference time is not required because the system calculates the transform parameters in every image in the sequence.
 - Set the Scale for the reference Point 1 and Point 2:
 - Select Point 1 and Point 2 from the drop-down lists.
 - Fill in Distance between points (value, unit).
- For Static Time Mode:
 - Set the Reference Time for valid analyse data (value and unit).
 - Fill in value and select unit from the drop-down-list.
 - OR
 - Select the  button to set the Reference Time to the current time.
 - Set the Scale for the reference Point 1 and Point 2:
 - Select Point 1 and Point 2 from the drop-down lists.
 - Fill in Distance between points (value, unit).

- For Manual Mode:
Note. If Manual mode is selected, a reference time is not required because the system bases the transform solely on the Scale factor.
 - Fill in Scale factor per pixel (value, unit).

6. Press OK button.

Multiple Parallel Mode

5. Select Time Mode and set the Scale:

- For Dynamic Time Mode:
Note. If Dynamic mode is selected, a reference time is not required because the system calculates the transform parameters in every image in the sequence.
 - Select No Scaling.OR
 - Set the Scale for the reference Point 1 and Point 2:
 - Select Point 1 and Point 2 from the drop-down lists.
 - Fill in Distance between points (value, unit).
- For Static Time Mode:
 - Set the Reference Time for valid analyse data (value and unit).
 - Fill in value and select unit from the drop-down-list.OR
 - Select the  button to set the Reference Time to the current time.
 - Select No Scaling.OR
 - Set the Scale for the reference Point 1 and Point 2:
 - Select Point 1 and Point 2 from the drop-down lists.
 - Fill in Distance between points (value, unit).
- For Manual Mode:
Note. If Manual mode is selected, a reference time is not required because the system bases the transform solely on the Scale factor.
 - Select No Scaling.OR
 - Fill in Scale factor per pixel (value, unit).

6. Select Planes:

- For a *Measured* Distance between Camera and Reference Plane:
 - Select Measured.
 - Fill in Distance (value, unit).
- For a *Calculated* Distance between Camera and Reference Plane:
 - Select Calculated (known internal camera parameters are required).
- For Secondary Planes:
 - Compensate for Plane Offsets relative to the reference plane by selecting this option.
 - Press Edit Offsets button.
 - Fill in Offsets value for applicable point in the Plane Offsets dialog and press OK button.OR

- Import Offsets values from file by pressing the Import button and then selecting file in the Open dialog.

OR

- Export Offsets values from file by pressing the Export button and then saving the file in the Save as dialog.

Note: The file format is text (not binary) XLS. This format is tab-separated values, which can be read by Excel or Notepad.

Each line in the file contains the name of a point (the name may contain spaces), followed by one or more tab characters and a floating-point number that specifies the offset of the point.

If the first line of the file starts with /unit (note that this is not a valid point name), followed by one or more tab characters and the name of a length unit, all offset values are interpreted as given in that unit. If no such line is present TEMA's current default length unit is used.

OR

- Fill in Offsets value for applicable point in the Test Contents dialog.

7. Press OK button.

Skewed Mode

5. Select Time Mode and set the Scale:

- For Dynamic Time Mode:


Note: If Dynamic mode is selected, a reference time is not required because the system calculates the transform parameters in every image in the sequence.

- Set the Scale for the reference Point 1 and Point 2:
 - Select Point 1 and Point 2 from the drop-down lists.
 - Fill in Distance between points (value, unit).

- For Static Time Mode:

- Set the Reference Time for valid analyse data (value and unit).
 - Fill in value and select unit from the drop-down-list.

OR

- Select the  button to set the Reference Time to the current time.
- Set the Scale for the reference Point 1 and Point 2:
 - Select Point 1 and Point 2 from the drop-down lists.
 - Fill in Distance between points (value, unit).

- For Manual Mode:

Note: If Manual mode is selected, a reference time is not required because the system bases the transform solely on the Scale factor.

- Fill in Scale factor per pixel (value, unit).

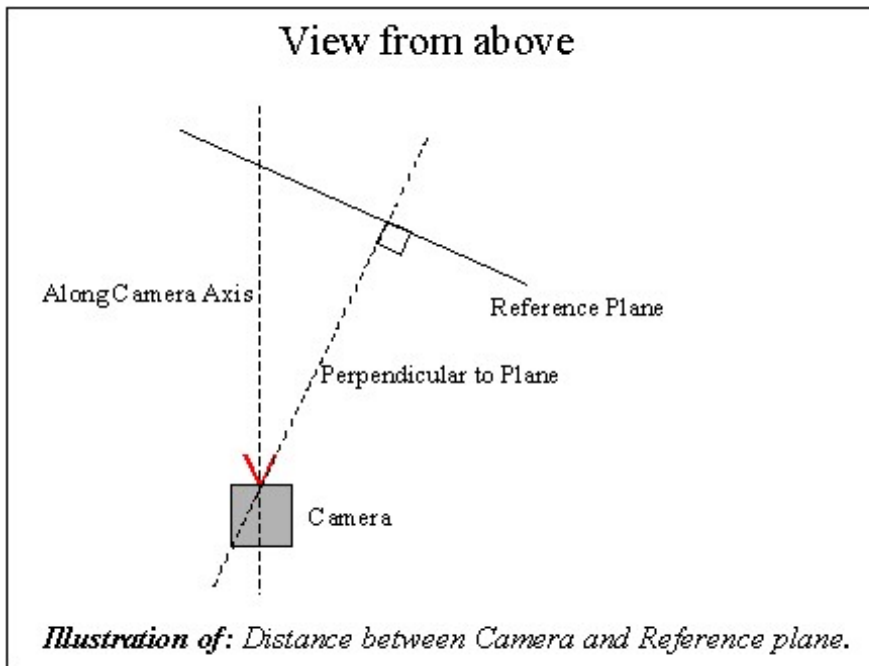
6. Select Planes:

- For a *Measured* Distance between Camera and Reference Plane:

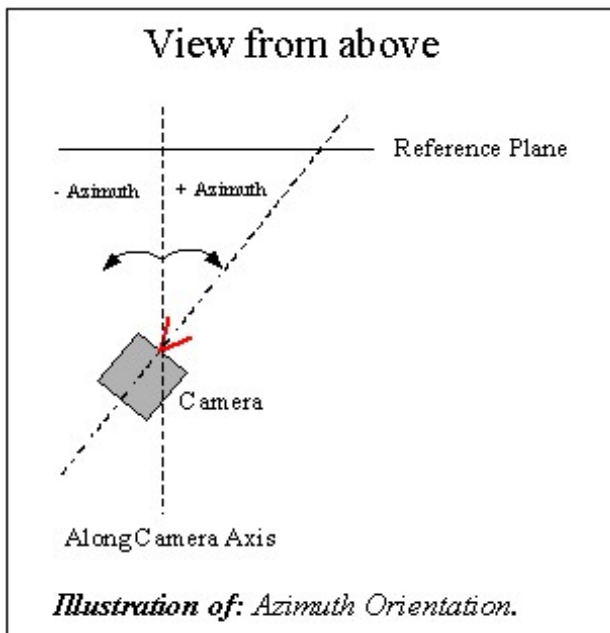
- Select Measured.
- Fill in Distance (value, unit).
- Select how the distance has been measured (see illustration below):
 - Perpendicular to Plane.

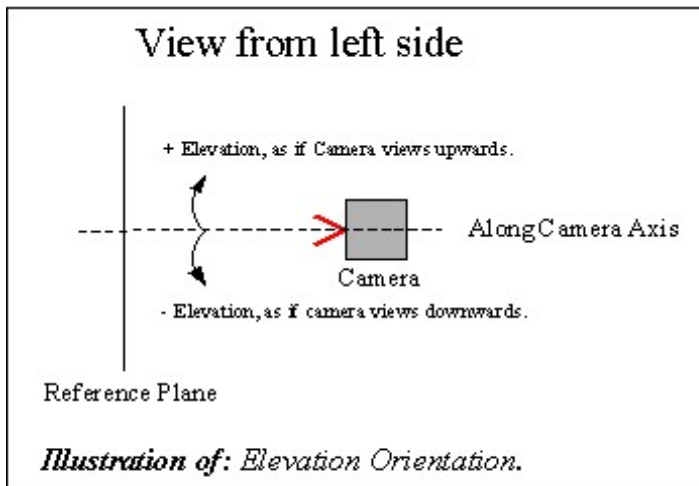
OR

- Along Camera Axis.



- For a *Calculated* Distance between Camera and Reference Plane:
 - Select Calculated (known internal camera parameters are required).
 - Select how the calculated distance shall be displayed:
 - Perpendicular to Plane.
 - OR
 - Along Camera Axis.
- Set the Orientation of the image plane relative to the reference plane.
 - Fill in Azimuth (value, unit), see illustration below.
 - Fill in Elevation (value, unit), see illustration below..






- For Secondary Planes:
 - Compensate for Plane Offsets relative to the reference plane by selecting this option.
 - Press Edit Offsets button.
 - Fill in Offsets value for applicable point in the Plane Offsets dialog and press OK button.
- OR
- Fill in Offsets value for applicable point in the Test Contents dialog.

7. Press OK button.

4 Points Mode

5. Select Time Mode:

- Dynamic.
- OR
- Static:
 - Set the Reference Time for valid analyse data (value and unit).
 - Fill in value and select unit from the drop-down-list.
 - OR
 - Select the  button to set the Reference Time to the current time.
- OR
- Manual.

6. Select four Reference Points:

- Select Point, Point 2, Point 3 and Point 4 from the drop-down lists.
- Note:* Only points with 2D model coordinates can be used as references.

7. Select Planes:

- For a *Calculated* Distance between Camera and Reference Plane:
 - Calculated is selected automatically (known internal camera parameters are required).
 - Select how the calculated distance shall be displayed:
 - Perpendicular to Plane.
 - OR
 - Along Camera Axis.

- For Secondary Planes:
 - Compensate for Plane Offsets relative to the reference plane by selecting this option.
 - Press Edit Offsets button.
 - Fill in Offsets value for applicable point in the Plane Offsets dialog and press OK button.
- OR
- Fill in Offsets value for applicable point in the Test Contents dialog.

8. Press OK button.

See Also...

[Motion Planes Explanation](#)

[Scaling and Coordinate System](#)

Motion Planes Explanation

A common case in motion analysis is that the motion is confined to a plane. For example, consider a car moving straight ahead. The side of the car is approximately flat and parallel to the direction of motion, so points on the side of the car will move in a plane (two-dimensional motion). In TEMA, such a plane is called a *Motion Plane*.

A slightly more complicated case is when points on both the left and right side of the car are observed. Then the points move in two parallel planes at different distances from the camera. Since objects further away from the camera look smaller, there will be two different scale factors, one for each plane.

The situation becomes even more complicated if the camera is not looking straight at the car (i.e. the sensor plane is not parallel but at an angle to the sides of the car). In this case, the scale factor will vary depending on which part of the plane is being looked at, since different parts of the plane are at different distances from the camera.

The *Motion Planes* function calculates the scale factors in cases such as these, and uses them to calculate the x and y coordinates within each *Motion Plane*. Another way of describing this is that the function removes the effects of perspective, recovering the actual size of objects despite the fact that their apparent size depends on their distance from the camera.

1 Different Modes of Transformation

Since this description is rather abstract, a set of simple, concrete examples will now be used to show how the *Motion Planes* function works in different cases. TEMA's Motion Planes function can operate in different modes that correspond to these cases.

1.1 The Single-Parallel Case

In the simplest case, all observed points are in the same plane and the camera is looking straight at the plane (i.e. the sensor plane is parallel to the *Motion Plane*).

Then the real-world positions of the points in the plane (x and y coordinates measured in e.g. metres or inches) can be obtained from their positions in the image (pixel coordinates) by just applying a simple scale factor. This is called the single-parallel case, since there is a single *Motion Plane*, which is parallel to the sensor plane.

Suppose the motion of the second hand of a wall clock is being studied. The camera is placed on a tripod in front of the clock and pointed straight at the wall. The second hand moves in the plane of the clock face, so if the camera is properly aligned, there will be a single *Motion Plane* which is parallel to the sensor.

Tracking the tip of the second hand gives x and y coordinates that are measured in pixels. If the end-user wants results in real-world coordinates, measured in metres, the *Motion Planes* function can be used to compute the image scale and apply it to the data.

To compute the scale two points (called the *reference points*) are needed with a known distance between them. For example, the length of the second hand can be measured and both ends of it tracked. It is also possible to enter the image scale (measured in metres / pixel) manually.

Note: in previous versions of TEMA (3.4 and earlier), this function was called "2D scaling".

1.2 The Multiple-Parallel Case – Adding more planes

Suppose now that not just the motion of the second hand is measured, but also the coordinates of some points on the wall on which the clock is mounted. These points will not lie in the same plane as the minute hand, but in a parallel plane that is further away from the camera. This means that a different scale factor must be used for these points.

Instead of tracking two new reference points on the wall, TEMA allows the user to compute the wall's

scale factor from that of the second hand, provided two more distances are being measured: the distance from the reference plane to the camera (to be precise, to the camera's focal point), and the distance between the reference plane and the wall plane (called the wall plane's *offset*). The offset is defined as positive when the plane is further away from the camera than the reference plane is, and negative otherwise.

TEMA can handle any number of *Motion Planes*. In fact, it assumes that each point has its own *Motion Plane*, and lets the user enter the plane offsets at a point-by-point basis. The only exception to this is that both reference points must lie in the reference plane.

If the focal length of the camera is known (e.g. if the camera has been calibrated), TEMA can calculate the distance between the camera and the reference plane automatically.

If the actual size of the object is not interesting, it is possible to omit the scaling and just compensate for the different offsets of the planes. This produces output coordinates that are measured in pixels. In this case the reference points are not necessary. On the other hand, it is not possible to calculate the distance from the camera, so this distance must be measured by some other method.

1.2.1 Another Example

Another way of describing what the *Motion Planes* function does in this case is that it removes the effects of perspective.

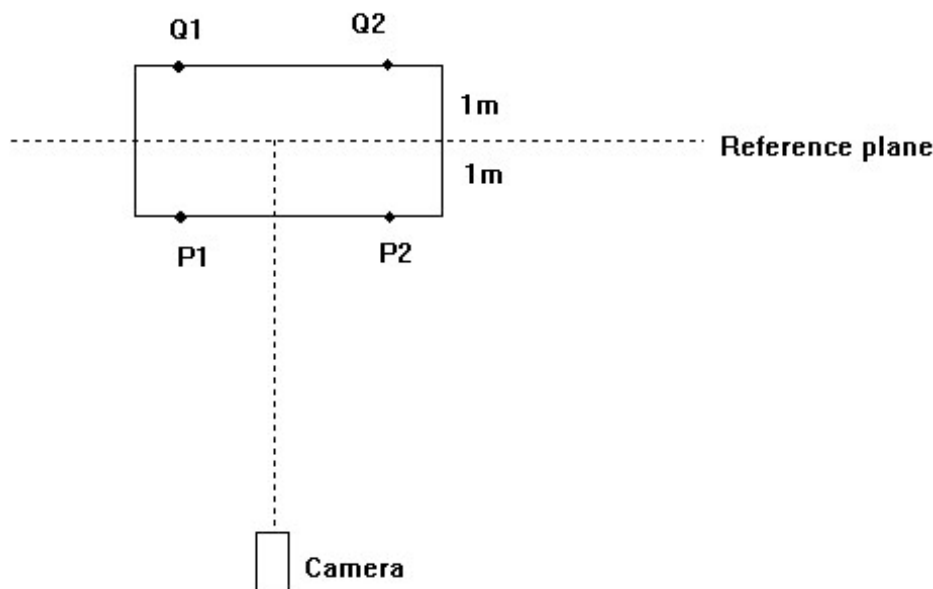
The following example shows a measurement of two distances on a vehicle.

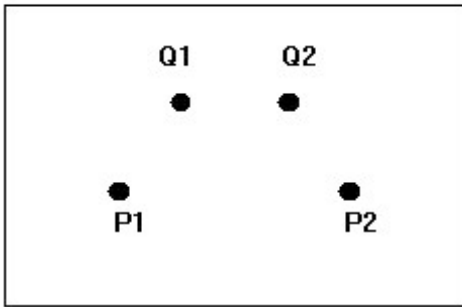
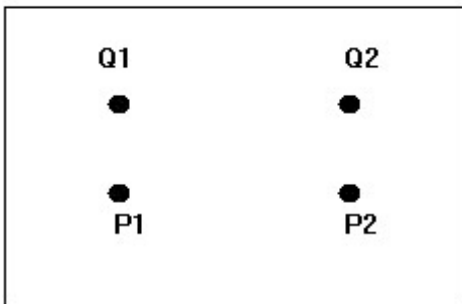
The points Q1 and Q2 have offsets = 1 m, since they are 1 metre behind the reference plane as viewed from the camera, while P1 and P2 lie in front of the reference plane and have offsets of -1 metre.

The two distances P1-P2 and Q1-Q2 are equal, but because of perspective the latter two points seem to be closer to each other in the image. Using the *Motion Planes* function removes this effect, as shown below:

Note: The operation of removing the perspective effects is also called *depth scaling*.

View from above



View from the camera**View after depth scaling****1.3 The Skewed Case**

In all the previous cases the camera sensor was parallel to the motion planes (or, in other words, the camera axes was perpendicular to the planes).

The case where this is not true is called the skewed case.

In the skewed case different points on the plane will have different distances to the camera, so the scale factor will not be constant but will vary over the image. In the example with the clock, the second hand will appear to be of different length at different times, and if the clock face is circular in reality its image will be an ellipse.

If the orientation of the camera relative to the planes is being known, TEMA can calculate the scale factor and how it varies across the image. As in the parallel case TEMA needs the distance from the camera to the reference plane and the offset of each additional plane, and two reference points that are a known distance apart must be defined.

If the camera's focal length is known TEMA can calculate the distance from the camera to the reference plane.

Unlike the parallel case, the two reference points and the distance between them are necessary.

The orientation of the camera relative to the plane is given as two angles, *azimuth* and *elevation*. Azimuth is measured horizontally (telling whether the camera looks to the left or the right) and elevation vertically (up or down). A positive azimuth means that the camera is turned clockwise, and a positive elevation that it looks up.

In the skewed case the *Motion Planes* function compensates both for the perspective effect caused by the offsets of the different planes (depth scaling as in the parallel case), and for the perspective effects caused by the oblique view (turning the elliptic clock face back into a circle).

1.4 The 4-Point Case

An alternative way of handling the skewed case is to use four rather than two reference points, and

calculate not only the scale, but also distance to and the orientation of the camera from these points.

The points must have known x and y coordinates in the plane's coordinate system. TEMA reads these coordinates from a file and stores them in the test. The camera's focal length must also be known.

2 Time Modes

In all the cases the user may specify whether the transformation should be dynamic, static or manual. This is called the *Time Mode* of the transformation.

In *Static* mode the transformation parameters are calculated only once and that is at the specified reference time. This means that the reference points only need to be tracked in one image.

In *Dynamic* mode the transformation is recalculated for each successive image. This can be used when the camera moves relative to the reference plane, or if the geometry of the setup changes in some other way; the effect is to remove the effects of unwanted motion from the data.

Finally, in *Manual* mode the user enters the scale factor manually. In the skewed case this value refers to the scale at the image's principal point (usually the centre of the image).

Maintaining 2D Coordinate Systems

The available coordinate systems for the currently selected camera view are listed in the Coordinate Systems frame. Initially, there is always one coordinate system, based on the bottom left corner of the image, with horizontal and vertical x and y axes. It is assigned the same name as the camera view.

1. Select the Scaling/Coordinate Systems option from the Edit menu.
The Scaling/Coordinate Systems dialog is displayed.
2. Select the Coordinate Systems tab.
3. You may:
 - o [Add a coordinate system](#).
 - o [Change the definition of a coordinate system](#).
 - o [Remove a coordinate system](#).
 - o [Assign a different coordinate system to a camera view](#).
4. Select the OK button.

To perform a coordinate transformation, there are two different interfaces; [Aligned](#), which is best suited for [image merging](#) in [image diagrams](#), or [Standard](#) for other uses.

Adding a Coordinate System

A new coordinate system needs to be added if the measurements made are not based on the bottom left corner of the image, the default, but on some other fixed point in the image.

Note: A new coordinate system can be set up without reference to tracked points. This is accomplished by using the following procedure, but without selecting points from the lists in the Translation and Axis Definition frames.

1. Select the Add button.
The New Coordinate System dialog is displayed.
2. Key the Name for the new system.
3. Select [Aligned](#) Or [Standard](#) to get to the desired coordinate system transformation interface.
3. Select the OK button.
The dialog is removed and all the fields are enabled in the selected Coordinate systems interface tab.

Changing the Definition of a Coordinate System

1. Select the coordinate system whose definition you wish to change.
2. Amend the settings as described in [Adding a Coordinate System](#).

Removing a Coordinate System

1. Select the coordinate system whose definition you wish to remove.
2. Select the Remove button.

Assigning a Different Coordinate System to a Camera View

If you wish to display data on the same diagram from two camera views in either the same or different tests, the camera views must both use the same coordinate system. When a camera view is created, a coordinate system with the same name is automatically defined. Additional coordinate systems may be defined, as required.

Typically, in a 3D test, the two camera views are called 'left...' and 'right...'. To display data on the same diagram from two camera views, a new coordinate system is created for the 'right...' camera view which has the same name and definition as the coordinate system for the 'left...' camera view. Both camera views are assigned to the same coordinate system as follows:

1. Select the coordinate system to be assigned to the camera view.
The change is effected when the OK button is selected.

See Also...


[Image Merge](#)

[Coordinate System - Setup Procedure](#)

[Scaling and Coordinate System](#)

Standard

Procedure

1. Select Dynamic or Static mode by clicking on the appropriate radio button.
If Static mode is selected, key in the Reference Time, selecting the time unit from drop-down list.
2. Alternatively, select the  button to set the Reference Time to the current time.
If Dynamic mode is selected, a reference time is not required because the system calculates the transform parameters in every image in the sequence.
3. If you wish to base the new system on a different origin, in the Translation frame:
 -
 - Select the new origin from the Point drop-down list.
 - Specify the x offset value, selecting the unit from the adjacent list.
 - Specify the y offset value, selecting the unit from the adjacent list.
4. If you wish to amend the names of the axes, in the Axis Names frame:
 - Select the First Axis name from the list.
 - Select the Second Axis name from the list.
5. If you wish to specify a new axis definition, in the Axis Definition frame:
 - Select the x or y radio button, depending on whether the line between Point 1 and Point 2 is the x or y axis.
 - The other axis is automatically offset from this line by 90°.
 - If you wish to invert the other axis, select the Invert x (or y) Axis checkbox.
 - Select Point 1 from the adjacent drop-down list.
 - Select Point 2 from the adjacent drop-down list.
 - If you wish to rotate the coordinate system about the origin, key the Offset Angle, selecting the unit from the adjacent list.
 - This is measured counter clockwise from the positive x axis.

See also...





[Aligned Coordinate Systems](#)

Aligned

Function

When it comes to [merging images](#), the align transformation interface is better suited than the [standard transformation interface](#).

Procedure

1. To the right in Coordinate Systems dialog is the graphical Align interface. This displays the two images that corresponds to the available [coordinate systems](#). The uppermost is the image whose coordinate system is the fixed. The lower is the one to be oriented in the fixed system. Tracked points (if any) in both images can also be seen. By the use of this interface, the second (lower) image is oriented in relation to the primary one (upper) by relating point(s) in one of the images are to point(s) in the other:
 - Click in a position in one of the images with the left mouse button. This will present a select tool marking the position. Drag the mouse to the other image and click at the position at where to associate those two positions. This can be done for as many positions as desired.
 - Tracked points with the same name in both images will be automatically associated. This can be overridden by dragging the select tool from one tracked point to another in both views. It is not possible to associate a tracked point with a non-tracked position.
 - Right clicking a association line will make it possible to remove it.
 - Each image in the graphical Align interface can be scrolled and/or zoomed in/out individually using the scroll bars and the zoom buttons   . The associations set will not be changed by this. When a point associated becomes non visible due to scrolling, an arrow will point to the direction of that point in the image.
2. Select transformation Mode. Select Dynamic or Static mode by clicking on the appropriate radio button.
If Static mode is selected, key in the Reference Time, selecting the time unit from drop-down list.
Alternatively, select the  button to set the Reference Time to the current time.
If Dynamic mode is selected, a reference time is not required because the system calculates the transform parameters in every image in the sequence.
3. More coordinate systems can be added using the Add button in the lower left corner of dialog. The New Coordinate System dialog will appear. Give the new coordinate system a suitable name. Then select Aligned Or Standard. Standard will open the [Standard Coordinate Systems](#) interface in which a new coordinate system can be created. When finished, this new coordinate system will show up in the list of available coordinate systems.
4. Scaling - put a mark in the Allow Scaling check box to enable scaling when orientating the aligned coordinate system (and its image). If not enabled, only rotation translation is done when aligning.
5. Click OK button when ready. Based on the point relations, the second image will now be oriented (rotated and translated) versus the primary image. The merged result can now be seen in an [image diagram](#).

See also...

[Standard Coordinate systems](#)

Maintaining 3D Coordinate Systems


The available coordinate systems for the currently selected camera view are listed in the Coordinate Systems frame. Initially in a 3D test, there is only one 3D coordinate system, based on the selected [calibration target](#). The cameras are [orientated](#) with respect to this coordinate system. Subsequently, other coordinate systems can be added, typically for use in the presentation of results.

1. Select the 3D Coordinate Systems option from the Edit menu.
The 3D Coordinate Systems dialog is displayed.
2. You may:
 - [Add a coordinate system](#).
 - [Change the definition of a coordinate system](#).
 - [Remove a coordinate system](#).
 - [Assign a different coordinate system to a camera view](#).
3. Select the OK button.

Procedure

Adding a Coordinate System

1. Select the Add button.
The New Coordinate System dialog is displayed.
2. Key the Name for the new system.
3. Select the OK button.
The dialog is removed and all the fields are enabled in the 3D Coordinate Systems dialog.
4. Select Dynamic or Static mode by clicking on the appropriate radio button.
If Static mode is selected, key in the Reference Time, selecting the time unit from drop-down list.

Alternatively, select the  button to set the Reference Time to the current time.

If Dynamic mode is selected, a reference time is not required because the system calculates the transform parameters in every image in the sequence.

5. If you wish to base the new system on a different origin, in the Translation frame:
 - Select the new origin from the Point drop-down list.
 - Specify the New x value, selecting the unit from the adjacent list.
 - Specify the New y value, selecting the unit from the adjacent list.
 - Specify the New z value, selecting the unit from the adjacent list.
6. If you wish to specify a new axis definition:
 - Select the x, y or z radio button to define the primary axis.
 - Depending on the choice made, the radio buttons in the Plane frame are modified to relate the selected axis with the other two, i.e.
 - For x, xy and xz;
 - For y, yz and xy;
 - For z, xz and yz.
 - Select a point from the Point 1 list in the Axis frame to define the selected axis.
 - Select a point from the Point 2 list in the Axis frame to define the selected axis.
 - Select the required radio button in the Plane frame.
 - Select a point from the Point 1 list in the Plane frame to define the selected plane.
 - Select a point from the Point 2 list in the Plane frame to define the selected plane.

Changing the Definition of a Coordinate System

1. Select the coordinate system whose definition you wish to change.
2. Amend the settings as described in [Adding a Coordinate System](#).

Removing a Coordinate System

1. Select the coordinate system whose definition you wish to remove.
2. Select the Remove button.

Assigning a Different Coordinate System to a Camera View

If you wish to display data on the same diagram from two camera views in either the same or different tests, the camera views must both use the same coordinate system. When a camera view is created, a coordinate system with the same name is automatically defined. Additional coordinate systems may be defined, as required.

Typically, in a 3D test, the two camera views are called 'left...' and 'right...'. To display data on the same diagram from two camera views, a new coordinate system is created for the 'right...' camera view which has the same name and definition as the coordinate system for the 'left...' camera view. Both camera views are assigned to the same coordinate system as follows:

1. Select the coordinate system to be assigned to the camera view.
The change is effected when the OK button is selected.

See Also...

[Getting Started - 3D](#)

[Coordinate System - Setup Procedure](#)

Coordinate Systems - Setup Procedure

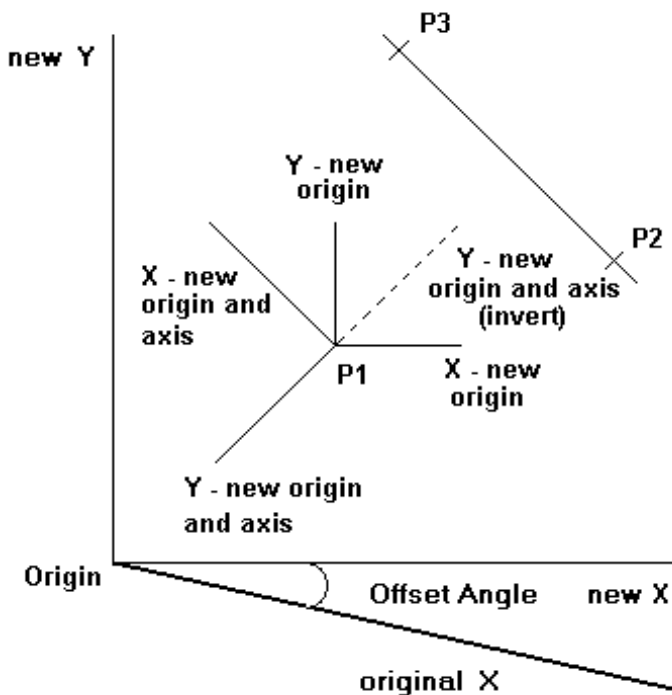
Coordinate systems may be defined as dynamic or static. A reference time is specified for a static coordinate system and the axis position at that time is retained for all other times.

A dynamic coordinate system means that the frame of reference is recalculated for each successive image.

A dynamic coordinate system is used where there is a need to remove the effects of unwanted motion from the data. For example, if part of the image is rotating, a dynamic coordinate system may be used to ensure that the two selected points remain on the x-axis.

A static coordinate system means that the frame of reference is calculated only once and that is at the reference time that you specify. Returning to the rotating example, it would mean that the two points do not remain on the x-axis.

The following diagram illustrates how to set up new coordinate systems.



The default coordinate system is based on X, Y with the Origin at their intersection, i.e. at the bottom left corner of the image.

If the origin is moved to point P1, coordinates are then based on X - new origin and Y - new origin, i.e. the origin is moved, but the orientation is not changed.

If a new x-axis is then defined running from point P2 to point P3, coordinates are then based on X - new origin and axis and Y - new origin and axis with the origin at P1, i.e. the origin is moved and the orientation is changed.

If the y-axis is then inverted, coordinates are then based on X - new origin and axis and Y - new origin and axis (invert) with the origin at P1.

Maintaining Coordinate Grids

A coordinate grid consists of two series of lines at 90 degrees to each other superimposed on the image. The orientation of the lines is not restricted to the horizontal and vertical planes. Different grid definitions may be specified for different camera views, but there can be only one grid definition per camera view.

For each camera view more than one [coordinate system](#) may be specified. In order to display a coordinate grid on an image, it must be related to one of the coordinate systems specified for the camera view. This is because the origin and orientation of the coordinate system are used to define the origin and orientation of the coordinate grid.

To specify a coordinate grid:

1. Select the Grid Coordinate System from the combination list.
The list contains only those coordinate systems defined for the selected camera view. The special entry "-- No grid --" is used to remove the grid from the image without removing the grid definition. This is useful if you wish to use the grid during analysis, but not on printed reports, or vice versa. The grid does not have to be redefined to redisplay it.
2. Specify the Grid division.
The smaller the division, the smaller the gap between the grid lines. The division may be specified in pixels or real world units.
3. Select the Grid Colour and Axis Colour.
4. Select the required Show checkboxes to specify the grid components to be displayed. The Show All and Hide All buttons are used to select/de-select all the checkboxes.
 - Grid - displays the grid.
 - Axes - displays the direction of axes and the components displayed on each.
 - Ruler - displays a legend indicating the scale of the image in the units selected for the Grid Division.
 - Grid Division - displays a legend indicating the size of the gaps between the grid lines in the selected unit. The area of grid block is also displayed.
5. Select the OK button.

See Also...

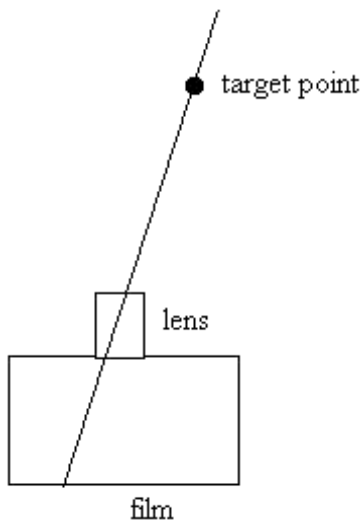
[Scaling and Coordinate System](#)

3D/6D

3D Calculations

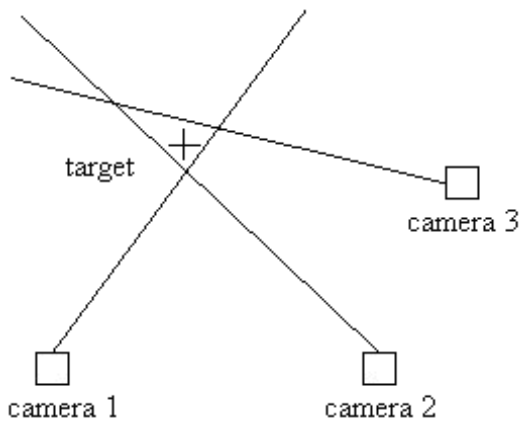
3D from intersection

When a photograph is taken of a 3-dimensional scene, information about depth is lost and a 2-dimensional image is generated. This means that it is in general impossible to reconstruct the 3D scene from only one image. When asked about the position in space of a given point in the image, the best that can be done is to compute the direction from the camera to the point.



Light from the target point enters the camera's lens and forms an image on the film. The target point could have been placed anywhere on the line and still have produced the same point in the image.

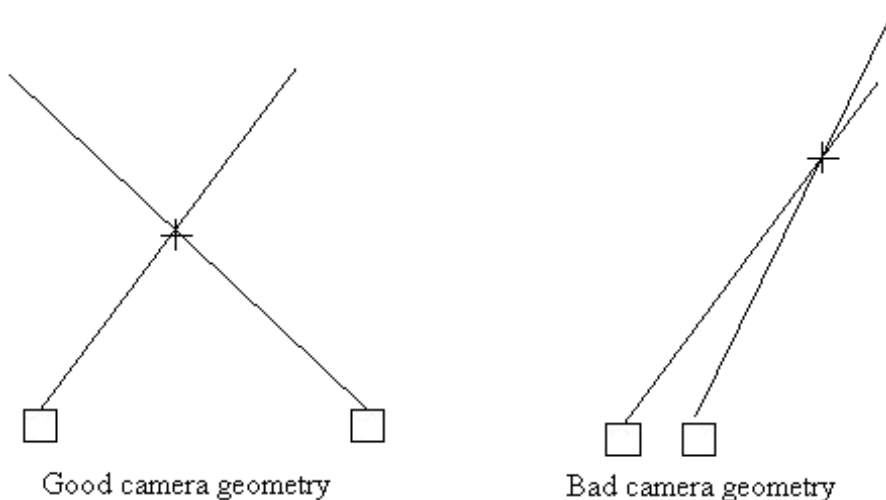
If there are two or more cameras viewing the same point, the situation improves considerably. Each camera gives a line in space on which the target should lie. In an ideal world, these lines intersect in a point and all that has to be done is to compute the point of intersection. In the real world, they do not and some, hopefully small, measurement errors are unavoidable causing the lines to miss the target. A complete 3D position computation can be done using just two camera views. Though, the accuracy increases when using more camera views than two. In TEM, there is no upper limit for the number of participating camera views in a 3D computation. The procedure as a whole using more than two camera views is similar to the case when only two camera views are used.



TEMA takes the observations (tracked pixel coordinates) from each camera, computes the direction from each camera to the target, and finds the target position that is the best fit to the observations. "Best fit" means that the sum of the squares of the difference between the observed directions and the direction to the computed position should be as small as possible. In other words, TEMA performs a least squares estimation of the target position.

Accuracy

The accuracy of the result depends on the camera geometry, i.e. the way the cameras are placed. This is especially important if only two cameras are used. The best results are obtained when the lines of sight from the cameras intersect at right angles. If they intersect at a very narrow angle the accuracy is considerably lower.



Camera Orientation

To compute 3D data, the position of each camera must be known. To convert pixel coordinates to a direction in space, the orientation of the camera must be known, i.e. the direction in which the camera is pointed. Some internal parameters (so called because they describe the camera-lens combination itself, not where it is placed) of the camera must also be known.

For each camera, TEMA uses six external parameters (three coordinates and three angles) and four internal parameters, making a total of ten parameters. Fortunately, it is not necessary to know all these parameters or to measure them. Instead, TEMA computes them from the image sequences.

Reference Points

- The reference points should be well spread out both in space and in the images. As a rule of

thumb, there should be reference points in all quadrants of the image, about two-thirds of the way from the image center to the edges.

- There must be at least four reference points visible in each camera view; this is the minimum number for a calibration to be possible. However, using more points gives a better result, and it is recommended that as many reference points are used as is practically possible.
- Note that the 3D coordinate system that is created when measuring the reference points will be used by TEMA when calculating camera positions and 3D data. TEMA supports right handedness only. A good advice is to have the Z axis pointing upwards also. See [here](#) for more info.

See also...

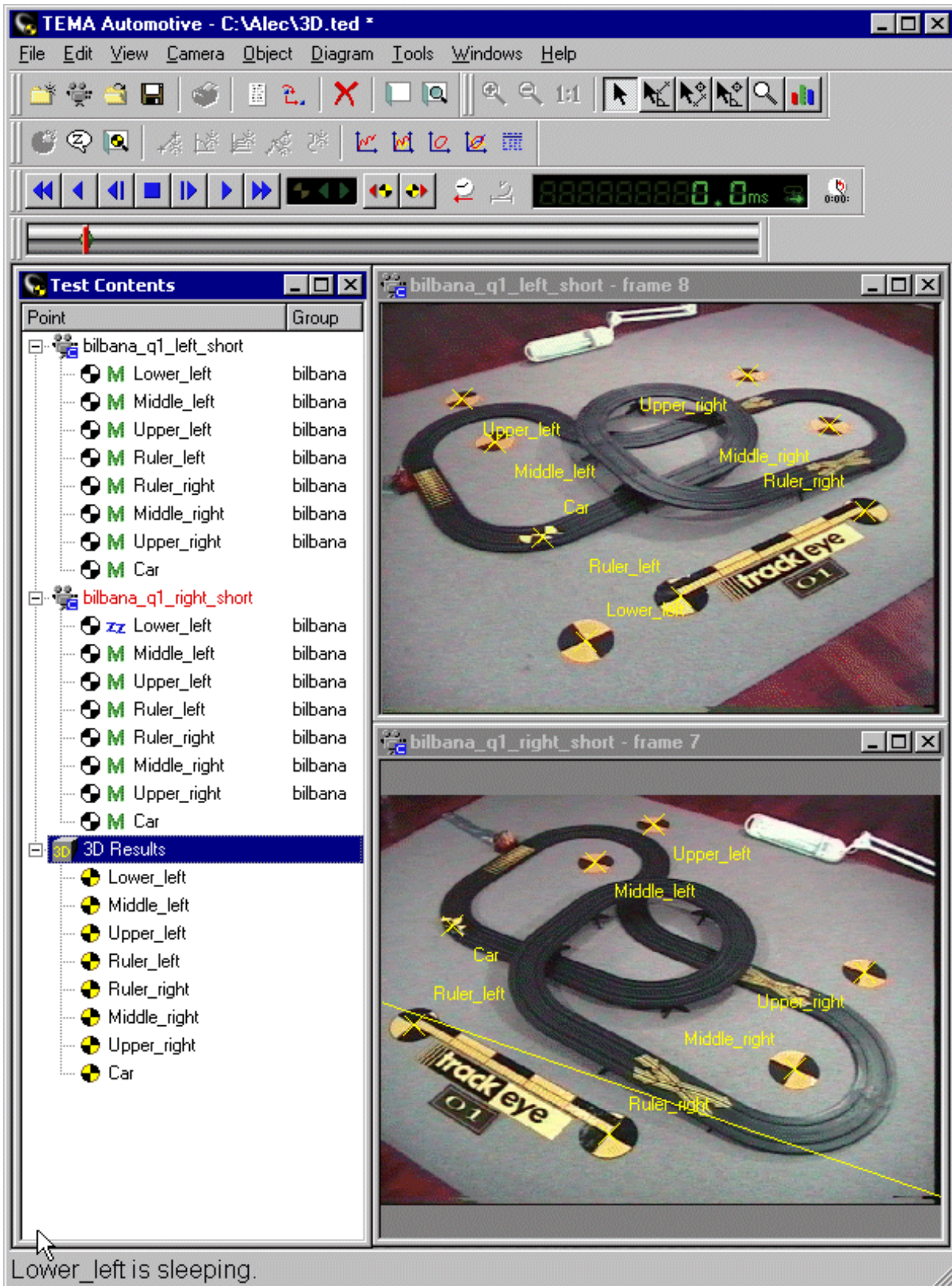
[3D - Getting Started](#)

[Camera Orientation](#)

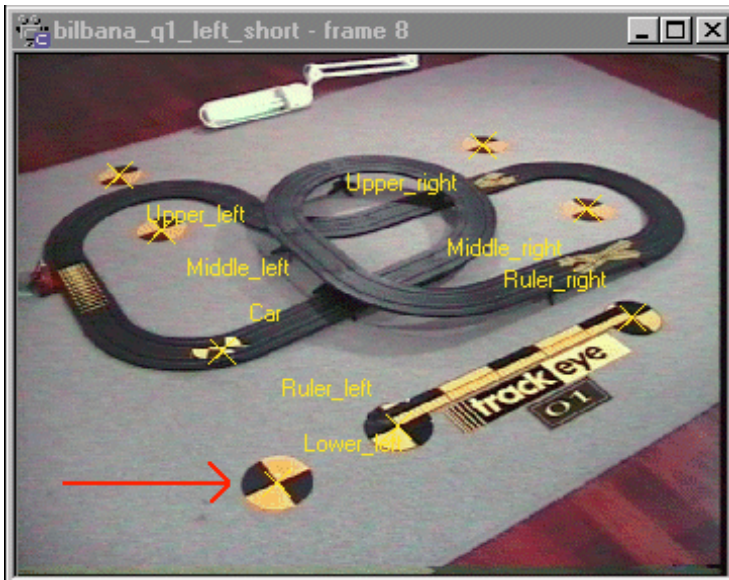
3D Tracking Help Lines (Optional Feature)

When tracking in 3D, once a point has been given in one camera view, help lines showing the possible positions of the point are shown in other camera views.

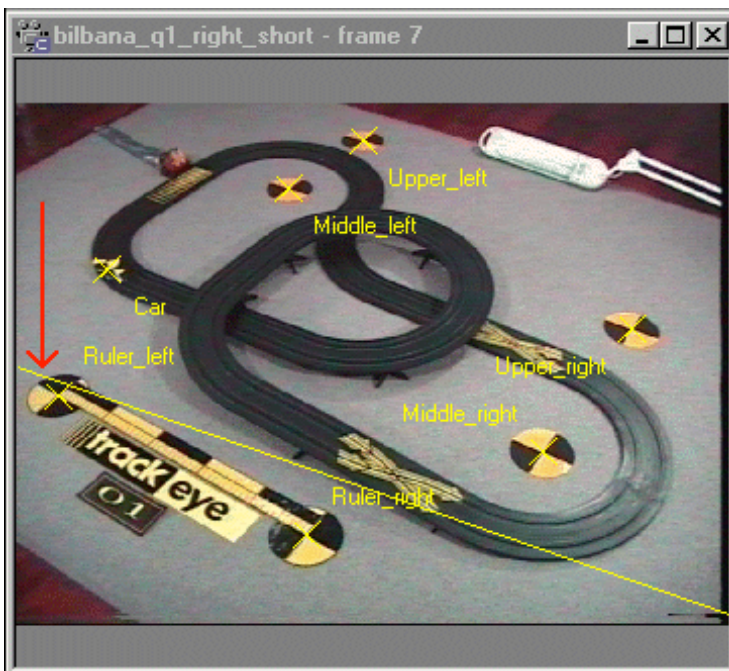
An example of this is shown below:



In the left camera view, point Lower_left is visible, as shown below:



However, it is not visible in the right camera view because it is outside the image. However, the location of point Lower_left is indicated as being somewhere beyond the left end of the yellow line which is the projection of the point from the left camera view, as shown below:



Note: In this case it can be seen that the line would not pass exactly through the centre of the target point. This is because the position and calibration of the cameras has not been specified accurately.

In order to display the help line, the point must be put to sleep in one camera view, in this case the right camera. When the point is positioned manually in the left camera view, the help line is automatically displayed in the right camera view, but only for the first image. For the help line to be visible in subsequent images in the sequence, the point must be put to sleep in the right camera view and tracked in the left camera view. If the point is not put to sleep during tracking, the tracker asks for its position to be marked in the right camera view, which cannot be done because it is outside that camera view.

Importing Camera Parameters (Optional Feature)

Note: This function is only available with the 3D or 6D Optional Feature.

Calibration and Orientation data is automatically saved when a test is saved. If you wish to use the same data in a subsequent test, you may import it from the saved test, thus avoiding the need to repeat the process.

1. Select the Import Camera Parameters option from the Camera menu.
A standard Open dialog is displayed with the file type preset to '.ted'.
2. Select the required test.
3. Select the Open button.
Import Camera Parameters dialog is displayed, listing the camera views in the test for which such data has been saved.
4. Select the required camera view.
5. Select the OK button.
The stored data for the selected camera view is imported.
6. Repeat the process for any other camera view that you require.

See Also...

[Getting Started - 3D](#)

[Getting Started - 6D](#)

Calculating the Orientation of a Camera (Optional Feature)

The Camera Orientation (camera position and direction) can be determined either

- in relation to a surveyed target, e.g. [Static Camera Orientation](#).

OR

- in relation to a another camera, e.g. [Relative Camera Orientation](#).

Please read more about applicable subject by clicking the links above.

See Also...

[Getting Started - 3D](#)

Static Camera Orientation




Function


To determine the camera position and direction in relation to a surveyed target. The points and their x, y and z coordinates must be specified in the target imported from an external file. It is not possible to add points to the target dynamically and use them for orientation because their coordinates are not known to the system. Once a target has been imported into one camera view, it can be copied into another. Note: The function is only available with the 3D Optional Feature.

Important notes about the 3D coordinate system



- The X,Y, and Z-axes of the 3D coordinate system are defined from the coordinate system of the reference points. E.g. if Z is "right" for your reference points, Z will also be "right" for any computed 3D coordinates in TEMA. Thus, the coordinate system used when measuring the reference points is the same that is used by TEMA when orienting the cameras and calculating the 3D.
- TEMA always assumes a right handed 3D coordinate system. Therefore, make sure that the reference points have been measured in the correct handedness. If a left handed coordinate system is the case, a quick solution is to switch sign on one of the axes. This will change the handedness of the coordinate system. If you try to do camera orientation on left-handed reference points you will get wrong 3D results (but no error messages).
- When orienting the cameras, TEMA calculates 3D position as well as attitude angles. Those angles are defined as: First yaw around original z-axis, then pitch around new y-axis, then roll around new x-axis. An effect of this is that yaw, pitch and roll values are easiest to interpret when the coordinate system of the reference points is defined as X forward, Y left and Z up. In this case yaw equals turning your head, pitch equals nodding your head, roll equals tilting your head.

Procedure



1. Select the Find Static Camera Orientation option from the Camera menu.
The Static Camera Orientation dialog is displayed.
2. Select the points to be used in the calibration by selecting/unselecting the appropriate check boxes.
The default is to include all the points listed.
3. Specify the Calibration Interval by selecting the appropriate radio button:
 - All times - performs the calibration over the complete time scale.
 - From/To - performs the calibration over the specified time scale:
 - Enter a From and/or To time, selecting the appropriate unit.
 - Select the appropriate  button to set the From or To time to the current time.
 - Select the  button to set the From time to the earliest time.
 - Select the  button to set the To time to the latest time.
4. Select the Calibrate button.
Note: An error message is displayed if too few calibration points have been tracked. [Track at least four calibration points](#) before continuing.
The Static Camera Orientation Results dialog is displayed, showing the results. The following details are displayed:
 - Camera Position - x, y and x coordinates in the 3D coordinate system. See the above Notes for the requirements on this.
 - Camera Orientation - Roll, Pitch and Yaw attitude angles. See the above Notes for angle definition.

- RMS Residual - The root mean square value of the individual point residuals.
 - Point Residuals - The level of error for each reference point between its measured position and its calculated position.
5. Check the RMS Residual value.
If it is small, the calculation is deemed to be accurate.
If it is large, check which of the Point Residuals are large.
A large value in any of the values shows that either a measured point position is not correct, the camera parameters have not been specified correctly or a reference point has not been positioned accurately in the camera view. The cause of the problem should be identified and eliminated before the calculation is repeated.
6. Select the OK button.
The Static Camera Orientation dialog is redisplayed.
7. Select the Close button.
The camera view icon in the Test Contents window changes to , indicating that the orientation of the camera has been set.
- Note: When the orientation of a second camera view has been calculated, the system automatically add a 3D Results item to the Test Contents window. It contains a list of the target reference points. Whenever another camera view is added, the 3D Results is recalculated. For a point to be classified as a 3D point, it must be available in at least two camera views, both from cameras whose 3D position has been calculated by TEMA.
8. The camera (with Camera Orientation) can be displayed either
- as a Curve showing its 3D position (applicable in all types of diagrams).
 - and/or
 - as a Visualizer (symbol) showing both position and rotation (applicable only in a 3D diagram).

To display camera as a Curve

- Select the Curves tab in the Plot section in the diagram Properties dialog.
- Highlight the applicable camera  in the Data Selection section and click Add button.
OR
Double-click on the applicable camera  in the Data Selection section.
The camera will be added in the Curves tab in the Plot section.
- Press OK button.
- The camera is now displayed in the diagram .

To display camera as a Visualizer *Note!* Only valid for a 3D diagram.

- Select the Visualizer tab in the diagram Properties dialog.
- Highlight the applicable camera  in the Data Selection section and click Add button.
OR
Double-click on the applicable camera  in the Data Selection section.
The camera will be added in the Visualizer tab.
- Press OK button.
- The camera is now displayed (default size) in the diagram .
- The size of the Visualizer can be set/changed, either by:
 - Simultaneously moving the cursor over the Visualizer and using the scroll function on the mouse.
 - Simultaneously keeping the left mouse button down and moving the cursor in the *vertical* direction.
 - Right-clicking on the Visualizer, selecting Visualizer and then setting the size in the Visualizer size dialog.
 - Right-clicking on the Visualizer in the diagram Properties dialog, selecting Properties and then setting the size in the Visualizer size dialog.

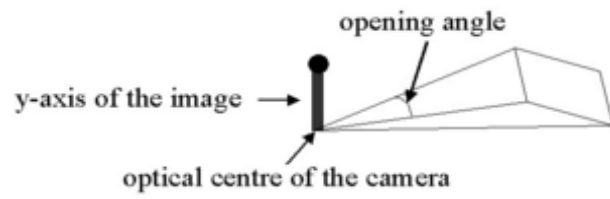


Illustration of camera as Visualizer.

See Also...

[Getting Started - 3D](#)

Relative Camera Orientation

Function

To determine the camera position and direction of one camera relative to another camera, using images of the same scene as seen by the two cameras.

Relative Camera Orientation always operates on a pair of cameras. One camera is called the primary camera and the other is called the secondary camera. The function calculates the secondary camera's position and orientation in a coordinate system defined by the primary camera.

The user must identify a number of points and place them in both camera views. At least six points are required but eight to ten points are recommended.

Unlike in Static Camera Orientation the points do not have to have known 3D coordinates. The distance between two of the points must be known and entered as an input to TEMA. This is because otherwise the system will not be able to determine the scale of the scene: if you make everything, say, twice as large, and move the cameras twice as far away from the scene, all images will look exactly the same, so you must tell TEMA how large things really are.

Important notes about the 3D coordinate system

- When orienting the cameras, TEMA calculates 3D position as well as attitude angles. Those angles are defined as: First yaw around original z-axis, then pitch around new y-axis, then roll around new x-axis. An effect of this is that yaw, pitch and roll values are easiest to interpret when the coordinate system of the reference points is defined as X forward, Y left and Z up. In this case yaw equals turning your head, pitch equals nodding your head, roll equals tilting your head.
- If the primary camera hasn't already been oriented, the coordinate system is defined to have its origin in the primary camera's focal point, and its axes are oriented as X forward, Y left and Z up as seen from the primary camera.

Notes about point selection

The points used for relative orientation should be easily identifiable and well-defined in both views. It is very important that these points are accurately tracked since inaccuracies here will affect the entire 3D process.




The points must not lie on or close to a line since then it is not possible to find the camera position (the points will look the same if the camera is rotated around the line). Ideally the points should be distributed evenly over the entire measurement volume, but this is not an absolute requirement (all the points can e.g. lie in the same plane). There should be points in all four quadrants of both images.

Calibrating more than two camera views

If you have more than two camera views they should be calibrated in pairs, e.g. (with three views) view 1 + 2 and view 2 + 3 or views 1 + 2 and 1 + 3. You do not have to use the same points for different pairs of cameras, since each pair is oriented separately.


Procedure

1. Create two camera views and define the camera parameters for each view.

2. Identify at least six (preferably 8-10) points in the two views and track them in both views. The points must have the same name in both views.
3. Select the Find Relative Camera Orientation option from the Camera menu. The Relative Camera Orientation dialog is displayed.
4. Select which camera views belong to the primary and secondary cameras (if you only have two camera view, this will be set automatically).
5. Select the points to be used in the calibration by selecting/unselecting the appropriate check boxes. The default is to include all the points listed.
6. Specify the Calibration Interval by selecting the appropriate radio button:
 - All times - performs the calibration over the complete time scale.
 - From/To - performs the calibration over the specified time scale:
 - Enter a From and/or To time, selecting the appropriate unit.
 - Select the appropriate  button to set the From or To time to the current time.
 - Select the  button to set the From time to the earliest time.
 - Select the  button to set the To time to the latest time.
7. Select the two points that will define the scale. Enter the distance between the points ("distance" refers to the 3-dimensional distance as measured by e.g. a ruler in the scene).
8. Press the Calibrate button.

Note: An error message is displayed if too few calibration points have been tracked. [Track at least six calibration points](#) before continuing.

9. The Relative Camera Orientation Results dialog is displayed, showing the results. The following details are displayed:
 - Camera Position - x, y and z coordinates for both cameras in the 3D coordinate system.
 - Camera Orientation - Roll, Pitch and Yaw attitude angles for both cameras. See the above Notes for angle definition.
 - Baseline – the calculated distance between the two cameras.
 - RMS Parallax - The root mean square value of the individual point parallaxes.
 - Point Parallaxes - The level of error for each reference point. The parallax is defined as the "miss distance" between the lines of sight from each camera to the point.
10. Check the RMS Parallax value.



If it is smaller than or of the same magnitude as the required measurement accuracy the calculation is deemed to be accurate. If it is large, check which of the Point Parallaxes are large. A large value in any of the values shows that either a measured point position is not correct, the camera parameters have not been specified correctly or a reference point has not been positioned accurately in the camera view. The cause of the problem should be identified and eliminated before the calculation is repeated. Please note that points that are far away from the camera will in general have larger parallaxes than points that are close to the camera.
11. If the calibration results are acceptable, press the Accept button. The camera view icon in the Test Contents window changes to , indicating that the orientation of the camera has been set.

Note: When the orientation of a second camera view has been calculated, the system automatically add a 3D Results item to the Test Contents window. It contains a list of the target reference points. Whenever another camera view is added, the 3D Results is recalculated. For a point to be classified as a 3D point, it must be available in at least two camera views, both from cameras whose 3D position has been calculated by TEMA.
12. The camera (with Camera Orientation) can be displayed either
 - as a Curve showing its 3D position (applicable in all types of diagrams).



and/or

- as a Visualizer (symbol) showing both position and rotation (applicable only in a 3D diagram).

To display camera as a Curve

- Select the Curves tab in the Plot section in the diagram Properties dialog.
- Highlight the applicable camera  in the Data Selection section and click Add button.
OR
Double-click on the applicable camera  in the Data Selection section.
The camera will be added in the Curves tab in the Plot section.
- Press OK button.
- The camera is now displayed in the diagram .

To display camera as a Visualizer *Note! Only valid for a 3D diagram.*

- Select the Visualizer tab in the diagram Properties dialog.
- Highlight the applicable camera  in the Data Selection section and click Add button.
OR
Double-click on the applicable camera  in the Data Selection section.
The camera will be added in the Visualizer tab.
- Press OK button.
- The camera is now displayed (default size) in the diagram .
- The size of the Visualizer can be set/changed, either by:
 - Simultaneously moving the cursor over the Visualizer and using the scroll function on the mouse.
 - Simultaneously keeping the left mouse button down and moving the cursor in the *vertical* direction.
 - Right-clicking on the Visualizer, selecting Visualizer and then setting the size in the Visualizer size dialog.
 - Right-clicking on the Visualizer in the diagram Properties dialog, selecting Properties and then setting the size in the Visualizer size dialog.

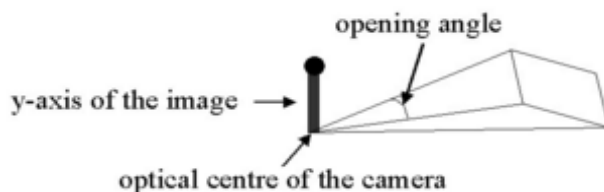


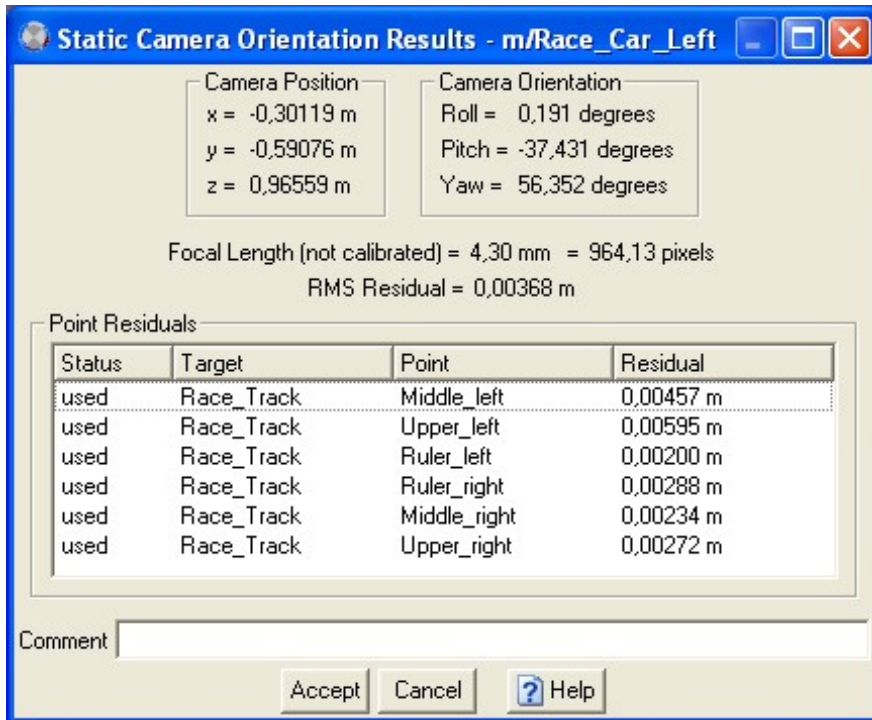
Illustration of camera as Visualizer.

See Also...

[Getting Started - 3D](#)

Camera Position and Rotation Definitions

When performing a camera orientation in TEMA, 6 parameters are computed for the camera: x, y, z, roll, pitch and yaw.



Example computation of the camera position (x, y, z) and orientation (roll, pitch, yaw).

External Coordinate System

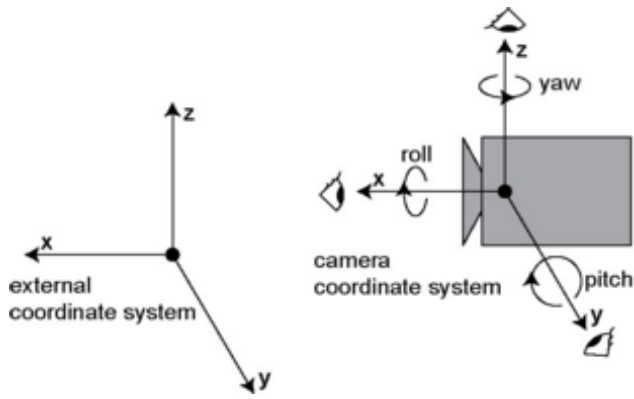
The position and attitude of a camera is always relative to a right-handed external coordinate system. In the case of a [static camera orientation](#) the coordinate system is defined by the reference points. In the case of a [relative camera orientation](#) the coordinate system is defined by one of the cameras.

Camera Position

The x, y and z parameters are position coordinates of the focal point, or projection centre, of the camera in the external coordinate system. Physically, the focal point is located inside the camera, along the optical axis. Its exact location along the optical axis depends on the focal length of the lens.

Camera Attitude

The roll, pitch and yaw parameters are Euler rotation angles according to the x y z (roll-pitch-yaw) convention, and they describe the attitude of the camera in the external coordinate system. Mathematically, the attitude describes a coordinate transformation between the *camera coordinate system* – a coordinate system which moves together with the camera, so that a given point on the camera always has the same camera coordinates – and the *external coordinate system* which forms the frame of reference in which we want our results. The camera coordinate system is defined to have the x-axis parallel with the optical axis of the camera, the y-axis parallel to the sensor and pointing left and the z-axis parallel to the sensor and pointing up.



The attitude of a camera with a certain roll, pitch and yaw parameters is defined as follows:

1. Start with the camera in the zero position, i.e. with roll=pitch=yaw=0. This means that the camera coordinate system and the external coordinate system are aligned, as in the illustration above.
2. Rotate *yaw* degrees around the *z*-axis of the external coordinate system. Positive *yaw* is counter-clockwise (ccw) as observed from above the camera.
3. Secondly, rotate *pitch* degrees around the *new/rotated* *y*-axis of the camera coordinate system. Positive *pitch* is clockwise (cw) as observed from left of the camera.
4. Third, rotate *roll* degrees around the *new/rotated* *x*-axis of the camera coordinate system. Positive *roll* is counter-clockwise (ccw) as observed from in front of the camera.

Note: The order of rotations is important!

An effect of this definition is that yaw, pitch and roll values are easiest to interpret when the external coordinate system is defined as *x* forward, *y* left and *z* up. In this case yaw equals turning your head, pitch equals nodding your head, roll equals tilting your head.

Examples:

- (roll=0°, pitch=0°, yaw=0°) corresponds to a camera in the zero position. I.e. the optical axis is aligned with the *x*-axis of the external coordinate system (ECS), "left" on the camera sensor is aligned with the *y*-axis of the ECS and "up" on the camera sensor is aligned with the *z*-axis of the ECS.
- (roll=90°, pitch=0°, yaw=90°) corresponds to a camera that is turned "left" 90°, then tilted to clockwise (as observed from inside the camera) 90°. I.e. the optical axis is aligned with the *y*-axis of the ECS, "left" on the camera sensor is aligned with the *z*-axis of the ECS and "up" on the camera sensor is aligned with the *x*-axis of the ECS.

The attitude of the camera can also be expressed mathematically as the following rotation matrix *R*:

$$\mathbf{R} = \begin{pmatrix} \cos\phi & \sin\phi & 0 \\ -\sin\phi & \cos\phi & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \\ \sin\theta & 0 & \cos\theta \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\psi & -\sin\psi \\ 0 & \sin\psi & \cos\psi \end{pmatrix}$$

where roll= ψ , pitch= θ and yaw= ϕ .

If we perform the matrix multiplications we get an explicit formula for *R* in terms of the sines and cosines of the three parameters:

$$\mathbf{R} = \begin{pmatrix} C_\phi C_\theta & -S_\psi C_\phi S_\theta + C_\psi S_\phi & -C_\psi S_\theta C_\phi - S_\psi S_\phi \\ -S_\phi C_\theta & S_\psi S_\phi S_\theta + C_\psi C_\phi & C_\psi S_\theta S_\phi - S_\psi C_\theta \\ S_\theta & S_\psi C_\theta & C_\psi C_\theta \end{pmatrix}$$

with the notation

$$S_\psi = \sin \psi, C_\psi = \cos \psi, S_\theta = \sin \theta$$

etc.

Enter Camera Orientation

Function

If the 3D orientation of camera used in a 3D test is known, this function can be used instead of the [Camera Orientation](#) function that calculated the 3D position of a camera by the use of reference points in two images.

Here, we manually enter the 3D position of the camera directly. After this, a 3D test can be done using this camera position.

If we have used the Camera Orientation function, when the Enter Camera Orientation dialog is opened, the output values from the Camera Orientation calculation will be present here. Any value can be entered here, amending the calculated position. If changed, the new position will be used in the 3D test.

Procedure

Maintaining 3D Point Properties (Optional Feature)

Note: Because a 3D point is derived from a 2D point in two or more camera views its definition is automatically specified. Only the name can be changed.

1. Select the required 3D point in the Properties List dialog.
2. Select the Properties option from the Edit menu.
The 3D Point Setup dialog is displayed
3. Key in the required Name for the point.
4. Select the OK button.

Inserting Reference/Target Points (Optional Feature)

This function is used to insert the reference/target points from an externally defined target. The reference/target points are subsequently used to calculate the orientation of the camera via the [Static Camera Orientation](#) function.

Note: The function is only available with the 3D(Reference Points) or 6D(Target Points) Optional Feature.

Procedure

1. Select the appropriate Camera View window.
2. Select the Insert Reference Points (3D) or Insert Target Points (6D) option from the Camera menu. Note that the 3D coordinate system that is created when measuring the reference points will be used by TEMA when calculating camera positions and 3D data. TEMA supports right handedness only. A strong recommendation is have the Z axis pointing upwards. See [here](#) for more info.
3. To import reference/target points from a file:
 - Select the Import from File option from the sub-menu.
 - A standard Open dialog is displayed with the file type preset to '.trg'.
 - Select the required target file.
 - Select the Open button.
 - The Imported Target Model dialog is displayed.
 - Amend the target model, if required. Note that the 3D coordinate system in which the target model is expressed will be used by TEMA. Therefore, there are a few requirements on the target model. See [here](#) for more explanation.
 - For each point you wish to define for the target:
 - Select the Add button.
 - A point is added to the Points list. which has a default Name (P1, P2, etc.) and its x, y, z coordinates set to 0,0,0.
 - Select the Name of the point and change it, if required.
 - In turn, select the x, y and z coordinates of the point and change them to the required values.
 - For any point you wish to remove from the target:
 - Select the point.
 - Select the Remove button.
 - The point is removed.
 - For any point you wish to modify:
 - Select the entry in the Points list.
 - Select the Name of the point and change it, if required.
 - In turn, select the x, y and z coordinates of the point and change them to the required values.
 - Select the required Unit from the list.
 - Select the OK button.
 - The target points are added to the selected camera view in the Test Contents window. The target file name is used as the name of the point Group.
4. To copy reference/target points from another view:
 - Select the Copy from Other View option from the sub-menu.
 - The Select Points dialog is displayed.
 - Select the required target from the list of those already in the test.
 - Select the Copy button.
 - The points from the selected target are displayed in the Test Contents window under the selected camera view. The target file name is used as the name of the point Group.

Target File Formats

The formats used by TEMA to import target models are described below:

- **TRG Files (*.trg) - 3D Targets**

The TRG format is the standard format for Cartesian target models in TrackEye and TEMA.

A TRG file is a Windows text file. Both 8-bit and Unicode characters are supported. It consists of two parts: point definitions and line definitions.

A typical TRG file may look like this:

```
length unit=feet
* Point definitions with normal vectors
A 0    -9.8550984 1.0933176
B -6.096 -3.7590984 0.155448
"Point 1" -6.096 -3.7590984 1.0445496
"Point 2" 6.096  -3.7590984 0.158496
"Point 3" 6.096  -3.7590984 1.0475976
```

The file starts with a line that specifies the length unit in which the coordinates are given. The same abbreviations for length units as are used inside TEMA. This line can be omitted. If it is not present TEMA interprets the coordinates in the current default length unit.

The following lines define the target points. Each line contains the name of the point followed by its x, y and z coordinates. The name and coordinates are separated by space and/or tab characters.

It is allowed to have point names containing spaces. In that case the point name must be surrounded by double quotation marks ("").

This file also contains one comment line. Any line starting with an asterisk (*) is skipped completely and can be used for comments. Blank lines or lines containing only space and tab characters are also skipped.

Note: Numbers may use either a decimal point or a decimal comma.

- **TGT Files (*.tgt) - 2D Targets**

The TGT format is the standard format for 2D target models in TrackEye and TEMA.

A TGT file is a Windows text file. Both 8-bit and Unicode characters are supported. It consists of two parts: point definitions and line definitions.

A typical TGT file may look like this:

```
length unit=cm
A 0 -9.855
B -6.096 -3.759
"Point 1" -6.096 -3.759
"Point 2" 6.096 -3.759
"Point 3" 6.096 -3.759
```

The file starts with a line that specifies the length unit in which the coordinates are given. The same abbreviations for length units as are used inside TEMA. This line can be omitted. If it is not present TEMA interprets the coordinates in the current default length unit.

The following lines define the target points. Each line contains the name of the point followed by its x and y coordinates. The name and coordinates are separated by space and/or tab characters. Numbers may use either a decimal point or a decimal comma.

It is allowed to have point names containing spaces. In that case the point name must be surrounded by double quotation marks ("").

The file may also contain comment lines. Any line starting with an asterisk (*) is skipped completely and can be used for comments. Blank lines or lines containing only space and tab characters are also skipped.

See Also...

[Getting Started - 3D](#)

[Getting Started - 6D](#)

3D with moving cameras

Function

In applications where the cameras are not still during a test, [a static camera orientation](#) will not work as it will only be valid for the exact image at where it is done.

When the camera moves, so will all reference points in relation to the camera. Therefore, a new camera orientation has to be done for each image of the sequence. This is what the Dynamic Camera Orientation function does.

The dynamic camera orientation will work for non-moving cameras as well, but the static orientation is faster if there are many reference points.

Procedure

This example has one moving camera and one that is still.

1. For the non-moving camera, perform steps [1-8 in the 3D calculation procedure](#).
2. Add the non moving camera view to the test.
3. For the moving camera, right click in the Contents list and select [Camera view properties/ Camera Parameters](#). Enable Dynamic Orientation by clicking in the check box.
4. [Insert Reference Points](#) for the moving camera. The Dynamic Camera Orientation does not have any settings dialog, as the static does. As soon as at least four reference points have been inserted in the view, the dynamic camera orientation function will calculate the camera position in the current image. In this case, as the still camera is already oriented, 3D data for the reference points will be produced at the same time.
5. Continue with points [12 - 18 in the 3D test](#).

See also...

[Static Camera Orientation](#)
[Inserting Reference Points](#)

6DOF Calculations (Optional Feature)

The 6DOF Calculations function computes the position and orientation of a tracked object from a single camera view.

The motion of a rigid body can be described with six parameters: three position coordinates (x, y and z), which give the position of a specific point on the body, and three attitude angles (roll, pitch and yaw), which give its orientation in space. We therefore say that the body has six *degrees of freedom*, or 6DOF. The term 6D (for "six dimensions") is often used as a synonym for 6DOF, and TEMA refers to the six parameters as the *6D position* of the body.

To be able to perform 6DOF calculations for an object we must define an object coordinate system that moves along with the object. If we know the 6D position of the object, and the object coordinates of a point on the object, we can calculate where in an image, taken by a camera with known parameters, the point will appear.

On the other hand, if we have observed at least three points with known object coordinates, and measure the coordinates of these points in the image, we can set up and solve a system of equations that give us the 6D position of the object. Unfortunately, with three points these equations usually have multiple solutions, of which only one corresponds to the correct 6D position. TEMA therefore requires at least four points to be tracked in order to get a unique solution.

Coordinate Systems

TEMA always assumes that the object coordinate system is right-handed.

All results are presented relative to the object's position at the time t_0 . This means that the computed 6D position is 0 at that time, and the value at any other time shows how the object has moved relative to its position and orientation at t_0 .

*** Starting from version 3.9 there is an alternative coordinate system, the 'Camera Coordinate System'. This coordinate system has its origin in the camera's focal point. The x-axis is the optical axis, the y-axis is left and the z-axis is up. The computed 6DoF parameters will be calculated relative to the camera.

Differences between 3D and 6DOF

The main differences between TEMA's 3D and 6DOF options is that the 3D option requires at least two cameras observing the same object, while the 6DOF option only needs one camera. On the other hand, the 6DOF option requires that at least four points on the object be tracked, and that these points have known coordinates in the object coordinate system, while the 3D option works with isolated points.

See Also...

[Getting started - 6D](#)

DIC (Digital Image Correlation, option)

DIC Inspection Lines

An "Inspection Line" can be placed anywhere inside the DIC ROI (region of interest). This line will appear as a plottable sequence in the Advanced Diagram and can also be exported from the "Export DIC Data" function.

This allows inspection of strain values along any line to get a cross-section. Inspection lines work by simply picking samples from the (previously calculated) continuous strain field along the line definition. This guarantees that the results shown in the inspection line will always agree with other results in TEMA DIC.

Camera Control (Optional)

Function

The camera control option enables the control of multiple high speed cameras of various types.

Camera Control delivers live images so that the user obtains instant feedback when parameters such as resolution, frame frequency, exposure time, etc. are changed.

Functions are provided for arming and triggering the cameras, downloading the recorded images and exporting them.

All the cameras that have ever been found by the program at some point are stored so that tests can be set up without network connection and with cameras unplugged.

Procedure

The following scenario shows a typical use of the system and includes all the main functions. See also [Ancillary Functions](#).

1. [Scan for Cameras on the Network](#)

This command scans the available network to identify all the attached cameras. The Camera Control functions start in [Live Digital mode](#).

Note: At any stage the test can be saved and recalled for later use. If a special test setup is often used, it is a good idea to save the test before arming so that it can be used as a template for other tests.

2. [Add Cameras to the Test](#)

This command enables you to select the cameras you wish to include in the test.

3. [Setup Cameras](#)

This command enables you to specify the parameters for the cameras in the test.

4. [Set the Black Reference for the Cameras](#)

This command enables you to set a "black area" as a reference point for the cameras in the test.

5. [Arm the Cameras](#)

This command activates the cameras and, optionally, downloads the captured images.

6. For each camera from which you wish to download images:

Note: This step is not necessary if the cameras are set to download automatically.

- o Select the camera in the Test Contents window.

- o [Download Images from the Cameras](#) (if not performed automatically).

7. Export the Downloaded Images.

If required, the downloaded images can be exported using the standard export functions, i.e.

- o for a single camera - [Exporting Images](#);

- o for multiple cameras - Exporting Multiple Images.

8. [Clear the Images from the Cameras](#).

This function deletes all the images from all the cameras in the test.

9. When the required image ranges have been downloaded, they can be used for tracking as usual in TEMA (if the Tracking option is set).

10. At any time you may use the [Time Overview](#) function to display the status of the available images.

Ancillary Functions

Preferences

Parameters relating to Camera Control and the cameras used are stored in the Preference Archive. Once they have been set up, they should not need to be amended unless new camera types are introduced, or if the physical connection of the I/O Module is changed. See [Maintaining Camera Control Preferences](#).

Camera Assignment

This function enables you to relate physical cameras to logical cameras in the test description. This becomes necessary if you have set up and performed a test and saved its description for subsequent use. When the test is setup again, the cameras (identified in the network by their unique IP addresses) may not be in the same physical locations as in the original test, i.e. the camera identified in the test description by the name "top" may now be physically pointing from the side. The Assign Cameras function enables you to switch the physical cameras to their appropriate logical names. See [Assigning Cameras](#).

Storing Camera Setups


When the cameras in a test have been configured and their black references set, the following procedure can be used to save the test setup for future use.

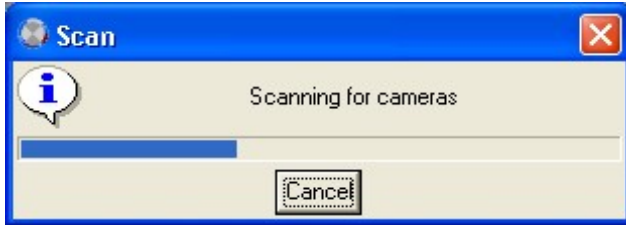
1. Select the Save Test option from the File menu.
The Save as dialog is displayed with the ".ted" file type pre-selected.
2. Save the test as a template in an appropriate file.
Continue with the current test.
4. When the template is to be reused, select the Open Test option from the File menu.
The Open dialog is displayed with the ".ted" file type pre-selected.
5. Browse for the file containing the template.
6. If the cameras have placed in different physical positions, use the [Assign Cameras](#) function to reallocate them to the correct logical names in the program.

See Also...

[Camera Control Toolbar](#)

Scanning for Cameras

1. Select the  Scan For Cameras option in the Camera menu.
A progress message is displayed while the network is scanned for existing cameras.




When the scan has been completed, the message is removed from the display.

See Also...

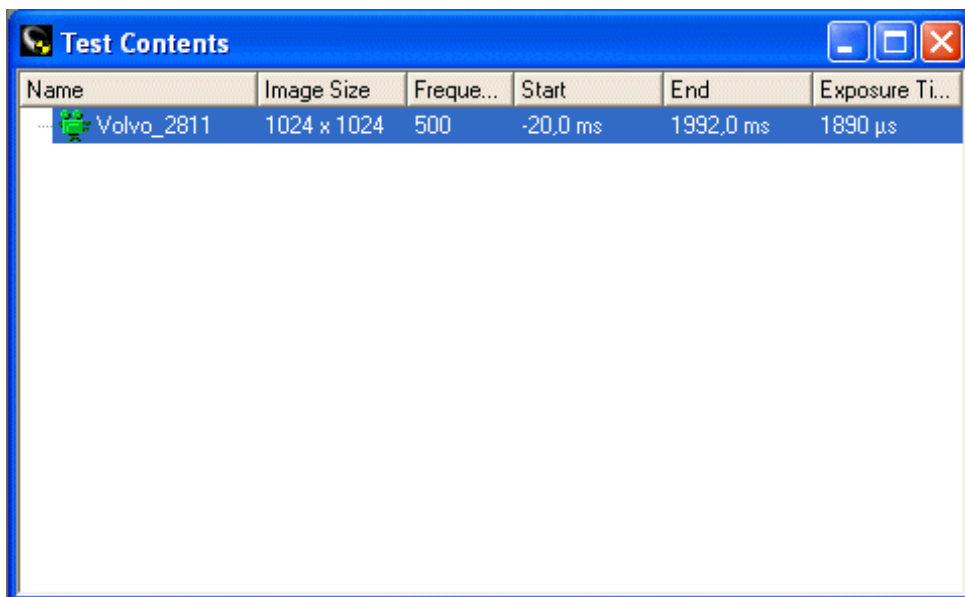
[Controlling Cameras](#)

Adding Cameras

1. Select  in the Standard toolbar.
The Add Camera dialog is displayed, showing the cameras located by the [camera scan function](#).

Each of the identified cameras can be in one of three states, i.e. "Empty", "Full" and "Armed"
If one of the cameras you wish to use is not listed, make sure that it is connected to the network and repeat the network scan.

2. Select the camera(s) (multi select with the <Ctrl> key) that you wish to use in the test. OR:
Select the Views tab. Select view(s) from the [Views](#) list. When a view is selected, the associated camera(s) will be added to the test.
3. Select the OK button.
The selected cameras or views are displayed in the Test Contents window.



Note: The parameters displayed in the Test Contents window can be changed directly. The new values are reflected immediately in the Camera Setup window

See Also...

- [Camera Setup Dialog](#)
- [Controlling Cameras](#)

Camera Setup Window

Function

Configure the Camera(s) used in a test before recording.

Appearance of Setup Window

Lock Parameters

Some parameters can be locked to aid the setup of cameras. The parameters that can be locked are Frame Frequency, Resolution and Duration. It is only possible these parameters when all cameras controlled by the setup window are on-line and both frequency and resolution can be changed freely (see Preferences).

- None
 - All parameters can be changed independently of each other.
- Resolution
 - When Frame Frequency is changed the Duration is calculated automatically.
 - When Duration is changed the Frame Frequency is changed to a value that will give the best match (duration is updated with the actual duration obtained unless the obtained duration is different for the different cameras then the typed value will be shown).
- Frame Frequency
 - When resolution is changed a new duration is calculated automatically
 - When duration is changed a resolution is calculated that, for the chosen Frame Frequency, will (if possible) give at least the desired duration (duration is updated with the actual duration obtained unless the obtained duration is different for the different cameras then the typed value will be shown).
- Duration
 - When Resolution is changed the Frame Frequency is changed to get the wanted duration. The displayed duration will be updated with the obtained duration unless the obtained duration is different for the different cameras then the typed value will be shown.
 - When Frame Frequency is changed the Resolution is changed to get the wanted frame frequency and (if possible) at least the duration wanted. The displayed duration will be updated with the obtained duration unless the obtained duration is different for the different cameras then the typed value will be shown.
 - When Duration is changed the Frame Frequency will change to adapt to the new desired duration.
 - A previously typed value for the duration will always be the goal even if it could not be reached in previous change of resolution or frame frequency.

Imaging

- Image Size
 - Specifies the pixel resolution of the image in the camera. Once a value has been selected, the Frame Rate, Exposure Time, Pre Trigger Frames and Total Frames values are calculated. Although these can be overridden, it is not recommended.
 - *Note: Values that are invalid for the selected camera are grayed out in the combination list.*
 - *Note: When "Free" is enabled in the preferences for Image Sizes the combination list is replaced by enter fields for width and height where the user can type in the desired Image Size (the resulting Image Size will change to the closest possible size). By pressing "Full" the maximum resolution for each camera will be obtained.*
- Frame Frequency
 - Specifies the image frequency in Hz.
 - *Note: Values that are invalid for the selected camera are grayed out in the combination list.*
 - *Note: When "Free" is enabled in the preference for Frame Frequencies the combination list will be replaced by an enter field where the user can type the desired Frame Frequency (the*

resulting Frame Frequency will change to the closest possible size).




Recording

- Pre Trigger Frames - Specifies the additional number of frames to be recorded before the Start Time.
- Total Frames - Contains the calculated total number of frames that can be stored in the camera, given the selected Resolution.
- Start Time - Contains the calculated time at which recording is to start.
- End Time - Contains the calculated time at which recording is to end.
- Duration – Only enabled when:
 - All cameras (controlled by the Camera Setup Window) are on-line.
 - Frame frequency and image size can be changed freely (see Preferences).
 - The Lock Parameters have been set to the same for all cameras (Resolution, Frame Frequency or Duration).

Auto Download

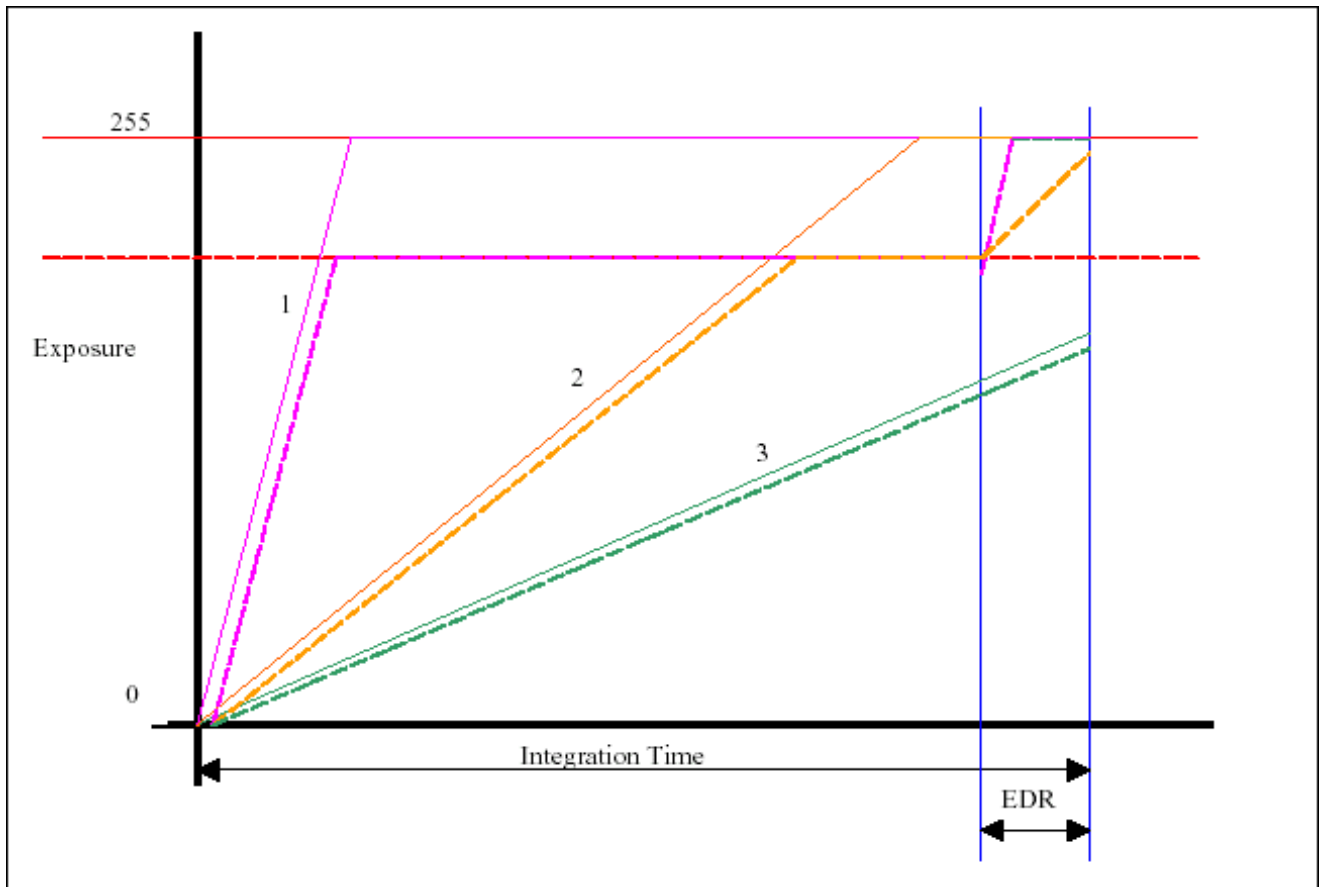
- Enable - Check box used to indicate that images are to be automatically downloaded from the camera to the system.
- Download Priority - A camera with a low number will download before a camera with a high number.
- Start Frame - Specifies the number of the frame, including Pre Trigger Frames, at which downloading is to start.
- End Frame - Specifies the number of the frame, including Pre Trigger Frames, at which downloading is to end.
- Start Time - Contains the start time calculated from the Start Frame number.
- End Time - Contains the end time calculated from the End Frame number.
- File names for [Dual download \(optional\)](#). Specify filename 1 and 2.

Exposure

- Exposure Time
 - Specifies the exposure time (μ s) for each image in Live Digital and Live Video operational modes. (The longer the time, the lighter the image).
 - *Note: The value set here will be used for Snapshots also (when in Camera Control Mode, clicking the Snapshot button .)*
- Auto Exposure
 - This is a Phantom Camera feature. If the toggle is enabled, the set Exposure level will be the maximum value.
 - A rectangle can be defined by typing the values of four corners (Left, Right, Top and Bottom) in the camera view, or by using a defined [Area Of Interest](#), using the  button.
 - The medium light in this rectangle is captured and used as Exposure Level. However, if the value is lower than what is manually typed, it is not used.
- Low Light Exp
 - The exposure and frame frequency are set to a special low light mode to allow for focus setting, etc. in low light conditions. The use of this feature is to be able to set up the camera before a test without the need of extensive light.
 - Note: The value set here will be used for Low Light Snapshots also (when in Camera Control Mode, clicking the Low Light Snapshot button .)
- EDR Exposure
 - This setting is applicable to Phantom cameras only.
 - Extreme Dynamic Range exposure is used when the images contain very bright areas as well as darker areas and both must be exposed correctly throughout the test. A typical example would be windscreen reflection from a light source appearing in part of the image sequence, where a shutter time that gives the correct exposure when the reflection occurs would cause overexposure when the reflection is not present. Traditionally, this type of application would require either two cameras set with different exposures, or two separate tests.
 - The EDR function enables the user to set a general exposure time for pixels that does not



cause overexposure and a separate pixel dependent exposure for those pixels that cause overexposure. It should be noted that the only reason to use EDR is if image data is expected to be in the overexposed areas of the image.

- The Y-axis indicates Black to White. The X-axis is the exposure time.



- Without EDR Applied:
Pixel 1 is exposed for the Integration period and becomes fully exposed, i.e. white, as does Pixel 2. For the same exposure time Pixel 3 has some grey level.
- With EDR Applied:
EDR time is always shorter than the main exposure time and is applied from the end of the main integration time. Pixel 1. is charged at the same rate as previous but is clamped at a factory set grey level. The Pixel is clamped for a duration until EDR time, where once again the pixel is allowed to charge. This is at the same rate and in the case of Pixel 1 is still overexposed. Pixel 2 however does not reach saturation and so has some grey level instead of being over exposed. Pixel 3 is not affected by EDR as it never reached the EDR clamp level. As data is gathering is not intended to produce aesthetic ally pleasing images, EDR is a featured to help obtain data where overexpose is an obstacle. EDR affects the image, i.e. a monochrome image appears flat while a color image does not have representative colors. The argument being that to have good data but wrong color is more of an advantage than correct color but poor data. The EDR function gives the effect of an increase in Dynamic Range, which is why it is often referred to as Extended Dynamic Range instead of Extreme Dynamic Range.

Features of the camera setup

- The camera setup is a [window](#). Therefore, it can be put in Free  or Locked  Mode.
 - If the camera setup window is in Free mode, it will display the settings for the camera currently selected in the [test contents](#) list. Even multi selections can be done.
 - If the camera setup window is in Locked mode, it will display the settings for the camera(s) at

where it was locked, no matter what is selected in the test contents list. The window can be locked having multi select cameras also. Having the camera setup locked on one camera view, another can be opened for the any other camera in the list, including the one already selected or multi selection.

Time Overview

- The Time Overview Window will be shown.

Show Summary

- Pressing this button a list is shown with name, image width and height, frame frequency, and exposure time for all cameras controlled by the Camera Setup Window.
- The Summary and Advanced will never be shown at the same time. The advanced section of the Camera Setup Window will, if shown, be hidden when the Show Summary button is pressed.
- Hide Summary – Will hide the summary list.

Show Advanced

- Button used to display the parameters in the Miscellaneous frame and the Low Light Exp and EDR Exposure parameters in the Exposure frame.
- The Summary and Advanced will never be shown at the same time. The summary section of the Camera Setup Window will, if shown, be hidden when the Show Advanced button is pressed.
- Miscellaneous
 - Lock to IRIG time code - This setting is applicable to Phantom cameras only. A physical input signal is used to control the camera timing.
 - Use External Frame Clock - The camera uses a signal from an external timing source for frame control.
 - Download JPEG compressed images - enable when using cameras with internal image compressing.
 - Ready signal even if camera goes off-line after arming (optional) - In some tests, we might have cameras that are disconnected during the actual Arm /Trigger sequence. Typical example is onboard cameras in impact tests. Because of the disconnection, TEMA cannot communicate with them. Enabling this option will make TEMA assuming they are armed and a download will be made after the test is ready and the camera is put back online.
- Hide Advanced - Button used to remove the Miscellaneous group of parameter settings.

Procedure


1. Select the camera to be configured.

Note: You may select more than one camera and configure them all in the same way in a single operation. In such multiple select cases, field values that are different for the selected cameras are represented by blanks, and toggles by a gray toggle. By selecting/setting a value the blank disappears and all selected cameras are updated with the value set.


2. Select the  Camera Setup Window option in the Camera menu. The Camera Setup window is displayed, showing a default set of parameters.

Note: Several of the parameters are also displayed in the Test Contents window and can be changed directly. The new values are reflected immediately in the Camera Setup window.

3. [Specify the required parameters](#), i.e. Imaging (image size and Frame frequency) , Recording , Auto Download and Exposure.
4. If necessary, select the Show Advanced button and configure the Miscellaneous parameters and the two additional Exposure parameters.
5. If a high Frame Rate is selected for the test, this limits the exposure time to short times only of course. If this short time is too short to give a good image without the heavy duty lighting on, a

special "low light" [operational mode](#) can be selected by clicking the low light button  in the tool bar. These are orthogonal to the Video and Digital operational modes. In low light mode the Frame Rate is always 50 Hz and the special Low Light Exp exposure slider is used. The purpose of this is to enable live images to be shown without the risk of the user forgetting to reset the Exposure and Frame Rate before arming.

6. Select the OK button.
7. Repeat the above procedure for other cameras that require different parameter settings.


It is also possible to set up multiple cameras if there is more than one present in the test. Multi select in the test contents list and select the Camera setup . If a multiselection is done, the camera setup window will not display any camera specific settings for any camera but only those common for the whole selection.

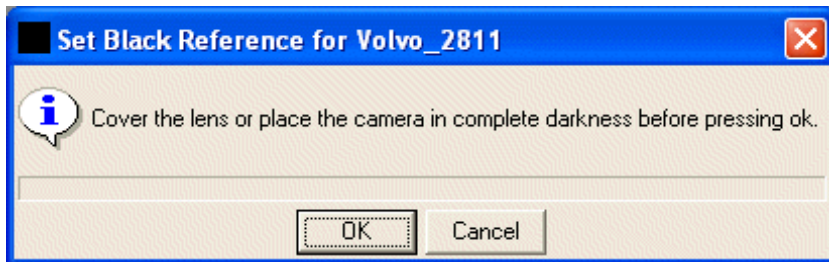
See Also...

[Controlling Cameras](#)

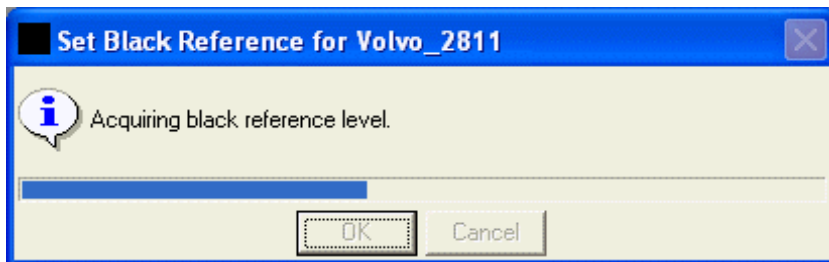
Setting the Black Reference for the Cameras

This function makes an image more even by compensating for the differing leakage currents of each pixel which cause the addition of a constant to each pixel value. It can be used to remove stripes or fixed pattern noise from images from Phantom imagers.

1. Select the camera to be configured.
2. Select the  Set Black Reference option in the Camera menu. The Set Black Reference for <camera name> dialog is displayed.



3. Place the lens cap over the lens.
4. Select the OK button.



5. When the function has completed, select the OK button.
6. Repeat the above procedure for the other cameras in the test.

See Also...

[Controlling Cameras](#)

Arming the Cameras



Function

The Arm command will arm all cameras in all Test Sections (optional) at once. The Trigger command, that will start to capture images and record on the camera memories, is reached from the Arm dialog.

Appearance

- Download Directory. With the [Dual Download](#) (optional) is used, there will be two different Download directories here. Both can be amended. The default value(s) are taken from the Preference Archive/Directories. By default, the path will be taken from what is specified in the Preference Archive. However, this can be amended to any other download path. If any of the directories specified does not exist, such will be created prior to the download.
- The list of all the Camera Views affected by the Arm command. For every camera in list, the following information is provided:
 - View - Name of the Camera View.
 - Camera - Name of the Camera.
 - Filename - The name of the file to be downloaded. With the Dual Download function (optional), there are two columns for this, one for each download directory. The filename(s) are taken from what is specified in the [Camera Setup](#) window for each camera, but can be clicked and amended in the columns as well. Not only the file name(s) can be specified here, but a whole path with the download directory can be typed. If a path is typed here, this will be used instead of or in combination with what is in the Download Directory entered above. Some examples of this:
 - If the Download Directory enter field contains the path *C:\teimage\Download*, and the Filename pattern here is *Download_1/Images*, then the final path and filename will be *C:\teimage\Download\Download_1\First_Shot*.
 - If the Filename pattern is *C:\teimage\Images\First_Shot* then the path in the Download Directory enter field will not be used at all, only the path in the filename pattern.
 - If any of the directories specified in the Filename pattern does not exist, such will be created prior to the download.
 - Status - status of each the camera during the Arm/Trigger procedure.
 - Empty - The camera RAM memory is empty.
 - Full - If automatic download is not selected, the "Full" status is displayed to indicate completion.
 - Armed - The camera is Armed, but no Trigger signal has been sent yet
 - Triggered - The camera has received a trigger signal
 - Downloading - The percentage of the specified download range.
 - Download Completed
 - Waiting - The camera is waiting for other cameras to finish downloading, as the number of parallel downloads is limited in order to save bandwidth.
 - DL Start - Image starting frame at Auto Download.
 - DL End - Image ending frame at Auto Download.
 - Warnings - Warning messages before and during the Arm/Trigger procedure. The warning messages are sorted in a tree structure in categories. To see which cameras that are affected by the warning, click the + adjacent.

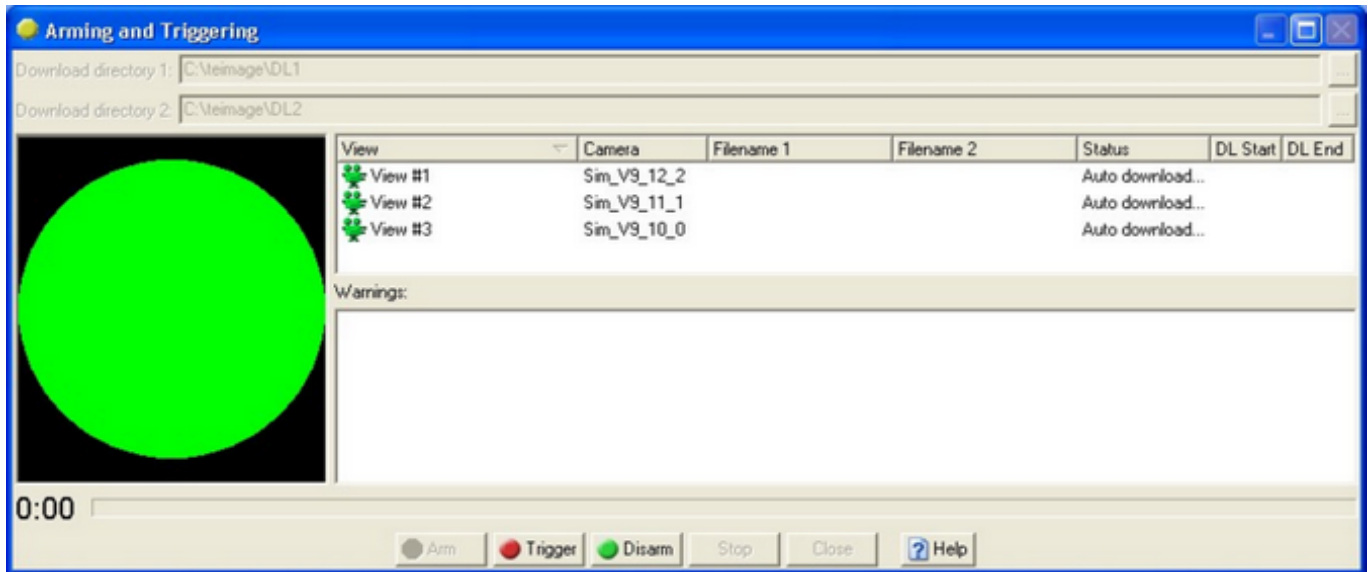
Procedure

1. Open the Arming and Triggering dialog by:
 - Selecting the  Arm option in the Camera menu
 - OR
 - Pressing the  Arm button in the toolbar.

The Arming and Triggering dialog is displayed.

The Status indicator (coloured circle to the left) is grey at start but will change colour depending on status:

- Grey - Arm button not pressed yet, waiting for recording.
- Red - Error.
- Green - Cameras are armed.
- Blue - Recording (and download) in progress.
- Yellow - Recording (and download) not completed.
- White - Recording (and download) completed.



2. If you wish to amend the download destination for a camera:
 - Amend the Download directory (directories).
 - Select the appropriate Filename and change it.
 - The Status indicator is grey (waiting for recording).
3. Press the Arm button.
 - The Status indicator will turn green.
 - The recording time indicator will start.
 Press the Disarm button to stop recording.
4. Press the Trigger button.
 - The Status indicator will turn blue during recording (and download).
5. Wait for the cameras to finish recording.
 - The Status indicator will turn white when recording (and download) is complete.
 - The image sequences will be automatically downloaded after recording is complete (if Auto Download is enabled).
6. Close the Arming and Triggering dialog.


See Also...

[Snapshot Recording](#)

There is an optional feature that is called [Single Frame Arm](#) that works in [Single Test Sections](#) only. This will capture a snapshot from the cameras in test.

Snapshot Recording

Function



The Snapshot Recording command (similar to the [Arm](#) command) will capture and record short image sequences (one to a few images) per camera. The  Capture command, that will start the recording, is reached from the Snapshot Recording dialog.

This command is very useful when capturing images of a calibration board for performing a [Lens Calibration](#).

Appearance

- Download Directory. The default value(s) are taken from the Preference Archive/Directories. By default, the path will be taken from what is specified in the Preference Archive. However, this can be amended to any other download path. If any of the directories specified does not exist, such will be created prior to the download.
- The list of all the Camera Views affected by the Capture command. For every camera in list, the following information is provided.
 - View - Name of the Camera View.
 - Camera - Name of the Camera.
 - Filename - The name of the file to be downloaded. The filename(s) are taken from what is specified in the [Camera Setup](#) window for each camera, but can be clicked and amended in the columns as well. Not only the file name(s) can be specified here, but a whole path with the download directory can be typed. If a path is typed here, this will be used instead of or in combination with what is in the Download Directory entered above. Some examples of this:
 - If the Download Directory enter field contains the path *C:\teimage\Download*, and the Filename pattern here is *Download_1/Images*, then the final path and filename will be *C:\teimage\Download\Download_1\First_Shot*.
 - If the Filename pattern is *C:\teimage\Images\First_Shot* then the path in the Download Directory enter field will not be used at all, only the path in the filename pattern.
 - If any of the directories specified in the Filename pattern does not exist, such will be created prior to the download.
 - Status - Status of each the camera during the Snapshot Recording procedure.
 - Waiting - The camera is waiting to start capturing/recording images.
 - Recorded images # - Number of recorded images in the image sequence.
 - Warnings - Warning messages before and during the Capture procedure. The warning messages are sorted in a tree structure in categories. To see which cameras that are affected by the warning, click the + adjacent.

Procedure

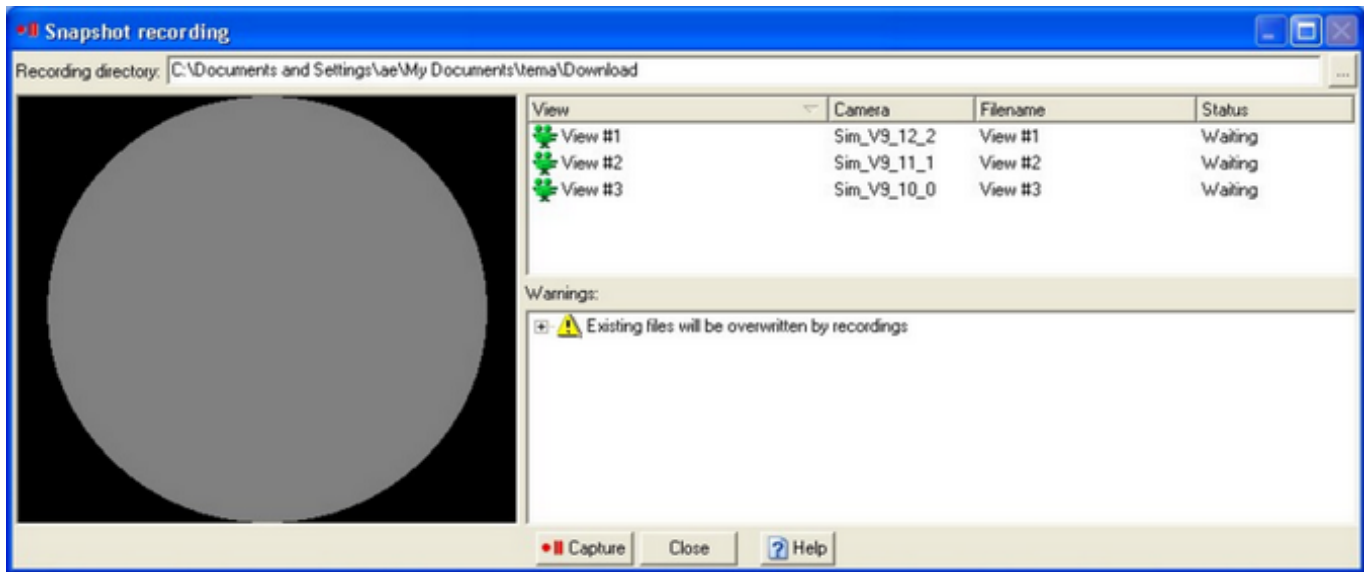
7. In the Test Contents dialog, select (mark) those cameras aimed to start capturing images.
8. Open the Snapshot Recording dialog by:
 - Selecting the  Snapshot Recording option in the Camera menu
 - OR
 - Pressing the  Snapshot Recording button in the toolbar.



The Snapshot Recording dialog is displayed.

The Status indicator (coloured circle to the left) is grey at start but will change colour depending on status:

- Grey - Capture button not pressed yet, waiting for recording.
- Red - Error.

- Pink - Recording and download in progress
- Green - Waiting for new recording.



9. If you wish to amend the download destination for a camera:
 - Amend the Download directory.
 - Select the appropriate Filename and change it.
 - The Status indicator is grey (waiting for recording).
10. Press the  Capture button.
 - The Status indicator will turn pink (recording and download in progress).
 - The Status indicator will turn green (waiting for new recording).Press the Close button to stop recording.
11. Press the  Capture button for each new image to be captured and added to the belonging image sequence.
 - The image sequences will be automatically downloaded after recording is complete.
12. Close the Snapshot Recording dialog.


See Also...

[Arming Cameras](#)

There is an optional feature that is called [Single Frame Arm](#) that works in [Single Test Sections](#) only. This will capture a snapshot from the cameras in test.

Single Frame Capture (Optional)

Function



If working with [Test Sections \(optional\)](#), and the active section is in [single](#) mode, the arm commando will be replaced with the Single Frame Capture, or *Snapshot Capture*, button .

Appearance

- Download Directory. With the [Dual Download](#) optional functionality, there will be two different directories available for camera download. The default value(s) are taken from the Preference Archive/Directories. However, this can be amended to any other download path. If any of the directories specified does not exist, such will be created prior to the download.
- The list of all the Camera Views affected by the Single Frame Snapshot command. For every camera in list, the following information is provided;
 - Name - name of the Camera View
 - Camera - name of the camera in View
 - Filename - the name of the file to be downloaded. With the Dual Download function (optional), there are two columns for this, one for each download directory. Both patterns can be amended. The filename(s) are taken from what is specified in the [Camera Setup](#) window for each camera, but can be clicked and amended in the columns as well. Not only the file name (s) can be specified here, but a whole path with the download directory can be typed. If a path is typed here, this will be used instead of or in combination with what is in the Download Directory entered above. Some examples of this;
 - if the Download Directory enter field contains the path *C:\teimage\Download*, and the Filename pattern here is *Download_1/Images*, then the final path and filename will be *C:\teimage\Download\Download_1\First_Shot*.
 - if the Filename pattern is *C:\teimage\Images\First_Shot* then the path in the Download Directory enter field will not be used at all, only the path in the filename pattern.
 - If any of the directories specified in the Filename pattern does not exist, such will be created prior to the download.
 - Warnings - warning messages before and during the Arm/Trigger procedure. The warning messages are sorted in a tree structure in categories. To see which cameras that are affected by the warning, click the + adjacent.

Procedure

The procedure is basically the same as with the [Arm](#) commando described above.

1. Select the Arm...  option in the Camera menu. The Single Frame Capture dialog is displayed.
2. If you wish to amend the download destination for a camera:
 - Amend the Download directory (directories).
 - Select the appropriate Filename and change it.
3. When clicking the [Low Light](#) button , the snapshot will be captured using Low Light mode.
4. Select the Capture button.
5. When the function has completed, select the Close button.
Note: The Stop button is used to cancel the capture of images, but the images already captured are downloaded.

Note: If working with [Test Sections \(optional\)](#), the Arm command will only arm the cameras which views are assigned to the currently active Test Section respectively.

For the camera views not assigned to the active Section, the message *Not Relevant for this Section* will be stated in the filename pattern(s) in the [Camera Setup window](#).




Manually Downloading Images from the Cameras

Function

To download recorded images from a camera in test. There are two main ways of doing this, Manual Download, as described below, and [Automatic Download](#), which is set before the [Arm/Trigger](#) command in the Camera Setup dialog.

Also, if no Arm/trigger command has been sent to the camera, there is a [Live Download](#) function that can be used for downloading the currently displayed image in a camera view.

Procedure

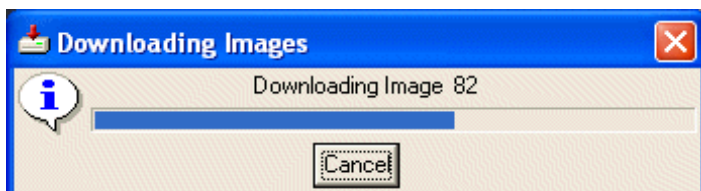
1. Select the camera from which images are to be downloaded.
2. Select the  Download Images option in the Camera menu. Alternatively, right-click the required camera icon in the Test Contents window. Select the  Download Images option in the pop-up menu. If an [Arm/Trigger](#) command had been performed, the Download images from <camera name> dialog is displayed, else the [Live Download](#) dialog will open
3. Use the image sequence [play buttons](#) or the [time slider](#) to identify the range of images to be downloaded.
4. If there is a large number of images, adjust the Speed slider to play the sequence faster.
5. Specify the Start and End images of the range you wish to download. If [Auto Download](#) had been enabled for the camera, the range specified there will be set as default here as well. Set the Current frame to Start/End by clicking the Use Current Frame buttons .
6. If required, amend the Filename for the generated image file. If set in the [Preference Archive/Directories](#) or [Sections](#) Setup (optional), default File Names will be inserted from start. Those can be overwritten. A full path including the destination directory can be typed here, or inserted via the browse function. If using [Dual Download \(optional\)](#), two destinations can be specified here.
7. Click in the Compress check box to enable file download in compressed format

Note: The Manual Download procedure might be of value even if [Auto Download](#) is enabled. This as the auto Download only downloads the range specified in the camera setup. Should some event of interest occur outside the boundaries of this interval, this can be downloaded manually.



7. Select the OK button.
If there are images already in the specified file, a message is displayed, in which you can select whether to overwrite the existing file or to cancel and go back to the download dialog and specify a new name to the view.

The selected image range is downloaded to the specified file. A progress dialog is displayed.



Note: The Cancel button is used to cancel the download, but it does not delete the half-written file but makes it a completely valid, but shorter, image file.

See Also...

[Auto Download](#)

[Redo Auto Download](#)

[Live Download](#)

[Camera Setup Dialog](#)

[Controlling Cameras](#)

Dual Download (optional)

Function

An optional feature where it is possible to specify two destinations for the automatic and manual [download](#) commands. The procedure used for this is to first download to the first destination (presumably on the local disk) and then copy from there to the second destination. This minimizes time until data is safe on one disk.

Procedure

1. Specify the two download destinations. Go to preferences/Directories and set the Download 1 & 2 directories. Type in full paths or browse.
2. Set the filename pattern also. The name typed here will be used to name the resulting downloaded files. By default the filename pattern \$VIEWNAME\$ is used. When downloading, this very syntax will be replaced by the name used for the camera view in the test contents list.
3. Go to the [Camera Setup Dialog](#). In the Auto Download area, there are two enter fields called First Filename and Second Filename. These are the dual download filenames. If the syntax pattern above has been used in the preference, the view name in the test contents list will be in the enter fields. If the view name is changed in the test contents list, so will the download filenames, but not vice versa. The reverse buttons



See also...

[Manual Download](#)

[Live Download](#)


Live Download (optional) (optional)



Function

If working with [Test Sections \(optional\)](#), and the active section is in [single](#) mode, this function will be available. The command will download the image currently displayed in a camera view window. If this is in snapshot mode, the latest snapshot using any of the snapshot functions (Normal Light  or [Low Light](#) Snapshot ) will be downloaded. If in continuous mode, the one image displayed when the Download button was clicked will be downloaded.

Appearance

Procedure

The live download command prerequisites that the camera is online (green camera  in the test contents list) and that no [Arm/Trigger](#) command has been sent to the camera. If this is done, the [Manual Download](#) dialog will open instead.

1. Mark the live camera in the test contents list and click the Manual Download button  in the tool bar OR right click the camera in the list and select Manual Download . The Live Download dialog appears.
2. Enable instant image compression to jpeg format when downloading by clicking in the Compress check box
3. If required, amend the Filename (2 filenames for [Dual Download](#) (optional)) for the snapshot download. If set in the [Preference Archive/Directories](#) or [Sections](#) Setup (optional), a default File Name will be inserted from start. This can be overwritten. A full path including the destination directory can be typed here, or inserted via the browse function.

See also..

[Manual Download](#)

Redo Auto Download

Function

To download recorded images from a camera in test. There are three ways of doing this:

- [Manual Download](#)
- [Auto Download](#) - automatic download which is set before the Arm/Trigger command in the Camera Setup dialog.
- Redo Auto Download - as described below, performs the Auto Download from the Redo Auto Download dialog and is reached from the Camera menu.

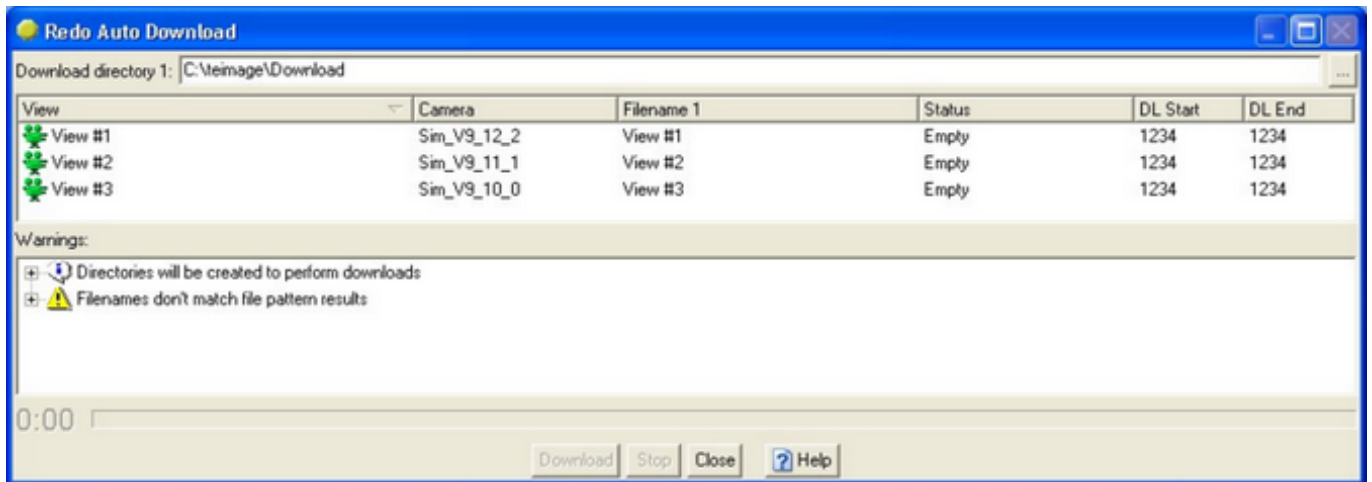
Appearance

- Download Directory - The default value(s) are taken from the Preference Archive/Directories. By default, the path will be taken from what is specified in the Preference Archive. However, this can be amended to any other download path. If any of the directories specified does not exist, such will be created prior to the download.
- The list of all the Camera Views affected by the Redo Auto Download command. For every camera in list, the following information is provided:
 - View - Name of the Camera View.
 - Camera - Name of the Camera.
 - Filename - The name of the file to be downloaded. With the Dual Download function (optional), there are two columns for this, one for each download directory. The filename(s) are taken from what is specified in the [Camera Setup](#) window for each camera, but can be clicked and amended in the columns as well. Not only the file name(s) can be specified here, but a whole path with the download directory can be typed. If a path is typed here, this will be used instead of or in combination with what is in the Download Directory entered above. Some examples of this:
 - If the Download Directory enter field contains the path *C:\teimage\Download*, and the Filename pattern here is *Download_1/Images*, then the final path and filename will be *C:\teimage\Download\Download_1\First_Shot*.
 - If the Filename pattern is *C:\teimage\Images\First_Shot* then the path in the Download Directory enter field will not be used at all, only the path in the filename pattern.
 - If any of the directories specified in the Filename pattern does not exist, such will be created prior to the download.
 - Status - status of each the camera during the Arm/Trigger procedure.
 - Empty - The camera RAM memory is empty.
 - Full - If automatic download is not selected, the "Full" status is displayed to indicate completion.
 - Armed - The camera is Armed, but no Trigger signal has been sent yet
 - Triggered - The camera has received a trigger signal
 - Downloading - The percentage of the specified download range.
 - Download Completed
 - Waiting - The camera is waiting for other cameras to finish downloading, as the number of parallel downloads is limited in order to save bandwidth.
 - DL Start - Image starting frame at Auto Download.
 - DL End - Image ending frame at Auto Download.
 - Warnings - Warning messages before and during the Arm/Trigger procedure. The warning messages are sorted in a tree structure in categories. To see which cameras that are affected by the warning, click the + adjacent.

Procedure

13. Open the Redo Auto Download dialog by selecting the Redo Auto Download option in the Camera menu.

The Redo Auto Download dialog is displayed.



14. If you wish to amend the download destination for a camera:
 - Amend the Download directory (directories).
 - Select the appropriate Filename and change it.
15. Press the Download button. (Press the Stop button to stop recording).
16. Close the Redo Auto Download dialog.


See Also...

[Manual Download](#)

[Auto Download](#)

Clearing Images from the Cameras

Certain cameras, e.g. Kodak, cannot provide live images while there is a stored image sequence. This command is used to clear such cameras. It has no effect on cameras, such as phantom cameras, that can provide live images while there is a stored image sequence.

1. Select the  Clear Cameras option in the Camera menu. The Clear Cameras dialog is displayed.




2. Select the OK button. All the images in all the cameras in the test are deleted.

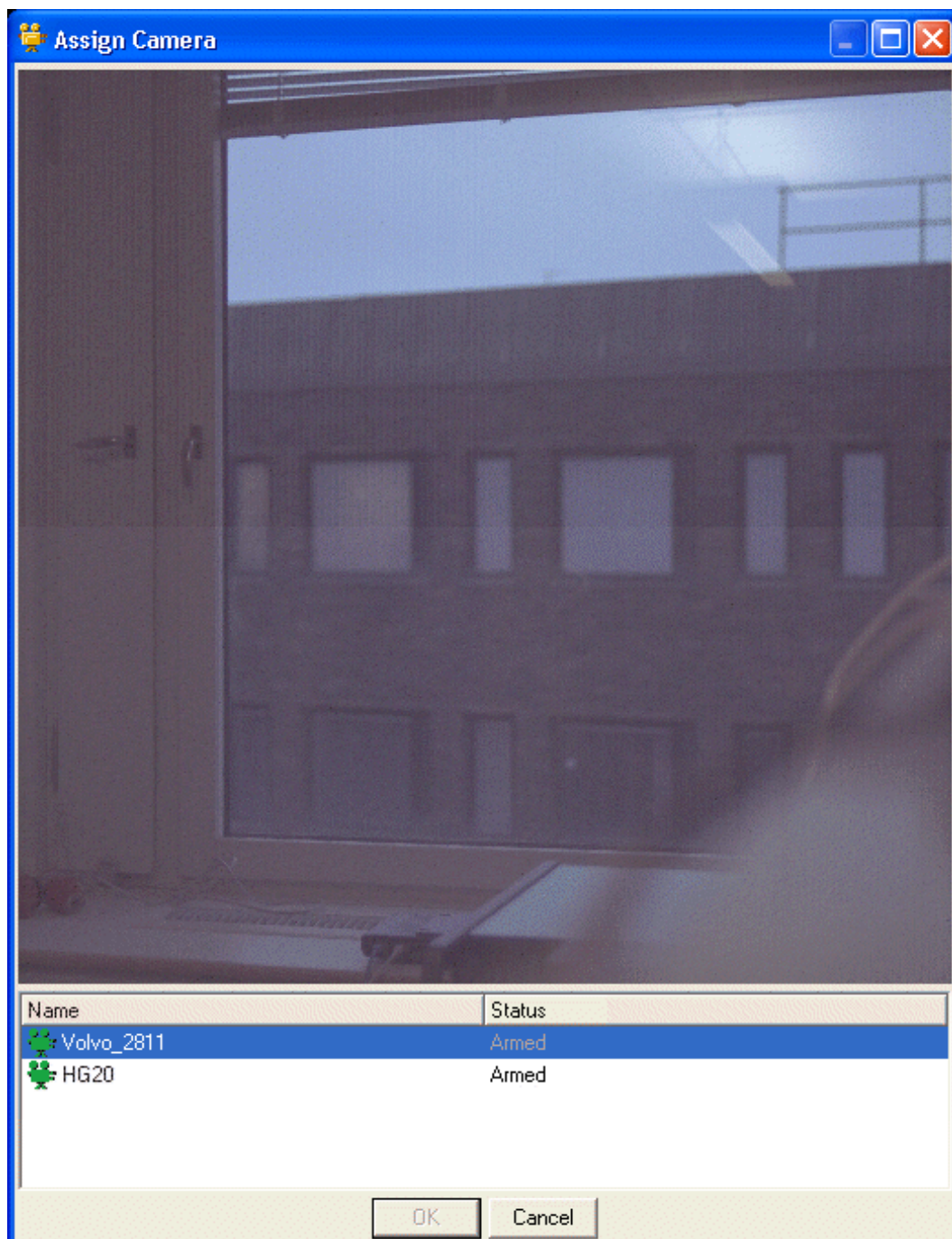
See Also...

[Controlling Cameras](#)

Assigning Cameras

This function enables you to relate physical cameras to logical cameras in the test description. This becomes necessary if you have set up and performed a test and saved its description for subsequent use. When the test is setup again, the cameras (identified in the network by their unique IP addresses) may not be in the same physical locations as in the original test, i.e. the camera identified in the test description by the name "top" may now be physically pointing from the side. The Assign Cameras function enables you to switch the physical cameras to their appropriate logical names.

1. Select the required camera in the Test Contents list.
2. Select the  Assign Camera To View option in the Camera menu. The Assign Camera dialog is displayed, showing the cameras located by the [Camera Scan Function](#).



3. Select the camera that you wish to use in the selected camera view in the Test Contents window.
4. Select the OK button.

See Also...

[Controlling Cameras](#)

Image Enhancement

Function

The Image Enhancement dialog is used to improve the colour composition and quality of a displayed image by adjusting the colours and associated factors in the image via a Vector Scope and/or the RGB waveform. Both tools are displayed in the dialog. See dialog illustration and [description](#).

Procedure

There are two ways of making adjustments:

- Use drag and drop in the Vector Scope and RGB Waveform graphs and view the results in the displayed image. The changes made are automatically reflected in the parameter values displayed below the two graphs.
- Adjust the parameter values displayed below the Vector Scope and RGB Waveform graphs and view the results in the displayed image. The changes made are automatically reflected in the Vector Scope and RGB Waveform graphs.
- Note: The Enabled Image Operations checkboxes can be used to view the before and after situation. When a checkbox is deselected, the effect of any corresponding parameter changes is removed. When the checkbox is selected, the changes are applied.

For instructions on the use of these tools, see:

- [Using the Vector Scope](#)
- [Using the RGB Waveform](#)
- [Using the Histogram](#)

The objective of image enhancement is to improve the quality of the displayed image. The nature of different image sequences dictates that no firm rules can be prescribed and that the procedure is necessarily subjective.

The image enhancement can be performed across the whole image or on just a [selected area of interest](#).

It is recommended that adjustments are made in the following sequence:

1. [White Balance](#)
2. [Saturation/Hue](#)
3. [Contrast/Brightness](#)
4. [Edge Enhancement \(Filter\)](#)





In normal circumstances the [Degamma/Gamma](#) operations should not be deselected.

Image Enhancement Window

Appearance

The Image Enhancement dialog contains the following:

Visualizations of the image dynamic and colour contents.

- Vector Scope - contains the vector scope graph and associated controls:
 - Intensity - slider used to increase or decrease the intensity of the colour representation in the Vector Scope.
 - Luminance - contains three radio button used to select the image luminance range displayed in the Vector Scope.
 - All - the full luminance range.
 - High - only top 50% of the luminance range is displayed.
 - Low - only bottom 50% of the luminance range is displayed.
 - Tool - contains a list of tools. The selection made determines the factor that is to be adjusted via the Vector Scope.
 - White Balance Low - the white balance of the top 50% of the range.
 - White Balance High - the white balance of the bottom 50% of the range.
 - Saturation/Hue - the colour intensity and shade.
- RGB Waveform - contains the RGB waveform graph and associated controls:
 - Intensity - slider used to increase or decrease the intensity of the colour representation in the RGB Waveform.
 - Tool - contains a list of tools. The selection made determines the factor that is to be adjusted via the RGB Waveform.
 - White Balance High/Low - the white balance of the full range.
 - Contrast/Brightness - the contrast and brightness.
 - Range - the contrast and brightness of the image is adjusted to make use of the full colour range available. The selected range is fitted into 5% - 95% section of the total displayed.
- Histogram - indicates which part of the colour range is most concentrated.
 - Tool - contains a list of tools. The selection made determines the factor that is to be adjusted via the Histogram.
- Show/Hide. The scope and histogram windows can be individually turned on and off, use the corresponding buttons for this;
 -  Show/Hide RGB scope.
 -  Show/Hide Vector scope.
 -  Show/Hide Histogram.
- Vertical/Horizontal appearance. The scopes and histogram windows can be positioned vertically or horizontally in the dialog, use the Vertical  or Horizontal  buttons for this.

Note: Settings can be made by editing in the scopes also. Dragging levels will give the program an input of desired new levels. The image will then be updated to match the new levels and, in turn, send a signal to the visualizations to change.

Tab Structure

- C/B - adjustment controls.
 - Contrast - the contrast can be adjusted by am ending the numeric value or by moving the

- slider. Adjusting one automatically changes the other.
- Brightness - the brightness can be adjusted by amending the numeric value or by moving the slider. Adjusting one automatically changes the other.
See Auto Adjust below.
- Colour - adjustment controls.
 - Saturation - the colour intensity can be adjusted by amending the numeric value or by moving the slider. Adjusting one automatically changes the other.
 - Hue Angle - the colour can be adjusted by amending the numeric value or by moving the slider. Adjusting one automatically changes the other.
- Edge - adjustment controls.
 - Strength - specifies how much sharpening is performed. The zero point is in the middle of the slider, i.e. the lower the number, the more blurring; the higher the number, the more sharpening.
 - Radius - specifies how the sharpening is performed. A low number concentrates the sharpening towards small features, a high number concentrates on larger, more diffuse features.
- WB - adjustment controls. The three columns relate to Red, Green and Blue.
 - High - the white balance for the top 50% of the colour range, i.e. these figures are related to the position of the top sliders in the RGB Waveform graph.
 - Low - the white balance for the bottom 50% of the colour range, i.e. these figures are related to the position of the bottom sliders in the RGB Waveform graph.
Note: The adjacent Auto buttons are used to perform the white balance automatically, based on the specified [area of interest](#).
 - WB Presets - contains a series of radio buttons used to select a lighting configuration, i.e. None, Daylight, Tungsten or Fluorescent. These apply preset calibrations to the image without the need to mark the image. The last option, White Patch, is always disabled and refers to the standard method. It is automatically selected when an area of interest is specified in the image.
- Gamma - adjustment controls.
 - Gamma - adds a Gamma correction related to the particular screen being used.
 - FileGamma - the Gamma correction made when the image sequence was recorded.
- Enable - contains a series of check boxes used to select which image properties can be adjusted. Those not selected cannot be adjusted, even automatically.
 - Contrast / Brightness - adjusts the contrast and brightness.
 - Edge - uses a sharpening filter to perform edge enhancement.
 - Colour - adjusts colour intensity and shade.
 - White Balance - adjusts the displayed colours relative to a selected colour.
The White Balance can be adjusted via the Image Enhancement tools or by the separate [White Balance tool](#).
- Reset - button used to remove the affects of the changes made.
- Reset All - button used to remove the affects of the changes made in all tabs.
- Auto Adjust - button used to adjust the contrast and brightness of the image automatically.
- Calibrate Camera - button used to transfer (and save) applicable data to the camera connected to applicable image view. (The transferred data will be found in the Tools menu\Preferences \Camera Control, when the camera is configured). Next time the same camera is connected to an image view these saved data will be used and the image intensity will be scaled accordingly.
- Help - button used to display context-sensitive help.

Pixels Statistics

The pixel statistics is updated automatically by the system. It cannot be amended by the user.

- Note: Crushed and clipped pixels can already be present in the image before adjustments are made.
 - Crushed % - contains the percentage of pixels whose colour has been minimized, i.e. become totally black, by the adjustments made.
 - Clipped % - contains the percentage of pixels whose colour has been maximized, i.e. become totally white, by the adjustments made.

See Also...

[Image Enhancement](#)

Image Enhancement - Contrast/ Brightness

1. Select the Auto Adjust button.
This adjusts the colour and brightness using an internal algorithm. The result can be amend, if required, as described below.
2. Select the Contrast/Brightness tool from the list in the RGB Waveform frame.
3. Amend the Contrast and Brightness levels in the C/B tab until the required result is obtained.

See Also...

[Image Enhancement Dialog - Description](#)

[Using the RGB Waveform](#)

Image Enhancement - Edge Enhancement

1. Amend the Strength and Radius levels in the Edge tab until the required result is obtained.

See Also...

[Image Enhancement Dialog - Description](#)

Image Enhancement - Saturation/Hue

1. Select the Saturation/Hue tool from the list in the Vector Scope frame.
2. If you wish to set different levels for the High and Low Luminance, select the appropriate radio button and perform the procedure for each.
3. Amend the Saturation and Hue Angle levels in the Colour tab until the required result is obtained.

See Also...

[Image Enhancement Dialog - Description](#)

[Using the Vector Scope](#)

Image Enhancement - White Balance Function

Procedure

The following instructions prerequisites that all the image enhancement visualization scopes are visible.

To set the White Balance for the low and high ranges separately

1. If you wish to set different levels for the High and Low Luminance, select the appropriate radio button in the [Vector Scope](#) frame and perform the procedure for each.
2. Select the White Balance High tool from the list.
3. Amend the High level RGB values in the WB tab until the required result is obtained.
3. Alternatively:
 - Draw an appropriate [area of interest](#).
 - Select the adjacent Auto button
4. Select the White Balance Low tool from the list.
5. Amend the Low level RGB values in the WB tab until the required result is obtained.
5. Alternatively:
 - Draw an appropriate [area of interest](#).
 - Select the adjacent Auto button

To set the White Balance for the full colour range

1. Select the White Balance High/Low tool from the list in the RGB Waveform frame.
2. Amend the High and Low levels in the WB tab until the required result is obtained.

To set the appropriate lighting configuration

1. Below the RGB values are the lightning configuration presets. Select the appropriate radio button

Note: The White Balance can also be set using the separate [White Balance](#) tool. A setting made using the White Balance tool are reflected in the Image Enhancement tool.

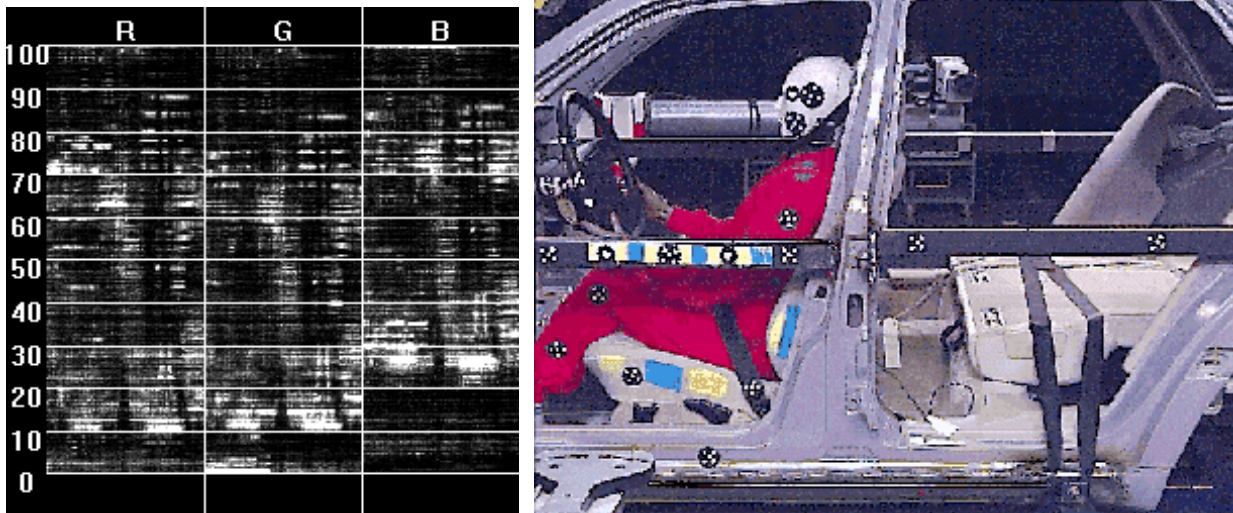
See Also...

[Image Enhancement Dialog - Description](#)

[Using the Vector Scope](#)

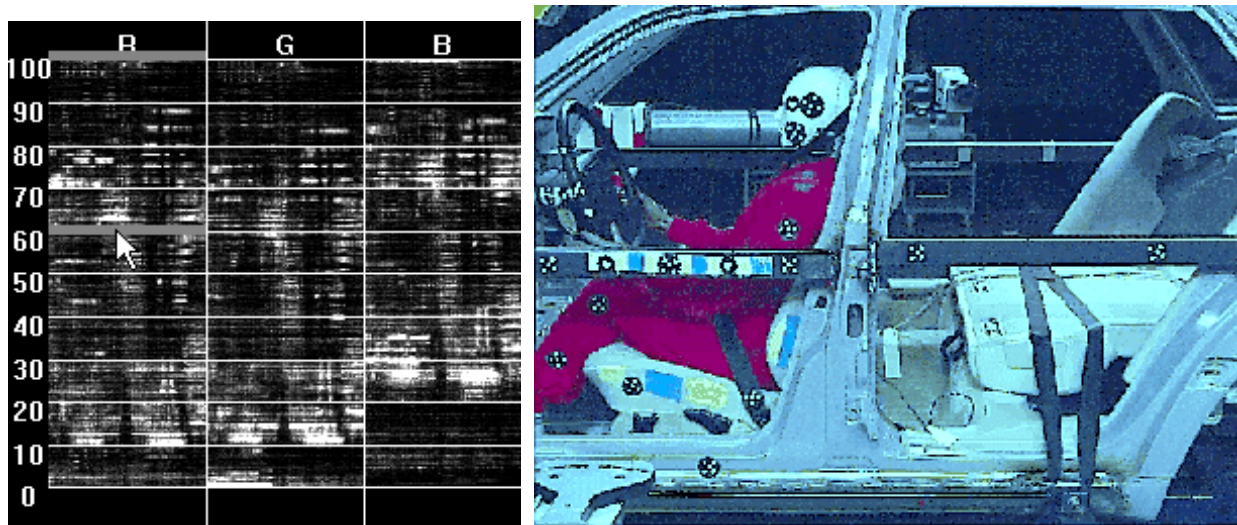
[Using the RGB Waveform](#)

Using the RGB Waveform

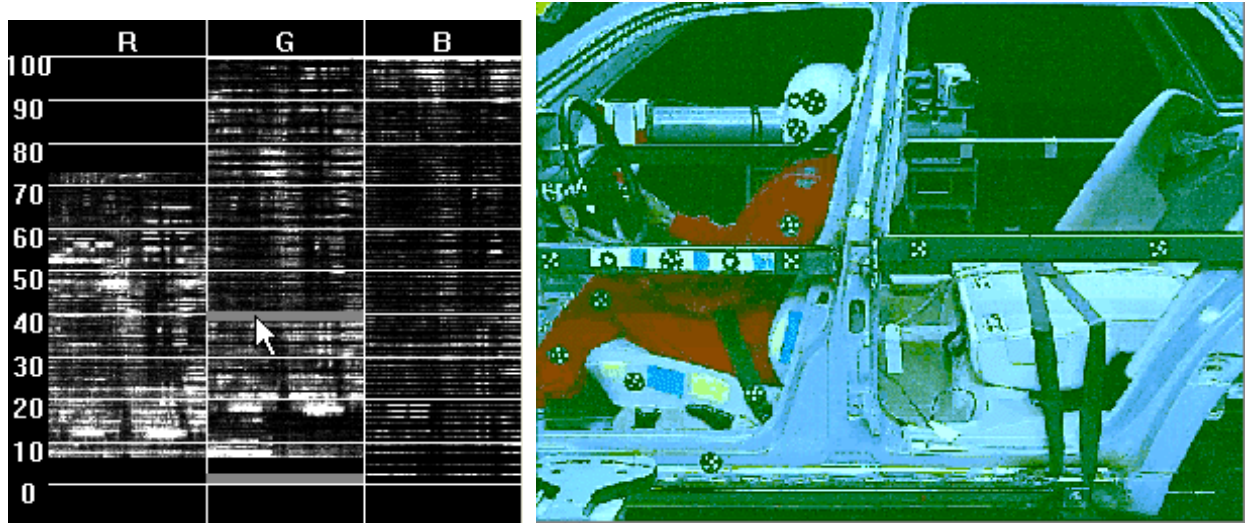


Each of the three columns represents 100% of the range for the associated colour and can be moved in two ways:

1. From the top down, reducing the amount of the selected colour:

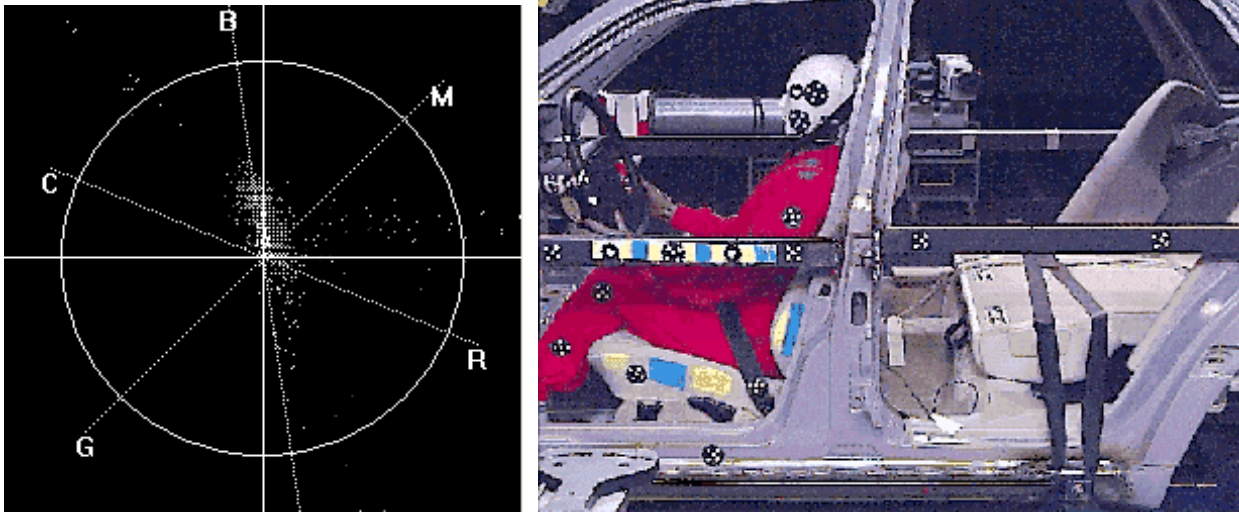


2. From the bottom up, Increasing the amount of the selected colour:



3. Also, set the appropriate Intensity by dragging the slider below the scope.

Using the Vector Scope

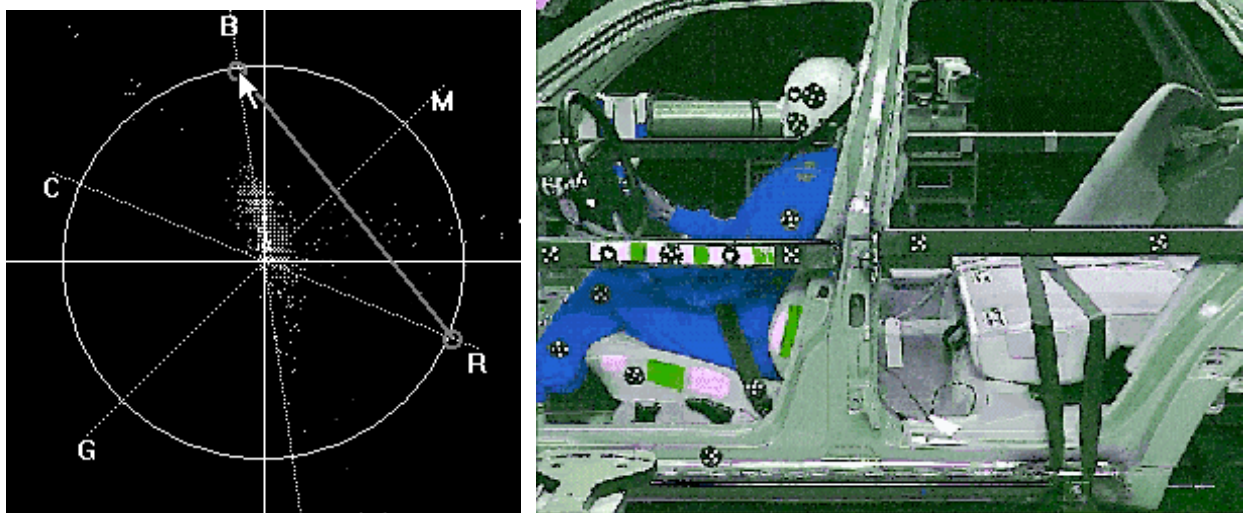


The direction lines superimposed on the graph indicate the colour towards which the colour balance is adjusted, i.e.

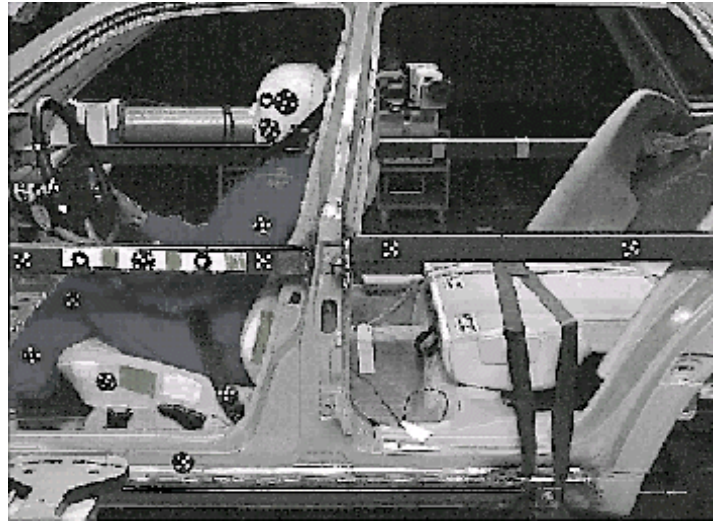
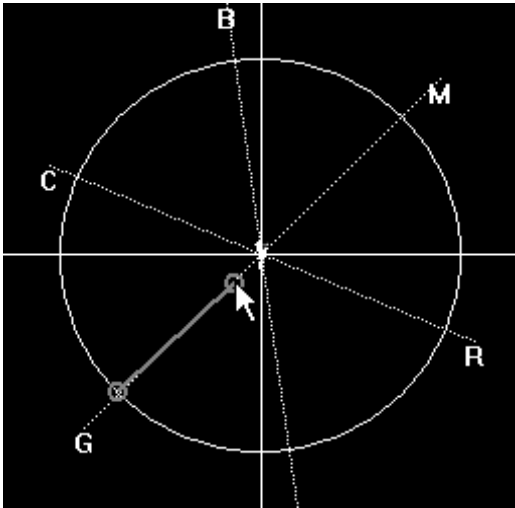
- B - Blue
- M - Magenta
- R - Red
- Y - Yellow
- G - Green
- C - Cyan

The lines can be moved in two ways:

1. Moving around the circle, adjusts the hue towards the target colour:

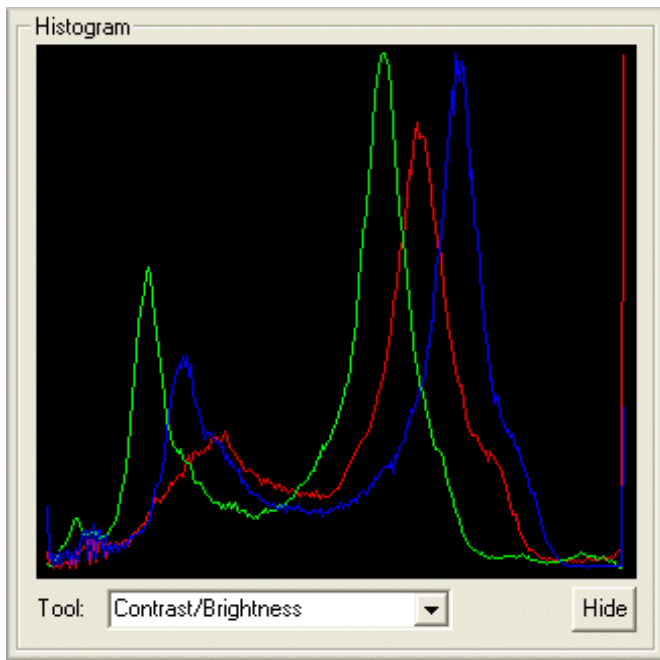


2. Moving towards the centre of the circle, adjusts the colour saturation:



3. The visualization can be set to Show All [RGB values](#), High or Low. Use the radio buttons below the scope.
4. Also, set the appropriate Intensity by dragging the slider.

Using the Histogram



Each of the three curves represents the grey scale value for a colour channel; Red, Green or Blue. The X axis represents the intensity and the Y axis represents the probability.

Preferences

Function

Preferences are default settings used by the system that you may set to your own requirements. The values set are used by the system unless overridden in particular circumstances. To carefully set up the preferences to match the way you work is well worth the effort and time.

Groupings

Each preference is assigned a grouping. The grouping for a preference is set in the [Preference Management \(optional\)](#).

- Global - affects all users
- Profile - affects the selected [Profiles](#)
- User - affects the current user only
- Machine - affects the current machine only. Used mainly when working towards a server. The settings for the server will then affect all the clients to this.

The preferences can be re-assigned a new grouping; a user preference can be set to a global instead etc. The assignment for the preferences set in TEMA from start is a recommended default.

Procedure

Preferences are maintained via the Preferences dialog which contains a list of the preference categories and a frame containing the settings for the selected category.

1. Select the Preferences option from the Tools menu.
The Preferences dialog is displayed.
2. Select the preference you want to amend:

Note! If you want to reset the changes in any preference to the factory default values, select Revert to Factory Settings by right-clicking the preference name in the preference list. This is valid for all preferences except for Image Export.

- [Attributes \(optional\)](#)
- [Analysis](#)
 - [Velocity](#)
 - [Acceleration](#)
- [Camera Control \(optional\)](#)
- [Camera Types \(optional\)](#) (3D and 6D only)
- [Directories](#)
- [Disc Cleanup \(optional\)](#)
- [General](#)
 - [Display](#)
 - [Cursor](#)
 - [Tool Color](#)
 - [Tracking](#)
 - [Windows Defaults](#)
 - [Time/Date](#)
 - [Image Cache](#)
 - [New Test \(optional\)](#)
- [Image Export](#)
- [Image Import](#)
- [Keyboard Bindings](#)

- [Policies \(optional\)](#)
 - [Precision and Units](#)
 - [Remote Export Servers \(optional\)](#)
 - [Test Planning System \(optional\)](#)
 - [Views \(optional\)](#)
 - [Presentation](#)
 - [Printing](#)
3. Repeat the above step until you have made all the required changes.
 4. Select the OK button.

Attributes

Function

A TEMA test and the camera views can be assigned extra information, or attributes.

Camera View Attributes

Camera view specific additional information; focal length etc. The camera view attributes created here can be reached from the Camera view right click menu/[Camera View Attributes](#)

Note: Updated Camera View Attributes will affect new tests only. Neither the currently opened nor any other existing tests are affected.



Test Attributes

Test attributes are additional test information that can be used in various places in the program.

Examples of use:

- When working with a [Test Database Interface](#), specific xml files from an external test system can be imported into TEMA. The contents in the file will then be re-interpreted and presented as a TEMA test. The xml file contains some test specific information in its syntax. Such will when imported into TEMA appear in as test attributes. With the help of this, the xml file can be quality checked before import into TEMA. The attributes setup is used for this. It is here the desired test attributes are set up. When making attempts to import, all of the required attributes must be in the file in order for TEMA to accept the file. We can also export a tem a text into xml format. The set test attributes will then be put into the resulting xml file.
- [Gun Scoring Test Data](#)

Procedure

1. Enter the Attributes tab in Preferences.
2. Select the Attribute type (Test or Camera View Attributes)
3. Add a new Attribute with the Add button. The Add Attribute dialog will open. In this, select the suitable Attribute name from the drop down list and then type in the Attribute name and tool tip if needed.
4. Press OK when ready.
5. Any attribute in the lists can be edited. Mark the attribute in the list and select Edit. The Edit Attribute dialog will appear.
6. in the Edit Attribute dialog, you can amend the following parameters;
 - Attribute name.
 - Tool tip. This will be shown in the attribute's entry field
 - Minimum numbers of characters entered. If set in [policy](#), the amount of characters are checked by TEMA at [End Test](#) command.
 - Number of lines for value.
 - Default value. For integer attributes, this must be an interger. For floating attributes a floating value will do.
7. Press OK when ready.
8. The order of the attributes in the list can be changed with the arrow buttons  .
9. Delete an attribute by marking it in the list and pressing Delete.

Accessed via...

Preferences/Attributes Set

See also...

[Test Database Interface \(optional\)](#)

[Test Planning System \(optional\)](#)

Analysis

The Analysis preferences are:

- [Velocity](#)
- [Acceleration](#)

Maintaining Velocity Preferences

The velocity preferences are used to specify how the velocity calculations are performed, i.e. how many adjacent points are taken into account when determining the velocity at a point. This is particularly important for short sequences and at the ends of long sequences.

1. Select the appropriate Filter Length radio button, i.e. 3, 5, 7 or 9-point.
This specifies how many points are taken into account when calculating the velocity at a point.
2. If you wish to limit the action of the specified filter at the ends of the sequence, select the Reduce Filter Length at Interval Ends checkbox.
When this option is selected, a shorter velocity filter is used at the ends of the sequence. This means that the number of samples that cannot be computed at the beginning and the end of the sequence is reduced.
3. If you wish to use a special length-two velocity filter to allow velocity calculations on very short sequences, select the Use Short-Sequence Filter checkbox.
This filter operates down to two samples. It is more sensitive to measurement noise than the normal filters, and is only be used if the Reduce Filter Length checkbox is selected.

See Also...

[Preferences](#)

The End

Maintaining Acceleration Preferences

The acceleration preferences are used to specify how the acceleration calculations are performed at the ends of sequences.

If you want the system to reduce the filter length, i.e. the number of points used in the calculation, select the Reduce Filter Length at Ends of Interval checkbox.

See Also...

[Preferences](#)

Camera Control Preferences (Optional)

Function



In order to organize the use of cameras in camera control, the cameras ever known by the system is stored. Those cameras can be set up to suit the way of use by the help of this preference pane.

Note: These preferences only apply if the Camera Control optional feature is included in the system.

Appearance

Information related to all the cameras seen by the program are stored in the Preference Archive for future use. This allows the operator to specify the cameras to pertain in a test even when they are off-line.

The following types of information are retained:

- [Image Sizes](#)
 - The Entries in this list are used to fill the image sizes combination list in the Camera Setup dialog.
 - Any value can be added here, but values that are invalid for the selected camera are grayed out in the combination list.
 - The order of the items in the list can be changed by help of the sort up  and down  buttons.
 - When "Free" is enabled the list will not be used and the user can change Image Sizes freely (within the limit of the camera specifications).
- [Frame Frequencies](#)
 - Entries in this list are used to fill the Frame Rate combination list in the Camera Setup dialog.
 - Any value can be added here, but values that are invalid for the selected camera are grayed out in the combination list.
 - When "Free" is enabled the list will not be used and the user can change the Frame Frequency freely (within the limit of the camera specifications).
- [Known Cameras](#)
 - Contains a list of the camera types known to the system.
 - New camera types are added to the list automatically by the [Camera Scan function](#).
 - New cameras can be added to the list. The Add Camera Dialog will then ask for camera configuration.
 - Present known cameras can be edited; renamed.
 - Cameras no longer used may also be removed from the list.
- [Advanced](#)
 - Settings for live cameras connected to a frame grabber.
 - Click the check box to enable live images.
 - The size of the frame grabber buffer can also be set here. Enter the appropriate memory size in MB. Set also the number of concurrent downloads.
 - Camera scanning and Remote control can also be configured from here.

Maintaining Image Sizes

To add a resolution:

1. Select the Add button in the Image Sizes frame.
The Add Resolution dialog is displayed.
2. Key in the Width and Height of the new resolution.
3. Select the OK button.

To remove a Image Size:

1. Select the resolution to be removed.

Note: Certain resolutions are classed as predefined and it is not possible to remove them. When selected, the Remove button becomes gray.

2. Select the Remove button in the Image Sizes frame.
The selected resolution is removed.

Maintaining Frame Frequencies

To add a frame rate:

1. Select the Add button in the Frame Rates frame.
The Add Frame rate dialog is displayed.
2. Key in the New Frame rate.
3. Select the OK button.

To remove a resolution:

1. Select the frame rate to be removed.
Note: Certain frame rates are classed as predefined and it is not possible to remove them. When selected, the Remove button becomes gray.
2. Select the Remove button in the Frame Rates frame.
The selected frame rate is removed.

Maintaining Known Cameras

Note: Cameras are added automatically via the Scan Camera function except for cameras connected via a frame grabber. Such cameras has to be added with the Add button.

To remove a camera:

1. Select the camera to be removed.
Note: Cameras that are currently in use cannot be removed. These are indicated by a green icon in the Known Cameras frame. Only cameras with a red icon can be removed.
2. Select the Remove button in the Known Cameras frame.
The selected camera is removed.

To configure a camera

1. Select the camera to be configured.
2. Select the Configure button in the Known Cameras frame. The Configure Camera window appears.
3. Change camera name by typing in the enter field.

Maintaining Camera Specific Preferences and various

- General
 - Max Number Of Concurrent Downloads from connected cameras can be set here. Type the value in the enter field.
- Phantom
 - Enable scanning. In order to make the camera scanning customized and more time efficient, the camera types included can be set. If this toggle is disabled, no Phantom Cameras will be included in the scanning.
 - Use NVRAM as backup if possible - Function used to emulate a battery backup function: if the power goes off after the camera became "Full" it will stay full.
- Photron
 - Enable Scanning. In order to make the camera scanning customized and more time efficient, the camera types included can be set. If this toggle is disabled, no Photron Cameras will be included in the scanning.
- Redlake 100k
 - Enable Scanning. This toggle is to speed up the process of scanning for cameras. When disabled, no Redlake 100k Cameras will be included in the scanning.
- Redlake HG

- Enable Scanning. In order to make the camera scanning customized and more time efficient, the camera types included can be set. If this toggle is disabled, no Redlake HG Cameras will be included in the scanning.
- Continuous Live Image. Due to the design of the HG camera, this toggle has to be enabled in order for live images to be captured from the camera.
- Limit Temperature. When enabled, TEMA will turn off the camera when the sensor reaches its limit temperature for function, +50° C. This is to prevent the sensor from the risk of getting too hot (which in turn can lead to sensor failure). NOTE: Unless the application demands it, it is recommended that this toggle is enabled at all times during camera usage.
- Emulated
 - Scan for DV cameras. Enable toggle to include Digital Video (DV) cameras in the scanning.
 - Frame Grabber Buffer Size (per camera). Key in the value in MB. Clicking the Add button will open up the Add New Camera dialog. Here, a new camera can be added to the test.
 1. Select the Configuration. There are two preset frame grabber-camera configurations. The frame grabber and camera can also be set up manually. Select from the drop down lists. If Gigabit Ethernet is the frame grabber, then
 2. Click Add when finished. The Add Camera dialog will appear. This will add the defined camera to the test. It will now be in the list of [known cameras](#).

Using Dalsa cameras on a Coreco frame grabber.

The configure camera window will appear with more settings when using a frame grabber.

1. Select the camera to be configured.
 2. Select the Configure button in the Known Cameras frame. The Configure Camera window appears.
 3. Camera Settings. Change camera name by typing in the enter field. Change camera type by selecting from the drop down list. Set also the appropriate COM port for the camera connection. Perform a fine camera calibration by enable the Time Calibration Settings check box. The camera readout time can be set. This is the time required by the camera to send data (one image frame) to the frame grabber. The default value is empirically determined.
 4. Frame Grabber Settings. Change Frame Grabber type by selecting from the drop down list. Set also the appropriate resource index, which is the port number on the frame grabber. The default value is -1. Set the CNF file by browsing to the file location on the workstation. Set also image mode. Default is L.
- Remote Control
 - Mode Single Client.
 Master - Slave.
 Slave Only.
 - Settings Group Name.
 Port.
 Arming Delay.
 - Sound Trigger
 - Use Microphone as trigger. A sound signal can be used for sending a trigger command to the cameras in the test. Enable for use. Connect a microphone to the workstation. Set also the threshold level for the trigger-sound signal.

Maintaining the Advanced settings

1. Enable the Use Continuous Live Image toggle to enable live images.
2. Key in the Frame Grabber Buffer Size in MB.
3. Set also the maximum number of concurrent downloads.
4. Configure Scanning. By selecting certain items in the camera list, the camera scanning can be customized and more time efficient.

5. Configure Remote Control.

Maintaining the I/O Module

1. If required, amend the I/O Module Address.
This is the IP address of the module in the network.
2. For each of the Inputs and Outputs, select the appropriate pin from the adjacent lists, i.e.
 - Inputs
 - Initiate Video Sequence - sending this signal is equivalent to clicking the Arm button in the Arm dialog.
 - Trigger Monitor - test signal, not used.
 - Outputs
 - Computer Ready - indicates that all cameras in the test are on-line and armed, and that the Arm dialog is in its armed state.
 - Video Setup OK - indicates that "Initiate Video Sequence" can be sent, i.e. that the Arm dialog is on the screen and its Arm button is enabled.
 - Computer Trigger - test signal, not used.

See Also...

[Controlling Cameras](#)

[Preferences](#)

Configure Known Cameras

Sapera

GigE

dv

phantom

redlake

Basic White Balance

More information to come (MITC).

Maintaining Camera Type Preferences (Optional Feature)

Note: These preferences only apply if the 3D and/or 6D optional features are included in the system.

If you work with the same cameras regularly, you can set the basic information for them as preferences so that it does not have to be entered each time a camera is used.

1. You may:
 - [Add a new camera type.](#)
 - [Edit a camera type.](#)
 - [Remove a camera type.](#)
 - [Revert to defaults.](#)
2. Select the OK button.

Adding a Camera Type

1. Select the Add button.
A new camera type is added to the list with a default set of parameters.
2. Amend the default parameters by selecting each field and editing it:
 - Name.
 - Image Width.
 - Image Height.
 - Pixel Size.

Editing a Camera Type

1. Select the camera type to be edited.
2. Amend the parameters by selecting each field and editing it.

Removing a Camera Type

1. Select the camera type to be deleted.
2. Select the Remove button.
The selected camera type is removed.

Reverting to Defaults

1. Select the Revert to Defaults button.
All new camera types are removed and the parameters for the remainder are reset to their original values.

See Also...

[Preferences](#)

Maintaining Default Directory Preferences

Function

Default Directories

In order to avoid re-keying a full path name to specify a frequently used destination you may specify a default folder and subsequently just key in the file name. Separate default folders may be specified for image export files and text export files. You may wish to specify a set of working folders to simplify the use of the system and copy particular files between these working folders and their permanent storage areas.

Filename Patterns

In general, to avoid re-keying a filename commonly used when exporting from TEMA, a filename pattern can set here can be used instead.

Generic default filenames can be set, using a type string enclosed in \$ characters. The result will be used as filenames in the Camera Setup window.

Example; we use \$VIEWNAME\$ as the default filename pattern in the Image Export Filenames patterns. This result in that the filename given to a Camera View in the contents tree is used as default filename for the image export automatically. Of course, this can be overridden by typing any filename in the Image Export dialog. This is not reversible; the view name will not change in the test contents tree if the changing image export filename is changed.

Appearance

Directories

Image Import -

Image export - default directory for Image Export Destination

Test Files - default directory for saving TEMA test files (.ted files) when performing the File/Save or File/Save As.. commando. It is also the default directory that opens when [opening up a existing test](#).

Download 1 & 2 - This is a Camera Control preference setting. When downloading files from a camera, there is a Dual download (optional) function which allows downloads to two different destinations simultaneously. The default download directories can be set here. If one of those two are left empty, no download will be made to this second directory.

Test [Templates](#) - default directory for saving TEMA template files when performing the File/Save as Template commando. Note: If nothing is typed here, and we perform the [File/New Test](#) command, TEMA will load the <Empty test> template instantly, in other words, the Template functionality is disabled.


Filename Patterns

Filename pattern for live image export

This is a Camera Control preference setting. When downloading files from a camera, there is a Dual download (optional) function which allows downloads to two different destinations simultaneously. The resulting directories and default filenames of the downloaded files can be set here.

The filename can include a full path to a destination directory, for example; C:\Test *folder\TEMA\Test\camct/*.

Procedure

1. Directories. For the used directories, key a new directory name including the full path, or select the  and browse for the name.
2. Enable the 'Add Empty test to [Template](#) list' toggle, in order to make an empty Template, with no setups at all, available when [Opening a new test](#). For normal use, it is recommended to have this toggle enabled at all times.
3. Filename Patterns. Any default filename can be typed in the enter fields. If using a macro replacement pattern, type in the macro enclosed in \$\$ characters.
4. Select the OK button when ready. If any of the specified directories are not present, TEMA will ask whether to create such directory or not.

Disc Cleanup setup

Function

This preference pane is used to setup a file deletion service. This allows you to schedule deletion of certain files after a specified file retention time has expired. Please be aware of the danger with this setup. After you enter a deletion request here it will remain in effect until removed. All files matching the patterns will be deleted without warning as soon as their retention times expire. Check your file name patterns one extra time before adding the deletion request!

The list shows the deletion requests that have been set up so far. Each request consists of a file pattern, a retention time in days and an option to include files in all sub-directories of the directory specified in the pattern, and also the sub-directories themselves.

Procedure

To add a new deletion request click the add button and enter the file pattern in the entry field. * characters are treated as wildcards which match any combination of letters in the file name. For instance to remove all .tei files in the directory c:\TEMA\download you specify the pattern:

```
c:\TEMA\download\*.tei
```

By selecting the Include Subdirectories option you indicate that the deletion request is to operate on files in all sub-directories of the directory in the pattern as well. Use this option with discretion, please!

By selecting the Empty Directories option you indicate that the deletion request is to remove all emptied subdirectories of the directory in the pattern as well.

Finally you must specify the file retention time in days. Files which are older than this day, and match the pattern, are removed any time that the application runs. This check is performed when the application starts and then once every hour.

General

Maintaining Display Preferences Preferences

Different computer screens handle the display of images differently. This is due to differences in the way that the voltage level is converted to a light level. The system assumes a default gamma value for imported image files. Depending on the nature of the screen you are using, you may need to set the display gamma to a different value to achieve clear images.

1. Key an appropriate Display Gamma.
2. Select the OK button.

See Also...

[Specifying Views](#)

[Maintaining Views - Image File Properties](#)

[Preferences](#)

Maintaining Cursor Preferences

Preferences

The choice of cursor shape is a matter of personal preference. The system offers a choice of three cursor shapes for point positioning.

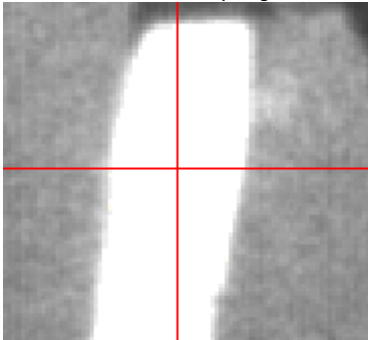
1. Select the required cursor.
2. Select the OK button.

The options available are:

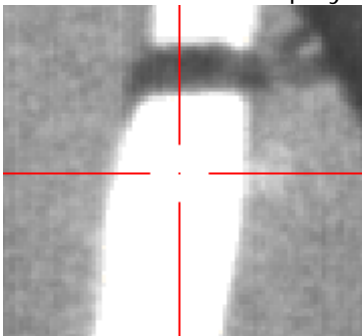
- Cross
The cursor is displayed as a simple cross, i.e.



- Cross wire
The cursor is displayed as a pair of cross wires extending to the boundaries of the image, i.e.



- Target Cross wires
The cursor is displayed as a pair of cross wires extending to the boundaries of the image, but with the center section displayed as a target point, i.e.



See Also...

[Preferences](#)

Maintaining Tool Colour Preferences

The Colour Editor dialog is displayed in which you can [specify the required colour](#) for TEMA tools.



See Also...

[Preferences](#)

Maintaining Tracking Preferences

Move Point Method

The normal mode of operation when repositioning points during tracking is to click on the point and drag it to the required position. The alternative is to click at the place where you want the currently selected point in the Points List window to be repositioned.

If you choose to reposition points by clicking, the normal mode of operation the system uses to move from point to point is to move to the next image automatically. You may amend the preference setting to prevent this, which means that the  or  button has to be pressed to move to the next image when all points in the current image have been specified.

1. If you wish to reposition points by dragging, select the Drag radio button.
2. If you wish to reposition points by clicking:
 - Select the Click radio button.
 - Select the Auto Step to Next Image check box if you to move automatically to the next image, otherwise deselect it.

Overwrite Manual Point

- Yes - Enables that manually tracked samples will be overwritten. A warning message will appear and must be acknowledged.
- No - Manually tracked samples keep their positions.

See Also...

[Preferences](#)

[Unregister a Point in the Selected Interval](#)

Window Defaults

In order to customize the appearance of the TEMA workspace, the defaults of the windows when appearing can be set.

- Text to show in Title Bar - type an initial default name for new windows. This can be changed in for each window individually later.
- Number of Image Window Columns - this value can be set between 1 and 4 and will result in as many columns that image windows (camera views) will be placed at. Useful in a test with many camera views. The sizes of the windows will be set to match the column condition set.
- New Image [Windows](#) are free - click in check box to enable.
- New [Camera Setup Windows](#) free - click in check box to enable.
- New [Image Enhancement Windows](#) are free - click in check box to enable.

At the bottom of the preference window/general is a number

Time/Date

Specify the format of the Timestamp display here.
For example YY-MM-dd

See also...

[Specifying Time Control](#)

Image Cache

Image Cache is an "Intermediate memory" for fast access, which enables to increase the speed when replaying an image sequence.

1. Fill in values for either:
 - Total size (Mbytes).
 - Time to keep (in seconds).

New Test

Enable certain windows to be initially open when starting up a new test.

- [Gun Scoring Setup](#) (optional: Gun Scoring)

Image Export

Function

The two Image Export Preference panes do not have any individual settings. The settings are all done in the Export dialog, either in:

- the [Image Export](#)
- OR
- the [Combined Image Export](#)

in which the set up parameters can be saved into the preference archive. Later, such saved preference setting can be applied in a test and used again.

The saved settings are all in the list presented in applicable preference pane.

Appearance


Each pane consists of a list of saved settings. There is always a Default setting, which cannot be removed. When a new test is created, the Default settings are applied as the initial settings suggestion when the user enters the Export dialog. Below the list are functions for removing or renaming items from the list.


Procedure

Save/Load Settings

When the Export dialog has been entered, but before the export is actually performed, some parameters may require some changes by the user. Now, the status at where the image export is at this stage can be saved in the preference archive also using the Save in Preference function. When this option is selected, there is a choice of where in the preference archive to store this information.

1. Store the settings as a new Default, thus overwriting the previous default setup. If this is done, this will be the settings that are initially applied on a new test etc.
2. Save the settings in another name. This will add a new instance in the list of preference settings.

If (1) is selected, the next time the Load Preference button  is clicked in the Export dialog, the "new" Default will be used.

If (2) is selected, the next time the Load Preference button  is clicked, the user will get the choice of which settings to apply; the Default (now, still the "old" one, which was untouched) or the new instance in the list.

Maintaining the List

1. Any item besides the Default can be removed. Mark the item in the list and click Remove.
2. Any item besides the Default can be renamed. Mark the item in the list and click Rename. A small rename dialog will appear where a new name for the image export setting can be typed.

Image Import

Function

To set the defaults for importing image sequences into a camera view.

Appearance

- Bayer - set the interpretation method for the color patterns used in Bayer files.
- Photo CD - set the image size used when importing pcd files.
- DRS Tiff - a DRS tiff file may contain one frame that can be used as black reference. To use this frame for image subtraction, removing noise in the image sequence as a whole, click the Remove Calibration Image Subtraction check box. If the user knows that the DRS tiff file to import is a color file, the Force Color Interpretation should be enabled in order for TEMA to handle the image correctly.
- AVI - Normally TEMA will detect automatically when to use DirectShow or not. However, in some rare cases the user has to intervene. Experiment by turning this parameter on or off if suspecting that the AVI sequence is not read correctly.

Maintaining Keyboard Binding Preferences

A large number of keyboard hot keys are used in TEMA. Most importantly, the time panel and tracking functions are available on the F-keys.

The list of factory keyboard assignments in the current version is given below.

| | | | | | |
|--------------------------|---------|---------------------|----------|----------------------------|--------------|
| Add Camera... | | Exit | Alt+F4 | Send To Notes | F12 |
| Arm... | | Help | F1 | Set Black Reference | |
| Assign Camera To View... | | Multistep backwards | Shift+F7 | Sleep | Ctrl+Shift+Z |
| Camera Setup Window | | Multistep forwards | Shift+F9 | Sleep in Selected Interval | Ctrl+Z |
| Clear Cameras | | New | Ctrl+N | Step backwards | F7 |
| Close Window | Ctrl+F4 | Open | Ctrl+O | Step forwards | F9 |
| Color Correction... | | Paste | Ctrl+V | Stop | F8 |
| Confirm | F2 | Play backwards | F6 | Track backwards | F3 |
| Copy | Ctrl+C | Play forwards | F10 | Track forwards | F4 |
| Cut | Ctrl+X | Print | Ctrl+P | Wind backwards | F5 |
| Disable | Ctrl+D | Save | Ctrl+S | Wind forwards | F11 |
| Download Images... | | Scan For Cameras | Ctrl+A | Zoom in | Ctrl+I |
| Enable | Ctrl+E | Select All | | Zoom out | Ctrl+Alt+I |

The list contains all the TEMA commands that are available for binding to a key combination. Where a key combination is not displayed, the corresponding command does not have a hokey

These assignments are stored in the Preference Archive and may be amended as required.

The following functions are provided:

- [Bind a command to a hokey.](#)
- [Unbind a command to a hokey.](#)
- [Revert a command to its factory setting.](#)
- [Revert all commands to their factory settings.](#)
- [Generate a printable key map.](#)

Binding a command to a hokey

1. Select the Command that you wish to bind.
1. Note: If an already bound command is selected, the old binding will be overwritten. Also, there are some commands that cannot be bound or have their binding changed, e.g. Exit. In these cases, the Bind and Unbind buttons are disabled.
2. Select the Bind button.
2. The Bind <command name> dialog is displayed.
3. Select the Key to which the command is to be bound.
4. Select the Modifiers to be associated with the key.
5. Select the OK button.
5. If the selected Key/Modifiers combination is already in use, the new binding is added to the list.
5. If the selected Key/Modifiers combination is already in use:
 5. The Unbind old command dialog is displayed.
 - Select the OK button to replace the original binding with the new one.
 - Select the Cancel button to leave the original binding intact.

Unbinding a command to a hokey

1. Select the Command that you wish to unbind.

1. Note: If the selected command is not already bound, the Unbind button is disabled. Also, there are some commands that cannot be unbound or have their binding changed, e.g. Exit. In these cases, the Bind and Unbind buttons are disabled.
2. Select the Unbind button.
2. The binding is removed from the list.

Reverting a command to its factory setting

1. Select the Command whose binding is to be returned to its factory setting.
2. Select the Revert button.
2. The factory setting is restored.
2. Note: The Revert button is disabled for commands that have not had their bindings changed.

Reverting all commands to their factory settings

1. Select the Revert All button.
1. The Revert All dialog is displayed.
2. Select the OK button.
2. The factory setting is restored for all commands that have had their bindings changed.

Generating a printable key map

1. Select the Key map button.
1. A printable list of the current bindings is displayed.
2. Select the Print button to print the list.
3. Select the Close button to close the list.

See Also...

[Preferences](#)

Policies (optional)

Function

Policies are settable security limitations for the changing of certain program parameters or the performance of certain program actions.

The policy levels spans from no limitations (lowest security level) to a password protected level where only an administrator can unlock and change the policy (highest security level).

The use of this is to minimize the risk of having important test settings changed by mistake.

Policy Levels

The policy levels from lowest to highest will result in the following when changes are to be made at where it is assigned;

- Allow - no action. The parameter change or program action can be performed with no limitation.
- Dismissible Warning - a warning will appear when then the attempt to perform the parameter change or program action is done the first time. A check box can be marked that will dismiss the warning next time a change is made.
- Warning Every Time - a warning will appear each time the parameter change or program action is to be made. This can not be dismissed.
- Password Protected - the [password](#) as set in the [Preference Management](#) will be required to perform the parameter change or program action.
- Password + Warning - the [password](#) as set in the [Preference Management](#) will be required to perform the parameter change or program action, plus a warning will appear.
- Forbidden - no changes can be done here. In order to perform the parameter change or program action, the policy level assigned for this action must be changed in the [Preference Management](#).

Appearance

The program actions that can be assigned policy levels are;

- Add remove views not specified from [Test Planning system](#). This policy controls the handling of camera views in a test when working towards a test planning system . When making attempts to add an external view, the system will react due to the policy set.
- Adding views that are not in the '[Views](#)' preference. This policy controls the handling of camera views not in the preference 'Views' list. When making attempts to add an a camera view that is not in the list, the system will react due to the policy set.
- Selecting file name other than the pattern in Save Test As command . This policy controls the name to which a test is saved when performing the 'Save As..' command. When the test was created, the name specified will be used as a reference. When making attempts to save the test in another name than this, the system will react due to the policy set.
- Selecting [Image download](#) file name other than pattern. This policy controls the name to which the file from a camera download is saved. When a download is about to be done, the system will react to the name set in the Camera Setup dialog, Arm dialog or Manual download dialog due to the policy set.
- Policy for Performing the [Image Export](#) Command. This policy controls the performance of image export, when making attempts to perform such, the system will react due to the policy set.

- Changing the [Image Export Format](#). This policy controls the possibility to change the image format to which an image export can be done. When making attempts to perform such, the system will react due to the policy set.
- Editing the [Image Overlay](#) setup. This policy controls the possibility to make any changes in the Image Export/Overlay setup. When making attempts to perform such, the system will react due to the policy set.
- [Ending a test](#) without downloading all images. This policy controls the possibility to perform the End Test command without downloading all images from the cameras used in the test prior to the command is given.
- [Ending a test](#) without saving the TED file. This policy controls the possibility to perform the End Test command without saving the test (.ted file) prior to the command is given.
- [Ending a test](#) where mandatory Attributes don't have values. This policy controls the possibility to perform the End Test command even when [Test Attributes](#), requiring [at least n characters](#), are without any values.

Note: in the [Preference Management](#), there are also settable policies with the same logic as what is used here. However, these are valid for whole preference panes, not only single program parameters.

See also...

[Preference Management](#)

Maintaining Precision & Units Preferences

Precision

The precision at which the values of various quantities are maintained by the system may be specified as a set of defaults. If you normally work at a particular level of accuracy or your organization has a standard governing precision levels, those levels may be specified as a set of preferences.

The precision at which values are displayed may be specified either in absolute or relative terms and can be set per data type.

- Absolute precision is specified in terms of providing a decimal accuracy level and a measurement unit. For example, a time precision specified as 0.0001 seconds would display all time values with a precision of one ten thousandth of a second. The first significant digit is the first non-zero digit from the left, and then more digits are added up to the desired precision. Below is a more illustrative example by rounding a number of numbers to four significant digits:

```
1.234567 -> 1.235
12.34567 -> 12.35
123.4567 -> 123.5
1234.567 -> 1235
12345.67 -> 12350
0.1234567 -> 0.1235
0.01234567 -> 0.01235
```

- Relative precision is specified in terms of the number of significant digits, irrespective of the decimal point position.

Specify or override an inherited precision

Many data types are organized into a tree structure of types and subtypes (the list in the left-hand pane in the preferences window shows this tree structure).

By default each data type inherits the precision setting from its "parent" type (if it has any). As an example, longitude, which is a sub-type of angle, inherits the settings from angle. This can be overridden by selecting the override option. This will make it possible to give a data type a setting different from that of its parent. Selecting don't override reverts to inheriting from the parent.

Procedure

To simplify the maintenance of the precision specification, some data types inherit their precision from a higher level in the tree, but you may override this, if necessary.

1. Select the measurement type from the Available Dimensions list whose precision you wish to specify.
2. To specify the precision in absolute terms:
 - Check the Absolute Precision box.
 - Key in a precision value (which specifies the precision to that level).
 - Select the appropriate unit, if appropriate, from the drop-down list (e.g. time precision may be specified in seconds, minutes, etc.).
3. To specify the precision relative terms:
 - Uncheck the Absolute Precision box.

- Key in the number of significant digits.
 - Select the appropriate unit, if appropriate, from the drop-down list (e.g. time precision may be specified in seconds, minutes, etc.).
4. To override an inherited precision:
 - Select the Override button.
 - Specify an absolute or relative precision.
 5. To specify an inherited precision:
 - Select the Don't Override button.
 6. Repeat the process for any other data types.
 7. Select the OK button.

Units

If your organization uses a particular standard set of measurement units for quantities such as distance, speed or acceleration, you may specify those units as defaults. In any particular situation if a different unit is required, you may override the default.

1. To amend a default unit, select the measurement type from the Available Dimensions list. The current Default Unit is displayed.
2. To change it, select the required unit from the drop-down list.
Note: The drop-down list only contains those entries that are valid for the selected measurement type.
3. Select the OK button.

See Also...

[Preferences](#)

Remote Export Servers

Function

In order to save processor capacity at the workstation, image exports can be set to be performed by an external computer. This external computer is called Server while the "main" computer is called Client.

Appearance

The preference pane contains a list of the current set up export servers. The list includes;

- The server IP address
- The used outport on the server machine
- The directory used for communication between the client and the server (job directory).

New items can be added to the list or present ones removed. Items in the list can also be edited.

Procedure

Go to the preference pane via Tools/Preference/Remote Export Servers

1. To set up a new remote server, click the Add button. The Setup Remote Server Parameters dialog will appear.
2. Browse to the set job directory for the Remote Export Server. If the selected directory does not contain the server information, TEMA will tell that this is no server job directory.
3. Click OK. The server is now defined and will be used at image export.

Note: If more than one server is defined here, a select dialog will appear at an image export. Here, we can select the desired server to use. The order of the servers in this list will be conserved in that dialog as well. To change the order of servers in the list, mark an item in the list and use the move up and

down buttons  .

If a local export might be in need occasionally in the way you work, add a Local Server by clicking the Add Local button. Having both a remote and a local server setup, when an Image Export commando is given, a select server dialog will appear. In this dialog, we you can select whether to use the remote of the local server for the export.

Accessed via...

Tools/Preferences/Remote Export Servers.

See also...

[Server Export](#)

Test Planning System (optional)

Function

This Preference Pane is used to setup how to communicate with an external Test Database. To make this interface flexible for different test databases used in various organizations the interface is fully configurable.

The [Test Database Interface](#) is based on execution of external command line programs which are run subordinate to TEMA to read or write information from the actual Test Database. These programs must be provided by the customer or the Test Database manufacturer. The interface programs must produce or read the Test information in a XML format file. The exact XML format is specified by [Image Systems AB](#)

Procedure

1. In the top part Test Identification of this Preference Pane you specify which elements your Test Specification consists of. Maybe the most common case is to have only one string, called something like "Test Id" or "Test number". In some cases it can be more convenient to enter the specification in several named fields, and here you can define exactly how the test specification is to be entered to suit your test database. This setup works in the same way as for other attribute sets, see further on [Attribute sets](#).
2. In the field XML file name you must enter the full path of a temporary file which will be used as the XML file which connects the Test Database Interface programs to TEMA. Before calling the "End Test" program and after calling the "Start Test" and "Refresh Test" programs TEMA will write and read this file respectively.
3. Password. This is a non-visible password that can be referred to using the syntax pattern *\$PASSWORD\$* in the Start, Refresh and End commands.
4. The three following sections ([Start](#), [Refresh](#) and [End Test](#) commands) are identical and specify the program to use for each of the three interface commands, along with their parameters. Note that in many cases the "Start" and "Refresh" commands could be identical, typically the Test Database doesn't care if this is the first or second time the data for a specific test is retrieved. Separating the commands allows the Test Database to keep track of which Tests have been started and disallow starting the same test twice. By having a separate Refresh command this can be allowed even if the test has already been started.
5. The Program Name part must refer to an executable file (.exe extension). A bat file is not ok, but in this case you can specify "cmd.exe" (Windows' command prompt) as the program and /C and the bat file's name as the two first parameters. This will run cmd.exe as the program and it in turn will interpret the bat file.
6. The Timeout field is a timeout in milliseconds for the external program. If the program does not run to completion within this period it is aborted and the command is aborted. This happens for instance if the network connection to the Test Database is lost.
7. In the Parameters part you can add the program's parameters one by one. By making this a list the problem with spaces in parameter values could be avoided. Click Add and then type the value in place in the list box. To transfer the Test Identification the user has typed to the external program you use a macro replacement syntax in the parameters. This is done by enclosing the name of the Test Identifier, for instance *Test number* in \$ characters inside the parameter text. If the Test Identifier contains spaces it must be enclosed in ' (single quotes) also. A simple parameter could look like this: *\$'Test number'\$*. If you have several parts of the identifier these can be sent as separate parameters

to the external program or as one long parameter which would look something like this: Model: *\$Model\$*, Test type: *\$'Test type'\$*, Run number: *\$Run\$*. This example encodes three different Test Id parts into one parameter of the command line program to call. If you add parameters which don't contain \$ characters to the parameter list these will be sent verbatim to the external program. One use of this is to merge all the three interface functions into one external program which is told what to do using an extra parameter, with values such as "Read" and "Write".

8. The Global Policies section is the place at where a [policy](#) is set for New Tests to be started that are outside the boundaries of the test planning system . Allowing this may risk the confusion of having tests outside and inside the test planning system at the same time.
9. Password. This enter field allows the user to store a non-observable password text string which can be used among the parameters to the external commands using *\$PASSWORD\$*. This feature allows sending of passwords to external programs such as databases without having to show them to everyone inspecting the preferences of TEMA.



See also...

[Test Database Interface](#)

Views (optional)

Function

To organize the camera handling in a test, the [known cameras](#) can be associated to views. If the list is not empty, the user can select a view into a test, using a procedure similar to this of adding a camera. The difference is that views can be given a customized name and be put into groups having the same camera settings.

For the views in the list, if any changes of Image Enhancement, Camera Control, Rotation and Mirroring or the assigned [Test Sections](#) (with [End Test Exports](#)), the setting can be saved in the Preference Archive using the Set As Preference function . The setting saved for a view can be loaded into the view in another test later using the Revert To Preference function . Also, settings can be copied between views in the list.

With test database interface.

The view list can be set to co-operate with a test database, if present. The database acts as master - camera view names can only be created and stored in the list via this.

Opening test with views not in the list.

When [opening a test](#) or when saving a new test with camera views not in the list, a dialog will offer the possibility to add this to the list (or those) and to copy settings from other views in the list to this new view(s).





Appearance

Camera Groups list

The list of the present camera groups.

The view list

For each camera view in the list, the following information is listed

- Name - View Name.
- Camera - the camera assigned to the camera view.
- Group - the group to which the view is sorted
- Enh - a 'X' will be present if the view has been amended using any [Image Enhancement](#) functionality, and the setting has been saved in the Preference Archive using the Set as Preference function .
- Cam - a 'X' will be present if any changes has been made for the view in the Camera Setup window, and the status has been saved in the Preference Archive using the Set as Preference function .
- Rot - a 'X' will be present if the [Orientation](#) (Rotation and Mirroring) of the view has been changed, and the setting has been saved in the Preference Archive using the Set as Preference function .
- Sect - a 'X' will be present if the view has been assigned/unassigned a [Test section](#) compared to what was the status when the view was added to the list, and the status has been saved in the Preference Archive using the Set as Preference function .

Procedure

1. Add a Group to the test. By using the Add button, new groups can be created. Note: No groups has to be defined in order to be able to add cameras to the views list. However, in a test with lots of cameras, it might be a fine idea to be able to sort the cameras into groups
2. Add a camera view to the list. Click the Add button. The Add Camera View dialog will open. Name the view. The View can also be associated to a group, if present, and a Camera from the list of [known cameras](#) in the Camera Control preference pane.

3. Click OK when ready. The camera view can now be seen in the views list.
4. Edit - Click the Edit button to change the View name, Group or camera for a view.
5. Remove - Delete a view from the list by selecting the item in the list and click the Remove button.
6. Copy Settings - To copy the status of one view for [Image Enhancement](#), [Camera Control](#), [Orientation](#) (Rotation and Mirroring) or [Test Sections](#) to one or several other views, mark the view(s) to copy to (multi select by holding the <Ctrl> key while selecting in the list) and select Copy. The Copy Settings Dialog will appear. In this, select the view to copy from and select the appropriate check boxes to the settings to be copied.
7. Erase Settings - To erase settings from one or several views, mark the view(s) to copy to (multi select by holding the <Ctrl> key while selecting in the list) and select Erase Settings. The Erase Settings Dialog will appear. In this, select the appropriate check boxes to the settings to be erased.
8. Click OK when ready.

Maintaining Presentation Preferences

If standards have been developed for the presentation of diagrams and tables, the details of the standard can be set as default preferences.

1. Select Preferences in the Tools menu and then Presentation.
2. You may:
 - [Specify Printing Preferences.](#)
 - [Specify the Angle Range.](#)
 - [Maintain the list of Line Colours.](#)
 - [Maintain the list of Line Styles.](#)
 - [Specify Diagram Preferences.](#)
 - [Specify Font.](#)
 - [Specify Colour Defaults.](#)
 - [Specify 2D, 3D and Image Diagrams.](#)
 - [Specify Text Diagrams.](#)
3. Select the OK button.

Specifying Printing Preferences

1. If a colour printer not is used , select the Always b/w check box.
This produces a better quality when printing colour diagrams on black and white printers. The system automatically uses colours on colour printers and 'dash-dot' on black and white printers. However, some printers claim to be colour printers but produce grey scale printing. Selecting the Always b/w check box ensures that 'dash-dot' is used rather than indistinguishable colours.
2. The Map Line styles makes it possible to relate specific colours with a line style when printing using a black and white printer.
3. Specify the measurability of the axes by:
 - Selecting the Auto, Manual or both Measurable Axes check boxes. (If *both*, see further about Printer Axis Length Dialog below).
 - Selecting the required measurement unit radio button, i.e. Centimetres or Inches.
 - Specify the Calibration factor for the X and Y axes.
These are used for printers where the measured distance on the paper is not as expected. This may happen with certain types of laser printer. In such circumstances, these values should be set to the measured value divided by the expected value.

Note:

The Measurable Axes function is used to control physical lengths on paper, i.e. it enables the axes to be adjusted so that either a ruler can be used for measurement, or the axes match those used on a diagram printed from an external source, i.e. another system or a text book. The Auto selection option allows the system to set the physical divisions of the axes automatically without further user input.

The Manual option causes the Printer Axis Length dialog to be displayed after the required printer has been selected during a print operation. This enables you manually to specify the physical divisions of the axes.

If both the Auto and Manual options are selected, the system performs the calculations automatically and then displays them in the Printer Axis Length dialog during the print operation so that the values may be adjusted.

Printer Axis Length Dialog

The dialog contains a setting for both the x and y axis. The value specifies the number of centimetres or inches, depending on the preference set, for the value range specified for the diagram axis. It also displays the maximum value, which obviously depends on the printer selected.

To specify the length of the axes:

1. Key the required value for the X-Axis.
2. Key the required value for the Y-Axis.
3. Select the OK button.

The diagram is printed.

Note: Selecting the Cancel button prints the diagram using the original axis length settings.

4. Specify the printed Line Width by entering the required value.
5. Show or hide the Time Marker by enable or disable the Show Time Marker check box.

Specifying the Angle Range

The Angle Range can be specified only in diagrams including angle data by selecting one of the following options:

- Continuous;
- 0 to 360°;
- -90 to 270°;
- -180 to 180°.

Maintaining the List of Line Colours

The available colours are displayed in the Line Colours list which you may amend.

To add a new colour:

1. Select the Line Colours Add button.
The Colour Editor dialog is displayed.
The default colour displayed is 'white'.
2. Specify the required colour.
The new colour added to the Line Colours list in the Presentation frame. Its name is assigned in terms of its primary colour values, e.g. 'R: 155, G: 155, B: 177'.

To edit a colour:

1. Select the colour to be changed from the Line Colours list.
Note: You can change the pre-loaded colours as well as those you have added.
2. Select the Line Colours Edit button.
The Colour Editor dialog is displayed.
The current colour is displayed in the Colour frame.
3. Change the colour.
The amended colour is replaced in the Line Colours list in the Presentation frame.

To remove a colour:

1. Select the colour to be removed from the Line Colours list.
Note: You can removed the pre-loaded colours as well as those you have added.
2. Select the Line Colours Remove button.
The selected colour is removed from the Line Colours list in the Presentation frame.

Maintaining the List of Line Styles

The available styles are displayed in the Line Styles list which you may amend.

To add a new style:

1. Select the Line Styles Add button.
The Add Style dialog is displayed.
2. Select the required style from the Line Style drop-down list.

Note: You cannot define a new line style.

3. Select the OK button.
The Add Style dialog is closed and the new style added to the Line Styles list in the Presentation frame.

To edit a style:

1. Select the style to be changed from the Line Styles list.
2. Select the Line Styles Edit button.
The Add Style dialog is displayed.
Select the required style from the Line Style drop-down list.
3. Select the OK button.
The Add Style dialog is closed and the amended style replaced in the Line Styles list in the Presentation frame.

To remove a style:

1. Select the style to be removed from the Line Styles list.
2. Select the Line Styles Remove button.
The selected style is removed from the Line Styles list in the Presentation frame.
Note: The removed style may be added back later.

Specifying Diagram Preferences

Font

2. Sets the font of all texts, except text box, in the diagram (s).
 - o Select the appropriate font, font style and size.
 - o The font settings will apply in all applicable diagrams.

Note: The font of [text boxes](#) is settable via the Text Box Setup dialog.

Colour Defaults

The following default colours can be amended:

- Background Colour;
- Axis Colour;
- Grid Colour;
- Box Colour.

To change a default colour:

1. Select the appropriate Edit button.
The Colour Editor dialog is displayed.
2. Change the colour in the same way as a line colour is changed.

2D, 3D and Image Diagrams

1. Set the 2D and/or 3D Diagram colours.
2. Specify the Origin of the coordinate system against which the data is to be displayed. The options are:
 - o source image, lower left.
 - o source image, image centre.
 - o source image, optic centre.
 - o source image, media centre.
 - o digitized image, lower left.
3. Specify the Marker size, size 0-5 is available.
4. Set the Line width of the lines/curves in the diagram.
5. If you want diagrams to be displayed by default with a grid, select the Grid check box.
6. If you like all data available to be inserted in any new diagram introduced, select the Auto select

option.

7. Select the Auto scale option if you like a 2D diagram to auto scale its axes to display all data at all times.
8. Specify the Legends to be displayed:
 - Select the Show Legend check box to display legends.
 - Select the Alt Colour check box to display the automatically calculated alternative colour as used for the corresponding plotted curve in diagram.
 - Select the appropriate check boxes to display a specific value, i.e.
 - Horizontal Axis Value.
 - Vertical Axis value.
 - Select the appropriate check boxes to display the minimum/maximum limits of the data for each curve, i.e.
 - Vertical Axis Min.
 - Vertical Axis Max.
 - Horizontal Axis Min.
 - Horizontal Axis Max.

Text Diagrams

1. For tables, i.e. Text Diagrams, enable by clicking in the check boxes;
 - Show Row Counter check box, if the diagram rows are to be numbered.
 - Show Interpolated values in parenthesis
 - Use Comma as decimal character
 - Show incomplete value with asterisk
 - Show values in full precision
2. Set the Stripe Colour (from the drop down list).
 - This preference is used to simulate, both on the screen and on plain paper, the use of horizontally striped paper. The selected colour alternates with white in a striped pattern.

See Also...

[Preferences](#)

Maintaining Printings Preferences

Function

The Printing Preferences are a set of default values used when printing cam era views, diagrams or reports. They may be maintained as part of the Preference Archive maintenance procedure or directly at the time the print function is selected.

To amend the print settings, see [Printing](#).

See Also...

[Preferences](#)

Preference Management (optional)

Function

To minimize the risk of a user changing certain preference setups parameters by mistake there is a "security" level above the preferences level. From here, an administrator can

- set the [Policies](#) for the changing of the preferences in the different [preference groupings](#).
- add new user [Profiles](#).
- [Regroup](#) preference panes.

Note: To set a policy at this level will affect the possibility to change any parameter within a certain preference, not only single program actions, as in the [Policies](#) preference.

Appearance

- The preference management dialog has all the [Preference](#) tabs in the leftmost list.
- The list to the right is the list of the existing [Profiles](#). New Profiles can be added here and old ones can be removed also. The default Profile can not be removed.
- Below the lists is where the preference [policies](#) are set.

Procedure

1. Enter the Preference Management from the Tools menu.
2. First time entering the preference management, a password must be set. This can be changed in the Preference Management dialog when entering.
3. After setting a password, the Preference Management dialog will appear.
4. In the list of Preference tabs, the column listing the [Groupings](#) can be right clicked. This will offer the possibility to change the groupings for the preferences. Note: If the grouping *Profile* is set, the current used Profile can not be changed. This has to be done from the [Profiles](#) dialog.
5. The list to the left is where new Profiles can be added or Removed with help of the buttons. Add will open up the Add New Profile dialog. Here, the new profile can be named. Settings can also be copied from another existing profile in the preference archive into the new profile.
6. [Policy](#) for entering this function. Change the way the Preference Management dialog can be entered (*this function* aims at the Preference Management dialog). Select from the drop down list; Warning every time will raise a warning every time the dialog is to be entered. Password Protected will ask for the password to allow entrance. Password + Warning will do both.
7. [Policy](#) for changing Profile specific Preferences. The Profile specific Preferences are Preferences having the grouping Profile. Select the policy level from the drop down list.
8. [Policy](#) for changing Machine specific Preferences. The Profile specific Preferences are Preferences having the grouping Machine. Select the policy level from the drop down list.
9. [Policy](#) for changing User specific Preferences. The Profile specific Preferences are Preferences having the grouping User. Select the policy level from the drop down list.
10. [Policy](#) for changing Profile after a test has started.
11. Password. Set a password to be used for entering the Preference Management and for each place

where the Policy level Password Protected is set.

- Set also the Retention time. This is the time for how long a password is active. If a retention time is not set (zero), we have to type the password every time when performing a Password Protected program action. If a retention time is set, the password will be active for that period of time. In other words, the retention time counts from when the password is typed. Before the time is to an end, we can enter/perform the same protected program action without having to type the password. After the retention time, the password has to be used again etc.

12. Copy/Import. Clicking the Copy/Import button will open up the Copy/Import Dialog. Select the desired option. Enable by clicking in the appropriate check box.

- Copy - this option will offer copying of preferences settings within the current preference archive. Enable and click Next. Select the desired preference from the list, to be copied. Click Next when ready. Depending of the current [grouping](#) of the selected Preference, the copying will be done between Users, Profiles or Machines using the present preference archive. Select the origin and click Next when ready. Then, select the destination by clicking in the check box(es). Confirm the copy action by clicking Copy.
- Import - this option will offer an import of preference settings used in an external Preference archive. Enable and click Next. Browse to the desired .tep file (which is the file that contains all preference settings for a TEMA installation). Click OK when Ready.

Note: The policies that controls the changing of parameters in the preference archive really controls any writing to this. There are other ways to write into the preference archive then through the preference panes. Such are:

- Updating settings regarding Test sections, Orientation, Image Enhancement and End Test exports for camera views in the [Views](#) list.
- Saving [Named Image Export settings](#) in the Preference archive
- Updating the [Default Tracker](#) in the Preference archive.

As all those actions imply writing in the preference archive, they are also affected by the policies in the same way as the changing of parameters in the preference panes.

See also...

[Policies](#)

[Preferences](#)

[Profiles \(optional\)](#)

Profiles (optional)

Function

In some applications there might be a need of having different users sharing the same set preference settings.

We call these sets Profiles. When logging on to TEMA, a dialog will ask the user to specify the Profile to be used. The preferences settings grouped as *Profile* will then be adjusted to what is specified for the specified Profile instantly.

When changing the used Profile to another, the program parameter settings will be changed to match the current profile.

Procedure

A new Profile is added in the [Preference Management](#) dialog.

To change a Profile, go to Tools/Profiles and select from the drop down list in the Profiles dialog. Press OK when ready.

See also...

[Policies](#)

Data Output

Copying to the Clipboard

The Copy option in the Edit menu enables the current data to be copied to the clipboard. The data may be textual or graphical. From the clipboard you may Paste the data into any appropriate application, e.g. a word processor, a spreadsheet application, a text editor, etc.

Image Export (optional)

Function

To export complete or partial images from an image sequence or a selected part of this. If any overlaid data, as curves displaying tracked data is present, this can be exported together with the images also. A title slate can be added in which information about the images can be given to the viewer. Several images from different camera views can be exported simultaneously. The image export can be done into most commonly used image formats.

Note: The image export can be done from All presentation windows (XT, XY, multi axis, 3D and image diagrams) also, not only camera views.


The image export can be performed on a Remote Export Server machine also





Appearance

The appearance of the Image Export window is Export Settings to the left and the Export Area to the right.


Export settings

The export settings are sorted under five different tabs;


- Output - defining the output file.
 - The Directory will override the Default Directory for image export as set in the Preferences.
 - File Name. (Optional - camera control: the use of the [built-in variables](#) \$DIRTIME\$ and/or \$DIRDATE\$ will result in the time and/or date of when a trigger command was given to the cameras)
 - Storage format - select amongst the available image formats in the Storage Format dialog.
 - Keep Compression - when enabled, if the original image file is compressed using jpeg, the same compressing will be used for the exported image file as well.
 - Full bit depth - The Bit Depth of an image is the number of bits used to hold a pixel. It is sometimes called "color depth" or "pixel depth," The bit depth determines the maximum number of colors that can be displayed at one time. In TEMA, overlaid graphics as tracked data (curves) has 8 bits depth. Due to technical limitations in MS Windows with different bit depths, an image with a bit depth greater than 8 bits can not be exported together with overlays in its full bit depth. The whole export will be done using the bit depth of the overlays in such case. If the full bit depth is to be conserved in the export, enable this toggle. The export will then be done with the image only, excluding the overlays.
 - Add source overlays - will export the image sequence and the tracker data (curves) but no other graphics on the image sequence (text boxes or image boxes added to an image diagram). The text boxes added into an image diagram will be scaled with the image. Text boxes can be added in the image export dialog also, which will not be scaled with the image.
 - Auto Size - will auto scale the exported image in order to fill the export window as best as possible.
 - Re-specify the part of the image to be exported by keying the X and Y Offset.
 - Re-specify the size of the image to be exported. To export the complete image - select the  button. In this mode, a new offset and image size can be set. Note: The re sizing and offset of the export window can be set by an export rectangle in the export area with the help of the mouse.
 - Zoom Factor - specify the size of the image that is to be written to the export file from by either the available Zoom Factors in the drop down list or select the "Zoom factor" option in the list and key an alternative zoom factor.
 - Select the Maintain Aspect Ratio check box, if required.

- Select the Down sampling Pre filtering check box to resample the original image before the selected zoom factor is applied. This improves the quality of the exported images.
- Title slate - This is an animated first image frame(s). This can be equipped with additional text boxes with any information, just like the rest of the exported sequence. However, the overlays added here will only be shown in the set title slates. The text boxes in the title slate may contain information about the image file in specific text and image boxes only shown here.
 - Background - set the background color to the title slate(s).
 - Text and image file overlays - list of the added text and image boxes to the title slate. The columns can be right clicked in order to change the positioning and alignment.
 - Maintain the contents in the list by the use of the buttons beneath it; Edit, Remove, Add Text box and Add Image Box.
- Time - amend the range of images to be exported, if required, by:
 - If 'Relative to Current Image' is checked, Time Range and Image Range (below) are relative to current time/image.
 - Modifying the Time Range.
 - Modifying the Image Range. To export the complete image sequence (all frames) - select the  button. To customize the range, unclick this. The export range can then be delimited manually by editing the time and interval start- and end limits.
 - Modifying the Number Of Images you wish to export. In order to lock the number of images to be exported, not being affected by any other parameter change, click the lock button . When locked, this will change to .
 - To export only the image currently displayed in the export window, click the  button.
 - If required, modify the Skip Count (i.e. the number of images in the sequence to be skipped between the images that are exported).
Note: Amending any of these parameters automatically updates the values of the others.
- Overlays - specify the overlays to be exported with the image file. Graphic overlays (curves and text boxes) present in the image diagram or tracking node can be removed and new text and image boxes can be added to the export window.
 - Text and image file overlays - list of the added text and image boxes to the export window. The columns can be right clicked in order to change the positioning and alignment. The built-in variables \$TIME\$ inserted in a text box will result in the current time in every frame when exported, \$EXPORTFILENAME\$ in the name of the name of the file as given in the image export dialog.
 - Maintain the contents in the list by the use of the buttons beneath it; Edit, Remove, Add Text box and Add Image Box.

Export Area

- The first image in the sequence is displayed in the Preview frame.
- The image to be exported is shown in the Export Window frame. This is either the full image or the part of the image pre-selected in the Zoom window.
- If Overlays has been added to the image, those will be visible on the images. This can be as text boxes or tracked data.
- [Save as Preference Archive setting](#) . The current export settings will be saved in the preference archive. There are two alternatives when saving here. Either save the setting as a new Default. This will make those settings to be applied to a new test when created. Or, the settings can be saved in your own name. Any number of settings can be saved in the preference archive like

this, to match different requirements of Image Export.

- [Revert to Preference archive setting](#) . The current export settings will be overridden by the settings in the preference archive. If there are more instances in the image export settings in the preference archive, then just the default (see above), then any of the alternatives can be selected and applied.
- Export will export the image sequence to a local directory on your workstation. In order to save CPU power on the workstation, a server can be set to perform the image export. This is useful when exporting image sequences containing high resolution images. In the Preferences/[Remote export server](#), a server can be defined and used for this. If a server is defined, this will perform the export automatically. In fact, several servers can be defined. If more than one is set up, a Select Server dialog will list the available options.

Having a server set up, there is no other specific actions to be taken when letting a server perform the image export.

Progress Bar



Below the Export Settings Area is the progress bar. This will reflect the export procedure in percentage. Cancel will cancel the export operation.

Procedure

The following steps are to be taken to export an image sequence used in a tracking icon or in an image diagram.

1. Select the camera views in the Test Contents window for which images are to be exported, hold the <Ctrl> key to multi select camera views.
2. Select the Export Images option from the Camera menu. The Image Export dialog is displayed. If an Area Of Interest rectangle have been defined, only the part of the image enclosed by this rectangle will be displayed in the dialog. The [Multi Image Export](#) dialog is displayed is more than one camera view has been selected.
3. Begin with the Output tab. In this, specify the output Directory and resulting File Name. The directory does not have to be on the workstation but can be on any place on your network available from the workstation. If Server Export is to be used, the directory must of course be available from the server.
4. Further, set desired image format. If a file format and configuration other than the default AVI file format and configuration is required:
 - Select the Storage Format button. The Storage Format dialog is displayed.
 - [Select and specify the required file format](#).
5. Produce a Title Slate, if desired. Use the Add text box dialog to create the overlays.
6. Key the Time Range or Image Range of the images to be exported. Those two ranges are of course dependent on each other and are merely two different ways of specifying the length of the image export.
7. The Number Of Images will be equal to the image range span. If set to a smaller value, the upper image range limit will be lowered to match the new amount of images to export. If every image in a sequence is to be exported, the Skip Count should be set to zero. Skip count *n* will export every *n*:th image in the sequence, thus effecting the Number of Images but not the Range spans.
8. The Window tab; re-size the export window, i.e. the Size of the exported images. The values can only be decreased, cutting the set export window. The Offset is the positioning of the cut outcrop in relation to the non re-sized image.
9. Amend the Zoom Factor of the export window if desired.
10. Go to the Overlays tab. Initially we see only one item in the Layout list. This is the image. If this is re-sized in the previous step, the position of the outcrop can be set. Right click the Position column and select an alignment from the drop down list.
11. Add additional overlays text boxes with any information. Use the Add text box dialog to create the

overlays.

12. When all parameters have been set, and if happy with them, Click the Save in Preference Archive button  to save the settings in the preference archive. You may also Revert to any of the currently saved settings in the Preference archive by clicking the Revert..  button. Just remember that the setup done will be overridden if done so.
13. Select the Export button to export the image sequence as set up.
14. Select Server Export if a Remote Export Server is to take care of the export operation.
15. The image export will be performed. A progress message is displayed while the export is underway. If the Cancel button is selected during the export, the images exported up to that point are retained in the exported files. These have to be manually deleted if they are not required. Note: If the specified export destination directory does not exist, a message is displayed asking if you wish to create it.

Note: When a successful Image Export has been performed, the settings used will be saved in the test (the .ted file). Next time an Image Export will be done in that test, those settings will be initially applied. At any time, the user can change any parameter and if done, when performing a new export, the image export information in the .ted file will be updated. This is not the same as the function of saving the Image Export settings in the preference archive, which can be done parallel to this.

Manage an Overlaid [Text Box](#)

- To add a new Text Box to the exported image, clicking the Add Text box button.
 - The Box position setting is where the position of the box within the export window is specified. This can be changed later in the Overlays tab in the image export dialog.
 - Alignment sets the text alignment within the text box. This can be changed later in the Overlays tab in the image export dialog.
 - Background - set the color of the text box background.
 - Border - set the color of the text box border.
 - The Text is set up like any text box.
- To Edit an already inserted text box, mark this in the list and click Edit. The Text Box dialog will then appear in which the text box can be re-edited.
- To Delete a text box in the list, mark this and select Remove.

Add or Edit Overlays Image Boxes

When clicking the Add Image box or Edit button (having an inserted image box marked in the list) has been clicked, the Add/Edit image box dialog opens. With the help of this, an overlay image box can be set up.

Accessed via...

Any Camera view window (right click menu) or via Camera/Export Images in the menu bar.

See also...

Multiple Image Export
Storage Formats
Combined Image Export

Specifying the Storage Format

The Storage Format dialog is used to specify the output file format in various situations. The nature of the details displayed in the dialog vary depending on the format type selected.

1. Select the required type from the Format list.
2. Depending on the type selected, specify the appropriate details:
 - Multiple TIFF files (.tif)
 - Compression:
 - No Compression.
 - LZW Compression - non-destructive compression of the output file.
 - Colour mode:
 - Auto - the software selects the most appropriate mode, depending on the original image and which modes are supported by the output format.
 - L - grayscale 8 bits.
 - RGB*24 - colour 8 bits per colour.
 - RGB*48 - colour 16 bits per colour.
 - MPEG (.m2v, .m1v)
 - Format (i.e. MPEG standard):
 - MPEG-1.
 - MPEG-2 Standard definition.
 - MPEG-2 High Level.
 - MPEG-2 4:2:0 (Mediaplayer compatible)
 - Frame Rate:
 - No Conversion.
 - 24fps to 25fps - creates 25 frame per second video sequences from 24 frame per second film.
 - Only I-frames - special variant of the MPEG format that does not compress as well, but is necessary for input to some editing systems.
 - Write Interlaced - should be used if the input is from video.
 - Bitrate (0-50 Mbit/sec) - compression level for MPEG.
 - Colour mode:
 - Auto - the software selects the most appropriate mode, depending on the original image and which modes are supported by the output format.
 - YUY2 - 16 bit colour data with 8 bit luminescence and 8 bit colour (typically used for video).
 - AVI-file (.avi)
 - Compressor - to select a compressor:
 1. Select the Change button.
The Video Compression dialog is displayed.
 2. Add a [Digital Signature](#) (optional)
 3. [Specify the required compression](#).
 - Frame Rates:
 - Recording, Desired. The default value is the frame rate that is set in TEMA. If you later load this file into TEMA, this will be the camera Frame Rate.
 - Play, Desired. The desired play speed in other programs, such as the Windows Media Player.
 - Fix Play Rate: As the AVI format does not allow exact representation of both these values, the program makes a compromise that is seen in the "Resulting" values to the right of the enter fields for Frame Rate and Play Rate. If this check box is marked, the Resulting Play Rate will be kept as desired. If not, the desired camera Frame Rate will not be changed.
 - Colour mode:
 - Auto - the software selects the most appropriate mode, depending on the original image and which modes are supported by the output format.
 - BGR*24 - Colour 8 bits per colour (different memory layout to RGB).
 - L - grayscale 8 bits.

- Multiple JPEG-files (.jpg)
 - Quality - The JPEG format compresses the images. If the image quality is set to a higher level, more disk space is used but the images look better.
 - Colour mode:
 - Auto - the software selects the most appropriate mode, depending on the original image and which modes are supported by the output format.
 - RGB*24 - Colour 8 bits per colour.
 - L - grayscale 8 bits.
3. Select the OK button.

Multiple Image Export

Function

This function is similar to the [Export Images](#) function, but enables simultaneous export of images from more than one camera view at the same time with same export settings, overlays etc .

This is for example useable when controlling several cameras in the TEMA [Camera Control](#).

Note: When multi selecting items in the test contents list and selecting image export, only the marked camera views will be exported, no point windows.

Appearance

The multi image export window differs from the [image export window](#) in that only the [Output](#), [Title Slate](#) and [Overlays](#) tabs are available.

Procedure

1. Select the camera views in the Test Contents window for which images are to be exported, hold the <Ctrl> key to multi select camera views.
2. Select the Export Images option from the Camera menu.
The Multi Image Export dialog is displayed.
3. Proceed as when performing a ordinary [image export](#).

See also...

[Image Export](#)

[Storage Formats](#)

[Combined Image Export](#)

Server Export (optional)

Function

[Image export](#) can be done on a Remote Export Server machine, saving CPU on the analysis machine.

Requirements

- A network where directories can be shared between two computers, with permissions to write.
- A correct set up [Remote Export Server](#) in preferences
- Image Systems Server program installed on the server computer. The program is an free standing application for performing image exports from a client, using a server. The program is used to configure the server machine to make communication between the machines possible.
- A Job Directory defined and shared for both client and server (see below).
- The export destination folder is available for both server and client (shared).

Communication

The communication between the client and the server is done via a directory on the network that is available to both machines. In most cases, this directory, called Job directory, is placed on the server machine. When the program IM Server starts on the server, the IP number of the server is checked and written on a file called *image systems export server configuration*. This file is placed on the job directory. When a server export is to be done, the client will read the server IP number in this file on the job directory. After this, it can connect to the server and letting the server export be performed.

Procedure

1. Set up the Remote Export Server in the [preference pane](#).
2. Install IM Server on the Remote Server Machine.
3. Set up the parameters in IM Server (Job directory etc.)
4. Perform steps 1-12 in the ordinary [Image export procedure](#). Step 3 - make sure the destination directory is shared, available from both Client and server.
5. Select Export.
 - If one single Remote Server is defined, this will be used automatically and there will be no progress bar on the client side. The progress can only be seen on the server side.
 - If several remote servers are defined, the select server dialog will appear. Here, we can select which Remote server to use.
 - We can add a local "server" in the preference pane server list. This represents a ordinary local Image export. The reason this can be added is if there is a need for performing local and/or remote exports in the same test. If a local server is present, this can be selected in the select server dialog and a local image export will be performed, with a progress bar present.

Digital Signature (optional)

Function

In applications where it is important to use the same image files as where used in a test for later use, a digital signature function is of great value.

When exporting an image sequence to .avi format using image export, a digital signature can be attached to the exported file. This will contain the date of export and a checksum.

With this option, when this file is used in TEMA later on, as a new camera view, TEMA will note that the file has a signature. In the [Open Image File](#) dialog, the Check Signature button will be enabled. By this, the checksum can be reviewed and controlled by the operator. Should the file have been tampered with, the checksum will change, proving this.

Procedure

1. At [Image Export](#), select [file format](#) .avi.
2. Click the Sign check box.
3. Proceed with the steps in Image Export.
4. When exported, the resulting file will contain a digital signature.

Image Boxes

Function

It is possible to insert a bitmap image as an overlay to an exported image.

Procedure

In the image box setup dialog, specify the following;

- The Box position in the export window. This can be changed later in the Overlays tab in the image export dialog.
- Filename - browse to an image on the workstation.

See also...

[Text Boxes](#)

Combined Image Export

Function

To export selected items for external presentation(s), in which the user decides and designs the contents and layout (alignment, file name, title slates, overlays etc).

Possible items (merged together) are:

- Complete or selected part(s) from an image sequence.
- Camera views.
- Diagrams (not tables) displaying tracked data.
- Point zooms, etc.

The export can be done into most commonly used image formats.

The Combined Image Export is performed via a wizard.

The appearance of the Image Export window is Export Settings to the left and the Export Area to the right.

Procedure

The wizard for Combined Image Export (in Edit menu) consists of three steps. Each step is numbered and gives a short guideline.

Step 1 - Selection





1. Select items in the list.
 - Hold down Shift button to select a range of items.OR
 - Hold down Ctrl button to add or deselect items.
2. Press Next button when ready.



Step 2 – Layout

1. Set the Width and Height of the Export Area, which will define the total size in pixels of the exported images.
2. Make a Selection in the list.
 - Use the arrow buttons to the right of the list to move the selected items within the predefined Layout (see below).OR
 - Use the mouse to move or resize items in the preview window to the right.
3. Set the Layout:
 - Auto enabled – The Layout is set by default.
 - Auto disabled – The Layout is set by entering No of rows and No of columns.
 - Fill last row(s) enabled – The last row(s) of items will be filled out.
 - Row <=> Column enabled – The row(s) will be transferred into column(s).
4. Press Next button when ready.

Step 3 – Export

1. Output tab - Define the Output File (directory, name and type).

- Directory - Browse for folder to set the Output File Directory. The Directory will override the Default Directory for image export as set in the [Preferences](#).
 - File Name - Enter File Name of Output File to be exported.
 - Storage Format – Select amongst the [available image formats](#) in the [Storage Format](#) dialog.
2. Title Slates tab – Add frames Before and After the main sequence.
This is an animated first (and/or last) image frame. This can be equipped with additional text boxes with any information, just like the rest of the exported sequence. However, the overlays added here will only be shown in the set Title Slates. The text boxes in the Title Slates may contain information about the image file in specific text and image boxes only shown here.
- Background - Set the background colour to the Title Slate(s) from the drop-down list. Disable One Frame to increase the Duration
 - Layout - Create a list of the added Text and Image boxes to the Title Slate(s).
 - Click Add Text Box or Add Image Box.
 - Maintain the contents in the list by using the buttons beneath it; Edit and Remove.
 - To Edit an already inserted box, mark this in the list and click Edit. The Box dialog will then appear in which the box can be re-edited.
 - To Delete a box in the list, mark this and select Remove.
 - The columns can also be right clicked in order to change the:
 - Text - The text is set up like any [text box](#).
 - Alignment - Sets the text alignment within the text box.
 - Colour - Sets the colour of the text in the text box.
 - Position - Specifies the position of the box within the export window.
 - Background - Sets the colour of the text box background.
 - Border - Sets the colour of the box border.
 - The [built-in variables](#) \$EXPORTFILENAME\$ inserted in a text box will result in the name of the file as given in the Output tab in every frame when exported.
3. Time tab – Amend the range of images (Time Extent) to be exported, if required, by:
- Modifying the Time Range .
 - Modifying the Image Range .
 - To export the complete image sequence (all frames) - select the  button.
 - To customize the range, unclick this.
 - The export range can then be delimited manually by editing the time and interval start- and end limits.
 - Modifying the Number Of Images (equal to image range span). If set to a smaller value, the upper image range limit will be lowered to match the new amount of images to export.
 - In order to lock the number of images to be exported, not being affected by any other parameter change, click the lock button . When locked, this will change to .
 - To export only the image currently displayed in the export window, click the  button.
 - If every image in a sequence is to be exported, the Skip Count should be set to zero. Skip count *n* will export every *n*:th image in the sequence, thus effecting the Number of Images but not the Range spans.
- Note:* Amending any of these parameters automatically updates the values of the others.
4. Overlays tab – Specify the Overlays to be exported with the image file.
Each item in the main sequence can be equipped with additional text boxes with any information. Graphic overlays (curves and text boxes) present in the image diagram or tracking node can be removed and new text and image boxes can be added to the export window.
- Background - Set the background colour to the Overlay(s) from the drop-down list. Disable One Frame to increase the Duration
 - Layout - Create a list of the added Text and Image boxes to the Overlay(s).
 - Click Add Text Box or Add Image Box.
 - Maintain the contents in the list by using the buttons beneath it; Edit and Remove.

- To Edit an already inserted box, mark this in the list and click Edit. The Box dialog will then appear in which the box can be re-edited.
 - To Delete a box in the list, mark this and select Remove.
 - The columns can also be right clicked in order to change the:
 - Text - The text is set up like any [text box](#).
 - Alignment - Sets the text alignment within the text box.
 - Colour - Sets the colour of the text in the text box.
 - Position - Specifies the position of the box within the export window.
 - Background - Sets the colour of the text box background.
 - Border - Sets the colour of the box border.
 - The [built-in variables](#) \$TIME\$ inserted in a test box will result in the current time in every frame when exported, \$EXPORTFILENAME\$ in the name of the name of the file as given in the Output tab.
5. Previous button – moves to previous step in the wizard.
Next button – moves to next step in the wizard.
6. Save Preference button  - The current export settings will be saved in the preference archive. There are two alternatives when saving here. Either save the setting as a new Default. This will make those settings to be applied to a new test when created. Or, the settings can be saved in your own name. Any number of settings can be saved in the preference archive like this, to match different requirements of Combined Image Export.
- Load Preference button  - The current export settings will be overridden by the settings in the preference archive. If there are more than just the Default settings (see above), then any of the alternatives can be selected and applied.
7. Press Export button when ready. Cancel button - cancels the export.

Note: When a successful Combined Image Export has been performed, the settings used will be saved in the test (the .ted file). Next time an Combined Image Export will be done in that test, those settings will be initially applied. At any time, the user can change any parameter and if done, when performing a new export, the information in the .ted file will be updated. This is not the same as the function of saving the Combined Image Export settings in the preference archive, which can be done parallel to this.

Accessed via...

Edit menu/Combined Image Export.

See also...

[Image Export](#)

[Multiple Image Export](#)

[Managing Diagrams via Test Contents](#)

Exporting Data

This function is used to export data from a table to a variety of different external formats for use in other systems.

1. Display the Table you wish to export.
It is important to [set up the table](#) so that it contains only the data you wish to export because the whole of the table is exported.
2. Select the Export Data option from the Diagram menu.
A Save as dialog is displayed.
The Save as type drop-down list contains the available formats.
3. Specify in the Save in field the folder to which you wish to export the images.
4. Key in the File name of the file to which you wish to export the images.
5. Select the type of file you wish to export from the Save as type drop-down list.

The options are:

- Excel - (.xls)
- Tab Delimited Ascii - (.txt)
- Diadem - (.dat.)
- ISO - (.iso)
- CASDAS - (.dat)
- MatLab - (.dat)

6. Select the Save button.

Exporting Tracked Data (Optional Feature)

Note: This option only applies if the Airbag tracker option is installed. It exports the tracked outline from the Airbag tracker, together with the name and 2-dimensional coordinates for other points.

1. In the Test Contents window:
 - Select the camera view to be exported.
 - Select the data to be exported, i.e. points, contours, etc.
Note: Selecting only the camera view exports nothing.
2. Select the Export Tracked Data option from the Object menu.
The Select Coordinate System dialog is displayed.
3. Select the required coordinate system from the list.
4. Select the OK button.
The standard Save as dialog is displayed with the ".xml" file extension pre-selected.
5. Specify the name and location to which the data is to be exported.
6. Select the Save button.
The tracked data is exported.

Note: Alternatively, right-click the item to be exported and select the Export Tracked Data option from the pop-up menu.

Specifying Video Compression

The Video Compression dialog is used to specify the type of compression used when exporting image sequences to an AVI file.

Note: The AVI settings are not TEMA settings, but are specific to each codec defined by the codec supplier.

1. Select the required type of compression from the Compressor list.
Depending on the type selected, the other fields in the dialog are enabled, otherwise they remain disabled.
Note: The Configure button is not always enabled with the other fields.
2. Amend the Compression Quality using the slider.
If the image quality is set to a higher level, more disk space is used but the images look better.
3. If you wish to specify key frames:
 - Select the Key Frame checkbox.
 - Key the required frequency of the key frames.
Without the specification of key frames, the compression of a frame is determined in terms of the differences from the previous frame.
With the specification of key frames, each key frame is retained in full and successive frames determined as differences until the next key frame is reached. This is useful if there are large scale changes between groups of images in the sequence
4. If you wish to specify the data rate:
 - Select the Data Rate checkbox.
 - Key the required rate.
Specifying a data rate overrides the quality setting and adjusts the quality to achieve the desired data rate of the output file.
5. If enabled, select the Configure button and specify the advanced parameters specific to the selected compressor.
6. If you wish to identify the version of the compression routine, select the About button.
7. Select the OK button.

Printing a Selected Item



This function is used to print a selected displayed image, diagram or table.

When the printer has been selected during a print operation and the print initiated, the [Printer Axes Length dialog](#) is displayed if the appropriate presentation printing preference has been set.

1. Select the required image, diagram or table.
2. Select the Print option from the File menu.
The Print dialog is displayed.
3. [Specify the print layout](#).
Note: The printing is initiated from the Print dialog.


Printing Test Reports

This function is used to print a report containing one or more camera views and/or diagrams included in the test.

1. Select the Print Report option from the File menu.
The Print Report dialog is displayed.
2. To preview an item, select the item in the Print frame.
It is displayed in the Preview Selected frame.
3. To remove an item from the report, de-select its checkbox in the Print frame.
4. To adjust the sequence of the item in the report, select an item and use the  and  arrows to place it in the required position.
5. Specify the Pagination by:
 - Selecting the No limit checkbox to allow the system to control the pagination.
 - De-selecting the No limit checkbox and keying the Maximum prints per page.
6. Specify the required Orientation by selecting the appropriate radio button:
 - Distribute - spreads the items across and down the page.
 - Vertical - spreads the items down the page.
 - Horizontal - spreads the items across the page.
7. Select the Options button.
The Print Options dialog is displayed.
8. [Specify the print options.](#)
9. Select the OK button.
The report is printed via the standard print dialog.

Specifying the Print Options

The Print Options dialog is used to specify how a selected item or a print report is to be printed. The same set of details can be set as a [print preference](#). It is these values that are displayed when the Print Options dialog is displayed. The values can be overwritten, as required, for individual prints.

1. To add the date and time, select the Date checkbox.
2. To specifying a logo:
 - Select the Logotype checkbox.
 - Key the Logotype path, or select the adjacent  button and browse for it in the standard Open dialog.
 - Specify the size of the logo by keying appropriate values for the Width (mm) and Height (mm) fields.
3. To specify descriptive text, key one or more lines of text in the Text frame.
4. If you wish to append the [test description](#) to text, select the Append button.
The test description is appended to the Text.
Note: If a test description has not been defined, nothing happens, i.e. nothing is appended.
5. To specify the page setup:
 - Select the Page Setup button.
The standard Page Setup dialog is displayed.
 - Specify the required settings:
 - Paper size and source;
 - Orientation (portrait and landscape);
 - Margins (top, bottom, left and right).
 - Printer properties
 - Select the OK button.
6. Select the Close button.


Miscellaneous

Defining an Area of Interest

A rectangular area of interest can be defined in a camera view to limit the part of the image used for:

- [Image Enhancement](#).
- [Image Export](#).

To draw an area of interest:

1. Select the  tool.
2. Press the <shift> key and hold it down.
3. Move the mouse to a corner of the required area of interest.
4. Press the left mouse button and drag the mouse to the opposite corner of the required area of interest.
5. Release the mouse button.
6. Release the <shift> key.

To amend the area of interest:

There are a number of ways that an area of interest can be amended:

1. Redraw the area of interest as described above.
2. Position the mouse inside the rectangle, press the left mouse button and drag the rectangle to the required position
3. Select any of the four sides or corners with the mouse and drag it to the required position.
4. Use the Area of Interest dialog:
 - Select the Area of Interest option from the Edit menu.
The Area of Interest dialog is displayed.
 - Key appropriate values for the Offset X, Size (X), Offset Y and Size (Y) fields.
 - Select the OK button.

To remove the area of interest:

1. Select the Area of Interest option from the Edit menu.
The Area of Interest dialog is displayed.
2. De-select the Activate checkbox.
3. Select the OK button.

Note: This action removes the area of interest from the display and disables its effect on other functions. However, it still remains defined and can be reactivated by re-selecting the Activate checkbox in the Area of Interest dialog.

Browsing for a Folder

1. Select the required folder in the file structure.
Alternatively, if you require a new folder:
2. Select the location for the new folder.
3. Select the Make New Folder button.
A new folder is inserted at the specified location.
4. Amend the folder name.
5. Select another entry.
The amended part of the file structure is re-sequenced.
6. Select the OK button.

Deleting an Item

1. Select the item, or group of items, you wish to delete.
2. Select the Delete option from the Edit menu.


Alternatively, click the  button.

In some cases a confirmation dialog is displayed before the deletion is performed, while in others it is not. Confirmation is always requested when removing a camera view.

For example:

- Unregistered points are deleted from the Test Contents window without confirmation, while the deletion of those containing tracked data causes a confirmation to be displayed.
- When a camera view is deleted from the Test Contents window, the Remove Camera View confirmation dialog is displayed. Confirmation must be provided before the deletion is performed.

Displaying a Camera View

1. Select the required camera view in the Points List window.
2. Select the Show Camera View Window option from the Camera menu.
Alternatively, select the  tool.
The Camera View window is displayed, showing the selected camera view.

Displaying Toolbars

The system displays all of its toolbars by default when the system is first used. You may toggle the display of each of the toolbars independently by selecting the appropriate option in the Tools/Toolbars sub-menu:

- [Standard](#)
- [Point Control](#)
- [Tools](#)
- [Default Trackers](#)
- [Data](#)
- [Time Panel](#)
- [Time Slider](#)
- [Camera Control](#)
- [Test Sequence](#)

Editing Colours

The Colour Editor is used in a number of dialogs to specify a display colour.

As the selection is changed, it is reflected in the Colour frame.

1. Specify the approximate colour by clicking at the appropriate place in the Hue and Saturation frame.
2. Select the colour more accurately by dragging the slider in the Value frame.
3. Specify the colour exactly by keying the value or dragging the slider in each of the Hue, Saturation, Value, Red, Green and Blue fields.
4. Select the OK button.

Expressions (optional)

Function

TEMA handles a set of expressions that can be used in combination with text in text boxes. An expression is different from ordinary text as it will be interpreted by TEMA as a value. The values can be predefined variables, data, attributes and a number of functions.

As an example, by using the Predefined variable COMPUTER will result in the name of the used workstation.

For each place where expressions can be used, the string expression [wizard](#) will be present. This will aid the creation of expressions. However, any expression can be created in a text box with no help from the wizard.

Below is a list of the expressions and from where in a TEMA test they can be reached

Predefined variables

The Predefined variables can be used in:

- Default directory paths (set in the Preference Archive).
- Text boxes in Diagrams and Image Export layouts.

The Predefined variables are:

- COMPUTER - the name of the used workstation.
- EXPORTFILENAME - the name of the exported file as set in the image export dialog.
- FIRSTIMAGE - Image number of first exported image.
- FIRSTTIME - Time of first exported image.
- INPUTFRAMEFREQUENCY - the frame rate for the sequence to export (Hz).
- INPUTSIZE X - the amount of pixels in x direction of the sequence to export.
- INPUTSIZE Y - the amount of pixels in y direction of the sequence to export.
- LASTIMAGE - Image number of last exported image.
- LASTTIME - Time of last exported image.
- NUMBEROFIMAGES - the number of images.
- OPERATOR - the name of the workstation from which TEMA is run.
- OUTPUTFRAMEFREQUENCY - the frame rate for the exported image sequence (Hz).
- OUTPUTSIZE X - the size of the output file in the x direction.
- OUTPUTSIZE Y - the size of the output file in the y direction.

- SECTION - the name of the current [Test Section](#).
- TESTFILE - the complete name of the .ted file from which the export was performed (with path and extension).
- TESTFOLDER - the path to the .ted file from which the export was performed.
- TESTNAME - the name of the .ted file from which the export was performed (without path or extension).
- TIME - current time in the [Time Panel](#).
- TRIGGER TIME - Camera control feature. The time at when the system recognizes that the first camera in a test has been triggered. Absolute time.
- VIEWNAME - the name of the camera view from which the export was done.
- ZOOMFACTOR - the set zoom factor for the image export.
- DIRTIME - (Camera control Variable) the time for when the Trigger command was sent to the camera shooting the image sequence to be exported.
- DIRDATE - (Camera control Variable) the date for when the Trigger command was sent to the camera shooting the image sequence to be exported.

[Gun Scoring](#) Statistics Variables (optional)

All coordinates are defined in the score card coordinate system . COG means Centre Of Gravity.

- AimToCenter [Section] - the 2D distance between the Aim Point and the COG point.
- AimX [Section] - the x coordinate of the Aim Point.
- AimY [Section]- the y coordinate of the Aim Point.
- Angle [Section] - Angle Of Impact.
- CenterX [Section] - the x coordinate of the COG Point.
- CenterY [Section] - the y coordinate of the COG Point.
- ExtremeMax [Section] - the greatest 2D distance between any two points.
- ExtremeX [Section] - the extreme x coordinate.
- ExtremeY [Section]- the extreme y coordinate.
- MRad [Section] - the mean distance between the COG point and all other points. This function is transparently used for calculating the Spread Circle in the Gun Scoring application
- StdDevRad [Section] - the standard deviation of the mean distance between the COG point and all other points.
- StdDevX [Section] - the standard deviation of the x coordinate of all points.

- StdDevY [Section] - the standard deviation of the y coordinate of all points.
- ShootingRange - the Shooting Range value as typed in the [Test Data setup](#).

See also..

[Variable Wizards](#)

The String Expression Wizard (optional)


Function

To effectively use Expressions, there is a Wizard available which appears when clicking the wizard icon. With the use of this, we do not have to type the expressions manually, nor remembering what variables there are. The wizard interface contains lists of all available variables, data, attributes and functions to use. We only have to select the correct combination of data and functions and insert in the text box.

The expression wizard can be looked upon as an extension of the text box setup, as expressions can be typed even there.

Note: All expressions can be entered without the help of the wizards, they are just there to ease the process if needed.

What about The \$\$ characters..?

Anything typed in an enter field that has the Variable Wizard icon  next to it, will be interpreted by TEMA as a string. If a *value* shall be entered here, such has to stand between \$ characters. We can say that a word enclosed in \$\$ characters goes untouched by this string-interpretation. Built-in variables are keywords that are to be used as values, not strings. Therefore, they need to be enclosed by \$\$ to result in anything useful, a variable. Any of the variable words typed just as they are (without the \$\$ enclosing) will be interpreted just as the string it is.

Note: When manually typing a variable, the user has to remember the \$\$ characters.

The Wizard contains the list of the available . Selecting one of built-in variables in the wizard-list will make the variable appear in the enter field between two \$ signs, inserted by the wizard automatically.

Note: Using this wizard means the user do not have to remember the \$ characters when selecting a variable.

Appearance

Data Select area

The upper part of the wizard is the data select area. Here, we can select Variables or/and Data to insert in the Edit area.

- Variables - The list of available [Predifined Variables.](#)
- Points - The list of the available tracking data for selection, per point.
- Attributes - The available attributes for each point selected in the Points list. The available Attributes varies depending on the tracking algorithm used. Also, the desired Time Derivative and Component can be selected here.
- Coordinate system - The available coordinate system in the test.


Edit area

The edit area is, in fact, the text box edit area. Any text can be typed here. The Expressions created by the wizard's data select area will end up here together with any optional text.

Preview area

Here is the initial result from the used expressions together with any optional text. Note that the message 'Value at' will not appear in the text box when the wizard is closed

Procedure

1. Enter the wizard by clicking the open string expression wizard button .
2. To use any of the Predifined Variables, select one from the list and click Use. The Variable will now be insted into the preview area.
3. Select the Point(s) to add to the Column list. Note that multi selections can be done here, selecting points from different trackers. Any subsequent specification done will affect the whole selection.
4. Specify what type of Attributes to use for the selected point. The range of attributes will depend on the type of point selected, thus, the list will update to match the range of the selection made in the point list. Note: If a multi selection has been done, including points from different trackers, the attribute list will list all available attributes from all selected points. It is therefore important to know what types of unique data that comes out from the different trackers.
5. Specify also the Time Derivative of the selection. The derivatives will be applied on all selected attributes for each point.
6. Specify the Coordinate System to be used when presenting the data selection. Select from the dropdown list. If more than one system is available in the test, the option All will present the specified data for each coordinate system in the test.
7. Select the desired Function which will be applied on the data before presentation; At Current time will pass the data untouched. The max and min functions will however calculate the extreme values of a sequence before presentation. Thus, the use any of those two functions will result in the presentation of data that is unaffected by the current time. This as it is just one value for all times in a sequence.
8. Click the Use button to insert the data selection as an expression in the edit area.
9. Type any text in the edit area togehter with the expressions added.
10. Click OK when ready. The final result will appear in the text box.

See also...

File Names

File names used in the system must conform to the standard Windows file naming convention.

In addition, the following restrictions apply:

1. File names must not end in a numeric digit. This is because integer numbers are appended to the file name by the system to identify individual images within a sequence.
2. The "-" (minus) must not be used. This is because image numbers may be negative. To separate words in file names, use the "_" (underline) character.



Find Image

Function

Some applications with high speed photography might result in image sequences where only a few or even one single image out of thousands of frames contains the actual event of interest. To go through such sequences in hunt for the interesting frame or frames can be both time consuming and hard.

In such cases, the Find Image function is a fine help. The function helps to identify the frame(s) of interest. This is done by analyzing the pixel content of the first frame in the sequence. This value is then compared with the ditto of the subsequent frames, in a scan-like process. When a frame with a pixel difference that matches the set parameters appears, the scan will stop at this frame. It is then up to the user to decide whether this is the frame of event or not.

Procedure

1. Select  Find Image from the Edit menu or right click a camera view and select  Find Image. This will open up the Find Image dialog.
2. The Sensitivity slider is the tool for setting how different the image of interest must be from the first image for the scan to stop.
3. Set the Duration. This is the least amount of frames to contain the event of interest.
4. Define the Object Size x and Object Size y. This is the expected size in pixels of the object that will appear and/or move in the event.
5. Enable the toggle Do fine search to find start of events in order for the scan to stop at the first frame of the event. If this is unchecked, and the duration is set to n frames, the scan might stop at $n-1$ frames from the start frame of the event.

Gun Scoring

Function

TEMA Gun Scoring combines Camera Control and Analysis functionality to perform a Gun Scoring test analysis in almost real time at the test shooting site. The single camera used does not need to be perpendicular to the scoring paper.

The system is designed for the use of a Frame grabber Camera. This has no internal memory. Therefore, all recorded images are always live images directly from the camera, downloaded to a set download directory.

The system allows the same camera to be used to shoot both a reference (2D scaling) sequence and the analysis sequence. This is done by [Test Sections](#), which enables the maintenance of two parallel image sequences and trackings in one test.

Note: Some of the functions described have extensive help sections in the rest of the TEMA help, some are described here only. Also, in addition to this functional description, there is a [Step-by-step guide](#) which describes how to use the functions in the Gun Scoring test analysis procedure in the most effective way.

Concept

The TEMA Gun Scoring concept includes two different parts;

1. The TEMA Gun Scoring functions package.
2. A [Factory Template](#) with all presets necessary for easy usage of the package.

Functions Package

Gun Scoring Setup

A setup dialog where certain Gun Scoring settings can be done.

Test Setup

- Statistical Analysis: Sets the Shooting Range value and used Unit. This will be used when calculating the Angle of Impact (see Statistics calculations below). The value can also be captured in the presentation with help of the [Statistics Variable](#) *ShootingRange*.
- Also, if we have set up [Test Attributes](#) in the test, those will be listed here together with a corresponding enter field where they can be specified with values.
- Download Filenames. Sets the download filename (per section). If the filename is useable, this will be indicated by the word *OK* below the enter field. This is done per section. In the Factory template, there are two sections defined from start. Those are called *GeoSetup* and *Test*. The filenames are also defined in the template, using some [built-in variables](#): *\$_VIEWNAME\$_GeoSetup* and *\$_VIEWNAME\$_Test*. The syntax *\$_VIEWNAME\$* will use the corresponding view name for each section automatically. Amend the pattern if desired.

Camera/Microphone Setup

- Camera Setups. In order for any settings to be done, a online live camera must be connected to the system.
 - Imaging. Frame frequency and image size for the frame grabber camera can be reviewed

- here, but not changed.
- Recording.
 - Sound Sync (Single Shot). For single shot tests. Set the time to pass between the sound peak (the shot) and the instant at when the camera will capture an image of the scoring card penetrated by the bullet just fired.
 - Sound Trig (Burst). For burst test (where the time between each shot is very small)
 - The Start time. Only values equal to or below zero can be entered here (note that the minus sign must be entered also). When a value is set, as many seconds as set will be recorded before the sound trig. If this is set to zero, the camera will start recording directly when the sound triggers the system.
 - The End Time. This is the amount of time for the camera to record after the sound trig.
- Microphone. Sets the Microphone threshold levels for the sound sync or sound trig.
 - Level Now is the current value in dB, updating continuously if a microphone is connected to the system
 - The Max Level is the maximum obtained value out of the current value since the reset button was last used.
 - The Reset function will reset the max value and start over.
 - The desired Threshold Level for the Sound Sync/Trig can be typed in the enter field.

Test Procedure

A small summary of the Gun Scoring step-by-step [guide](#) below.

[Geometry Scaling](#)

Single Frame Capture

This is where we can download a single snapshot from the camera in Camera Control Mode, mainly for use in the GeoSetup section before the reference points are positioned. The Caption command will only arm the cameras which views are assigned to the currently active Test Section respectively.

- Download Directory. By default, the path will be taken from what is specified in the Preference Archive. However, this can be amended to any other download path. If any of the directories specified does not exist, such will be created prior to the download.
- The list of all the Camera Views affected by the Single Frame Snapshot command. For every camera in list, the following information is provided;
 - Name - name of the Camera View
 - Camera - name of the camera in View
 - Filename - the name of the file to be downloaded. The filename is taken from what is specified in the Gun Scoring Setup, but can be clicked and amended in the columns as well. Not only the file name(s) can be specified here, but a whole path with the download directory can be typed. If a path is typed here, this will be used instead of or in combination with what is in the Download Directory entered above. Some examples of this;
 - if the Download Directory enter field contains the path *C:\teimage\Download*, and the Filename pattern here is *Download_1/Images*, then the final path and filename will be *C:\teimage\Download\Download_1\First_Shot*.
 - if the Filename pattern is *C:\teimage\Images\First_Shot* then the path in the Download Directory enter field will not be used at all, only the path in the filename pattern.
 - If any of the directories specified in the Filename pattern does not exist, such will be created prior to the download.
 - Warnings - warning messages before and during the Arm/Trigger procedure. The warning messages are sorted in a tree structure in categories. To see which cameras that are affected

by the warning, click the + adjacent.

Note: the Arm command will only arm the cameras which views are assigned to the currently active [Test Section](#) respectively.

Arm

This function has much in common with the Single Frame Caption function described above. However, there are a few differences.

- This function downloads the moving images from the test, not only one single image.
- The camera view list;
 - Status - status of each the camera during the Arm/Trigger procedure.
 - Empty - the camera RAM memory is empty.
 - Full - If automatic download is not selected, the "Full" status is displayed to indicate completion.
 - Armed - The camera is Armed, but no Trigger signal has been sent yet
 - Triggered - The camera has received a trigger signal
 - Downloading - the percentage of the specified download range.
 - Download Completed
- Manual Trigger button. In case sound trigger is not an option, the trigger signal can also be manually given to the system by clicking this button.
- Warnings - warning messages before and during the Arm/Trigger procedure. The warning messages are sorted in a tree structure in categories. To see which cameras that are affected by the warning, click the + adjacent.
- Download progress bar. When the Trigger command has been given, a main progress bar will visualize the download procedure. This bar will reach 100% at the amount of set recorded live images from the frame grabber camera, thus this will always complete.

[Point Generator](#)

In Gun Scoring, the Point Generator is limited to 5 points per frame when tracked.

Statistics calculations

When a test is performed, there is a number of parameters that are calculated automatically with no settings for the user. The results are captured by the use of [Statistics Built-in Variables](#) into the final report.

The gun scoring statistics are constant values, not sequences of time. They are computed per [section](#), and are based on the last tracked samples (per section) of all points that are considered 'valid'. A point is 'valid' if it doesn't belong in a group (this excludes e.g. all reference points) and has a name different from the aim-point name, which is specified in the [Test Data Setup](#) dialog.

The results are all using the same coordinate system, the Scoring Paper coordinate system. This is oriented in the reference plane as set by the [2D reference points](#) and its 2 axes defined by the patterns of the perforation holes in the paper in the last tracked image frame. The axis definition is; the y axis goes through the point farthest to the right and the x axis through the lowest point.

- Extreme Vertical. Vertical distance between the center of the hole made by uppermost shot and the center of the hole made by the lowermost shot.

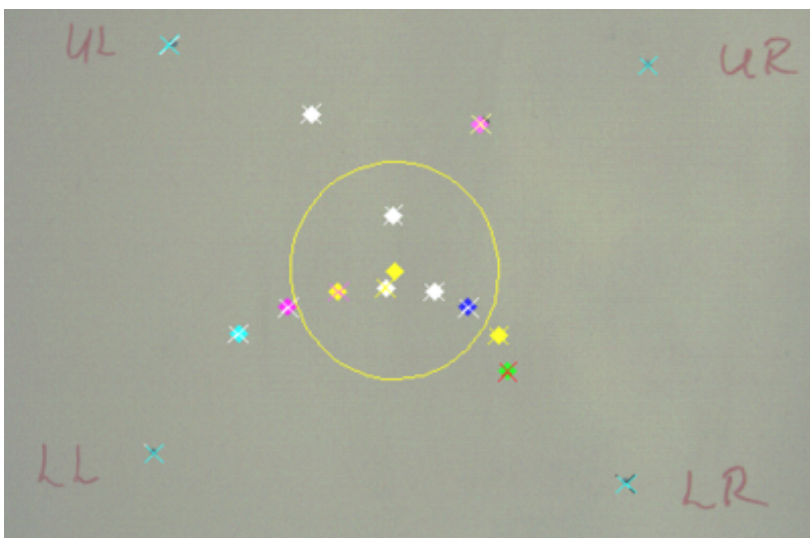
- Extreme Horizontal. Horizontal distance between the center of the hole made by the shot farthest to the right and the center of the hole made by the shot farthest to the left. uppermost shot and the center of the hole made by the lowermost shot.
- Extreme Spread. Distance Between centers of the shot holes farthest apart.
- Position. x, y coordinate value of each shot.
- Center Of Impact (COI). The point at which the algebraic sums of the vertical and horizontal components respectively of the distances to the center of each slot hole are zero.
- Mean Radius. From the center of impact, measures the distance to the center of each shot hole of the target . Add these distances and divide by the total number of holes.
- Standard deviation. The square root of the average squared deviation from the mean. x,y coordinate value.
- Aim to Center of Impact. Distance.
- Angle of Impact (AOI). This is half the opening angle; $AOI = \arctan(MRad/ShootingRange)$.

Spread Circle

The Spread Circle is a point specifically produced for Gun Scoring reports, which cannot be seen in the test contents list. Its position is the Center of Impact, and its accuracy radius is the Mean Radius, as described above, transparently using the Statistics Variable MRad.

When in an image diagram, the spread circle can be added to the diagram just like any other curve. It will then appear as a tracked point in the Center Of Impact.

1. Right click the Spread Circle in the Curves list
2. Select Show Accuracy.
3. Standard Deviation.
4. Press OK. The calculated Mean Radius will now be visualized as the actual spread circle.



Note: The Spread Circle is different from the other points in the test. Each tracked point in TEMA has a corresponding accuracy. This accuracy can be visualized in e.g. XY and image diagrams as an uncertainty

ellipse. The Spread Circle is different in the sense that its ellipse is not a visualization of its accuracy, but instead corresponds to the [statistical Variable MRad](#). When added to a XY or image diagram, it does indeed appear at the Center Of Impact. It is, however, not the Center Of Impact (COI) by definition. When displaying the Mean Radius, this is done via the Accuracy drop box. The circle around the point is really the calculated Mean Radius visualized and not the accuracy of the COI point.

Preferences

- [Preferences/General](#) - open [Gun Scoring Setup](#) dialog at new test startup. Enable by clicking in the check box.

Factory Template

The factory Template is a .ted file that shall be copied into the Templates Directory in your TEMA installation. When starting up the program, this template can be selected from start. If this is done, all the most important program parameters will be preset instantly. The presents are;

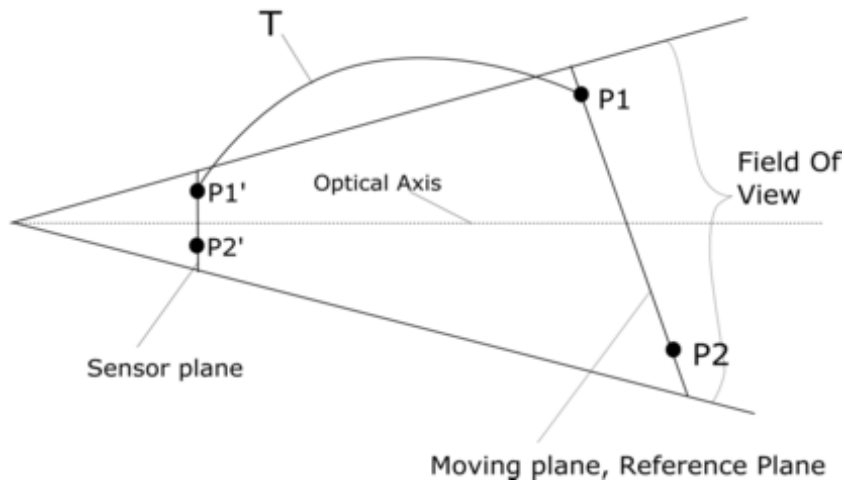
- Two [Test Sections](#). Those are called *GeoSetup* and *Test*. The Calibration function has a setting that will download one single image from the camera only. This will be used for locating or tracking the 2D reference points. The Analyze section has no such limitation for the download but will allow downloading of all images from the actual test
- One Camera View. This is assigned to both sections in order to use it both when performing the 2D geometry setup and during the analysis.
- Default filenames for the downloads, per section. The filename patterns contains the Project name and each sections name. This is done with help of the syntaxes '\$Project Title'\$_GeoSetup & '\$Project Title'\$_Test where Project_Title is a Test attribute (see below) specified in the Gun Scoring Setup.
- A 2D reference model imported in the GeoSetup section. This contains the measured 2D coordinates for the reference points on the Scoring paper. The Reference Points are listed on the point list ready for tracking when an image is provided.
- 2D Reference Points are defined in Geometry setup.
- Aim Point track Point is added to test in the *GeoSetup*.
- A [Point Generator](#). This has been set up using a Perforation hole as reference. The tracker algorithm is Center Of Gravity Tracker for detecting dark object on white background. No Frame To Frame Prediction is used. The point generator can detect 5 perforation holes maximum.
- Exclude areas have been added to the image, per section. This is because the point generator looks in the whole image and we need to restrict the generator to looking only at the areas of interest. The image has been set to exclude by default and then been equipped with one more exclude area enclosing the Scoring paper in which tracking will be allowed.
- [Test Attributes](#). A number of attributes have been defined as follows
 - Project Title. This is used for default filename patterns.
 - Date
 - Test Site

- Project Manager name
 - Weapon Type
 - S/N# (Serial Number)
 - Ammo Type
 - Comment
- [Report Generator](#) in test. This contains
 - a [Test summary](#) that lists the Gun Score Statistics in the project Specification. This is all done using built-in Variables.
 - an [Image Diagram](#). This is specified for plotting the result from the Point Generator when tracking is performed in the *Test* section.
 - [Spread Circle](#) in Image Diagram that shows the calculated Mean Radius of the hole burst.



Geometry - Scaling (optional)

Function

A special case of 2D tests is a 2D test where all points of interest are in one plane (Gun Scoring is such an application). Such has an advantage that can be used for obtaining a good result even if the camera's optical axis is not perpendicular to this plane (called Motion Plane). The Geometry setup is used for that. By defining a Reference plane based on points on the Motion Plane, a projective plane to plane transformation T can be made. T has 8 degrees of freedom. Therefore it requires four reference points to be estimated. Each of those has two equations to be solved, x and y .



Procedure

1. Select the Geometry option from the Edit menu. The Geometry Setup dialog is displayed.
2. Key in the Reference Time manually or alternatively, select the  button to use the current time. Select also the correct time units from the drop-box.
4. Select the four Reference Points (from the [2D Reference Target](#)), with the use of the corresponding drop boxes.
5. Select the OK button when all required points have been defined. When the reference points have defined the geometry for a camera, this will be indicated with a blue C  on the camera icon in the test contents list.

Note: The coordinate system defined by the reference points is used for the transformation purpose only. When calculating the actual Gun Scoring results ([statistics](#)), another coordinate system (the Scoring Paper coordinate system) is used. Those has nothing in common.

See Also...

[2D Reference Points](#)

2D Reference Points

Function

This function is used to insert 2D reference points from an externally defined target, used for calculating the camera's position in [Arena tests](#).

Note: The function is only available with the Arena Test Optional Feature.

1. Select the appropriate Camera View window.
2. Select the Insert Reference Points option from the Camera menu.
3. To import reference points from a file:
 - Select the Import from File option from the sub-menu.
 - A standard Open dialog is displayed with the file type preset to '.tgt'.
 - Select the required target file.
 - Select the Open button.
 - The Imported Target Model dialog is displayed.
 - Amend the target model, if required.
 - For each point you wish to define for the target:
 - Select the Add button.
 - A point is added to the Points list. which has a default Name (P1, P2, etc.) and its x and y coordinates set to 0,0
 - Select the Name of the point and change it, if required.
 - In turn, select the x and y coordinates of the point and change them to the required values.
 - For any point you wish to remove from the target:
 - Select the point.
 - Select the Remove button.
 - The point is removed.
 - For any point you wish to modify:
 - Select the entry in the Points list.
 - Select the Name of the point and change it, if required.
 - In turn, select the x and y coordinates of the point and change them to the required values.
 - Select the required Unit from the list.
 - Select the OK button.
 - The target points are added to the selected camera view in the Test Contents window. The target file name is used as the name of the point Group.
4. To copy reference points from another view:
 - Select the Copy from Other View option from the sub-menu.
 - The Select Points dialog is displayed.
 - Select the required target from the list of those already in the test.
 - Select the Copy button.
 - The points from the selected target are displayed in the Test Contents window under the selected camera view. The target file name is used as the name of the point Group.

Target File Format

Target files are text files containing actual measurements for the reference points, one line for each reference point. Each line contains the name of the reference point and its x and y coordinates, separated by spaces, as shown in the following example.

Note: The measurements that you make for the target imply that a particular origin is selected. This should be a readily identifiable fixed point in the test area.

Example target file:

Lower_left 0.204 0.942
Upper_left 0.216 1.224
Lower_right 0.9878 0.5188
Upper_right 1.0035 0.884

Gun Scoring

Step By Step guide to Gun Scoring test

For more detailed help, turn to the [Gun Scoring](#) functions descriptions or use the links.

The procedure has two parts;

- Software setup procedure; how to set up TEMA Gun Scoring prior to the testing procedure.
- The Operational Test procedure. The steps required to run a Live Fire Test. In applications with a fixed camera mount there is a special procedure that can be used to decrease the overall time required to run a test. This is referred to as Fixed Camera Procedure.

Software setup procedure

This part of the guide describes the initial steps to be taken in TEMA before the first live test is performed. Once this is done these same settings will be available for use in future tests.

1. Copy the .tep file provided by IS into the TEMA installation directory, overwriting the existing file.
2. Copy the factory template *GunScoring* (.ted file) provided by IS into the TEMA installation/Templates directory.
3. Set up the test rig with the scoring paper.
4. Mark four reference points on the scoring paper. All points has to be seen be the cam era used in the test, as those points will be tracked in TEMA later. A point can be a black dot or a quadrant m ark. Define a 2D coordinate system on the board. Measure the 2D positions of the reference points on the board (x and y as measured in any coordinate system). Create a [2D reference model](#), consisting of the point names and their 2D coordinates. Save as a file with ending .tgt, using any text editor.
5. [Connect A live camera](#) to the workstation.
6. Start TEMA with Gun Scoring functionality.
7. Make sure the Factory Template GunScoring is opened.
8. If enabled in the preference archive, the Gun Scoring Setup dialog will appear automatically at startup of the new test. Here, make the following settings and definitions:
 - Test Setup
 - Statistical Analysis: Set the used Shooting Range and the used units.
 - The [Test Attributes](#), as defined in the factory Template, give values to those ones here.
 - Download Filenames. In the Factory template, there are two sections defined from start. Those are called *GeoSetup* and *Test*. The filenames are also defined in the template, using some [built in variables](#): *\$VIEWNAME\$GeoSetup* and *\$VIEWNAME\$Test*. The syntax *\$VIEWNAME\$* will use the corresponding view name for each section automatically. Amend the pattern if desired. .
 - Camera/Microphone Setup
 - Camera Setups. In order for any settings to be done, a online live c amera must be connected to the system.
 - Imaging. Frame frequency and image size for the frame grabber camera can be

reviewed here, but not changed.

- Recording.
 - Sound Sync (Single Shot). Enable this option when performing single shot tests. In General, the longer the Shooting Range, the longer the time might be needed. The time might be close to one second or smaller. If the time between each shot is smaller than that, the time might be long enough for two shots to penetrate the scoring card before the camera captures the image. In such case, *Burst mode* (below) might be a better approach.
 - Sound Trig (Burst). Enable this option when performing burst tests (where the time between each shot is very small). Set the Start and End Times for the camera recording in relation to the sound trig of the first shot.
 - The Start time. Only values equal to or below zero can be entered here (note that the minus sign must be entered also). When a value is set, as many seconds as set will be recorded before the sound trig. If this is set to zero, the camera will start recording directly when the sound triggers the system.
 - The End Time. Set the amount of time for the camera to record after the sound trig.
- Microphone. Set the Microphone threshold levels for the sound sync or sound trig. Position the microphone where it will be at the forthcoming test. Perform a test shot. Use the values of the Level Now and Max Values as your guidance. The Level Now is the background noise level. If a test shot is fired, this will be indicated by a new max value. Set the Threshold level a bit below this max level and considerably higher than the background noise.

9. Set the Directory for camera Download. This is done in the [Preference Archive/Directories](#).

10. Select the Section *GeoSetup*.

11. The [2D Reference Model](#) in the provided [.tgt file](#) provided may not have the correct 2D coordinates for the test site. In case not, the [.tgt file](#) must be edited (outside TEMA) using a text editor, for example Notepad. Make sure to keep the format with the space delimiters. Save the file and note the directory. It will be used in TEMA in the next step

12. [Import the 2D reference target](#) into TEMA via Camera/Insert Reference Points. Browse to the directory at where the [.tgt file](#) was saved. In the import dialog, make sure the scaling of the 2D coordinates is correct!

13. Go to [Geometry setup](#) (Right Click the Camera View and select the option from the list). Define the four reference points. The 2D transformation calculation will be performed instantly here and no Camera Calibration is needed.

14. (Optional) In applications where the camera is fixed at all times, AND if the Aim Point measurement is not used, the process can be streamlined even further. After step 13 above, perform a single frame capture and place the four reference points in the image.




15. Create a new Template at this stage (Select File/Create Template). Note: If the optional step 12 was performed and the camera is fixed in all tests, activate section *Test* and uncheck the Toggle Wipe Images and Tracked Data. The created Template will now contain pointers to the used images as well as the tracked data for the reference points. Such Template will be referred to as *Fixed Camera Template* in the following Test procedure instructions. If the template has no such information, the template is a *Free Camera Template*.

Operational Test Procedure

The operational test procedure guide is divided into Free and Fixed Camera Mount, using Free or Fixed Camera Templates (see step 15 above). Please note that the Fixed Camera Procedure is only a suggestion in order to run the test faster in case the camera is fixed. The Free Camera procedure will work in all conditions.

Free Camera Template

The Free Camera Procedure describes the steps to be taken in each test when a new Scoring paper has been installed, or if the camera has been moved between two tests. (Free Camera application)

16. Open up a New Test and Select the Template as was created in chapter 6 above. (Select File/New Test. Select The Template as saved above).
17. Select the Section *GeoSetup*.
18. In the Sections tool bar, make sure the *GeoSetup* section is selected in the drop box.
19. [Add a live Camera view to the test.](#) The camera shall overlook the test area and the reference points.
20. Position the aim laser beam towards the scoring paper.
21. Perform a [Single Frame Capture](#) from the Camera (As the name indicates, this will just be a Snapshot as we are in Single mode).
 - Select the Arm...  option in the Camera menu. The Single Frame Capture dialog is displayed.
 - Amend the Download directory, if desired.
 - Select the appropriate Filename and change it.
 - Select the Capture button. When the function has completed, select the Close button.
22. Position the 2D reference points at their corresponding positions in the image. Make sure the camera icon in the test contents list will be equipped with a blue "C", . If not, go to the Geometry setup; right click the camera view and select [Geometry](#). The Geometry dialog will appear. Make sure the [the four Reference points](#) are specified in this. When this is done, a [2D Geometry transformation](#) will be performed, and the blue C will appear on the camera icon.
23. The point *Aim Point* in the test contents list can be positioned in the image at where the laser pointer was aimed. This is optional. Positioning this point will make certain [Gun Scoring statistics](#) calculations. Thus, the aim point must have exactly this name in order to be included in calculations, don't change this!
24. Switch section to the *Test* section.
25. Now it is time for the test shooting.
 - Open up the Arm dialog; Select the  Arm option in the Camera menu. The Arming and Triggering dialog is displayed.
 - Arm the camera; Select the Arm button.
 - Amend the Download directory, if desired.
 - Select the appropriate Filename and change it.
 - Fire onto the scoring paper.
 - As we have set up the Sound Trigger, firing will arm and trigger the camera instantly. (Note: If we do not have any sound trigger set up, we must manually trigger the camera by clicking the Trigger button.)
 - The Status changes to "Armed", and the Trigger button is enabled.

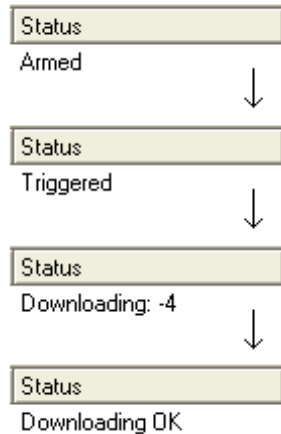
Note: The Disarm button is used to reverse the action of the Arm button without triggering.

A number of warnings can be displayed during the arming process. Those are sorted in categories in a foldable structure.

- "Image file will be lost." - displayed if automatic download is enabled and the file to which the download is to be made already exists.

■

During the data capture (with automatic download selected), the Status changes as follows:



■

When the download has completed, select the Close button.

Note: The Stop button is used to cancel the capture of images, but the images already captured are downloaded.

26. The downloaded sequence will now appear in the camera view.

27. Step to a typical frame in the image at where at least one perforation hole pattern is clearly visible.

28. The point generator is already added to the test when the template was loaded. All we have to do is to set this up to detect preformation holes. (Right Click the Point Generator and select [Point Setup](#). Set up the point generator Tracker. Select [COG tracker](#). Set the threshold values of the COG tracker to detect the pattern in the best way. Uncheck the 'Frame To Frame Prediction' if not unchecked).

29. When the point setup is ready, Right Click the Point Generator again and select [Auto find Similar](#). The initial result of the point generator can then be seen in this frame directly. The result must be that all perforation holes are detected and nothing else. If this is not the case, go back to the point setup and amend the COG tracker. Select Autofind again and trim the point generator until a fine result is obtained.

30. Track through the sequence.

31. The produced [Statistics](#) will now be presented in the [Report](#) present in the template;

- a [Test Summary](#) with certain [Statistics Variables](#).
- a [XY](#) diagram with the [Spread Circle](#).
- a [Image Diagram](#). Note that the data can be presented using the unsc aled image coordinate system or the [scoring paper coordinate system](#).

Fixed Camera Template

This section describes the steps to be taken in each test when a new Scoring paper has been installed in a fixed Camera application and a Fixed Camera Template has been produced.

1. Open up a New Test and Select the Fixed Camera Template as was created in chapter 6 above. (Select File/New Test. Select The Template as saved above).
2. Make sure the section Test is now active.
3. Continue with steps 25 to 31 in the Free Camera procedure above.

Note: Even in a fixed camera application, the camera might have been slightly moved between two tests due to vibrations or other. If this is the case, it is easily detected in the image diagram as the reference points placements can be seen there. If those does not match the positions of the quadrant marks on the scoring paper, the camera has been moved.

Now, even though this is detected after a test shooting has been performed, the test does not have to be redone. Instead, change section to *GeoSetup*. Perform a new single fram capture and place the reference points in this. The test data will now be recalculated using the new referenc e points.

Maintaining Properties

Many of the items displayed in the TEMA Main Window have a set of properties specific to the type of item. The majority of these properties may be specified by the user.

1. Select the required item in the Test Contents window or a Diagram window.
2. Select the Properties option from the Edit menu.
The dialog is displayed depends on the type of item selected, i.e.
 - [Camera View](#) - Camera View Properties dialog.
 - [2D Point](#) - Point Setup dialog for points.
 - [3D Point](#) - 3D Point Setup dialog.
 - [Angle](#) - Angle Setup dialog.
 - [Contour](#) - Point Setup dialog for contours
 - [Distance](#) - 2D Distance Setup dialog.
 - [Stick Figure](#) - Stick Figure dialog
 - [Data View](#) - Data File Properties dialog.
 - [Data Item](#) - Data Setup dialog.
 - Diagrams:
 - [Advanced Diagram](#) - Advanced Diagram Properties dialog.
 - [Multi Axis Diagram](#) - Multi Axis Diagram Properties dialog.
 - [Table](#) - Table Properties dialog.
 - [XT Diagram](#) - XT Diagram Properties dialog.
 - [XY Diagram](#) - XY Diagram Properties dialog.

Note: The Properties for an item may be reached via its corresponding right click menu as well.

Maintaining Data File Properties

Data files containing appropriately formatted sequence data can be imported into the system.

The Data File Properties dialog is displayed when a data file is selected and its properties displayed. It contains the full path name of the imported file. It cannot be amended.

The Data Setup dialog is displayed when any of the data sequences is selected and its properties displayed. The dialog is empty in this version of TEMA.

Notes Window

Every time the <F12> key is pressed, the Notes dialog is displayed and the current contents of the status bar are moved to the top of the list in the Notes window. This function can be used for a number of purposes such as recording the result from the distance measurement tool, recording airbag coordinates, or saving an error message raised during tracking.

Note: This function works even while dragging with the mouse.

1. Select the Notes option from the View menu.
The Notes dialog is displayed.
The following functions can be initiated from the Notes window:
 - [Clear the list](#);
 - [Delete items from the list](#);
 - [Add a comment manually](#);
 - [Add a separating line](#);
 - [Print the list](#);
 - [Copy the list](#);
 - [Save the list](#).
2. Select the Close button.

Clearing the List

1. Select the Clear button.
A confirmation message is displayed.
2. Select the OK button.
The complete list is cleared.
Note: To remove items from the list, use the Delete command.

Deleting Items from the List

1. Select the items to be deleted from the list.
The <shift> and <control> keys can be used in the standard manner.
2. Select the Delete button.
The selected items are deleted.

Adding a Comment Manually

1. Select the Comment button.
The Add Comment Manually dialog is displayed.
2. Key the required text.
Note: You can edit the text, if required.
3. Select the OK button.
The new comment is added to the end of the list.

Adding a Separating Line

1. Select the Add Line button.
A dotted line is added to the end of the list.
Note: A line cannot be added other than at the bottom of the list.

Printing the List

1. Select the Print button.
The Windows Print dialog is displayed.
2. Select the required printer.
3. Select the Print button.
The list is printed.

Copying the List

1. Select the Copy button.
The complete list is copied to the clipboard.
Note: Individual items or selected groups of items cannot be copied.
2. If required, you can select the Comment button and paste the copied list into a new comment and edit it before selecting the OK button.

Saving the List

1. Select the Save button.
The Windows Save as dialog is displayed.
2. Specify the save location.
3. Select the Save button.
The list is saved.

Renaming a View

To rename a view:

1. Select the Rename View option from the Camera menu.
The name of the selected view in the Test Contents window is placed in edit mode.
2. Amend the name.

Show Disabled Items

This function shows all disabled items in the Camera View window.

Disabled items that can be shown are:

- Points
- Distances
- Angles
- Stick figures
- Contours

When the Show Disabled Items function is:

- Enabled - All items are visible in the Camera View window.
- Disabled - Only enabled items are visible in the Camera View window.

The Show Disabled Items function is accessed by:

- Right-clicking in the Camera View window.
- OR
- Right-clicking on required Camera View in the Test Contents window.

Supported Image Formats

Reading

The following image formats are supported for reading.

Proprietary Formats:

- Trackeye Image Format (.tei) - Image Systems proprietary format.

General Formats:

- Tagged Image File Format (.tif)
- Windows Bitmap format (.bmp)
- Photo CD format (.pcd)
- Portable Network Graphics (.png)
- JPEG format (.jpg, .jpeg)
- Windows Media Video (.wmv)
- Windows AVI format (.avi)
- Quicktime (.mov) - Requires Quicktime to be installed on the computer.
- MPEG-1, MPEG-2 (.mpg, .m1v, .m2v, .mpeg, .vob, .mts, .m2t, .m2ts)
- MPEG-4 (.mp4)
- DPX format (.dpx)
- Cineon format (.cin)
- Graphics Interchange Format(.gif)

High Speed Camera Specific Formats:

- Bayer format (.bay) - Redlake/Kodak format.
- Photosonics Range Camera Format (.rdf) - Photosonics format.
- BLD format (.bld) - Weinberger format.
- WRAW format (.vraw) - Weinberger Speedcam format.
- CCI format (.cci) - Phantom format.
- CIN/CINE format (.cin, .cine) - Phantom format.
- DRS format (.tif) - Special multiimage TIFF variant used by DRS.
- Image Express format (.tif) - Special multiimage TIFF variant used by Image express software.
- FTIF format (.ftif) - Photron variant of .tif with a possibility of extra information from the camera.
- MRAW/RAWW format (.mraw, .raww) - Photron camera raw format.
- MCF format (.mcf) - NAC camera format.
- VR2 format (.vr2)

Writing

The following image formats are supported for writing:

- Tagged Image File Format (.tif)
- JPEG format (.jpg)
- Windows Media Video (.wmv)
- Windows AVI format (.avi)
- Quicktime (.mov)
- MPEG-1, MPEG-2 (.m1v, .m2v)

- DPX format (.dpx)

See also...

[Opening Image Sequences](#)

[Image Diagram](#)

[Exporting Images](#)

TEMA Viewer

The TEMA Viewer is a version of TEMA that is used to view tests [exported from TEMA](#) or TrackEye, typically to a CD. It contains a subset of the full TEMA functionality and is geared towards viewing test results rather than conducting tests.

When the Viewer has been [started](#), the TEMA Viewer window is displayed. It contains:

- A [Menubar](#)
- A set of [Tool bars](#)
- A Diagrams list - essentially the [TEMA Test Contents window](#), but containing only camera views, diagrams and zoom windows.

Note: There is an [Advanced TEMA Viewer](#) also which includes more functionality than the basic one described here.

Menubar



The TEMA Viewer contains the following menu options:











Note: The full TEMA functionality is not available for all of the listed Viewer options.

- File
 - [Open](#) - opens a test.
 - Close - closes the current test.
 - [Print Setup](#) - displays the Print Setup dialog to specify the print layout.
 - [Print](#) - prints the selected item.
 - [Exit](#) - Closes the TEMA Viewer.
- Edit
 - [Copy](#) - copies the current item to the clipboard.
 - [Time Properties](#) - sets the time properties, excluding the user defined interval.
- View
 - [Test Description](#)- displays the test description. It cannot be amended.
 - [Tool bars](#) - toggles the display of each of the Tool bars.
- Tools
 - [Select Tool](#) - selects the Select tool.
 - [Distance Tool](#) - selects the Distance tool.
 - [Angle Tool](#) - selects the Angle tool.
 - [Zoom Tool](#) - selects the Zoom tool.
 - [Optimize display](#) - Optimizes the display of images to increase performance.
- Diagram
 - Zoom 1:1 - Redisplays the diagram at the original size.
 - Grid - Toggles the display of the diagram grid.
 - Legends - Toggles the display of the diagram legends.
- Window - contains a list of open windows.
- Help - controls access to the help system.

Tool bars

The TEMA Viewer contains the following tool bars:

- [Time Panel](#) - not all the TEMA tools are available.
- [Time Slider](#) - not all the TEMA functionality is available.
- General - contains the following tools:
 -  - [Open Test](#)
 -  - [Print](#)

-  - [Copy](#)
-  - [Select Tool](#)
-  - [Distance Measurement Tool](#)
-  - [Angle Measurement Tool](#)
-  - [Zoom Tool](#)
-  - [Zoom In](#)
-  - [Zoom Out](#)
-  - [Zoom 1:1](#)
-  - Toggles the display of the diagram grid.
-  - Toggles the display of the diagram legends.

Starting the Viewer

1. Load the CD containing the Viewer and the exported tests.
2. Start Windows Explorer and locate the CD
3. Double-click the "te_view" application.
The Choose Test Presentation dialog is displayed.
4. Select the required test from the list displayed.
5. Select the Open button.
The selected test is displayed in the TEMA Viewer window.

See also..

[TEMA Advanced Viewer](#)

Exporting to a Viewer CD (Optional Feature)

The CD Viewer is a separate application that is used to display test data and images, together with a browser with viewing capabilities only. When the viewer is started, a list of available tests is displayed from which the user can make a choice. Once a selection has been made, a CD Viewer Session is started. This session is a reduced functionality version of the Image Systems TEMA application.

Tests are exported from the Session window as CD Viewer Folders which contain all the relevant information. The exported data is written to a specified folder structure that contains the viewer software at the top level and a series of sub-folders, one for each exported test. There is also a sub-folder containing help information. You can also [customize](#) the appearance of the Viewer.

Prior to creating the CD, the contents of the Viewer CD folder structure can be reviewed and amended.


When one or more tests have been exported, the complete CD Viewer Folder structure can be written to a CD. In this way a complete test, or series of tests, can be sent to a customer without the customer having to purchase and install a TrackEye system.

There is an auto start function on the Viewer when written to a disk. When this is enabled, the Viewer will automatically start once the CD is inserted into a computer. There is one requirement for this to be working. When a Viewer export has been performed, the Viewer CD export directory will contain a file named autorun.inf. In order to get the auto start function working, all files at the level at where this file is should be written to the CD.

When a Session is exported to a Viewer CD folder, you have the opportunity to rename or delete existing exported files before performing the new export. This management function may also be initiated directly from the Archive window.

Note: The default Viewer CD folder is specified in the [Preferences](#).

1. Select the Export to Viewer CD option from the File menu.
If the default Viewer CD folder does not exist, you are asked if you wish to create it.
2. If you wish to create it, select the Yes button, otherwise select No.
The Export To Viewer CD dialog is displayed with the:
 - CD Image Folder preset to the default set in the preferences.
 - New test presentation name preset to "untitled".
3. Key in an alternative CD Image Folder, if required.
If the folder does not exist, a message is displayed when the Create button is selected asking if it should be created.

Alternatively, select the  button and browse for the required folder.

If the selected folder already contains one or more exported Presentations, they are listed in the Current Test Presentations frame.

4. You may:
 - Select an entry and Rename it via the Rename dialog which is displayed.
 - Select one or more entries and Delete them.
 - A confirmation dialog is displayed to which you must respond.
5. Amend the New test presentation name, as necessary.
6. Specify the [Splash And Copyright Directory](#) by browsing to desired location.
6. Specify the time period which you wish to export by keying the Exported time interval: Start Time and End Time.
Note: The Min Time and Max Time fields are used to display the complete time interval spanned by the MDS. They cannot be amended.
7. If you wish to compress the exported data:

- Select the Compress using MPEG-2 check box.
 - Specify the compression rate.
8. Select the Create button.
The currently displayed test is saved as a Viewer Presentation, but remains as the current test.
You may continue to work with it. A progress dialog is displayed while the export is underway.

See also..

[The advanced Viewer](#)

Customizing TE/TEMA Viewer Startup

It is possible to change the startup sequence of CD-ROMs created with the Viewer Export function. You can define how the splash screens shown while the Viewer program starts should look and also add a special startup dialog showing copyright and/or disclaimer information. The viewer user will have to click a button to accept the conditions for viewing the contents of the CD-ROM.

Implementing this is done in two steps:

- Create the files necessary to define the splash sequence and place them in a directory.
- Specify this directory under "Splash and Copyright Directory" in the "Export to Viewer CD" function.

An example directory called ViewerSplashesExample is available after installing TEMA and TrackEye, located directly in the install directory. This directory contains all the necessary files for a sample set of splashes and an amusing disclaimer text.

The file te_view.spd and image files

These files control how the splash screen(s) look. [te_view.spd is a XML-format file](#) which refers to all the used image files and define where and when to show each.

For best results you should use the .png format for image files. Png is a standard format which can be created by for instance Adobe Photoshop. The possibility of .png files to include a transparency layer allows for nice visual effects. For simple cases you can use for instance .bmp, .gif or .jpeg images just as well.

The file disclaimer.txt

The file disclaimer.txt contains the text of any copyright/disclaimer dialog. If this file is present such a dialog box is shown whenever the viewer starts.

The first line in this file has special meaning. It can contain up to three comma separated strings. The first string is shown in the title bar of the dialog. The second string, if any, is shown as a button in the bottom of the dialog. This is the "Accept" button. The third string is the text of the "Decline" button.

If there is no decline text only one button will be shown, continuing to the application. If there is no accept text two buttons are shown, called exactly "Accept" and "Decline" respectively.

Example file:

```
-----  
Copyright, Yes, No  
This CD-ROM contains Copyrighted material which  
may only be viewed by authorized persons. Click Yes below to confirm  
that you are allowed to see the images.  
-----
```

Notes and Tips

All files in the "Splash and Copyright Directory" are copied to the CD-ROM so this feature can as a bonus be used to make sure that other types of files not used by TE/TEMA Viewer are copied to each created CD-ROM.

By creating several different directories you can select different sets of splashes and copyright texts

depending on the nature of the data, for instance whether it is classified or unclassified. Then you just select one of these directories when exporting.

If you don't include any te_view.spd file a standard file from the installation will be provided. This file specifies the standard TE /TEMA Viewer splash sequence.

See Also...

[Exporting the Graph as a Viewer CD Session](#)

TEMA SPD file format

The TEMA SPD file format is used to specify the splash screen layout and animation cycle. The file uses the XML format for easy customization.

Introduction

An SPD file contains two main sections; the first defining the images that will be used by the splash, and the second defining how these images will be displayed. An image is defined by specifying a file name and optionally a default position. The image is also given a unique ID which will be used in the second section to specify which image to display. The SPD file must contain an image with the ID set to "splash". This image will be used as a background and should be large enough to accommodate all other images that will be displayed.

The second section, the animation block, contains a sequence of frames specifying which images to display at different times, making it possible to animate the splash. A frame can contain a number of images and their respective positions in relation to the background image.

General layout

A typical SPD file has the following layout:

```
<?xml version="1.0" ?> Needed to identify the file as XML
<splash> Splash description block
```

```
<image id="splash"> Main image, "canvas"
```

```
<filename>file.png</filename>
```

```
</image>
```

```
<image id="0"> Additional images
```

```
<filename>otherfile.png</filename>
```

```
<xpos>10</xpos>
```

```
<ypos>20</ypos>
```

```
</image>
```

```
<image ...>
```

```
<anim wait="false"> Animation block
```

```
<delay>100</delay> Speed
```

```
<mode>once</mode> Type
```

```
<frame> Animation frame block
```

```
<show id="0"> Image display block
```

```
<xpos>0</xpos>
```

```
<ypos>-1</ypos>
```

```
</show>
```

```
<show ...> Additional image display blocks
```

<frame ...> *Additional animation frame blocks*

</anim>

</splash>

XML Tags

<?xml version="1.0" ?>

All SPD files must start with an XML header like this.

<splash>

The main block. Must contain at least one image block and exactly one anim block.

<image id="identifier" >

The first image block in the file must have the id set to "splash". This is the main splash image. The image needs to be large enough to fit any additional images that will be animated on top of it. Additional image blocks with unique identifiers may be specified after this image block.

An image block may contain the following blocks (filename is required):

<filename>file.png</filename>

<xpos>x-position</xpos>

<ypos>y-position</ypos>

The x-position and y-position are the offsets in pixels from the top-left corner of the main image. Negative values will be interpreted as offsets from the bottom or right edge of the image.

<anim wait="waitmode" >

The animation block follows the section of image blocks and contains information about the splash animation. The animation block may have a wait attribute which, if set to "true", will ensure that the application waits for the splash animation to complete before removing it from the screen. The animation block should contain the following blocks:

<delay>delay-ms</delay>

<mode>loop-mode</mode>

The delay block specifies the number of milliseconds to wait before advancing to the next frame. The mode block specifies the loop mode of the animation. This can be one of the following values:

- once - *Go through all animation frames and stop at the last.*
- loop - *Loop the animation frames until the application is loaded.*
- pingpong - *Loop the animation frames in a ping-pong fashion.*

After these blocks at least one frame block must follow.

<frame delay="override-delay-ms" loopstart="start" >

The frame block describes a frame in the animation. The optional delay attribute is used to override the main animation speed for this frame. The optional loopstart attribute can be set to "true" to define this frame as the starting point when the animation loops. The frame block can contain any number of show blocks.

<show id="id" >

The show block is used to display an image at a certain position in the splash. The show block must contain the id attribute which specifies which image to display. The position of the image is specified

with the position blocks:

```
<xpos>x-position</xpos>  
<ypos>y-position</ypos>
```

Note that the image data will be copied with the SRCCOPY operator directly on top of the splash image, which means that all pixels, including its alpha-values will be overwritten. Also note that the splash image is progressively altered by the animation frames, meaning that the result of a frame's display operations is the starting image for the frame following it.

The Advanced TEMA Viewer (optional)

Function

The optional advanced version of the TEMA Viewer offers more functionality than the [basic TEMA viewer](#). Besides all functionality in the basic viewer, the advanced viewer contains the following features:

- Modify graphs and spread sheets in viewer
- Build new graphs and spread sheets from existing data
- Export images, data, graphs and spreadsheets from the viewer
- Print graphs and spreadsheets
- Perform image format conversions with export capability

Procedure

The procedure when [exporting a TEMA test](#) as well as [starting up](#) the advanced viewer is similar to the TEMA base viewer.

Appearance

Besides the [Menu bar](#) and the [Tool bar](#) of the basic TEMA viewer, there are a few more features in the Advanced viewer. Those are;

[Add XT diagrams](#)

[Add XY diagrams](#)

[Add Advanced diagrams](#)

[Add multi axis diagrams](#)

[Add image diagrams](#)

TEMA Arena

Function

TEMA Arena is used to analyze tracked sequences of shrapnel from an Arena Test. The test results are expressed in a 3D coordinate system with the warhead as the origin.

For each input shrapnel sequence the following statistics are produced:

- Position

The position of the shrapnel pierce, both 3D position or pixel 2D coordinates within the panel.

- Panel name (const)

The name of the panel that the shrapnel pierced.

- Exit time

The time passed between t_0 and the penetration of the panel

The tracking is automated by the use of a [Point Generator](#).

There is a [Step-by-step guide](#) which describes how to use the functions in the whole Arena test analysis procedure in the most effective way.

Appearance

The arena setup dialog is the interface where all the geometries of the test are set.

The camera/panel geometry is set by using a 2D target model with 4 reference points

The panel orientations are expressed in a 3D polar coordinate system, having the Warhead as the origin.

A laser gauge is used, which intersects with the origin.

All the panels are assumed to be completely vertical

The orientation of the panels requires the following components:

- Distances and azimuth angles from the origin to each of the panel's edges.
- Distances from the lower bottom of the panels (left and right) to a laser gauge. This is done to calculate if there is any tilting in a vertical plane.

Guide

Procedure

The following instruction prerequisites that a [TEMA Arena](#) test configuration is used.

In order to automate the process a bit, test Templates can be used. The meaning with a Template is to make all settings first and store those in a template that can be used in all future tests. The template must be populated to contain all the necessary settings to perform the test, including the tracker parameters. In order to set the tracker parameters, an image sequence must be present.

The instruction is divided into two main steps;

- Procedure: Create a Test [Template](#).
- Procedure: Use a Test Template

Create Test Template

Setting up geometry (steps 1 – 27)

1. First, create the 2D target models for each panel in the image sequence. For each panel, define four reference points. The reference points must be measured in the panels local 2D coordinate system. If multiple panels are used in the test, they need one target model each, even if they are identical.
2. Create target files for later use in TEMA Arena. The Notepad text editor is the best tool for this. The format of the target files looks like this:

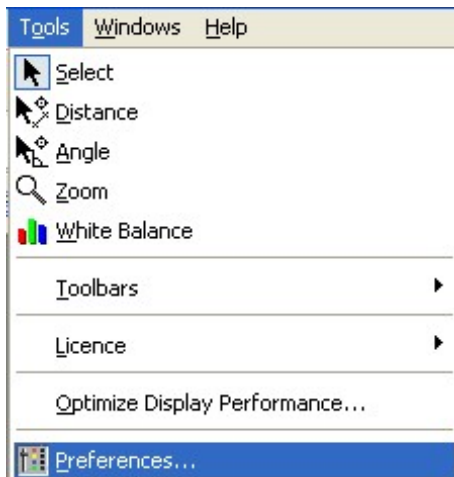
```
LL 1 1  
UL 1 15  
LR 3 1  
UR 3 15
```

Where the first column in the name of the point. The next 2 columns is the measured x and y components of the reference points. Use space as the column delimiter.

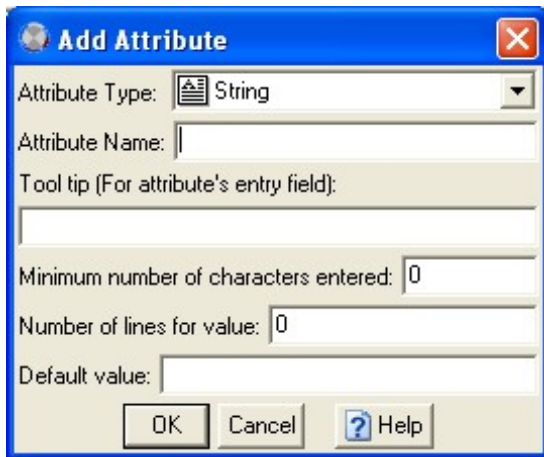
Save the file as *<panel name>.tgt* and note the path to where the files were saved.

Repeat this for all panels.

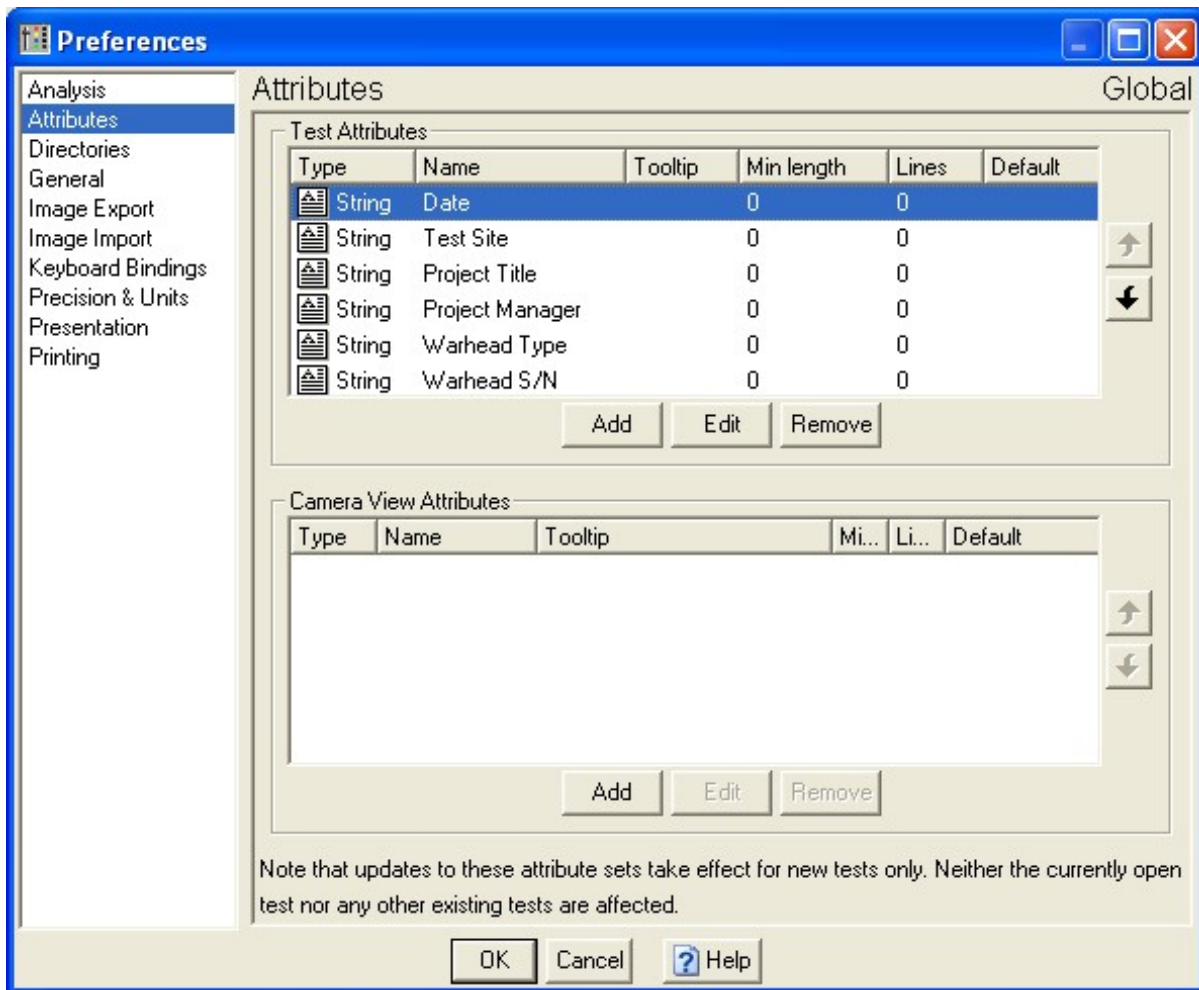
3. Open up a new TEMA test
4. Add some [Test Attributes](#), if desired. This is done in Preferences/Attributes. Test attributes are used for creating reports.



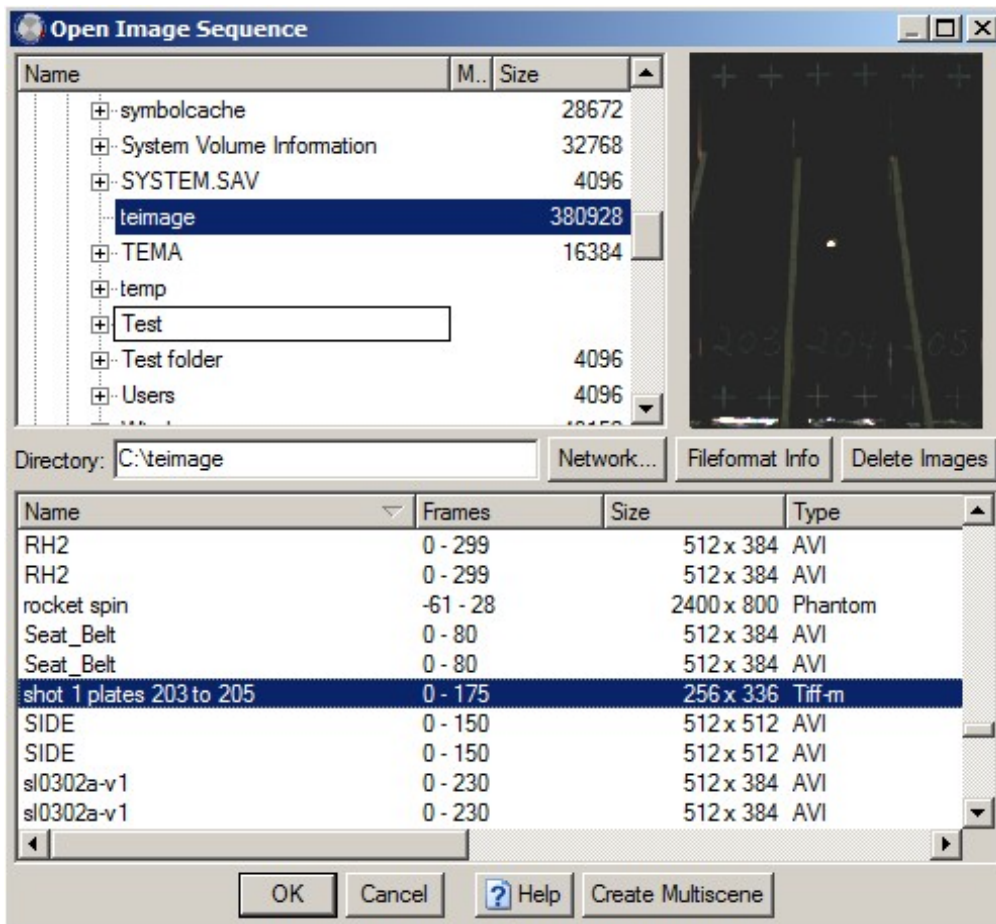
5. In the [Preference Archive](#), go to the [Attributes](#) pane. Click the Add button to add new attributes. The Add Attribute dialog will then open.



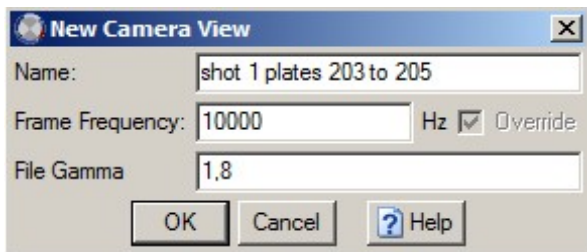
Below is a recommendation of useable attributes. See the presentation part of the guide for more information.



6. Start a new test to activate the [Test Attributes](#).
7. Add a new Camera View to the test. This is done by Selecting File/[New Camera View](#). Select a typical image sequence that is shot at the test site using the same lighting conditions as most forthcoming tests.



Make sure to set the correct image frequency.



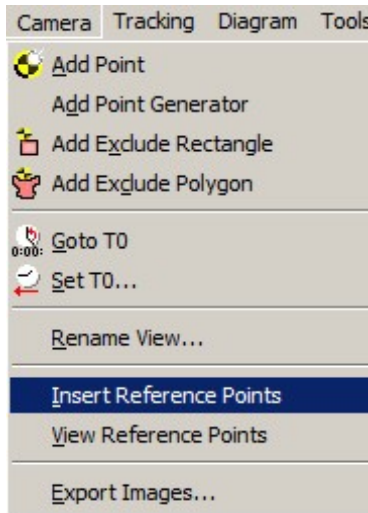
The illustration below shows a frame in such an image sequence, displaying three panels.



8. In this image, there is an area in the lower part of the image that will interfere with the tracking of the shrapnel. Therefore, position an [exclude area](#) in the image, covering this area. This is done via Camera/Add [Exclude areas](#). The illustration below shows a part of the image with such exclude area added.



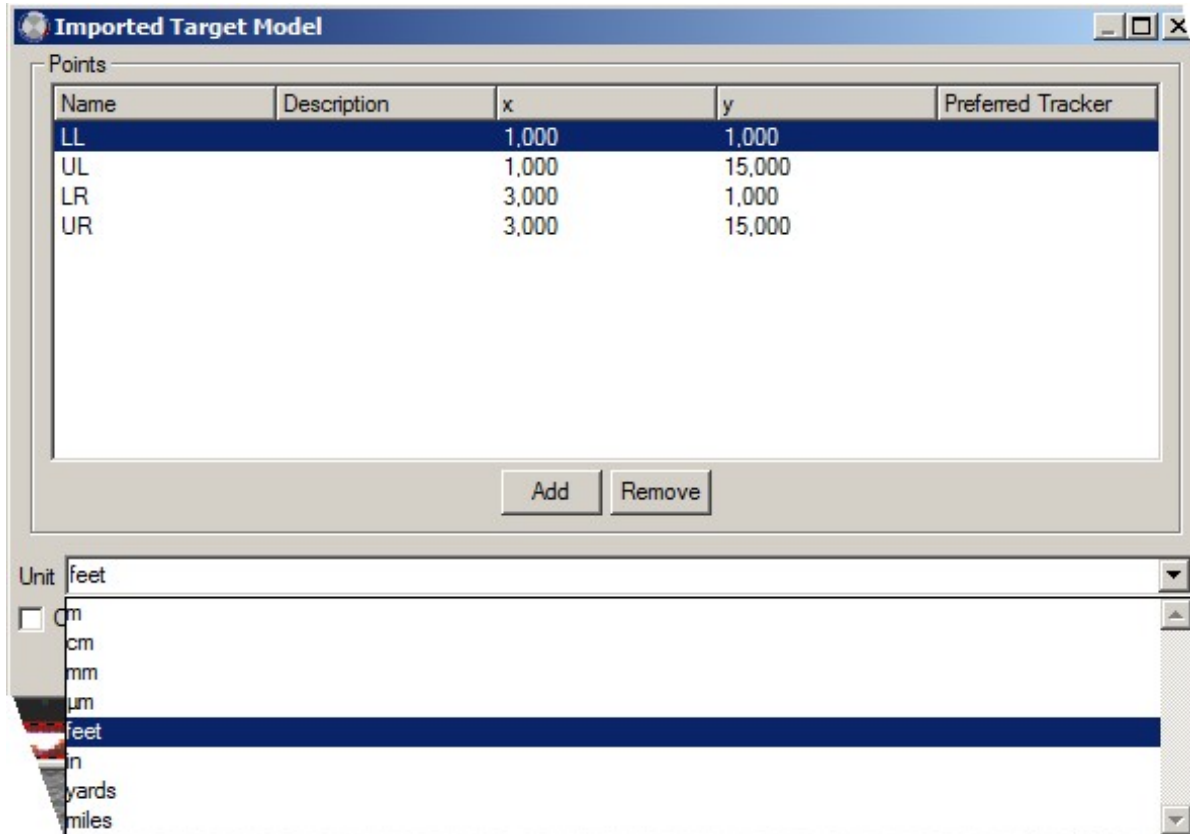
9. Import the 2D target models into TEMA Arena. This is done by clicking Camera/[Insert Reference points](#).



10. Browse to the created tgt files and mark one of them. Click Open.

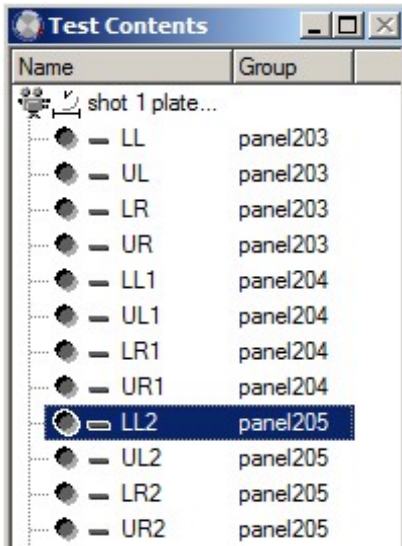
11. The [Imported Target Model](#) dialog will now open. This contains the target points and their 2D coordinates. Be sure to select the correct Unit.

12.




13. Click OK to import the target into the test. Repeat for all panels.

14. The test contents list will now be filled with the target points, sorted in the three panels.



15. Position the target points in the image, for each panel.



16. Click the [Arena setup](#) button  in the Tool bar. The Arena setup dialog will now open up.

17. Specify the Test Attributes with values for the test site.

Arena Setup

Test Attributes

Date: 2008-01-18

Test Site: Example Site

Project Title: Example Title

Project Manager: Example Project Manager

Warhead Type: Example Warhead Type

Warhead S/N: Example S/N

Note: To add more attributes, visit Tools/Preferences/Attributes.

Panels

| ID | WH-Panel L [ft] | WH-Panel R [ft] | Panel-Laser L [in] | Panel-Laser R [in] | Az. L [deg] | Az. R [deg] |
|-----|-----------------|-----------------|--------------------|--------------------|-------------|-------------|
| 203 | 20,875 | 20,875 | 96 | 96 | 29,5 | 40,5 |
| 204 | 20,875 | 20,875 | 96 | 96 | 40,5 | 51,5 |
| 205 | 20,875 | 20,875 | 96 | 96 | 51,5 | 62,5 |

Add Remove Edit

OK/Apply Cancel Help

18. Click the Add button. The Add New Panel interface will open up. All geometries of the test template is set here.

19. Enter the Panel Name/ID.

20. Set the Reference time (t_0) with the correct Unit. The reference time should be set to the time at when the reference points are located in the image.

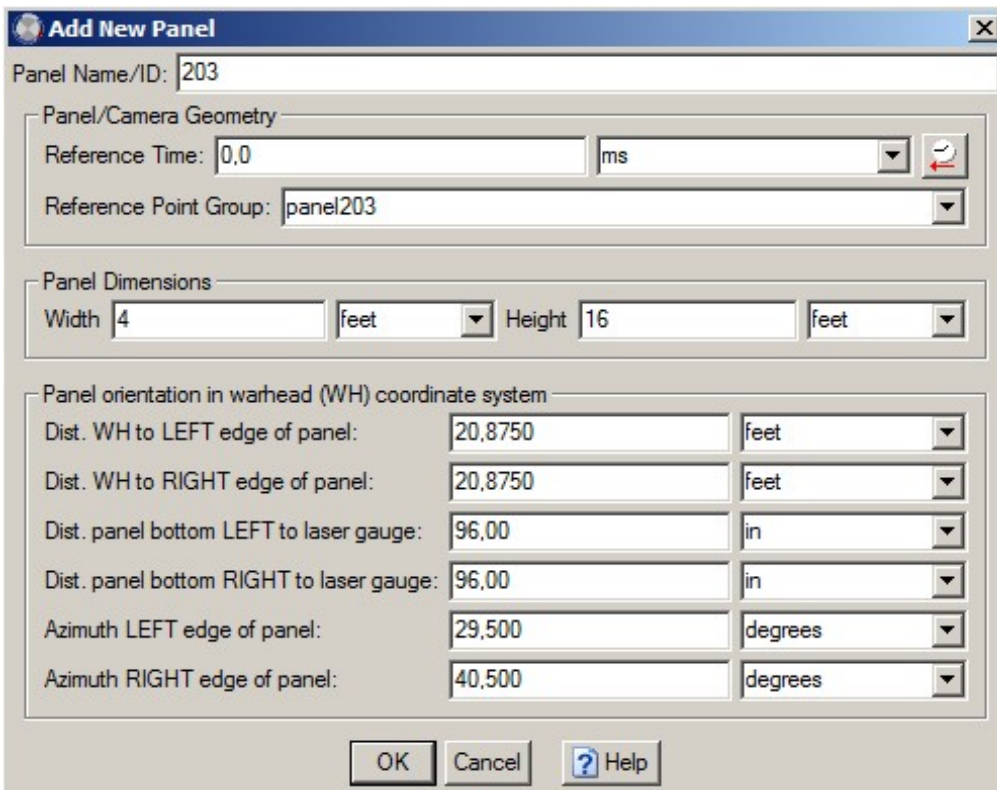
21. Select the corresponding Reference Point group. There will be one group for each panel.

22. Set the Panel Dimensions. Make sure to use the correct units!

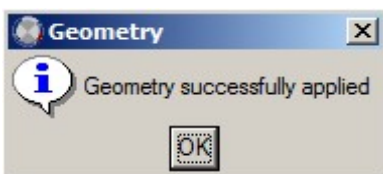
23. Enter the Panel Orientation parameters, as measured at the test site

- Distance from Warhead to panel's left and right edges.
- Distance from laser gauge to bottom left and right corners of panel.
- Azimuth angles to panel's left and right edges.

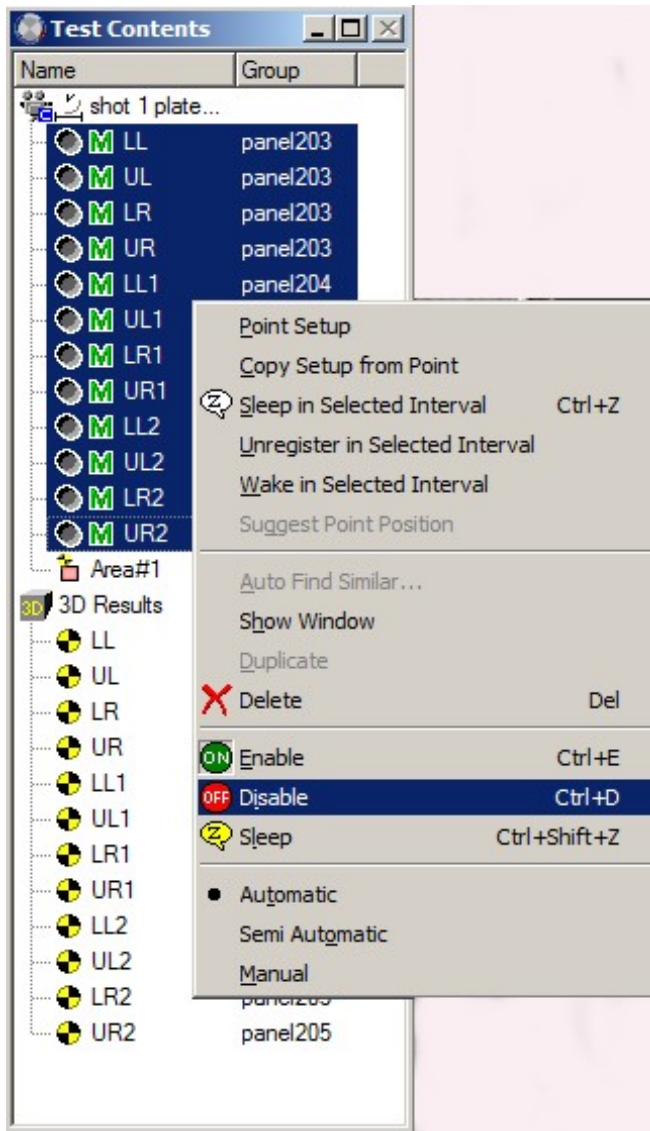
Make sure to use the correct units!



24. Click OK when ready. Repeat for all panels.
25. To change any geometry set, mark the panel in the list in the Arena setup dialog and click Edit. The Edit Panel dialog will then open. This is the same as the Add New panel dialog. Make the desired edits and click OK.
26. Click OK/Apply when ready. TEMA Arena will now apply the test defined geometries. If this was successful, the message Geometry successfully applied will then appear. Click OK to continue.



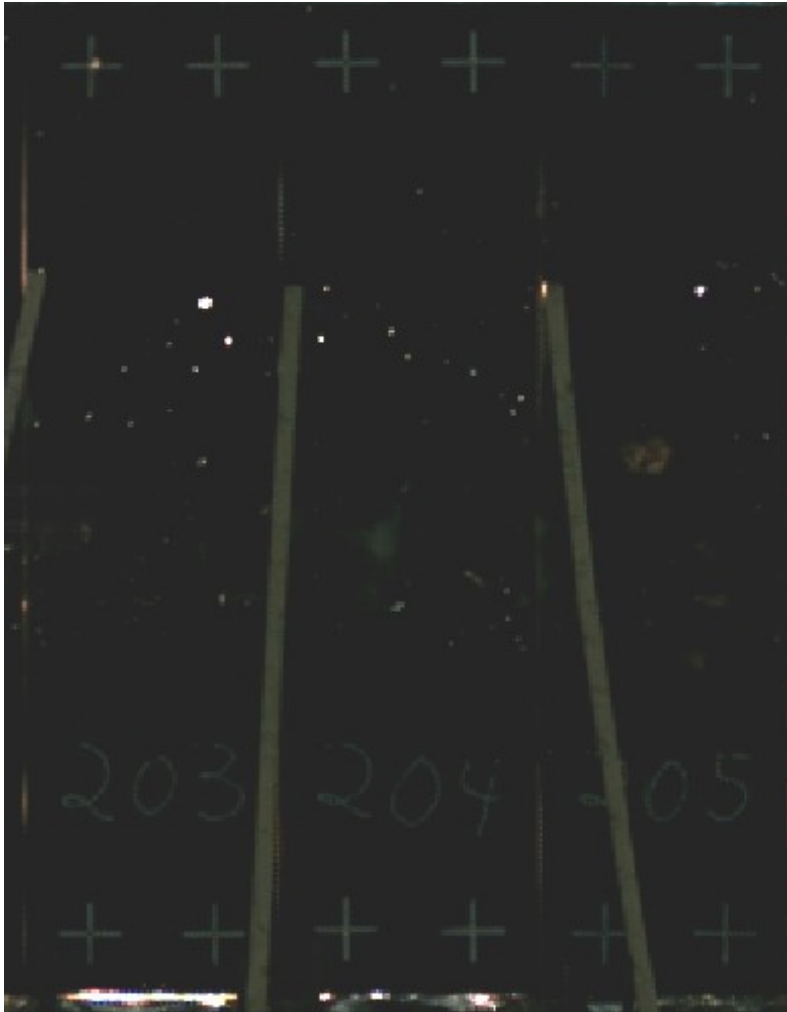
27. Disable all the target points. This is done by multi selecting all the points in the test contents list (hold the <Shift> key and mark in the list), right click and select Disable. The geometry setup is now finished!



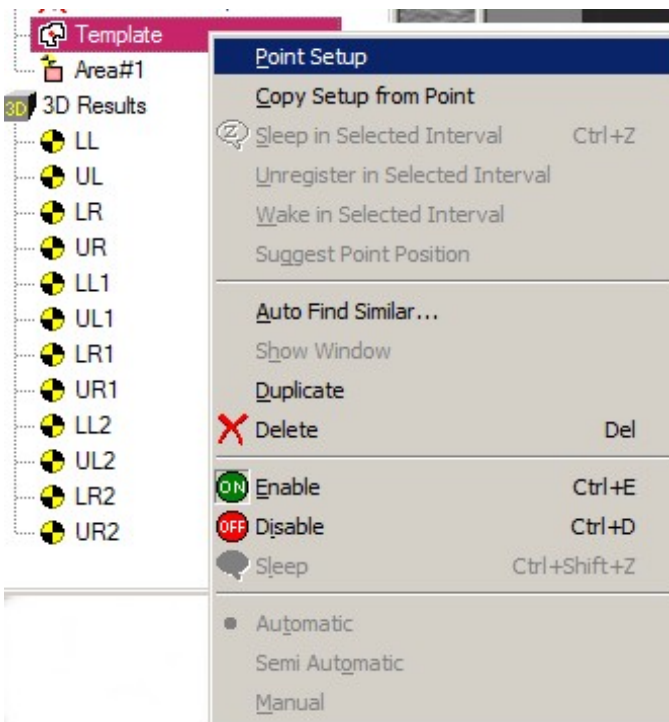
Setting up Tracking

28. Using the time panel, step forwards in the image sequence until you find a typical shrapnel. The illustration below shows such a frame in the same sequence; the same area pierced with several holes from shrapnel. Those appears in the image as shrapnel (white dots). The goal is to automatically track the shrapnel that pierces panels.





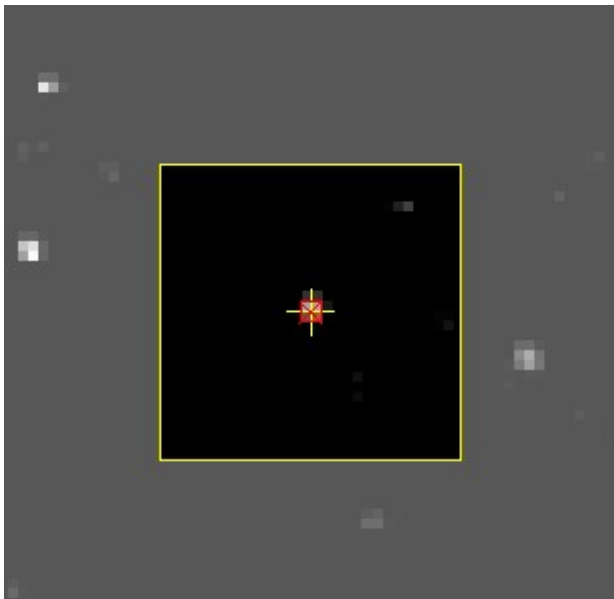
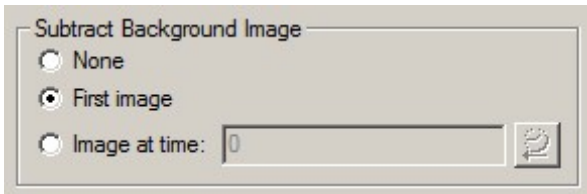
29. Add a [Point Generator](#), to the test. This uses Autofind similar points functionality in each frame.



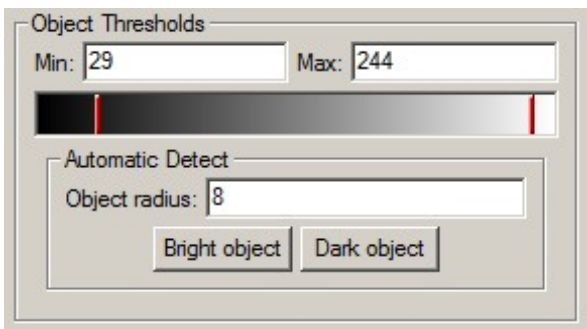
30. Right click the Point Generator and select [Point Setup](#). Select [center-of-gravity \(COG\)](#) tracker on one

of the shrapnel.

31. Enable the Subtract Background image/First Image to increase the contrast.



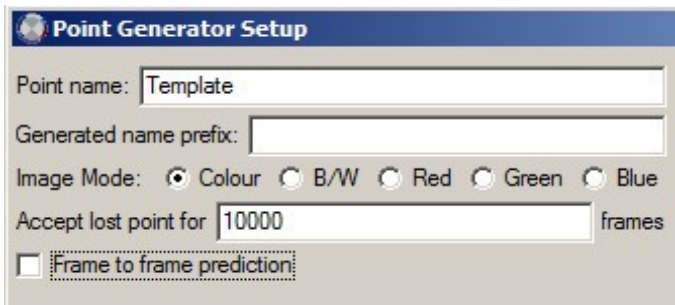
32. Configure the thresholds like the illustration below. Remember that the lower (darker) bound must be pretty low to catch every shrapnel.



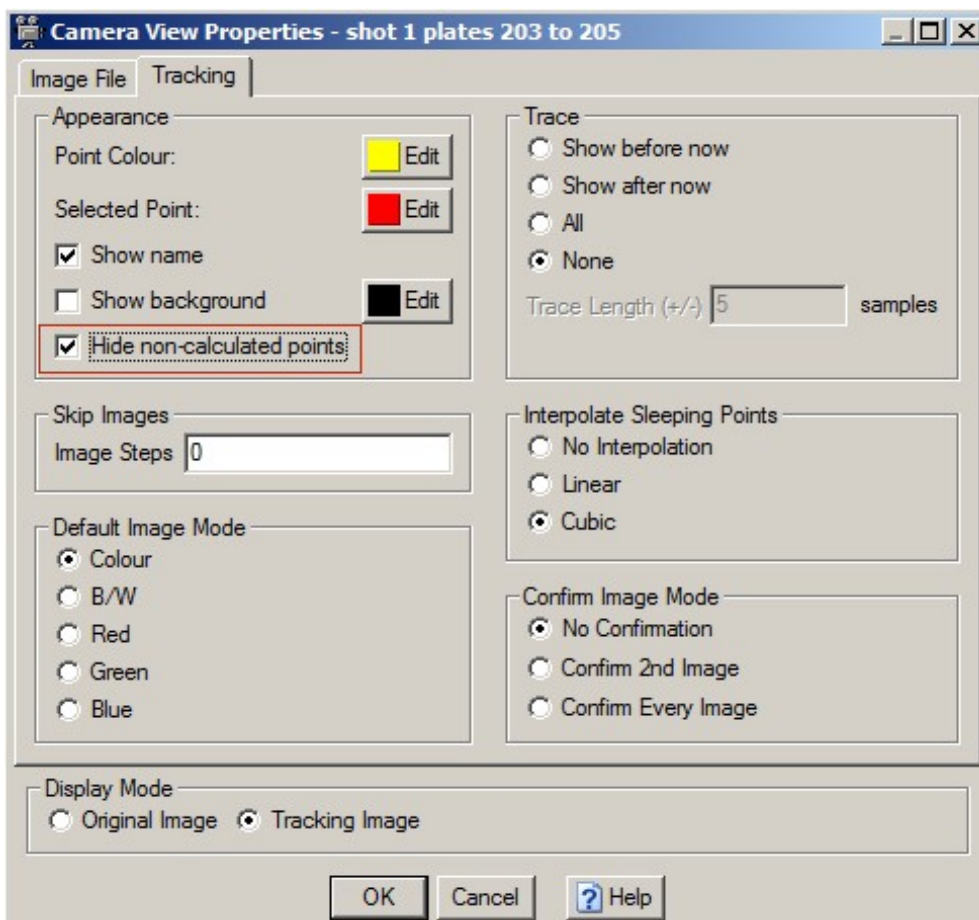
33. We recommend a blank Generated Name prefix in order to avoid confusion in the image when the point generator has created a lot of track points.

34. Disable Frame to frame prediction, as the points that we autofind will not move.

35. In the field [Accept lost point for](#), enter a number greater than the total number of frames in the sequence, e.g. 10000. The reason for this is shown below.




36. Click OK in the Point generator setup when ready.
37. Enter the [Camera View properties](#)/Tracking tab. Enable the Hide Non-Calculated Points to minimize the confusion when there are many points in the image. Click OK. The tracking setup is now finished!



Setting up presentation

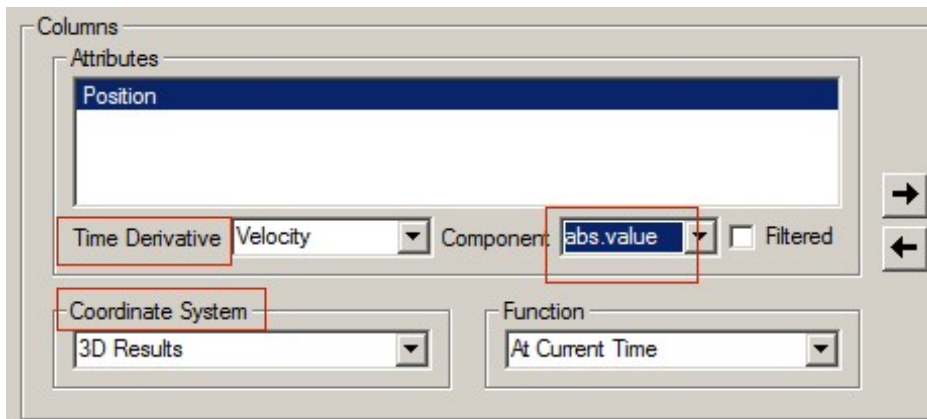
In this example we setup: [Point table](#), [3D diagram](#) and [report](#).

Point Table


38. Define your data presentation. Recommended: add a [Point Table](#) to the test. Click the Point Table button  in the tool bar. Right click the table and select properties. The Point Table Properties dialog will open.
39. Set up the Point Table. This is an example of a setup:

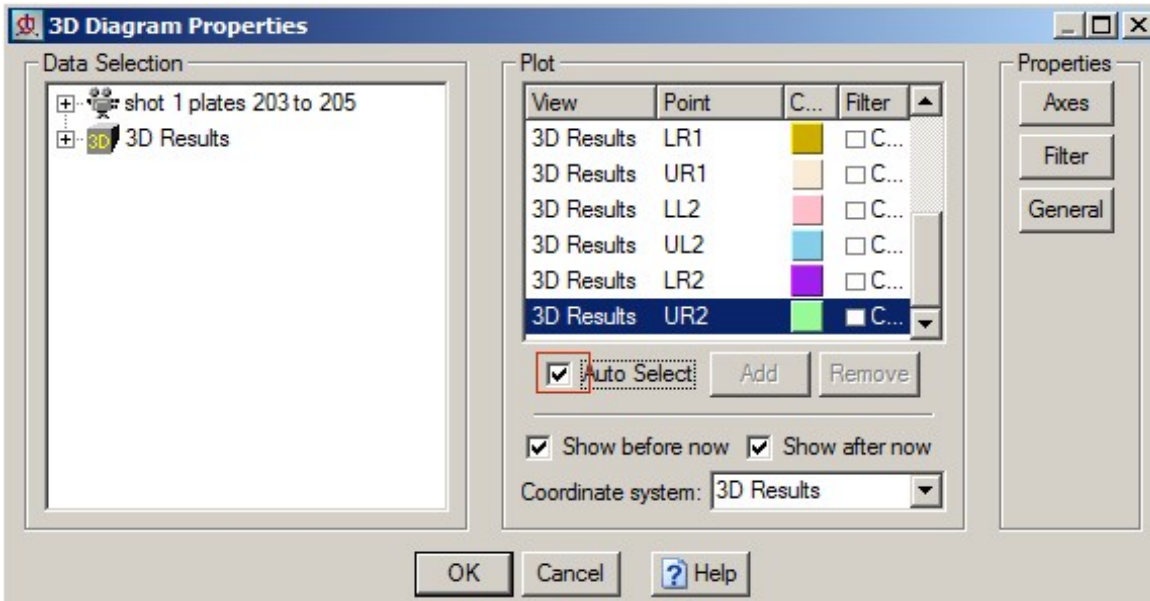
- Panel Name
 - Select Panel name in the Attributes list.
 - Click the insert button .
- Position
 - Select Position in the Attributes list.
 - Select 3D Results in the Coordinate System drop down list.
 - Select Last in the functions drop down list.
 - Click the insert button .
- Velocity
 - Select Position in the Attributes list.
 - Select Velocity in the Time Derivatives drop down list.
 - Select 3D Results in the Coordinate System drop down list.
 - Select Absolute Value in the components list.
 - Select At Current Time in the functions drop down list.
- Exit Time
 - Select Exit Time in the Attributes list.
 - Select None in Time Derivative drop down list
 - Select <All> in the components drop down list,
 - Select <All> in the Coordinate System drop down list.
 - Click the insert button .

Click OK when ready

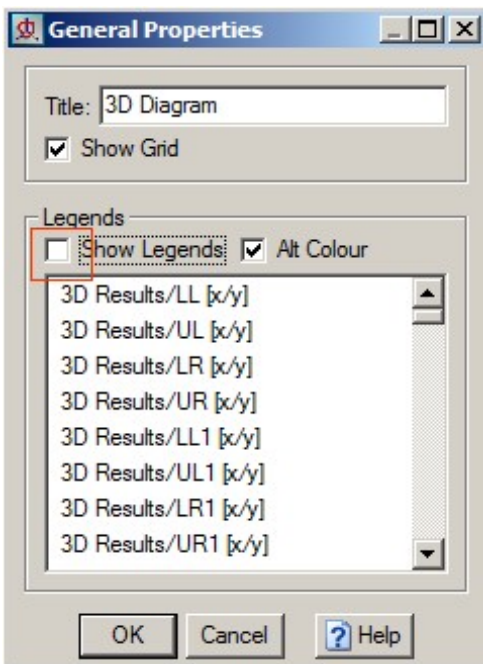


3D Diagram

40. Add a 3D diagram to the test. Click the 3D Diagram button  in the tool bar. Right click the diagram and select properties. The 3D Diagram Properties dialog will open.
41. In the [3D diagram](#) properties dialog, click the Auto select check box to insert all 3D data into the 3D Diagram.



42. Click the General button to the right. Unclick the Legends check box.




43. Click OK when ready.

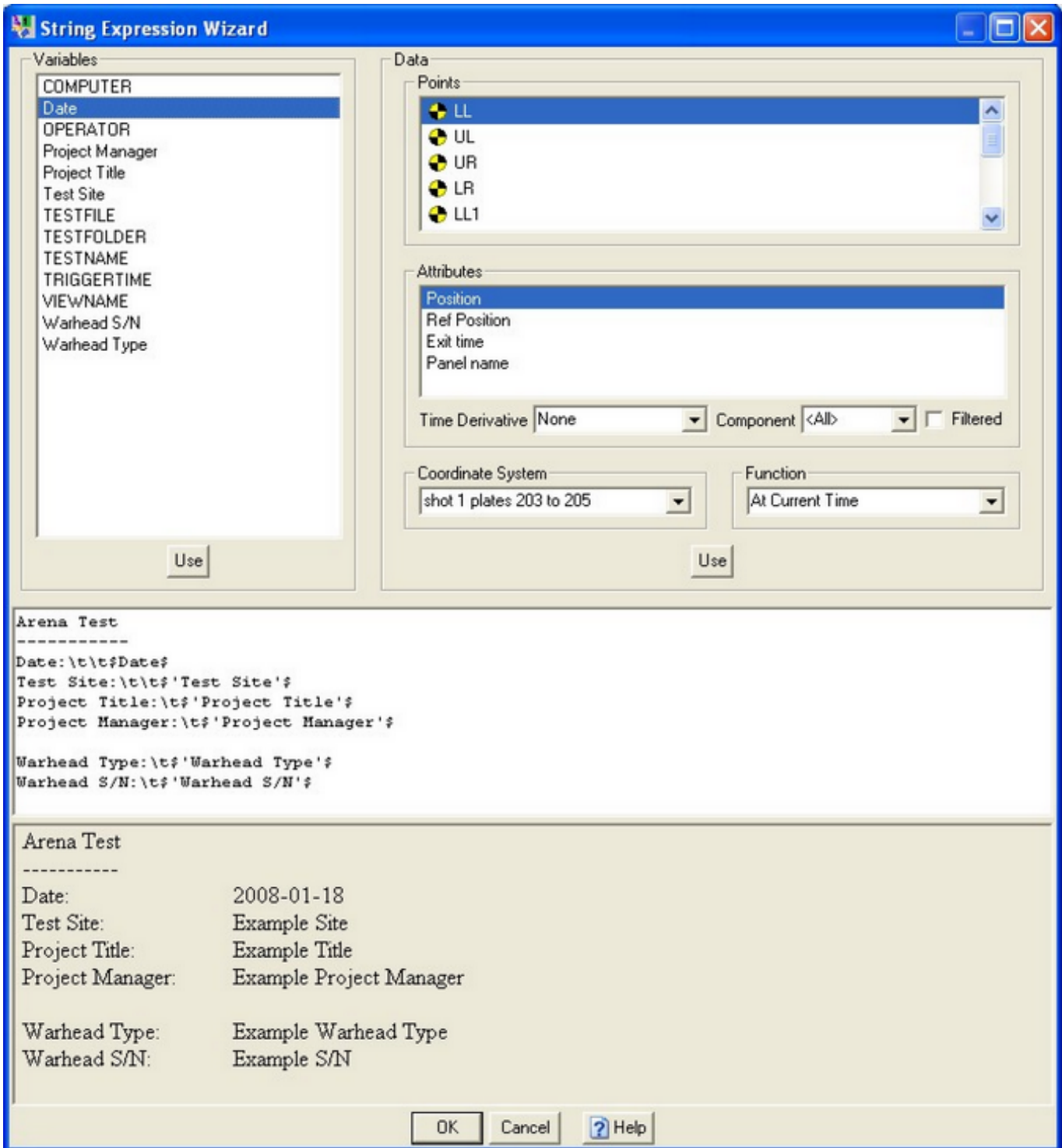
Report

44. Add a report generator to the test. Click the [Report](#) button  in the tool bar. In the report window.

45. Add a [Test Summary](#) text box  into the report.

46. Click the setup button . The Test Summary setup dialog will open. item. Click the string

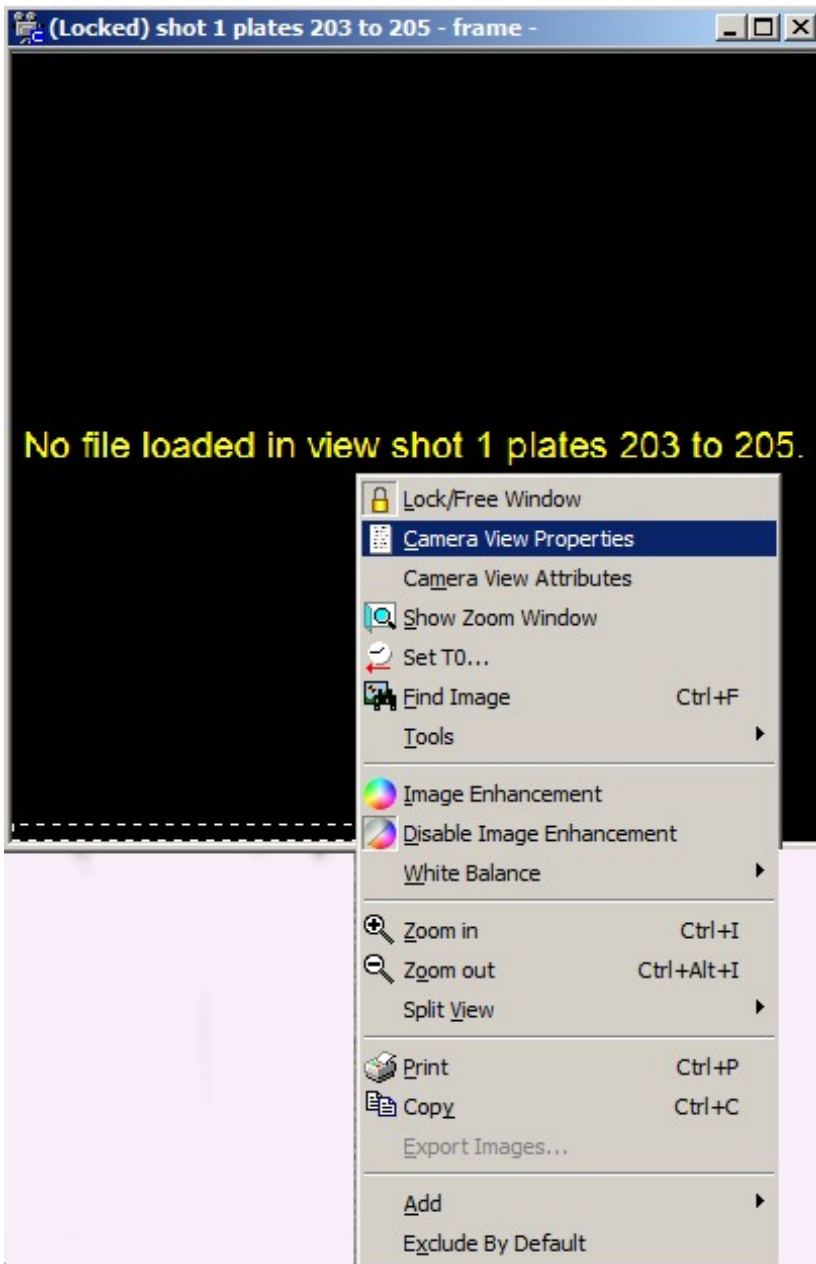
Expression Wizard button . The [String Expression wizard](#) will open up. Here, both your [Test Attributes](#) from the Preference archive as well as a number of permanent ones (Operator name etc) can be found and inserted into the text box. Below is a recommendation of items added to the Test Summary.



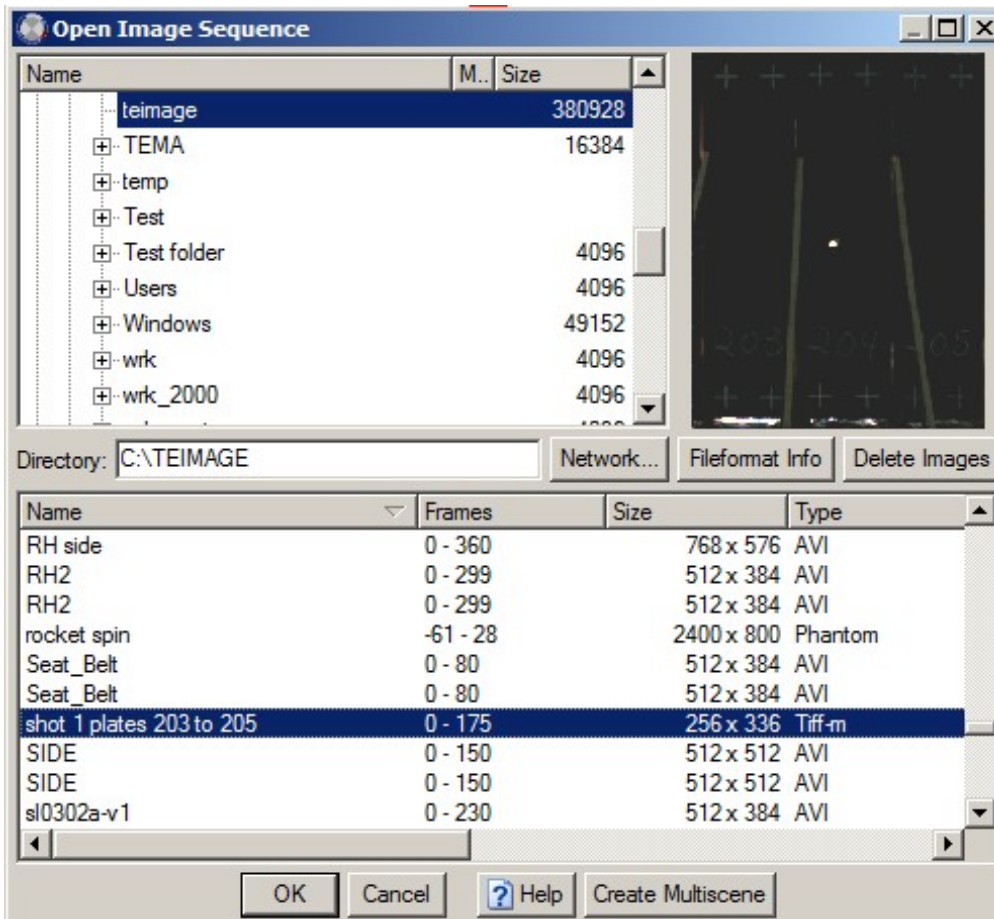
47. Click OK when ready.

to the instructions above. An empty TEMA test with all the settings done above will now open up.

2. Right click the empty Camera View window and select [Camera View Properties](#). The Camera View Properties dialog will open.



3. Click Load. The [Open Image Sequence](#) dialog will open.



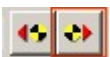
- Browse to an image sequence for analysis.
- Click OK in both dialogs to insert the image into the camera view.
- Using the [time panel](#), step to a frame where a number of shrapnel are visible in the image.



- Adjust the parameters for the [Point Generator](#) to match the images. This is done by right clicking the Point Generator in the test contents list and select Point Setup. Reset the [COG](#) sliders. Click OK in the Point Generator Setup when ready. Note: if the light conditions are similar between tests, this step is unnecessary.
- Make sure the first frame of the [image sequence](#) is present. Look at the time panel, the current time marker should be to the leftmost position.

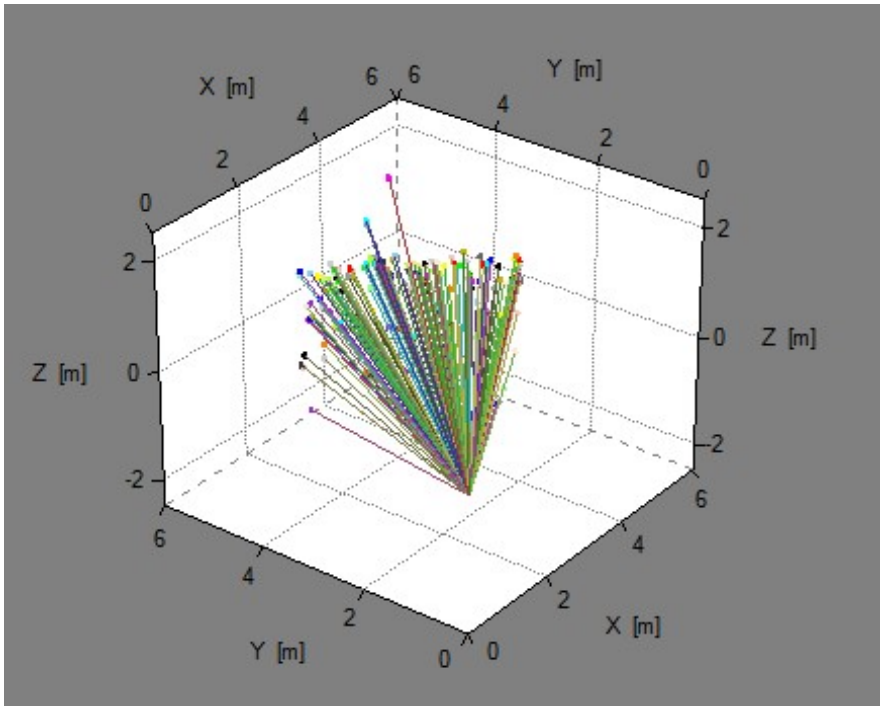


- Start [tracking](#) forwards.



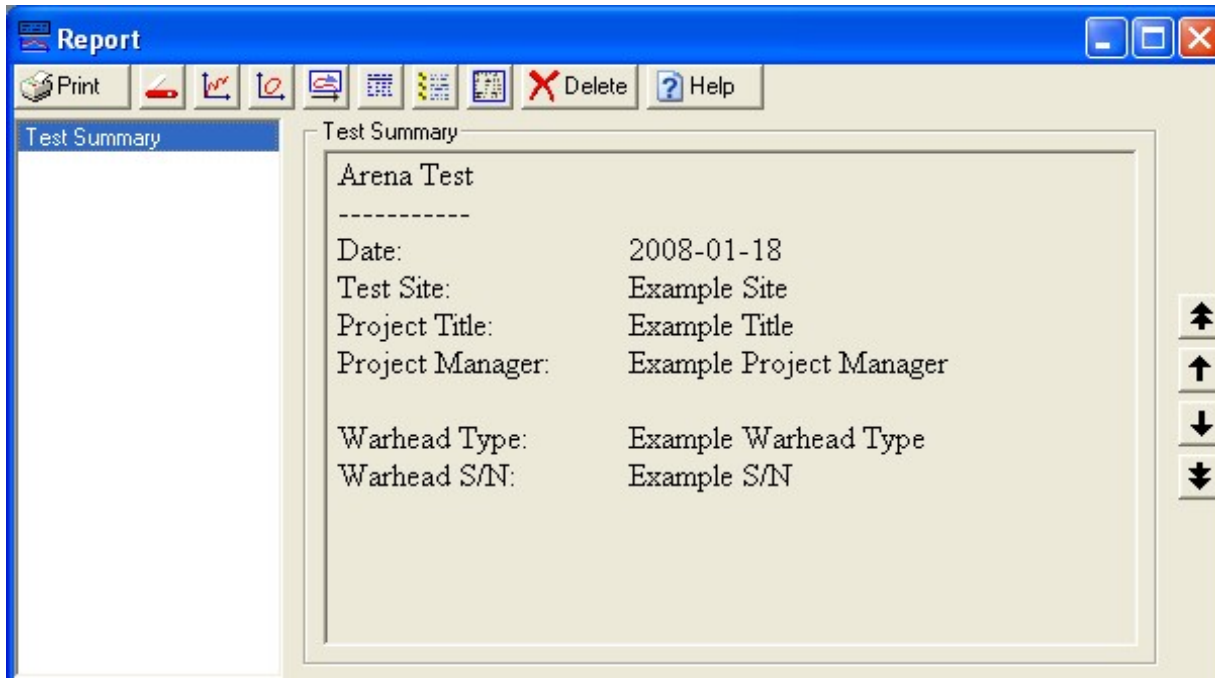
- When a shrapnel pierces a panel, the point generator will automatically produce a point and assigned to it.

11. The produced [3D data](#) will now be presented in the [3D Diagram](#) and [Point Table](#).

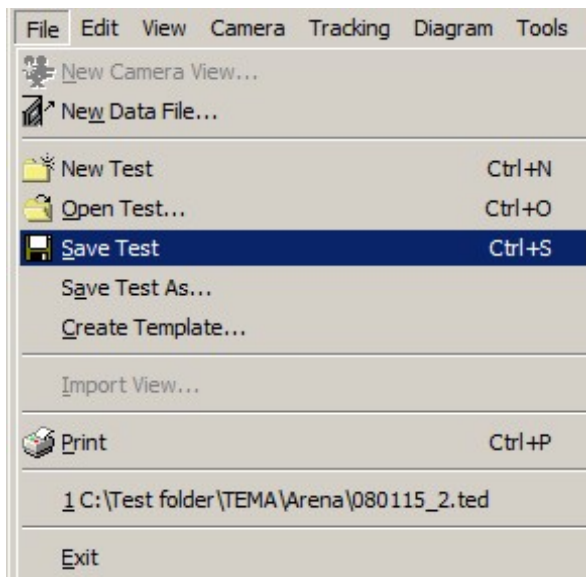


| CS1:1 | CS2:1 | CS3:1 | CS3:2 | CS3:3 | CS4:1 | CS5:1 |
|------------|--------------------------------|-------------------------------|-------------------------------|-------------------------------|---|---------------------------------|
| Point Name | Panel name String (3D Results) | Position last x[m] 3D Results | Position last y[m] 3D Results | Position last z[m] 3D Results | velocity (Position) abs[m/s] 3D Results | Exit time time[ms] (3D Results) |
| 2 | 204 | 4,545 | 4,416 | 0,090 | - | 0,5 |
| 3 | 204 | 4,467 | 4,490 | 0,043 | - | 0,7 |
| 4 | 204 | 4,433 | 4,524 | 0,039 | - | 1,4 |
| 5 | | - | - | - | - | - |
| 6 | 204 | 4,413 | 4,543 | -0,721 | - | 10,9 |
| 7 | | - | - | - | - | - |
| 8 | 205 | 3,018 | 5,592 | -0,944 | - | 11,0 |
| 9 | 203 | 5,058 | 3,819 | -0,233 | - | 11,0 |
| 10 | 203 | 5,149 | 3,688 | -0,811 | - | 11,1 |
| 11 | 203 | 5,362 | 3,384 | -0,458 | - | 11,2 |
| 12 | 205 | 3,538 | 5,254 | -0,434 | - | 11,2 |
| 13 | 205 | 3,089 | 5,545 | -0,296 | - | 11,2 |
| 14 | 205 | 3,102 | 5,537 | -0,281 | - | 11,2 |
| 15 | 205 | 3,140 | 5,512 | -0,225 | - | 11,2 |
| 16 | 205 | 3,063 | 5,563 | -0,039 | - | 11,2 |
| 17 | 203 | 5,510 | 3,172 | -0,411 | - | 11,3 |

The [Report](#) will display the selected attributes. The report can also be set to contain the other diagram with test data.



12. Save the test. This is done by selecting [File/Save Test](#). Give the test a suitable name, i.e. the day's date.



Tips and tricks

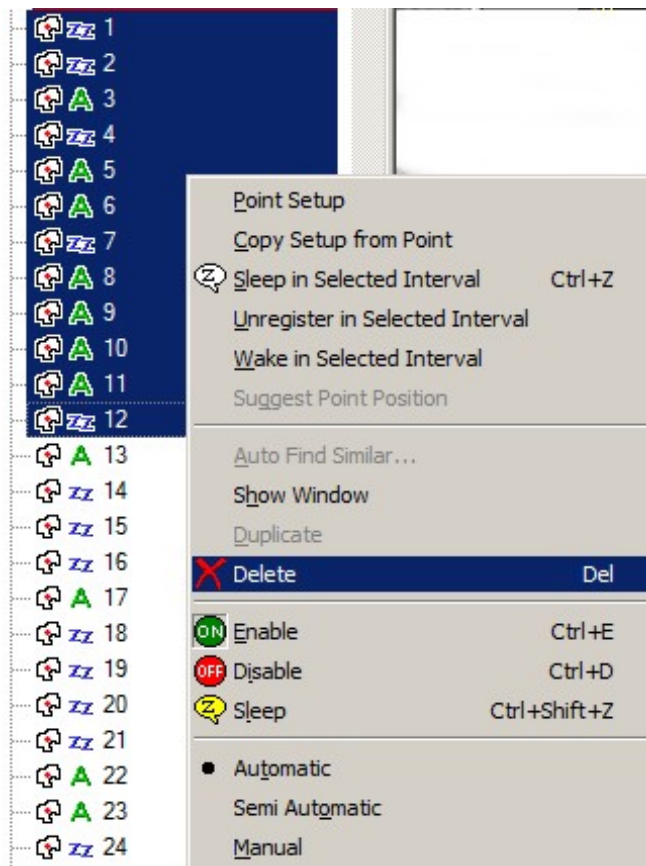
If error occurs during tracking.

13. Stop the tracking procedure using the [time panel](#).



14. Remove the generated points from the points list by selecting in the list using < Shift > and clicking

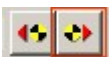
Delete .



15. Re-adjust the parameters for the [Point Generator](#). This is done by right clicking the Point Generator in the test contents list and select Point Setup. Reset the [COG](#) sliders. Click OK in the Point Generator Setup when ready.
16. Make sure the first frame of the image sequence is present. Look at the [time panel](#), the current time marker should be to the leftmost position.

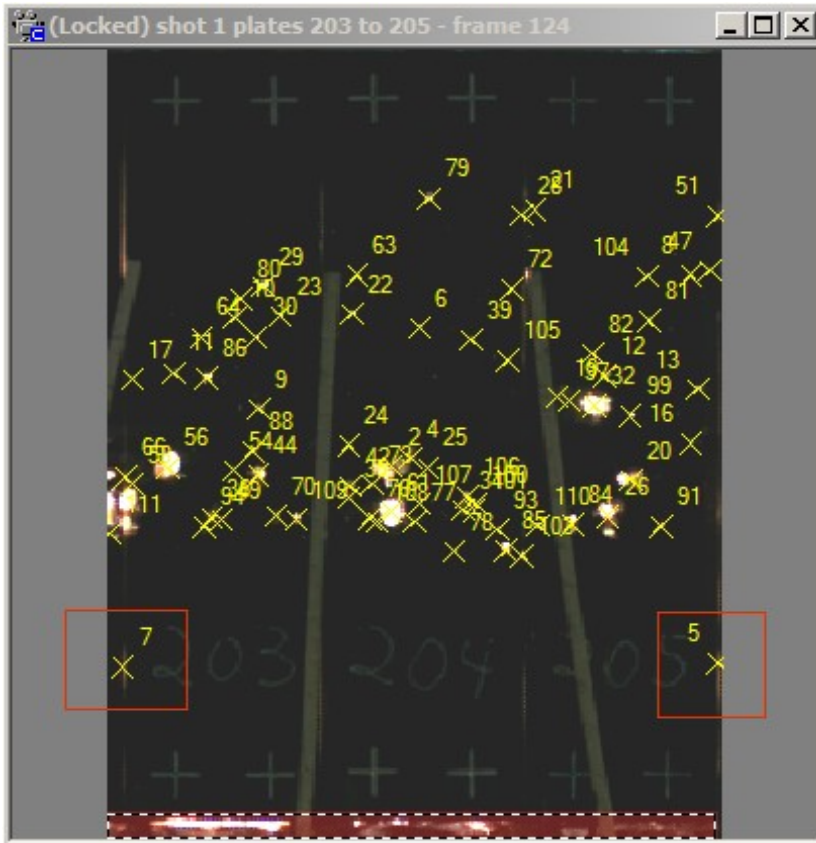


17. Start [tracking](#) forwards again.

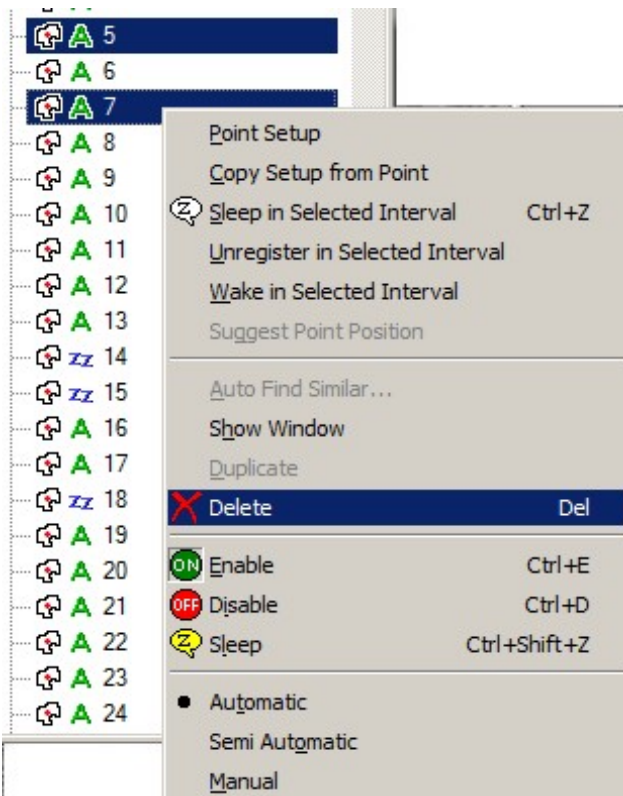


Unwanted points from tracking

Sometimes we get false track points on the panels that are not shrapnel pierc ing.



To remove those, step back using the time panel. Identify the false points and note the point indexed in the view. Mark the points in the point list and click delete.





See also...

[Exclude areas](#)

[Autofind similar points](#)

Undo/Redo

The Undo option, available in the Edit menu or through the  button in the Standard Toolbar, cancels operations made to any item in the [Test Contents](#) window. The shortcut is Ctrl+U.





The Redo option, available in the Edit menu or through the  button in the Standard Toolbar, restores undone operations made to any item in the [Test Contents](#) window. The shortcut is Ctrl+Y.

Limitations

- A deleted item from the Test Contents window can be restored in the Test Contents but not in the Diagram.
- A deleted Diagram can not be restored.
- Undo/Redo is reset when changing the current time (step, play, track etc.)
- Undo/Redo is reset when a Camera View is deleted/added.

Using the Zoom Window

A Zoom window is used to show part of a Camera View in greater detail to enable greater accuracy when positioning points or measuring distances, for example.

1. Select the required View window.
2. Select the Show Zoom Window option from the View menu or via the Tool bar, the Zoom window button .
The Zoom window is displayed, containing the complete image. Scroll bars are used if the window is not large enough.
3. *To make the image larger*, select the Zoom In option from the View menu, or click the  tool. This operation may be repeated as often as required.
4. To make the image smaller, select the Zoom Out option from the View menu, or click the  tool. This operation may be repeated as often as required.
5. To return the image to its normal size, select the Zoom 1:1 option from the View menu, or click the  tool.

Note: The options in the View menu are not always enabled:

- All three are enabled in the Zoom and View windows.
 - In a Diagram window only the Zoom 1:1 option is enabled. (This is equivalent to the Show All option in the pop-up menu). The magnification of diagrams is controlled by the Zoom tool.
6. To *move* the Zoom window in a Camera View window, hold the keys <Ctrl> while left clicking in the new desired place for the Zoom window within the Camera View window or diagram. The Zoom window will then be placed with its centre at the place left clicked. When in Zoom window, the same action taken will move the centre of the Zoom window to the place clicked.

See Also...

[Using the Zoom Tool](#)

[Point Zoom](#)

TEMA 64-bit - exceptions

Tracking

The MXT tracking algorithm licensed from the Fraunhofer Institute is not supported.

Image Formats not currently supported

*.VR2 & *.VRAW Old Weinberger formats.
*.RAWW Photron format.

What's New?

[What's new in TEMA 4.0?](#)

[What's new in TEMA 3.9?](#)

[What's new in TEMA 3.8?](#)

[What's new in TEMA 3.7?](#)

[What's new in TEMA 3.5?](#)

[What's new in TEMA 3.4?](#)

[What's New in TEMA 3.3?](#)

[What's New in TEMA 3.1?](#)

[What's New in TEMA 3.0?](#)

[What's New in TEMA 2.6?](#)

[What's New In TEMA 2.5?](#)

[What's New In TEMA 2.4?](#)

[What's New In TEMA 2.3?](#)

[What's New In TEMA 2.2?](#)

[What's New In TEMA 2.0?](#)

What's new in 4.0?

Version 4.0 of TEMA includes/integrates DIC 2D functionality as an option.

Digital image correlation and tracking is an optical method that employs tracking and image registration techniques for accurate 2D and 3D measurements of changes in surface structures.

This is often used to measure deformation, displacement, strain and optical flow, but it is widely applied in many other areas.

Please refer to DIC manual.

What's new in 3.9?

The following major changes have been made to TEMA between this release (3.9) and the previous release (3.8).

64-bit version

- TEMA is now available as a 64 bit application (please note some [exceptions](#) regarding functionality)

Operating Systems

- New: Support for Windows 8, 32 & 64 bit versions

Tracking

- Major revision of '[Point Setup](#)'. This is now a live window reflecting selection in other session windows.
- New [algorithm](#) to remove background image for 'airbag' tracking algorithm. Removes static background without superimposing any pattern from the background on the foreground objects.

Analysis

- Considerably improved acceleration filters for smother data.

AOS

- All image formats from high speed camera manufacturer AOS in Switzerland are now recognized.

Camera Calibrations

- To simplify camera position/orientation handling it is now possible to export this type of data to a file which later can be imported in to any TEMA test. In the '[Camera View Properties](#)' there is now two new buttons, one for import camera calibration parameters and one for exporting. For some types of calibration a new 'Export' parameters button is introduced.

Mandarin Chinese language version (option)

- As an option supplied with a translation of menus and dialogs to Chinese Mandarin. Additional language support is installed during the install process via the configuration code. Languages can then be swapped from the 'Tools' menu but TEMA has to be restarted before new language setting is applied.

Wand Calibration (option)

- Enhanced algorithms increase processing speed with 25-45%, depending on type and size of images.

6DoF (option)

- To compute [6DoF](#) data relative to the 'Camera Coordinate System' is now an alternative to the 'Object Coordinate System'. The selection is made from the 'Camera' menu.

See Also...

[Previous Release](#)

What's new in 3.8?

The following major changes have been made to TEMA between this release (3.8) and the previous release (3.7).

Tracking

- A new tracking algorithm(beta) to track circular objects is introduced. The [Advanced Circle Tracker](#). Data sequences generated are circumference, area.
- The existing [Circle Tracker](#) now also generates data sequences for radius and area (tracked).

Analysis

- The [Frequency Analysis Diagram](#) calculates frequency components of a signal (such as tracked coordinates, a computed angle, or imported measurement data) and plots a curve that shows the signal's relative strength at different frequencies.
- The default length of the velocity filter is increased for, in most cases, smoother results. Filter settings are now also available per diagram.

Presentation

- [Copy to Time Table](#) function creates a Time Table using current data in an existing XT, Multi-axis, XY, Advanced XY or 3D diagram.
For multi-dimensional data the Time Table will show all the data components, even if only one component is displayed in the original diagram.

Calibrations

- The automatic WAND calibration algorithm is improved and is now more robust. Exposure of wand calibration images is still important though, normal room exposure with wand illuminated balls appearing very white.

See Also...

[Previous Release](#)

What's new in 3.7?

The following major changes have been made to TEMA between this release (3.7) and the previous release (3.5).

Analysis

- TEMA [Wand Calibration](#) is the brand new calibration tool for 3D analysis of any high-speed test in the automotive industry. The use of Wand Calibration will increase accuracy and ensure that the results acquired from the analysis are accurate enough to draw the correct conclusions. The wand calibration replaces the traditional 3D test preparations, i.e. Lens Calibration and Camera Orientation.
- [Plane offsets values can be imported or exported](#) in Multiple-parallel motion planes.
- The external camera parameters can be reset by selecting Camera Orientation/[Reset Camera Orientation](#) in Camera menu.

Tracking Usability

- [Adding Point\(s\) to Multiple Point Groups \(Add Group to Selection\)](#).
- The [Show disabled items](#) shows all disabled items (Points, Distances, Angles, Stick figures, Contours) in the Camera View window.

Presentation

- [Combined Image Export](#) - Wizard for combining selected image sequences, diagrams etc. and exporting them to any image file format such as AVI.
- New preference for continuous/manual [Angle Range](#) in diagrams/tables.
- The Diagrams/Tables are visible in the [Test Contents](#) window and can be managed from there.
- Image Warping - [The Lens Correction option corrects image distortion in an Image diagram](#).
- The Test Contents items displayed in the Diagram Properties Data Selection list can [be sorted by Name and Group](#).
- A [Diagram copy](#) of the existing diagram/table can be created. Any changes can be made without changing the original.

General Usability

- Undo - [Cancels operations made to any item in the Test Contents window](#).
- Redo - [Restores undone operations made to any item in the Test Contents window](#).

See Also...

[Previous Release](#)

What's new in TEMA 3.5?

The following major changes have been made to TEMA between this release (3.5) and the previous release (3.4).

Compatibility

- Windows 7 support (32-bit and 64-bit).

Analysis

- Non-parallel [motion planes](#):
 - Handles motion planes that are non-parallel to the camera sensor by correcting for the varying scale in the image. Useful for 2D applications with constraints on where to position the camera.
 - Flexible UI for setting up the motion plane in different ways:
 - Azimuth/elevation angles between the optical axis of the camera and the motion plane.
 - 4 reference (i.e. surveyed) points.
- Increased number of supported coordinate systems, maximum is now 15.
- Toggle for enable/disable of depth scaling.

Speed optimization

- Multi-core CPU support for speed improvements on modern computers.
- Algorithm optimizations for tests with many points, relations and diagrams.
- Functionality for [minimizing/restoring diagram windows](#).

Tracking usability

- New preference "[Overwrite manually tracked points](#) during tracking [Yes/No]".
- Maintaining virtual points will be easier by using the function [Recalculate All](#), which overwrites the virtual point's position in each frame according to the current 2D model.

Camera Control

- Snapshot download:
 - New function "[Snapshot Recording](#)" for quick capture of single or multiple snapshots.

Presentation

- XT, Multi, XY, 3D, Image and Advanced Diagrams:
 - The colour of a curve representing interpolated points can easily be change by the "[Alt Colour](#)" function.
- 3D Diagram:
 - Adjustable size for [Camera Visualizer](#).
- Time table:
 - Can be configured to automatically add columns by the new function "[Auto Select](#)". (Also available for XT, Multi, XY, 3D and Image Diagrams).

General usability

- Preferences:
 - Functionality for [reverting preferences to factory default values](#).
- New dongle for dongle licences:
 - The old dongle is replaced with a new model that is supported by Windows 7 and can be updated remotely, e.g. at the customer site.
- Image export:

- Functionality to overlay absolute time information on each frame in image export.

See Also...

[Previous Release](#)

What's new in TEMA 3.4?

The following major changes have been made to TEMA between this release (3.4) and the previous release (3.3).

Tracking usability

- New function "[Step Track](#)" in Time Table toolbar:
 - "Step track" tracks one frame forwards or backwards and stops (leaves tracking state and enters normal state).
 - "Step track" keyboard bindings (shortcut keys) and toolbar buttons are added.
 - "Step track" makes confirm image and automatic/semi/manual modes obsolete. These modes are removed.

General usability

- Improved [error message](#) handling in diagrams/tables/reports:
 - If the user sets up an incorrect scaling or coordinate system, or removes/unregisters a point that is used for scaling or a coordinate system, an error message will be shown in the diagram/table.
- Toolbar revision:
 - Toolbar buttons that are seldom used are removed:
 - New data file (Standard toolbar).
 - Show time overview window (Standard toolbar).
 - Open notes window (Standard toolbar).
 - Use area of interest (Tools toolbar).
 - Find image (Time table toolbar).
 - Toolbar button Time properties (Time Panel) is now optional.
 - New "[Point Control](#)" toolbar with buttons for:
 - Enable
 - Disable
 - Sleep
 - Sleep in selected intervals (moved from Data toolbar).

Templates

- Improved templates concept including factory templates with the TEMA installation:
 - Template installation:
 - A selection of [factory templates](#) is installed during installation. The selection is controlled by the configuration code.
 - Template management:
 - Functionality to [delete and rename templates](#).
 - New functionality:
 - Templates can be configured to [ask for image files](#).

Presentation

- 3D diagram:
 - [New toggle for "Keep aspect ratio"](#). When disabled, the axes will be scaled so that the ranges of the axes form a cube (3D only).
- All diagrams:
 - [Settable fonts](#) for diagram texts in the Diagram Preferences.

Analysis

- New [Spline filter](#) for data smoothing.
- New settings for [3D Interpolation](#) algorithm:

- Linear or cubic.

See Also...

[Previous Release](#)

What's new in TEMA 3.3?

The following major changes have been made to TEMA between this release (3.3) and the previous release (3.1).

At a glance

- Lens Calibration – A new Lens Calibration feature is developed. Will dramatically improve the accuracy in 2D and 3D tests.
- General Usability – Tracking optimization, improved image handling, user interface updates.
- Relative Orientation – Perform your camera orientation directly from two camera views, without a surveyed target (e.g. a cage). This feature will simplify the test procedure for all 3D users.
- Presentational Improvements – New diagram features for extended presentational possibilities.

In detail

- Usability:
 - Relative image file search paths. With relative image file search paths it is easier to distribute TEMA tests.
 - [Sort windows](#). Sorts the windows (test contents, camera view windows and diagrams) as tiled or cascade.
 - Improved icons for set t0 and goto t0 in the time toolbar.
 - Automatic adjustment of reference times for scale setup and coordinate systems setup when setting the frame rate or t0.
 - Open image sequence dialog: A "refresh"-button is added to the dialog. It will refresh the image cache stored in the files imglist.tmp. Also, all imglist.tmp files now have the file attribute hidden.
 - The camera type list can now be configured to only contain camera models from specific vendors.
- Presentation:
 - Added visualization of cameras and 6DOF in 3D diagrams.
 - Improved UI for manual legends in diagrams.
 - Improved UI for adding accuracy visualization in diagrams.
 - Added accuracy columns for the timetable.
- Licensing and installation:
 - [Demo license](#). It is now possible to install a demo license of any configuration on a computer with TEMA already installed, without affecting the current installation.
 - TEMA now requires a reboot after installation if prompted for it during installation of the program. This removes potential licensing problems.
 - An additional check is made to ensure that the request.txt and license.txt files match when installing a license. This removes potential licensing problems.
- Tracking:
 - Greatly improved tracking and playing speed in AVI-files with incremental codecs, e.g. DivX and XviD.
 - Quadtracker: The function of the search area is adjusted so that the template is allowed to stretch outside the search area.
- Analysis:
 - [Lens calibration for 2D and 3D tests](#). A new lens calibration system for planar targets has been added. It is highly recommended to use it in both 2D and 3D tests as it improves the accuracy and traceability of the result. It is included in TEMA Motion and TEMA Autom otive.
 - [Relative orientation for 3D tests](#). Perform your camera orientation in 3D tests directly from two

camera views, without a surveyed target (e.g. a cage). This feature will simplify the test procedure for all 3D users.

- [3D interpolation](#). A cubic interpolation is automatically done on the 3D data on intervals with sleeping points in one or more camera views.

See Also...

[Previous Release](#)

What's new in TEMA 3.1?

The following major changes have been made to TEMA between this release (3.1) and the previous release (3.0).

- Usability:
 - [Default Tracker toolbar](#). The toolbar contains a user-defined set of trackers. When a new point is added to the test, the selection in the toolbar controls the settings of the point.
 - [New mode for adding points](#). If the "auto" toggle in the new Default Tracker toolbar is enabled, a left-click in the camera view window will add and position a new point to the test. If it is disabled, the user must first add and then position the point to the test, as in earlier versions.
 - Drag-and-drop in diagrams. It is now possible to add points, distances, angles and stick figures to diagrams simply by dragging the items from the test contents window and dropping them in the diagrams.
 - [Set point position](#). By selecting Position... in the Tracking menu, the user can manually set the pixel coordinates of a tracking point.
- Presentation:
 - [3D diagram improvements](#). The 3D diagram now features visualization of stick figures, distances, angles and axes.
 - [Sorting in Time tables](#). By clicking on the header of a column in the Time table, the rows are sorted in increasing/decreasing order according to that column.
 - [Variable line width in diagrams](#). A preference for setting the line width in all diagrams has been added.
- Tracking:
 - [Corner contour tracker](#). A brand new tracker for corners, based on the curvature of edges.
- Analysis:
 - [Contour analysis](#). The calculated parameters are extreme points (up, down, left, right), major axis angle and size. The results can be presented in original or user-defined 2D coordinate systems.

See Also...

[Previous Release](#)

What's New in TEMA 3.0?

The following new functionality has been added to TEMA between this release (3.0) and the previous release (2.6).

- TEMA General issues:
 - New user interface for [image export](#) which also includes new functionality; title slate and overlays (text and image boxes) can be added to the exported image file.
 - [Image Export Settings](#), specified in the Image Export interface can be stored in Preference Archive and used in any test.
 - [New Windows definition](#). A window can be Free or Locked. A free window will display any item(s) selected in the test contents tree. Thus, multi-display is now possible.
 - New user interface of the preference settings.
 - A set of special [Expressions](#), for easy output of test information in text boxes, Image Export etc. A [Wizard](#) for the aid of using the variables is also included (optional)
 - [3D Diagram](#)
 - [Report Generator](#). Tool for producing customized reports including graphs and spreadsheets. The report includes the [Test Summary](#) text box, which handles Expressions.
 - [Point Table](#). Table with the tracked points as index instead of time. Each point will produce one row in table.
 - [Intersection tracker](#). Detects edges and finds intersections between detected edges.
 - Tracking image mode: [Correlation](#), [Intersection](#) and [Quadrant Symmetry](#) trackers now operates in 16 Bits. Thus, tracking can be done in color mode, including enhanced images.
 - Settable defaults for tracking Image mode. The set default can be overridden for each tracked point.
 - Settable [Policies](#) for making changes in preference settings and specific program actions.
 - [Templates](#). Create generic templates from a TEMA test, with or without images and tracked data.
 - [Image Enhancement window](#) improved.
 - Multi selection in Open Image File dialog possible.
 - Camera Menu. Possible to view used reference points via Camera/View Reference Points
 - Find Image, for locating events in image sequences.
 - [Camera Menu](#). Possible to view used reference points via Camera/View Reference Points
 - Quality data out from trackers
 - New Install Shield version (MSI)
 - Windows Vista supported.
- TEMA server:
 - Complete new [Remote Server](#) standalone solution. Allows a server to perform an image export instead of the TEMA analysis workstation (optional).
- Camera Control issues (Enterprise edition):
 - [Dual destination](#) download.
 - Simultaneous setup of multiple cameras is now possible.
 - [Live Camera Download](#)
 - [Preference Management](#) (optional).
 - Camera Control: Default Interval in [Manual Download](#)
 - User [profiles](#).
 - [Test Sections](#)
 - Settable Default File patterns in various places
 - Settable Default Interval for Manual Download
 - [Interface](#) towards a [Test Planning system](#).

- [End Test Exports](#) using named image export settings.
- TEMA [Arena](#)
 - A complete new product for Arena test analysis.
- TEMA [Gun Scoring](#):
 - A complete new, streamlined product for Gun Scoring Measurements.
 - [Point Generator](#)
 - [Report Generator](#)
 - [Test Summary](#).

See Also...

[Previous Release](#)

What's New in TEMA 2.6?

The following major changes have been made to TEMA between this release (2.6) and the previous release (2.5).

- [3D presentation of airbag volume data](#) - used to display airbag volume data from the airbag volume analysis functionality (optional) in three dimensions as a rotatable body.
- [3D with moving Cameras](#) - dynamic camera orientation makes 3D calculation possible with moving cameras.
- [Image Diagram](#) - a plotted curve can be superimposed on the image. Using [Image Merge](#), several image sequences can be displayed in one image diagram simultaneously.
- [Advanced Viewer](#) - More functionality to the TEMA viewer;
 - Modify graphs and spread sheets in viewer
 - Build new graphs and spread sheets from existing data
 - Export images, data, graphs and spreadsheets from the viewer
 - Print graphs and spreadsheets
 - Perform image format conversions with export capability
- [Airbag visualizer for all times in Camera view](#) - show tracker (visualizer) data in camera view window.

See Also...

[Previous Release](#)

What's New in TEMA 2.5?

The following major changes have been made to TEMA between this release (2.5) and the previous release (2.4).

- [Airbag volume](#)
- [Airbag circumference](#)
- [Remove License](#)
- [Exclude area](#)
- [Autofind similar points](#)
- [Suggest Point Position](#)
- [Confirm Image mode](#)
- [Floating Licence, possible to see current users](#)
- Lens calibration
- Floating Licence on Server 2003 is now supported

See Also...

[Previous Release](#)

What's new in TEMA 2.4?

The following major changes have been made to TEMA between this release (2.4) and the previous release (2.3).

- File menu
 - New Camera View: See [Camera Parameters](#).
 - [Print Options](#): The Print Setup dialog is now called Print Options.
 - [Print Report](#): The procedure has been simplified. The Print dialog is now called Print Report.
- [Edit menu](#)
 - [Area of Interest](#) - defines a rectangular area of interest in a camera view that can be used to limit the part of the image used for Image Enhancement and Image Export.
 - [Delete](#): The deletion of tracked points displays a confirmation, while the deletion of unregistered points does not.
- [View menu](#)
 - None.
- [Object menu](#)
 - [Export Tracked Data](#): Data for particular tracked items can be exported by right-clicking on the item in the Test Contents window.
 - Point State: During tracking, points may now be [unregistered](#) or [woken up](#).
 - Note: These functions are selected from the pop-up menu rather than the Object menu.
- [Camera menu](#)
 - [Camera Control](#) (Optional Feature): A camera control function has been added to enable the control of multiple high speed cameras of various types via Ethernet.
 - [Image Enhancement](#): The colour composition of a displayed image can be improved by adjusting the colours in the image via a vector scope or the RGB waveform.
 - Image Export ([Video Compression](#)): When exporting single or multiple camera views to AVI files video compression can be specified.
 - Image Export ([Setup Procedure](#)): This has been improved for single camera views.
 - Insert Reference Points: These can be inserted in two ways:
 - [Importing from a file](#) (original method).
 - [Copying from another view](#) (new method).
 - Multi Export Images: Similar to the [Export Images](#) function, but enables simultaneous export of images from more than one camera view.

 - [Time Overview](#): The status of the data in the test can be displayed graphically. It is of particular benefit when used in conjunction with the Camera Control option.
- [Diagram menu](#)
 - None.
- Tools menu
 - [Licence/Disconnect](#): A connected network licence can be disconnected.
 - [Preferences/Camera Types](#): The procedure has been changed so that all maintenance is done in the tab. The Add and Edit dialogs are no longer used. A revert to defaults feature has been added.
- Camera View pop-up menu
 - Camera View Properties:
 - Camera Parameters:
 - [Aspect Ratio](#): This can be specified.
 - [Lens Distortion](#): The distortion parameters can be specified.
 - [Tracking](#): The number of images to skip during tracking can be specified.

See Also...

[Previous Release](#)

What's new in TEMA 2.3?

The following major changes have been made to TEMA between this release (2.3) and the previous release (2.2).

- [Edit menu](#)
 - Camera View Properties/Airbag Analysis:
 - [Extreme Points](#): The user can choose whether to compute the extreme points of the airbag contour either as the points with the maximum/minimum x or y coordinate (old method) or as the intersections of the contour with the coordinate axes.
 - [Volume](#) (Optional Feature): Rotates the airbag contour around an axis and computes the volume of the resulting rotational solid.
 - Scaling/Coordinate System:
 - [2D Coordinate Systems](#): These can now be defined without reference to tracked points by giving the coordinates of the origin and the rotation angle of the axes relative to the image coordinate system.
 - [3D Coordinate Systems](#): The user can define additional coordinate systems for 3D data, in a way analogous to how 2D coordinate systems are defined. Tracked points are used to define the origin as well as the coordinate axes.
 - Note: This feature is only available with the 3D optional feature.
- [View menu](#)
 - [Notes](#): This function opens a window which can "collect" information from the status bar at the bottom of the main window.
 - [Split View](#): This function enables an overview of a sequence to be displayed in the image window.
- [Camera menu](#)
 - Add Body Model (Biomechanical system only): A body model can be added by:
 - [Importing from a file](#).
 - [Copying from another view](#).
 - [Advanced Airbag](#) (Only available with the Airbag Optional Feature) - new tracker added.
 - Camera View: Airbag edge coordinates can be displayed in the Statusbar for both the [Airbag tracker](#) and the [Advanced Airbag tracker](#).
 - [Copy a Tracker Setup](#): It is now possible to copy a tracker setup from one point to the selected points in the Test Contents window.
 - [Duplicate Point Definition](#): It is now possible to add a new point with the same tracker as an existing point (Duplicate).
- [Diagram menu](#)
 - [Legends](#): Curve coordinates can now be displayed.
- Tools menu
 - [AICON Lens Calibration](#) (Optional Feature): A lens calibration algorithm from AICON 3D Systems GmbH is now supplied with TEMA. The algorithm requires the use of AICON's proprietary calibration target and associated software.
 - [Body Models](#) (Biomechanical system only): Body models can be created and maintained.
 - Preferences: The following preferences have been added or amended:
 - Velocity
 - [7 and 9 point filters added](#).
 - [Reduce Filter Length at Interval Ends](#).
 - [Use Short-Sequence Filter](#).
 - [Key Bindings](#): Keyboard keys can be assigned to TEMA functions.

See Also...

[Previous Release](#)

What's new in TEMA 2.2?

The following major changes have been made to TEMA between this release (2.2) and the previous releases (2.0 and 2.1).

- General
 - [New Versions](#): Two new versions of TEMA have been produced that contain subsets of the 2D functionality.
 - [Time Resolution](#): The system can handle time resolution to a level as low as nanoseconds (10⁻⁹).
 - [Help lines](#): When tracking in 3D, once a point has been given in one camera view, help lines showing the possible positions of the point are shown in other camera views.
- File menu
 - Import View: This option has been renamed from Import Camera View.
 - [Print Report](#): This option now displays the [Print Setup](#) dialog from which the Print Report dialog can be displayed.
 - [Print Setup](#): This option has been merged with the [Print](#) option which is used to print a selected item.
 - [New View/Camera View](#): The Open Image Sequence dialog has been improved.
- [Edit menu](#)
 - Airbag Analysis Setup: The Airbag Analysis algorithm has been improved. The user interface has not changed.
 - Scaling/Coordinate System:
 - [2D Scaling](#): The Perform Scaling checkbox has been removed, i.e. the selected scaling is always applied. The default is No Scaling.
 - Coordinate Systems:
 - [Origin](#): The specification of the origin has been improved.
 - [Axis Names](#): The Axis names can now be specified.
 - [Axis Definition](#): An offset angle can now be defined.
 - [Depth Scaling](#): The user interface has been changed.
 - [Test Description](#): This new option enables a description of the test to be created and maintained.
- [View menu](#) - no change.
- [Camera menu](#)
 - [Add Contour](#): The implementation of contours has been improved, i.e. contours are now tracked:
 - A contour may be tracked manually from frame to frame.
 - A contour may also be used to control virtual points, i.e. the opposite to the function in previous versions.
 - Add Limit: A set of limits can be selected for the View window and used to display a boundary in the image, in terms of one or more lines, for the presented data.
 - Add Point: The following changes have been made to the Point Setup dialog.
 - Airbag Tracker:
 - [Accept search area edge hits](#) - added.
 - Shading compensation - removed.
 - [Subtract background image](#) - added.
 - Circular Symmetry Tracker:
 - [Pull point to straight path](#).
 - [Constant Tracker](#): A tracker has been added to specify a fixed point in the image that can subsequently be used as a reference point for analysis and display.
 - Correlation Tracker: the following functions have been added:
 - [Sobel filter](#).
 - [Pull point to straight path](#).
 - MXT Tracker:

- [Tracker version](#) - added.
- [Point Setup](#): The user interface has been revised, i.e. all settings are specified in one dialog, whereas previously the tracker settings were specified in a separate dialog.
- Quadrant Symmetry Tracker:
 - [Pull point to straight path](#).
- [Virtual Tracker](#):
 - A tracker has been added to specify points or contours as being virtual. Their position is calculated from the known positions of related points and contours.
 - When a virtual point in a group changes, its position within the group is automatically changed. This did not happen previously.
- Auto Find Points: This new option has been added to find points automatically. It is currently implemented only for the [MXT Tracker](#).
- [Image Export](#): Changes have been made to the Image Export dialog (Downsampling Prefiltering and Colour checkboxes).
- [Point Groups](#): This new option groups together the options relating to point groups:
 - Create Point Group
 - [Import Point Group](#): This new option enables point groups to be imported from external files.
 - Move Selection to Group
 - Remove Selection from Group
- [Point Name](#): A background colour may be specified for a point name.
- [Select New Image File](#): The Open Image Sequence dialog has been improved.
- [Set t0](#): The user interface has been changed.
- [Object menu](#)
 - [Export Tracked Data](#): This new option exports the tracked data from the Airbag tracker to an XML file.
- [Diagram menu](#)
 - [Advanced Diagram](#): A new diagram type has been implemented to enable more complex diagrams to be displayed, i.e. individual components from different sequences can be displayed against each other, e.g. azimuth versus elevation.
 - [Export Data](#): The CASDAS and MatLab export formats have been added.
 - [Filters](#): The resampling mode can no longer be specified.
 - [Legend Settings](#): The content of the displayed legends can be specified.
 - [Multi Axis Diagram](#): Improvements have been made to the Multi Axis Diagram properties in the following areas:
 - [Align Axes](#)
 - [Diagram Limits](#): A set of diagram limits can be selected for a diagram and used to display a boundary on a diagram.
 - [Legends](#)
 - [Table](#): Improvements have been made to the Table properties in the following areas:
 - [Data Attributes](#)
 - [Coordinate System](#)
 - [Decimal Point](#)
 - [XT Diagram](#): Improvements have been made to the XT Diagram properties in the following areas:
 - [Diagram Limits](#): A set of diagram limits can be selected for a diagram and used to display a boundary on a diagram.
 - [Legends](#)
 - [XY Diagram](#): Improvements have been made to the XY Diagram properties in the following areas:
 - [Diagram Limits](#): A set of diagram limits can be selected for a diagram and used to display a boundary on a diagram.
 - [Legends](#)
 - The range of diagrams that can be specified has been expanded to include a function introduced with Advanced diagrams, i.e. [data type selection](#).
- Tools menu

- [Limits](#): A set of limits can be stored in an external file and used to display boundaries for the presented data in terms of one or more lines in the displayed image or diagram. It is typically used to indicate the acceptable limits of the data. An example is where there a measured quantity must be within either legal or industry-accepted limits.
- [Optimize Display Performance](#): The two previous menu options have been merged into one that displays a dialog from which automatic or manual performance setup can be initiated.
- Preferences:
 - [Preferences Dialog](#): The dialog has been rearranged as a series of tabs.
 - [Acceleration](#): New preference category.
 - [Default Directories](#): A default directory for Viewer Export can now be specified.
 - [Printing](#) - New preference category.
 - [Presentation](#): The Diagram preferences section has been extended.
 - [Tool Colour](#): New preference category.
 - [Velocity](#): New preference category.

See Also...

[Previous Release](#)

What's new in TEMA 2.0?

The 2.0 release contains the following additional functionality.

- [Contours](#) (Optional Feature)
- [Coordinate Grids](#)
- [Point Groups](#) (Optional Feature)
- [Stick Figures](#)
- [Tracking Status Icons](#)
- [Viewer Export](#) (Optional Feature)
- [Virtual Points](#) (Optional Feature)

Release 2.0 also contains the following changes from the 1.0 release:

- [Site licences](#) have been implemented.
- A [performance test](#) has been implemented to optimise the display of images.
- An [Autosave feature](#) has been added.
- A [camera view may be renamed](#).
- The File/Close menu option has been removed.
- The [Import Camera View](#) dialog has been simplified.
- The default setting for [Depth Scaling](#) has been changed to "off".
- A third [2D Scaling](#) mode ("Manual") has been added that is based solely on a specified scale factor.
- Additional features have been added to the specification of [Coordinate Systems](#).
- The Search Area used by the following trackers may be reduced after the second image has been tracked:
 - [Correlation](#)
 - [Quadrant Symmetry](#)
 - [Circular Symmetry](#)
 - [MXT](#)
- A shading compensation feature has been added to the [Airbag tracker](#) setup procedure.
- The [Image Export](#) function has been rewritten.
- Text may be displayed against a background colour for [tracked](#) and [exported](#) images.
- Compare two or more curves displayed in the same [XT Diagram](#) or [Multi-axis Diagram](#).
- In Multi-axis Diagrams the scales of the third and fourth axes has changed place.
- The [Zoom function](#) has been improved to enable Zoom In, Zoom Out and Zoom 1:1. previously only the window size could be adjusted manually.

Managing Licences

The use of the TrackEye system is controlled by a [licensing system](#) designed to prevent the use of unauthorised copies of the system.

If you attempt to start an unlicensed copy of the TEMA system, the Unlicensed dialog is displayed, which requires you to acquire a licence before continuing.

After upgrading the TEMA system, for example through the addition of an optional feature, a new licence is required. If you attempt to start the TEMA system using the old licence, the Configuration Changed dialog is displayed, which requires you to acquire a licence before continuing.

Both dialogs contain the following buttons:

- [Request licence](#) - used to request a licence key.
- [Install licence](#) - used to install a licence key.
- [Temporary licence](#) - used to obtain a licence that is automatically revoked after a period of trial use.

Licences are managed from the TEMA Main Window through the Licence option in the Tools menu, which contains the following sub-options:

- [Request](#) - used to request a new licence key.
- [Install](#) - used to install a licence key.
- [Connect](#) - used to connect to a floating/site licence server.
- [Disconnect](#) - used to disconnect to a floating/site licence server.

Requesting a Licence Key

To request a licence key:

1. Select the Request licence button in the Unlicensed dialog, or the Request option from the Tools/Licence menu.
The Request a Licence Key dialog is displayed, showing the Configuration code, i.e. the serial number you keyed in when the system was installed, and the Site code, i.e. a number generated by the system from information about the specific hardware, i.e. it is unique to the machine on which it is generated.
2. Verify that the Company name is correct.
3. Verify that the Computer identification is correct.
4. Key your Fax number if you intend to make the request via that method.
5. If you intend to make the request on paper, i.e. by fax or post, select the Print button.
The request is printed and the Request a Licence Key dialog is removed from the display.
6. If you intend to make the request electronically, i.e. by e-mail or diskette, select the File button to display the standard Save as dialog and save the request as a text file.
7. Select the OK button.
8. Send the request to Image Systems, preferably via [email](#)

Installing a Licence Key

To install a licence key:

1. Select the Install licence button in the Unlicensed dialog, or the Install option from the Tools/Licence menu.
The Install Licence Key dialog is displayed.
 - To install the key manually:
 - Select the Enter manually button.
 - The Enter Licence Key dialog is displayed.
 - Key the Licence key.
 - Select the OK button.

- To install the key from a licence file:
 - Select the Load file button.
 - A standard Open dialog is displayed.
 - Browse for the required licence file.
 - Select the Open button.

In either case, if successful, the TEMA Main Window is displayed.

Connecting to Floating/Site Licence Server

1. Install the new TEMA software.
2. Select the Connect licence button in the Unlicensed dialog, or the Connect option from the Tools/Licence menu.
The Connect to Licence Server dialog is displayed.
3. Key the name of the directory of the TEMA installation on the server.

Alternatively, select the  button and browse for the directory.

4. Select the OK button.
If a licence is available, it is assigned to the requesting computer and a confirmation message displayed.
If a licence is not available or the licence server is not accessible, a warning message is displayed and the licence is not assigned.

Disconnecting from Floating/Site Licence Server

To disconnect from a floating/site licence server:

1. Select the Disconnect option from the Tools/Licence menu.
The licence is disconnected.

Removing a licence key

Removing a licence key from the TrackEye system will make the program unuseable. Performing the command will create a file which can be sent to Image Systems AB, support@imagesystems.se, [e-mail](#) to verify that the licence has been removed. After removal, the only way to run the application again on the computer from which the licence key was removed is to request and install a new licence from Image Systems AB. .

To remove licence key, select the Remove option from the Tools/Licence menu. The Remove Licence dialog is then displayed. Follow the instructions given.

Acquiring a Temporary Licence Key

A temporary licence for trial use of the TEMA system may be granted once, and once only, for a machine. The licence cannot be renewed on the same machine. The length of the trial period is specified by Image Systems for each temporary licence.

To install a temporary licence key, select the Temporary licence button in the Unlicensed dialog. No further action is required and the TEMA Main Window is displayed.

Before the end of the trial period you need to [request a normal licence key](#) based on both the computer and TrackEye configurations.

Licensing System

The TEMA product is protected by a licensing system based on CrypKey. The system offers stand alone licences, multiple licences and floating licences.

Stand alone licences

A stand alone licence is locked to a specific computer. It has to be issued by exchanging codes between the customer and Image Systems AB. In the event of a hard disk crash the licence has to be re-issued by Image Systems AB. The licence can be moved to another computer by the customer without involving Image Systems.

Multiple/Site licences

If a customer buys several licences for its own computers, they are managed via the concept of a multiple licence. This works using a combination of the stand alone licence methods.

The TEMA system is installed on one of the customer's computers and the regular licence code exchange with Image Systems AB is performed, but the licence code obtained automatically indicates the number of licences purchased, all of which are initially assigned to the same computer. When installing TEMA on other computers, the licence is acquired by using transfer commands from the first computer. Only the purchased number of licences can be transferred in this way.

A site licence is a multiple licence with a very high licence count which enables a customer to install as many copies of the software as required.

Floating licences

A floating licence enables a specified number of licences to be dynamically available to any number of computers in the network. The restriction is that at any one time, the number of computers assigned a licence is limited by the number of individual licences purchased as part of the floating licence.

The floating licence system relies on remote file transfer between a server computer (a Windows machine) and client computers. The server has service running that scans for licence requests in a specific directory. The clients must have read and write access to this directory.

When installing TEMA with a floating licence, the licence server is installed separately from the TEMA software. The server control files must be placed in a directory physically on the server machine. The licence server obtains a licence code from Image Systems AB that specifies the maximum number of simultaneous users. This number may be increased by obtaining a new licence code from Image Systems AB.

Each client installation needs to be able to access the server control directory. This means that the server must be online for any of the clients to operate. If there are no licences available when a client tries to obtain one, a warning message is displayed and the client repeatedly checks for licence availability. Licences are assigned on a "first come, first served" basis. If a client computer or its TEMA system crashes, its assigned licence is returned to the licence server after a delay period of several minutes.

New in TEMA 2.5 is that using Floating Licences will allow users to see which other clients that are currently logged onto the same Floating Licence. If the number of clients are the maximum allowed, the next client trying to log on will get a message telling login is not permitted and which other clients that are already logged on.

Dongle Solution

As an alternative to managing [licenses](#), TEMA can be run with a dongle from Image Systems AB. A dongle is a hardware key that fits in one of the USB ports.

Procedure

1. Install TEMA with the configuration code labeled on the CD back cover. The following Warning dialog will appear;



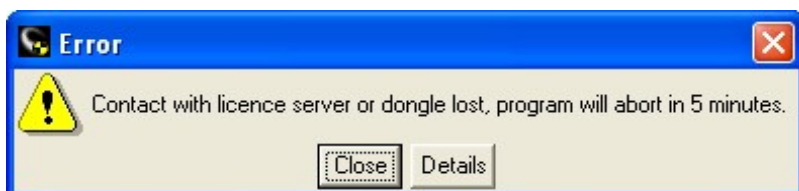
2. Remove all USB dongles. Click OK when ready.
3. After the TEMA installation procedure, place the dongle in the USB port.
4. Start TEMA. Done.

Note:

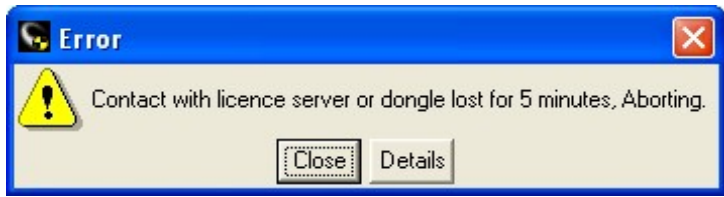
- The message as illustrated below appears if you start TEMA without the dongle in place. In case this happens, Click Exit and insert the dongle in the USB port. Start TEMA again



- If you remove the dongle when you are running TEMA, the dialogue as illustrated below appears. In case this happens, click Close and insert the dongle in the USB port again.



- If TEMA can not contact the dongle it will be closed after 5 minutes. When this has happened, the dialogue as illustrated below appears. Click Close. This will end TEMA and you have to make another try. Check that the USB port is working properly.



Minidumps

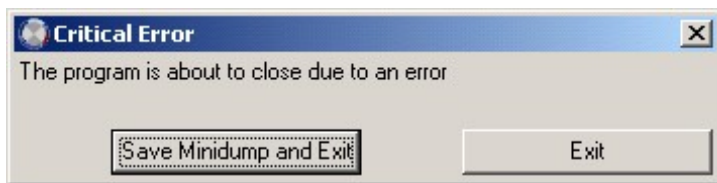
Minidumps are for fault finding and debugging purposes.

If a software crash should occur TEMA tries to save valuable information for debugging purposes. This information does not contain any user data. The TEMA user has to decide whether to pass on this information to Image Systems or not.

Files generated by the minidump function can be attached to an email and sent to support@imagesystems.se .

Up to and including version 3.8 [001]

The possibilities to analyze severe program crashes has been improved significantly. In this version, when such an error occurs, this window will open



with two options:

- **Save Minidump and Exit.**

This will create a small file (roughly 50KBytes) with software status at time of problems. No user data!

This file will have a unique name including TrackEye version and date/time stamp, typically **tema_4.0-3050-64-64_2014_12_15_09_13_54.dmp**, and will be found in the "Minidump" sub directory of the software installation. You have to attach this file to an email to support@imagesystems.se in order for us to analyze it. We appreciate if you send us all 'minidumps' you have, whether or not having a service contract.

- **Exit**

This option will just close TrackEye.

From TEMA version TEMA v3.8 [002] the minidump mechanism has changed.

The purpose is to always get a minidump. Currently there are situations when the dump is never written.

New behaviour:

The dialog coming up at crash time is gone.

Instead a basic minidump is written directly. Naming as before (application_version_datetime.dmp)

After that a more elaborate dump is written (that includes script language stack)

This has the word 'cpm' added to the filename: application_version_datetime_cpm.dmp

The date/time stamp is now the time when the crashing application was started, not crash time.

Depending on the nature of the crash the second dump may not be written.

If possible (depending on how serious the crash is) a command window is shown with the location of the dumps.

The location is not changed:

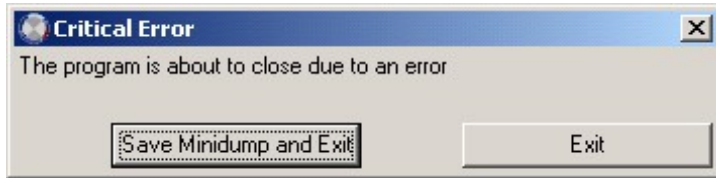
XP : subfolder 'Minidump' for each installed version (Program Files/Image Systems AB/<appl>)

Win7: c:\ProgramData\<appl>\minidumps

-> v3.8 [001]

The possibilities to analyze severe program crashes has been improved significantly.

If an error occurs, this window will open



with two options:

- Save Minidump and Exit.

This will create a small file (roughly 50KBytes) with software status at time of problems. No user data!

This file will have a unique name including TrackEye version and date/time stamp, typically trackeye_5.0.1836.0_2007_12_17_08_23_16.dmp, and will be found in the "Minidump" sub directory of the software installation. You have to attach this file to an email to support@imagesystems.se in order for us to analyze it. We appreciate if you send us all 'minidumps' you have, whether or not having a service contract.

- Exit

This option will just close TrackEye.

The minidump file can easily be attached to an email and sent to support@imagesystems.se , if possible together with a short description what steps preceded the problem.

Location of **minidumps**:

- XP : subfolder 'Minidump' for each installed version (Program Files/Image Systems AB/<appl>)
- Win7: c:\ProgramData\<appl>\minidumps

v3.8 [002] ->

From TEMA version TEMA v3.8 [002] the **minidump** mechanism has changed. The previous **minidump** mechanism did not always succeed to save debugging info.

The purpose is of course to always get a minidump.

New behaviour

- The dialog coming up at crash time is gone. Instead a basic minidump is written directly. Naming as before (application_version_datetime.dmp)
- After that a more elaborate dump is written (that includes script language stack). This has the word 'cpm' added to the filename: application_version_datetime_cpm.dmp
- The date/time stamp is now the time when the crashing application was started, not crash time.
- Depending on the nature of the crash the second dump may not be written.
- If possible (depending on how serious the crash is) a command window is shown with the location of the dumps.

Location of **minidumps**:

- XP : subfolder 'Minidump' for each installed version (Program Files/Image Systems AB/<appl>)
- Win7: c:\ProgramData\<appl>\minidumps

