correlated
SOLUTIONS

Application Note

Marker Tracking

VIC-3D 9

2021

Marker Tracking

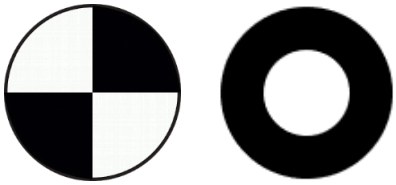
Introduction

Completing a test using marker tracking in VIC-3D is fairly straightforward but a few pointers can help to get the best results in the shortest period of time. This document explains the basics of a test from start to finish. The topics covered will be:

- Preparing the specimen
- Setting up the camera
- Running the test
- Setting up marker tracking
- Extracting marker data
- Coordinate systems
- Description of marker tracking tools

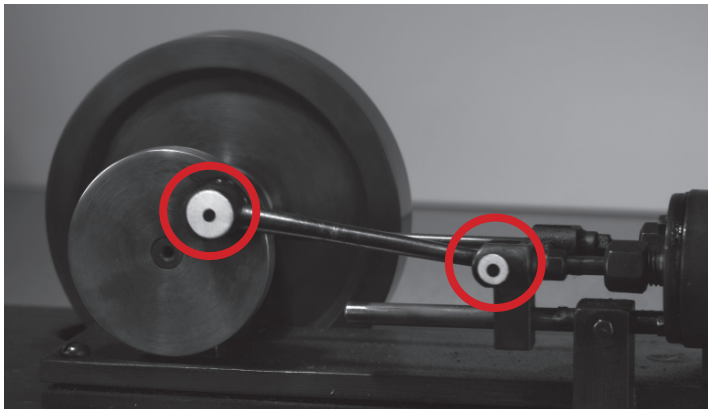
Preparing the Specimen

Begin by preparing the point of interest on the specimen with a marker, either an elliptical marker or a quadrant (bowtie) marker. It is also possible to track regular dots on the specimen if they are relatively circular and of sufficient size, at least 20 pixels, but this is less effective than using the specific markers (using an ellipse marker).



Quadrant Marker and Ellipse Marker Examples

This example uses a model steam engine with two inverted ellipse markers applied to the specimen using printed adhesive labels, as shown. Note that the specimen does not need a speckle pattern if the interest is only on the marker points.



Sample with Inverted Ellipse Markers

Setting up the Camera & Running Test

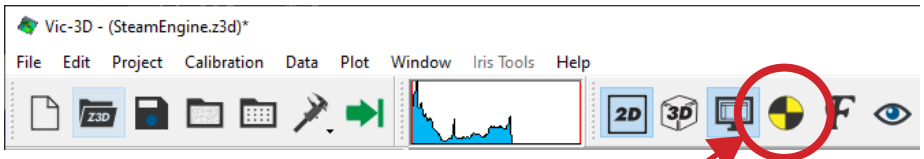
Follow basic setup procedures outlined in the VIC-3D Testing Guide. Then proceed with running the test while capturing images.

Starting VIC-3D

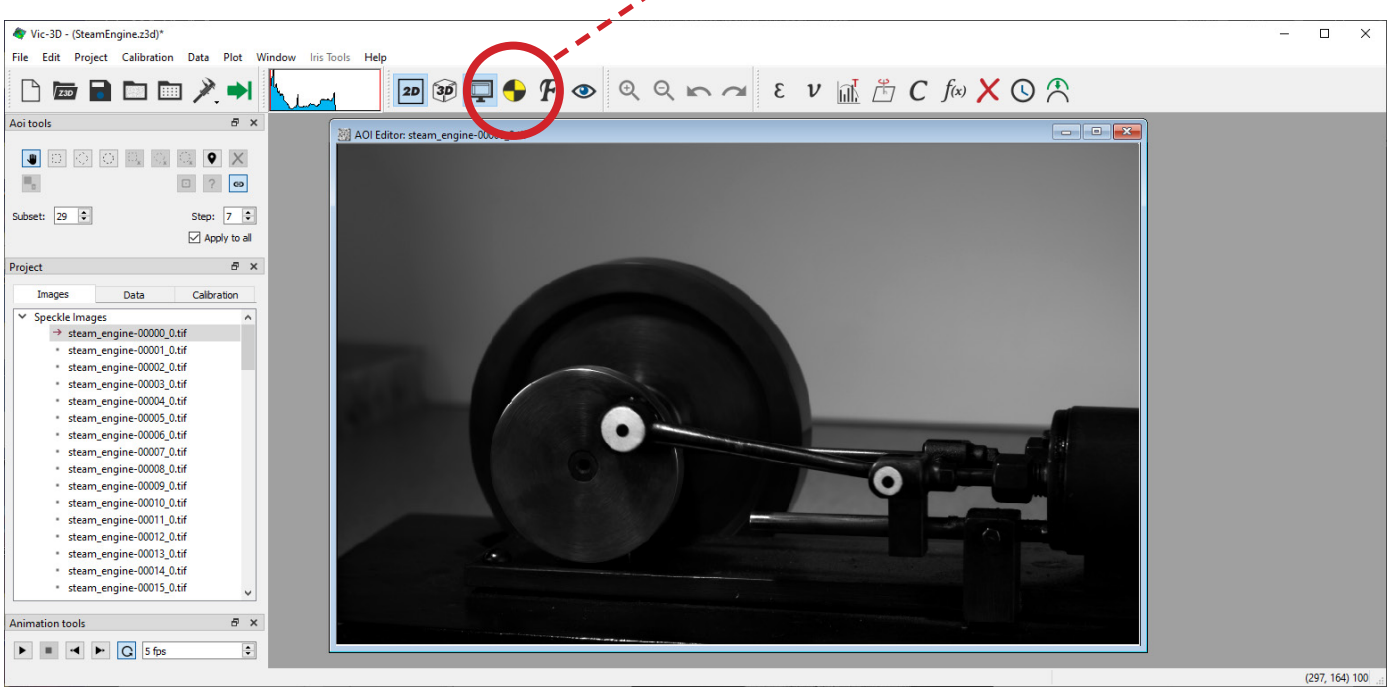
Follow same start up procedures for running a digital image correlation in VIC-3D. Calibrate the system, then import marker images as speckle images.

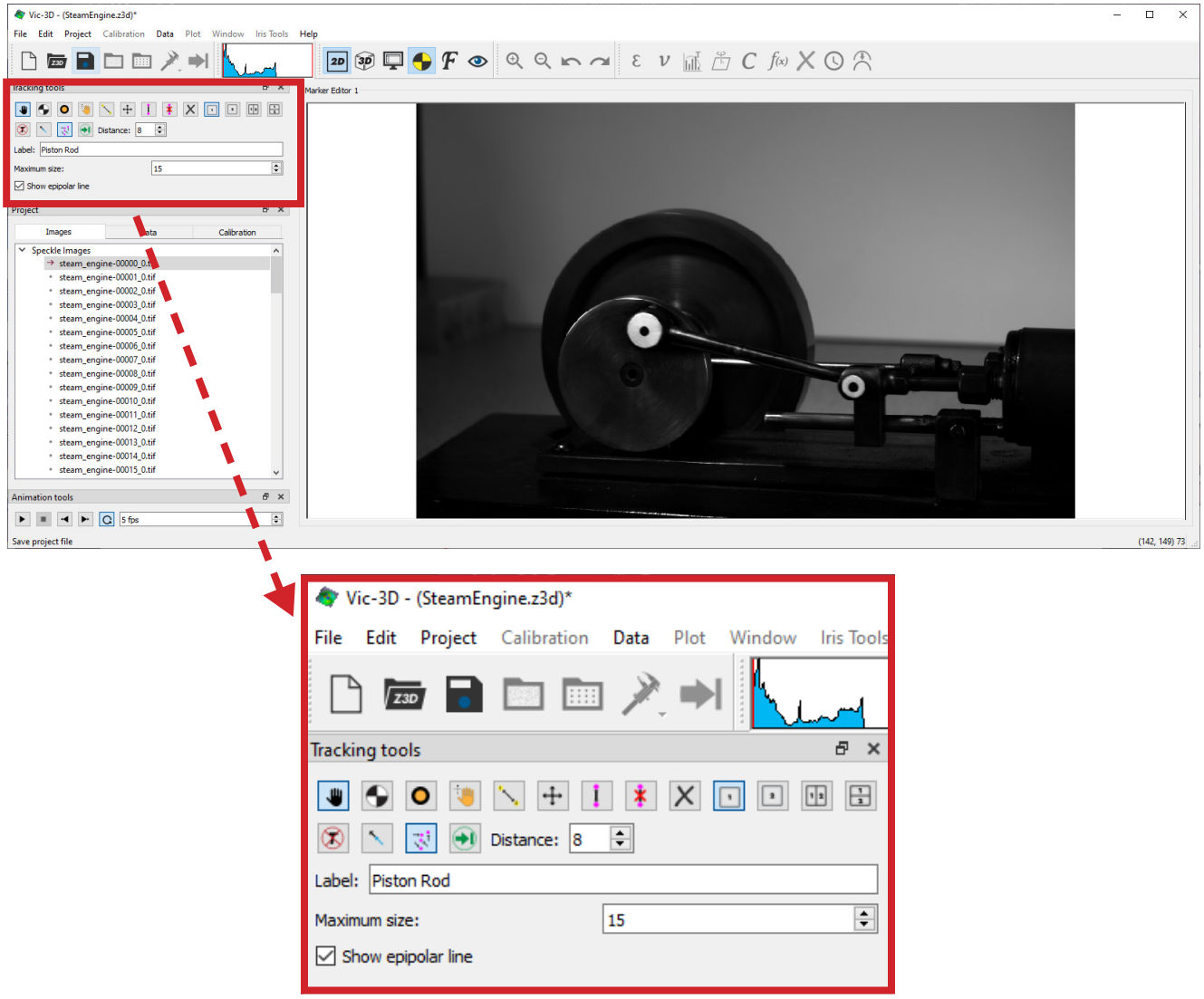
Setting up Marker Tracking

Marker tracking is done by switching to the marker tracking tools by selecting the *Marker Editor* icon. The tracking tools are then shown on the left-hand side of the window.



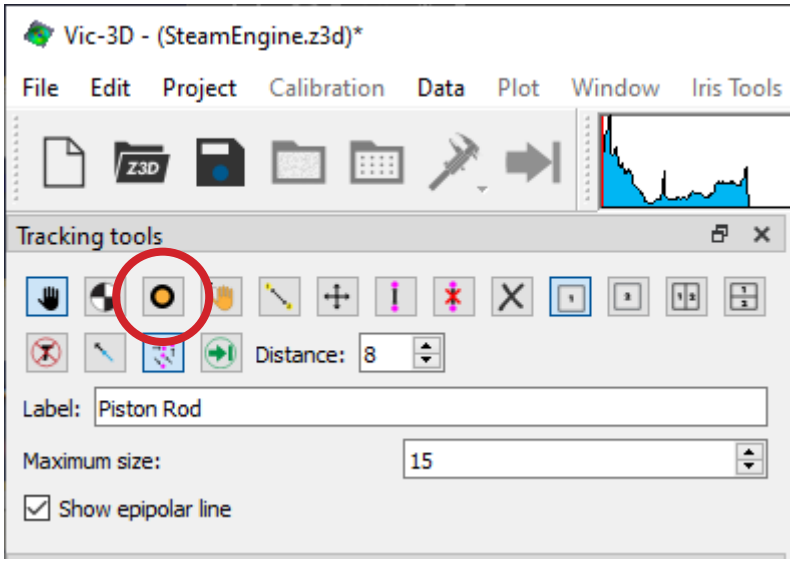
Marker Editor Icon



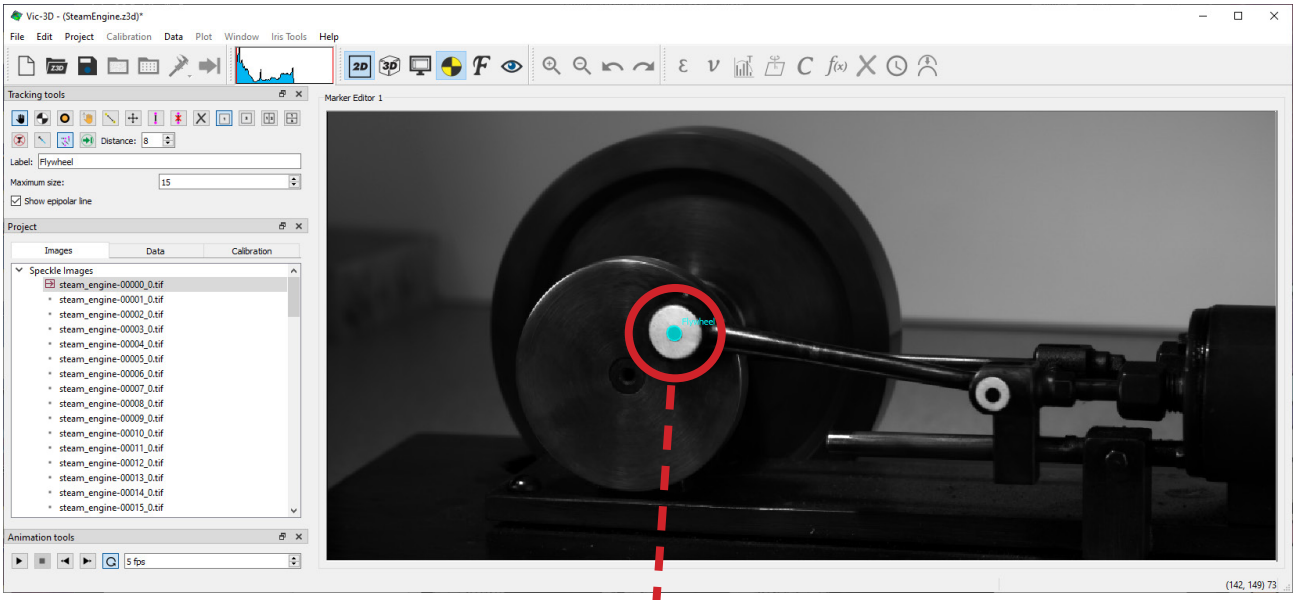


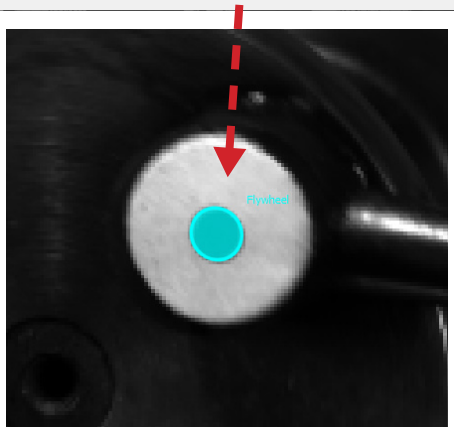
Tracking Tools

For this example, ellipse markers were used. By selecting the *Add Ellipse Marker Tool*, clicking near the center of the marker in the image will identify that marker. Markers will be numbered in sequence starting with zero, unless specified by a given label. A correctly identified marker will look similar to that shown below. Repeat for each tracking marker. Markers can be removed by selecting them using *Pan/Select* and pressing *Delete*.



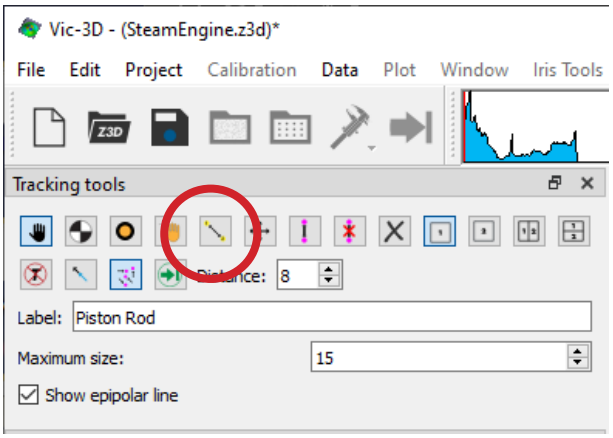
Add Ellipse Marker Tool



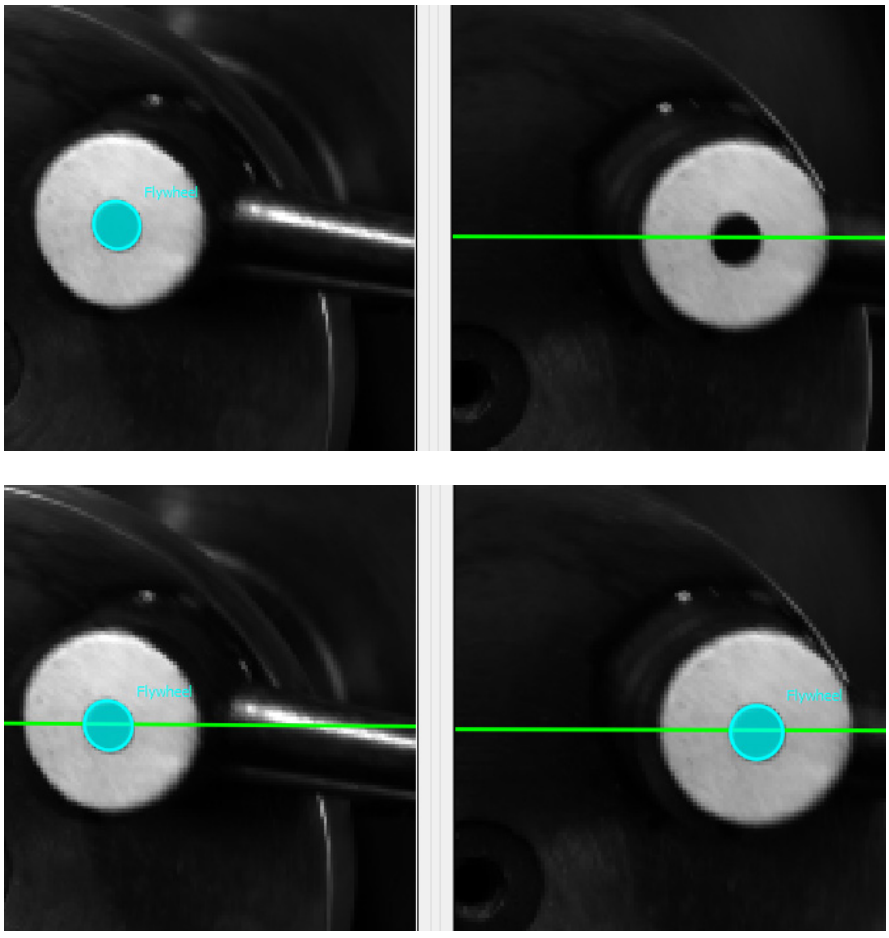


Correctly Identified Marker

The next step is to look at the other paired image and associate the first image markers to the second image. This is accomplished using the *Associate Markers* tool. Select a specific marker using the *Pan/Select* tool and then switch to the *Associate Markers* tool. In the second image of the pair, click near the center of the corresponding marker. Showing the epipolar line may be useful in distinguishing markers between images. Repeat this process for each marker that is being tracked. The figure below provides an example of how the markers will appear once associated.



Associate Marker Tool



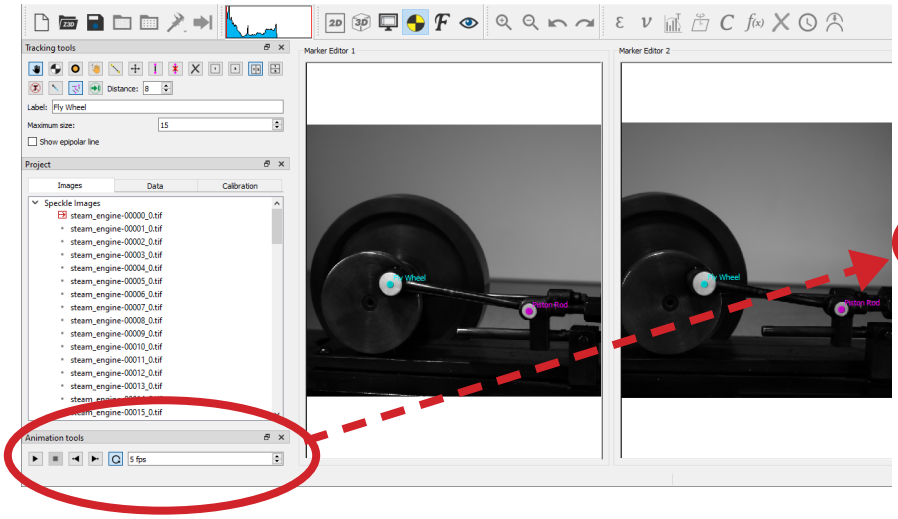
Unassociated

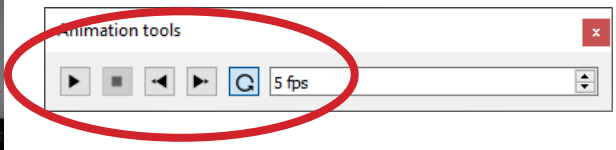
Correctly associated

Associate Markers

Tracking Markers

The next step is to track the markers through the test images. This is done by stepping through the images using the Animation tools. The markers will automatically snap to the correct location for most cases. Should a marker go off track, reposition it by dragging the marker to the correct location using the *Pan/Select* tool.

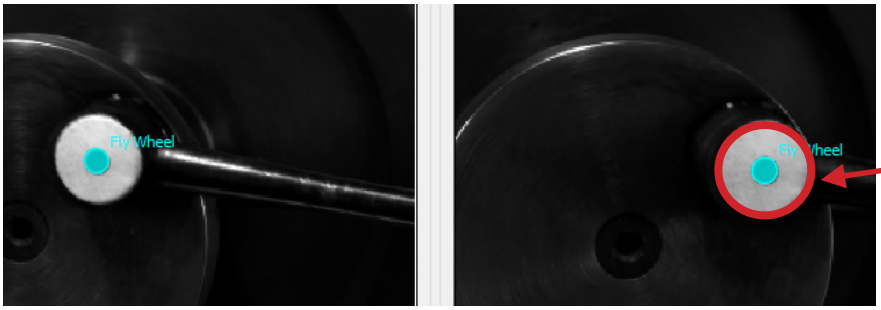




Animation Tools

Reposition markers that are off-track

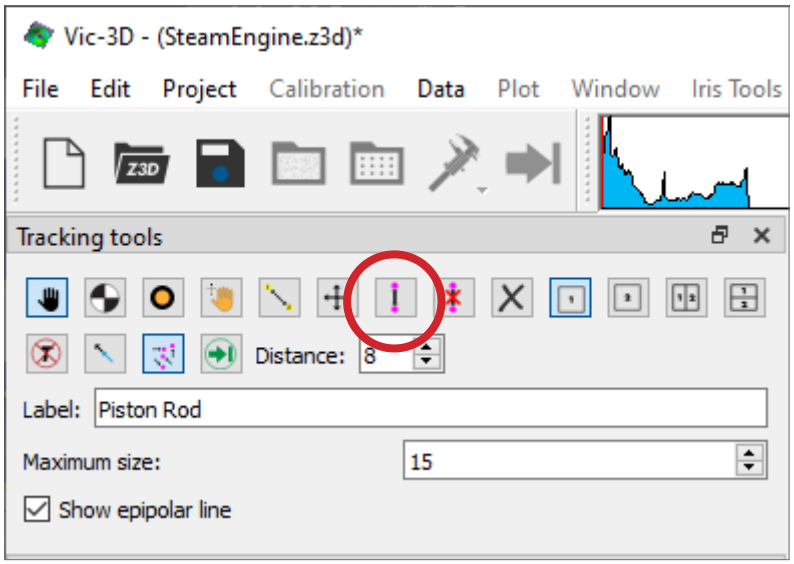
Marker at incorrect location



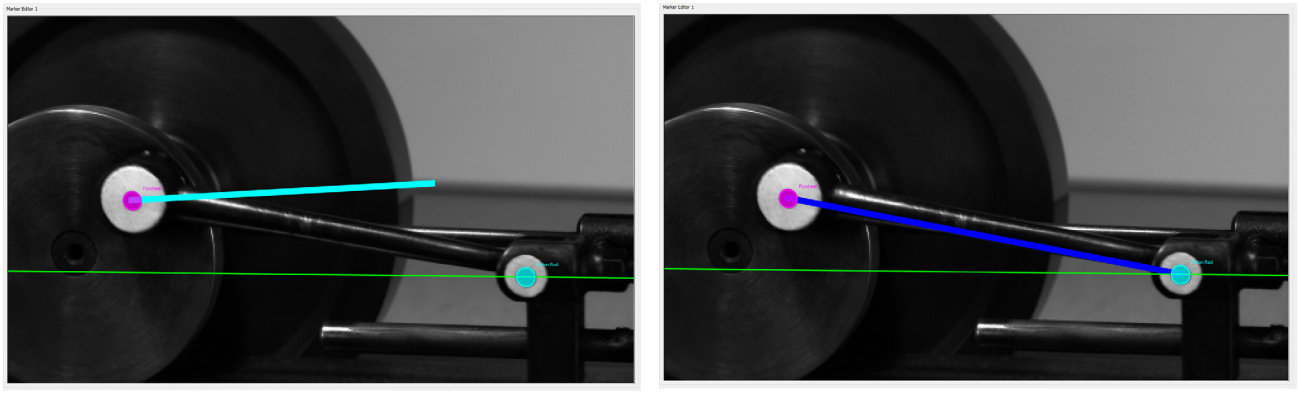
Drag marker to the correct location

Connecting Markers

Once all markers have been placed, tracked, and triangulated, connections can be made to visualize linkages between markers. To create linkages, first select the connect markers button from the tracking tools (pictured in the figure below). Then, select the markers to show the linkages between them. To Remove a linkage between markers, simply select the disconnect marker button from the tracking tools and select the linkage to be removed.



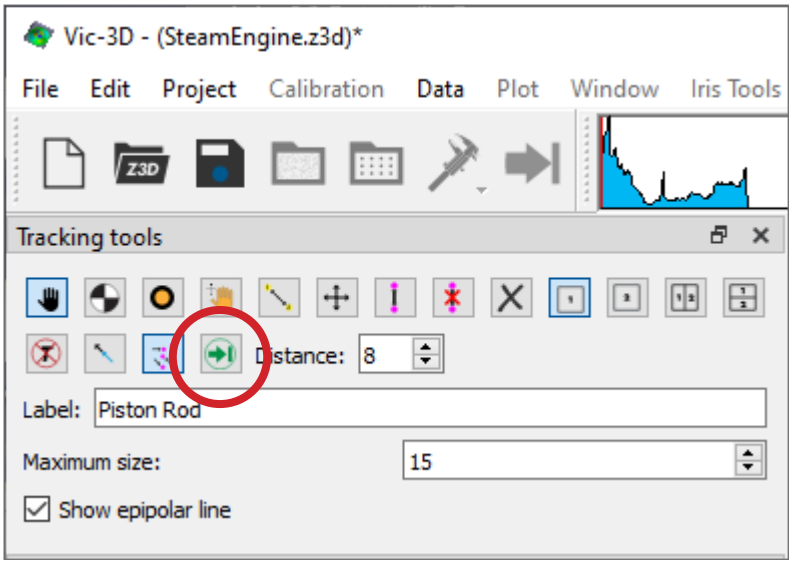
Connect Markers Tool



Linkage between markers

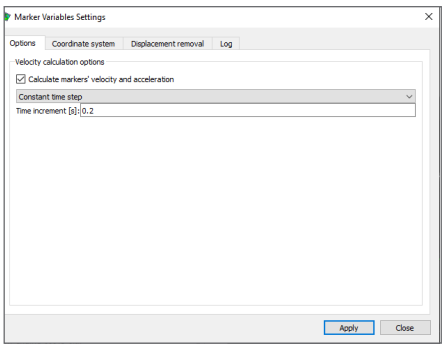
Process Marker Variables

Once all markers have been placed, tracked, and triangulated, other marker variables options and settings such as velocity, acceleration, coordinates systems, and displacement removal can be applied by selecting the process marker variables button from the tracking tools (seen in the figure below).

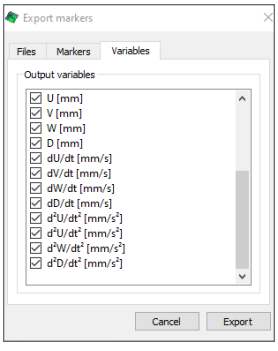


Process Marker Variables Tool

Velocity and acceleration calculation options can be found under the options tab within the marker variables settings. Selecting the calculate markers' velocity and acceleration checkbox will calculate velocity and acceleration for all markers based on the specified constant time step, constant frame rate, or time recorded from a VIC-Snap CSV file, input by the user. Once applied, the data from these variables can be exported using the Export Marker Data feature and selecting the variables from the variables tab.

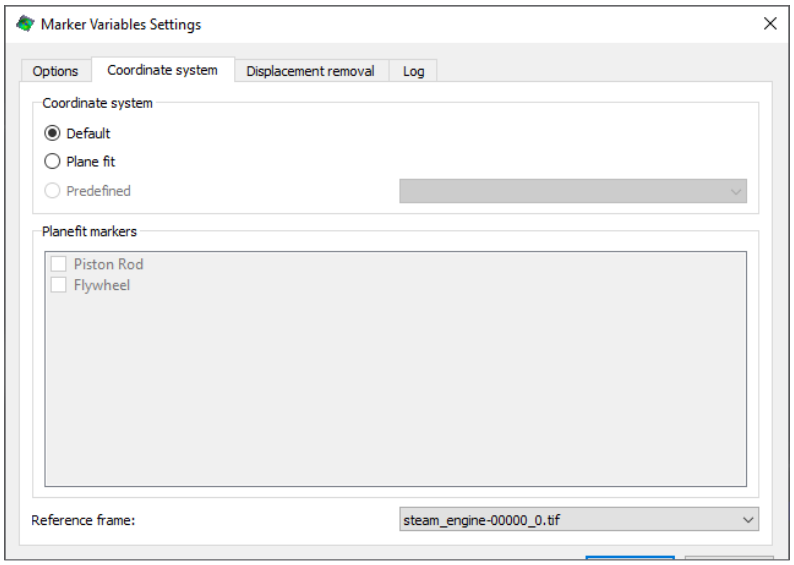


Marker Variables Settings



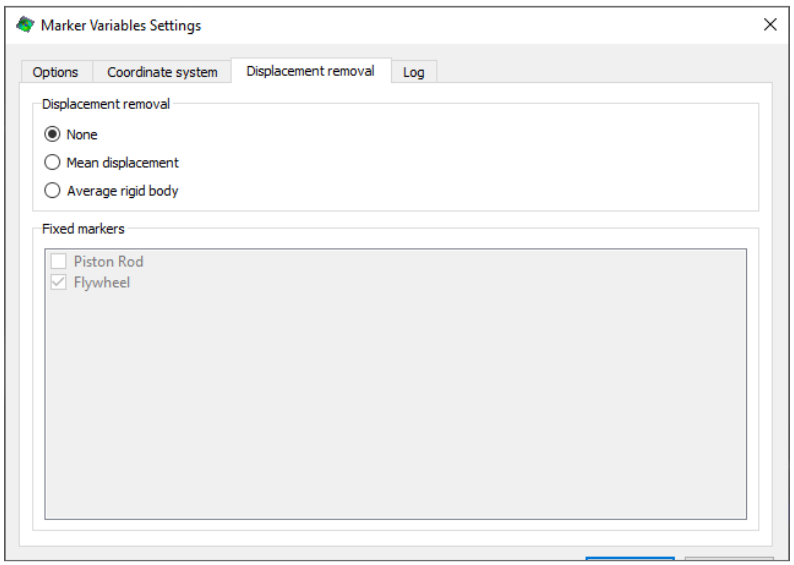
Variables in Export Marker Data

To apply a coordinate transformation from a predefined transform or a plane fit, select the coordinate system tab from the marker variables settings. Coordinate system options, markers, and a reference frame can be selected to define the transformation. A minimum of three markers is required for plane fitting.



Coordinate System Options

To remove displacements from the marker data, select the displacement removal tab from the marker variables settings. From this tab, displacement removal options and fixed markers can be selected. A minimum of three markers must be selected for displacement removal.



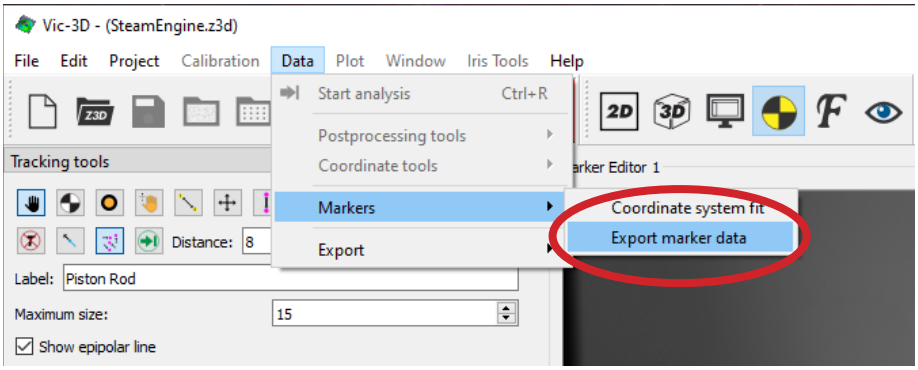
Displacement Removal Options

Extracting Marker Data

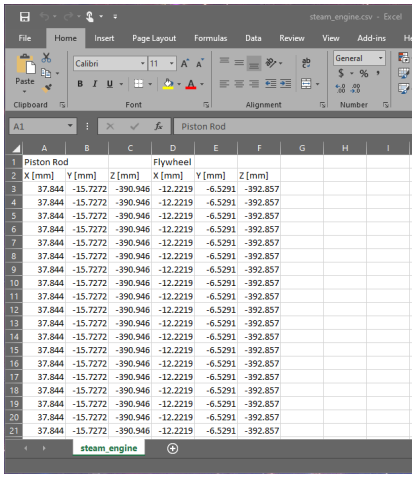
After the markers are tracked through all of the images the data can now be extracted for analysis. This is done by going to the drop-down menu for *Data* > *Markers* > *Export Marker Data*. Clicking *Export Marker Data* will bring up a window to select the output file path. Choose the output path and file name and export the marker data. Choose to export data from some or all images and markers, the coordinate system used, what variables are exported, and if displacement is removed.

Coordinate systems are covered in the next section.

Displacement removal can be done using mean displacement, in which U/V/W displacement is removed but rotation is not, or by using average rigid body displacement, which removes both. Select the markers to use in the calculation of displacement. At least three markers must be selected to use the rigid body displacement.



Exporting Marker Data



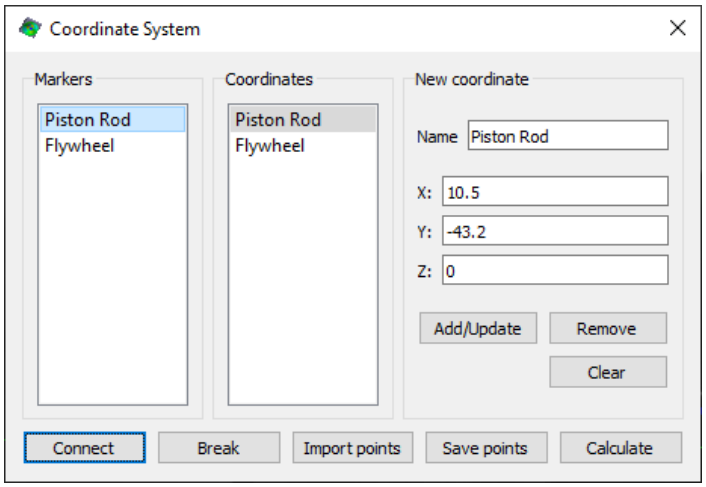
Example of Exporting Data in .csv File

Coordinate Systems

By default, the coordinate system used is camera coordinates. For details on this, see: https://correlated.kayako.com/article/11-camera-coordinate-system-in-vic-3d.

When exporting data, the coordinate system used can also be changed to plane fit, in which case three markers are needed to define the plane, or by using a predefined coordinate system transform from the existing project.

Coordinate system transforms can be computed by navigating to *Data* > *Markers* > *Coordinate System Fit*. Select the marker number, enter the respective known coordinate location (in millimeters), and click *Add/Update*. Select both the marker number and the corresponding coordinates number and click *Connect*. Repeat this for three markers that are not co-linear, and then *Calculate* the transform. The computed transform will be displayed and can be saved to the current project.



Coordinate System Fit

Support

If you have any questions about this document or any other questions, comments, or concerns about our software, please contact us at support@correlatedsolutions.com, or visit our website at support.correlatedsolutions.com.

Definitions of Marker Tracking Tools

Pan/Select: Used to move image and select images and marker points

Add Quadrant Marker (Q): Type of marker, typically known as bow-tie marker

Add Ellipse Marker (E): Type of marker, black circle with white center

Add Manual Marker (F): Type of marker, added after digital image correlation on a speckle pattern. Must be manually positioned.

Associate Markers (A): Used to associate markers in one image to its paired image

Manually Position (M): Manually position a marker on image

Connect Marker (C): Shows linkages between markers

Disconnect Marker (D): Removes linkages between markers

Delete (Del): Delete the currently selected marker

Show Camera 1: Only first image of pair is shown

Show Camera 2: One second image of pair is shown

Split Left/Right: Both images are shown in image pair with one on left of screen and one on the right

Split Top/Bottom: Both images are shown in image pair with one on top of screen and one on the bottom

Track None: None of the markers are tracked

Track Current: Selected marker is tracked

Track All: All markers are tracked

Process Marker Variable: Open the triangulation settings dialog

Distance: Distance in pixels the software searches for the movement of the marker

Label: Name of the marker

Maximum Size: Maximum size of the marker in pixels