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SOLUTIONS

Application Note

Using the Stereo Microscope Module

VIC-3D

2024

Using the Stereo Microscope Module

Introduction

The stereomicroscope module in VIC-3D uses an inverse mapping technique to correct for the complex distortions present in a dual camera stereomicroscope imaging setup.

Necessary Equipment/Software

The most important requirement will be a dual C-mount stereomicroscope combined with a stereo pair of digital cameras. In addition, the microscope should be of a type that allows maximum image overlap at all magnifications. Some microscopes will be correctly set up this way from the factory, but others will make this impossible. The best solution is a custom fixture with adjustable mirrors.

A speckle pattern large enough to cover approximately 120% of the field of view will be necessary for the inverse mapping step. A traditional grid target will also be required to complete the stereo calibration.

Finally, the microscope module for VIC-3D must be installed. This requires the installation of a software key license or a hardware key with the correct module present.

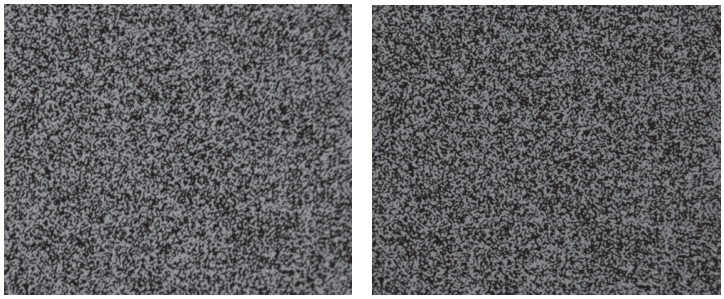
Acquiring Distortion Correction Images

The distortion calibration will only be valid for a specific aperture, camera geometry and zoom level, so these should be fixed before calibration begins. Set the aperture to a value which will allow enough depth of field to accomplish your test, but beware apertures that are too small; the image may become blurred due to diffraction limits in the optics. This limit will vary depending on magnification and camera selection, so check the image carefully, zooming in if necessary.

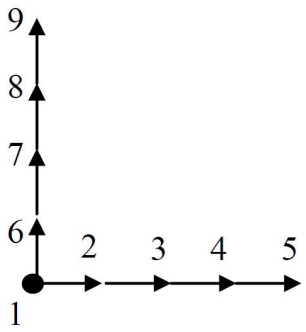
Note that because of the way a stereomicroscope focuses, focus *may* be adjusted after calibration, in contrast to normal C-mount type lenses.

To begin, place the speckle pattern in the imaging field, and position the field of view so that the pattern covers it completely.

Check that focus and lighting are good across the pattern. Also, make sure that the two images are well aligned with the same field of view visible from edge to edge. An example image pair is shown to the right.



Take a starting image. Then, take a sequence of images which contains in-plane motion. A good sequence is shown below:

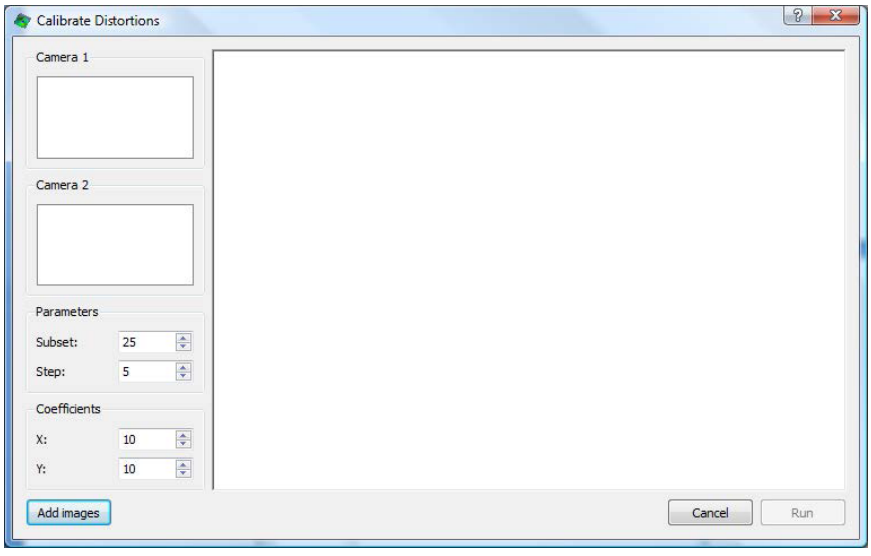


The total motion should be approximately 15% of the field of view, which means each step in the sequence above will be approximately 4% of the field of view. Also, the motions need to be in the exact plane of the pattern itself. It is best to start in the corner of the pattern, as shown, to give the largest final corrected field of view.

When equipped with a motorized stage controlled by VIC-Snap, you can select the magnification and use the “Distortion Sequence” button to acquire these images automatically.

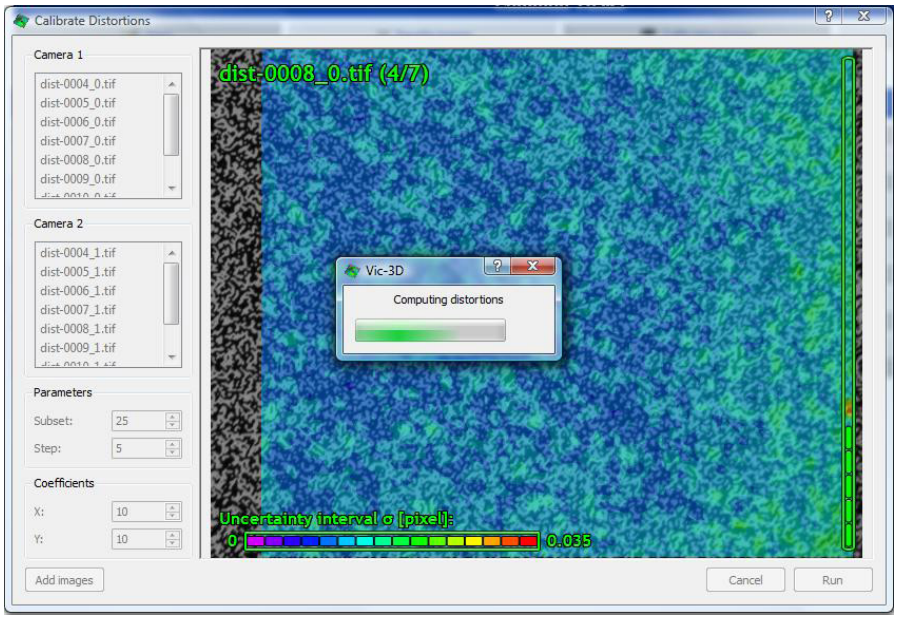
Analyzing Distorion in VIC-3D

Start VIC-3D and select **File… Mode… Stereo-microscope**. The following dialog appears:



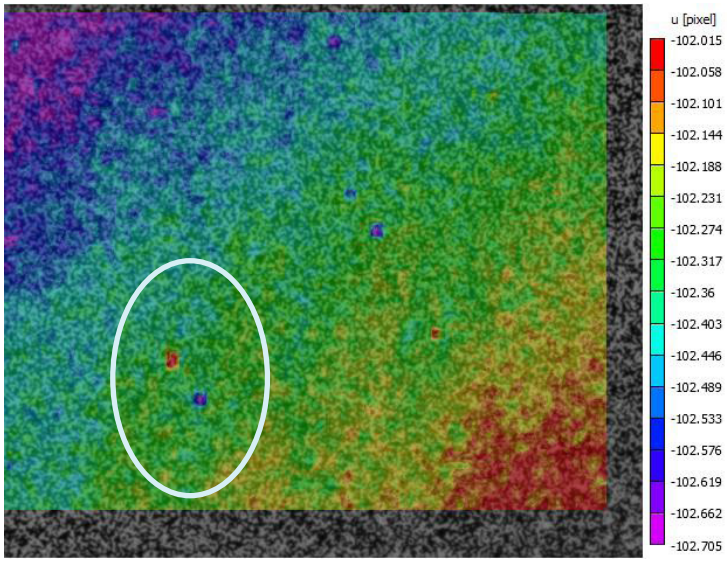
Click **Add images** and select the distortion sequence you just acquired.

Select a subset size appropriate to the speckle pattern. For the conditions present in a stereomicroscope, the default step size and coefficient values will work well. Click **Run** to start the analysis.



Each image will be analyzed and the sigma value will be displayed. When analysis is complete, you will see a message indicating success or failure.

In case of failure, the most likely cause is bad points in the disparity analysis. To diagnose, you can import the raw data files from the disk by clicking **Project… Data files**. The files will have the same name as the input files, with the extension *.out*. Double click on a data file; select the **2D** plot view; and right-click to view the *u [pixel]* and *v [pixel]* data. An example of an image which led to a failed distortion correction is plotted below:



Two obvious erroneous values are circled in white. In this case the cause was dust on the sensor; the dust was cleaned and the analysis was re-run successfully.

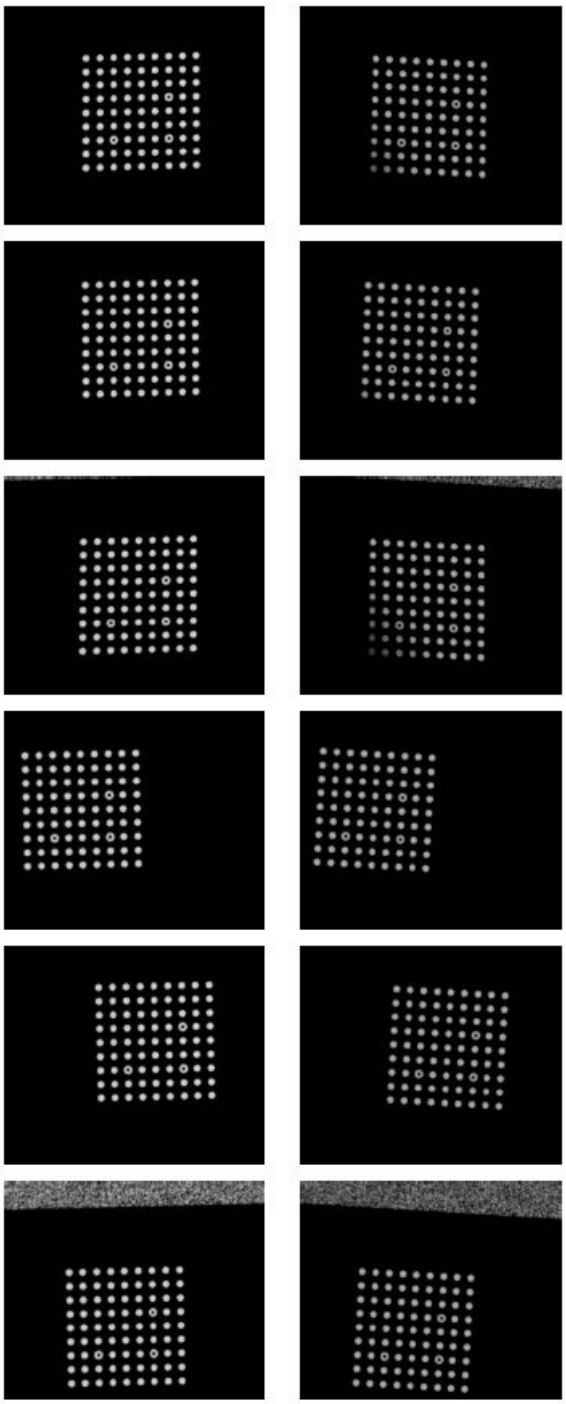
Once a successful distortion calibration is run, the project contains the full distortion correction spline map. Save the project at this point to store the corrections.

Acquiring Grid Images

To acquire grid images, use a grid which fits completely in the image, and position it in the microscope's field of view. Typically, a coated glass grid will be used with a fixture for positioning. Adjust focus as necessary – but not zoom, aperture, or alignment.

Acquire a sequence of images that contains the grid in various in-plane positions, along with as much off-axis rotation and tilt as the microscope's depth of field allows. This will be quite small compared to the amount of tilt present in typical 3D setups due to the very limited depth of field.

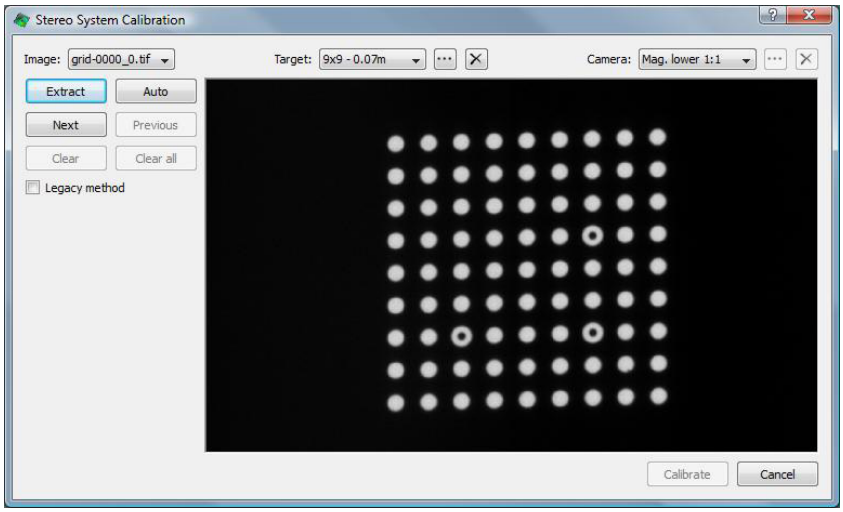
An example grid sequence is given on the next page.



Grid Calibration in VIC-3D

In VIC-3D, without starting a new project, select ***P*roject… Calibration images**, and add the grid images you just acquired. The distortion calibration will be applied to these images automatically during analysis.

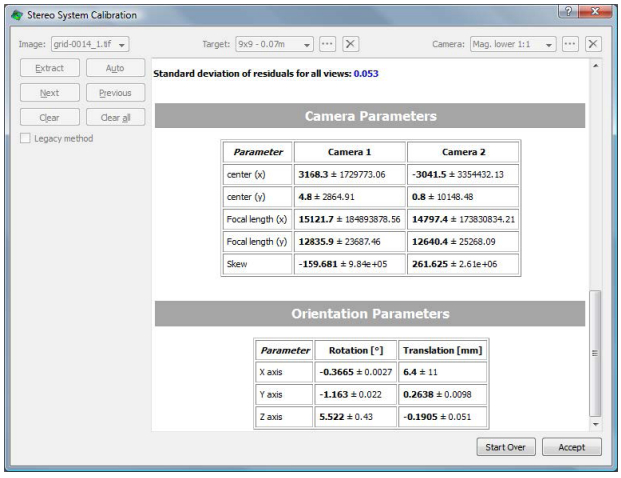
Select **Calibration… Calibrate stereo system**.



For **Target**, select the grid geometry for the target you used. Here, we've used the 9x9 grid with 0.07mm spacing from the glass 6-in-1 speckle/grid slide.

For **Camera**, choose whether your magnification was greater than or less than 1:1. This is important to ensure the coordinate system is correctly represented in your results.

Finally, click **Auto** to extract. After points extract, click **Calibrate** to see results.



As with normal stereo-calibration, check to see that the standard deviation of residuals for all views is low and represented in blue and not red. Click **Accept** to finish. Save the project once again to store the stereo calibration.

Analyzing Test Images in VIC-3D

At this point, you may add your speckle images to the project and run as normal. The inverse mapping calibration will be applied to the images before processing.

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.