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Application Note

IR Integration with VIC-Snap and Combining IR Data with VIC-3D

VIC-3D 9

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Measure with Confidence

IR Integration with VIC-Snap & Combining IR Data with VIC-3D

Introduction

This guide lays out the steps for combining 3D DIC data with temperature data from an IR camera. The basic parts of the procedure include:

- Selecting a camera
- Setting up the cameras
- VIC-Snap settings
- Taking calibration images
- Calibrating the IR camera
- Taking test images
- Importing IR data
- Working with IR data

Selecting a Camera

FLIR cameras which support GenICam over a GigE interface are supported (i.e., A615).

For 3D calibration, a camera with at least 640x480 resolution should usually be selected, although lower resolution cameras can be calibrated with special care.

Setting up the Cameras

The stereo camera setup for IR-combined testing will be exactly as with a normal test. Set the cameras up in a stereo rig, observing a proper minimum stereo angle, and fix the focus, aperture, and exposure time as normal.

The IR camera should be mounted rigidly together with the stereo rig, if possible. Depending on the magnification of your camera, it may need to be closer to or farther from the specimen, as lens selection is usually limited; in this case, it should still be mounted securely to avoid relative motion.

IR readings can vary with angle of incidence; the best placement for the IR camera will be between the DIC cameras, pointing directly at the specimen.

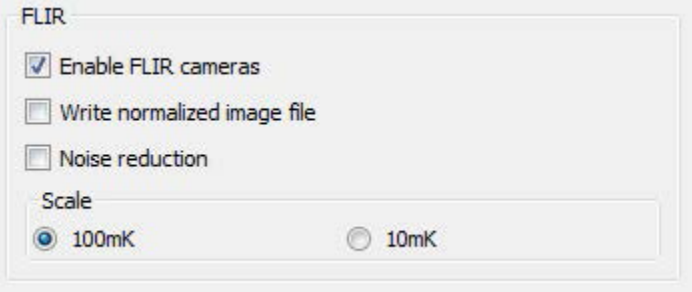
System Setup

To access FLIR cameras in VIC-Snap, the National Instruments **Vision Acquisition Software** must be installed. This can be purchased from NI and a 30-day evaluation is also available.

NI-IMAQdx is now fully 64-bit compatible and VIC-Snap now supports the FLIR camera. It is still required to install the latest version of the NI Vision Acquisition Software as well as the latest version of VIC-Snap.

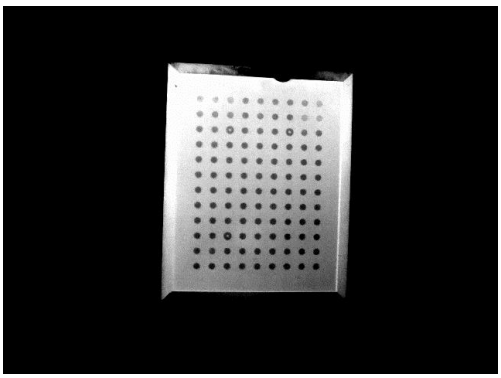
VIC-Snap Settings

Options for the FLIR cameras can be found under *Advanced Options… Camera Settings*.



- To allow VIC-Snap to search for FLIR cameras on opening, click **Enable FLIR cameras**.
- The images are written as 16-bit TIFFs which contain an absolute temperature. To also write a normalized file, which will be much more visible for working with and for calibration, check **Write normalized image file**.

Standard



Normalized

- FLIR cameras have an optional **noise reduction** feature which will reduce the image noise somewhat.
- There are two scale options. Selecting **100mK** will result in a TIFF where each grey value is equal to the temperature, in K, multiplied by ten. Selecting **10mK** will cause a value of the temperature multiplied by 100.

Flir Window in VIC-Snap

The FLIR window will appear as a camera window in VIC-Snap.

- Right-click in the window to select imaging options.
- The temperature under the mouse cursor is displayed in the caption.
- Double-click in the window to lock the temperature display on a certain point; double-click again to clear.

Troubleshooting

If there is a problem with the camera, it may be difficult to tell whether it is a configuration problem or a hardware problem. First, download the FLIR GEV Demo:

http://support.flir.com/SwDownload/app/RssSWDownload.aspx?ID=155

- If the camera appears and works in the FLIR GEV Demo, please contact Correlated Solutions support for help with the VIC-Snap setup.
- If the camera does not appear in the GEV Demo, check that the camera is connected via Ethernet, and that the PC's firewall is off or is set to allow the camera to communicate.
- If the camera appears in the GEV demo but images are black, check that the lens is securely attached to the camera. The camera will not image if it is not connected to a lens or is not communicating with its lens.

Taking Calibration Images

To calibrate the system, you will need a grid which is visible both in the IR camera's wavelength range as well as in visible light for the DIC cameras. Some grid options:

- For short IR wavelengths, a glass grid can be 'backlit' with a hot or cold source such as a hot metal plate. If the plate is white or bright this can also be the backlight for the visible cameras.
- For longer wavelengths, most glass will be opaque. In this case, a glass grid may still be used but it must be warmed above ambient – the glass has a different emissivity than the coating and the grid will show a good contrast at even moderately warm temperatures (100-110F).
- A black anodized aluminum grid with clear etched dots will also show a good contrast when warmed.

Anything which is visible in both types of cameras will work.

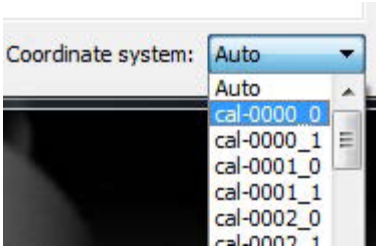
To calibrate, the normal number (at least 5, usually 15-20) of calibration images must be acquired, for all three cameras. Only one image must be common to all three cameras! The remainder of each set does not have to be visible by both IR and white light cameras.

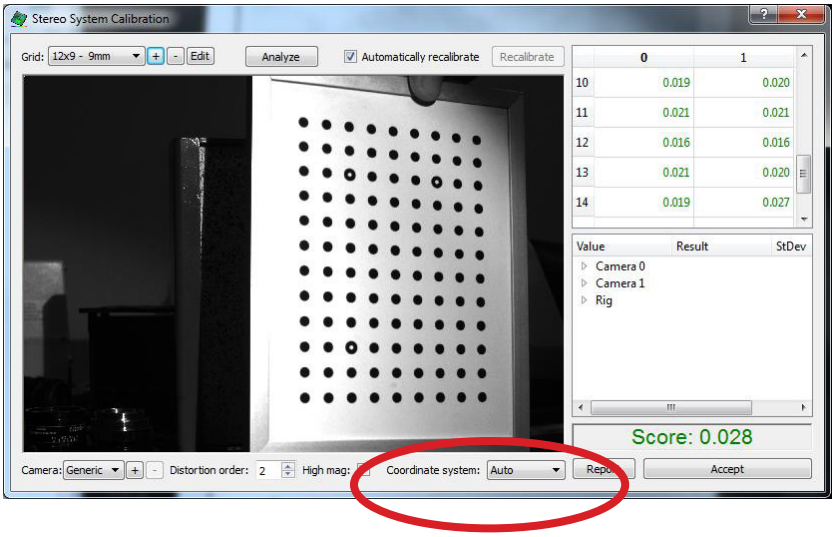
For example, we can use 20 visible calibration grid images, and 20 IR calibration images, but only only one of those images has to show the grid in both the IR and visible cameras, in the same position. This can be achieved either by carefully synchronizing the cameras, or by fixturing the grid in place while the images are taken.

Calibrating the Stereo Cameras

Calibrate the stereo cameras exactly as usual, with one addition:

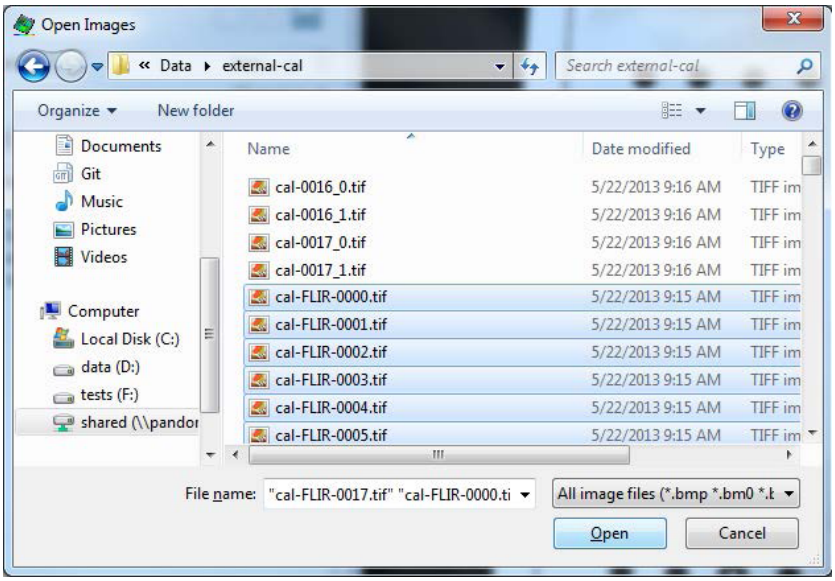
Under the Coordinate system: pulldown, you must select the image which corresponds to the grid image that was in view in all three cameras.



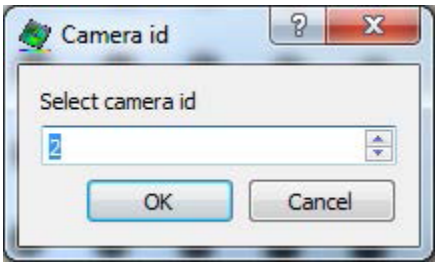


Calibrating the IR Camera

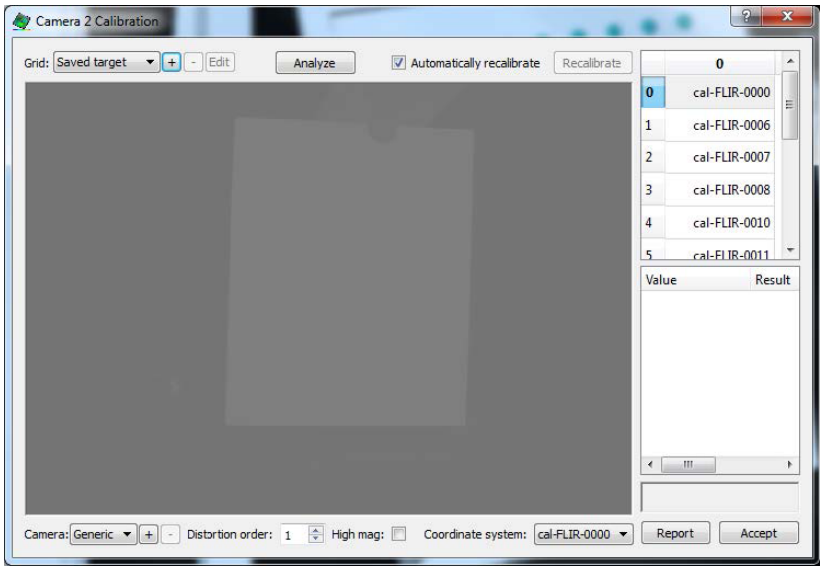
To calibrate the third camera, select *Calibration… Calibrate external camera* from the *Calibration* menu. A file dialog will appear; select all of the IR calibration images.



Click *Open*; a dialog will appear to allow you to select a camera ID:

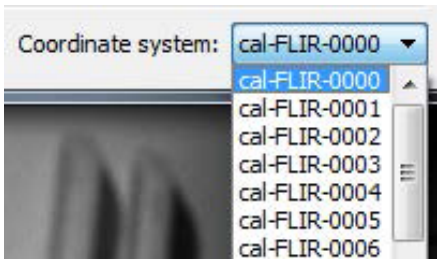


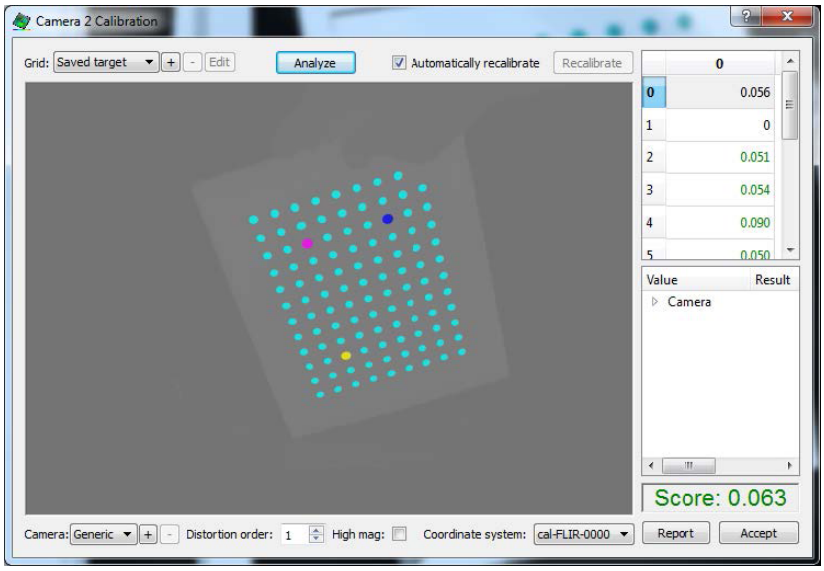
If multiple external cameras will be used, you can select an identifier here; otherwise, the default will work fine. Click *OK* to proceed.



The grid should be saved but if not you can select the correct grid, and click *Analyze*.

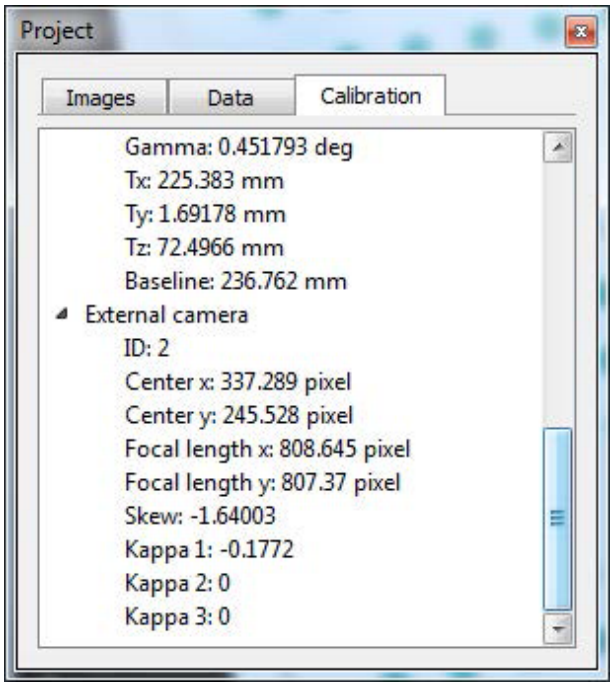
Select the image from the Coordinate system pulldown that matches the image you selected in the stereo calibration step.





This is critical – selecting the wrong system will cause results are projected incorrectly or not visible at all.

When this is complete, click *Accept*, and you should see an external calibration under the Calibration tab (depending on your VIC-3D version).



Taking Test Images

When running the test, images from the DIC camera pair will be taken as normal. Images from the IR camera should be taken at (or close to) the same time. This can be accomplished using hardware triggering, or in software with VIC-Snap and the IR camera module.

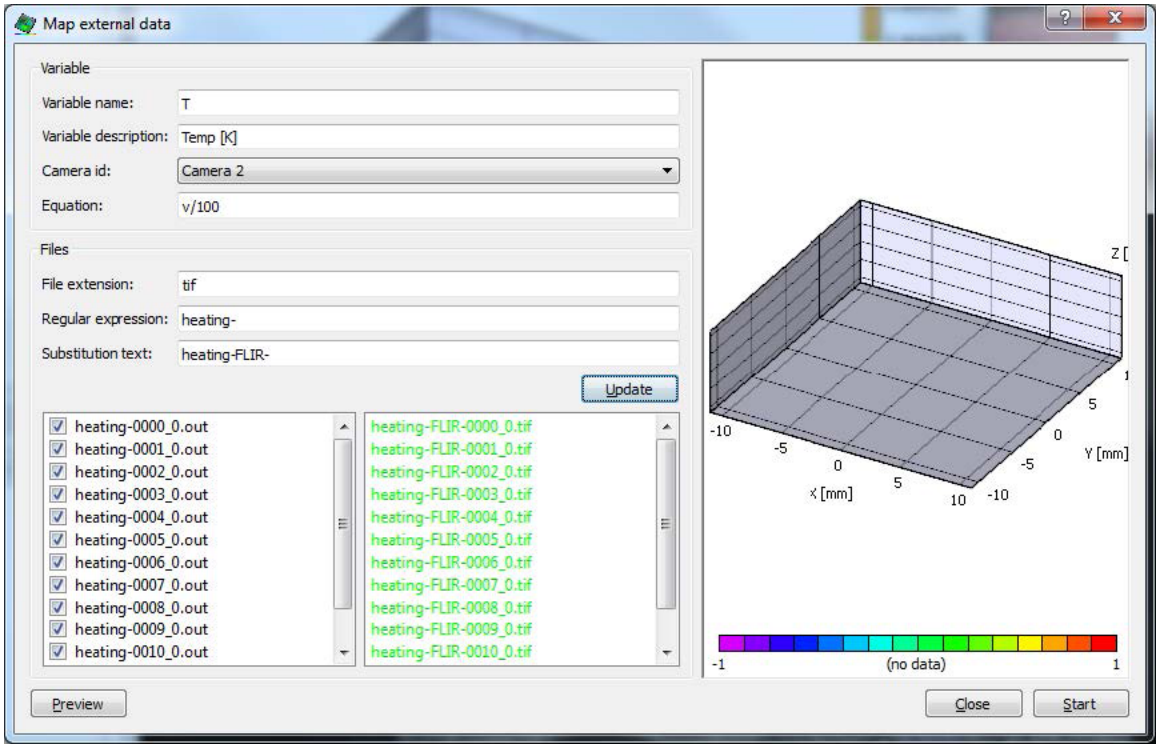
Running Images

To begin mapping the IR data, analyze your DIC images as usual (create an AOI; select options; Run.)

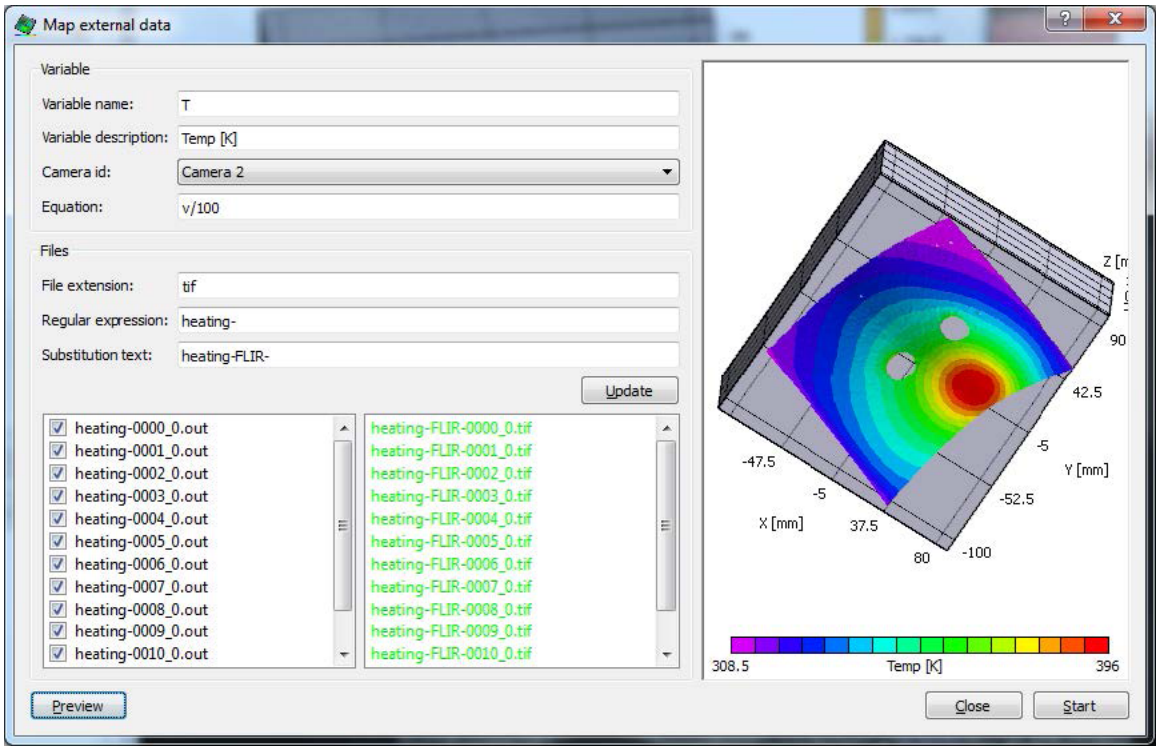
After this step you should have a complete set of output data in X/Y/Z/U/V/W/etc.

Mapping IR Data

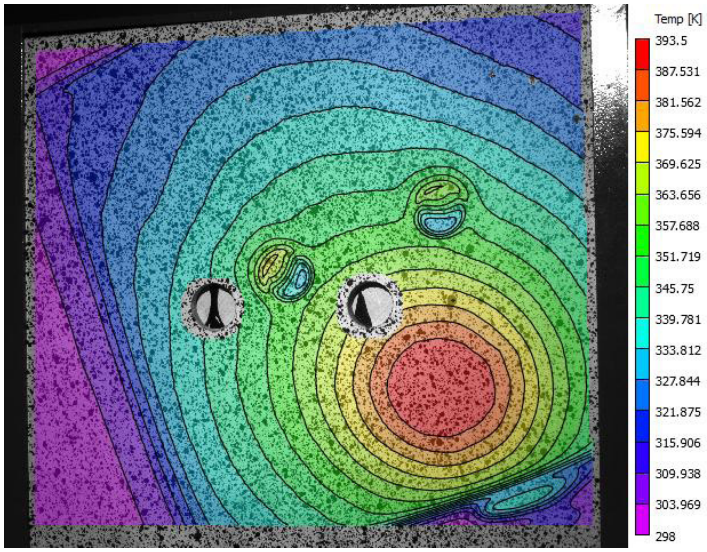
Click on *Data… Postprocessing tools… Map external data*.



- For **Variable name**, fill in the name of the new variable that will store the IR data - here, we enter T.
- For **Variable description**, enter a description – here, Temp [C].
- For the **Camera id**, select the ID that you used for external calibration, if more than one is present.
- For the **Equation**, you must enter the equation that maps the grey values in the file to your desired temperature value.
    - o If you selected a 10mK scale: the equation will be *v/100* (or *v/100-273* for Celsius.)
    - o For the 100mK scale, the equation will be *v/10* (or *v/10-273* for Celsius).
- Under **File extension**, select the extension for your image files; ours are .TIFs.
- For the next two fields, enter an expression and the replacement text. Our DIC images are called heating-, and our FLIR images are called heating-FLIR-, so we enter these two. For more complicated cases, you may use full regular expression syntax.
- Click **Update** to check your file entries. Files which are found will be highlighted in green. If the files are red, check the regular expression and substitution text.
- Finally, click **Preview** to see results.



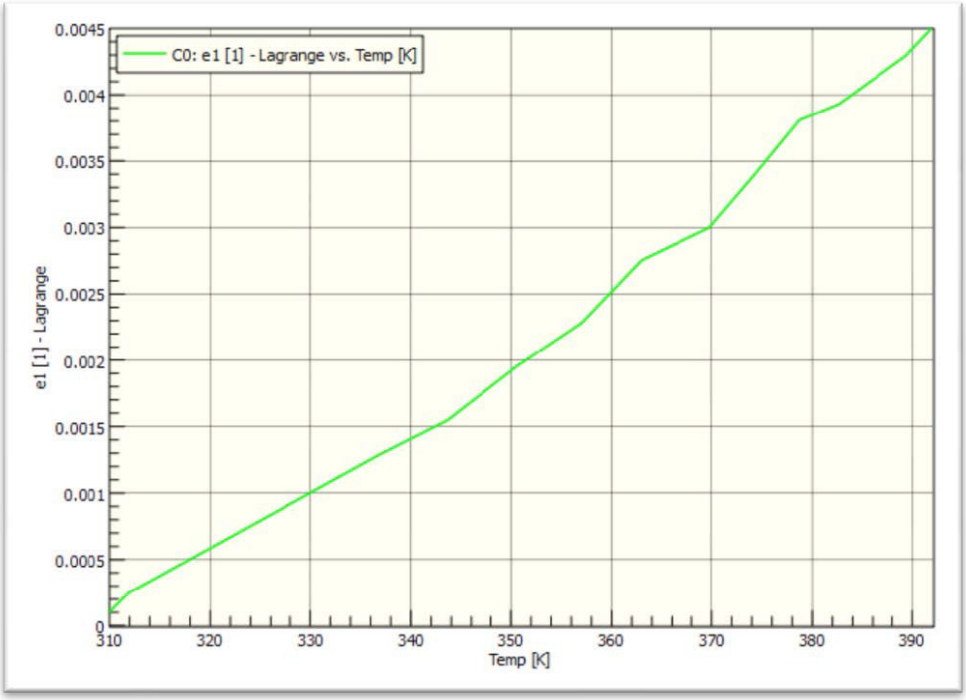
Here, we see that the temperature has been mapped to the object as a new contour variable. The most common issue that you might see at this point is data that is incorrectly mapped:



Here, the IR data is skewed relative to the DIC data. In this case, **check the selected coordinate system from the pulldown in the calibration dialogs**. Most likely, a different view was selected for the stereo calibration vs. the external calibration.

Working with IR Data

IR data is now a contour variable and can be treated like other data. For instance, we can use an extraction point to plot major strain against temperature:



One More Note

When working with IR data, temperature differentials are likely to be present. This means we need to be very cautious about refractive heat waves. Use fans or insulation to make sure that the air in your optical path is either well mixed, or at a steady state temperature.

Support

The data for this test can be found under Example Data in the Downloads section of our Support page.

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.