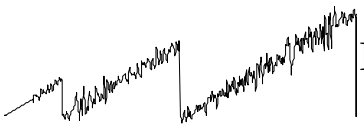
CU-NEES-08-07



NEES at CU Boulder

01000110 01001000 01010100

The George E Brown, Jr. Network for Earthquake Engineering Simulation

Vic-2D Manual

By

Rommel Cintrón
University of Puerto Rico, Mayagüez

September
2008

Center for Fast Hybrid Testing
Department of Civil Environmental and Architectural Engineering
University of Colorado
UCB 428
Boulder, Colorado 80309-0428

Vic-2D Manual

Rommel Cintrón

Introduction

- Vic-2D:

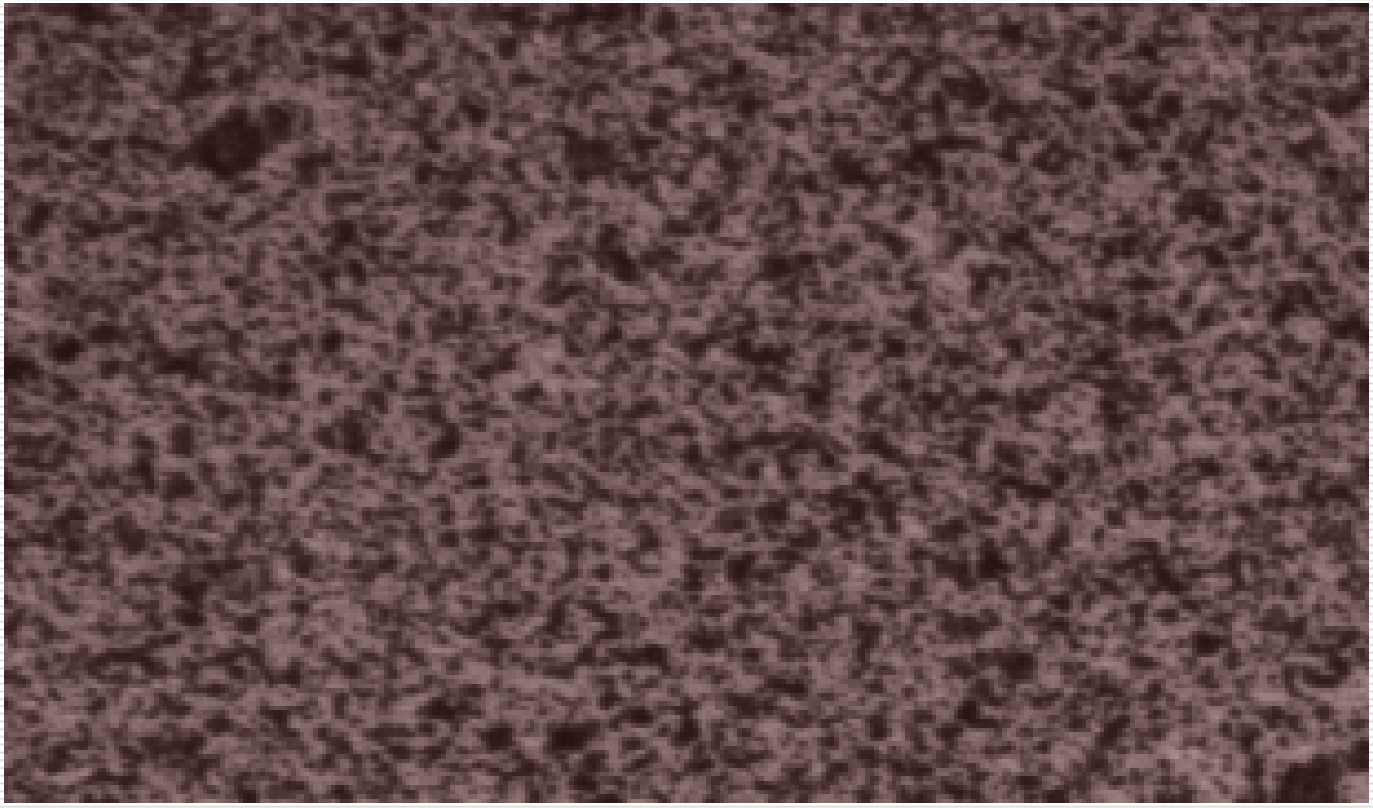
  The Vic-2D is a system that uses the digital image correlation technique to make strain measurements. This system is able to provide two dimensional strain maps of any entire planar specimen. The equipment consists of computer software and a digital camera with appropriate lens and resolution.

Introduction

Digital Image Correlation Technique:

The digital image correlation consists on capture a series of pictures with a digital camera of a specimen during the deformation process. With computer software the images are analyzed to create a contour map of strains. The specimen needs to be prepared with a random dot pattern (speckled pattern) to permits that the software be able to calculate the displacements. During the tests, while the specimen is subjected to external loads, the camera takes one picture before and others after deformation, and the software analyze the difference between pixels of the different images and correlate them to show the strain map.

How to Apply the Speckle Pattern?

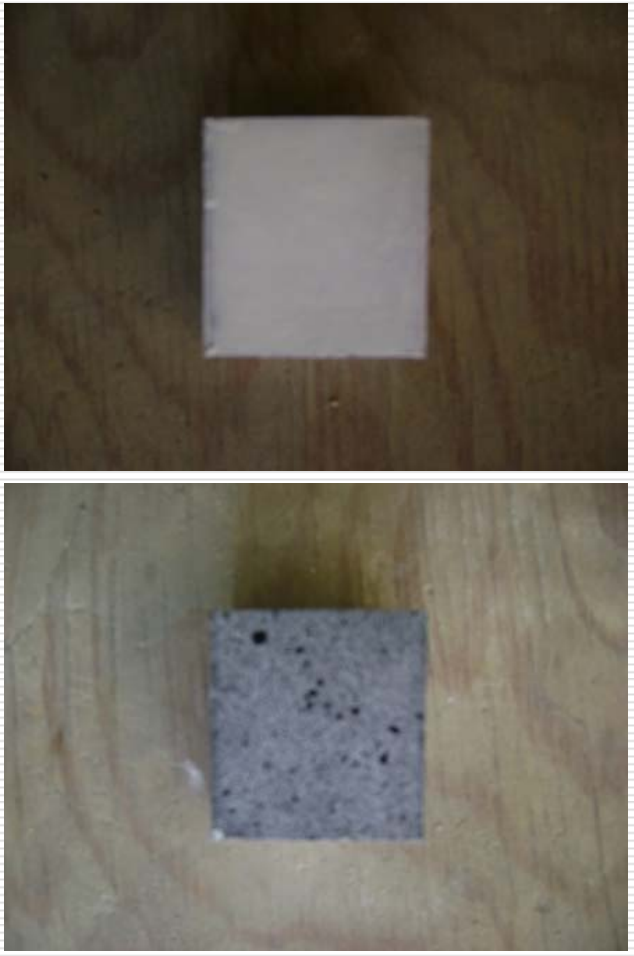


Materials

- Specimen
- White paint - It could be brush paint or spray paint.
- Black paint - Only could be spray paint.

Speckle Pattern

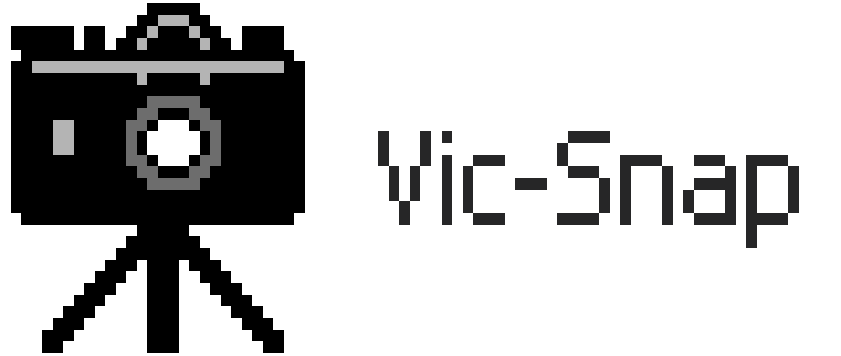
- First apply a layer of white paint in the specimen surface.
- Then apply the black speckles with the black spray paint.



Speckle Pattern

- For a good speckle pattern, make the black speckles with a mist of black paint.
- Keep approximate 2 feet of distance between the specimen and spray can.

How to Take the Images?

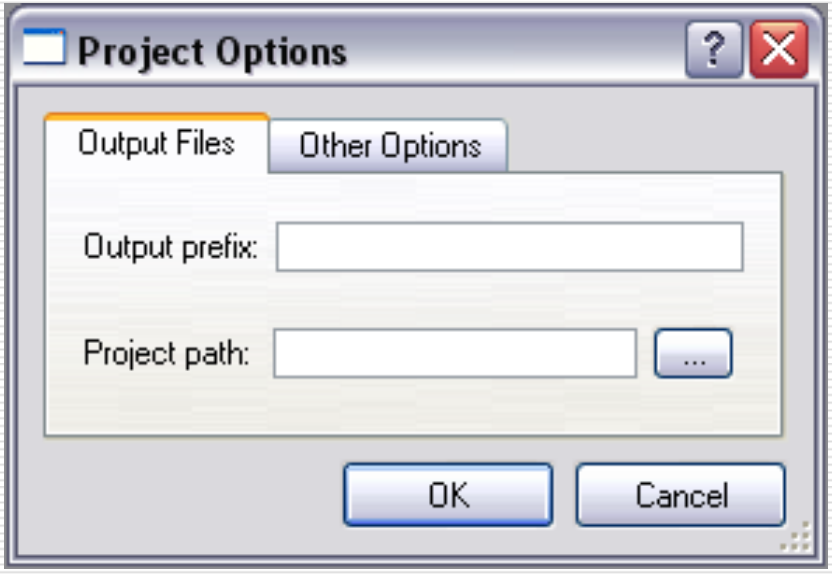


Vic-Snap

- Connect the digital camera with the computer.
- Open Vic-Snap - Start → All Programs → Correlated Solutions → Vic-Snap → Vic-Snap.

Create a File

- When Vic-Snap is open, a new window will appear (Project Options).
- This window is to create a file for the images.
- Write a file name (Output prefix) and choose where the file is going to be saved (Project path).
- Then press “OK”.



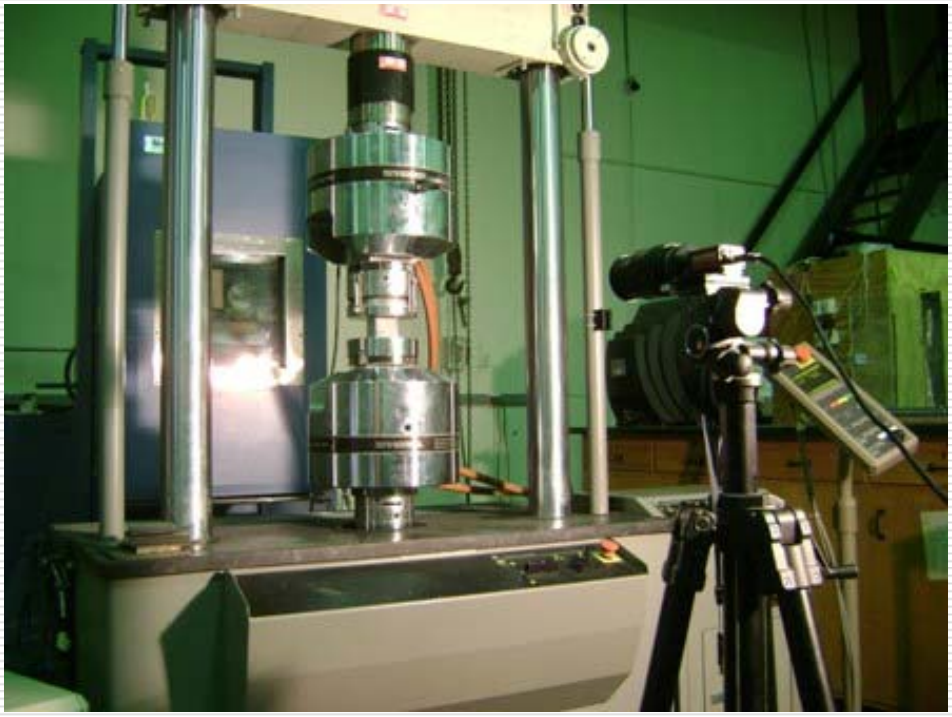
Digital Camera

The digital camera can be adjusted:

- The focal length ■
- The f-numbers ●
- The focus ▲
- The lens (normal or macro) ♦

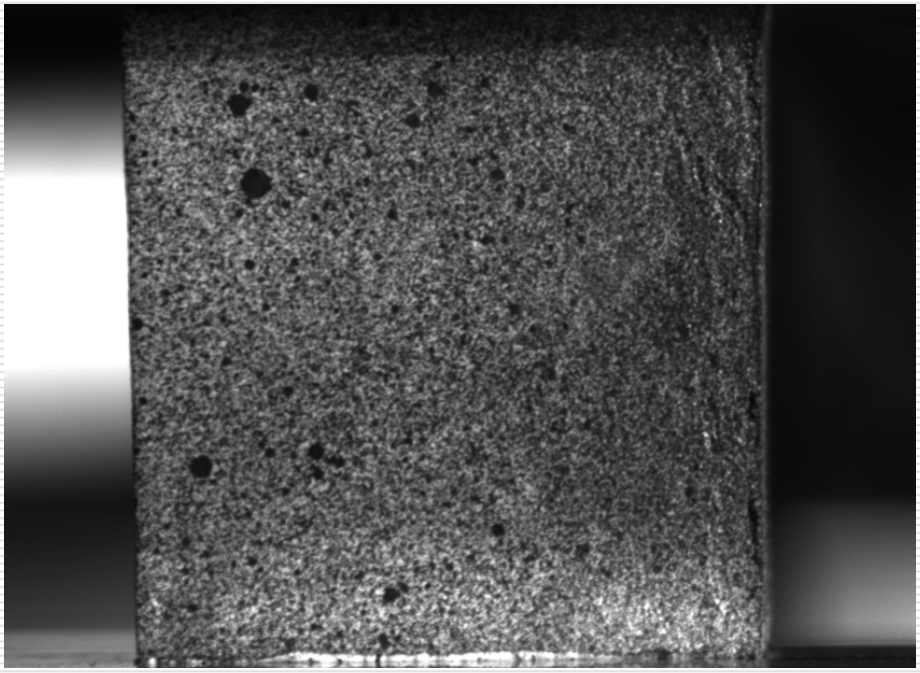
Focus the Image

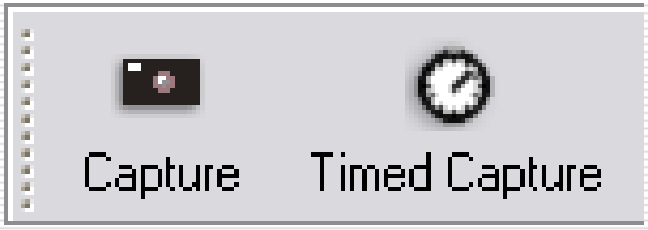
- When the specimen is prepared to be subject to mechanical tests, prepare the camera to get the specimen image.
- To focus the image set a distance between camera and specimen and adjust the focal length.
- It is recommendable to use the lowest f-number (aperture) to let the enter of maximum amount of light possible.
- Probably, is going to be necessary to add a white light source to illuminate the specimen.



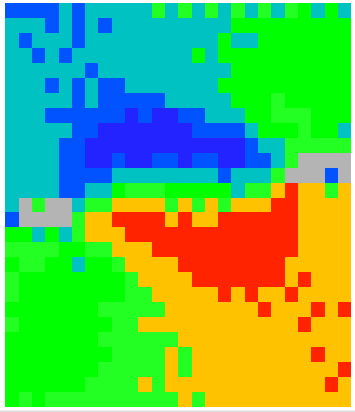
Capture the Image

- Do not use maximum zoom lenses and centralize the image to avoid distortion effects.
- Click on “Capture” to take a single picture.
- Click on “Timed Capture” to take a series of picture by an interval time.





How to Operate the Software?



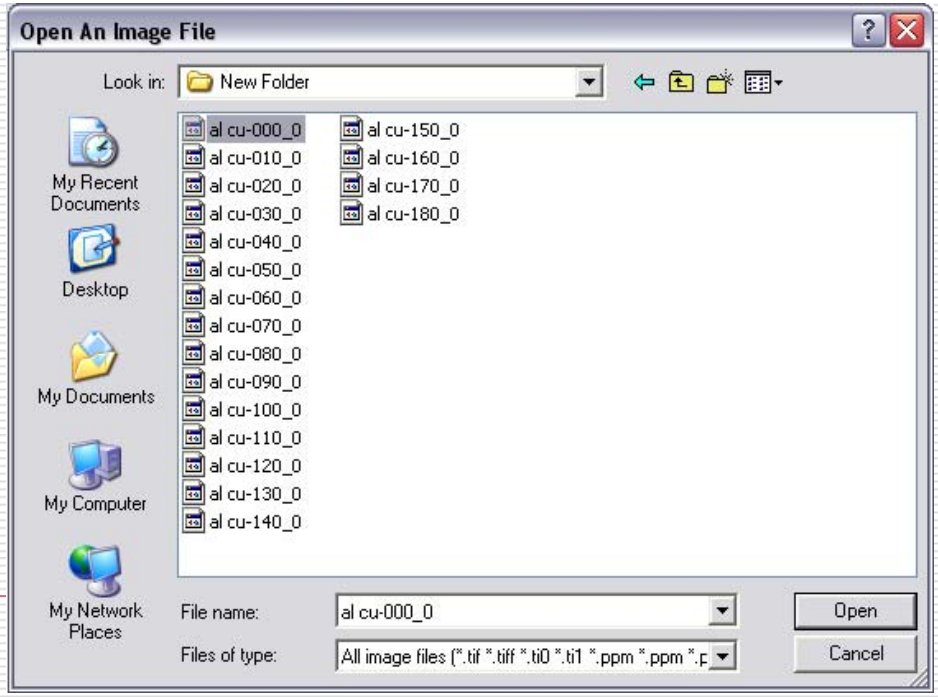
Vic2D

Vic-2D

- Open Vic-2D - Start → All Programs → Correlated Solutions → Vic-2D → Vic-2D.

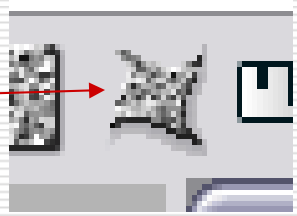
Select Reference Image

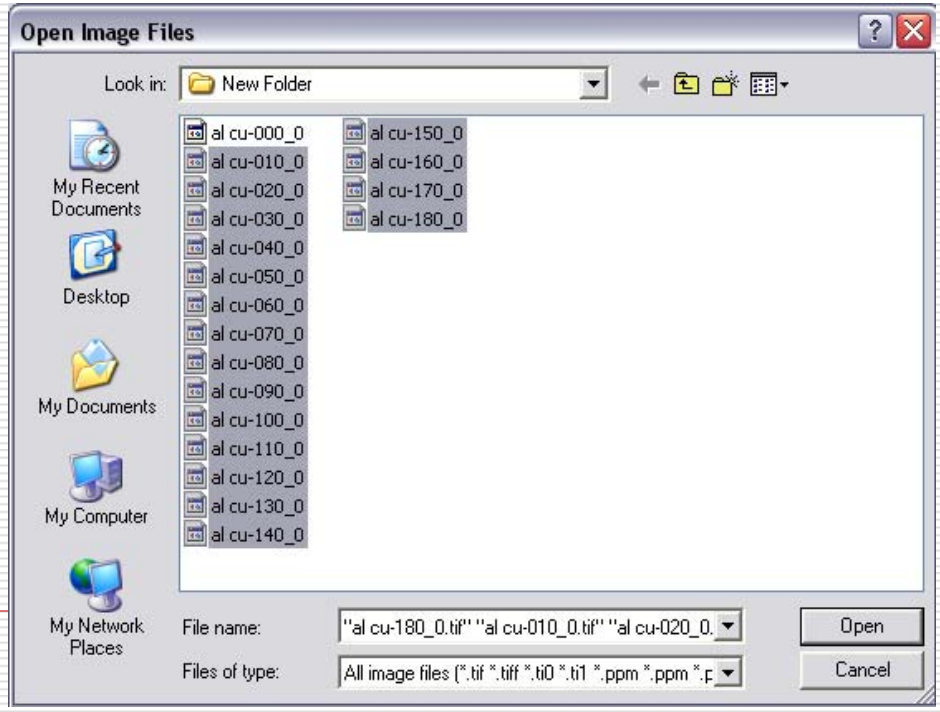
- When Vic-2D is open, click on “Select Reference Image”.
- A new window will appear (Open an Image File).
- Select the non-deformed image. Usually, is the first picture taken.
- Then press “Open”.



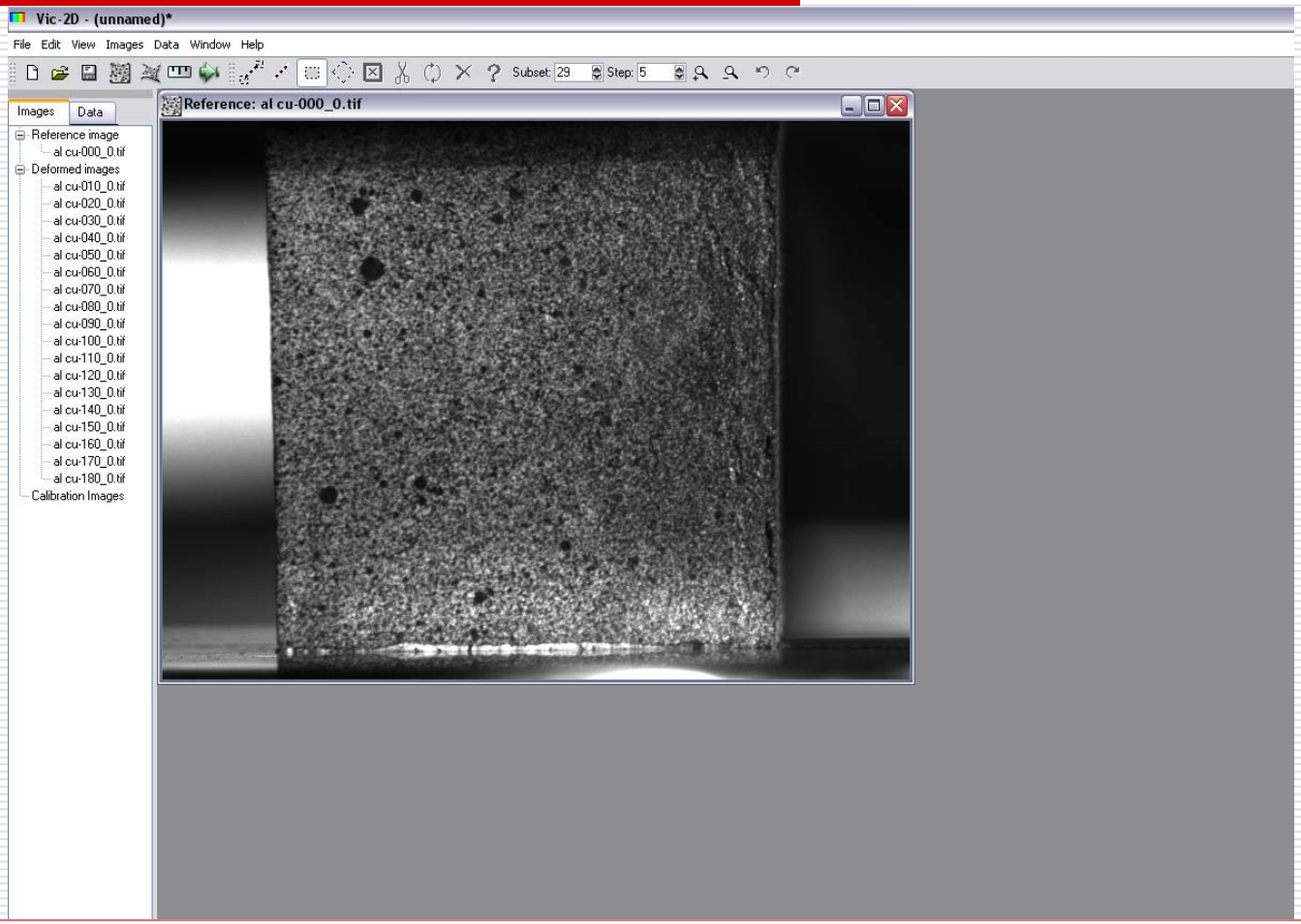
Add Deformed Images

- Click on “Add Deformed Images”.
- A new window will appear (Open Image Files).
- Select all the deformed images desired.
- Then press “Open”.



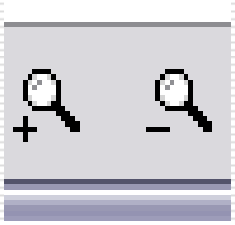


This is how the Vic-2D software should looks like after opening the reference and deformed images.



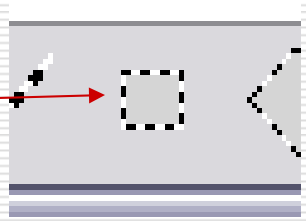
Vic-2D

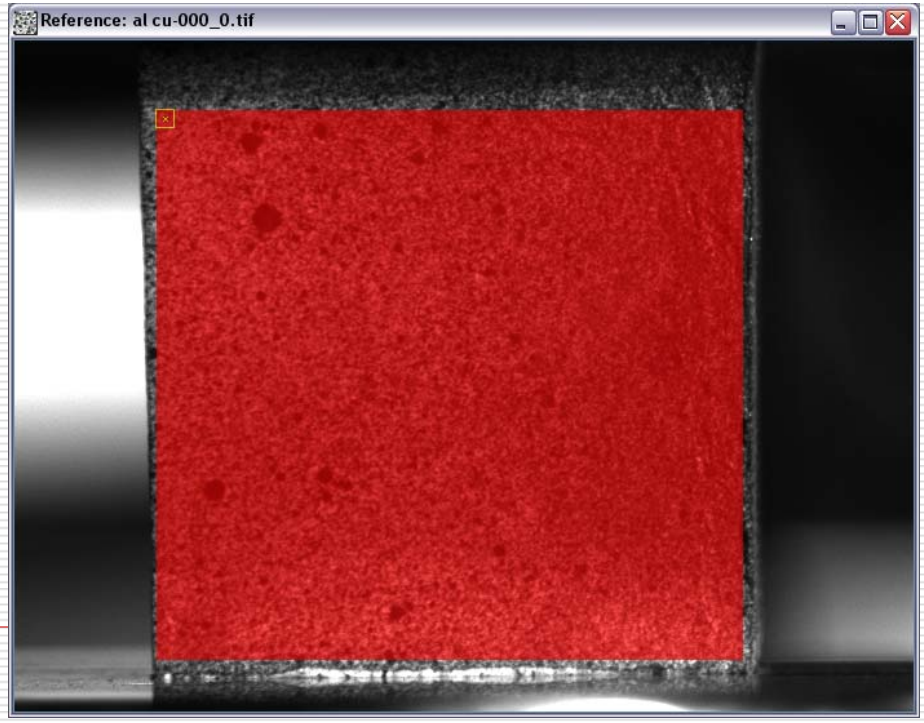
- Set the subset and step sizes for a better correlation.
- It is advisable to use it as default (Subset: 29, Step: 5).
- Use the magnifying glasses to zoom in or zoom out the image for convenience.



Select Rectangular Area of Interest (Aoi)

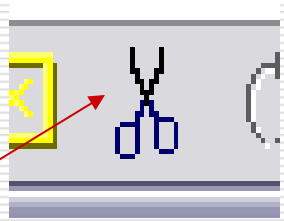
- Click on “Select Rectangular Aoi”.
- Choose the specimen area desired to be evaluate.
- To set the Aoi (red area) click on one corner of Aoi, move the mouse to the opposite corner and click again.

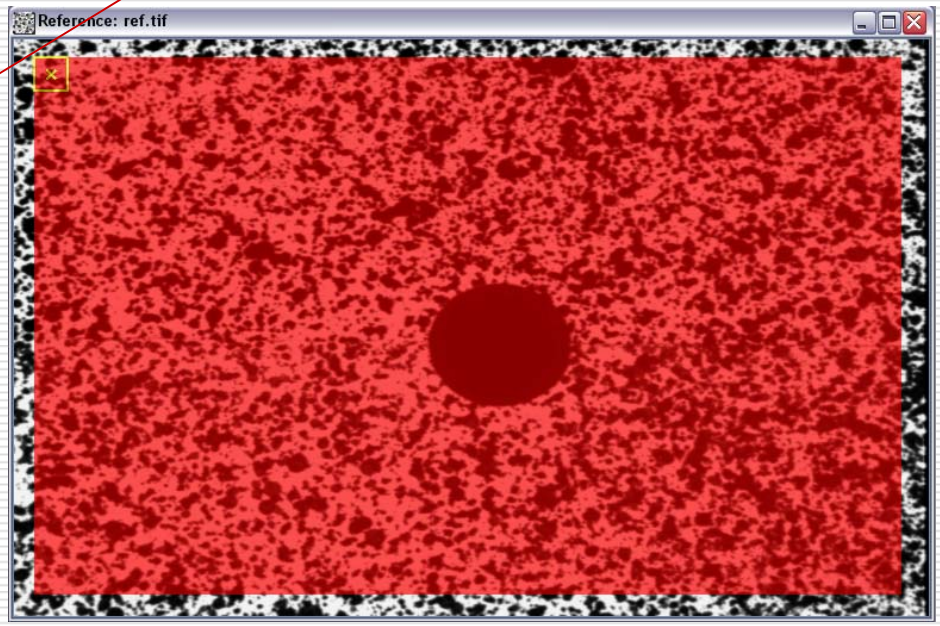




Cut Region from Area of Interest (Aoi)

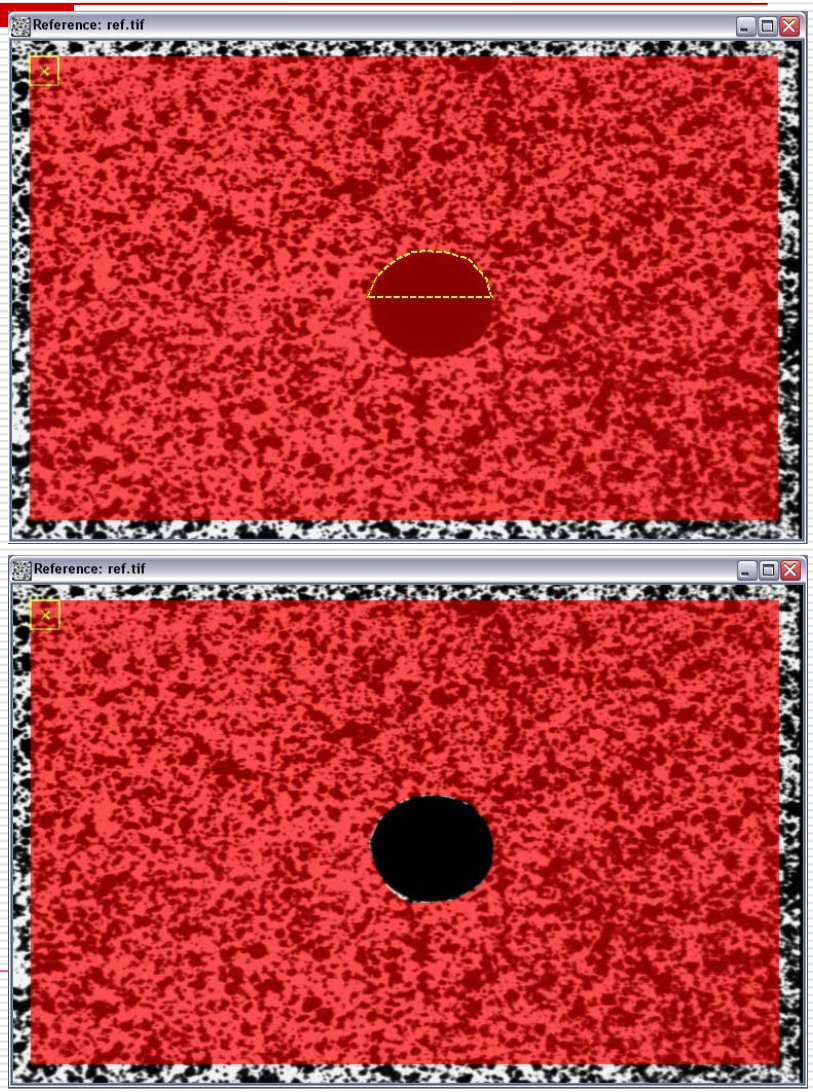
- If there is an undesired zone (without speckle pattern) inside the Aoi, click on “Cut Region from Aoi”.



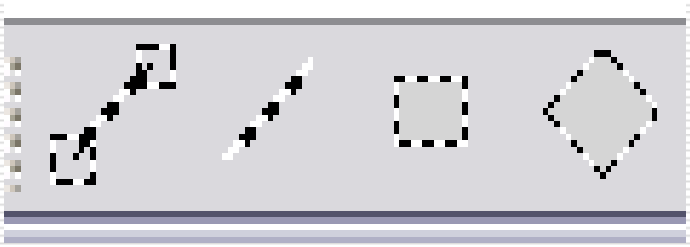


Cut Region from Area of Interest (Aoi)

- First click on any edge of the undesired area.
- Make many clicks as necessary to cut the desired shape.
- Having the desired shape, double click to cut the undesired area.



Area of Interest (Aoi)

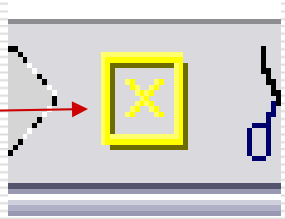


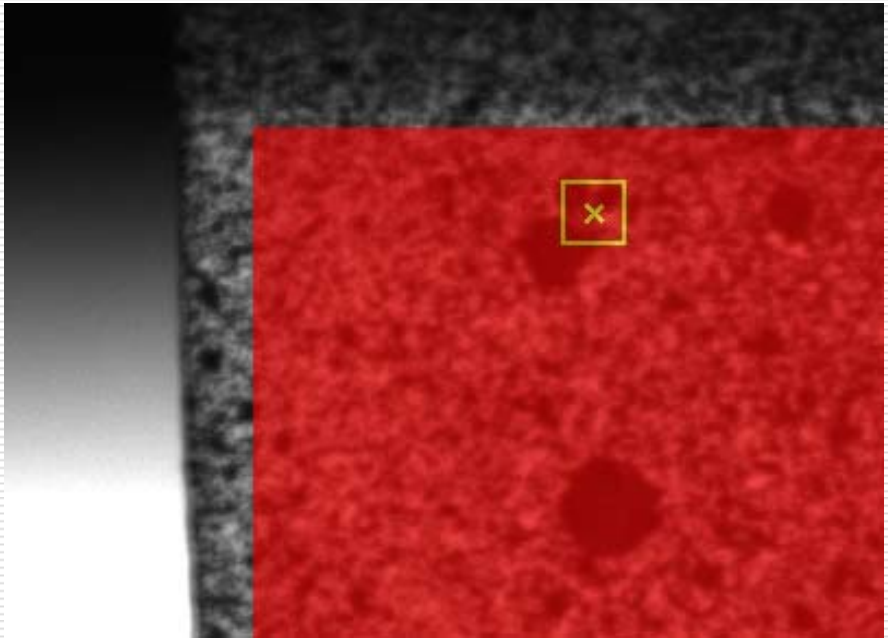
There are different ways to determine the Aoi. It depends on the specimen shape and the Aoi desired. From left to right:

- “Select Extensometer Aoi”
- “Select Line Aoi”
- “Select Rectangular Aoi”
- “Select Polygon Aoi”

Move Seed Point

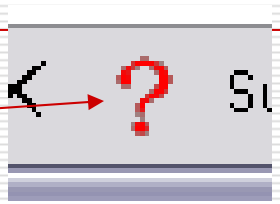
- Click on “Move Seed Point”.
- Select a seed point inside the Aoi.
- It is highly recommended to select a point where the black speckles are easy to identify.

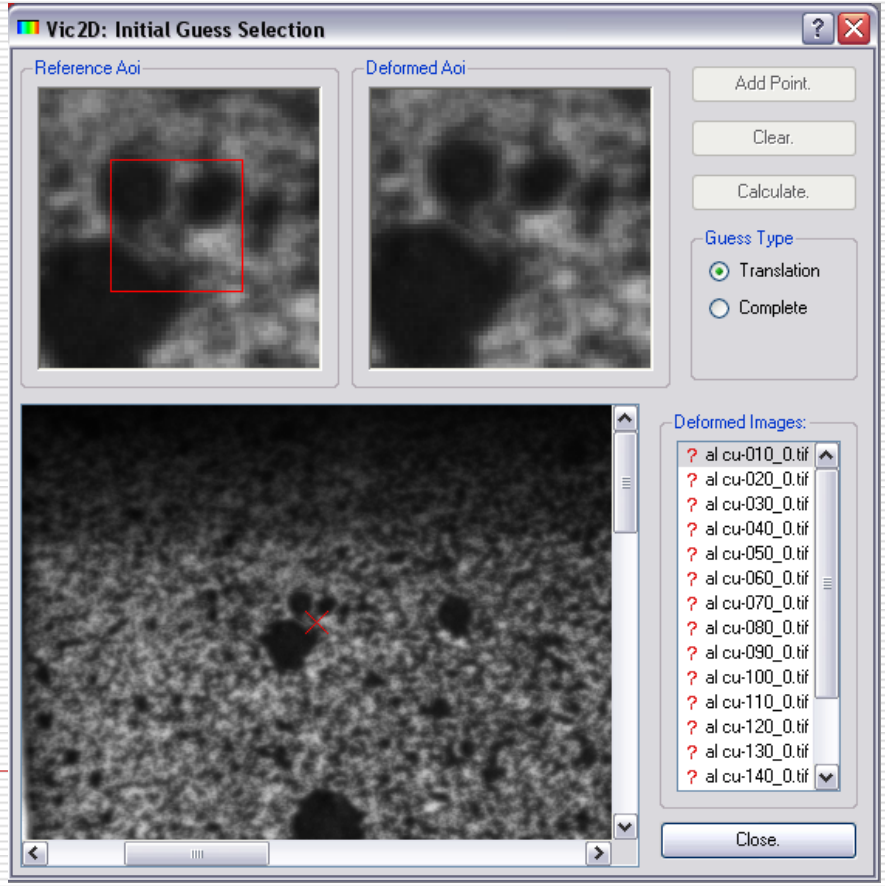




Select Initial Guess

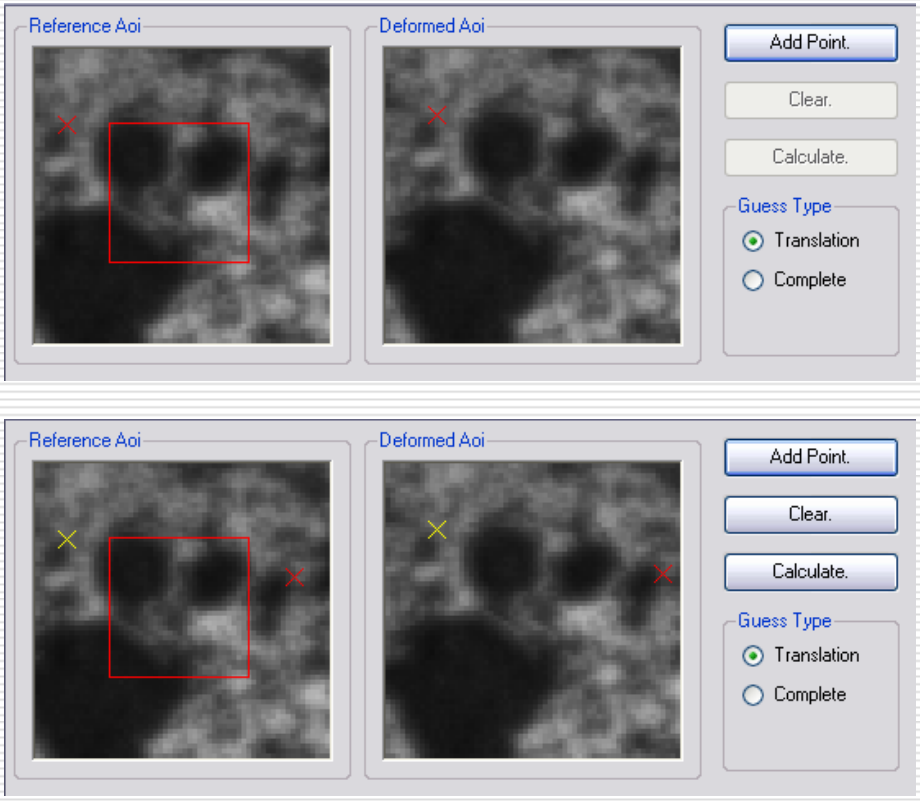
- Click on “Select Initial Guess”.
- A new window will appear (Vic-2D: Initial Guess Selection) with three images.
- The top images are from Reference Aoi (left) and Deformed Aoi (right).
- The bottom image is to move the Deformed Aoi until coincide with the Reference Aoi.





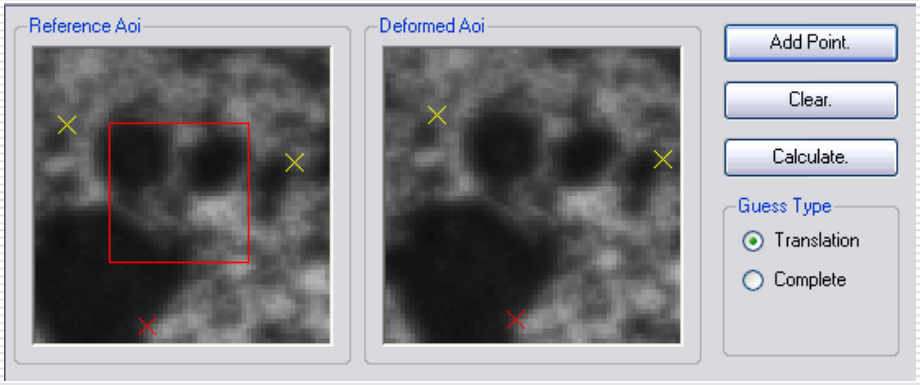
Select Initial Guess

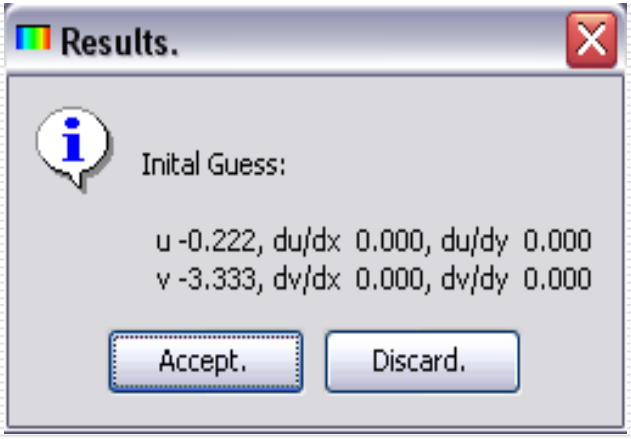
- Add a point in the Reference Aoi.
- Add the same point in the Deformed Aoi.
- Press “Add Point”.
- Add a second point in a different place in the Reference Aoi.
- Add the same second point in the Deformed Aoi.
- Press “Add Point”.



Select Initial Guess

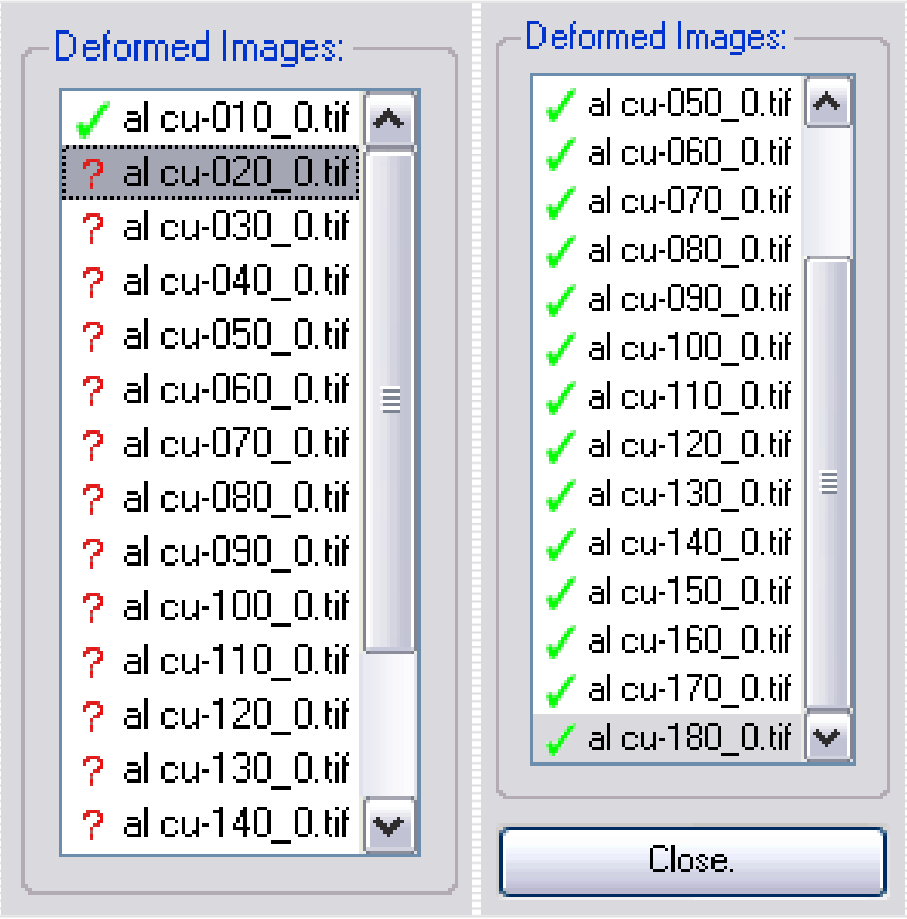
- Add a third point in the Reference Aoi.
- It is not recommended to form a straight line with the three points to get more accurate results.
- Add the same third point in the Deformed Aoi.
- Press “Add Point”.
- Then press “Calculate.
- A dialog box will appear with the displacement calculations (Results).
- Press “Accept”.





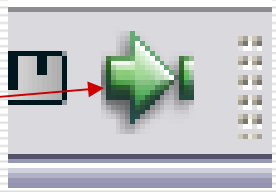
Select Initial Guess

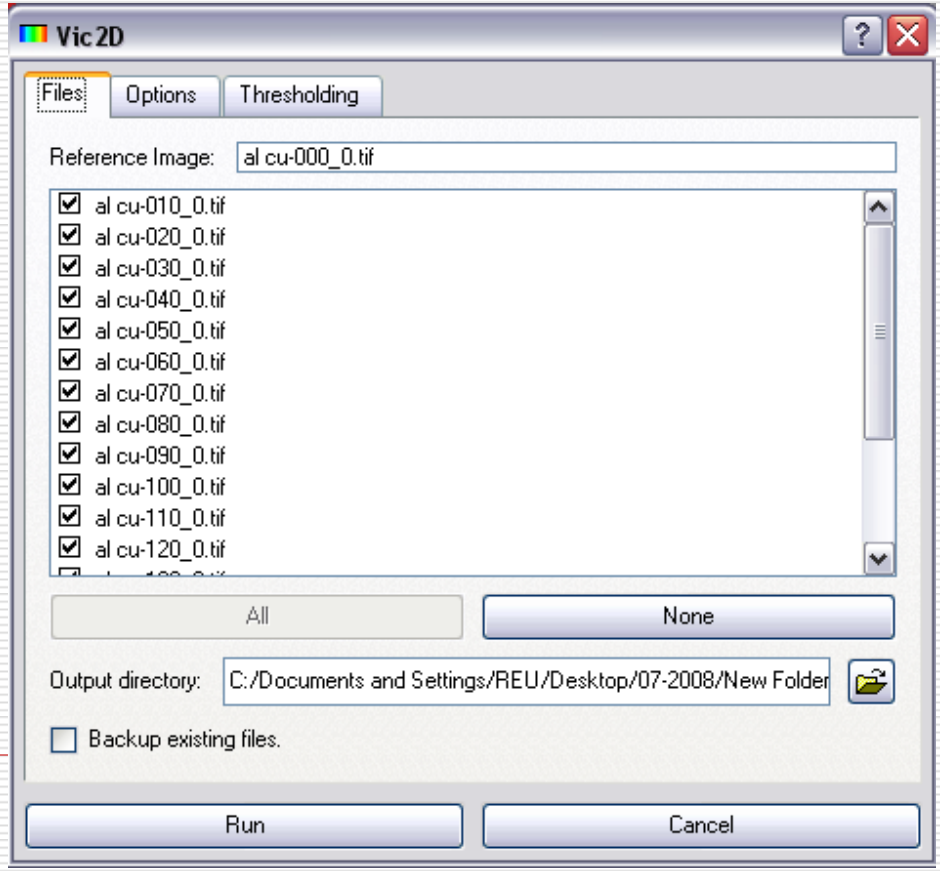
- Choose another deformed image (?).
- Repeat the steps from slide 26 to slide 27 for each deformed image.
- When all the initial guesses of the deformed images are settled, press “Close”.



Run Correlation

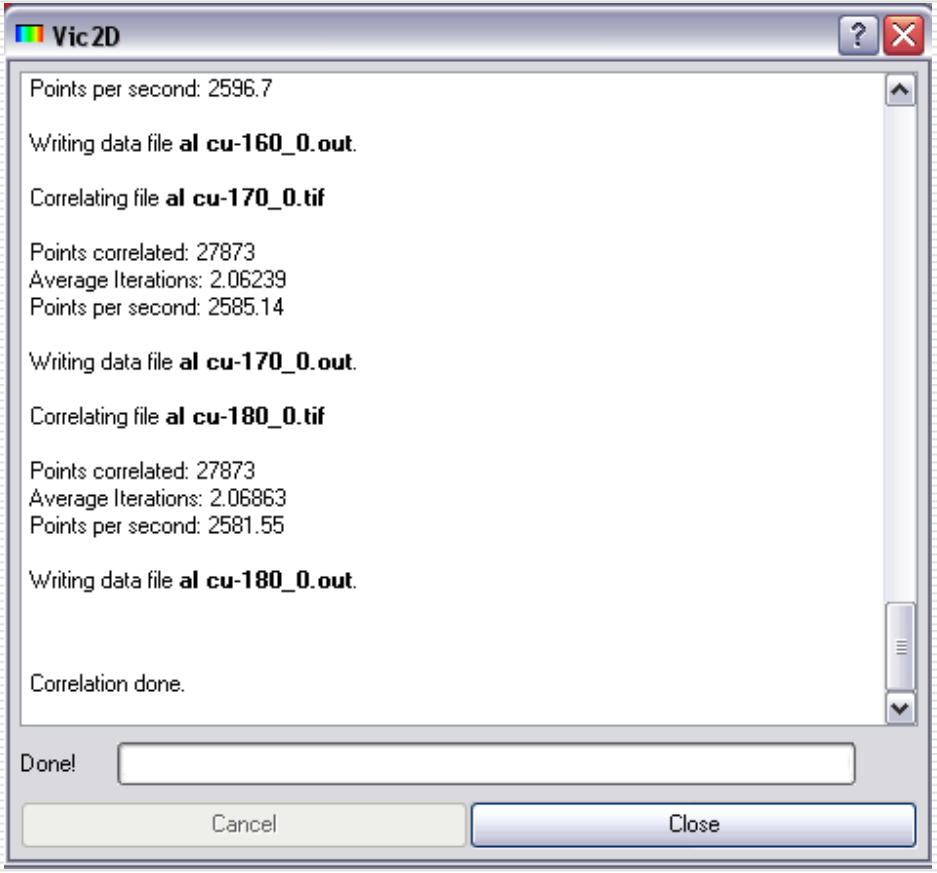
- Click on “Run Correlation”.
- A new window will appear (Vic2D).
- Press “Run” to start the correlation.





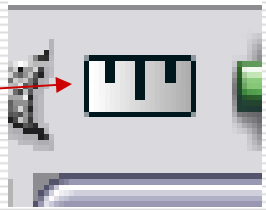
Run Correlation

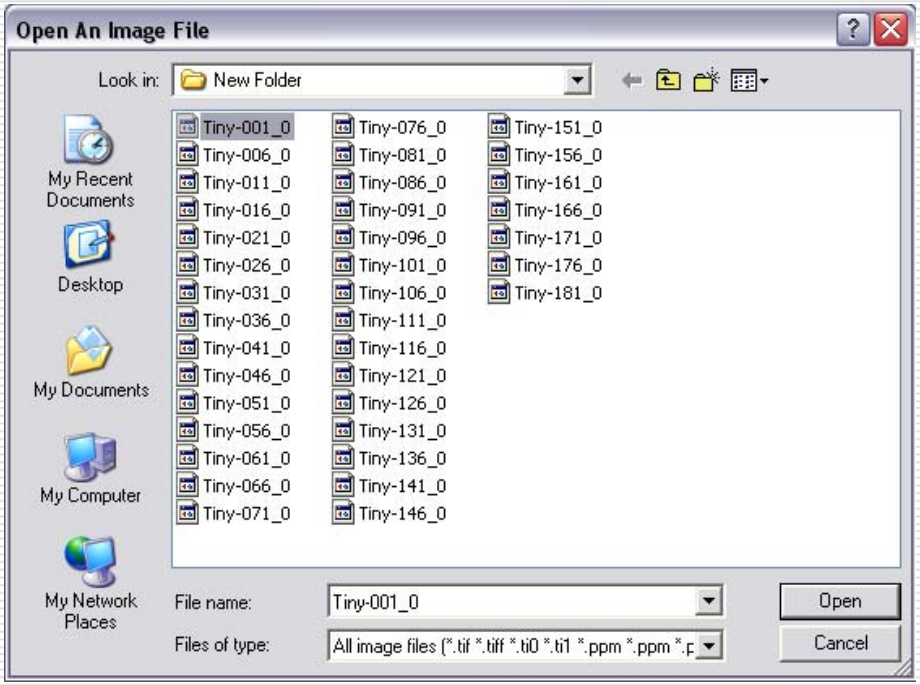
- To get accurate results it is important to get a low number of average iterations (less than five).
- The average iterations depend on how consistence and accurate were the initial guesses.
- When the correlation finish, press “Close”.



Calibration Image

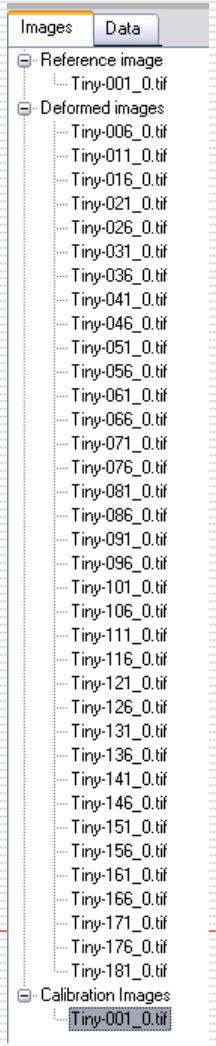
- Click on “Select Calibration Image”.
- A new window will appear (Open An Image File).
- Select the non-deformed image.
- Then press “Open”.

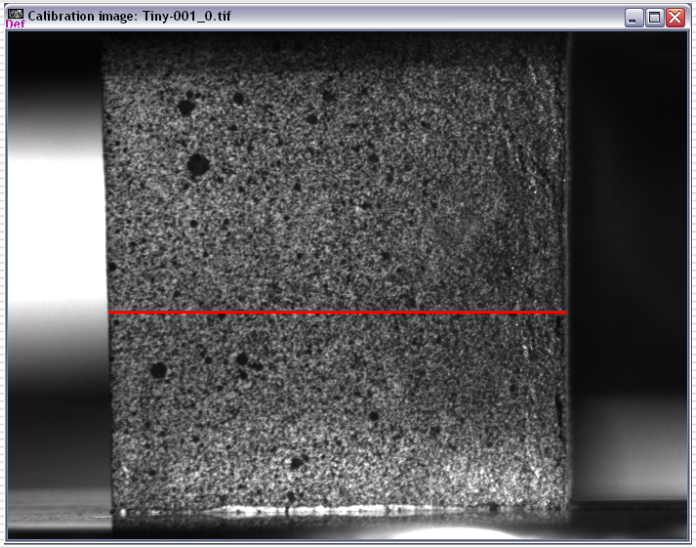




Calibration Image

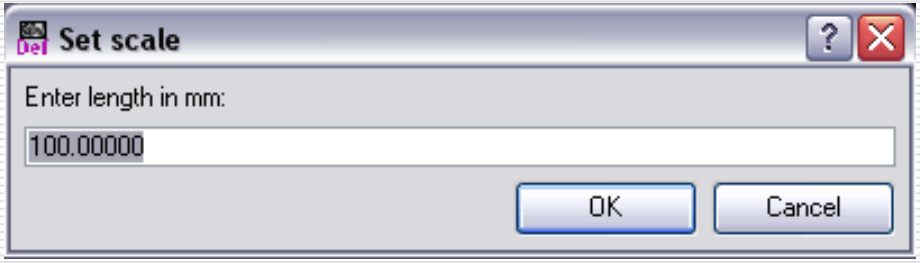
- Go to the left side of the screen and select the “Images Sheet”.
- Double click on the last picture (below “Calibration images”).
- A new window will appear (Calibration Image) with the non-deformed image.
- Click and hold the mouse button on one side of the specimen.
- Drag the mouse to the other side of the specimen and release the mouse button.
- A red line will appear.

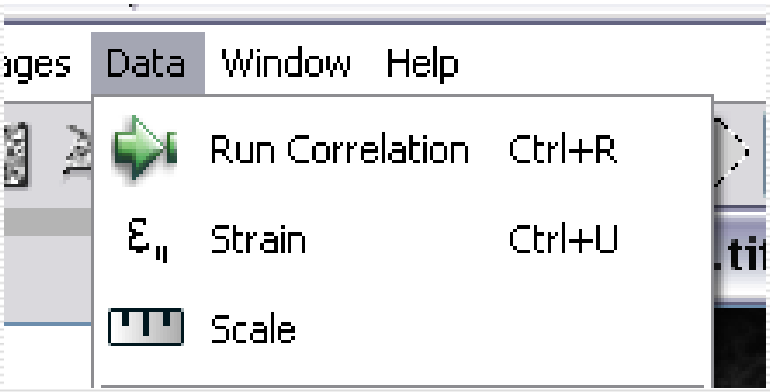




Calibration Image

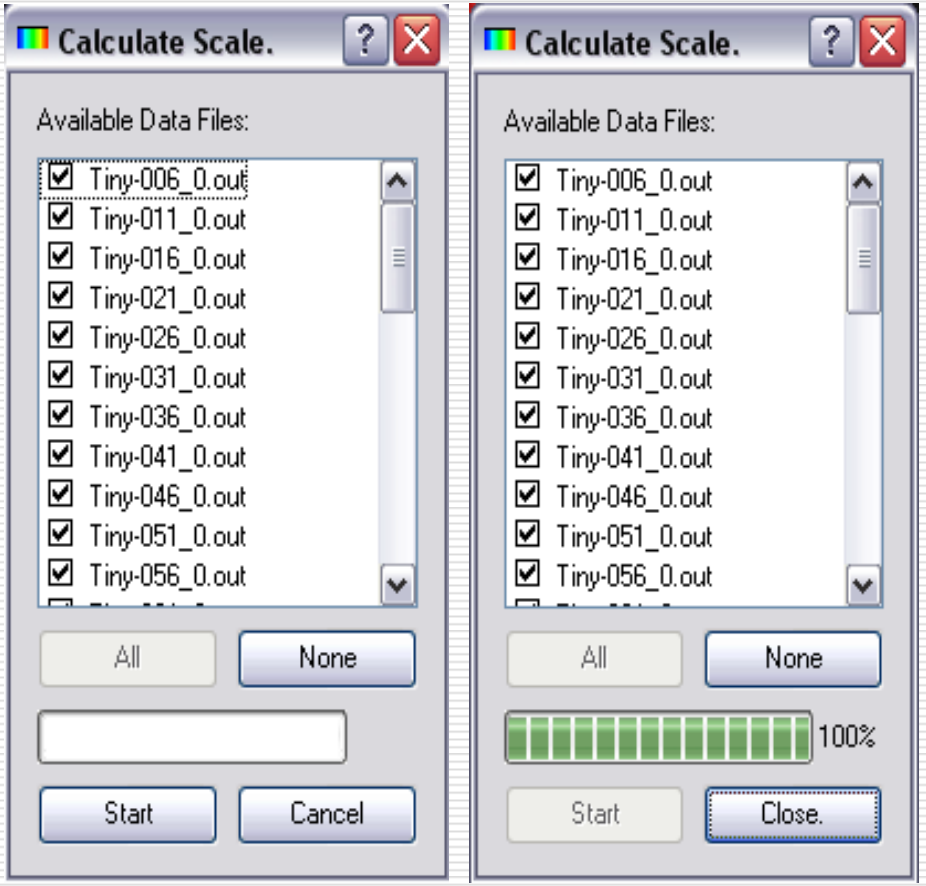
- A new window will appear (Set Scale).
- Write the length of the side chosen (red line).
- Then press “OK”.
- To calculate the scale calibrations go to “Data”.
- Then select “Scale”.





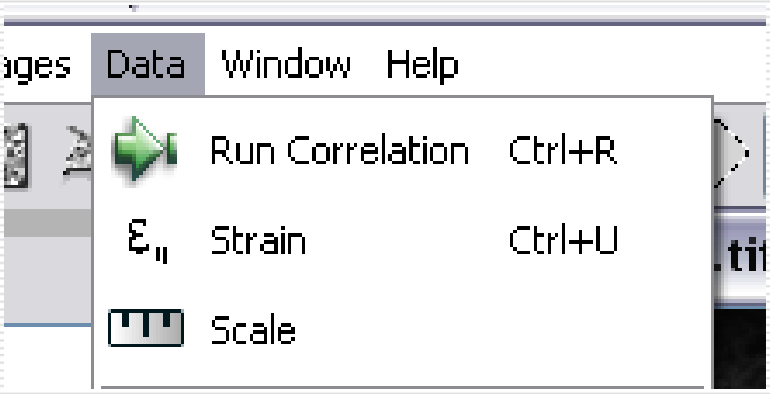
Calibration Image

- A new window will appear (Calculate Scale).
- Press “Start” to calculate the scale calibrations.
- When the calculations finish, press “Close”.



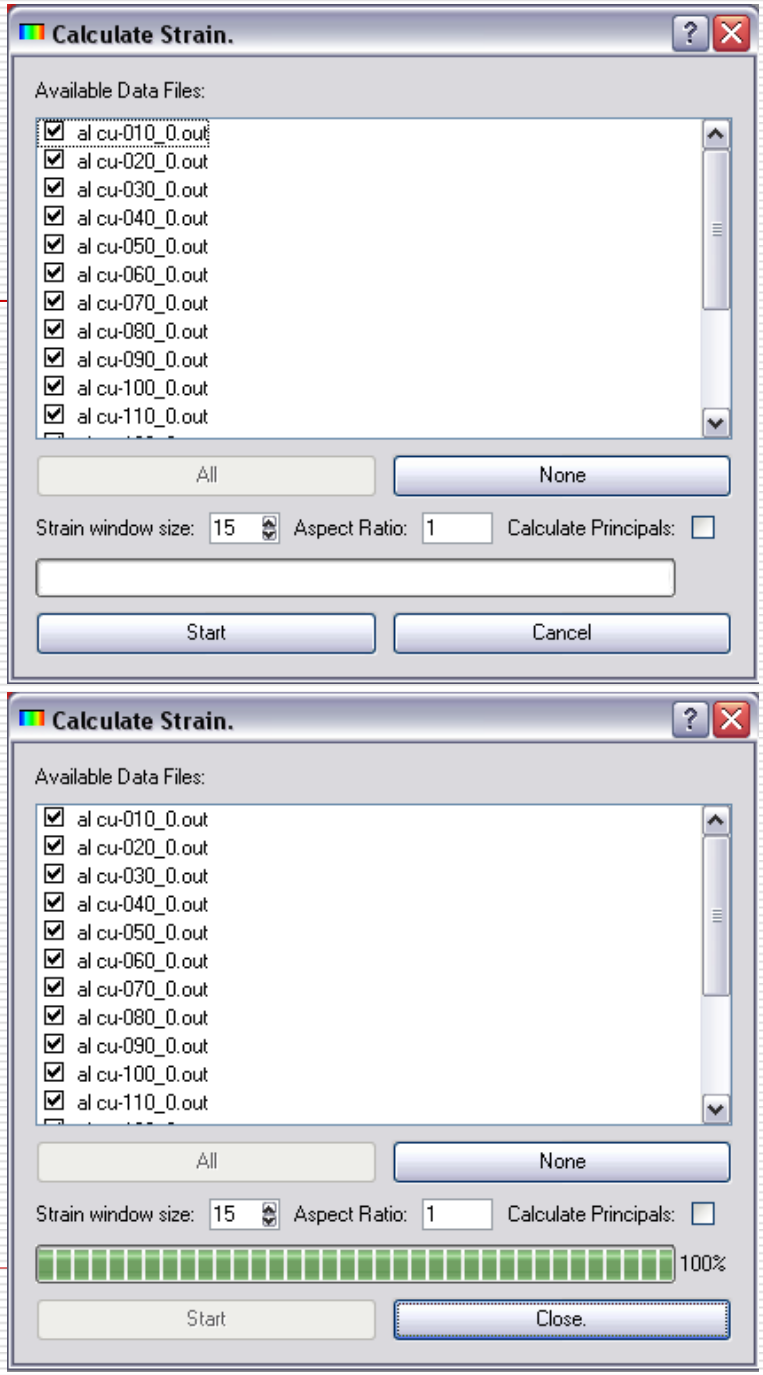
Calculate Strain

- To calculate the strains go to “Data”.
- Then select “Strain”.



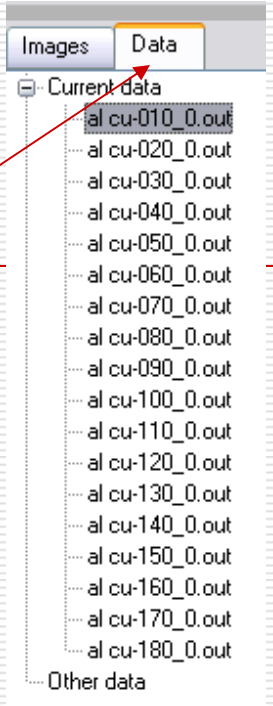
Calculate Strain

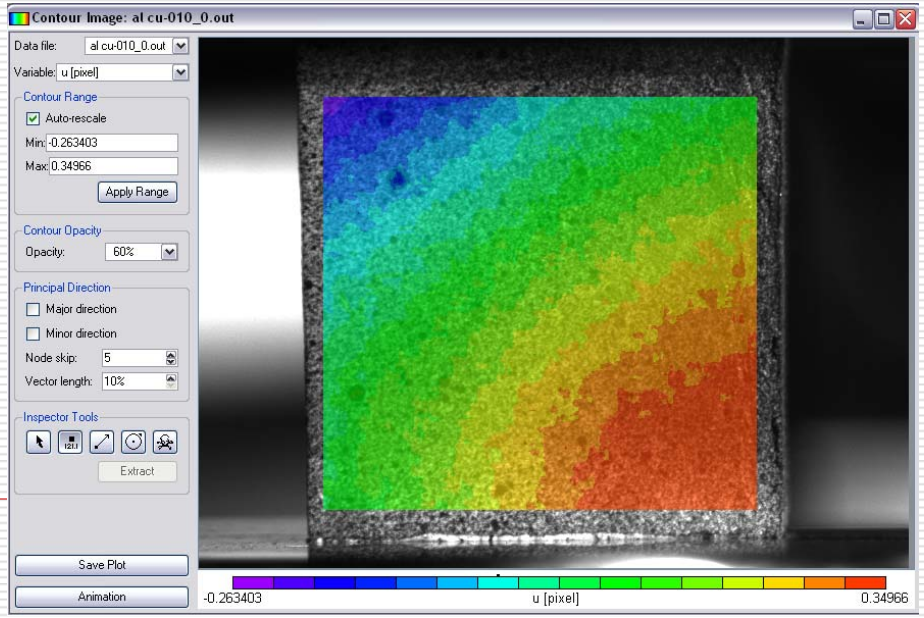
- A new window will appear (Calculate Strain).
- Press “Start” to calculate the strains.
- When the calculations finish, press “Close”.



Contour Map of Strains

- Go to the left side of the screen and select the “Data Sheet”.
- Double click on any deformed image to see its contour map of strains.
- A new window will appear (Contour Image) with the strain map.

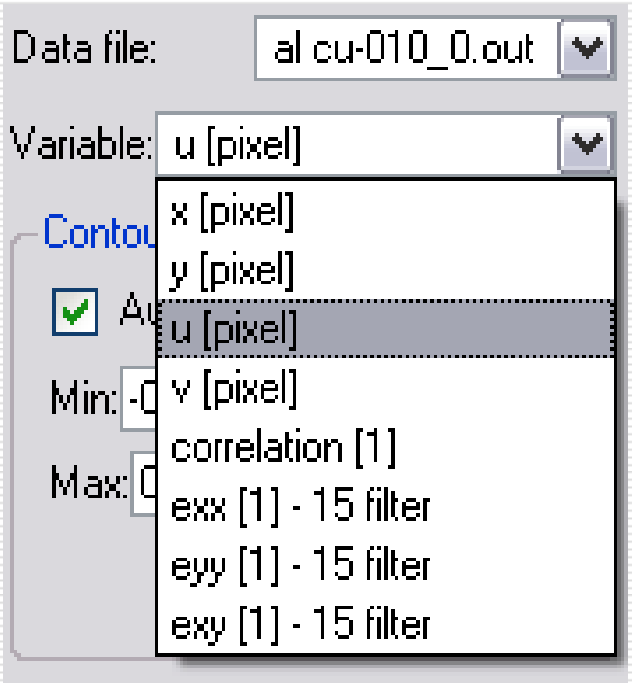




Contour Map of Strains

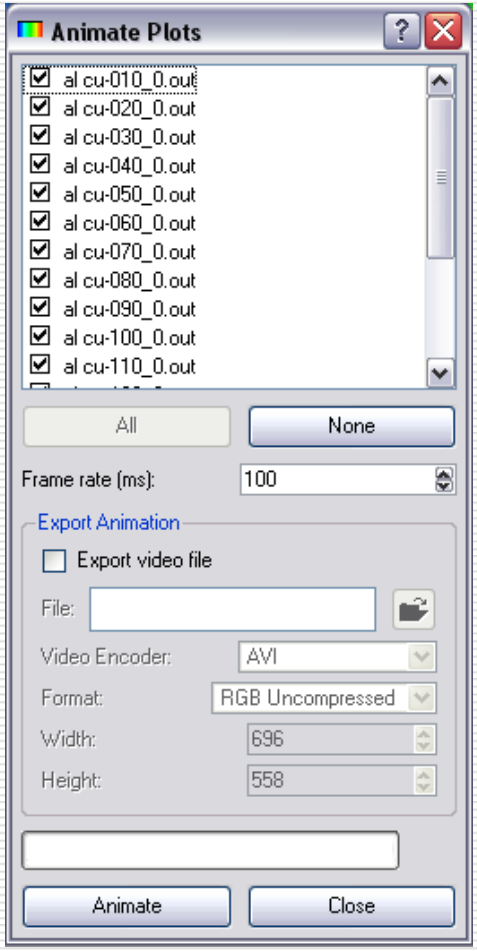
For any deformed image it can be seen different variables in the contour map:

- x,y = motion of the object in x and y direction
- u,v = displacement in x and y direction
- exx,eyy,exy = lateral, axial and shear strains



Contour Map of Strains

- An animation of the strain map of all the deformed images in sequence can be seen.
- To see the animation press “Animation”.
- A new window will appear (Animate Plots).
- Then press “Animate”.



The End!

NEES

NSF

UNIVERSITY OF COLORADO
1876

RECINTO UNIVERSITARIO DE MAYAGÜEZ
UNIVERSIDAD DE PUERTO RICO