

# GRID\_METHOD\_GUI T1.0.X – MANUAL

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## Contents

1	What is it?	1
2	Requirements	1
3	How to use it?	1
4	Main screen	1
5	File menu	1
6	Images	4
6.1	Mask	4
6.2	Zoom	5
6.3	Statistics	6
6.4	Sampling	6
7	Phases	7
8	Unwrapped phases	8
9	Displacements	9
10	Strains	10
11	Tutorial on an Open Hole specimen	11

## 1 What is it?

This software is dedicated to the image processing of inplane grid method for two images. It can be used to compute and visualize the phases, displacements, or strains. Also, it is possible to export the produced data in various formats. Fig. 1 details the data processing.

## 2 Requirements

This software has been developed using MATLAB r2010a and compiled using MATLAB COMPILER 7.13. It requires the installation of the appropriate MATLAB COMPILER RUNTIME (MCR). They are available at the following addresses.

Windows	32 bits	<a href="http://www.ecco-qua.tk/?fi=gZOTi9rgm6&amp;fn=MCRInstaller_7.13_32.exe">http://www.ecco-qua.tk/?fi=gZOTi9rgm6&amp;fn=MCRInstaller_7.13_32.exe</a>
Windows	64 bits	<a href="http://www.ecco-qua.tk/?fi=30tlhj13EH&amp;fn=MCRInstaller_7.13_64.exe">http://www.ecco-qua.tk/?fi=30tlhj13EH&amp;fn=MCRInstaller_7.13_64.exe</a>

## 3 How to use it?

Once the MCR is installed, double click on the file. It may take time to show the main screen depending on the computer's specifications. The following sections will detail the different menus and parameters.

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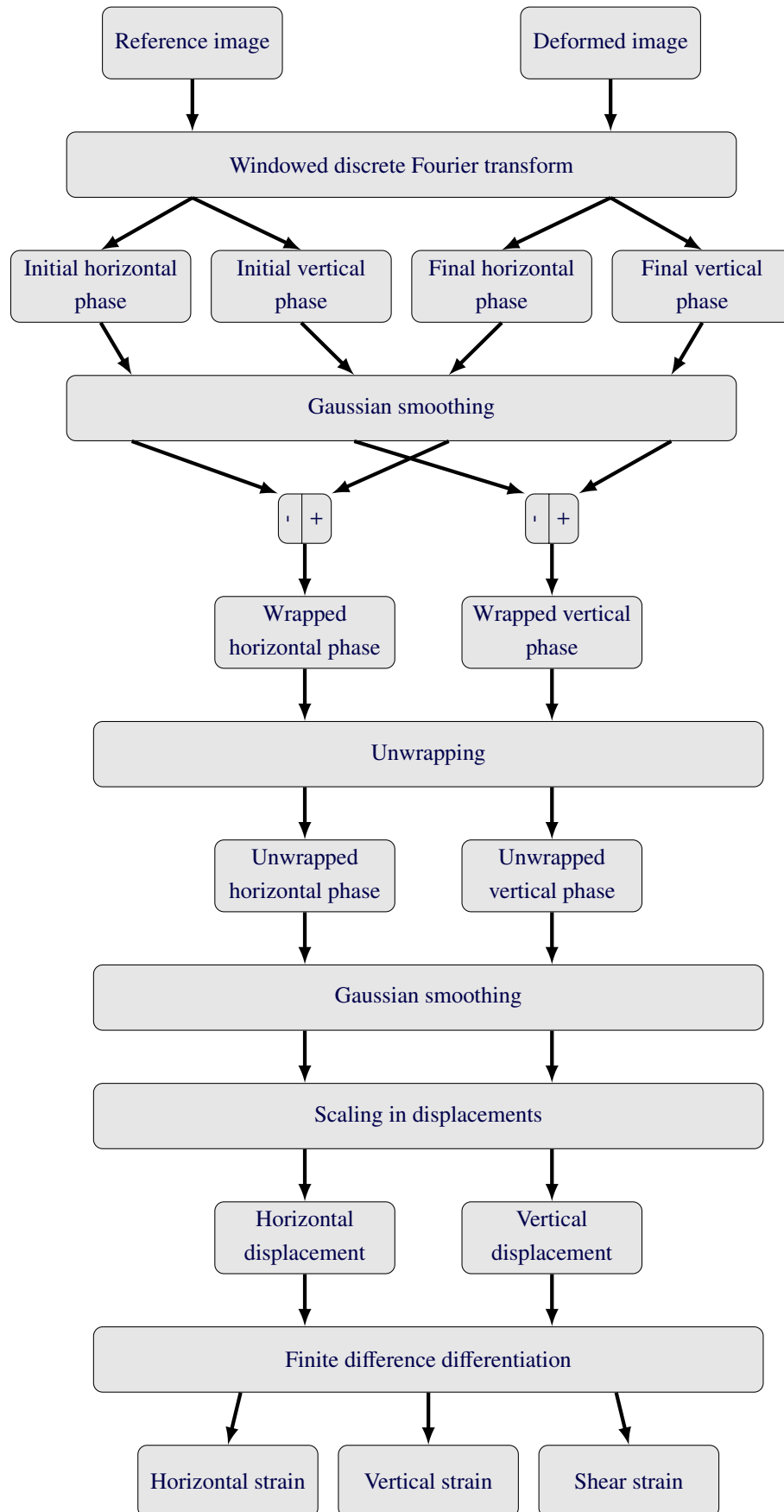


Figure 1. Processing flow chart

## 4 Main screen

Fig. 2 presents the main window. Several zones are circled in red as detailed below.

**Zone 1** File menu,

**Zone 2** Buttons to switch between panels,

**Zone 3** Colour scales,

**Zone 4** Text zone for feedback to user.

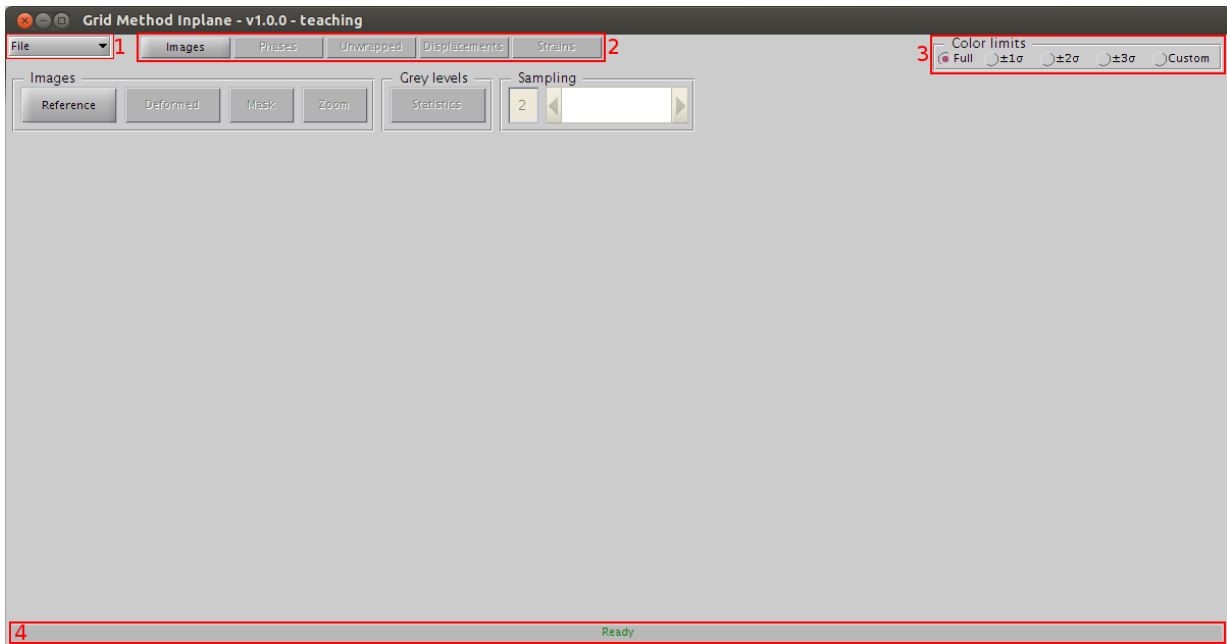


Figure 2. Main window

## 5 File menu

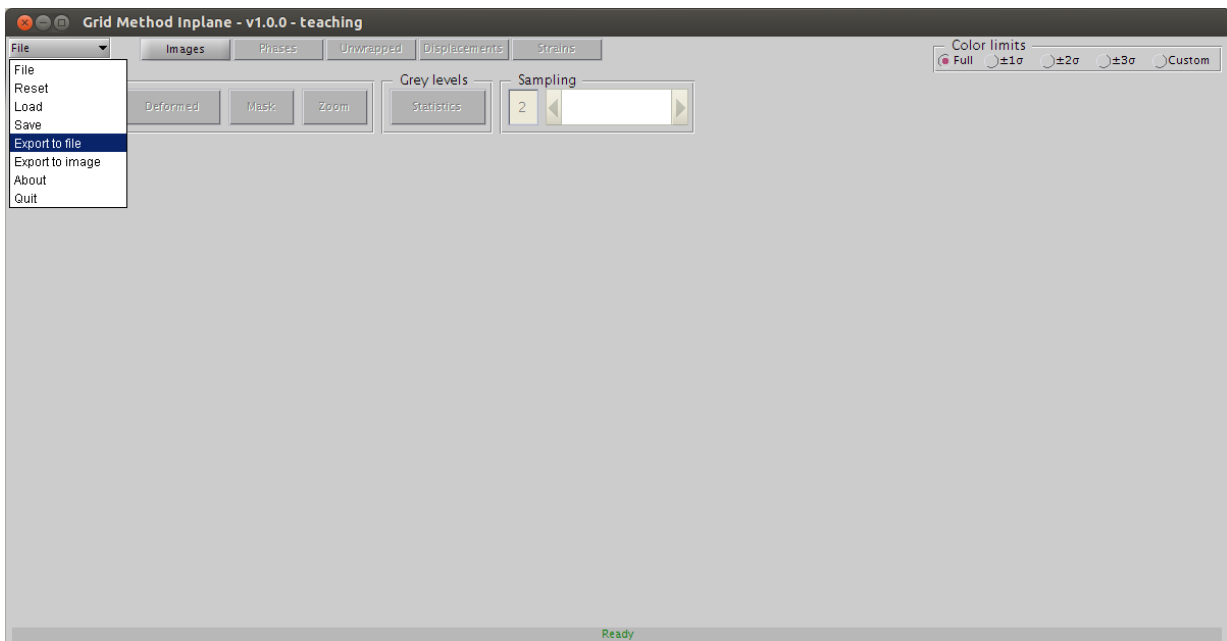


Figure 3. Filemenu opened

**Reset** Delete any loaded data from the memory and shows the initial screen,

**Load** Load a data set previously saved by this software using the extension *\*.GRD*,

**Save** Save a data set using the extension *\*.GRD*,

**Export to file** Export a data set to a text file or a MAT-file,

**Export to image** Save current viewport to a *\*.PNG* image file,

**About** Shows information about the software,

**Quit** Quit.

## 6 Images

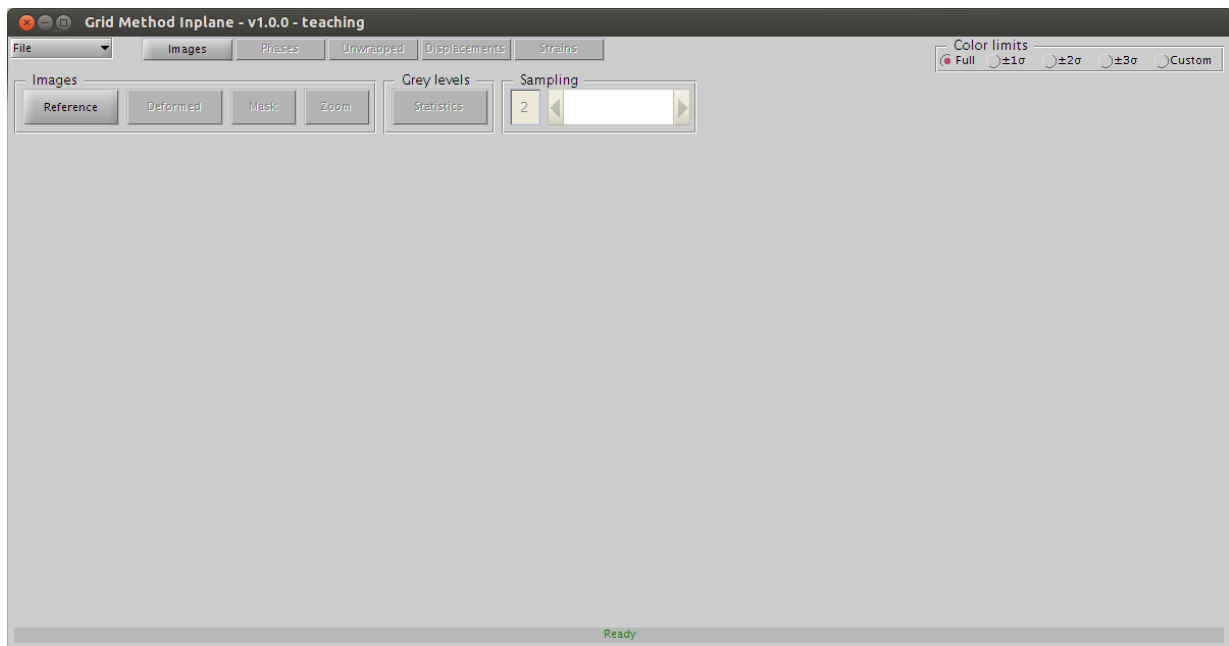


Figure 4. Images panel

**Reference button** Click to load image of sample under reference state.

**Deformed button** Click to load image of sample under loading.

**Mask button** Cf section 6.1 p. 4.

**Zoom button** Cf section 6.2 p. 5.

**Statistics button** Cf section 6.3 p. 6.

**Sampling textbox and slider** Cf section 6.4 p. 6.

### 6.1 Mask

In this module, the user can create a mask also called Region Of Interest (ROI). If no mask has been created, the full image will be used. It is possible to create the mask before or after loading the deformed image but always after loading the reference image. The mask can be a collection of various shapes such as polygon, rectangles, and ellipses. The shapes are added on the viewport called *working area* on the right hand side of the window and the result is displayed on the viewport called *ROI preview* on the left hand side of the window. **Note:** There is sometimes a bug in Microsoft Windows OS where the preview is not updated. To force a preview, click anywhere on the *working area* viewport.

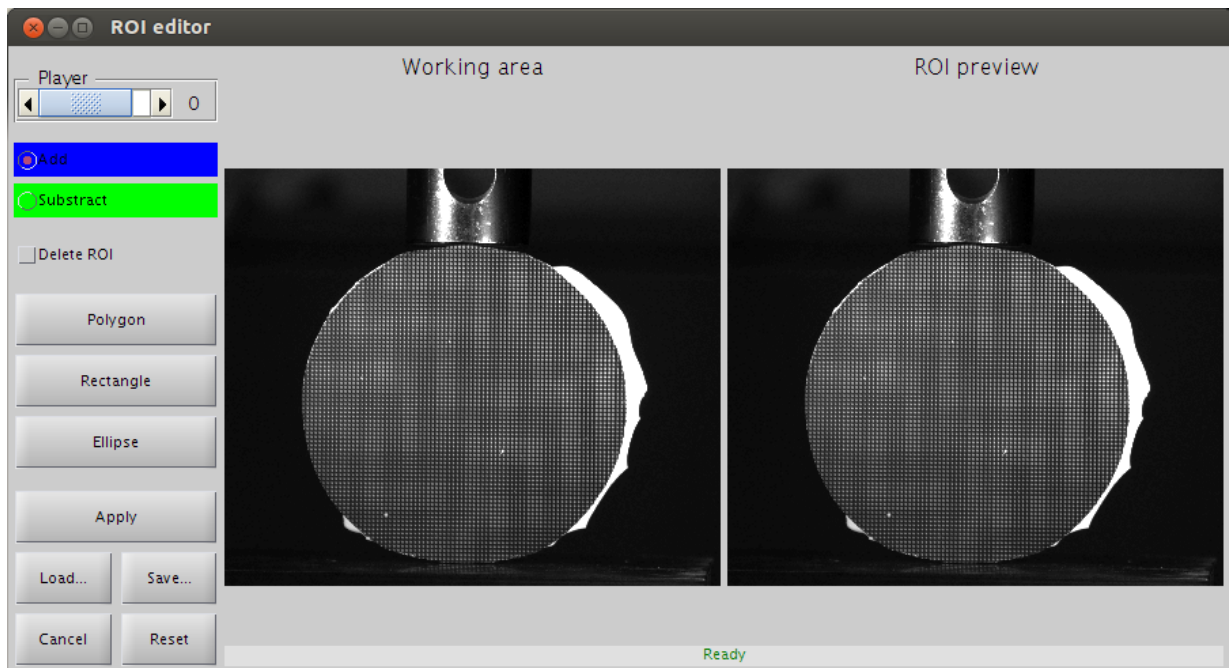


Figure 5. Masking module

**Player slider** Allows to navigate between images.

**Add and Subtract toggle buttons** Select mode to keep or ignore a zone. The shape will have the same color as the selected mode during its creation.

**Delete button** Allows to delete a shape. Tick the checkbox and then click on the shape to delete.

**Polygon button** Creates a polygon by clicking on the points. Click back on the first point to close the polygon. A right-click will delete the last point. After creation, drag-n'drop a point will move this point and drag-n'drop a line will move the shape to which it belongs. **Note:** It is not possible to add a point while the mouse is moving.

**Rectangle button** Creates a rectangle by two corners. After creation, drag-n'drop a point will move this point and drag-n'drop a line will move the shape to which it belongs. Pressing the **CONTROL** key while drag-n'dropping a corner allows to rotate the shape. Pressing the **SHIFT** key while drag-n'dropping a corner allows to resize with constant aspect ratio the shape. Both key can not be pressed at the same time.

**Ellipse button** Creates an ellipse by centre and radius. After creation, drag-n'drop a point will move this point and drag-n'drop a line will move the shape to which it belongs. Pressing the **CONTROL** key while clicking a point not on an axis allows to rotate the shape. Pressing the **SHIFT** key while clicking allows to resize with constant aspect ratio the shape. Both key can not be pressed at the same time.

**Apply button** Closes this module to return to the main window and will apply the mask.

**Load... button** Loads a collection of shapes previously saved by this module using the extension *\*.MSK*.

**Save... button** Saves a collection of shapes using the extension *\*.MSK*.

**Cancel button** Cancels the current modifications brought to the mask. Closes the window and return to main window.

**Reset button** Deletes every shapes created.

## 6.2 Zoom

It opens a new window showing the reference image. In this window, it is possible to zoom, change the font size and much more. Pressing the **SHIFT** key while clicking makes the new window show the deformed image.

### **6.3 Statistics**

It opens a new window showing the histogram of the reference and deformed images if loaded.

### **6.4 Sampling**

This value is adjusted to the closest integer number that samples a single period.

## 7 Phases

This panel presents the phase maps as extracted by the Windowed Discrete Fourier Transform algorithm. It is only available when the deformed images have been loaded.

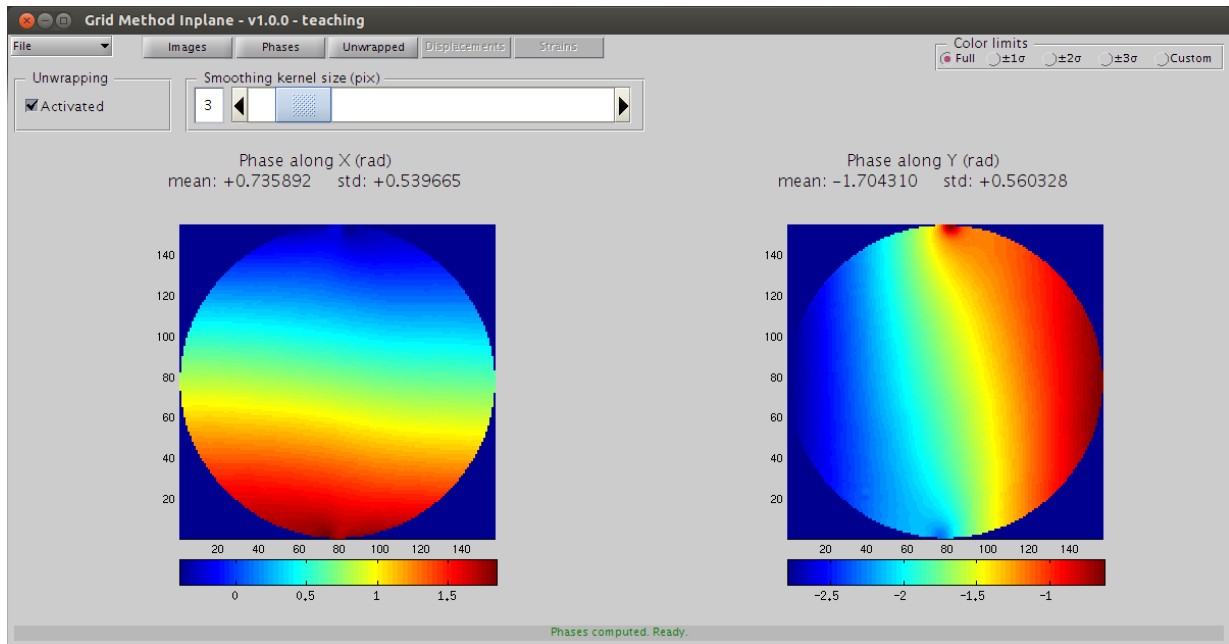


Figure 6. Phases module

**Activated/Disactivated checkbox** Allows to activate or not the unwrapping process for the next step.

**Smoothing textbox and slider** Introduces spatial smoothing during phase extraction using a Gaussian window if the kernel size is strictly larger than 1. **Note:** The larger the kernel size, the longer this step will take to finish.

## 8 Unwrapped phases

This panel presents the unwrapped phase maps. The algorithm is based on a noncontinuous path\*.

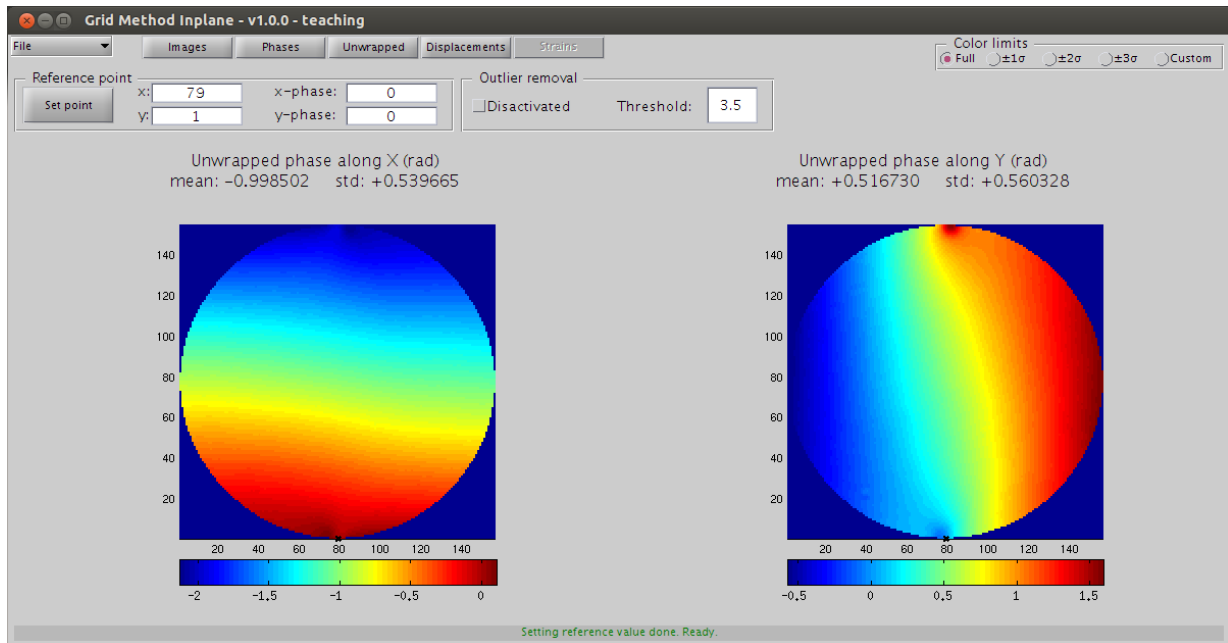


Figure 7. Unwrapped phases module

**Set point button** Allows to interactively select a point to set reference phase value.

**x and y textbox** Allows to specify exact coordinates for the reference point.

**x-phase and y-phase textbox** Allows to specify the phase value at the reference point.

**Activated/Disactivated checkbox** Allows to activate and deactivate the outlier removal process.

**Threshold textbox** Allows to tune the sensitivity of the outlier removal process. A large value will reduce the number of detected points and vice-versa.

\*[http://link.springer.com/chapter/10.1007%2F978-3-540-30463-0\\_14](http://link.springer.com/chapter/10.1007%2F978-3-540-30463-0_14)



## 9 Displacements

This panel presents the displacement maps.

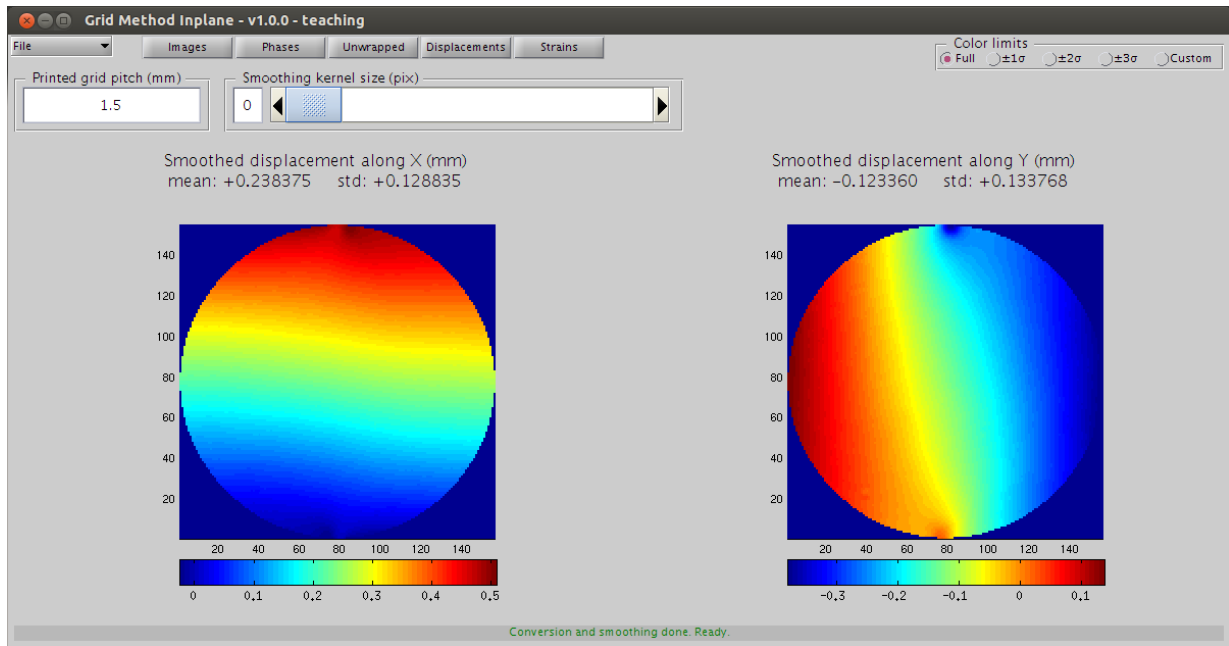


Figure 8. Displacements module

**Printed grid pitch textbox** Adjust the value to obtain displacement in millimetres.

**Smoothing textbox and slider** Introduces spatial smoothing in the unwrapped phase maps using a Gaussian window if the kernel size is strictly larger than 1. **Note:** The larger the kernel size, the longer this step will take to finish.

## 10 Strains

This panel presents the strain maps. They are calculated using the finite difference algorithm.

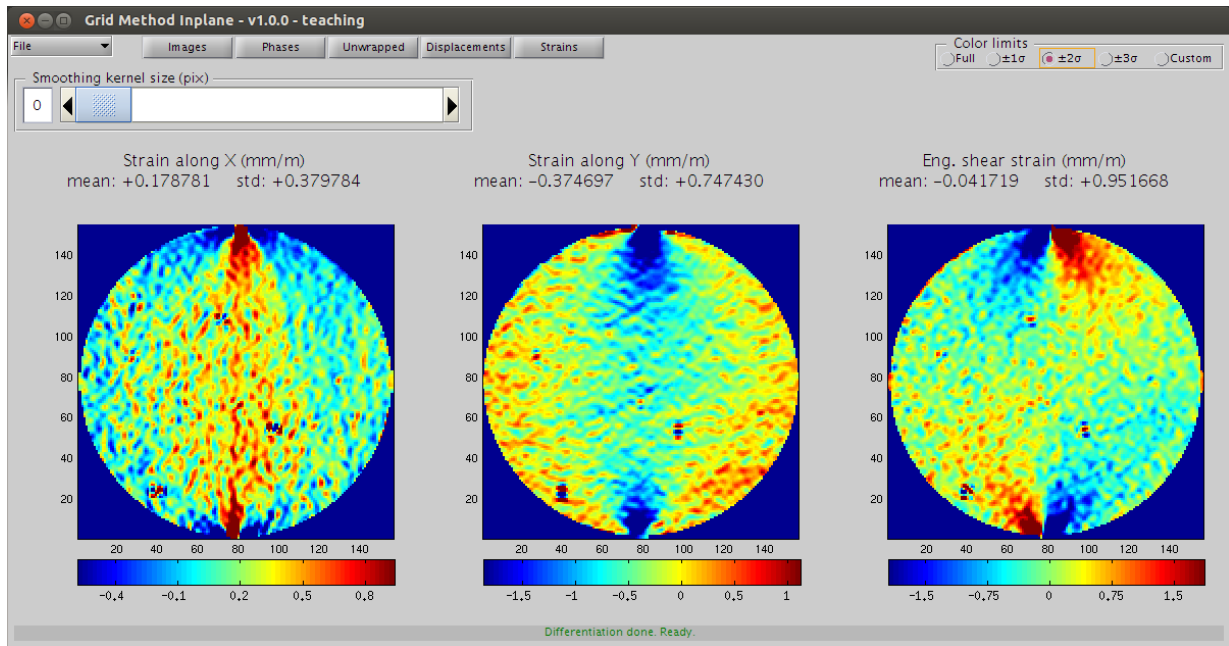


Figure 9. Strains module

**Smoothing textbox and slider** Introduces spatial smoothing in the unwrapped phase maps using a Gaussian window if the kernel size is strictly larger than 1. **Note:** The larger the kernel size, the longer this step will take to finish.

## 11 Tutorial on an Open Hole specimen

This tutorial will guide you through the processing of images for a test of an open hole specimen.

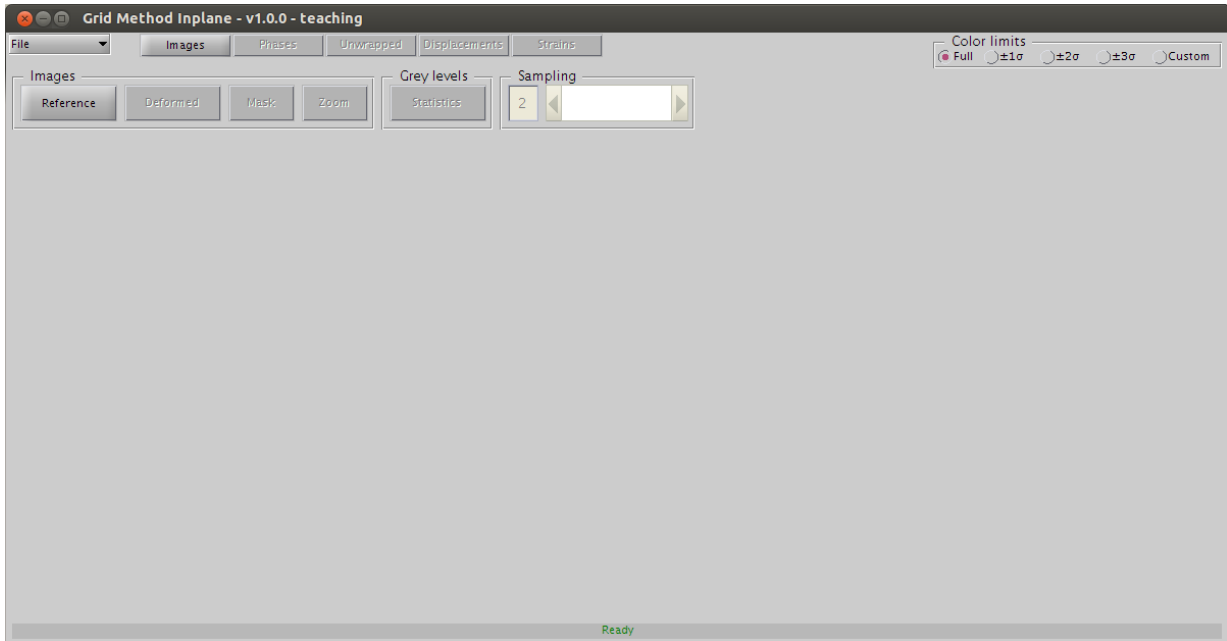


Figure 10. Once you have executed the file you should have this window.

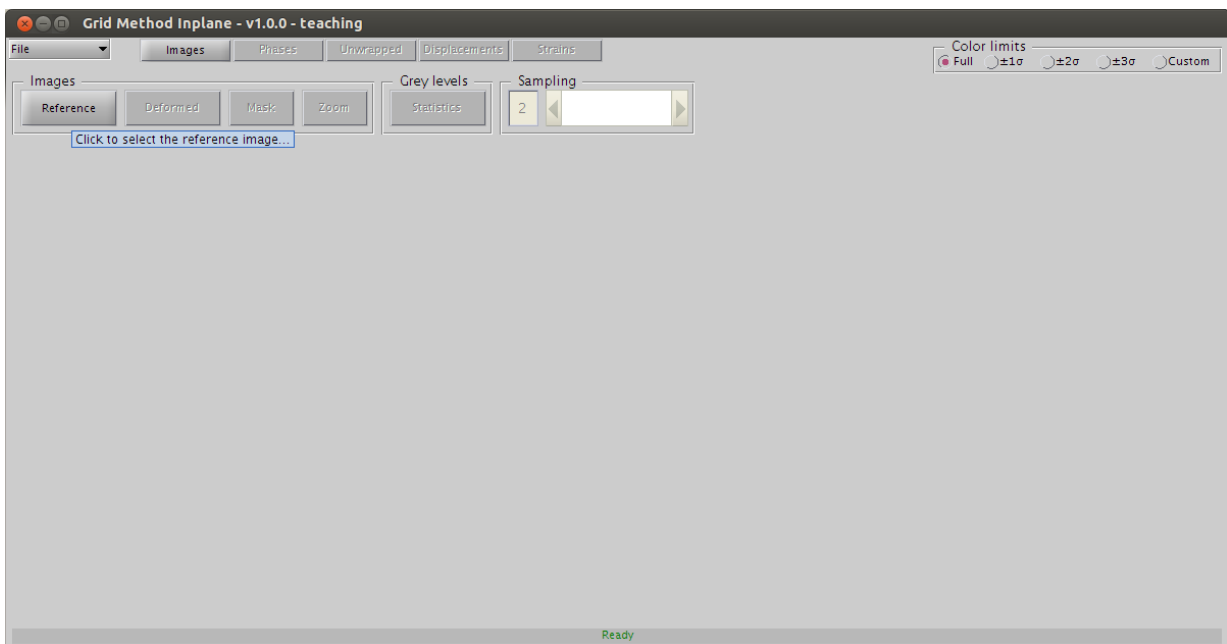


Figure 11. Click **REFERENCE** button to load the reference image.

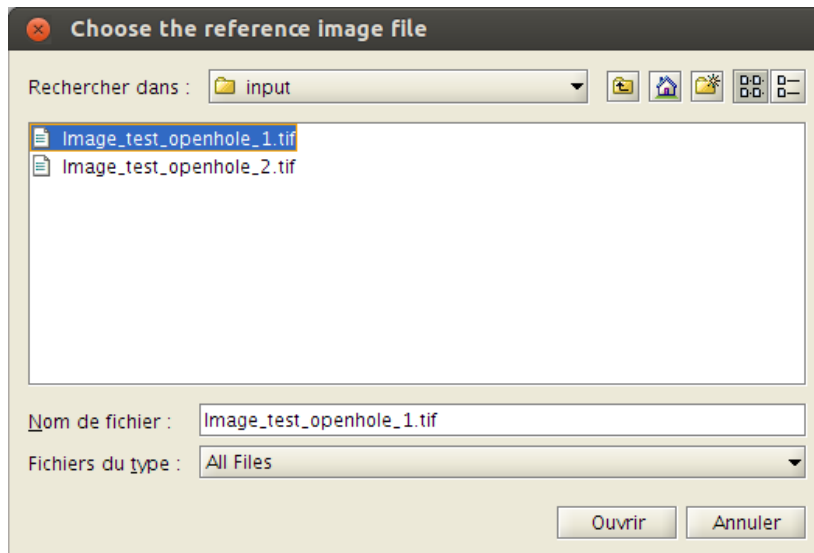


Figure 12. Select the file with the filename *Image\_test\_openhole\_1.png*.

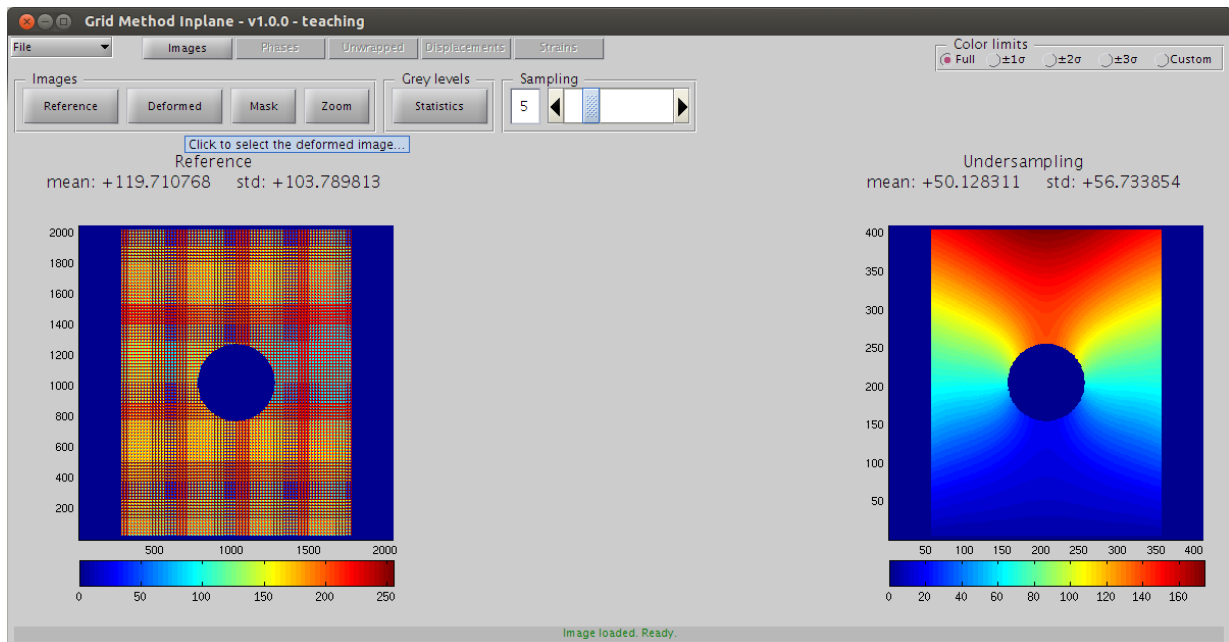


Figure 13. Click **DEFORMED** button to load the deformed image.

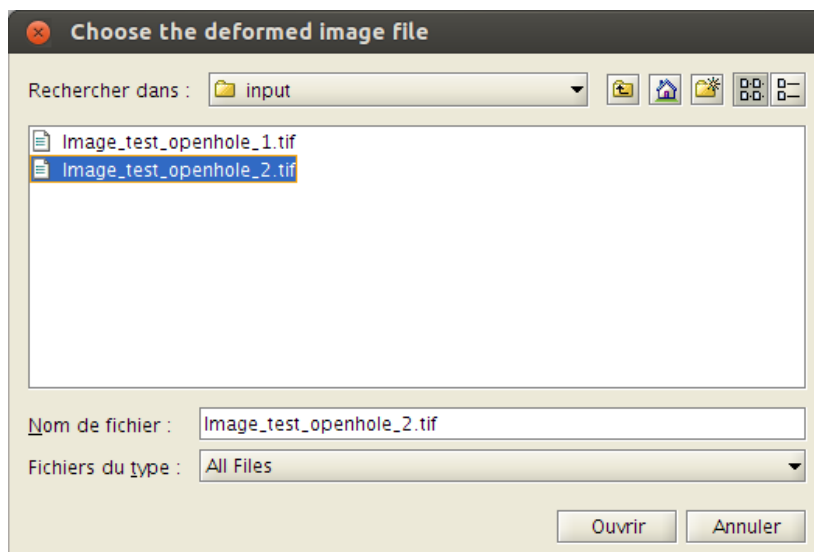


Figure 14. Select the file with the filename *Image\_test\_openhole\_2.png*.

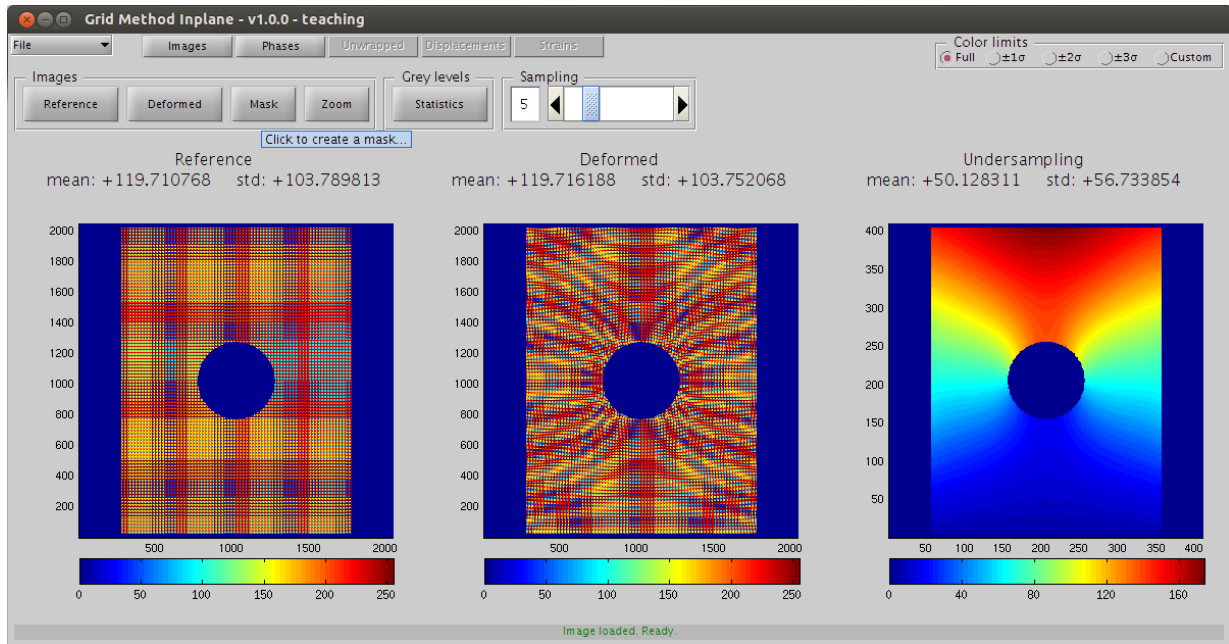


Figure 15. Click **MASK** button to open the masking module.

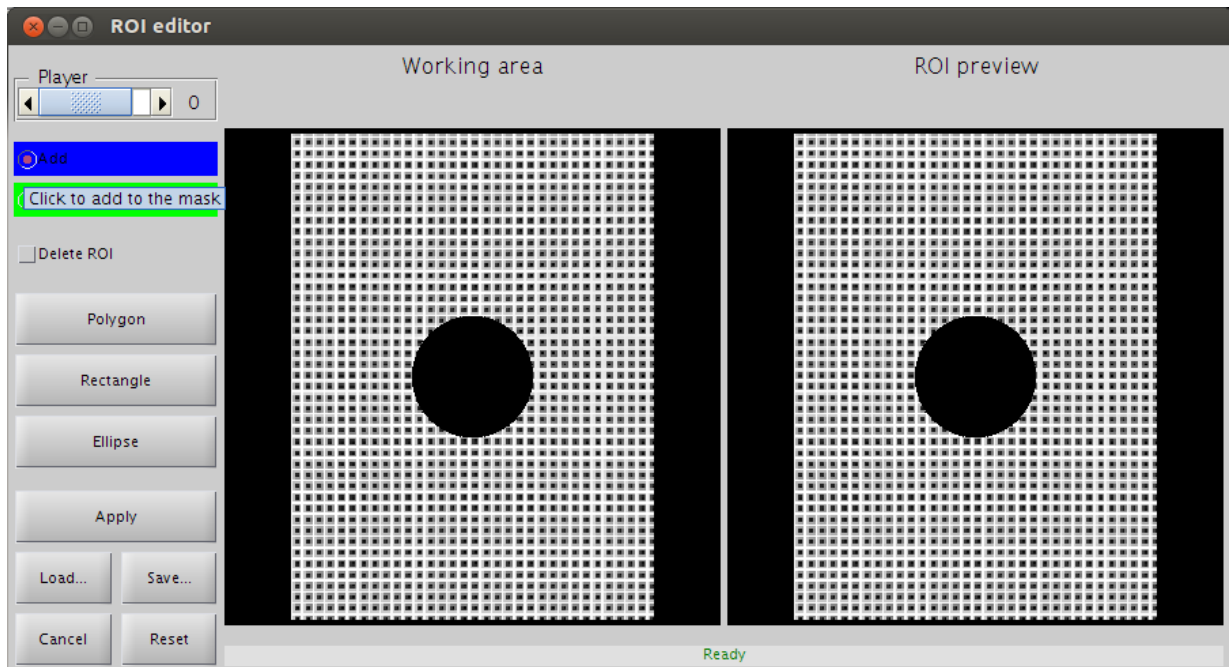


Figure 16. Click **ADD** radiobutton.

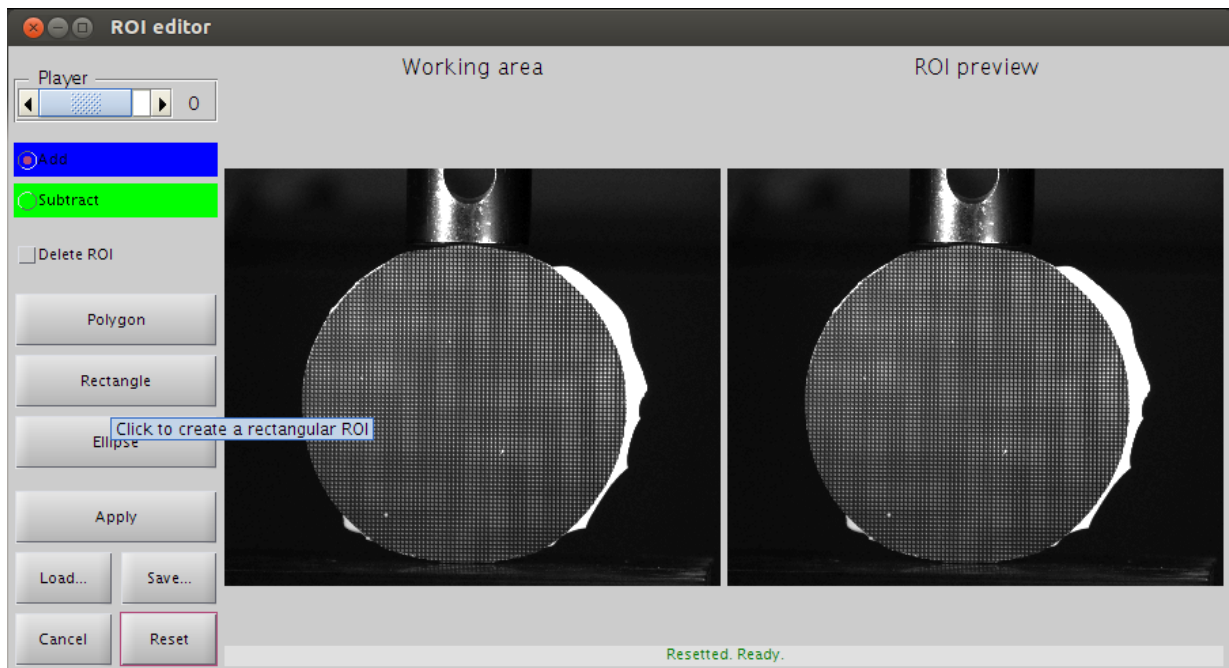


Figure 17. Click **RECTANGLE** button to create a rectangular shape.

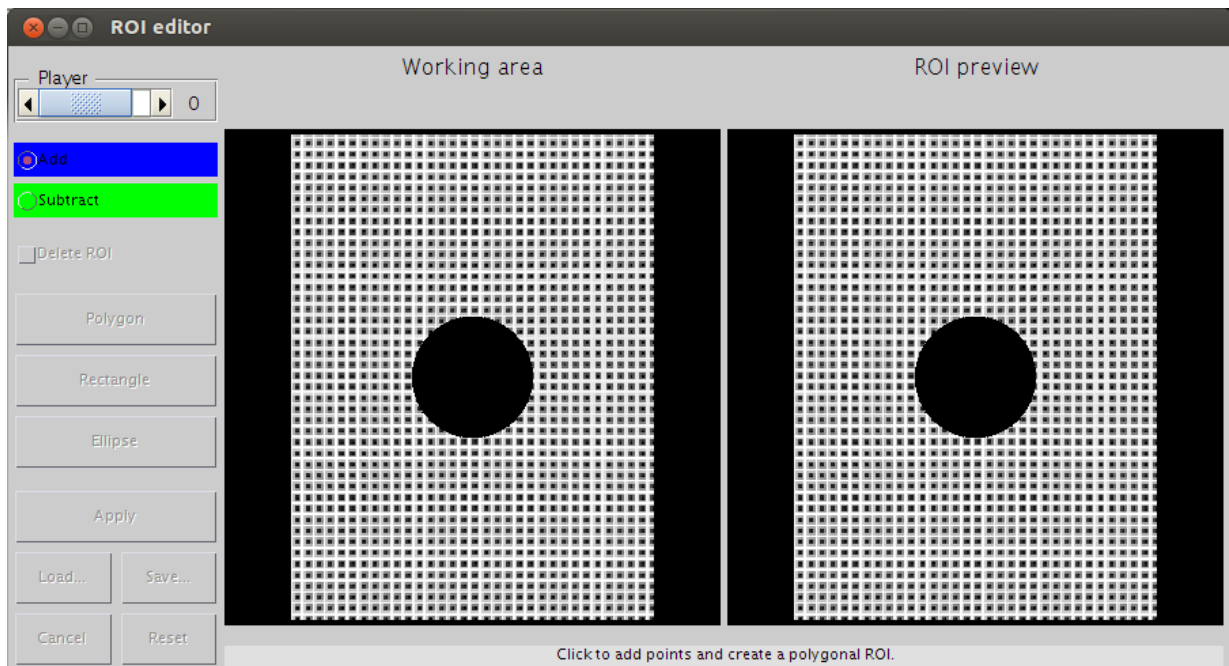


Figure 18. Click on the "working area" viewport to add a first corner.

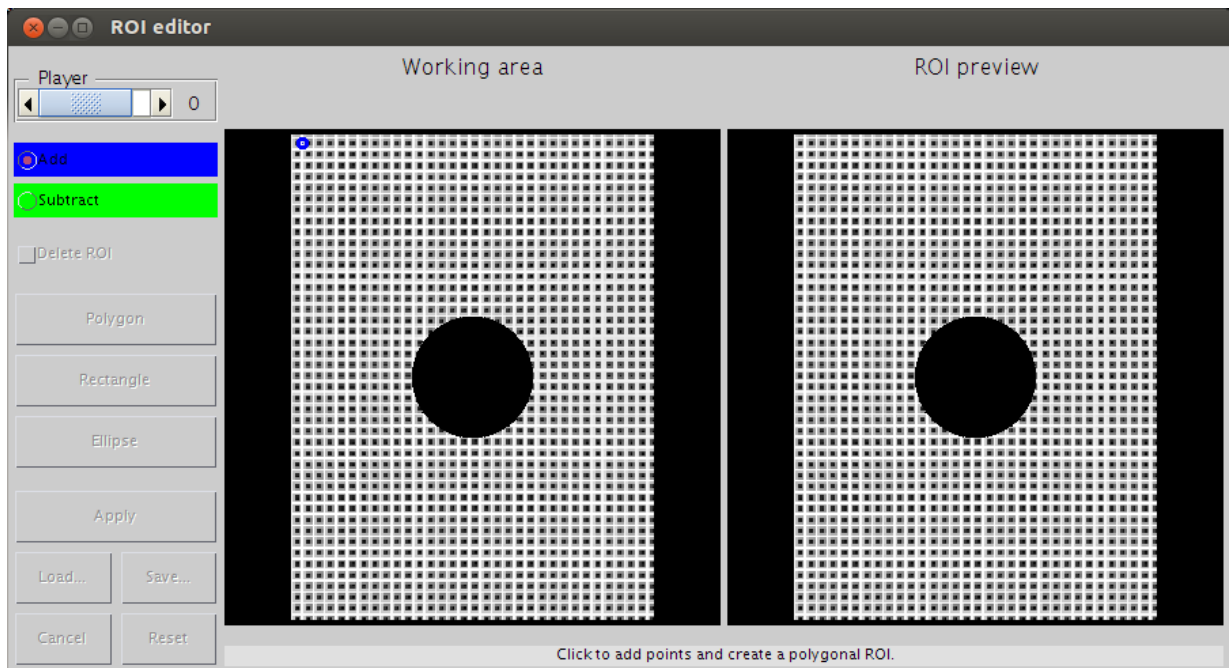


Figure 19. Click a second time to add the last corner.

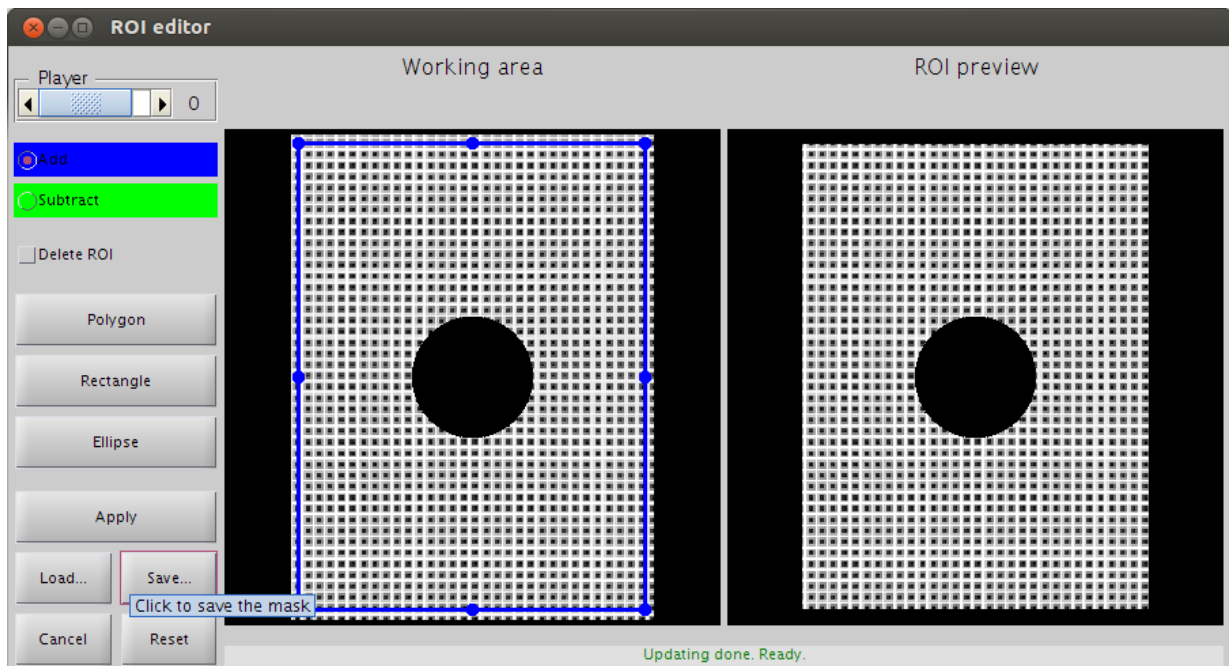


Figure 20. Click **SAVE** button to save the current mask.

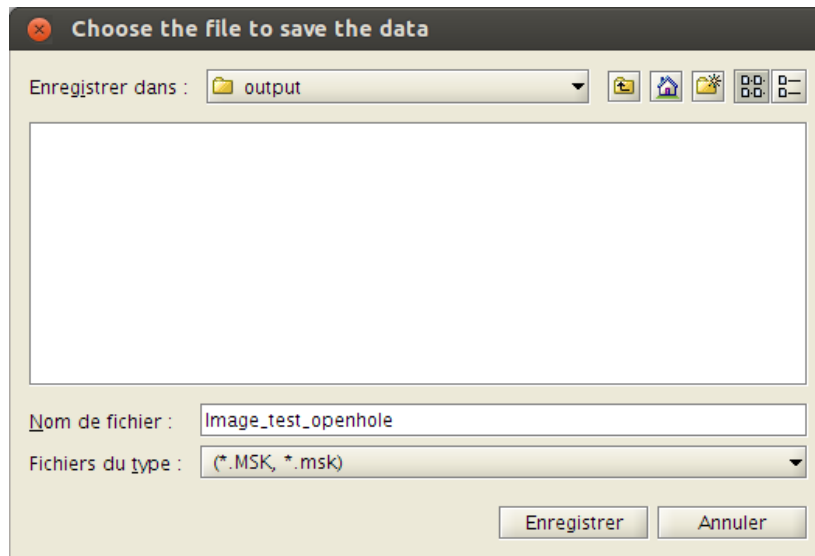


Figure 21. Select a filename to save the mask.

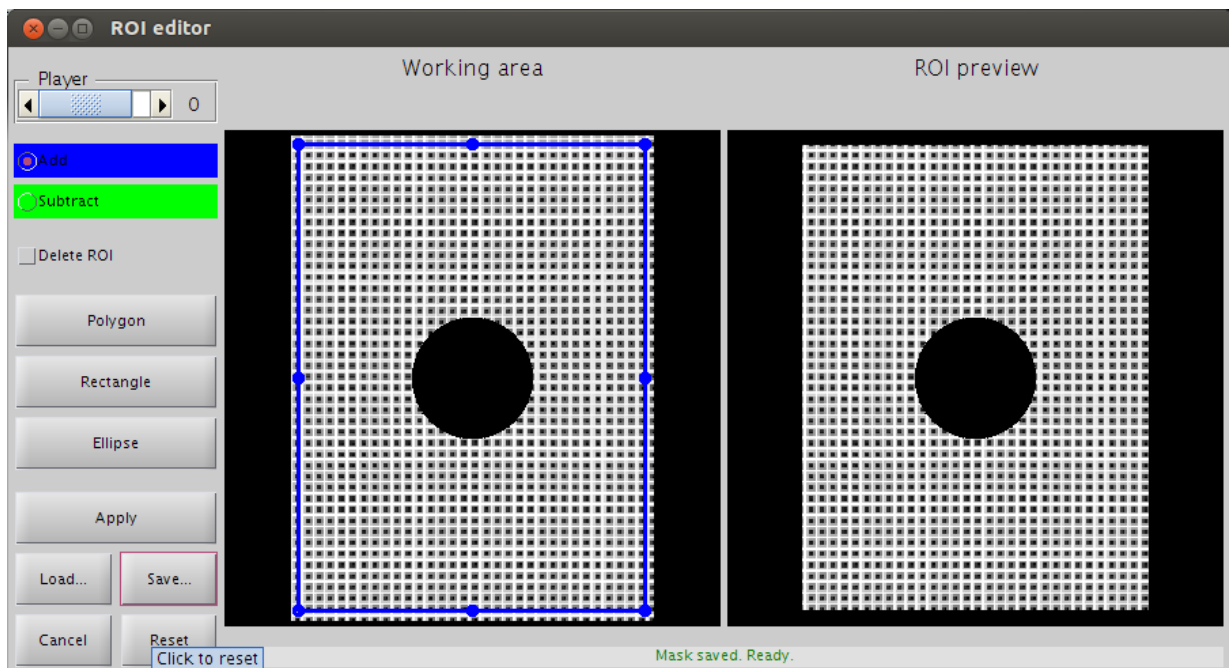


Figure 22. Click **RESET** button to reset the current mask.



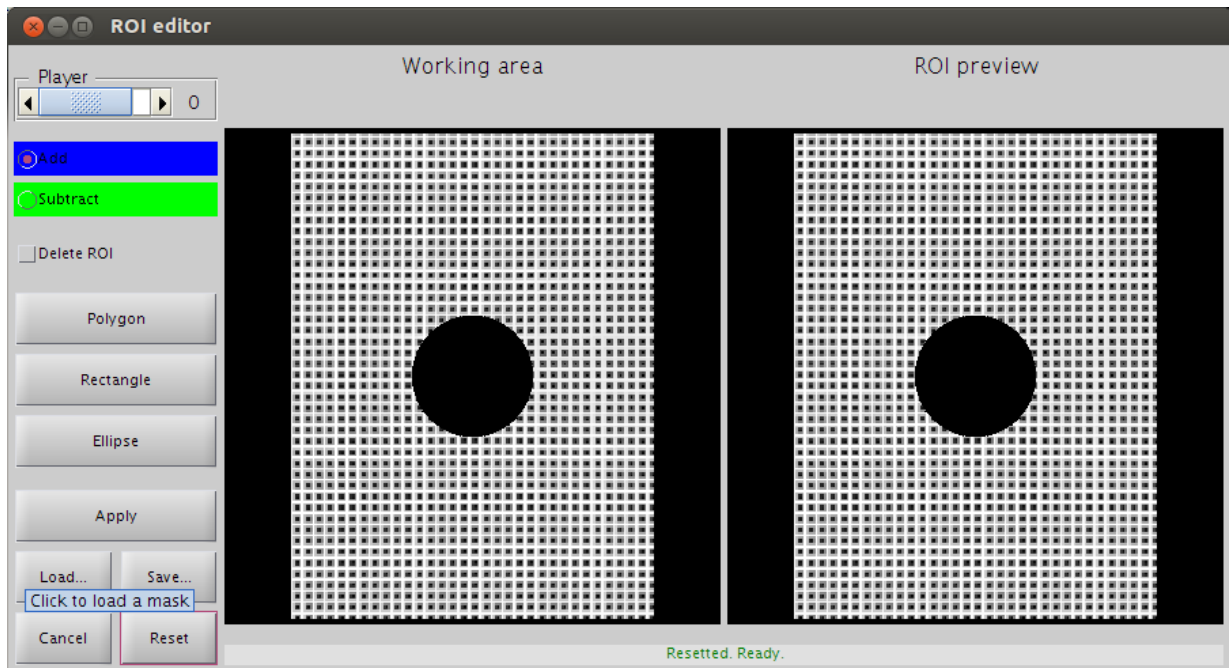


Figure 23. Click **LOAD** button to save the mask just saved.

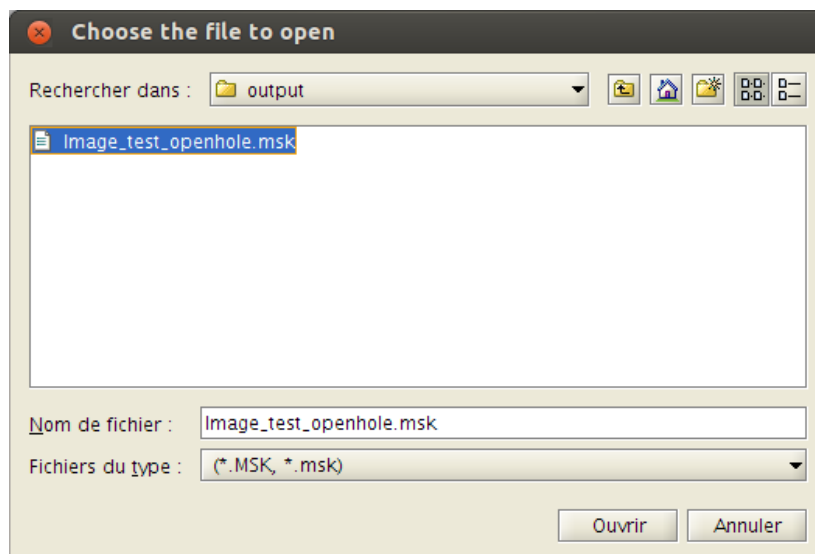


Figure 24. Select the *\*.MSK* file just saved.

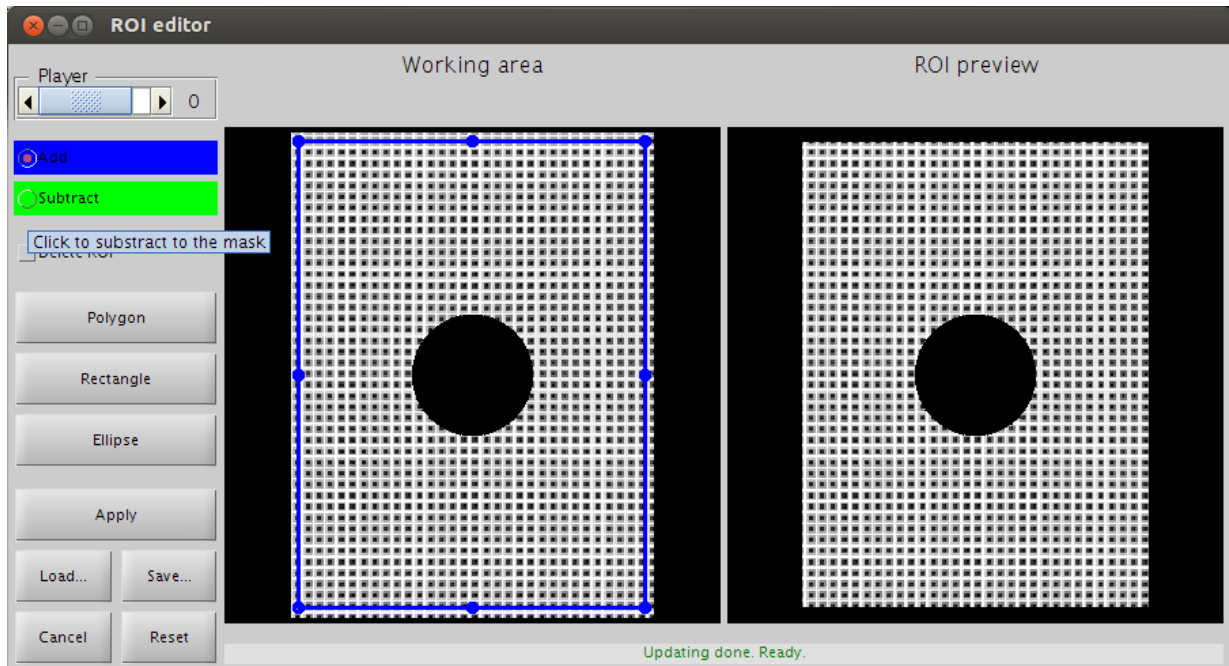


Figure 25. Click **SUBTRACT** radiobutton.

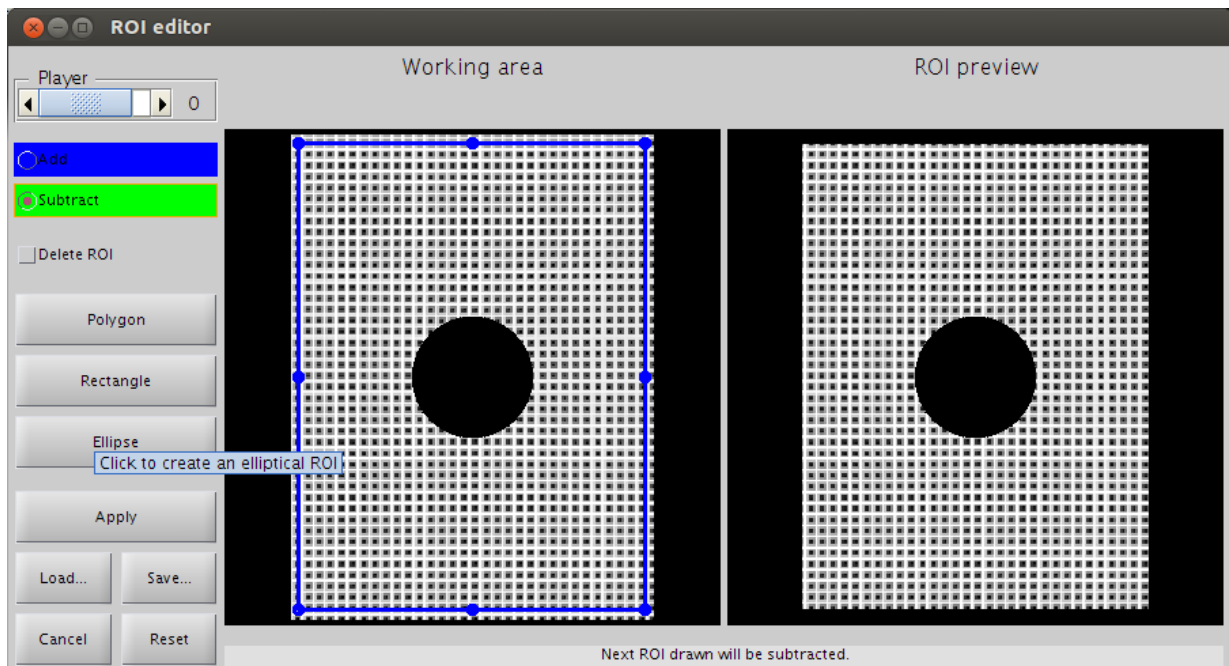


Figure 26. Click **ELLIPSE** button to create an ellipsoidal shape.

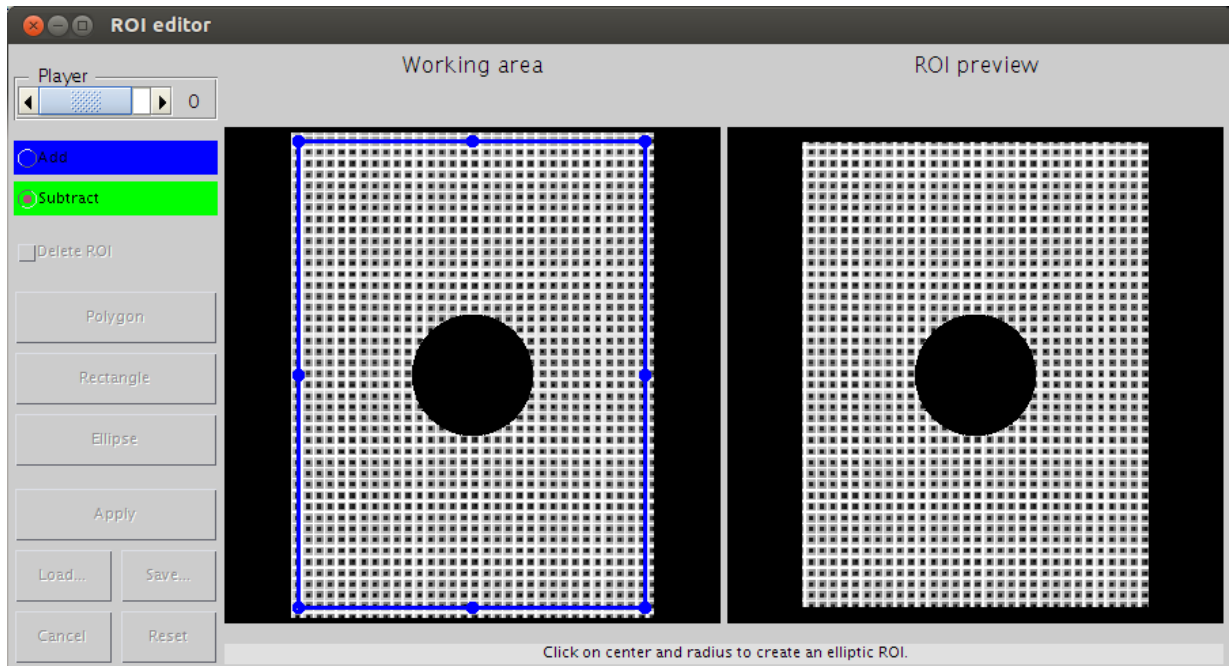


Figure 27. Click on the "working area" viewport to select the centre of the ellipse.

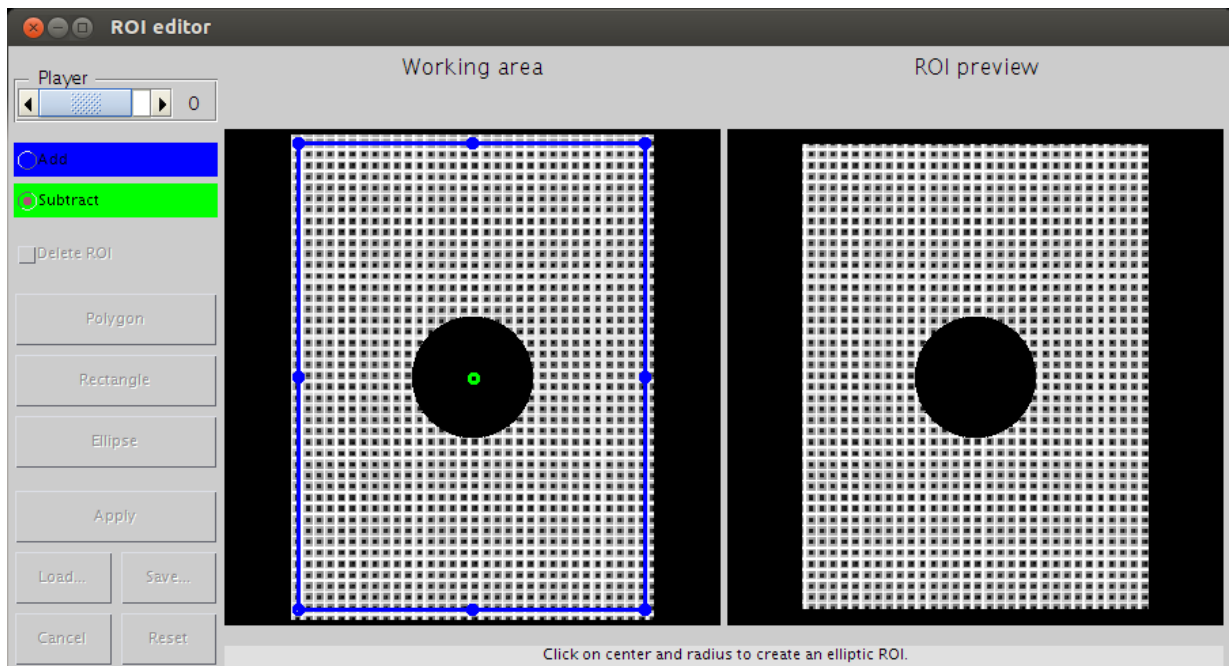


Figure 28. Click on the "working area" viewport to select the radius of the ellipse.

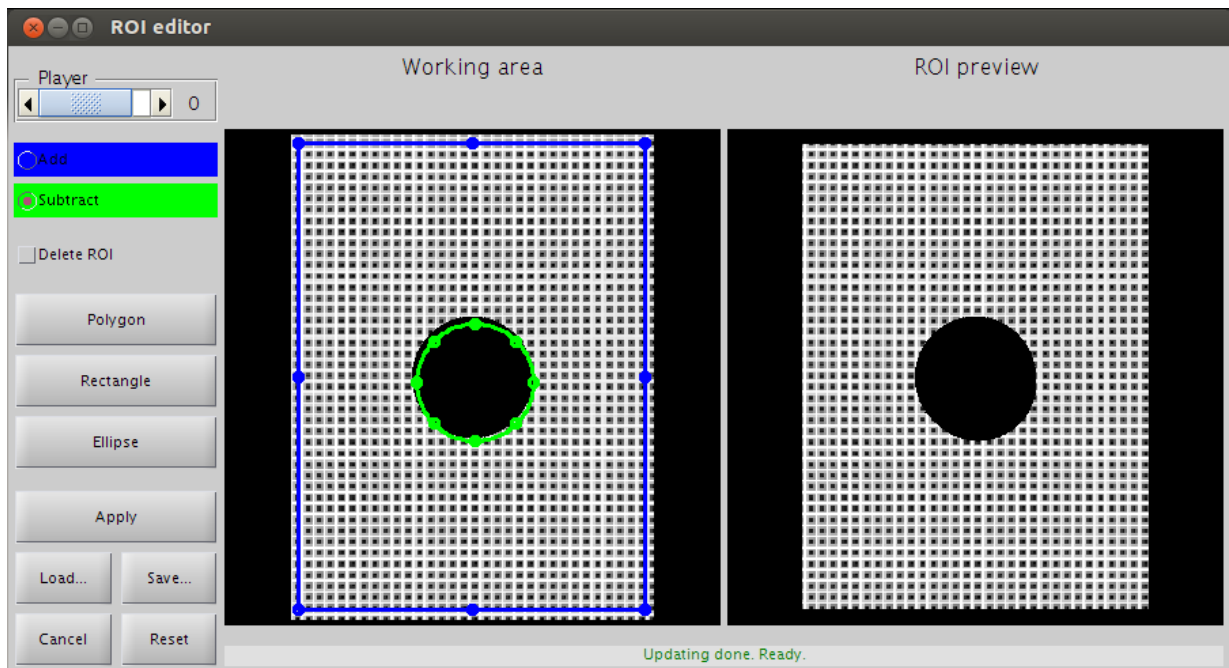


Figure 29. Adjust position and size of both shapes for best fit.

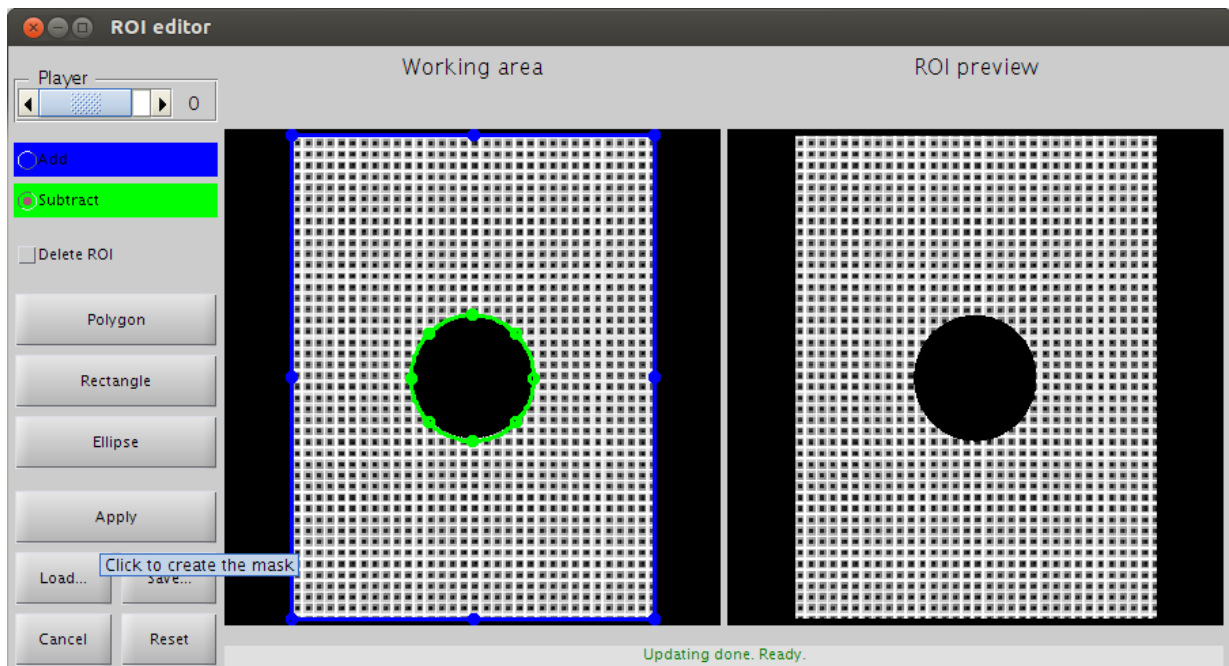


Figure 30. Click **APPLY** button to create the mask

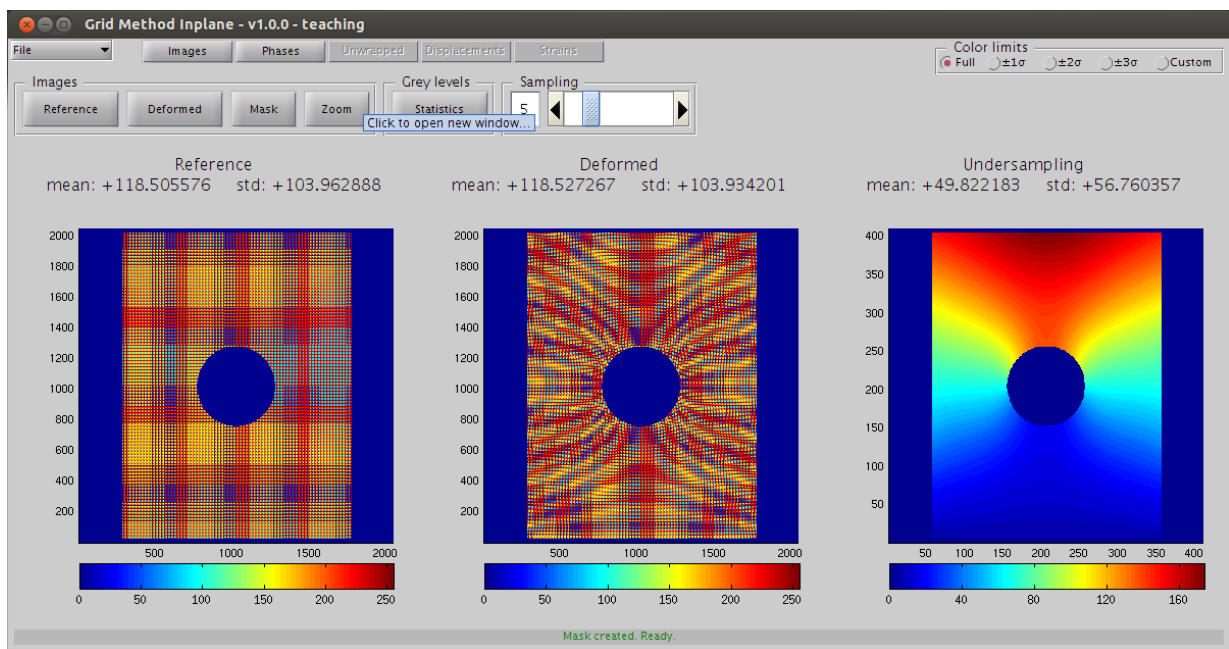


Figure 31. Click **ZOOM** button to open new window.

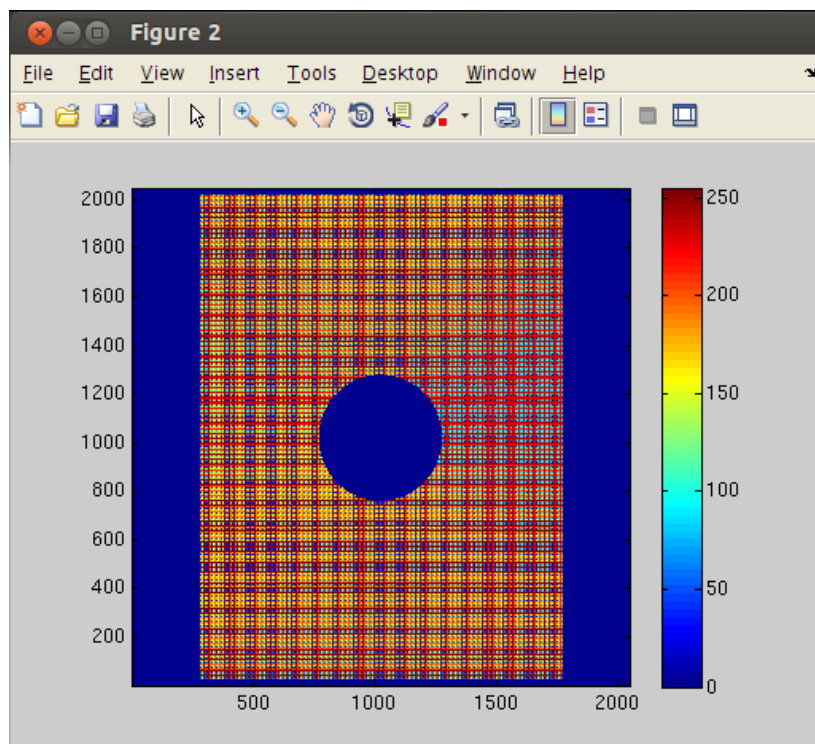


Figure 32. Traditionnal MATLAB figure window showing the undeformed image.

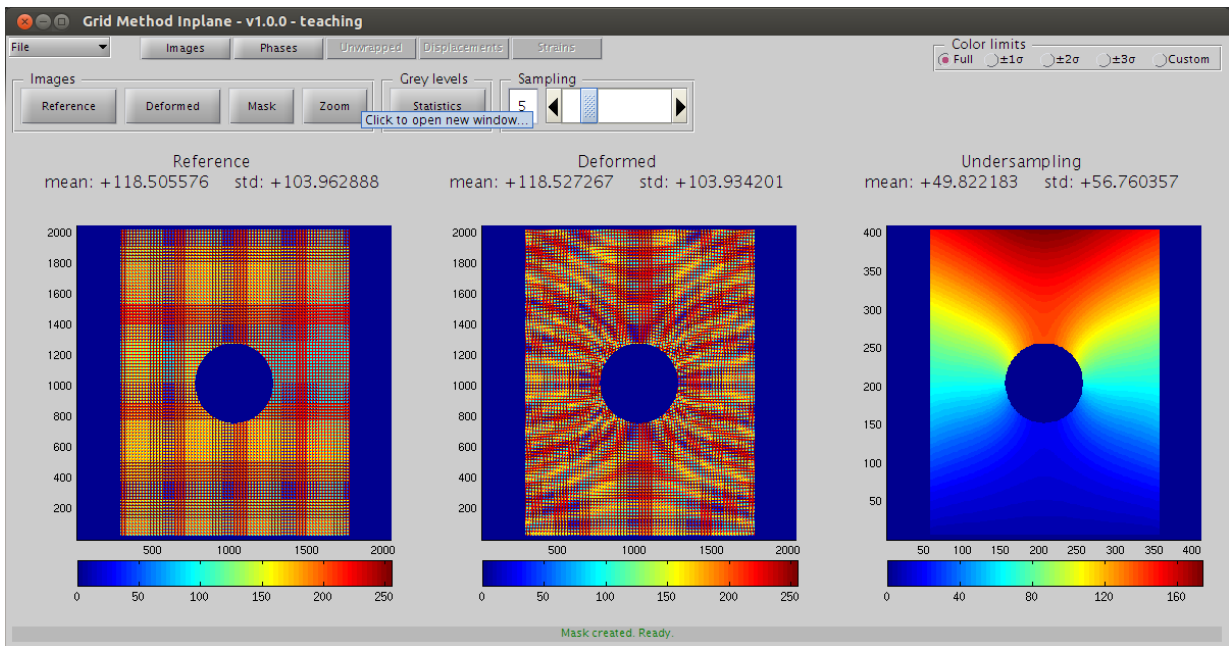


Figure 33. Press **SHIFT** and click **ZOOM** button to open new window.

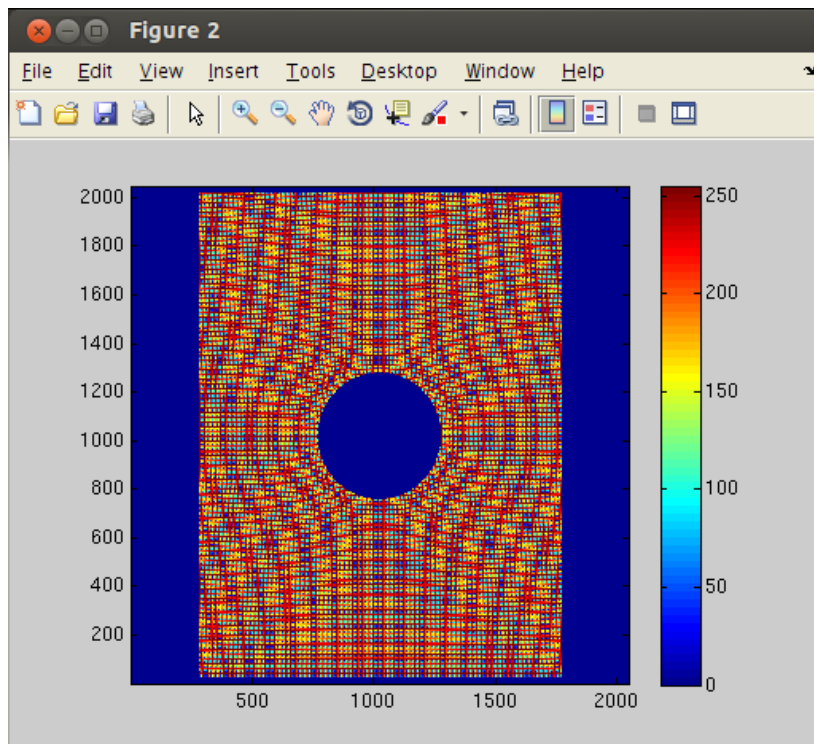


Figure 34. Traditionnal MATLAB figure window showing the deformed image.

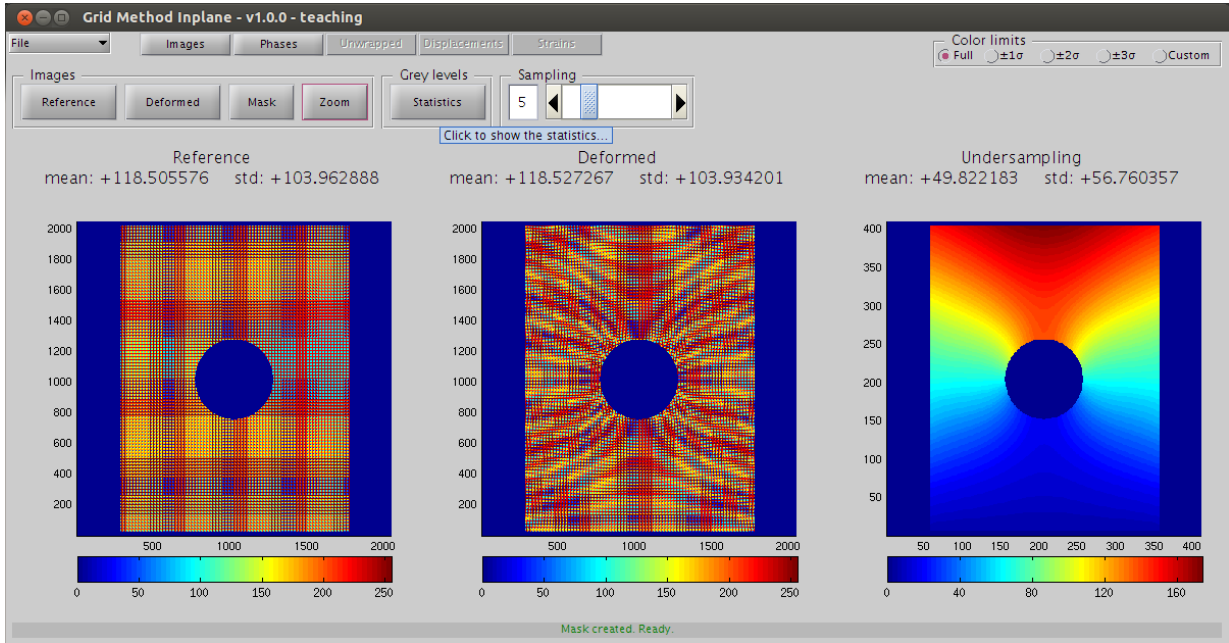


Figure 35. Click **STATISTICS** button to open new window.

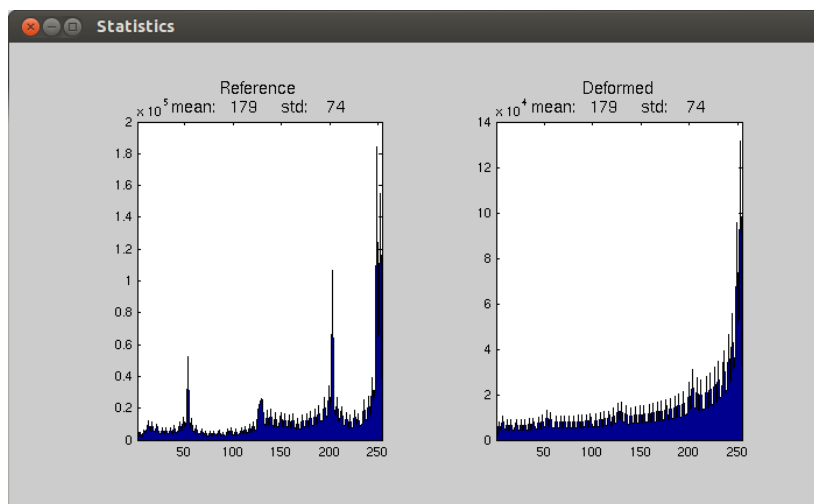


Figure 36. New window showing the grey levels statistics of both the undeformed and deformed images.

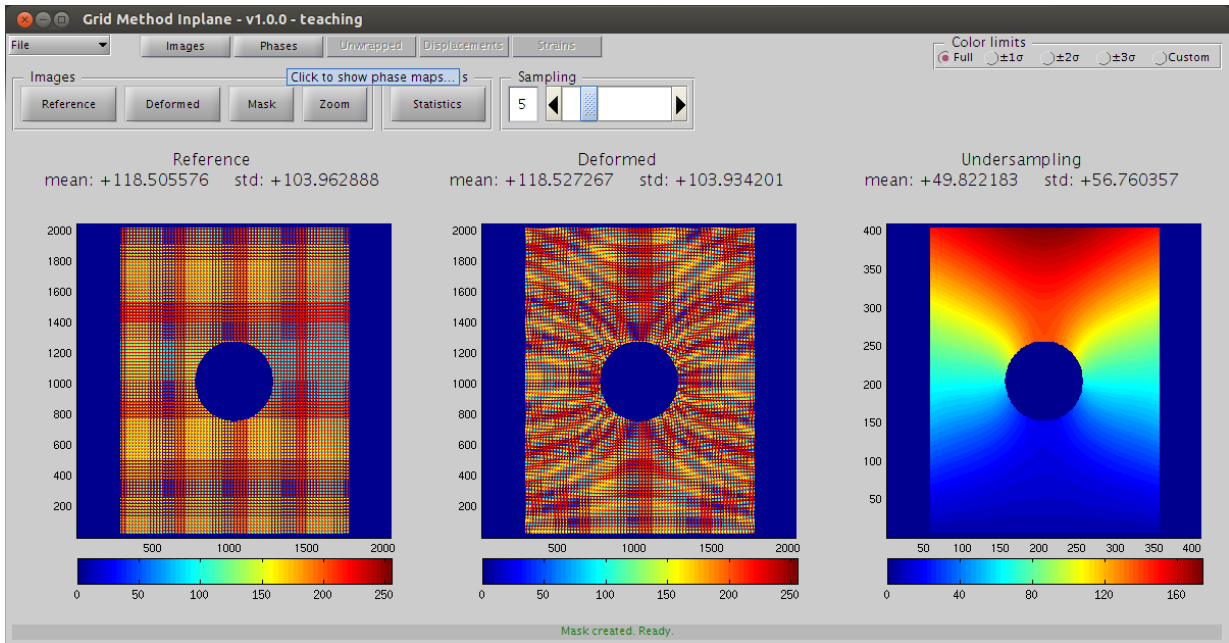


Figure 37. Click **PHASES** button to show the second panel.

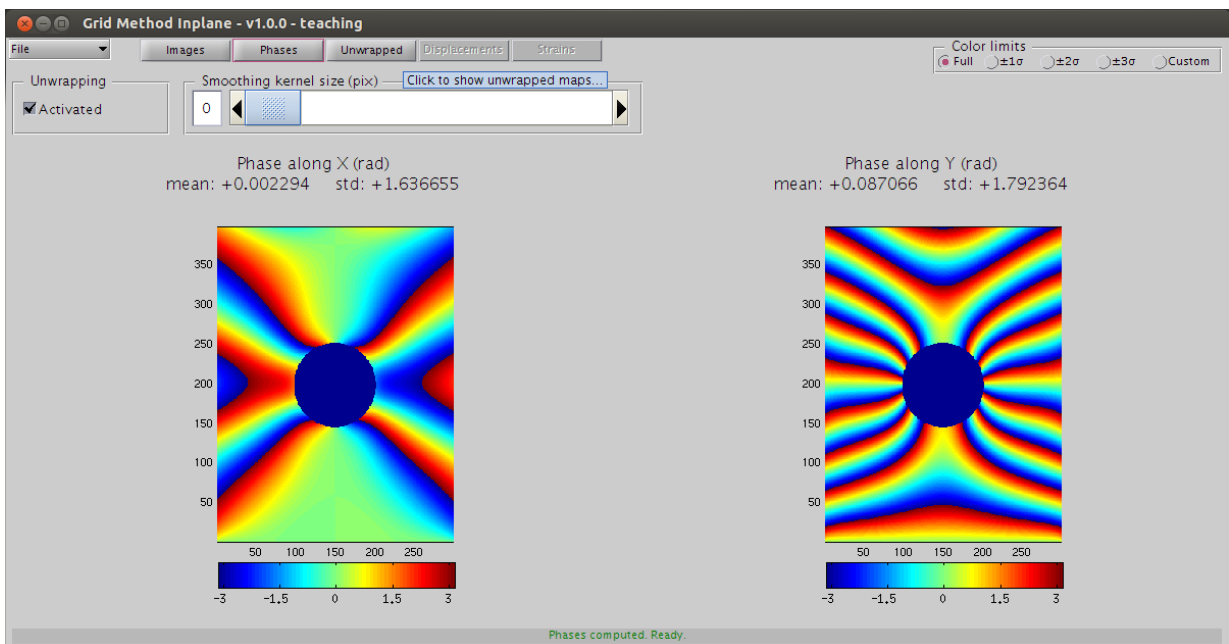


Figure 38. Click **UNWRAPPED** button to show the third panel.



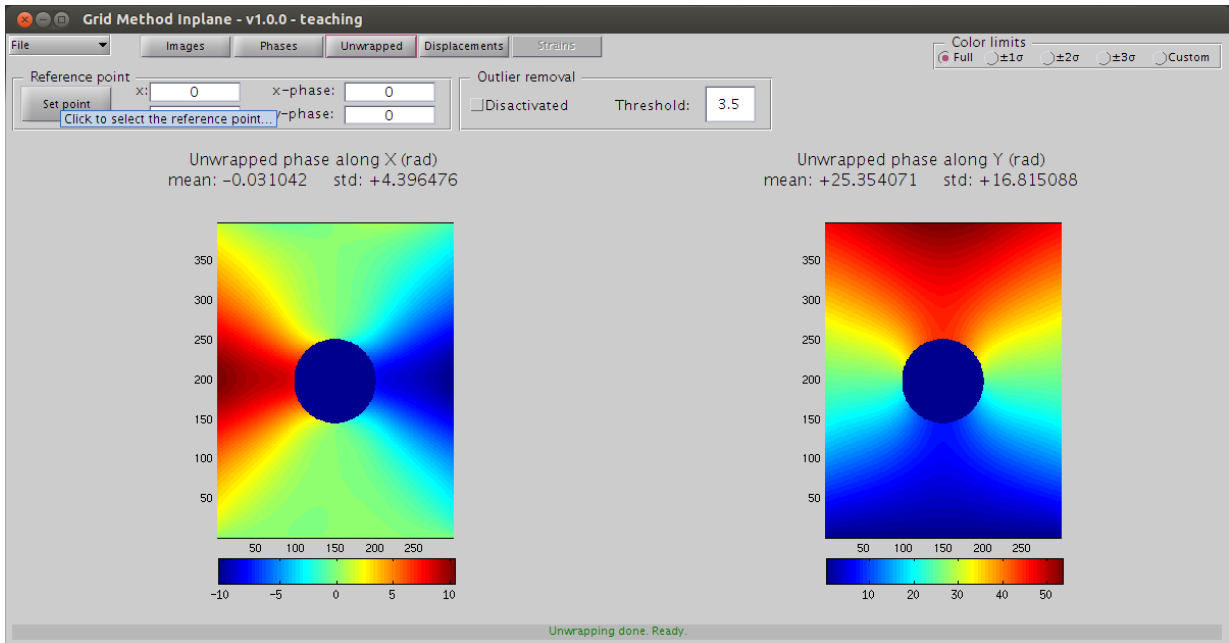


Figure 39. Click **SET POINT** button to select the phase reference.

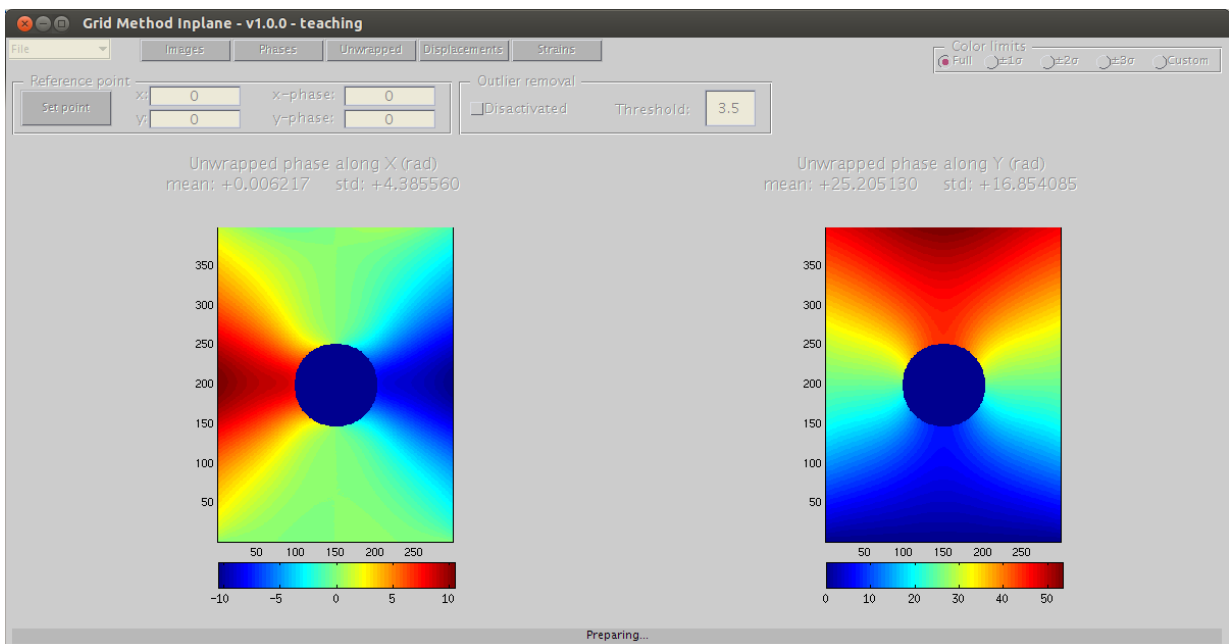


Figure 40. Select the bottom middle point to define the phase reference.

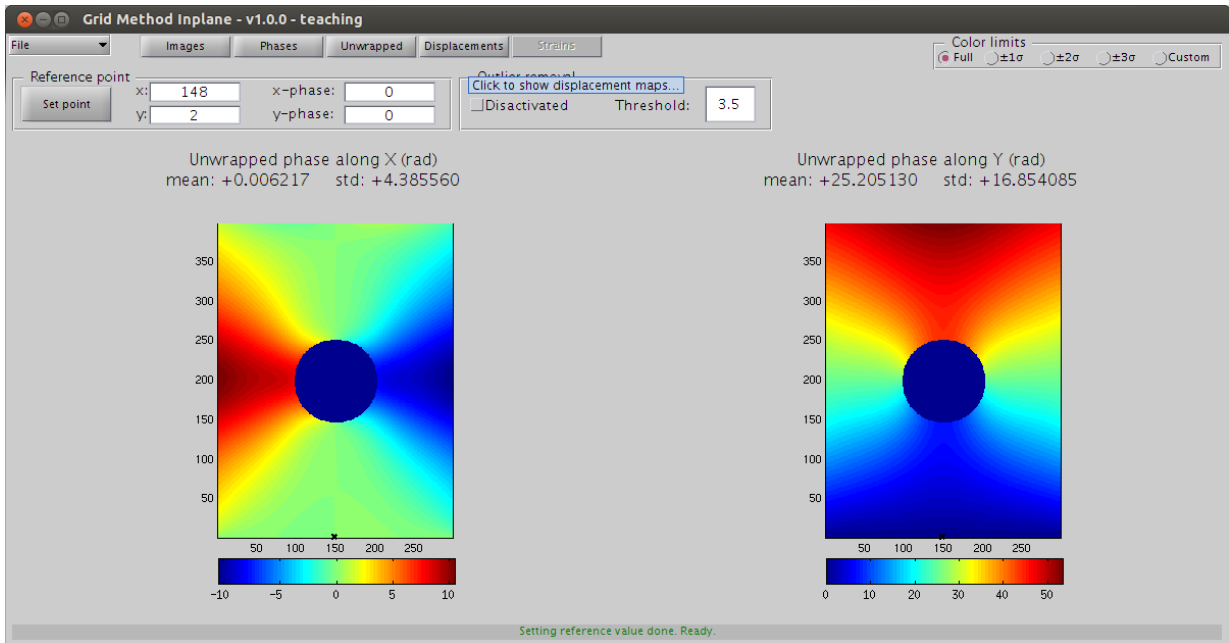


Figure 41. Click **DISPLACEMENTS** button to show the fourth panel.

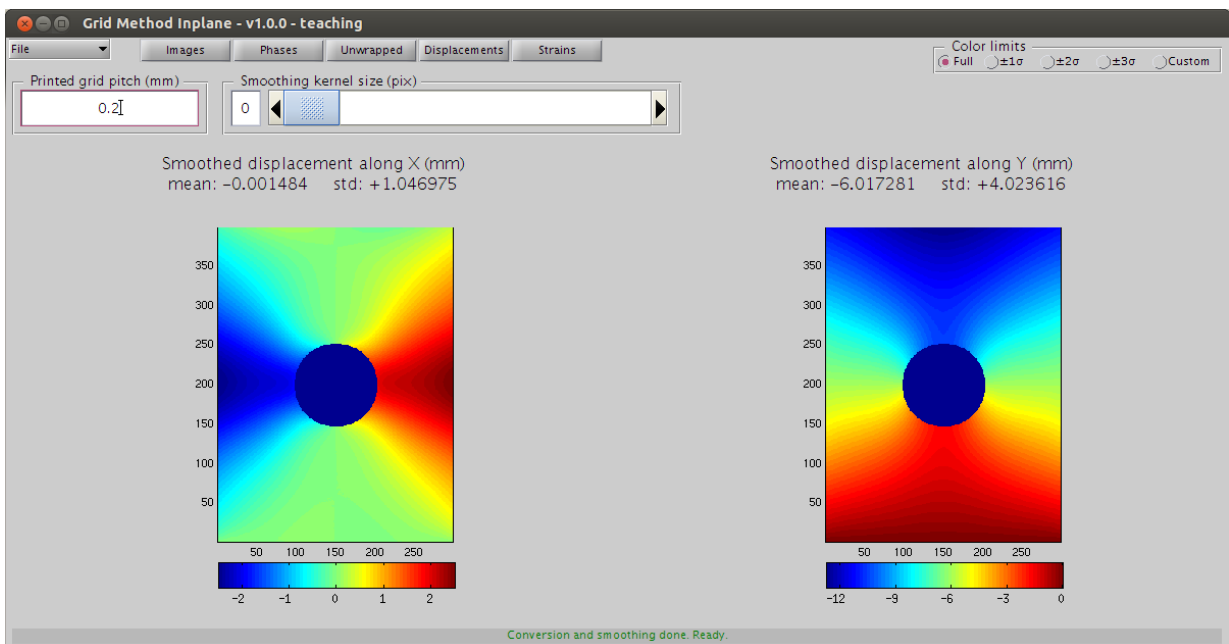
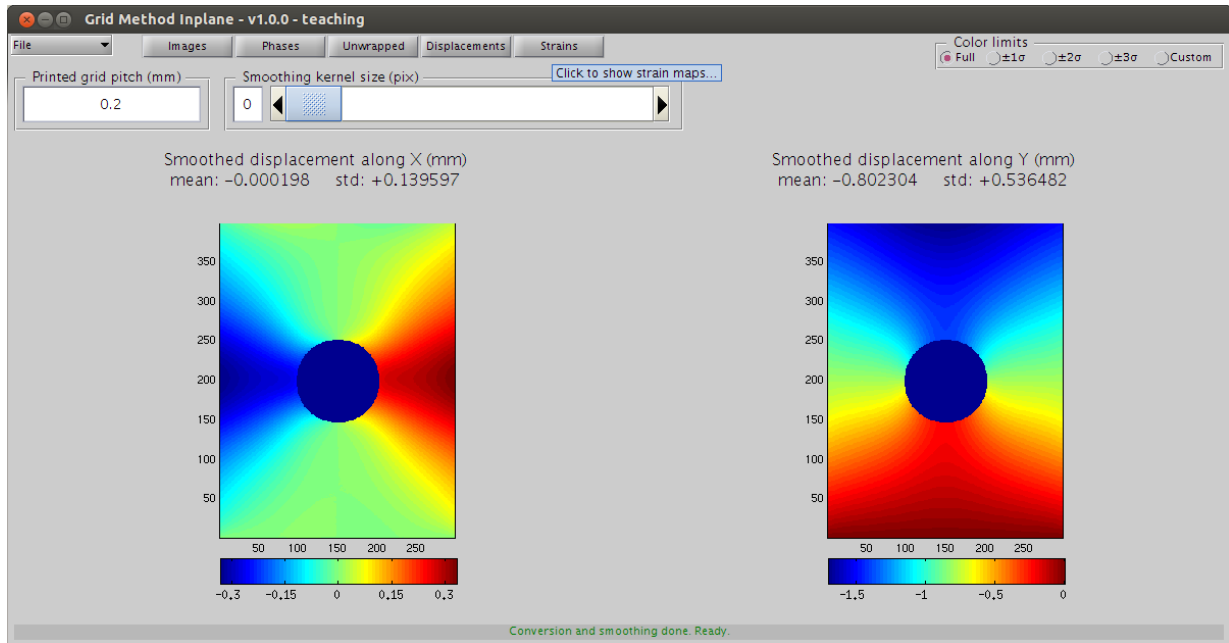
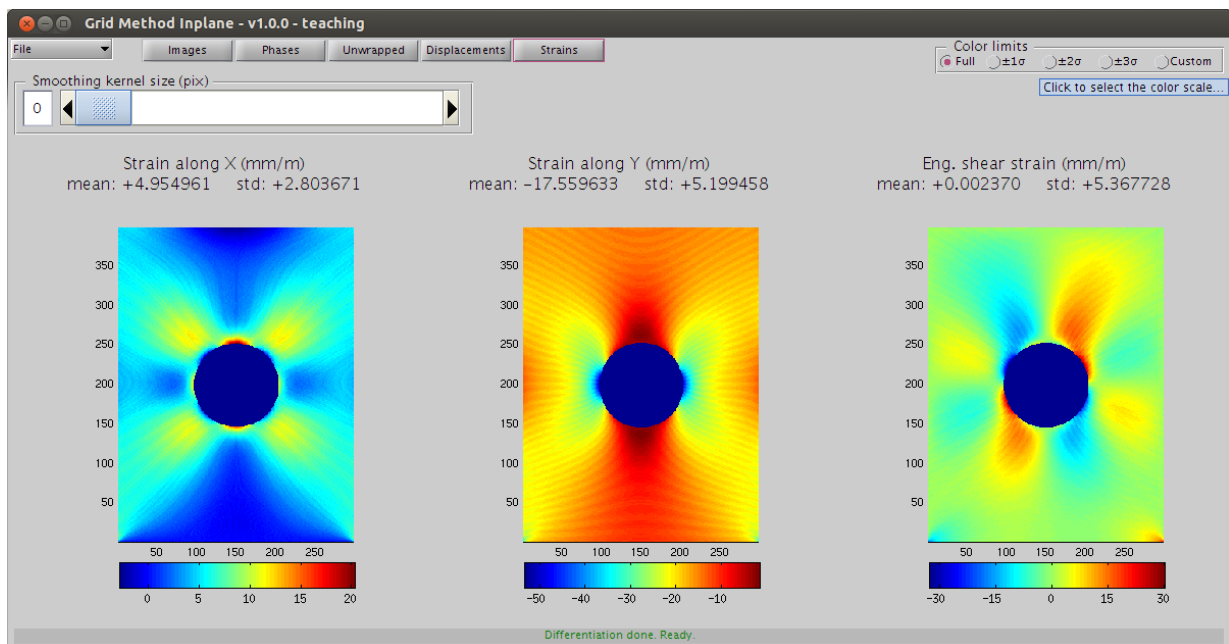


Figure 42. Adjust the **PRINTED GRID PITCH**.

Figure 43. Click **STRAINS** button to show the last panel.Figure 44. Click  $2\sigma$  radiobutton to adjust the colour limits.

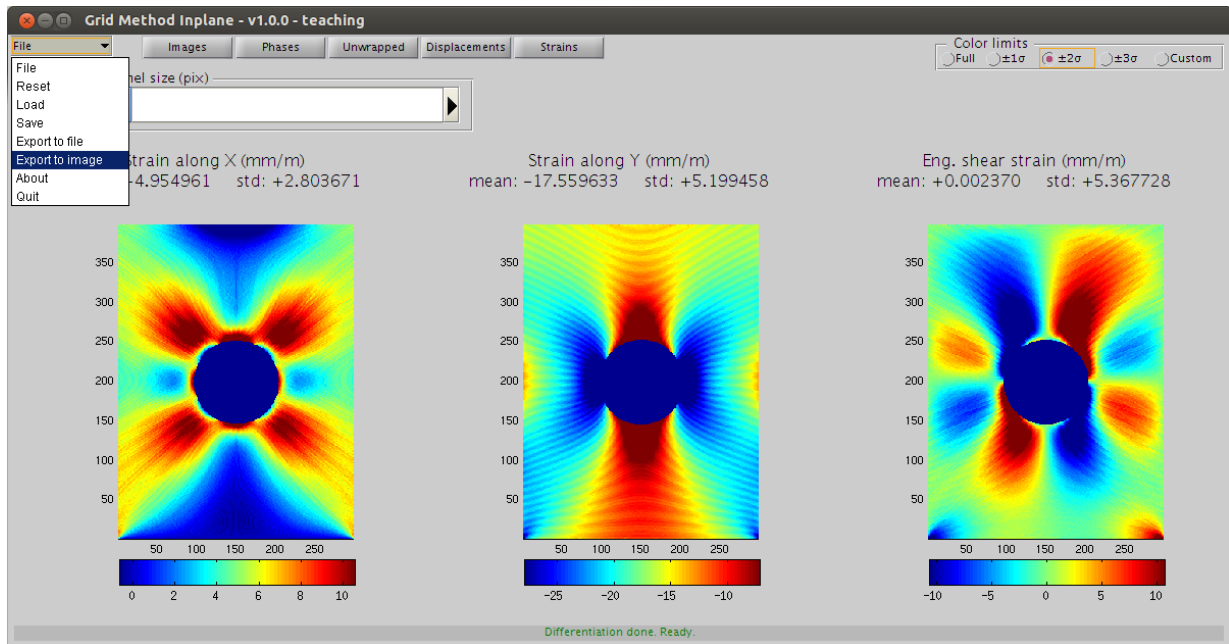


Figure 45. Click **FILE**→**EXPORT TO IMAGE** to export current viewport to a \*.PNG file.

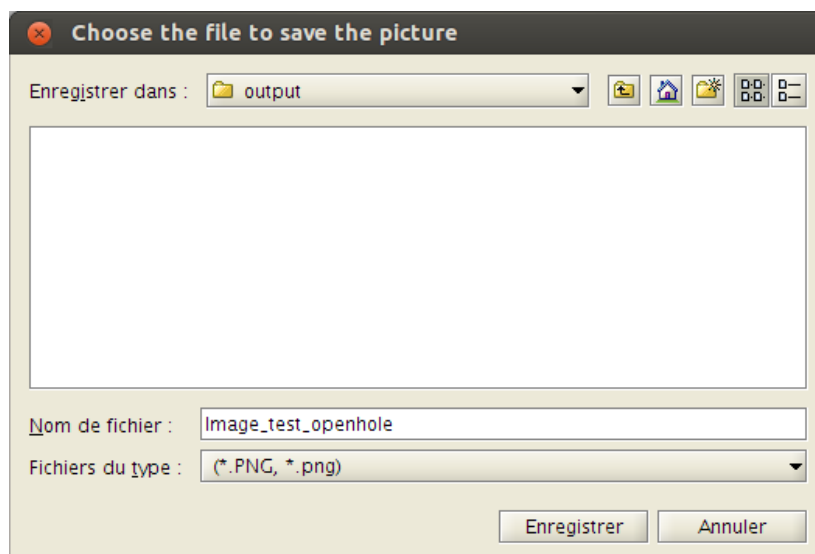


Figure 46. Enter a filename to save the image.

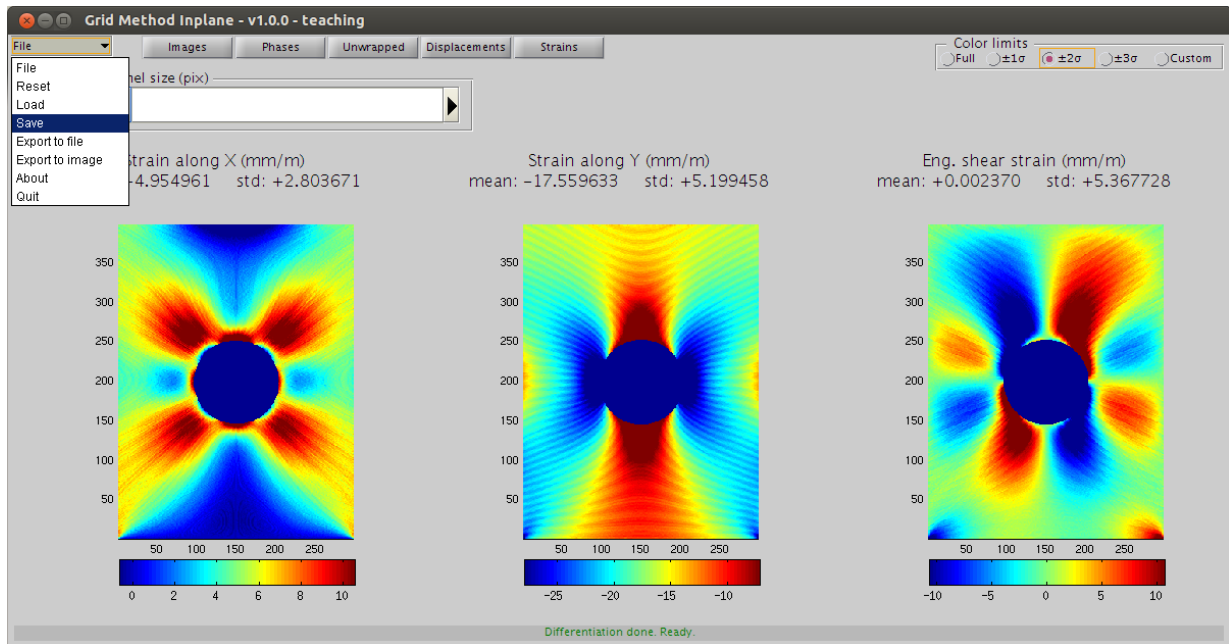


Figure 47. Click **FILE**→**SAVE** to save current dataset to a **\*.GRD** file.

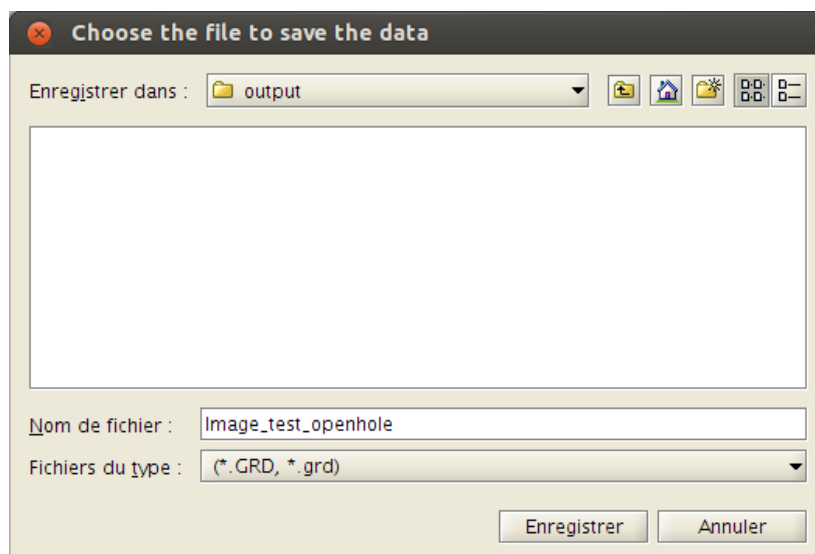


Figure 48. Enter a filename to save the current dataset.

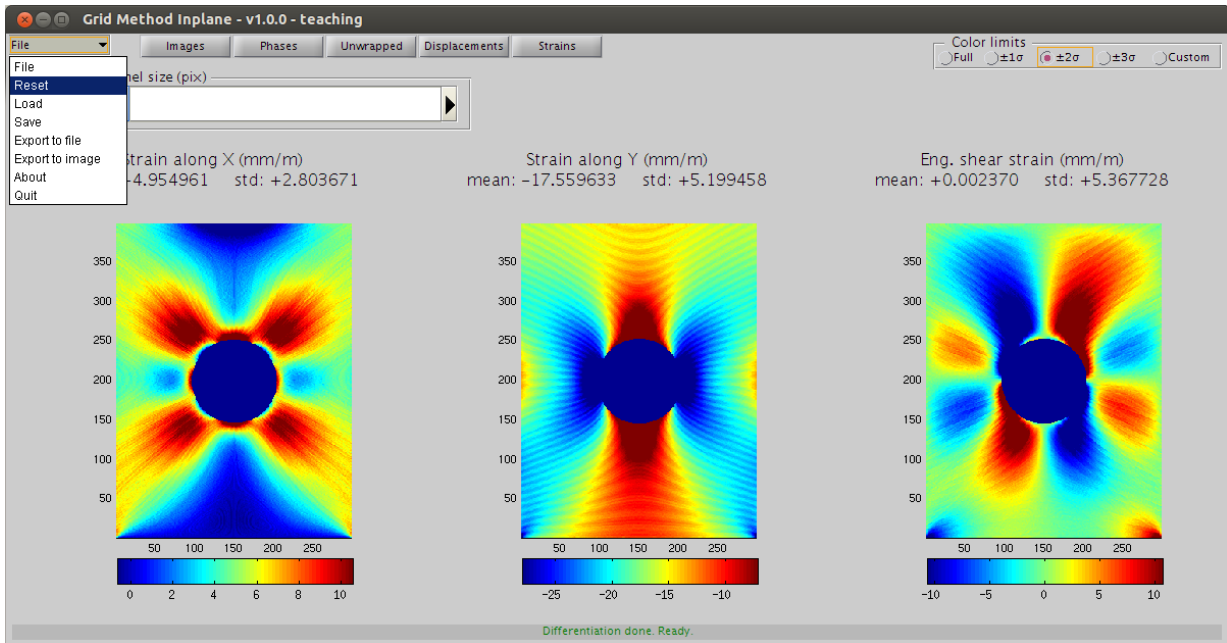


Figure 49. Click **FILE**→**RESET** to delete any currently loaded data.

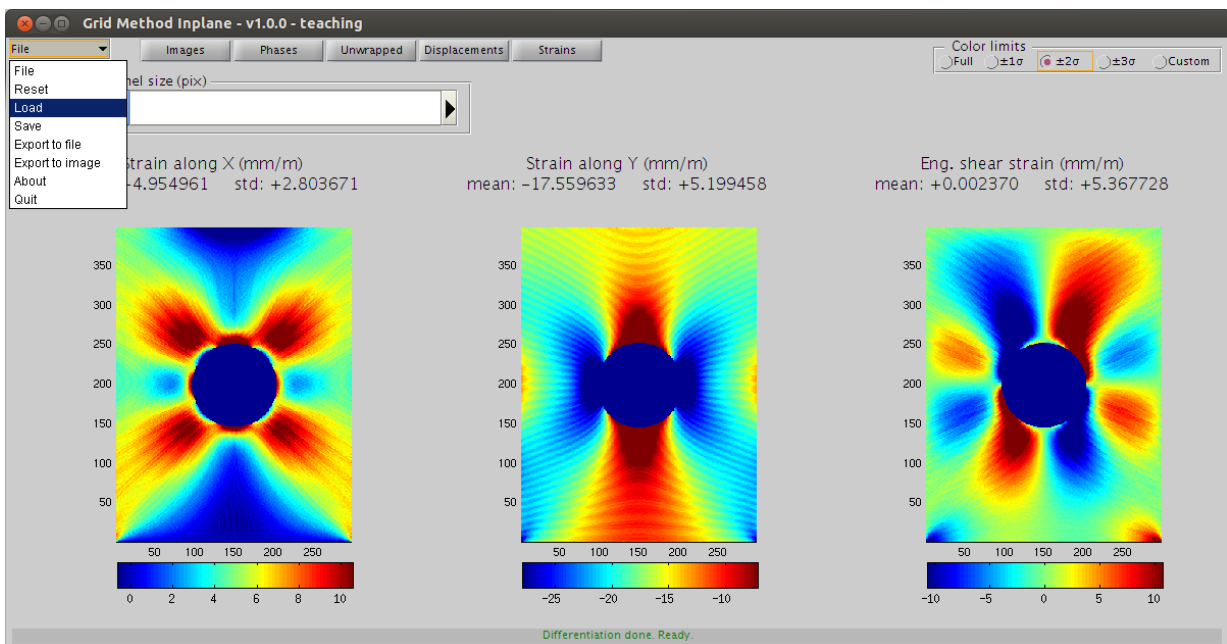


Figure 50. Click **FILE**→**LOAD** to load a previously saved data set.

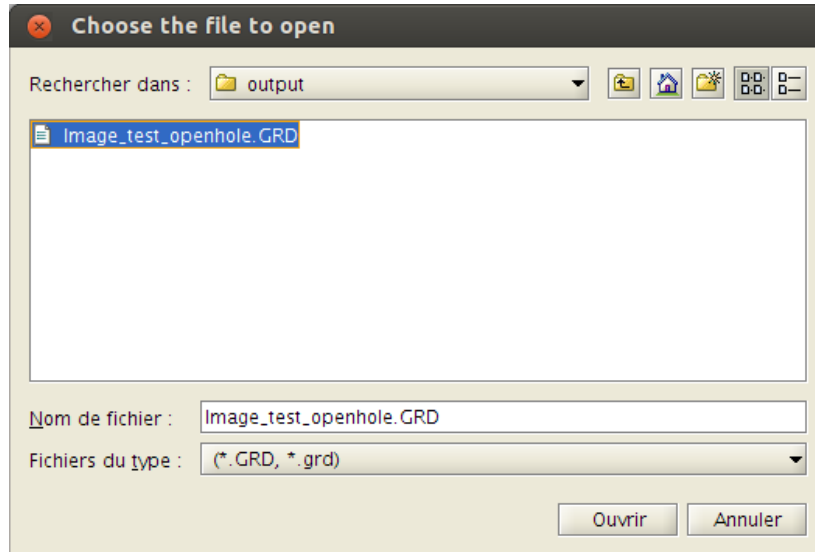


Figure 51. Select the file previously saved.

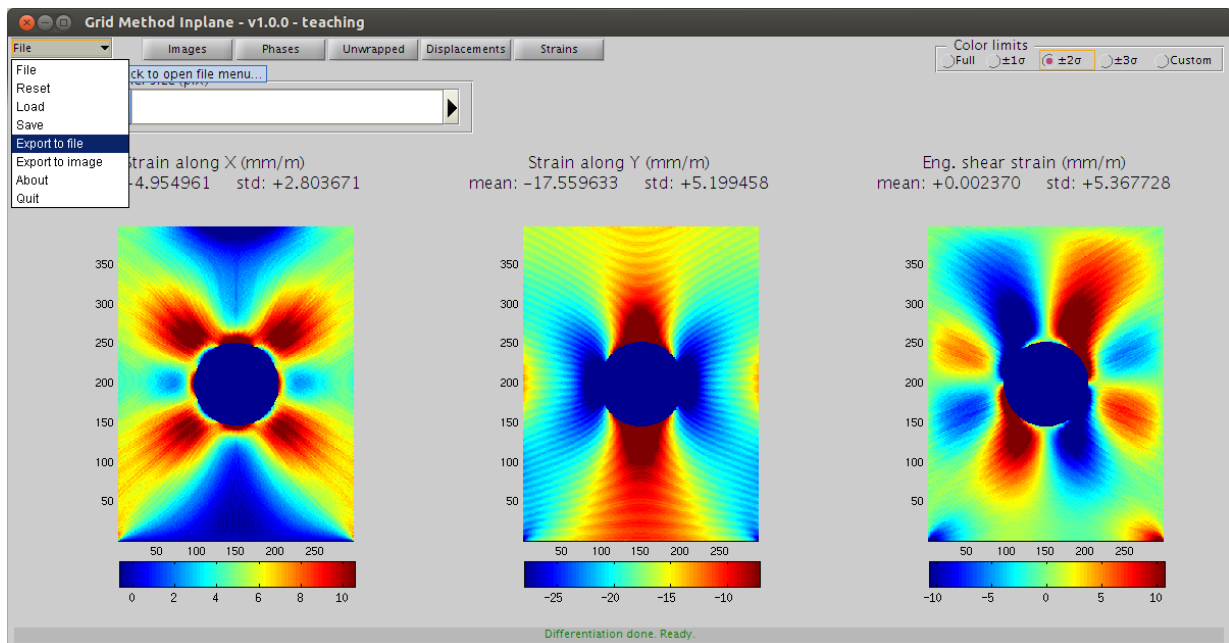


Figure 52. Click **FILE**→**EXPORT TO FILE** to export data to files.

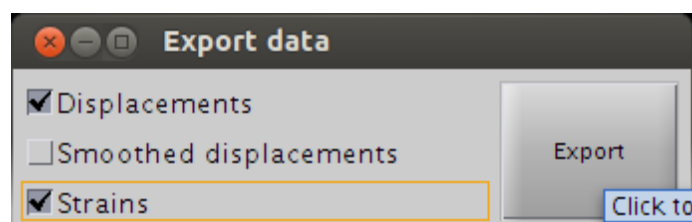


Figure 53. Check **DISPLACEMENTS** and **STRAINS** and click on **EXPORT**.

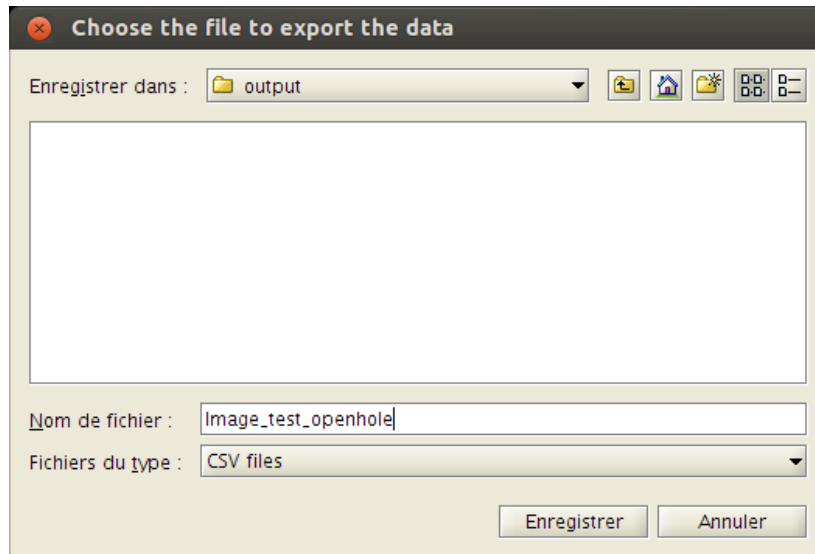


Figure 54. Enter a filename to save the data and select the file type (\*.CSV or \*.MAT).

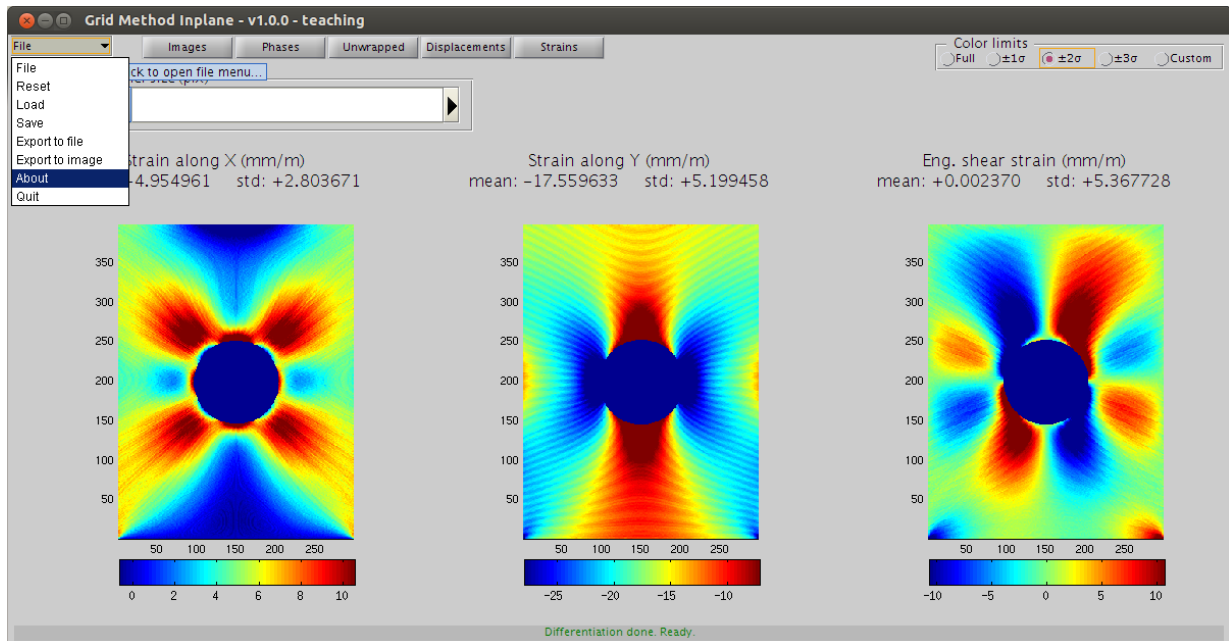


Figure 55. Click **FILE**→**ABOUT** to show information about the software.





Figure 56. About dialog window.