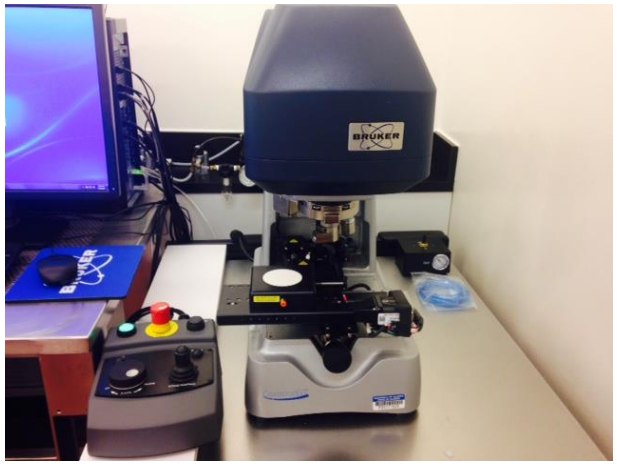
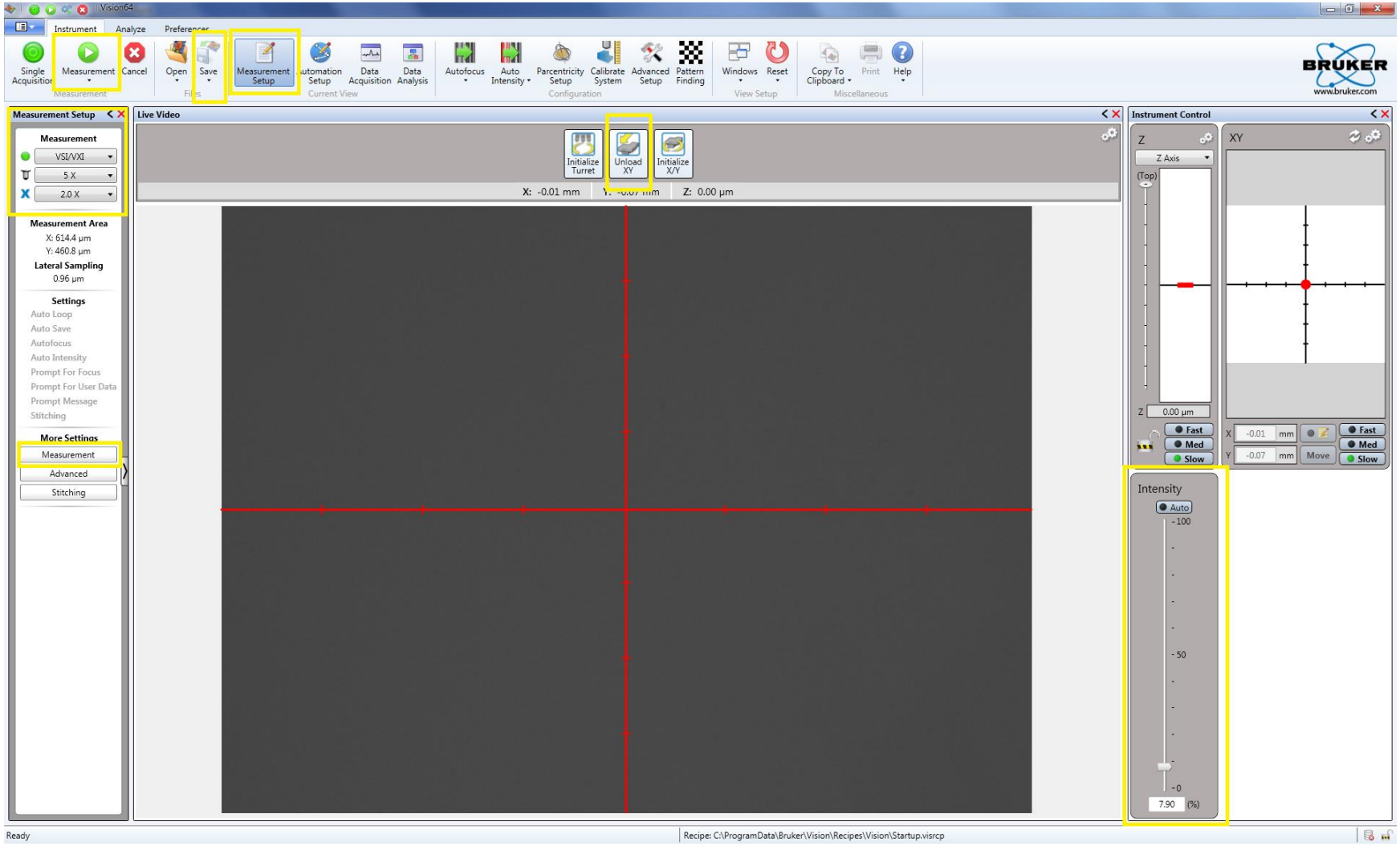
BRUKER CONTOUR GT-K OPTICAL PROFILER OPERATING PROCEDURE

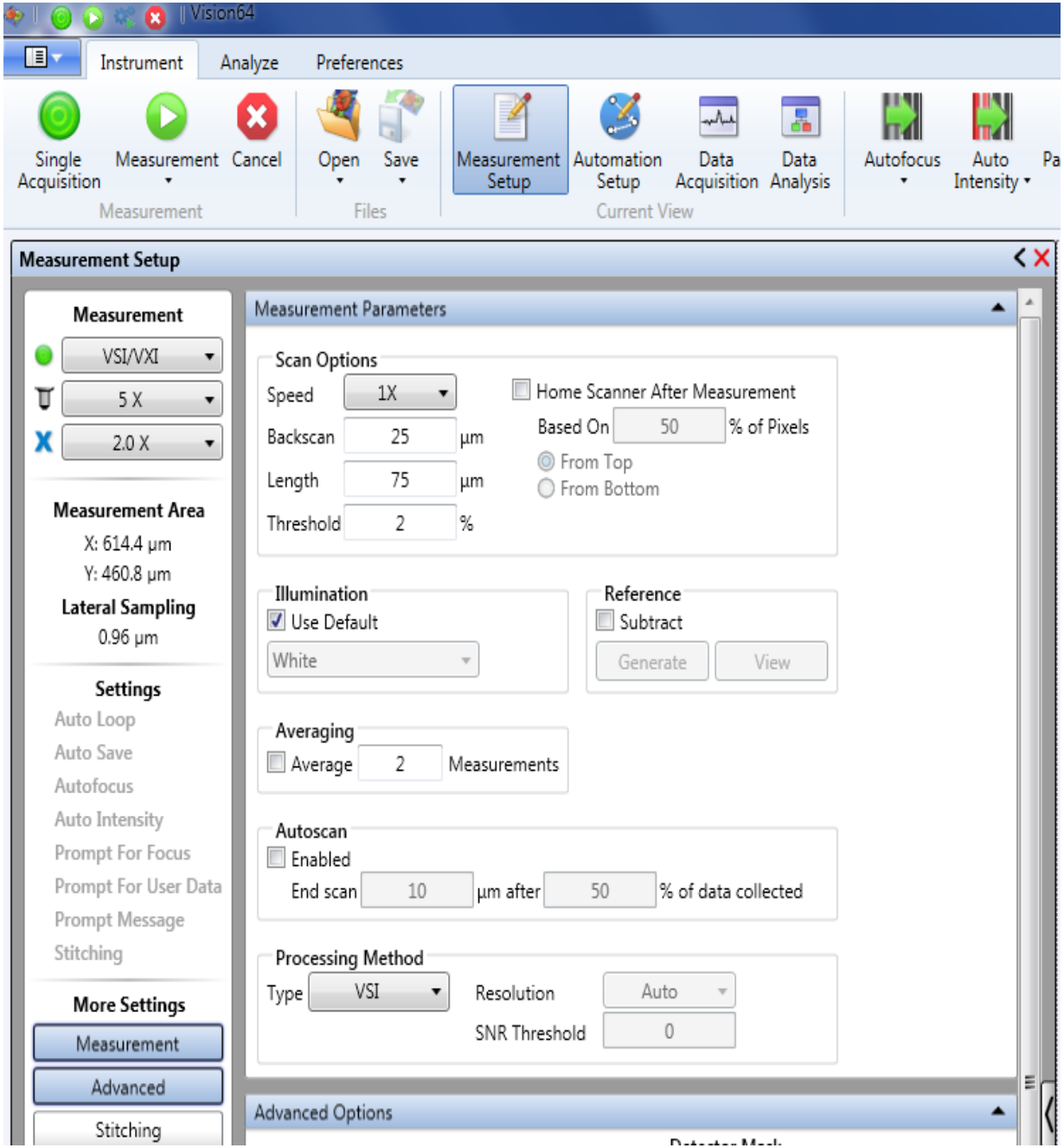


This profiler performs vertical scanning interferometry using a broadband (normally white) light source. It is effective for measuring objects with rough surfaces, as well as those with adjacent pixel-height differences greater than 135 nm. VSI mode yields precision in the nanometer range. In vertical scanning interferometry, the internal translator moves the objective while the camera periodically records frames. As each point on the surface comes into focus, the modulation on that point reaches a maximum, then tapers of as the objective passes through focus. By recording the height of the translator at maximum modulation, the system can determine the height of each pixel. The maximum scan length for a VSI scan is 10 mm.

1. Open **"Vision 64"** software

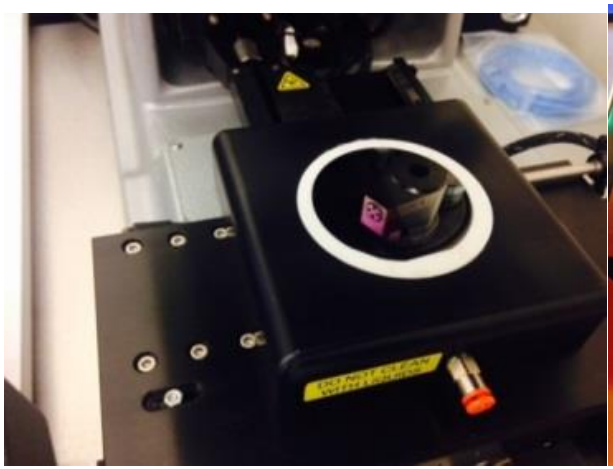


2. Click on **Measurement Setup.** Enter the parameters needed for the sample. Under the **More Settings** option you can access more options for the measurement.



- The **back-scan** parameter indicates distance that the system moves backward before it begins a scan. Set the backscan large enough to account for the greatest possible variation in feature height (that is, large enough to enable the scanning of even the tallest features). The larger the backscan, however, the longer the scan time.
- The **length** indicates the movement of the fringes through the sample from the highest to lowest points (that is, the length of the primary scan). To determine the appropriate length, estimate the peak-to-valley height of the thick film that you are measuring, and then set the length 10% to 20% higher.
- The fringes must translate over the entire field of view to measure the full surface. If the fringes don't move all the way through the surface, the scan length is not enough.
- The **Averaging** parameter can be set to prompt the profiler to take an average of several measurements.
- The measurement **type** should be VSI.

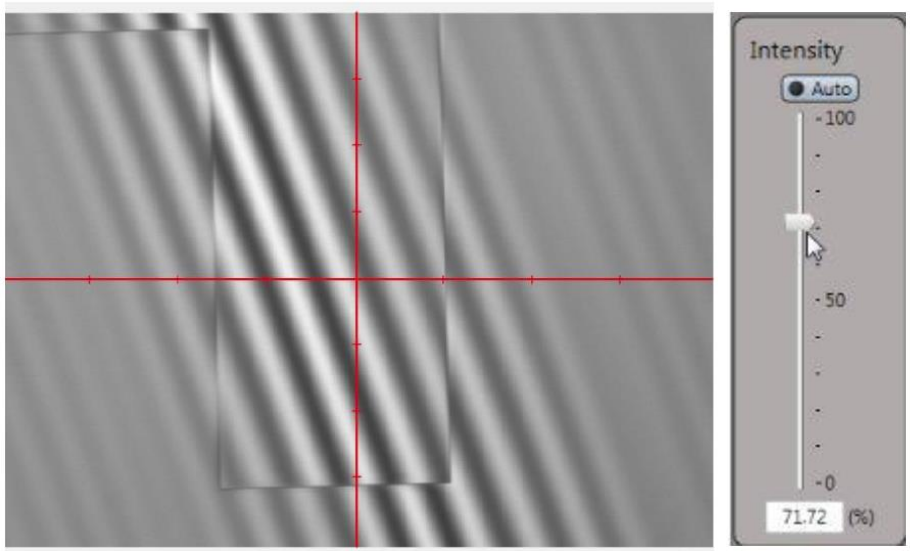
3. Place your sample on the stage and use the joystick to move the stage into place. **Press down the button on top of the joystick to move it faster**.



4. Focus on the surface by moving the stage up using the **"Z-Axis"** control. (Pressing the **"Fast"** button moves the stage faster)

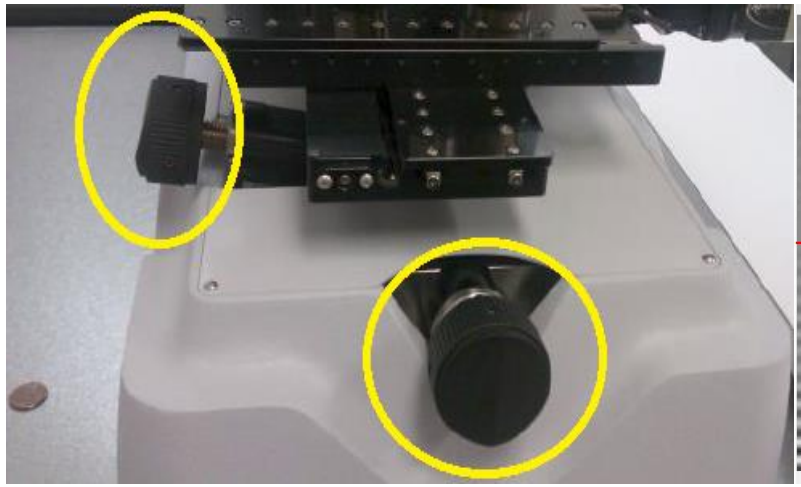
NOTE: Constantly monitor the gap between the objective lens and sample while adjusting the Z position. Crushing the objective lens to sample will seriously damage the instrument and result in expensive repair.

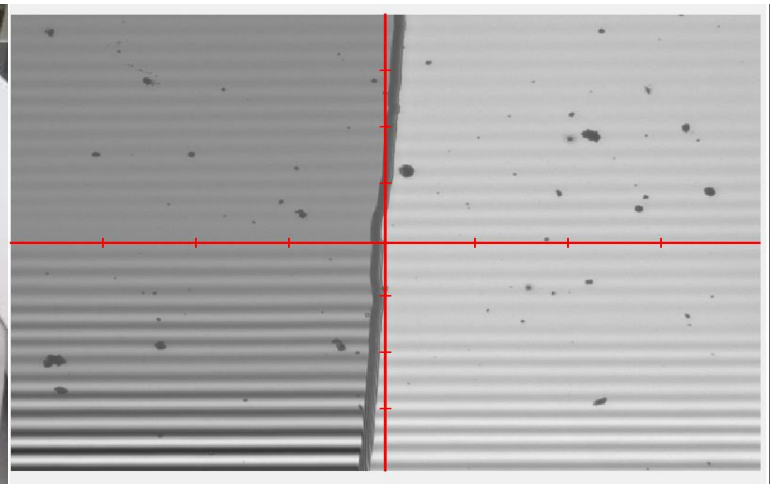
5. Find the fringes by using the **Z-Axis** knob on the controller. Stop pressing the **Fast** button to move the stage slowly. This allows you to find the fringes.



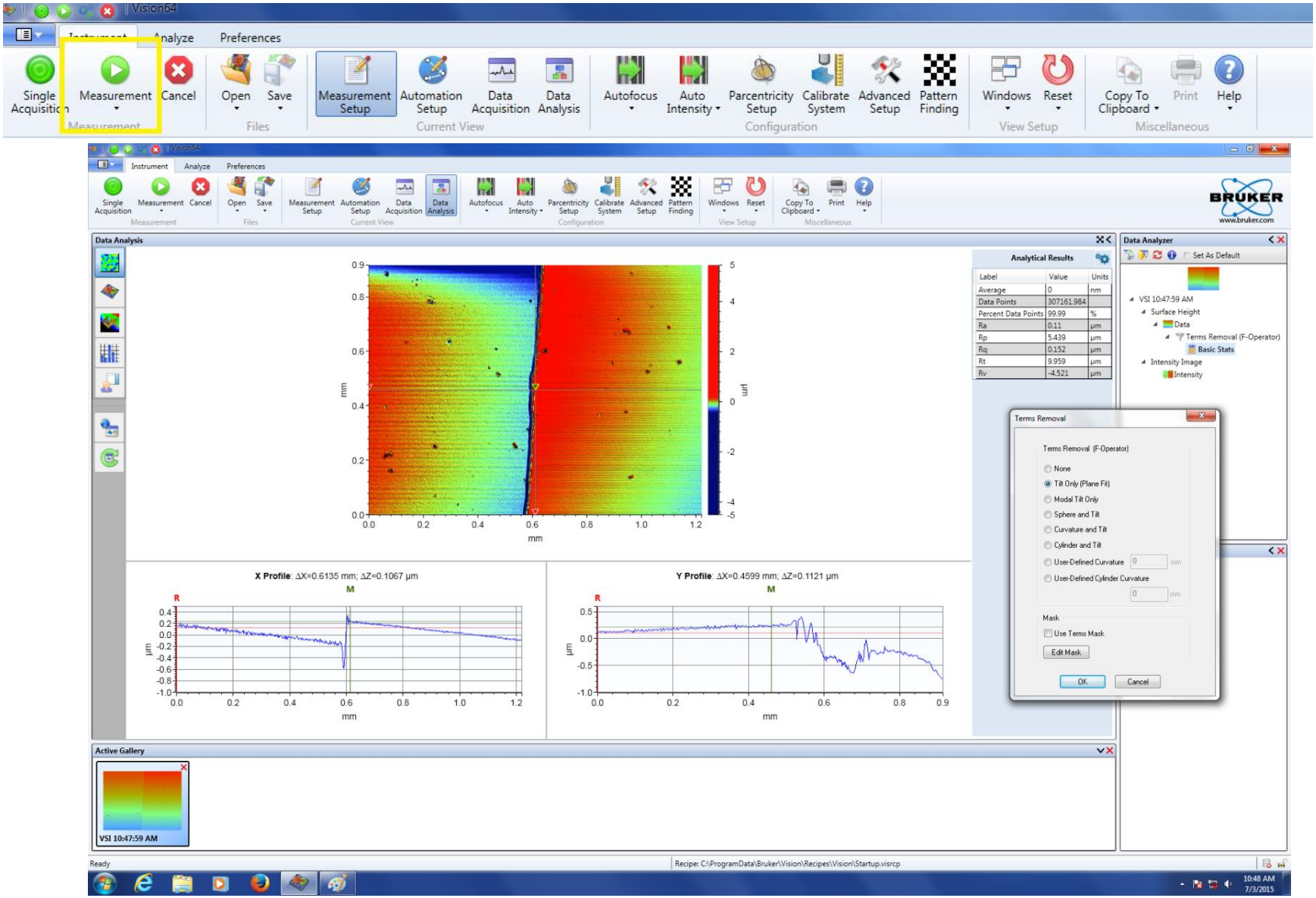
6. Part of the image might be red indicating that the detector is saturated. Click **Auto** to automatically adjust the intensity.

7. You can tilt the stage by using the knobs on the bottom of the microscope. This usually isn't necessary when you have flat sample.

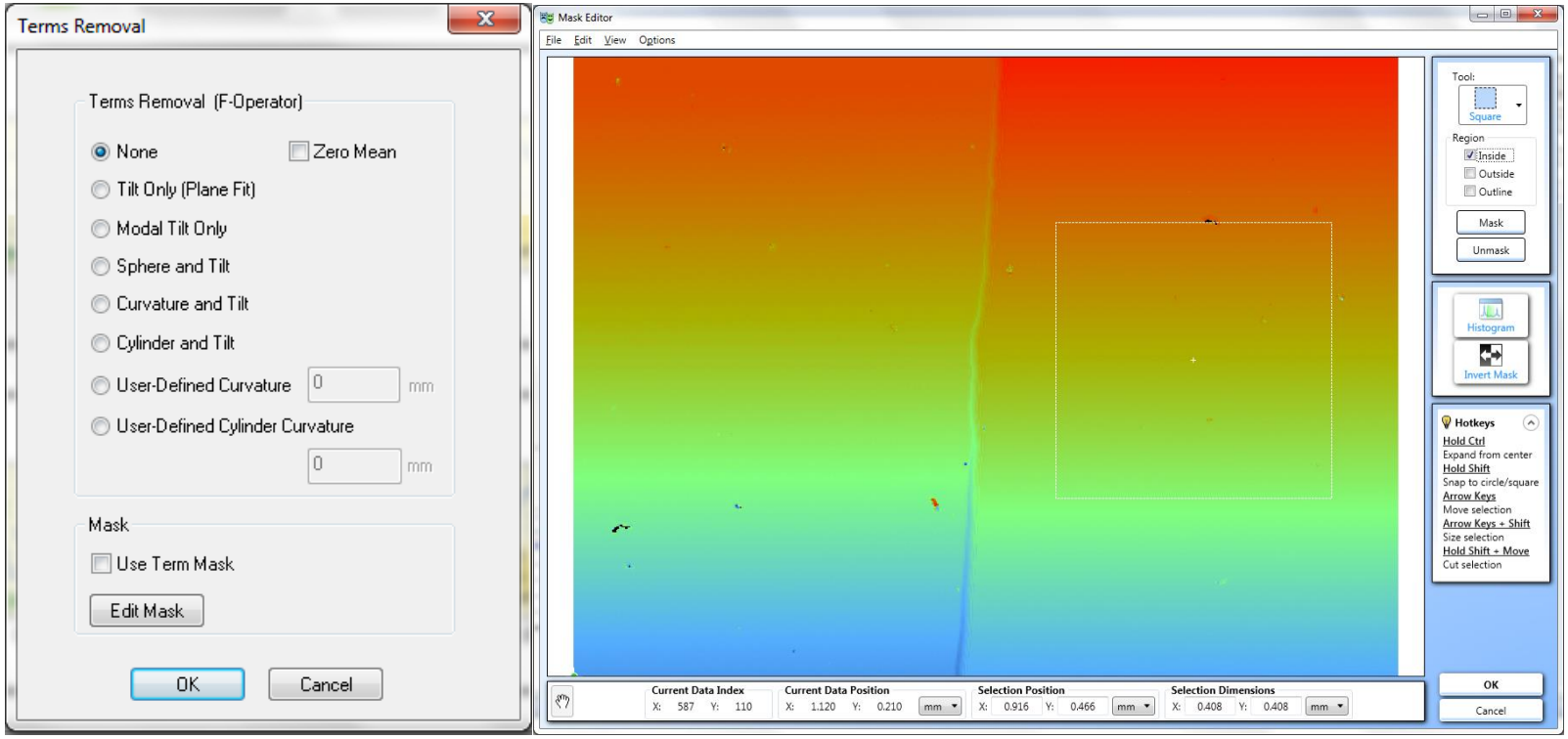




8. Click **Measurement**. The following page will appear after a measurement is taken.

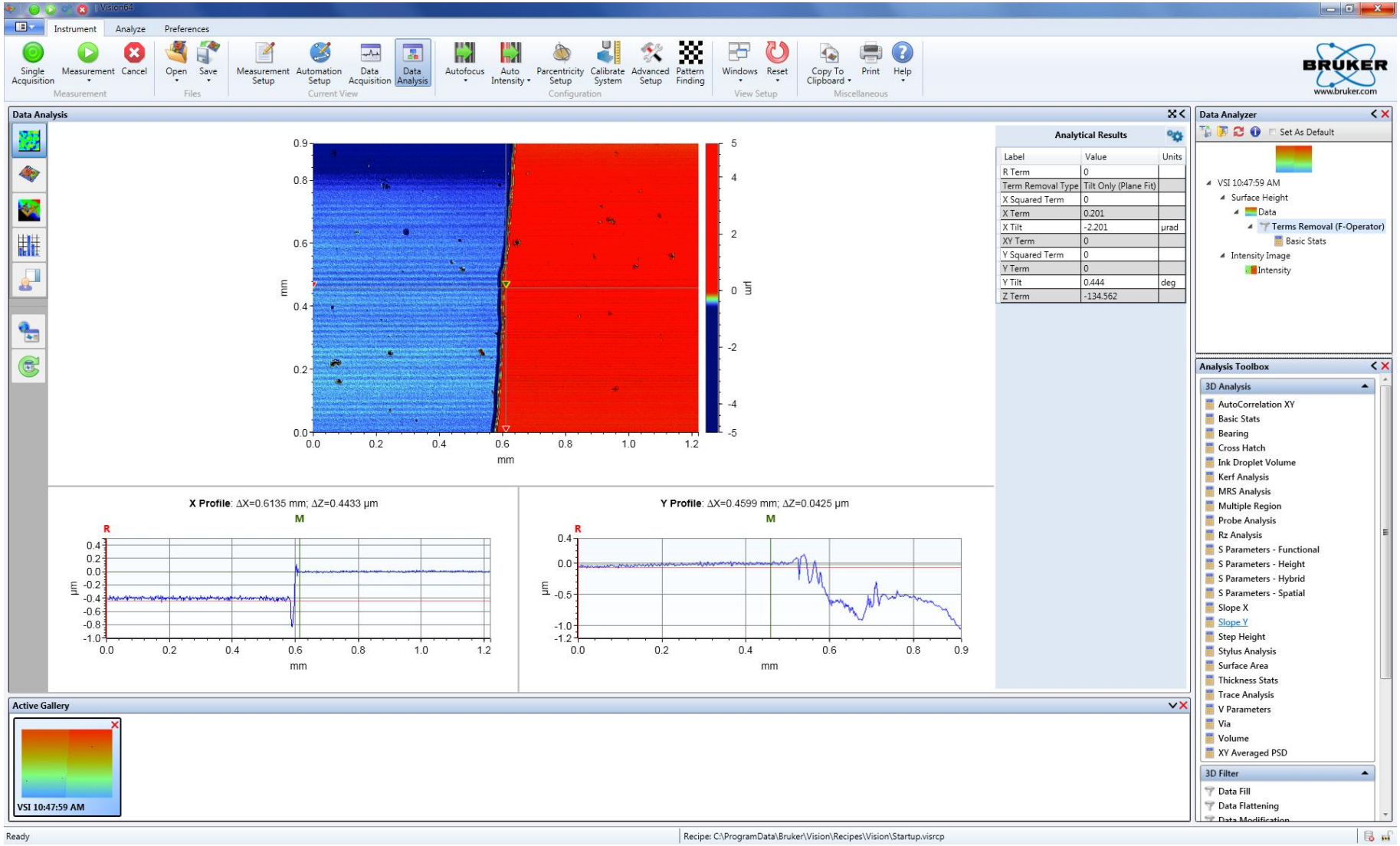


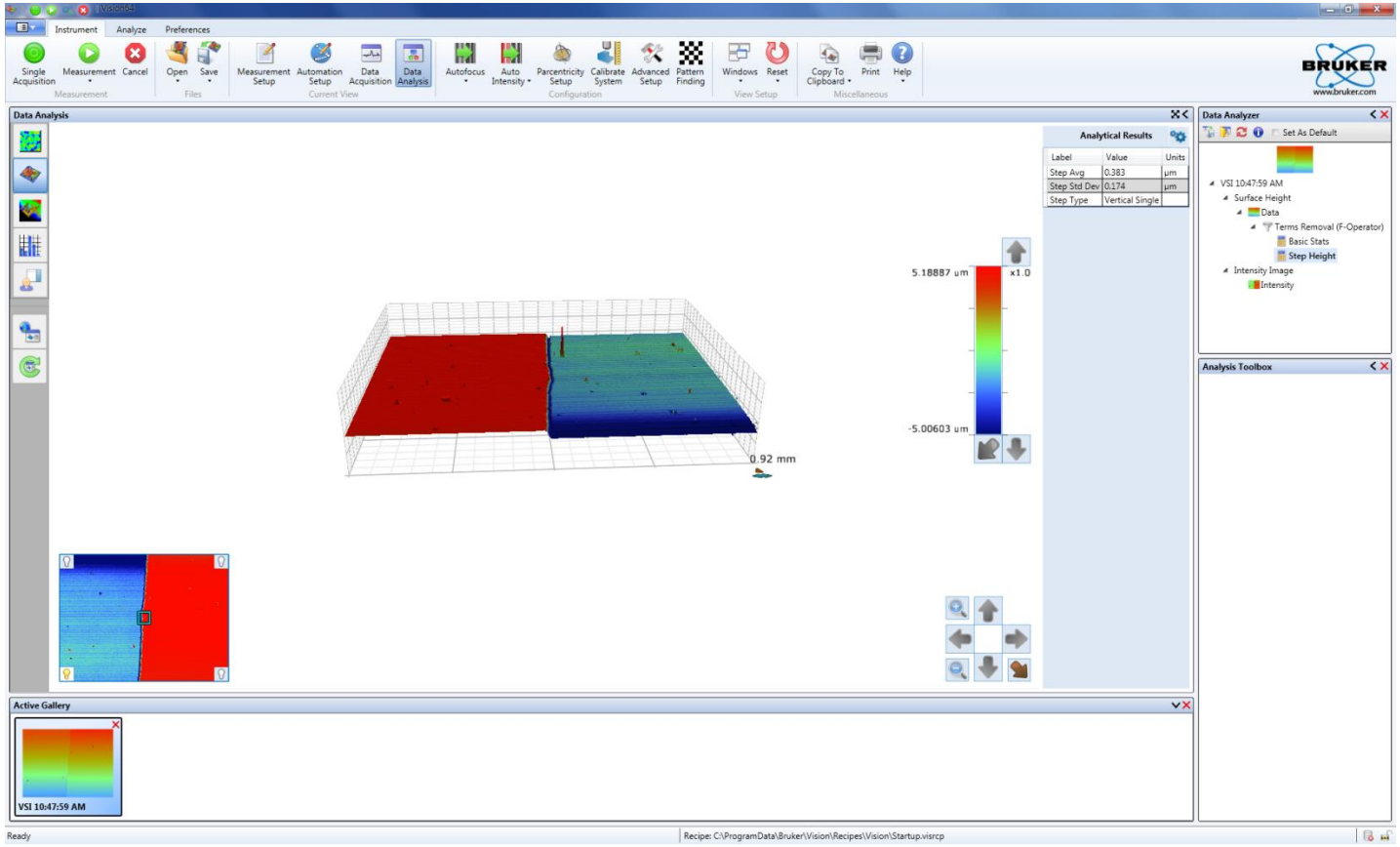
9. Once measurement is done, right click on **Terms Removal (F - Operator) --> Edit Settings --> Edit Mask** and then choose the section to be leveled. Usually, this is flattest part of the sample, i.e. bare Silicon surface.



10. You can use in the area inside or outside the mask as the leveled area. Click **Ok** in the **Mask Editor** when done. Make sure the box for **Use Terms Mask** is selected. Click **Ok** in **Terms Removal.**

11. The data will now be level and you can select the what data parameters to view by clicking on **Terms Removal (F-Operator).**



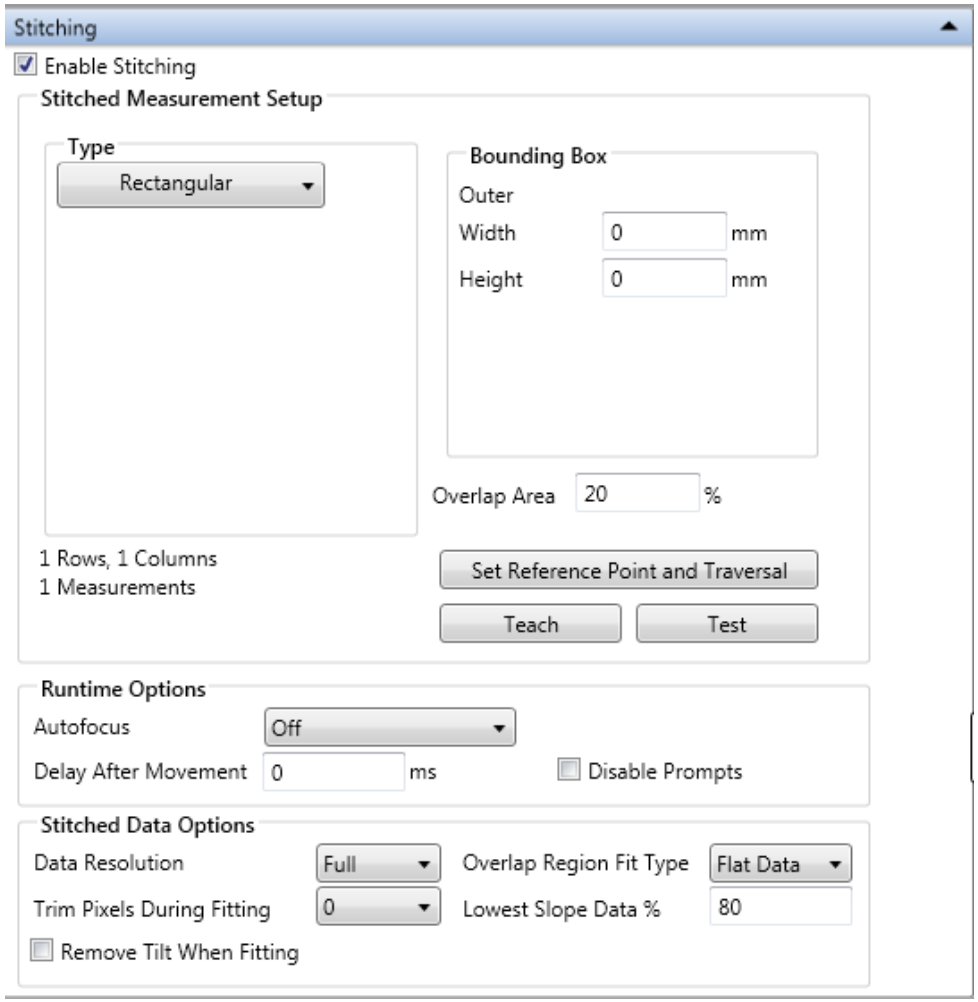


12. You can select other graphs and plots by clicking any of the icons on the left-hand side of the **Data Analysis** window.

Stitching

You might want to scan a large area that cannot be captured in one scan by any of the objectives. During a stitching operation, two or more partially overlapping measurements are registered and matched to form a single dataset. The system uses the overlap regions to calculate best fit.

13. Click the **Stitching** button under **More Settings** in the **Measurement Control Panel**. Click the **Enable Stitching**.

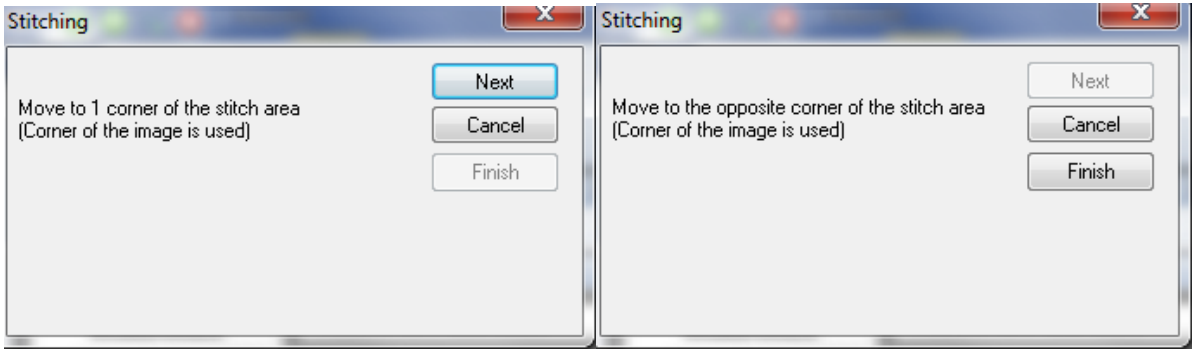


- Select the shape of the areas that you want to stitch: **Rectangular**, **Circular**, **Circular Annulus** (ring-shaped), **Cylindrical, Rectangular Annulus** (frame-shaped), or **User Defined**.
- If you know the dimensions of your sample, enter the dimensions in the field(s) to the right of the list of sample shapes—the bounding box for a rectangle, the diameter for a circle, the outer and inner bounding boxes for a rectangular annulus, the outer and inner diameter for a circular annulus, etc.
- For the **User Defined Type** use the **Browse** button to select the **Locations Filename**, which contains a list of comma-separated XY locations where the first line contains the units. Click the **Import** Locations button to load the XY locations.

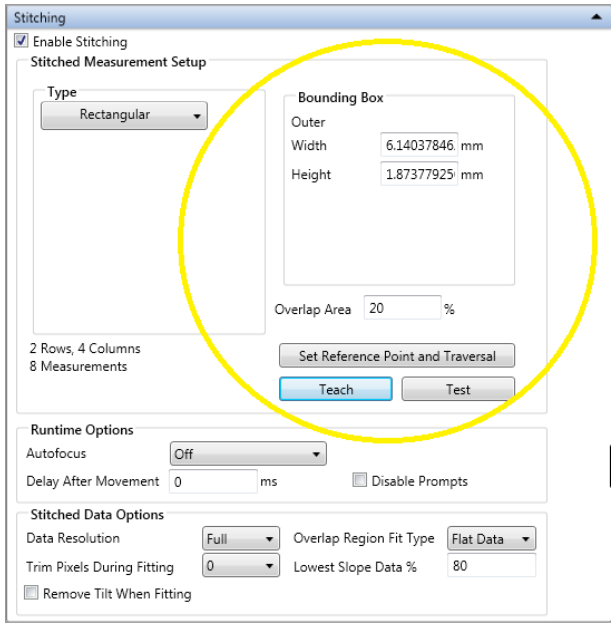
14. In the **Overlap Area** field, enter the amount of area that you want the system to overlap on the stitched scans. A higher overlap percentage produces a better fit but requires more scans. Because the system spaces the scans evenly, the actual overlap may be higher than the percentage that you set.

Option	Type of Data Used to Calculate Best Fit
All data in overlap region	The system uses every datapoint in the area of overlap with the measurement that is being added. It then uses the accumulated data to calculate best fit. This option provides the best resolution by using all points. It can, however, introduce error in measurements of surfaces with artifacts.
Low in overlap region	The system uses only data that is below the average in the area of overlap with the measurement that is being added. It then uses the accumulated below-average data to calculate best fit. This option minimizes error in measurements of surfaces with discrete steps.
High in overlap region	The system uses only data that is above the average in the area of overlap with of the measurement that is being added. It then uses the accumulated above-average data to calculate best fit. This option minimizes error in measurements of surfaces with discrete steps.
Flat data in overlap region	The system uses only the flattest data in the area of overlap with the measurement that is being added. The average slope in all four directions is first calculated for each point, and then the user-specified percent of the data with the smallest slope is used to calculate best fit. This option minimizes error in measurements or edges by using only the smoothest or flattest areas of data.

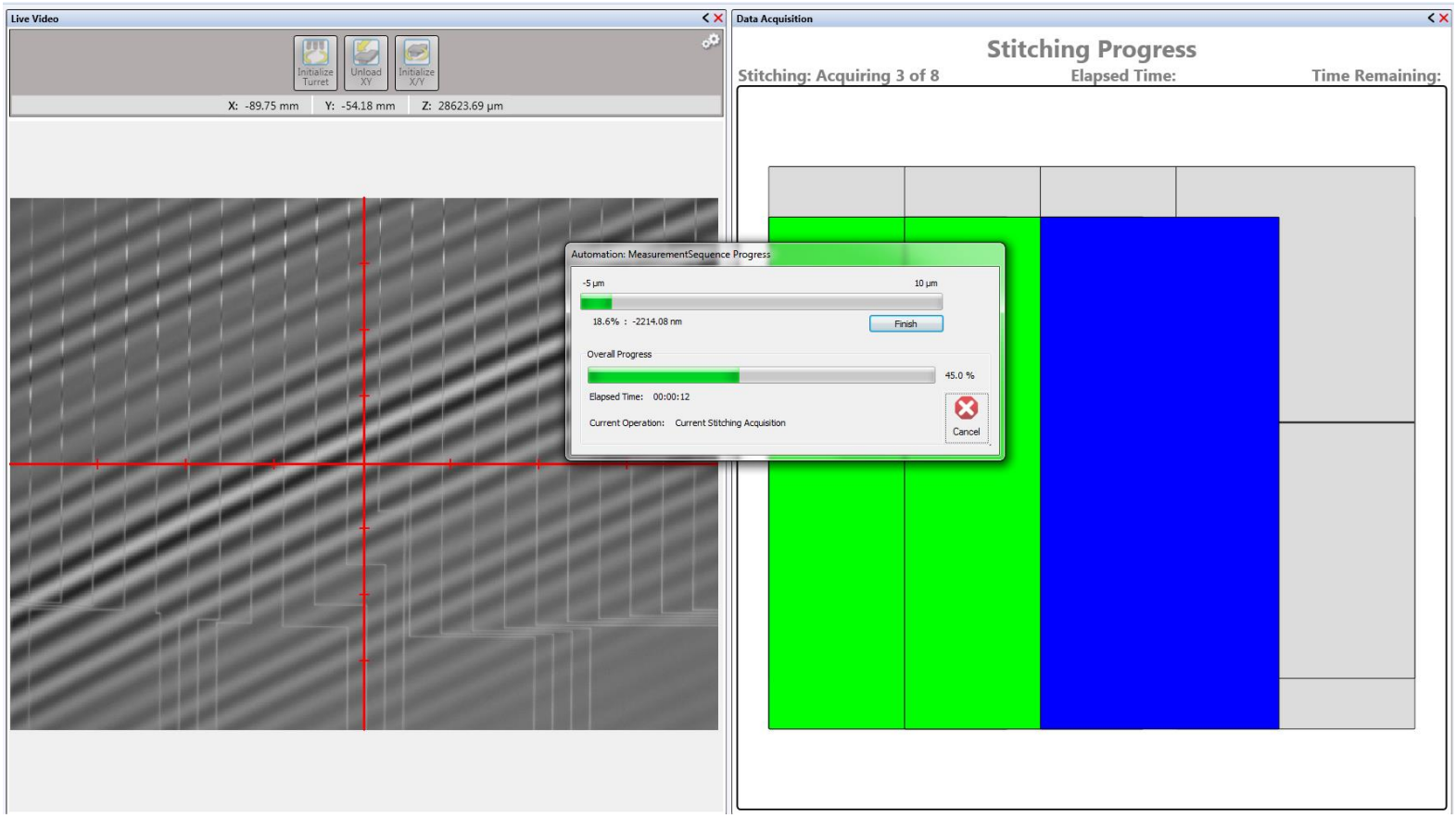
15. If you do not know the dimensions of your sample, click the **Teach** button below the **Set Reference Point and Traversal** button.
16. The system will ask you to move to the 1st corner of your bounding box. Move there and click **Next**. The system will ask you to move to the 2nd corner of your bounding box. Move there and click **Finish**.



17. The Bounding Box section will be populated with the locations you just taught the system.



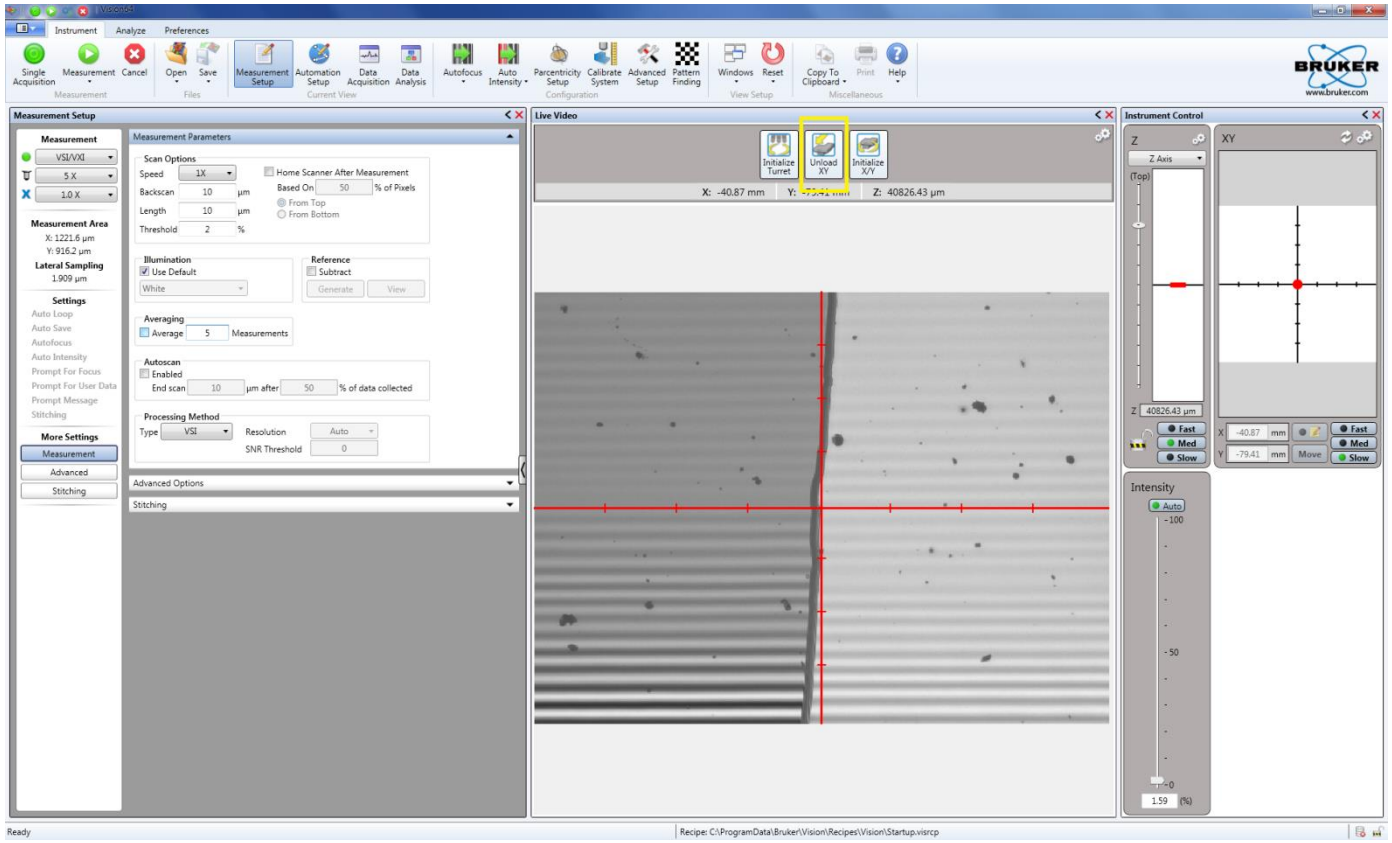
18. Click **Measurement**. The following page will appear while the measurement is taken.



NOTE: Analysis of a stitched image is the same as a regular image. Follow the steps used for a regular image earlier in this manual.

NOTE: Manual stitching can also be done. This is where the user manually stitches individual files together. Please consult the Help Manual for instructions.

19. To scan another sample, move the stage up using the **Z-Axis** control. Pressing the **Fast** button moves the stage faster.
20. Click **Measurement Setup -> Unload.**



21. Place a new sample on the stage and repeat from step 3.
22. If you are done, simply exit **Vision64** by closing the window.

NOTE: The analysis software is free and be installed on personal computer for later use. Please ask a member of the NCF staff for the software and they will give it to you.

APPENDIX

VSI Measurement Mode

Vertical Scanning Interferometry uses a broadband (normally white) light source. It is effective for measuring objects with rough surfaces, as well as those with adjacent pixel-height differences greater than 135 nm. **VSI** yields precision in the nanometer range.

During a **VSI** measurement, the internal translator moves the objective while the camera periodically records frames. As each point on the surface comes into focus, the modulation on that point reaches a maximum, then tapers off as the objective passes through focus. By recording the height of the translator at maximum modulation, the system can determine the height of each pixel. The maximum scan length for a **VSI** scan is 10 mm.

PSI Measurement Mode

Phase-Shifting Interferometry uses a narrowband light source. It is typically used to test smooth surfaces (roughness less than 30 nm), such as mirrors, optics, or other highly polished samples. It is very accurate, resulting in vertical measurements with sub-nanometer resolution.

However, PSI cannot obtain a correct profile for objects that have large step-like height changes. It thus becomes ineffective as height discontinuities of adjacent pixels approach one quarter of the used illumination wavelength (about 135 nm when using green light). During a PSI measurement, the internal translator precisely alters the optical path length of the test beam. Each optical path change causes a shift in the fringe pattern. The shifted fringes are periodically recorded by the camera, producing a series of interferograms. Computerized calculations then combine these interferograms to determine the surface height profile.

Intensity Measurement Mode

When you select the Intensity measurement mode, the measurement results depict the intensity of light on the sample rather than its surface height characteristics. This is helpful, for example, when you want to evaluate the uniformity of the intensity.