ATAMI Standard Operating Procedure

Zescope

Last saved by Randy Greb on 12/31/2019 10:24 AM

Revision	Date	Description/Change	Curator
0	12/4/2019	New document	Randy Greb
1	12/30/2019	Updated shutdown and restart procedures	Randy Greb

Contents

Scope:

Operation of the Zescope for surface measurements.

System Specifications:

Please see description on the ATAMI website and principles of operation information below.

Safety

General

NA

PPE Required

Standard room PPE.

Hazardous Energies

Electrical

NA

Mechanical

The scan head and stage move. Use caution to avoid a pinch hazard.

Stored/Potential

The scan head will drop slowly when it is powered down.

Thermal

NA

Materials/Consumables Hazards

NA

Interlocks

NA

Training Requirements

1. Pass all ATAMI required safety courses

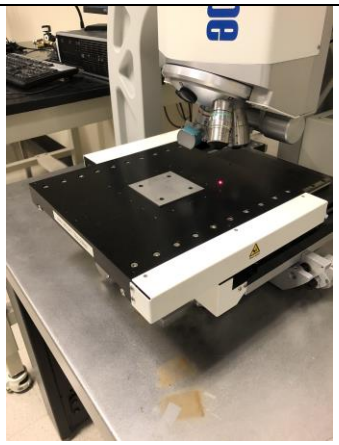
2. Finish lab tour with qualified ATAMI trainer.
3. Complete all hands on training for this system and signed off by trainer.
4. Verify access to this document for reference.

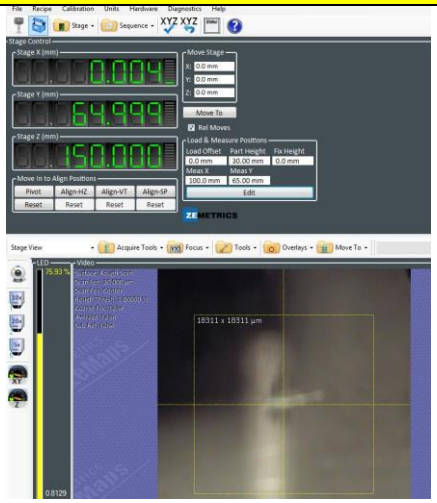
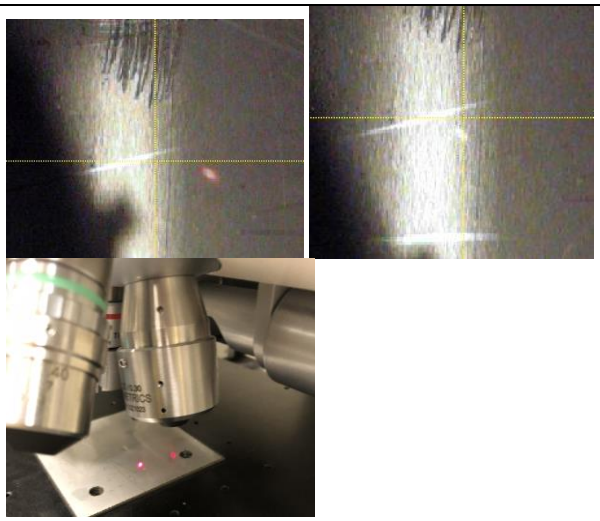
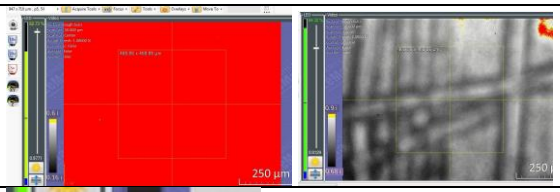
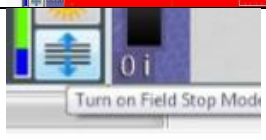
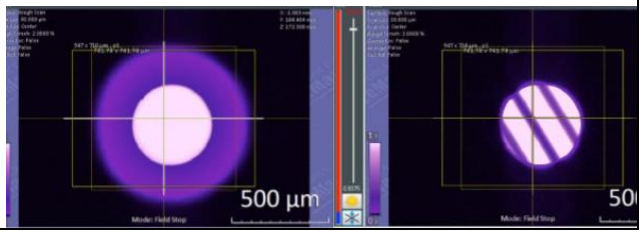
Standby Condition:

The Zescope should normally be left on, with the application software open.

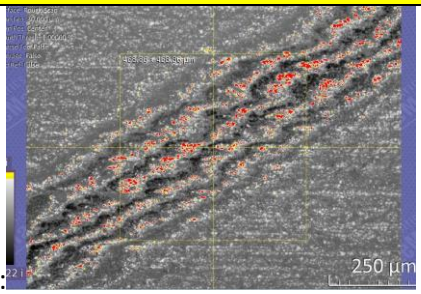
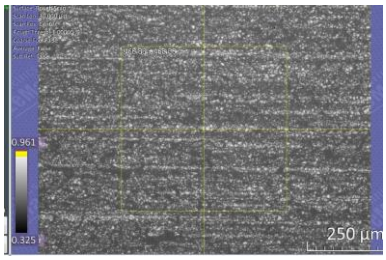
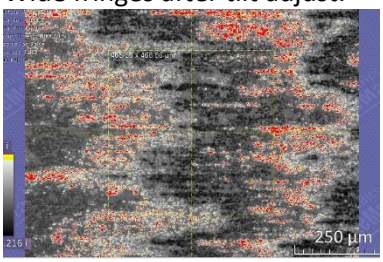
Procedures

How to Load and Focus on a Sample:

Step	Action	Notes
1	Default load position should be roughly (0,0,150) for (x,y,z). If not, select "Move To -> Load Position".	
2	Place your sample at roughly the center of the stage.	

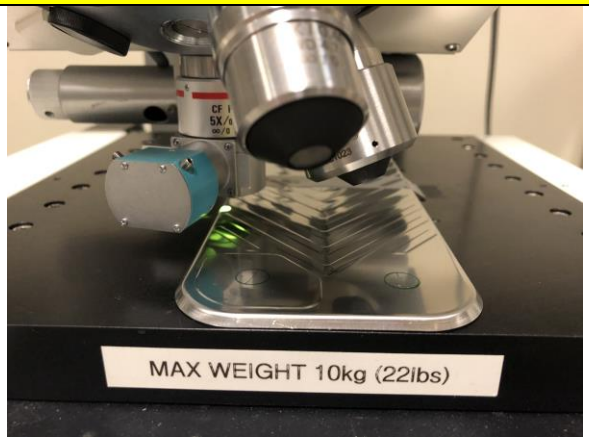
Step	Action	Notes
3	Select "Move To -> Load Position". The stage should move to roughly (0,65, 150).	
4	Use the Z-joystick to bring the object into focus. The red LED will be at the vertical line of the cross-hair when it is in focus. The focus position will be at a z-height of roughly 177 minus your part thickness. So if your part is 3mm thick, focus should be at roughly 174 for Stage Z.	
5	Select the lens of interest (typically 5X to start). If the image is fully saturated (all red), you may have to adjust light levels with the set measurement light level, contrast bar and/or the auto-contrast button.	
6	If you have good contrast on the surface, you can focus using the image. If you have a very smooth sample, you can also use the field stop image to help focus. When the purple ring is fuzzy, the images is out of focus. When it is sharp, it is in focus.	 

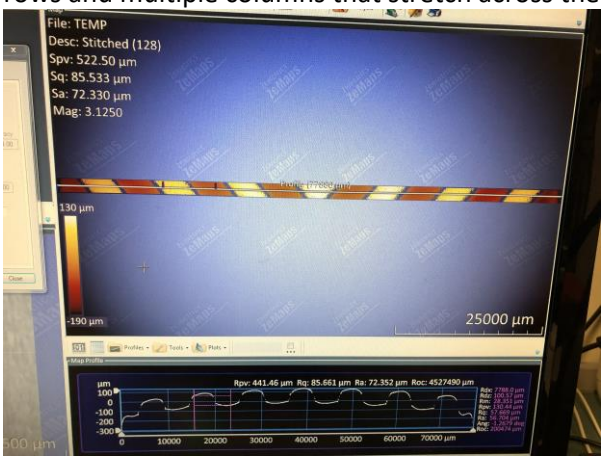
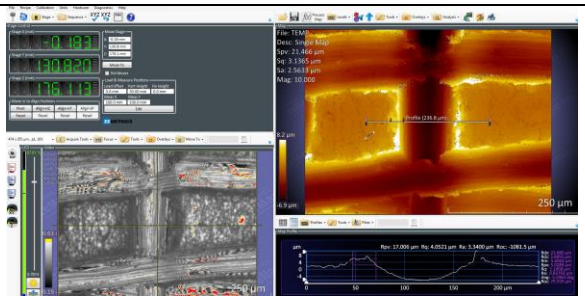
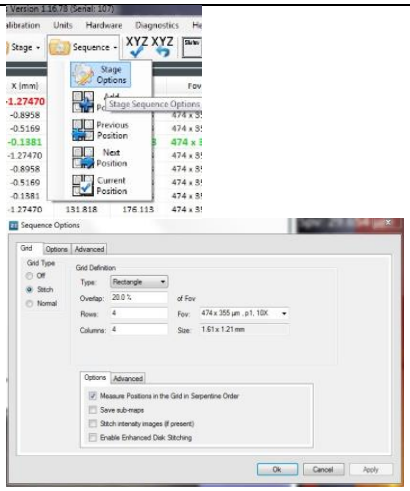
A General Method for Collecting a Basic 3D image:

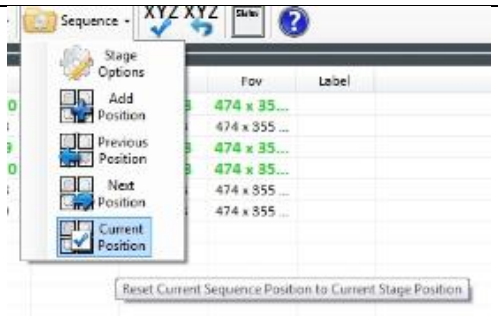
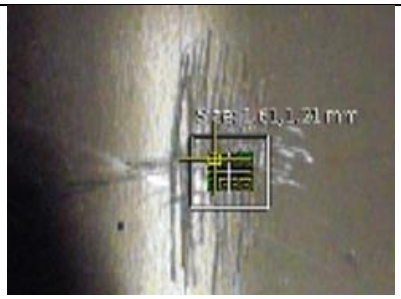
Step	Action	Notes
1	After loading, and you have your image in focus, you will want to find the fringes. They can fly by quite fast, especially if you have a sample surface that has high tilt or curvature, or your surface is very smooth.	Finges:  No Fringes: 
2	f you have a relatively flat sample, you can find a spot with fairly low topography and use the tilt nobs to get the fringes aligned either vertically or horizontally (whichever is closer) and then the other tilt nob to make them as wide as possible. This can be a bit tricky and may take some practice.	Wide fringes after tilt adjust:  Tilt knobs:  
3	This is a basic image collection method using either the Atami or Default recipes. See below for standard recipe parameters. It's only a guideline, and image collection parameters will likely need to be fine-tuned for your sample.	In the Threshold tab: Signal Threshold: 2.0% default, but OK to go as low as 0.2% to get more signal from deeper, darker features. Saturation Threshold: typically 20-50%

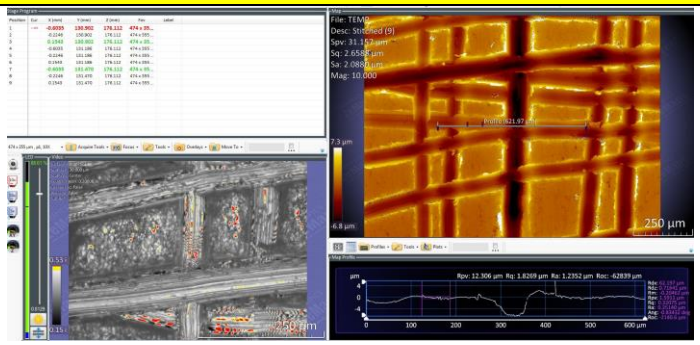
Step	Action	Notes
4	Once you've found the highest point, go past (decrease Z) by 5 microns (0.005 mm).	This assumes you are scanning from the top. If you are scanning from the center or middle, you'll need to pick the appropriate focus position.
5	Generally pressing the auto-illumination button at this time give the best gain and offset for the image collection, but depending on the sample you may have to adjust.	
6	Select "Acquire Tools -> Acquire Options"	This is where you setup image collection. See below for standard setups. You will need to optimize for your sample.
7	This is a basic image collection method using either the Atami or Default recipes. See below for standard recipe parameters. It's only a guideline, and image collection parameters will likely need to be fine-tuned for your sample.	In the Threshold tab: Signal Threshold: 2.0% default, but OK to go as low as 0.2% to get more signal from deeper, darker features. Saturation Threshold: typically 20-50% Decreasing signal threshold and increasing saturation threshold will reduce dropped pixels, but also introduce a bit more noise.
8	Then press "Start Acquire - F2" to collect the image, which will show in the upper right panel.	The scanned image will appear in the upper right panel.

How produce a large area, stitch image:

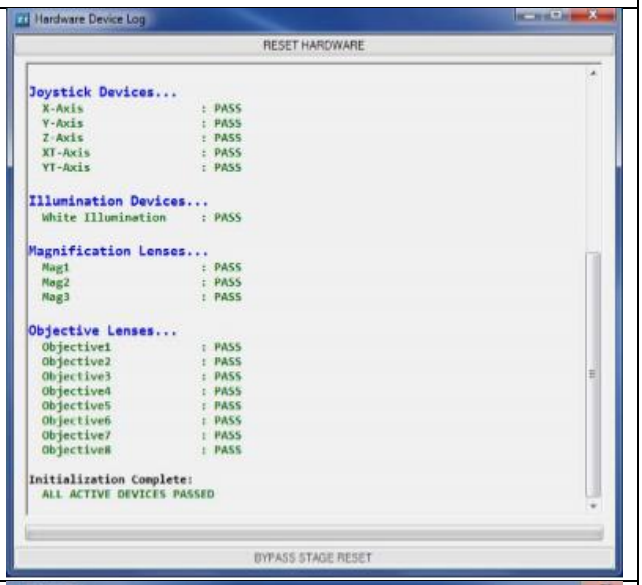
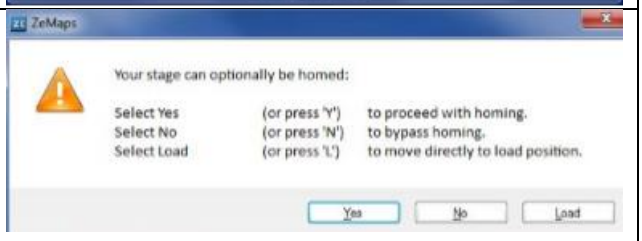
Step	Action	Notes
1	By stitching images together, it is possible to scan larger areas of an object, such as shown here.	

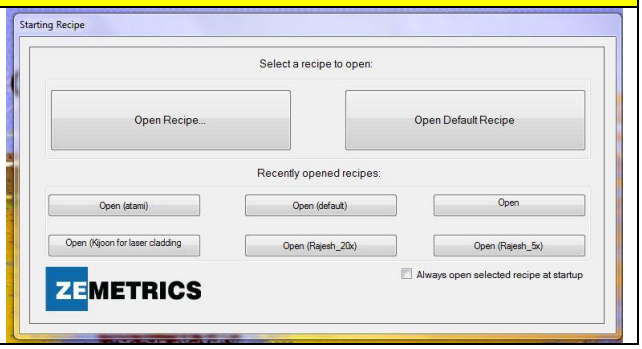
Step	Action	Notes
		For example, the image below shows a profile across the metal object shown above. This includes roughly two rows and multiple columns that stretch across the object. 
2	Setup your image as described earlier	
3	Press Sequence -> stage options to get the Sequence options dialog box.	
4	Be sure to select the FOV that matches the lens you are using for your image. **<u>This is critical.</u>**	
5	Select the number of rows and columns you would like to collect.	

Step	Action	Notes
6	Click stage -> stage program to see the positions of the sequence. Verify that the cursor is pointing to the first row.	
7	Click "Sequence -> Current Position" to reset the grid to the current position you are imaging (if this is what you want to do).	
8	Choose re-align to shift the whole grid.	
9	You can toggle to Stage view to see the current position of the grid on the sample. You can also zoom in and out with the cursor. Zoom by drawing a box. Double click to go back to starting field of view. You can also adjust the grid manually, although it may be more accurate to do that in the sequence options dialog box.	
10	After you have verified the sequence, be sure to go back to the lens you specified.	
11	Press F3 to start the sequence. You can also select it from the Acquire Tools dropdown. The processing will show each image as it's collected, and then at the end, will automatically stich together the images.	

Step	Action	Notes
12	The final image will be a stitched image and all statistics and processing will apply to the stitched image.	

How to start up Software if it is shutdown:

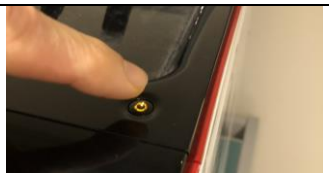
Step	Action	Notes
1	Open the ZeMap software from the desktop. The icon is labelled, “start here”.	
2	Wait for the hardware to initialize. The SPIP application will also start up. You can minimize that window.	
3	Verify that the sample stage is clear, and then select “yes”, when prompted, to proceed with home the stage.	
4	When warned that the z-axis is moving down, verify that the sample is clear, and click “proceed” to move the tower to its initial load position (Z= 150mm).	

Step	Action	Notes
5	You can choose one of the two standard recipes (Default, Atami), or your own recipe, if you have one saved.	

How to do a full system shutdown:

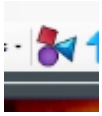
Step	Action	Notes
1	**Be sure to remove all samples from the stage, and if possible move to the load position.**	
2	Shutdown the Zemaps software.	
3	Press the power button on the Zescope scan head.	The scan head will drop to its lowest position. If it does not drop, toggle it again. 
4	**After the scan head has completed moving**, press the power button on the joystick box.	
5	Wait 30 seconds	
6	Shutdown the PC using the windows interface.	
7	Wait 10 minutes before restarting.	

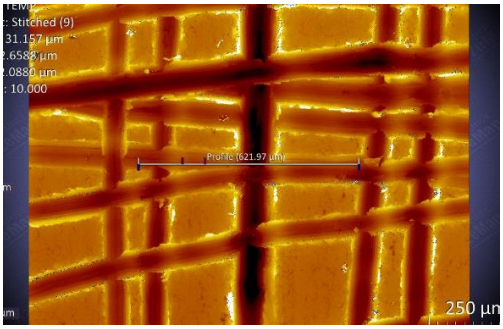
How to do a full system startup:

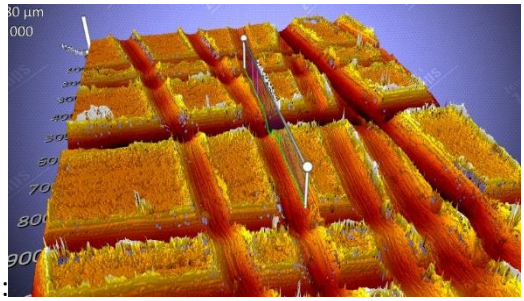
Step	Action	Notes
1	Press power button on the Zescope scan head. It will go all the way to the top.	
2	Press the power button on the joystick box.	
3	Wait 30 seconds.	
4	Press the power button on the PC.	
5	After the PC has fully re-booted, you can start the Zemaps software.	
6	If you get “Motor failure #M03” and/or a “Timeout Error moving off limit switch” error, go ahead and press OK. Then can proceed to load your recipe and start measurements.	

Miscellaneous How to:

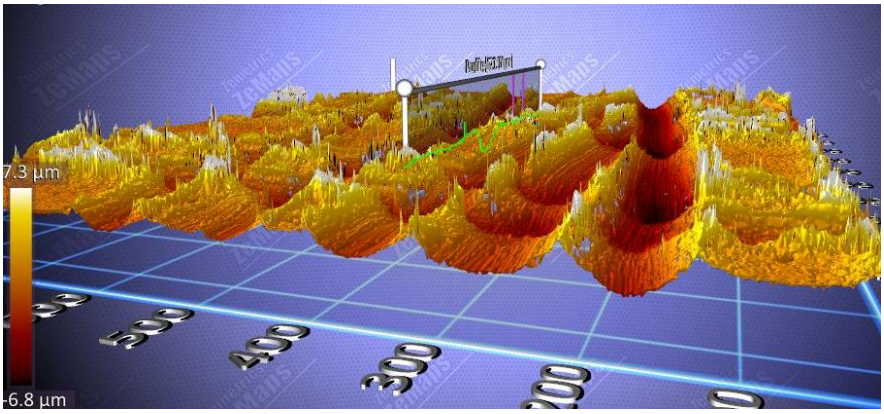
Toggle between 2D and 3D view:

Press this button to toggle between views: 

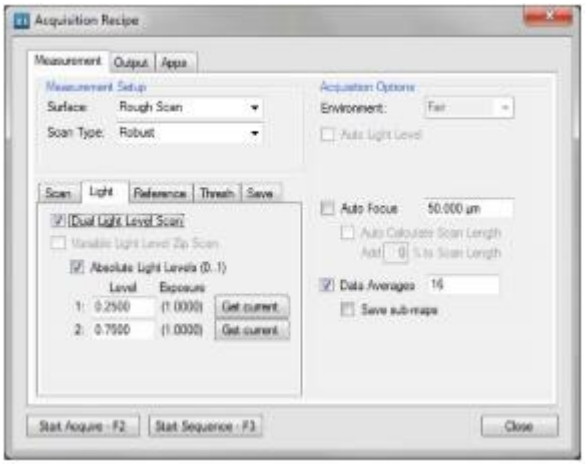
To go from this: 

To this: 

You can also rotate and tilt the 3D image by using the mouse:



Set up Dual Lighting Option for surfaces with large differences in reflectivity:



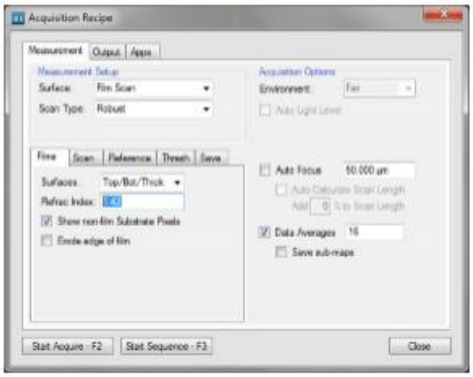
Use the Light tab in the Acquisition Parameters screen.

Focus on one surface, click the sun symbol to set brightness and contrast, then select the first “get current”

Focus on the second surface, set lighting, and select the second “get current”.

Use Film Scan Options:

The thin film setup readies ZeMaps to recognize and process fringes from a single film on a substrate.



Films down to an optical thickness (refractive index times thickness) of 2.5 microns can be processsed.

Be sure to enter the correct index of refraction of the film.

Refer to page 50 of the ZeScope manual for more setup and output details.

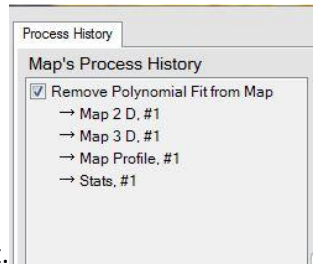
Zoom in and out of the scanned image:

Use scroll bar on mouse to zoom in and out of map.

Double click on the map to go back to full view.

Use tilt correction options:

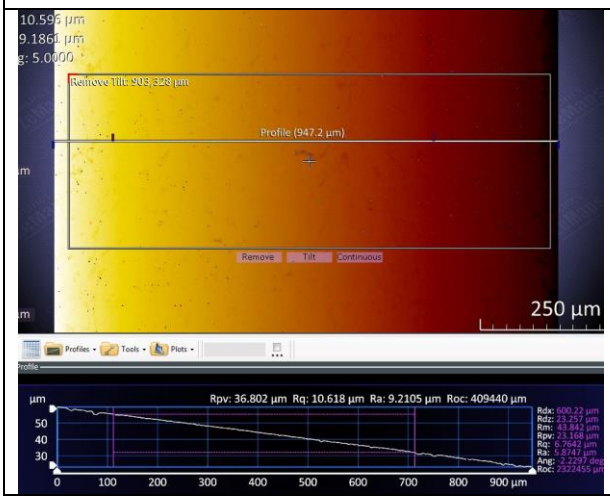
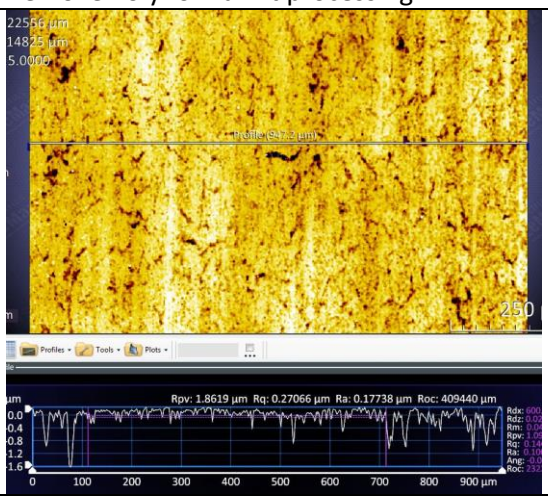
The Remove Polynomial Fit from Map function will automatically be applied to your sample to remove overall surface tilt.



If you don't like this, you can click right in the image and select process maps.

Then uncheck it an**d** hit apply.

They you can click right on the image and use "Tools->Show Remove Tilt Tool" to get a tilt removal tool that can be manipulated and applied.

Before Tilt Correction (raw data)	After tilt correction with Remove Tilt Tool, or Remove Polynomial Fit processing:
	

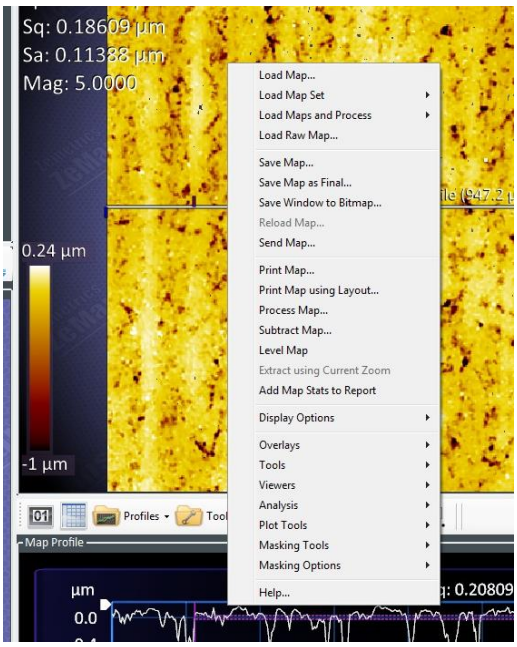
If you don't like the processing, click right and select "Reload Map" to get the original map (which will include the "Remove Polynomial Fit" processing.

Change Profile Tool setup:

Right click on the profile bar, and then you can change it to free form, circular, etc…

Process the image, apply tools, save images as Zmap files or Windows bitmap images:

Right click on the image to get the menu:

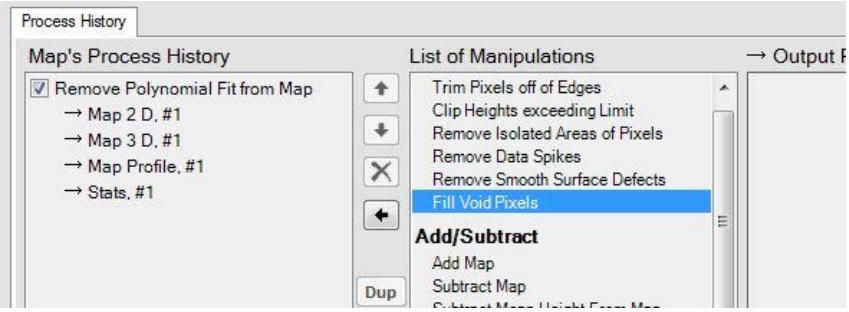


Remove Void Pixels:

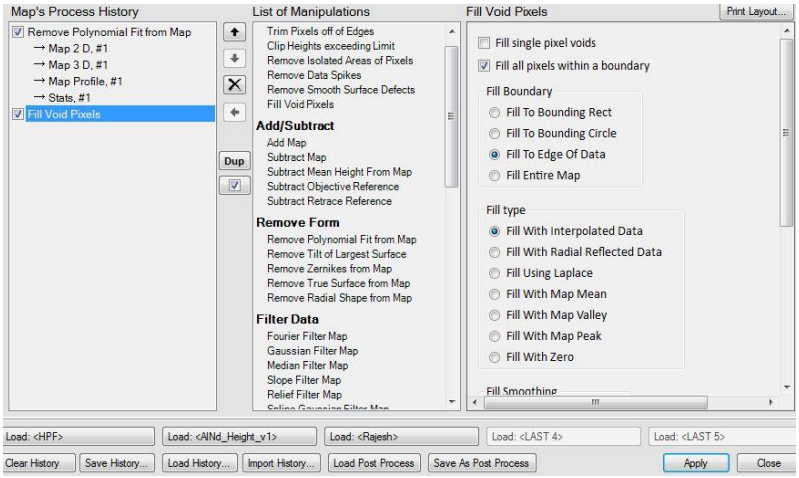
This will use interpolations to remove void pixels. This will make the image look better, but may also introduce false pixel values depending on the amount of processing.

Right click on the image to get the menu.

Select Process Map to get the processing options.



Add Remove Void Pixels to the processing list, choose “Fill all pixels within a boundary”, and then select apply.

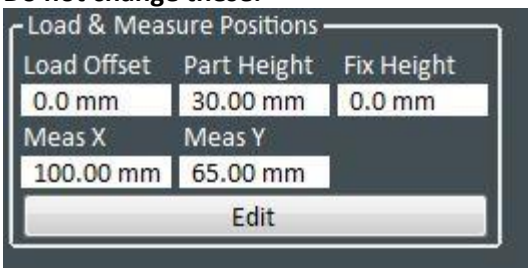


You can fine tune and adjust this process as needed for your application.

Standard or Example Recipes

Default Load and Measure Positions:

Do not change these:



ATAMI:

In the scan tab:

Surface: Rough Scan
Scan type: Robust
Scan Position: Top
Scan Levels: 1 Level Standard Scan
Scan Length L1: 30 um default
Auto Light level unchecked.
Auto Focus unchecked.
Data averages unchecked.

In the Threshold tab:
Signal Threshold: 0.5%
Saturation Threshold: 50%

Default:

In the scan tab:
Surface: Smooth Scan
Scan type:
Scan Position:
Scan Levels: 1 Level Standard Scan
Scan Length L1: 30 um default
Auto Light level unchecked.
Auto Focus unchecked.
Data averages unchecked.

In the Threshold tab:
Signal Threshold: 2.0%
Saturation Threshold: 20%

Basic Troubleshooting

If:

Step	If	Then
1	**You have lots of dropped pixels.**	• Try reducing signal threshold and increasing Saturation Threshold. • Try adjusting illumination and focus position. • You may need to increase scan length.
2	**You get a turret error.**	Do a full shutdown and restart as documented above in this SOP. **Be sure to do the shutdown exactly in order, step by step.**
3	**You have high tilt in your image.**	See the tilt correction procedures above.

Attachments

Location of User Files:

All user results should be stored here. You can create your own directory. Format is <FirstnameLastNameinitial>. For example, JohnL, PaulM or GeorgeH.

C:\Users\OSU\Desktop\MBIATAMI Users

Direction of Z-motion:

Scan head up relative to stage: Z-values decrease, joystick forward to monitor.

Scan head down relative to stage: Z-values increase, joystick back away from the monitor to keyboard.

Number of Pixels in scanned image:

640x480

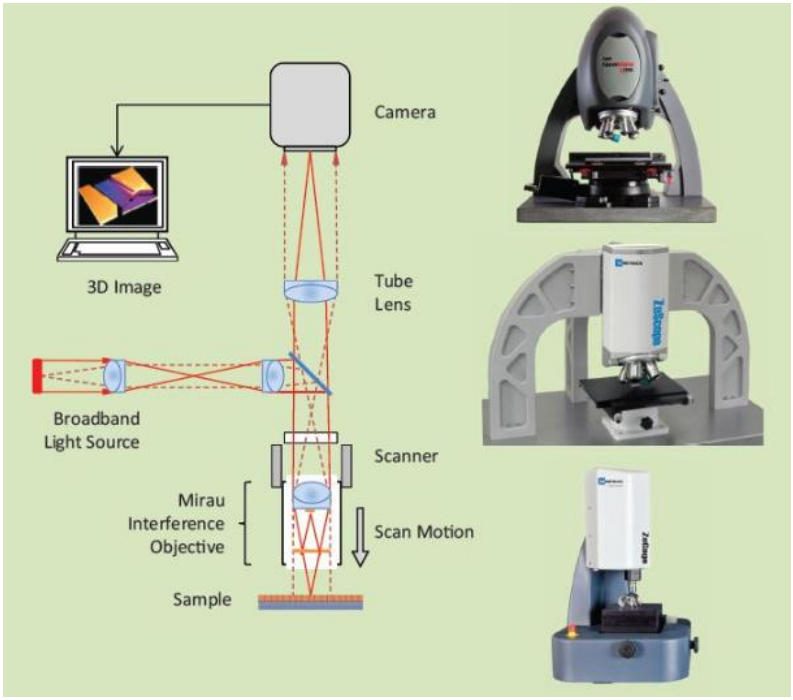
Video on Youtube showing how to use the Zescope:

https://www.youtube.com/watch?v=ZYAaZVnEDPQ

Objective Lens Magnifications and Fields of View:

Objective	Mag changer	Magnification	X size (µm)	Y size (µm)
5X	—	3.15x	1500	1225
		5x	935	700
	+	10x	470	350
20X	—	12.6x	380	285
		20x	240	180
	+	40x	120	90
50X	—	31.5x	150	123
		50x	95	70
	+	100x	47	35

Basic Description of Operation:



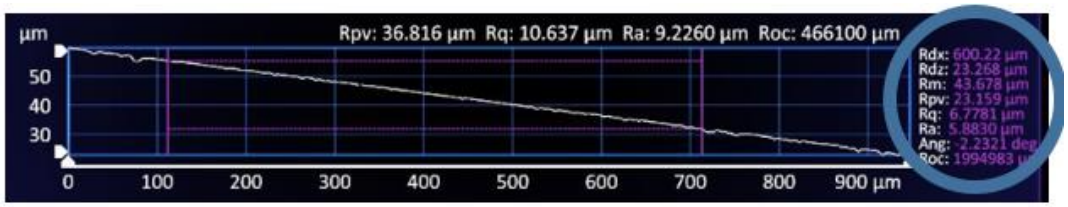
A SWLI system has specialized microscope objectives that perform two functions: one is magnification, and the other is measurement of the topography of the test surface. This process involves comparing the test surface to a reference surface — usually a very flat, smooth mirror integrated in the objective.

The microscope's illuminator projects light through the objective, where a beam splitter sends some of the light to the reference mirror, and some to the part under test. When the optical path length from the beam splitter to both the reference and test surfaces are equal, the reflected light from both the test and reference surfaces recombine, resulting in light and dark bands called interference fringes. The shape and position of these fringes

are directly proportional to the difference in height between the test surface and the reference mirror. They can be thought of as contours of the surface, where the contour intervals are proportional to the illumination wavelength, and processing algorithms can further refine this precision to small fractions of this illumination wavelength.

In order to profile the topography of the test surface, the microscope objective is scanned perpendicular to the test surface, thus varying the test length. As the objective is scanned, a camera and computer system monitor the changing fringe patterns. Sophisticated software interprets these patterns to construct a full 3D map of the surface under test. In contrast with other microscope-based 3D topography techniques, SWLI has the distinct advantage that the height resolution of the measurement is constant across all magnifications. Whether the field of view is 20 microns or 20 millimeters, the topography resolution is constant for a given tool.

Profile Statistics:



Name	Description
Rv	The value of the deepest valley in the sample.
Rpk	The top portion of the surface that is worn away during the run-in period. Used with bearing ratio measurements.
Rpv	The distance between the highest and the lowest points within the sample. When used to quantify roughness, RpV is the maximum roughness height. It is the worst case point-to-point error in the data set. RpV compares the two most extreme points on the surface.
Rm	Average of all the data points in the sample.
Rq	Root-mean-square (rms) roughness. The average of the measured height deviations taken within the profile and measured from the mean linear surface.
Ra	Arithmetical mean deviation. The average roughness or deviation of all points from a plane fit to the test part surface.
Rdz	This is the height difference between the two end points of the profile. If an end-point of the profile is positioned between two pixels, then the height is an interpolation of the heights of those two pixels.
Rdx	The distance between the two calipers in the X axis.
Rsk	Also known as skewness; it is a measure of the symmetry of the profile about the center line.

Rku	Kurtosis is a measure of the randomness of heights, and of the sharpness of a surface. A perfectly random surface has a value of 3; the farther the result is from 3, the less random and more repetitive the surface is. Surfaces with spikes have higher values; bumpy surfaces are lower.
Rk	The long-term running surface which influences the performance and life of the bearing. Used with bearing ratio measurements.
Rvk	The lowest part of the surface that retains the lubricant. Used with bearing ratio measurements.
Rmr 1	Material component relative to peaks—the material ratio at which Spk and Sk meet. It represents the upper limit of the core roughness profile. Used for bearing ratio analysis.
Rmr 2	Material component relative to valleys—the material ratio at which Spk and Sk meet. It represents the upper limit of the core roughness profile. Used for bearing ratio analysis.
Rz	Ten-point height. The profile is divided into 5 equal sections. The ten points represent the peak and valley from each of the 5 sections. The average of the 5 valleys is then subtracted from the average of the 5 peaks.
Roc	Radius of curvature of 2nd order polynomial fitted to the profile.
Ang	The angle of the line fitted to the profile data.
Pts	The number of points in the profile sample.
Dist	The length of the slice.
Avgs	The number of individual profiles that were averaged together to create the profile sample.
X1, X2	The position of the two calipers in the X axis.
Y1, Y2	The position of the two calipers in the Y axis.
XC, YC	For circumferential profiles, this is the center where the profile was positioned.
Rad	The radius of the circumferential profile.
Pos 1 & Pos 2	For a profile tag, this is the position of the tag on the full profile. If the profile is zoomed, this is the zoomed position.
Level	Displays the leveling mode when the profile stats were calculated: Off, Full, Zoom, or Tool.
Tag 12 dZ	The difference in average heights of Tag 1 and Tag 2.
Tag 12 dA	The difference in average angles between Tag 1 and Tag 2.
Tag 23 dZ	The difference is average heights of Tag 2 and Tag 3.
Tag 23 dA	The difference in angles between Tag 2 and Tag 3.