zygo

Basic Operator Procedure Training
NewView 6300

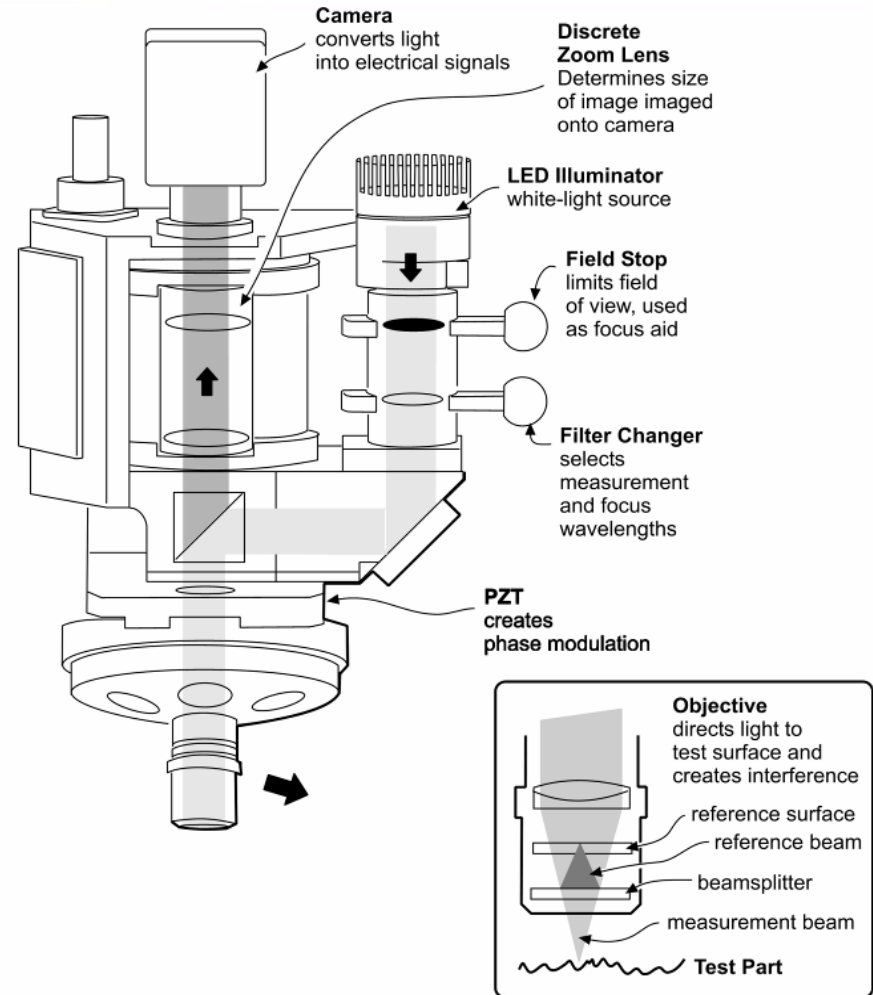- System Overview

Objective

Motion Controller / Joystick

Live Image Monitor

Application Monitor

Motorized Stage
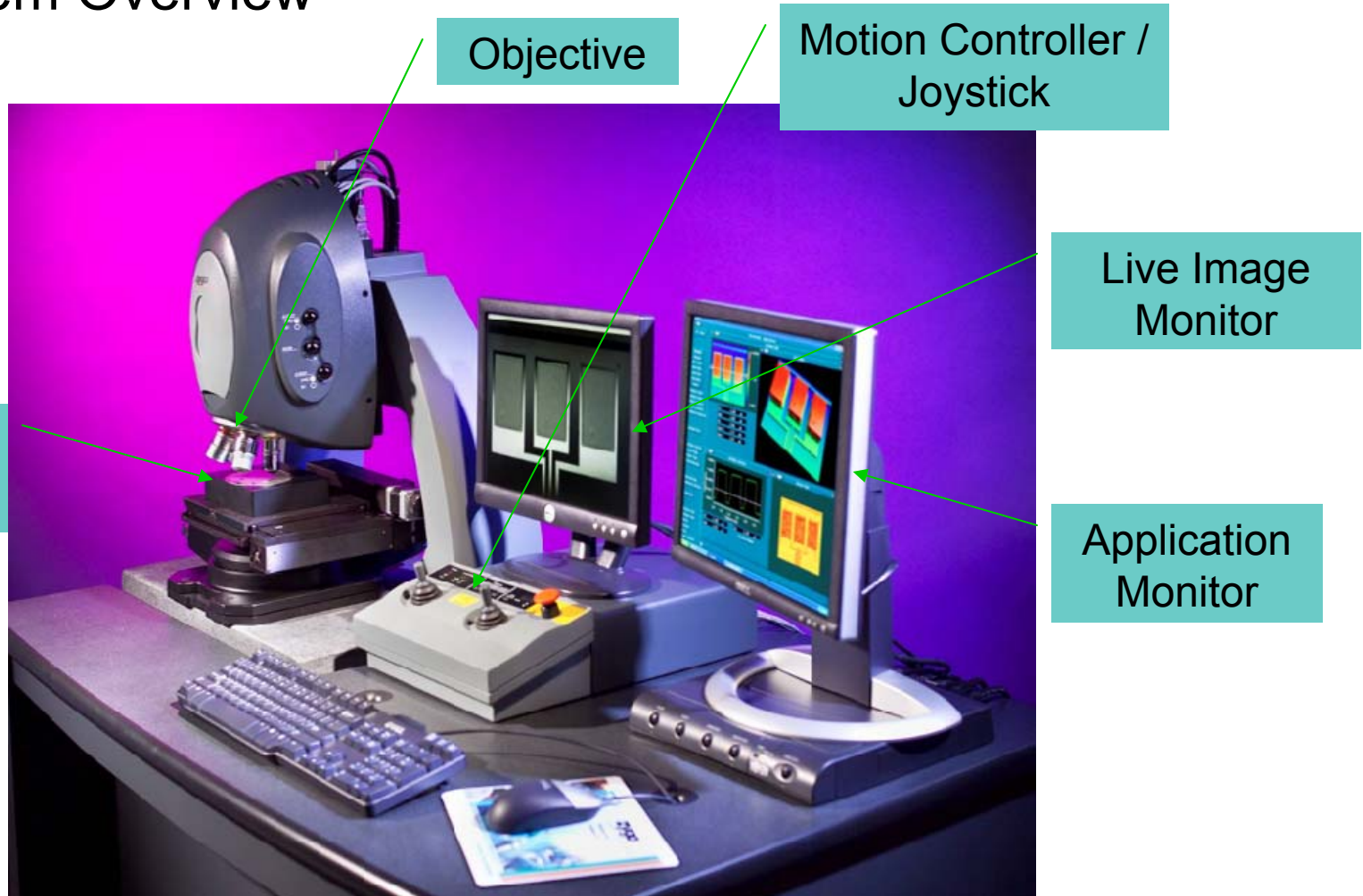
NewView Theory of Operation

- Measurement Technology: Scanning White-light Interferometry (SWLI)
    - Interferometric objective mounted in a piezo scanning device that moves vertically
    - Camera detects interferogram intensities
    - Computer stores only good (modulating) data as 3D interferogram
    - Frequency domain analysis (FDA) determines heights of each pixel to <0.1nm resolution and <0.3 nm repeatability

Camera converts light into electrical signals

Discrete Zoom Lens Determines size of image imaged onto camera

LED Illuminator white-light source

Field Stop limits field of view, used as focus aid

Filter Changer selects measurement and focus wavelengths

PZT creates phase modulation

Objective directs light to test surface and creates interference
- reference surface
- reference beam
- beamsplitter
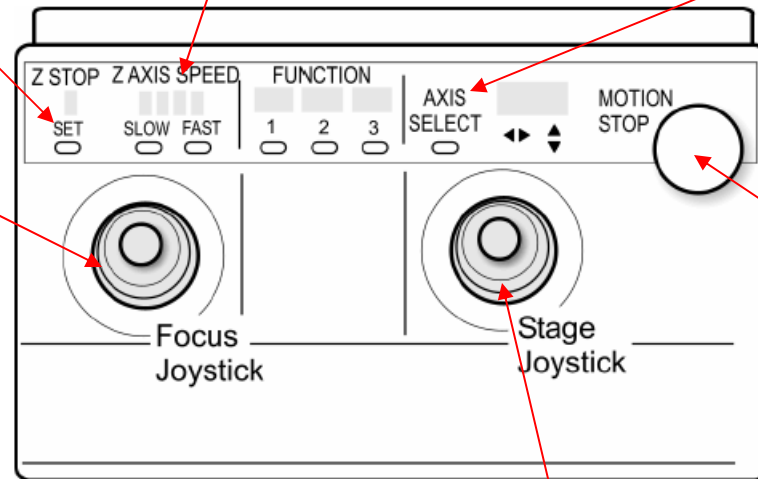- measurement beam

Test Part

Motion Controller/Joystick

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Set Z STOP
To avoid crashing
objective into
sample

Change Z AXIS
SPEED to speed up
or slow down travel
for focusing

Use AXIS
SELECT to select
X Y for moving
stage or R P for
adjusting tip/tilt

FOCUS JOYSTICK
Move up to raise z
away from stage;
Move down to lower
toward stage

Press MOTION
STOP to halt
motion
in case of
emergencies

Move STAGE JOYSTICK left/right to
move in X or R and up/down to move
in Y or P

Operator Process Flow

Load Application

Select Objective

Load Sample

Set Z Stop

Find and Null Fringes

Set Light Level

Set Measurement Controls

Set Analyze Controls

MEASURE

Save Results

Load Application

- Open the MetroPro Shortcut on the Desktop

- Click on the desired application to open
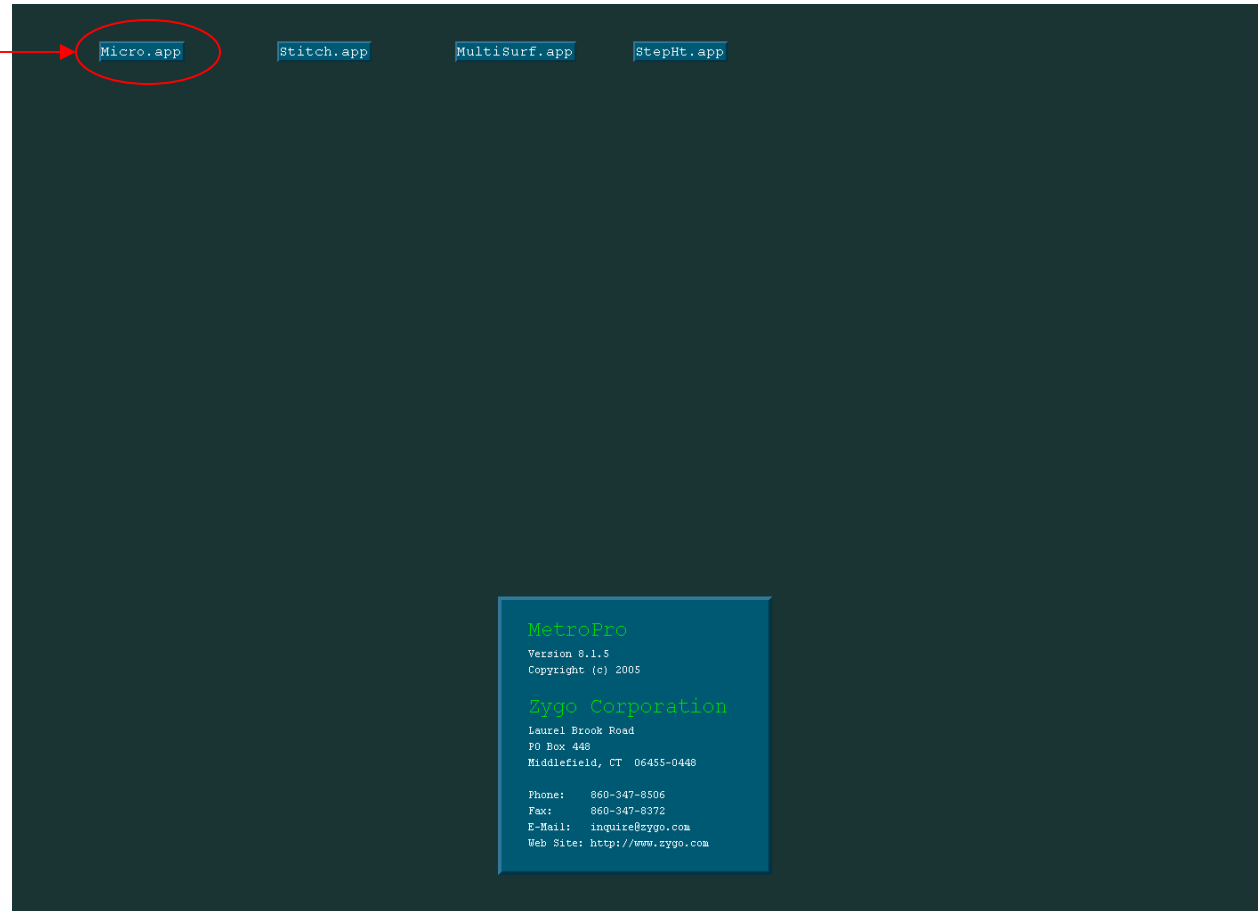
Load Application

- If application not on desktop, right-click to "Load Application"

- Select and load application from list
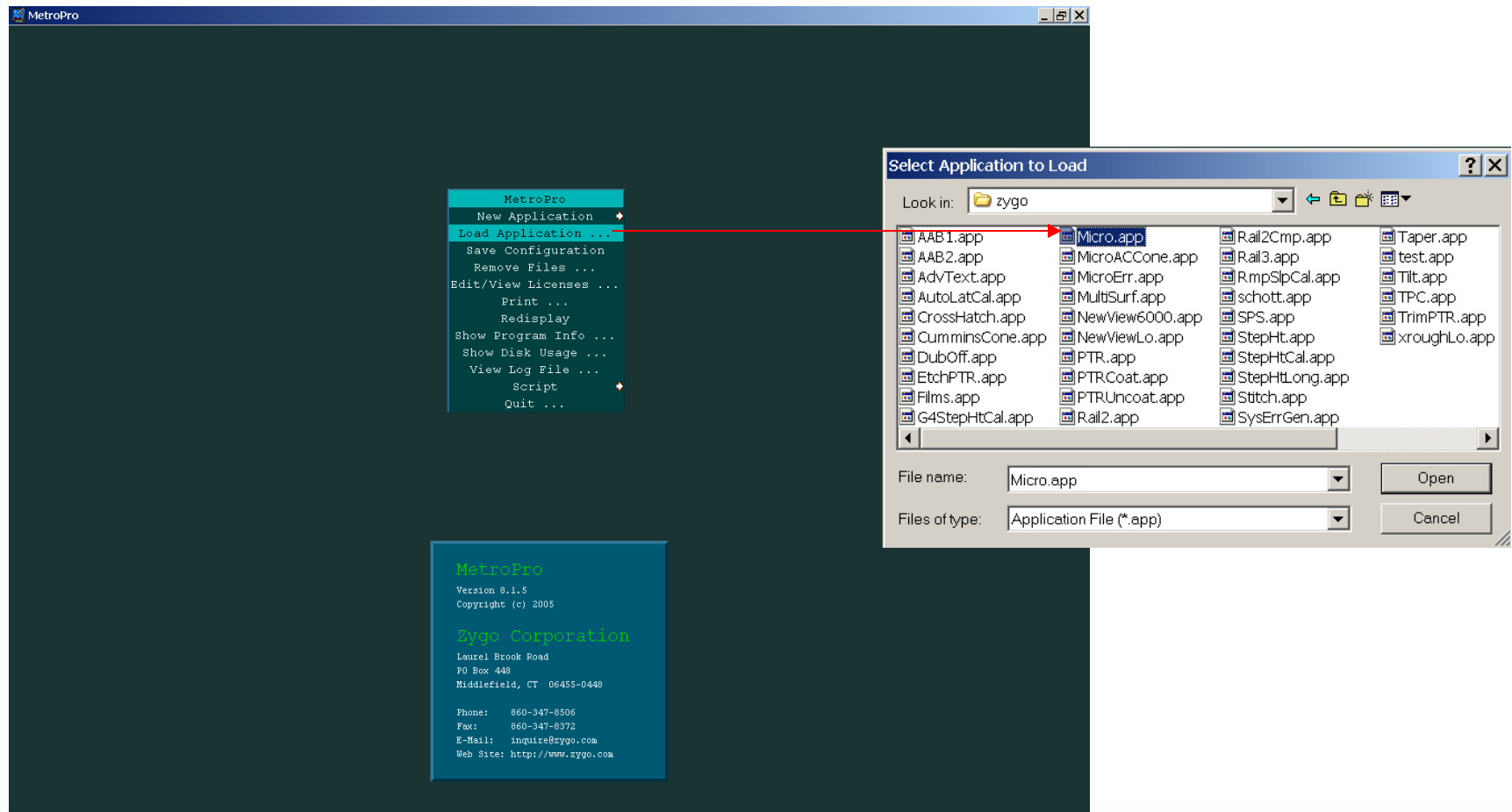
Typical MetroPro Layout

- <u>Micro.app</u>: generic application for measuring surface structure and roughness of samples

Select Objective

- Click the Objective Button to select the objective

- For automated turret, ensure sample stage is clear first

- Choose objective based on resolution and desired field of view
  - Tradeoff: Lower magnification yields a wider field of view but provides coarser lateral resolution
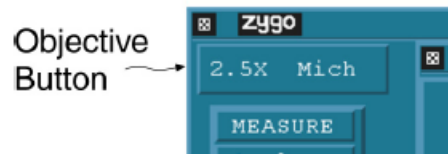
Load Sample and Set Z-Stop

- Place test sample on stage under objective

- Using joystick, lower head to slightly less than the objective working distance

- Press "SET" Z-stop
  - Important step to avoid crashing objective into sample

Objective	1X	2.5X	5X	10X	20X	50X	100X	SLWD
Working Distance (mm)	8.3	10.3	9.3	7.4	4.7	3.4	0.8	40

Focus Sample

- Adjust z using the focus joystick until sample is focused

- Focus is found when fringes appear on Live Display
  - Fringes are the light and dark bands produced by the interference of light

- *Hints:* if having trouble focusing, press "F5" to set the light level automatically for viewing, or try using the field stop
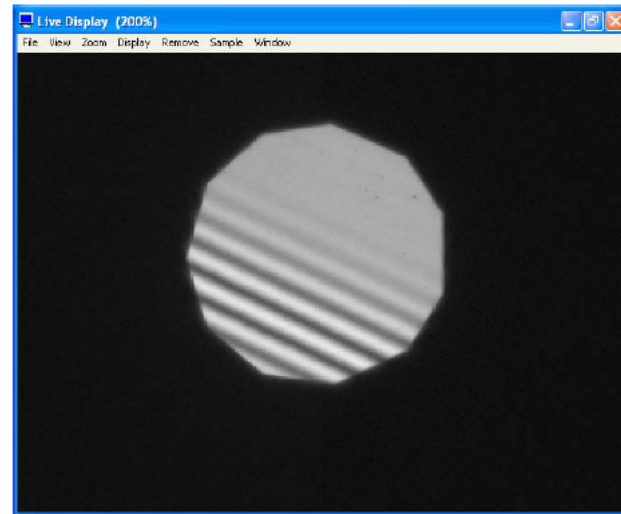
Example: Part focused with fringes
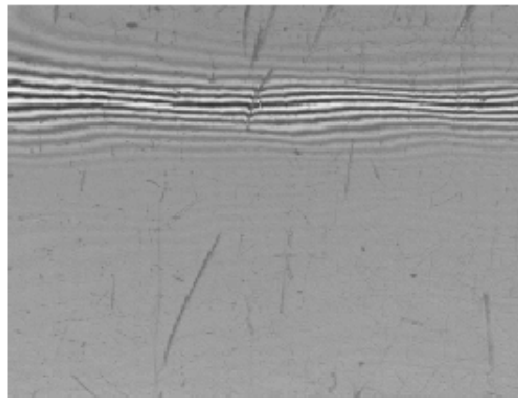
Focus Sample: Field Stop Focus Aid

- The field stop on the side of the NewView can be used as a focus aid

- When the sample gets close to focus, a second image of the iris will appear blurred; when they exactly overlap, fringes should appear

- Most effective for high magnifications and smooth samples
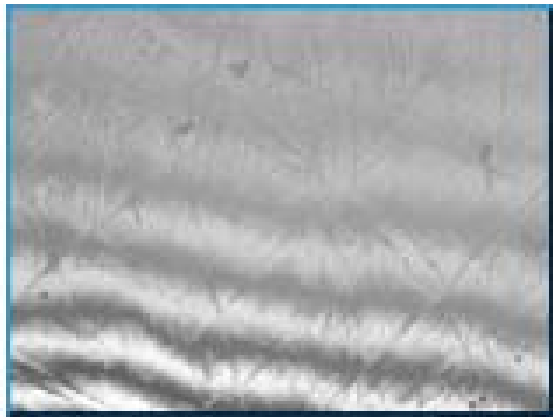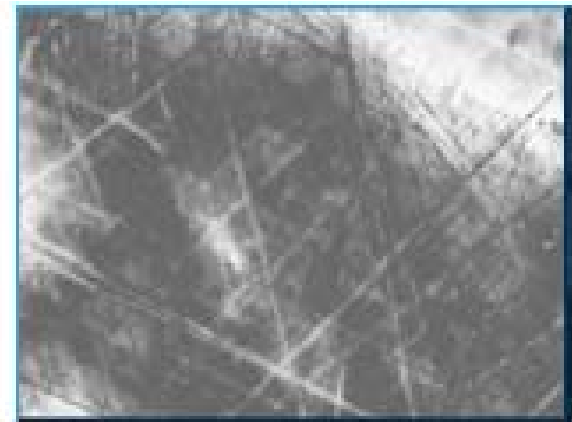

System Out of Focus

System In Focus

Null Fringes

- Nulling is the process of minimizing the number of fringes

- Null sample by adjusting tip/tilt or "R P" using the joystick

- As the tip/tilt is adjusted, it may be necessary to male fine z-adjustments to keep the fringes viewable on the live display monitor
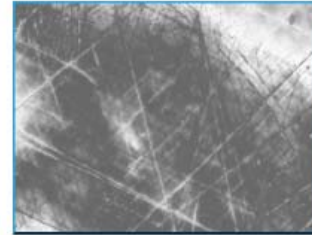
Fringes due to Tilt
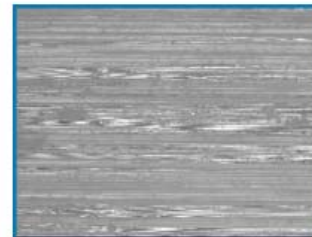NOT NULLED

Minimum Fringes
NULLED

Null Fringes

- *Note:* The null fringe location will look different depending on the part
  - in most cases, think of "spreading out" the fringes
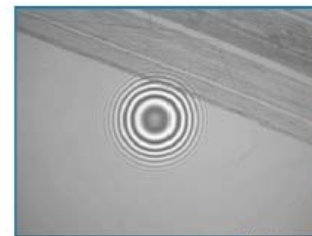 - for a spherical part, center the bulls eye

Example of Nulled Parts

Smooth Flat Part
Adjust for high contrast and the least number of fringes.

Rough Flat Part
The fringes are in smaller isolated areas. Center the fringes and adjust focus between the high and low fringes.


Spherical Part
Adjust the stage and focus to center the circular fringe pattern.

Set Light Level

- Set **automatically** by pressing "F5"
  - Must be centered on the brightest fringe

- Set **manually** by pressing "F4"
  - Use numeric keypad to set peak intensity to approx 90 – 99 %
  - Make sure there is no saturation (red)

Key	Function
/ *	Coarse down (/) and up (*).
- +	Fine down (-) and up (+).
1 2 ... 9	Adjust level in 10% steps, 1 = 10%, 3 = 30%, 9 = 90%
Tab	Toggle between last two light settings.
Esc	Cancel current action and abort measurement.
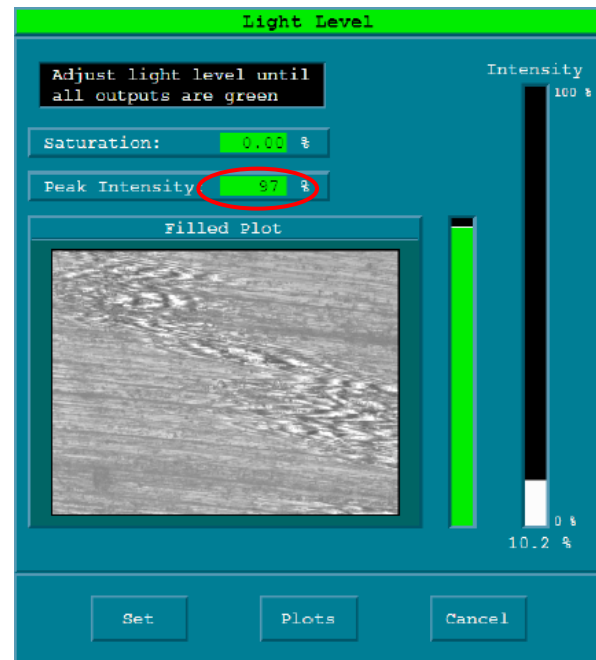
Set Measurement Controls

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User entry for part identification

Adjust to acquire more data points

Use to subtract system errors

Using averaging to improve accuracy

For use with extended scan option

Measurement Controls

Comment:

Part Number:

Min Mod (%): 15

Serial Number:

Min Area Size: 7

Instrument: None

Acquisition Mode: Scan

Camera Mode: 640x480 22Hz

Image Zoom: 1X

Remove Fringes: On

Subtract Sys Err: Off

Number of Averages: 0

Sys Err File: SysErr.dat

Phase Controls

AGC: On

Phase Res: High

Connection Order: Location

Discon Action: Filter

Scan Controls

Scan Length: None

Extended Scan Length: 1000 um

FDA Res: None

Measurement Controls

- <u>Image Zoom</u> to increase or decrease field of view, if available
  - 1X standard; 0.5X, 0.75X, 1.5X and 2.0X optional

- <u>FDA Res</u> control sets how the software processes the data collected
  - "High 2G" for smooth surfaces
  - "Normal" for rough surfaces, typically > 75 nm Ra
  - "Low" required for extended scans

- <u>Camera Mode</u>
  - Selects effective camera size for collecting data
  - More pixels resolve smaller details but result in increased processing time
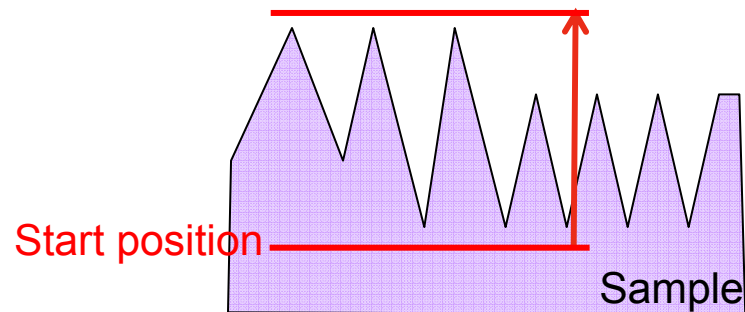
Measurement Controls

- ## Scan Length
  - Select length of measurement scan
  - Ranges from 5 um to 15 mm
  - Longer scan = Longer acquisition time
  - Bipolar Scan: from initial position, objective moves down half the scan length and then scans upward
  - Extended Scan scans upward only

Bipolar Scan
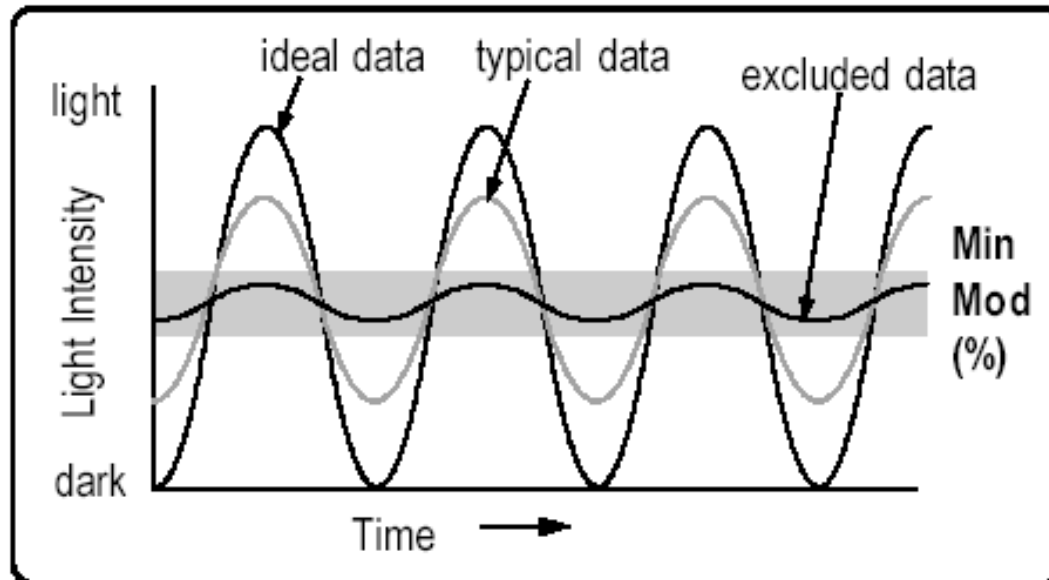
Extended Scan

Start position

Sample

Start position

Sample
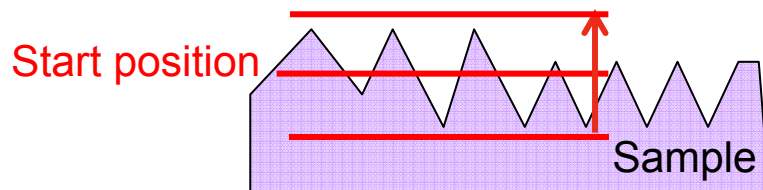
Measurement Controls

- ## Min Mod (%)

  - Specifies minimum modulation or intensity range for a valid data point

  - Setting can range from 0 to 100 %

Analyze Controls

Removes "form" from the data

Removes edge effects

Fill holes in the data

Filtering controls are used to select and analyze the various spatial frequency components that make up the test part.

Analyze Controls	
Remove: Plane	Min Area Size: 0
Sphere Radius: 0 nm	
	Remove Spikes: Off
Trim: 0	Spike Height (xRMS): 7.50
Trim Mode: All	
Data Fill: Off	
Data Fill Max: 25	
Filter: Off	
Filter Type: Average	
Filter Window Size: 3	
Filter Trim: Off	

Filter Low Wavelen:	mm	Filter Low Wavelen:	nm
Filter High Wavelen:	mm	Filter High Wavelen:	nm
Filter Low Freq:	1/mm	Filter Low Freq:	1/mm
Filter High Freq:	1/mm	Filter High Freq:	1/mm

- *Note:* Changes to these controls can be made after measurement Press "F2" or ⟨ Analyze ⟩ button to re-analyze after changes

Analyze Controls

- <u>Remove specifies the surface to remove to minimize form</u>
  - As a general rule of thumb, remove a plane for flatness or a cylinder for roughness

- Turn <u>Data Fill</u> On to fill missing data points; The maximum number of pixels that will be filled is based on the <u>Data Fill Max</u> control

- <u>If Remove Spikes</u> is On, a pixel will be removed if its height is greater than the surrounding pixel heights by the <u>Spike Height</u> value

Analyze Controls

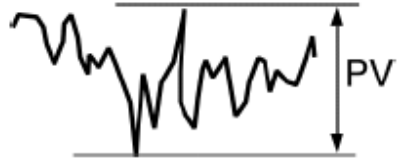- <u>Filtering</u>
  - Low pass, high pass, band pass or band reject filters are available in the <u>Filter</u> control (Off by default)
    - Low pass highlights waviness or form; high pass highlights roughness
  - Use <u>Filter Type</u> to choose an average, median, 2 sigma, FFT or Gaussian type filter
  - For FFT fixed, enter cutoff values in the high and low wavelength (or frequency) controls
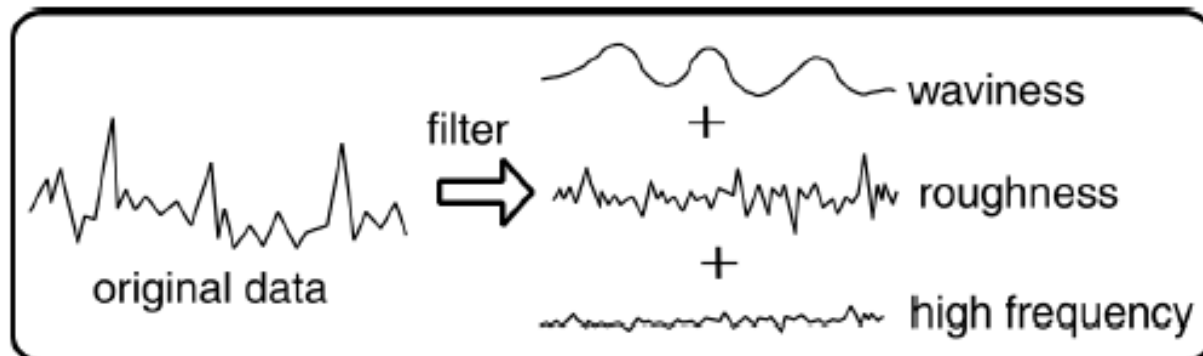
Measure

- Press "F1" or click **MEASURE** button to measure
- System will scan then display results
 - Do not touch vibration isolation table or sample stage until measurement is complete

Numerical Results

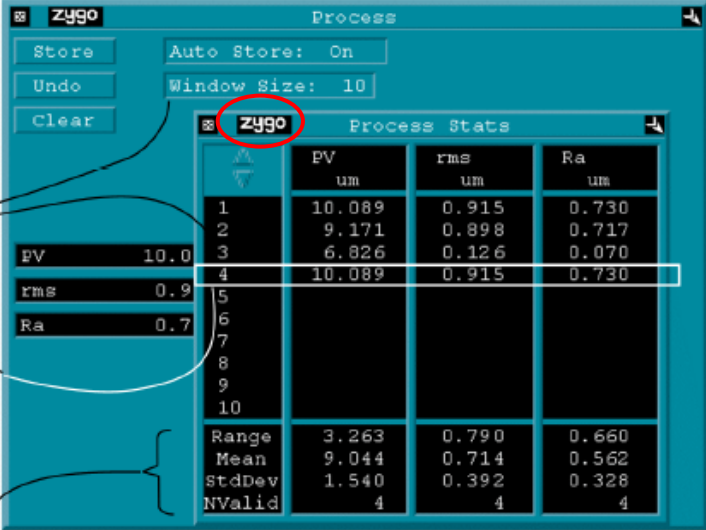| Result	Description	
PV	The height between the lowest and the highest point on the test part surface.	
rms	The root-mean-square deviation of all points from a plane fit to the test part surface.	
Ra	The average roughness, or the average deviation, of all points from a plane fit to the test part surface.	
Size X	The dimension of the data set in the X-axis (on-screen horizontal).	
Size Y	The dimension of the data set in the Y-axis (on-screen vertical).	

Save Data: **Store screenshot**

- Options to Save Data: Save a screenshot, save the raw data or save process stats

- To acquire a <u>screenshot</u> from MetroPro
  1. Click on the Zygo button on the upper left corner of the application
  2. Choose File, .bmp, Color from the Print Panel then click Print
  3. Save the file with a .bmp extension
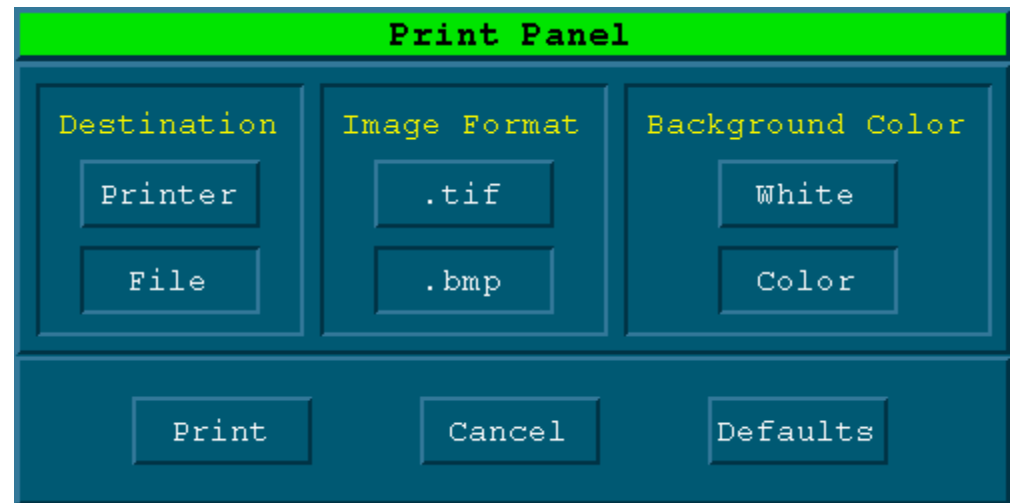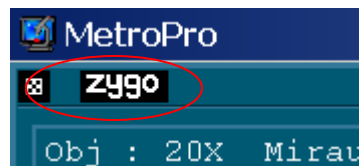
Save Results: Save Process Stats

- Click the process icon to open the process window

- To save a series of data as a txt or csv file, press the zygo button and choose to print to a file

The Process Window

Store- adds one set of data
Undo- removes last data set
Clear- erases ALL data sets

Window Size sets the number of rows displayed.

Each row shows the results for one measurement. Rows fill in as measurements are made when Auto Store is On.

Range- difference between largest and smallest values.
Mean- arithmetical average of all values.
StdDev- standard deviation
NValid- number of valid values

Save Results: Data

- Press `Save Data` button

- In the file handler, enter a name for the file ending with ".dat"

- Raw data is saved; Can be post-analyzed

Troubleshooting

- What to do if MetroPro returns "No Valid Data" error or if there is too much data dropout
  - Check Focus: Do you see fringes and are they nulled? (Or for an extended scan, are you positioned below focus?) 3 or fewer fringes is a good rule of thumb
  - Check Scan Length: Is your scan long enough? Do you see all of the fringes go by?
  - Check Light Level (F4): Is light level in green zone?
  - Check Min Mod %: Does it need to be lowered?

Resources

- NewView 6200/6300 Operating Manual, OMP-0503

- NewView Microscope Application Booklet, OMP-0360

- MetroPro Reference Guide, OMP-0347

- Available for download online:

  http://www.zygo.com/?sup=/resource/manuals.cgi

  User ID: manuals

  Password: d5g2r8

  Note: User ID and password periodically changing; Contact Zygo if unable to access