OMP-0376C

MultiSurf MetroPro Application

MultiSurf.app

This booklet is a quick reference; it assumes that you are familiar with MetroPro and the instrument. Information on MetroPro is provided in the *MetroPro Quick-Start Guide*, OMP-0469, and the *MetroPro Reference Guide*, OMP-0347. For information on the instrument, please refer to the applicable ZYGO manual. Information herein is applicable as of MetroPro version 8.1.1.

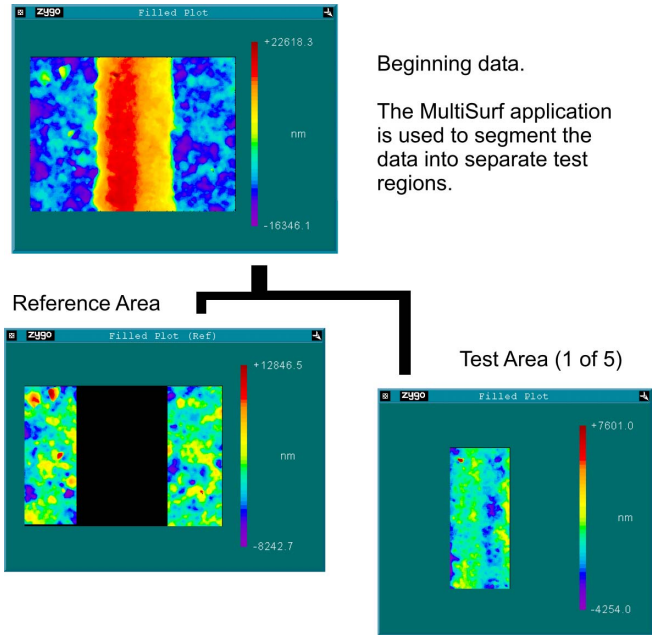
The MultiSurf Application

The MetroPro MultiSurf Application provides a complete set of controls, plots, and results, to isolate areas of interest on the surface of your test part. In simple terms, it is used to segment or divide a single data set into multiple test areas. And once the control settings are established, similar parts can be measured and test areas isolated automatically.

The MultiSurf Application is based on Test and Reference Data Windows, where a reference surface serves as the standard to which test surfaces on the same part are compared during the analysis process. The application is unique in that it generates test and reference areas based on part data itself; this helps overcome problems aligning regions on the part to predefined masks. Data is easily separated into multiple surfaces; one serves as the reference surface, and up to four other areas serve as test surfaces.

The MultiSurf application supports ZYGO's NewView and GPI instruments. The application is supplied as standard with MetroPro software; no unique license is required. For information on licensing, see the *MetroPro Quick-Start Guide*.

When used with the NewView, the MultiSurf Application is used for measuring the surface structure and roughness of test parts. When used with the GPI, the application measures the surface quality of optical elements. And you can always use the application to analyze existing data.



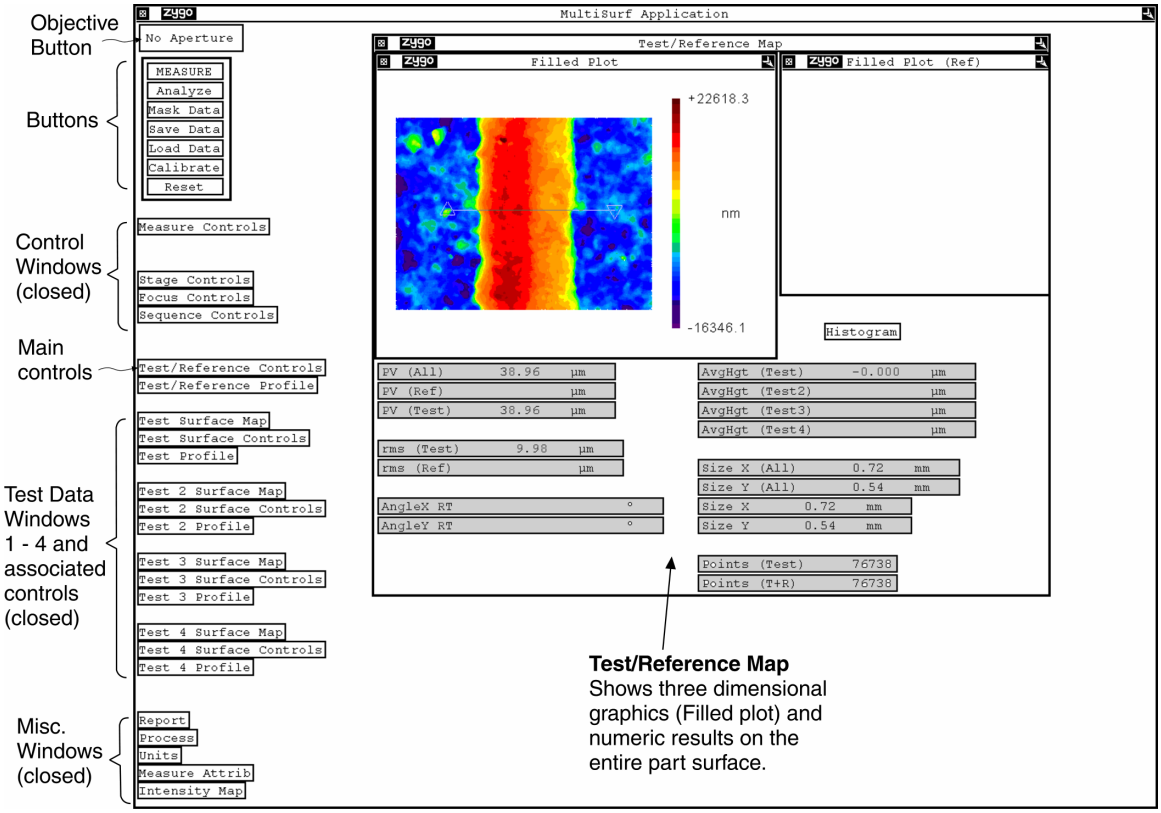
Key Features:

- Displays test data derived from the original data set in up to five unique test surface windows. Each test window has its own set of controls to remove and filter data independently.
- Segments data based on height or size of part features. It includes multiple methods for segmenting data.
- Does not require drawing and aligning masks to part features for reference and test comparisons, so it overcomes problems related to aligning masks to parts during analysis.

MultiSurf.app

To open the application, click on the MultiSurf.app icon. If the icon is not on the MetroPro base window, then use the Load Application command from the MetroPro Window menu to first load the application icon.

The MultiSurf Application Screen

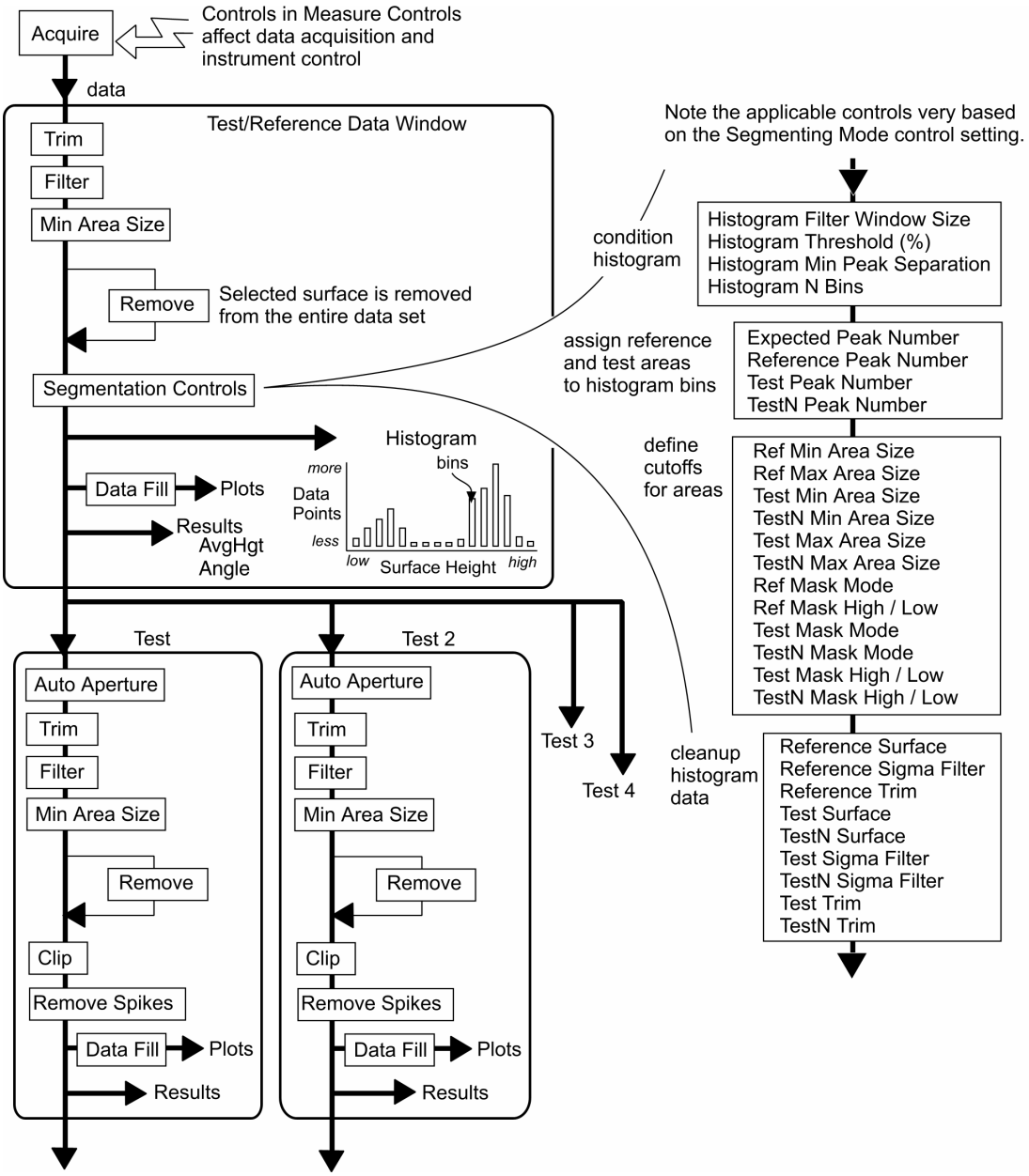


Guidelines

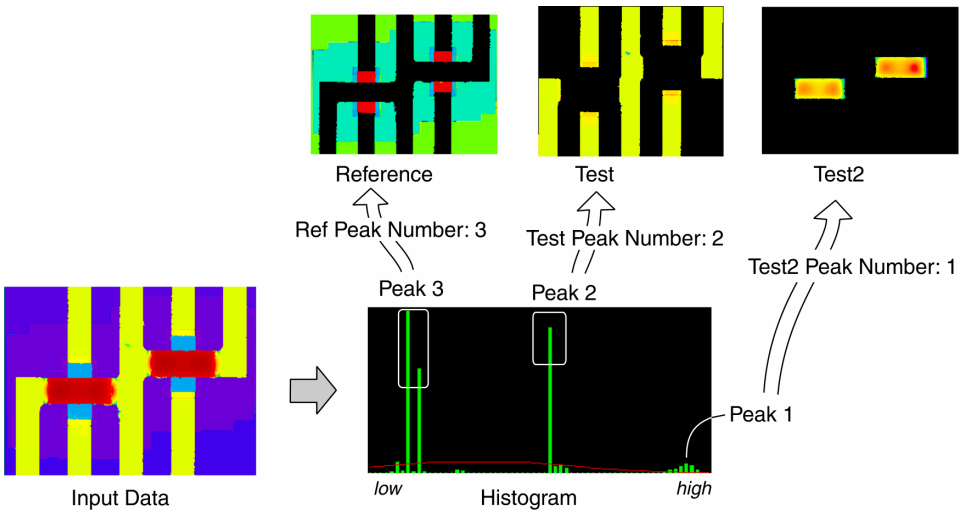
- *Use Non-segmented Data to Determine Proper Settings* – Either load existing data into the application or make your first measurement with the Segmenting Mode control set to Editor (Mask Editor). This ensures that you start with good data before determining control settings for your part. See also “Determining if Data is Appropriate for Segmenting.”
- *The Part Determines Segmentation Mode* – Select the Segmentation Mode based on the characteristics of part you are measuring.
- *Know What You’re After and Experiment* – Know what surfaces you want to isolate and don’t be afraid to experiment with the control settings. Once data is loaded, simply change settings and click Analyze (F2). Control settings will vary with different parts.
- *Follow General Instrument Guidelines* – Create and use a System Error File when you are measuring very smooth or very form critical surfaces, where the form deviation is on the same magnitude of the system error deviation. And ensure that the light level (F5) is set and the fringes are nulled before making measurements to improve data acquisition.
- *Save Your Changes* - To save changes made an application, select the Save Application command from the Application Window menu. In the File Handler, click Current Selection, enter a name for the application, ending with “.app” and press [Enter], then click Done.

MultiSurf Data Flow

An understanding of the data flow will help you to use the application. In MetroPro Reference and Test data windows, the area defined as the "test" is compared to the area defined as "reference". The areas are not only compared, but a user-defined surface (with the Remove control) is fit to the reference and removed from all the data (including all test regions). The reference surface is zeroed to become the datum surface. The controls in the Test/Reference data window affect the overall analysis; the controls in the individual test data windows affect only the analysis within that window.

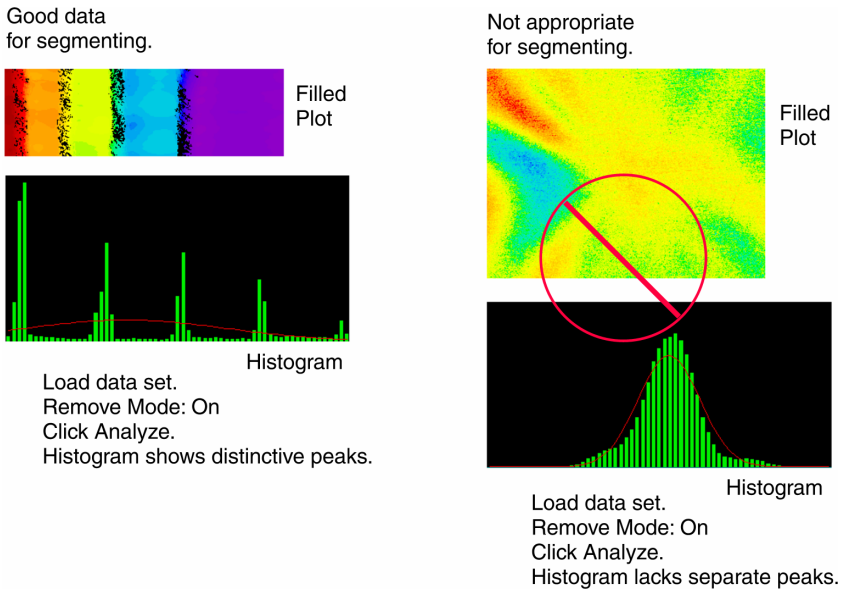


This shows an overview of how the MultiSurf Application works. A histogram function segments the input height data into multiple distinct peaks. The data that corresponds to each of these histogram peaks is segmented based on control settings and displayed in separate windows.

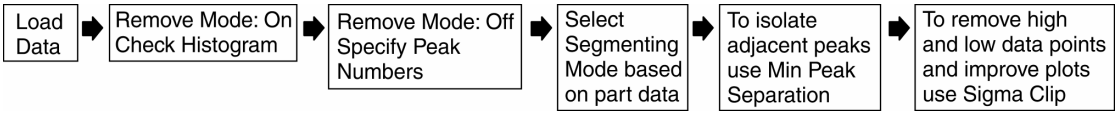


Determining if Data is Appropriate for Segmenting

Set the Remove Mode control to On and click the Analyze button to determine if the data is appropriate for segmenting as based on the histogram. This does not apply when the Segmentation Mode control is set to Editor or Islands.



The Segmentation Process - Simplified



Segmentation Mode: Editor

- Selects areas of interest based on location.
- Requires user-created reference mask and test mask using the Mask Editor.
- Manual segmenting method based on the reference mask and test mask; it supports only one test area.
- Requires that the test part be consistently located in the field of view.
- Functions identically to standard MetroPro applications. When Segmenting Mode is Editor, the segmenting and histogram controls are not used.
- Refer to Mask Editor in the *MetroPro Reference Guide* for more information.

Segmentation Mode: Histogram

- Selects areas of interest based on heights.
- Manual segmenting technique that defines reference and test areas based on control settings, which are relative to the best fit surface specified by the Remove control.
- The user examines the Histogram plot using plot inspectors to determine entries for the Ref Mask Low/High controls and Test Mask Low/High controls.

1. Initial control settings-

   Segmentation Mode: Editor
   Remove Mode: Off
   Remove: Plane
   or appropriate surface type
   Load data.

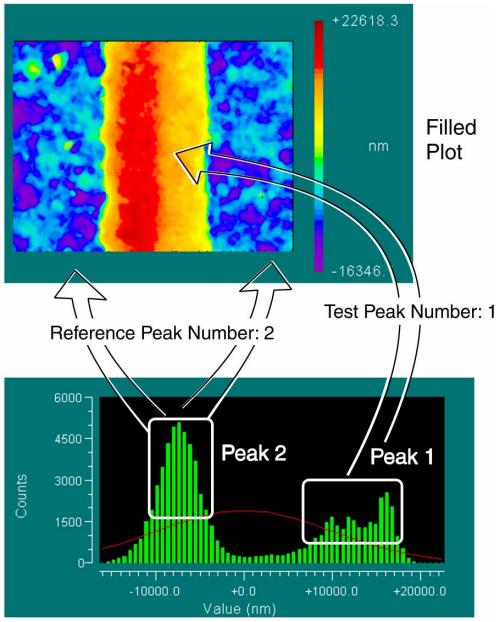
2. Specify peaks-

   Expected Peak Number: 2
   Corresponds to the two peaks found in the histogram.

   Reference Peak Number: 2
   This defines the larger lower area as the reference surface.

   Test Peak Number: 1
   This defines the higher region as the test area.

A Quick Look at the Data



Histogram

3. Locating and defining levels-

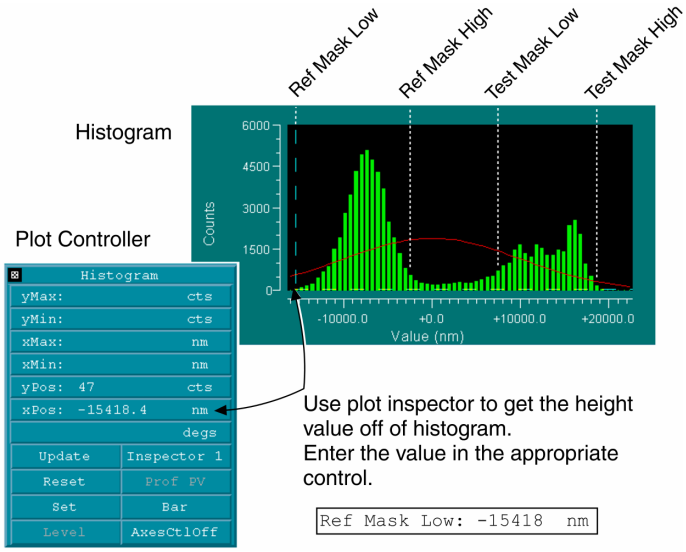
   Open Histogram plot in Test/Reference Map.

   Use plot inspector to determine the heights where each surface falls.

   Reading from the Histogram plot controller, enter values for-

   Ref Mask Low
   Ref Mask High
   Test Mask Low
   Test Mask High

Determining Heights from the Histogram



4. Segmenting the data-

   Segmentation Mode: Histogram

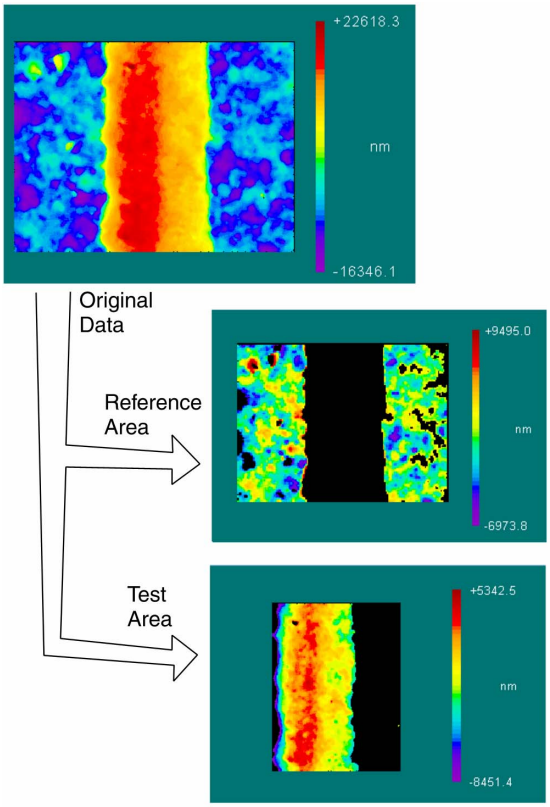
   Click Analyze button.

   The Filter, Trim, and Data Fill controls in Test/Reference Controls affects the data in both the reference and test areas.

   The Filter, Trim, and Data Fill controls in Test Surface Controls affects only the test area data.

   In this example, both the reference and test areas require tweaking to fill in missing data and to eliminate spurious data.

Segmented Data



Segmentation Mode: Peaks Midpoint

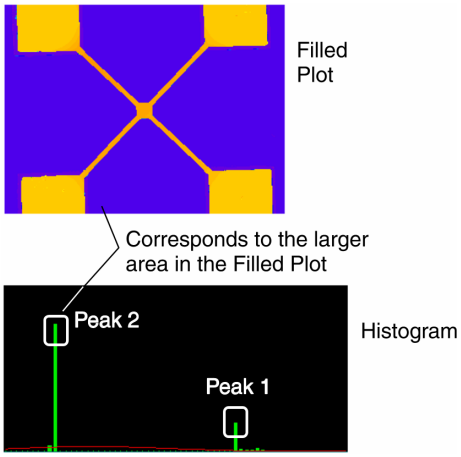
- Selects areas of interest based on heights.
- For relatively smooth parts with clearly separated height areas; not recommended for rough parts or parts with slopes.
- Most common Segmenting Mode.
- Ref Mask Low/High and Test Mask Low/High values determined automatically.

1. Determine if the data can be segmented-

   Load data.
   Remove Mode: On
   Click Analyze button.

   There are two distinct peaks in this Histogram; the data is good for segmenting.

Examine the Histogram Before Segmenting



2. Define segmenting-

   Remove Mode: Off

   Expected Peak Number: 2
   Correspond to the two peaks found in the histogram.

   Reference Peak Number: 2
   This defines the larger lower area as the reference surface.

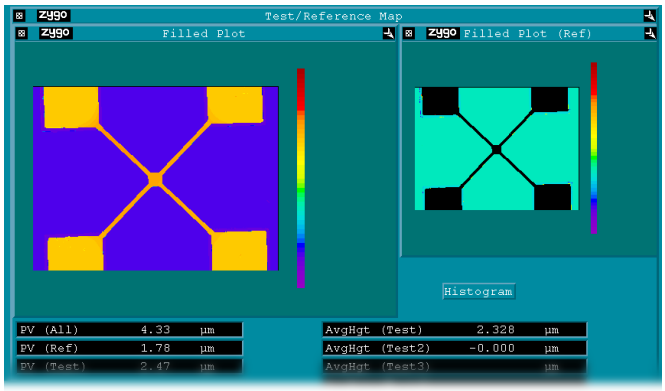
   Test Peak Number: 1
   This defines the upper region as the test area.

   Segmentation Mode: Peaks Midpoint

   Click Analyze button.

   Segmentation is successful.

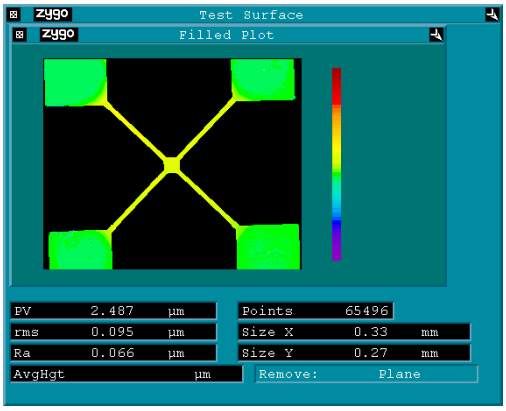
The Test/Reference Map Window shows the entire data set on the left and the reference area on the right.



3. To view results on just the test area, open Test Surface Map.

   The data in this window can be modified using the Test Surface Controls.

The Test Surface Map Window shows the results on the test area



4. To view results on just the reference area-

   Test2 Peak Number: 2
   This assigns the reference area to be displayed in the Test 2 windows.

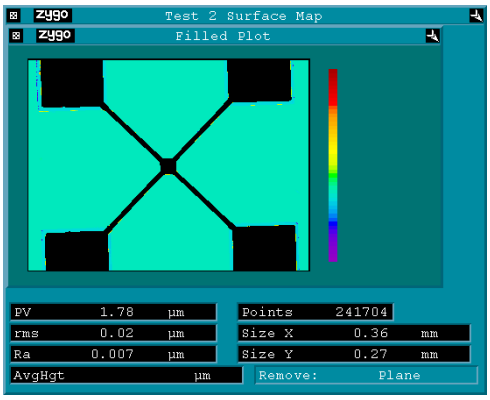
   Click Analyze button.

   Open Test 2 Surface Map

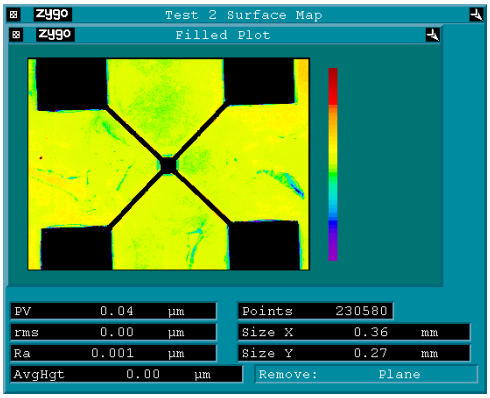
   Note: In Test/Reference Controls, enter Test2 Sigma Clip: 3 and click Analyze to show greater detail.

   The data in this window can be modified using the Test 2 Surface Controls.

In this case, the Test 2 Surface Map Window shows the results on the reference area



Sigma Clip removes high and low spikes from the data so greater detail can be seen



Segmentation Mode: Peaks Relative

- Selects areas of interest based on heights.
- For rough parts with steps and parts with slopes between steps. This mode is also useful to segment out small areas that may be difficult to see in the histogram.
- Manual segmenting technique that defines reference and test areas based on control settings, which are relative to the histogram peak at a given vertical location.
- The Ref Mask Low/High and Test Mask Low/High controls allow you to clip the data relative to the peak of each surface in the histogram. Note that in this case, the height values are relative to the peak and are not absolute values, like entered in the Histogram mode.

Segmentation Mode: Peaks FWHM

- Selects areas of interest based on heights.
- Similar to Peaks Midpoint, except that this mode defines Ref Mask Low/High and Test Mask Low/High values to be full width at half maximum of a given peak. This mode may help differentiate between two adjacent peaks than Peaks Midpoint.
- Ref Mask Low/High and Test Mask Low/High values determined automatically.

Segmentation Mode: Islands

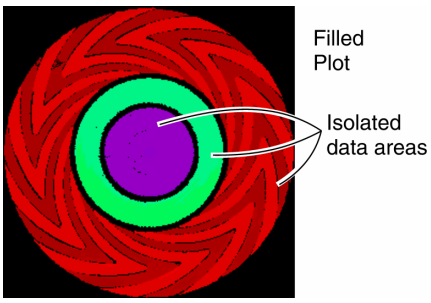
- Selects areas of interest based on size.
- Only for parts with discontinuous or distinct areas (isolated islands) of data.
- Well suited for measuring multiple parts on a single substrate with the GPI.
- The software automatically numbers islands of data from largest (1) to smallest (N).
- Segments based on area size and not heights; does not use histogram functions.

1. Determine if the data is appropriate for "Islands."-

   Load data.
   Data must contain separate areas of isolated data.

   There are three distinct areas in this Filled Plot; the data is good for "Islands."

Example of Data Suited for Segmenting Mode: Islands



2. Enter control settings-

   Expected Peak Number: 3
   There are three isolated areas in this data.

   Reference Peak Number: 1
   Assigns the largest area as the reference.

   Test Peak Number: 2
   Assigns the second largest area as the test area.

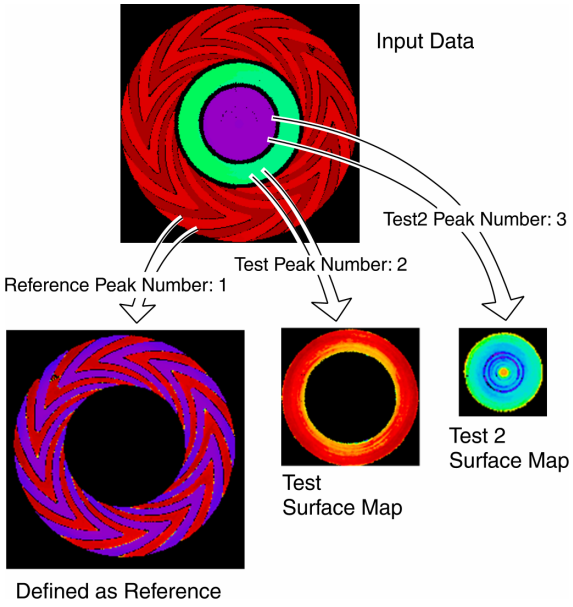
   Test2 Peak Number: 3
   Assigns the third largest area as test 2.

   Segmenting Mode: Islands

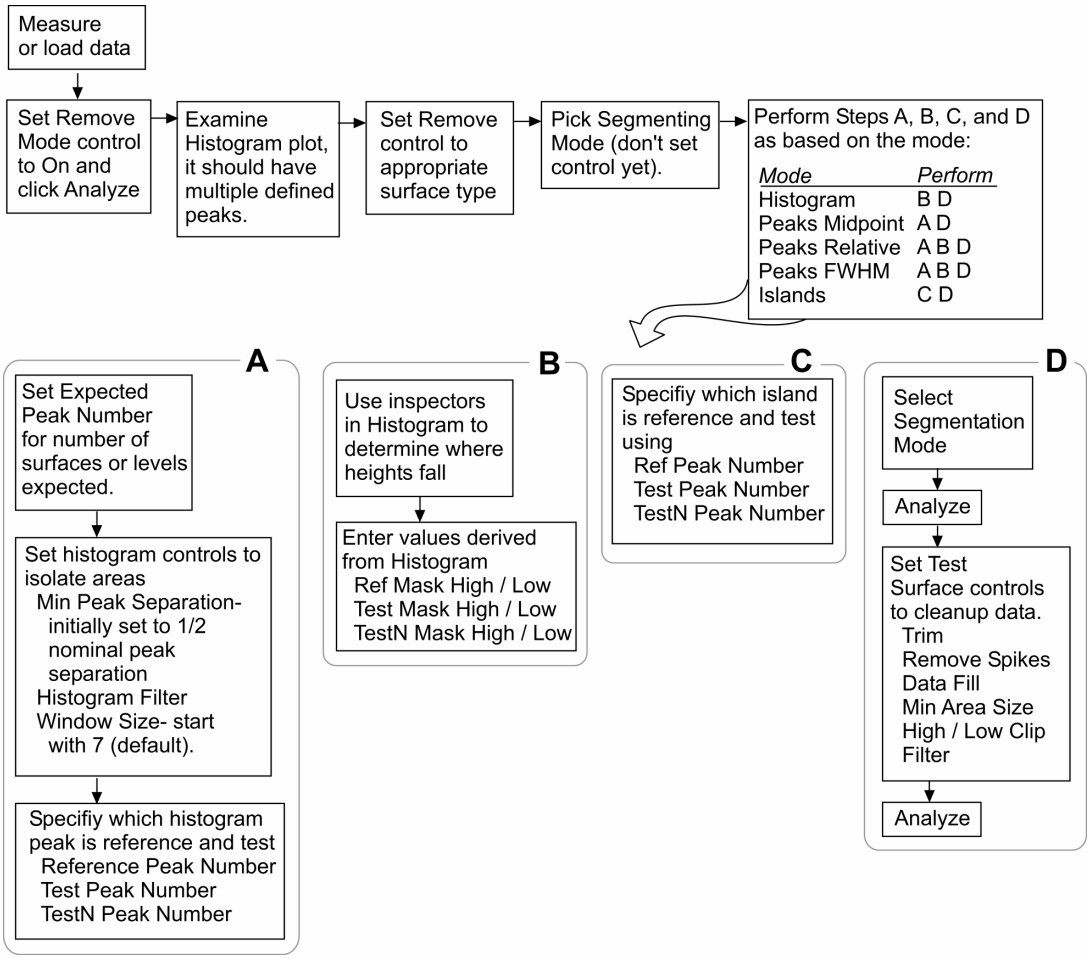
   Click Analyze button.

   Segmentation is successful.

Islands - Data Segmented by Area



Segmentation Flowchart

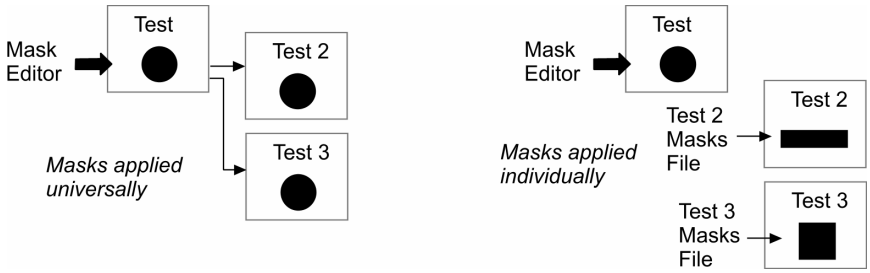


Analyzing Multiple Data Sets

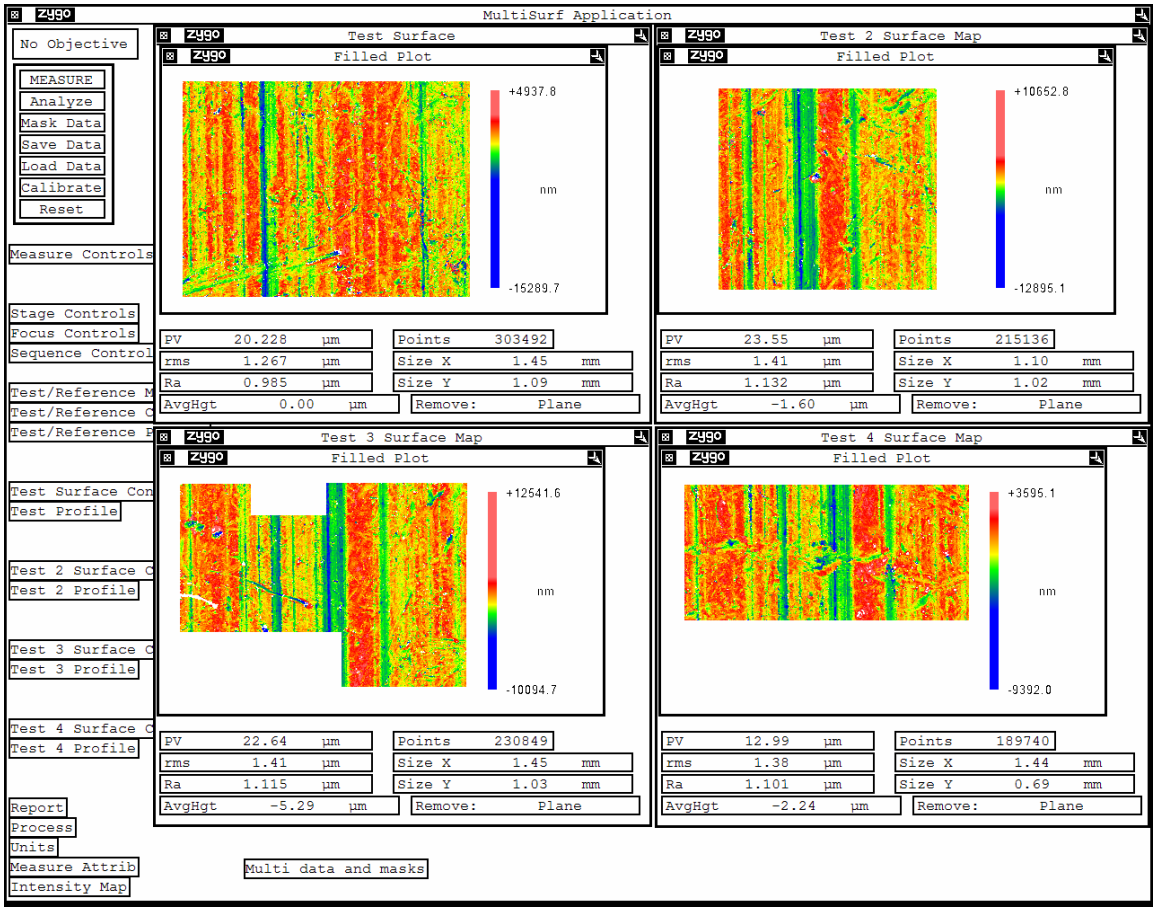
From 2 to 5 data sets and test masks can be loaded and analyzed simultaneously. The following constraints must be followed when using multiple data sets and masks:

- The Test Surface Data window must contain data.
- All data files must be made with the same objective and zoom setting, and use the same Phase Res control setting.
- The Segmentation Mode control must be set to Editor, Peaks Midpoint, or Peaks Relative.
- Mask files must be defined and saved prior to specifying the mask file name. All mask types are assumed to be "default" masks when loaded into Test 2 to 5 data windows. If no mask files are specified with the Test X Masks File controls, any masks used on the Test Surface are applied to all data windows.

Options for Applying Masks



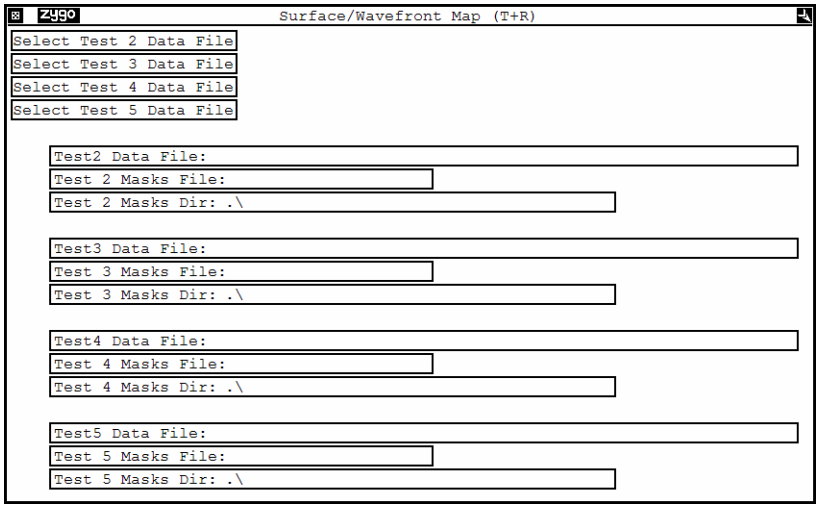
Example of Four Different Data Sets and Masks Analyzed Simultaneously (in each data window the data file and masks applied are unique)



Multiple Data File and Mask Controls

Multiple data file and mask controls are available in the Surface/Wavefront Map (T+R) Data window. In the following table, X represents a number from 2 to 5. For example: Test X Data File can refer to Test 2, Test 3, Test 4, and Test 5 Data File controls.

Sample Data Window with Data File and Mask File Controls



Item	Function
Select Test X Data File button	Click to select a data file to load into the corresponding Test window. The selected path and .dat file name are automatically entered into the corresponding TestX Data File control. This button is available in the Surface/Wavefront Map (T+R) Data window with the New Button → Segmentation → Test X menu.
TestX Data File	Specifies the pathway and name of the data file to load into the corresponding Test window. The path and name may be entered by clicking the control and typing the path, or by selecting the file with the Select Test X Data File button. This control is available in the Surface/Wavefront Map (T+R) Data window with the New Control → Segmentation → TestX menu.
Test X Masks File	Specifies the name of the mask file to apply to the corresponding Test window. This control is available in the Surface/Wavefront Map (T+R) Data window with the New Control → Segmentation → TestX → Test X Mask menu.
Test X Masks Dir	Specifies the directory path to where the corresponding mask file is located. The default directory is .\ which indicates the MetroPro working directory. This control is available in the Surface/Wavefront Map (T+R) Data window with the New Control → Segmentation → TestX → Test X Mask menu.

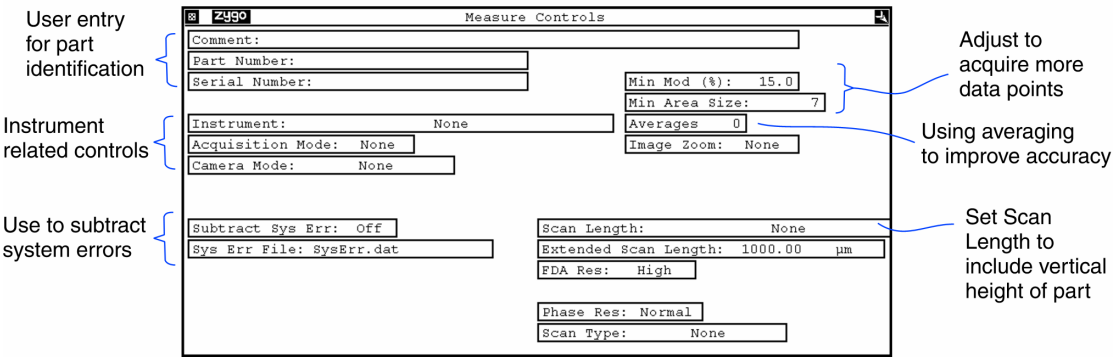
In MetroPro version 8.1.1 the mask file directory name cannot contain spaces.

Control Windows

Measure Controls

To open this window, click the Measure Controls icon. These controls determine the way data is acquired. Make changes before measuring.

Measure Controls determine how data is acquired (NewView Controls Shown)

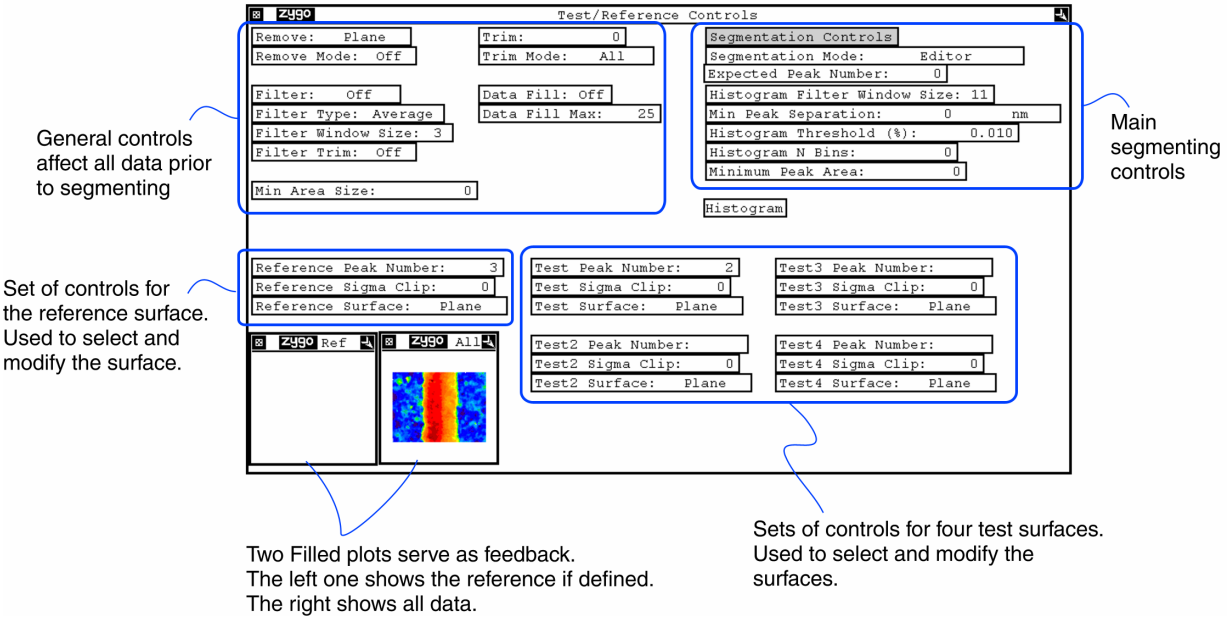


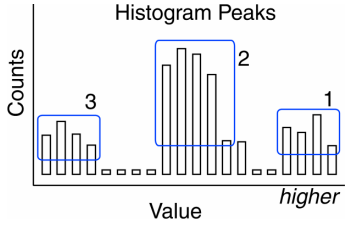
Control	Function
Acquisition Mode	Selects the technique used to acquire data. Settings are Scan or Phase. Scan is for the NewView.
Averages	Specifies the number of measurements that are averaged together, thus improving repeatability. Averaging increases processing time.
Camera Mode	Selects the effective camera size in pixels. More pixels resolve smaller details, but increase processing time.
Extended Scan Length	For NewView with extended scan option only. Specifies the length of the scan. The Scan Length control must be set to Extended. The value entered should be the vertical range of detail in the part plus 10%.
FDA Res	NewView. Selects the resolution used during analysis when Acquisition Mode is set to Scan. Use Normal when measuring rough surfaces; use High when measuring smooth surfaces and steps.
Image Zoom	For microscopes with image zoom option to ensure that lateral type results are calibrated. Set the control to match the setting selected on the microscope's zoom thumbwheel. On some models this is automatically set.
Min Area Size	Specifies the number of data points in a valid region. Decrease to allow smaller areas. Increase to accept larger areas and reject smaller.
Min Mod (%)	Specifies the minimum modulation necessary for a valid data point. Decrease to accept areas with poor fringe contrast or low reflectivity. Increase to exclude unwanted data points.
Scan Length	Selects the vertical scan length for the NewView. The longer the scan, the greater the height measuring capacity, and the longer the time required to make a measurement. Set to the minimum value to encompass the part detail.
Subtract Sys Err	Activates a system error correction function to improve measurement accuracy. An error file must exist for the specific objective in use.
Sys Err File	Specifies the name of a data file to subtract from measurements.

Test/Reference Controls

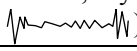
To open this window, click the Test/Reference Controls icon. These controls select the way data is analyzed. After changing settings, click the Analyze button or F3. This is the primary control window for the MultiSurf Application. Use the window's menu to create controls not shown.

Test/Reference Controls select how data is segmented in multiple surfaces



Control	Function
Data Fill	When On, holes or missing data points are filled as based on the setting of the Data Fill Max control. When Off (default), missing data points are not filled. Filling data affects plot displays and numeric results; the raw data is not modified.
Data Fill Max	Specifies the maximum size of a data hole that is filled when the Fill Data control is On. It is the total number of pixels in any one hole. A value of –1 fills everything.
Expected Peak Number	Specifies the number of histogram peaks in the histogram data that you expect to find. For values greater than 1, the software automatically adjusts the Histogram Threshold (%) until the set number of peaks are found. Peaks are numbered from highest (1) to lowest (N). Not applicable when the Segmenting Mode control is Editor or Islands. 
Filter	Activates data filtering options. Filtering is used to highlight the roughness (high frequency components) or waviness (low frequency components) of a test part. Settings are Off, Low Pass, or High Pass. Off disables data filtering; all other filter controls are ignored. The affect of filtering varies based on the settings of the Filter Type and Filter Window Size controls.

Test/Reference Controls (continued)

Control	Function
Filter Trim	Selects how filtering interacts with edge data. When On, filtering performs normally and some edge data is lost. When Off, edge data is preserved that is usually lost due to filtering. Set to On, if you notice "ringing" effects at the data edges (for example: ).
Filter Type	Selects the filtering algorithm when the Filter control is activated. The choices are: Average, Median, and 2 Sigma. *Average* uses all valid data points in each filter window and averages them. *Median* uses the middle value of all valid data points in each filter window. *2 Sigma* uses data points that are within two times the rms value in each filter window and disregards values outside this range. When the Average, Median, or 2 Sigma filters are used, the Filter High/Low Wavelen (or Freq) controls are ignored.
Filter Window Size	Selects the number of data points used to generate a new filtered data point when the Filter Type control is set to Average, Median, or 2 Sigma. As the window size is increased the affects of filtering are increased.
Histogram Data Type	Selects the type of data used in the histogram. Only Surface (or height data) is supported at this time. To view this control, use the New Control → Segmentation → Histogram menu.
Histogram N Bins	Specifies the number of bins in the histogram data into which the height values of the present data are distributed. The default setting is 0, which selects an appropriate number automatically. The maximum value is 1024. Multiple steps with wide dynamic range in the histogram bins require more bins to separate smaller steps. Not applicable when the Segmenting Mode control is Editor or Islands.
Histogram Filter Window Size	Selects the number of data points used to generate a new histogram data point. It functions as a smoothing filter to remove noise in the histogram prior to looking for peaks. The default setting is 11. A smaller value detects levels with small areas. A larger value discriminates against small areas and closer peaks. Not applicable when the Segmenting Mode control is Editor or Islands.
Histogram Min Peak Separation	Specifies the minimum distance between histogram two peaks for them to be counted separately. Peaks closer together than the minimum separation are counted as one. Not applicable when the Segmenting Mode control is Editor or Islands.
Histogram Min Intensity Peak Separation	Specifies the minimum intensity difference between two peaks for them to be counted separately. Peaks closer together than the minimum separation are counted as one. This control is not supported at this time. The Histogram Data Type control must be set to Intensity. To view this control, use the New Control → Segmentation → Histogram menu.
Histogram Remove	Selects the surface to subtract from the data prior to the histogram operation. This is only a temporary data set, the remove is not reflected in the final data. Settings are None, Mode, Plane, Sphere, and Cylinder. To view this control, use the New Control → Segmentation → Histogram menu.

Test/Reference Controls (continued)

Control	Function
Histogram Threshold (%)	Specifies the minimum percentage of the histogram data for a peak to be considered valid. It performs a filtering function to remove small numbers of high or low points in the incoming data before the histogram function. The default setting is 0.01. Not applicable when the Segmenting Mode control is Editor or Islands.
Min Area Size	Specifies the number of data points in a valid region. Decrease to allow smaller areas. Increase to accept larger areas and reject smaller. Used to remove spurious data points.
Min Peak Separation	Specifies the minimum height difference between two peaks for them to be counted separately. Peaks closer together than the minimum separation are counted as one. The most useful segmenting control. Not applicable when the Segmenting Mode control is Editor or Islands.
Minimum Peak Area	Specifies the minimum number of data points required to form a peak in the histogram. It can be used to eliminate small areas and surface defects from the histogram. The default setting is 0. Not applicable when the Segmenting Mode control is Editor or Islands.
Ref Mask High	Specifies the higher height limit used in defining the reference mask. When Segmenting Mode is Histogram, the limit is in relation to zero (the best fit surface specified by the Remove control). When Segmenting Mode is Peaks Relative, the limit is in relation to the center of the reference peak area. This control is used along with the Ref Mask Low and Ref Mask Mode controls to determine the reference mask area. To view this control, use the New Control → Segmentation → Reference menu.
Ref Mask Low	Specifies the lower height limit used in defining the reference mask. When Segmenting Mode is Histogram, the limit is in relation to zero (the best fit surface specified by the Remove control). When Segmenting Mode is Peaks Relative, the limit is in relation to the center of the reference peak area. This control is used along with the Ref Mask High and Ref Mask Mode controls to determine the reference mask area. To view this control, use the New Control → Segmentation → Reference menu.
Ref Mask Mode	Determines how the Ref Mask High and Ref Mask Low controls are applied to the data when creating the reference mask. Settings are Unfill or Fill. When set to Fill, the data points above Ref Mask High and below Ref Mask Low are deleted. When Set to Unfill, the data points between Ref Mask Low and Ref Mask High are deleted. Not applicable when the Segmenting Mode control is Editor or Islands. To view this control, use the New Control → Segmentation → Reference menu.
Ref Max Area Size	Specifies the maximum or the largest contiguous number of data points in a valid reference area region. It is useful for eliminating the effect of large data areas that are not meant to be included in the data. To view this control, use the New Control → Segmentation → Reference menu.

(continued)

Test/Reference Controls (continued)

Control	Function
Ref Min Area Size	Specifies the minimum number of contiguous data points in a valid reference area region. It is useful for eliminating isolated data areas that are not meant to be included in the data. To view this control, use the New Control → Segmentation → Reference menu.
Reference Peak Number	When the Segmenting Mode control is set to Histogram, Peaks Midpoint Peaks Relative, or Peaks FWHM, it specifies which histogram peak within the histogram data is used as the *reference* area. Peak areas within histogram data are numbered from highest (1) to lowest (N). See Expected Peak Number control. When the Segmenting Mode control is set to Islands, it specifies which discontinuous area of data is used as the *reference* area. Islands are numbered from largest (1) to smallest. A value of 0 uses all areas.
Reference Sigma Clip	Applies a sigma filter to the reference area to remove spurious data. Conservative use of this control can help increase the repeatability of your measurement. If a data point height is greater than the entered value times the rms from the reference surface (specified by the Reference Surface control), it is removed. The lower the value the greater the filtering effect; when set to 0 there is no filtering. Use this control for data clean-up after segmenting into test and reference areas.
Reference Surface	Specifies the type of surface that the Reference Signal Clip is applied to. Settings are Plane, Sphere, and Cylinder. The setting should match the underlying form of the part.
Reference Trim	Specifies the number of pixel layers to remove from edges and from isolated obscurations on the reference surface after the histogram operation. To view this control, use the New Control → Segmentation menu.
Remove	Specifies the surface to subtract from measurements to minimize form. Settings are Plane, Piston, Sphere, and Cylinder.
Remove Mode	When On, the dominant slope in the original data is leveled and the standard Remove control is non-functional. Remove Mode is mainly used as a preview tool to determine if data is appropriate for segmenting. Once the Segmentation Mode is selected, Remove Mode should be Off. Remove Mode levels the data to the dominant surface and may fail on very rough parts. If this is the case, try to isolate the histogram peaks by using a low pass filter. When not segmenting data, the Remove Mode can be set to On to automatically level data for more appropriate viewing.

(continued)

Test/Reference Controls (continued)

Control	Function
Segmentation Mode	Selects the technique used when segmenting data. Settings are: Editor (default), Histogram, Peaks Midpoint, Peaks Relative, Peaks FWHM, and Islands. *Editor* uses test and reference masks created by the user with the Mask Editor. A fixture is recommended to locate parts exactly in the field of view. This mode supports a reference area and only one test area. *Histogram* defines the test and reference areas as based on user input in the Ref Mask Low/High controls and the Test Mask Low/High controls. The histogram plot is measured by the user with the plot inspectors to determine the appropriate values. *Peaks Midpoint* automatically generates reference and test areas based on part data, halfway between the specified test peak and reference peak in the histogram. *Peaks Relative* automatically generates reference and test areas based on part data, relative to each corresponding histogram peak. The height values for defining masks are user-entered into the Ref Mask Low/High controls and the Test Mask Low/High controls. *Peaks FWHM* automatically generates reference and test areas based on part data, at full-width-at-half-maximum of a given peak. *Islands* automatically generates reference and test areas based on the size of discontinuous areas in part data. This mode does not rely on histogram data for segmenting, therefore histogram controls are not used. Use the Reference Peak Number and Test Peak Number controls to specify which island is the reference and test area.
Test Peak Number **TestX Peak Number**	When the Segmenting Mode control is set to Histogram, Peaks Midpoint Peaks Relative, or Peaks FWHM, it specifies which histogram peak within the histogram data is used as the *test* area. Peak areas within histogram data are numbered from highest (1) to lowest (N). See Expected Peak Number control. Note that if Test Peak Number and Test2 Peak Number controls are set to the same number, that the resultant data windows can be analyzed separately. When the Segmenting Mode control is set to Islands, it specifies which discontinuous area of data is used as the *test* area. Islands are numbered from largest (1) to smallest (N). A value of 0 uses all areas.
Test Sigma Clip **TestX Sigma Clip**	Applies a sigma filter to the applicable test area (1–5) to remove spurious data. If a data point height is greater than the entered value times the rms from the reference surface (specified by the Remove control), it is removed. The lower the value the greater the filtering effect; when set to 0 there is no filtering. Use this control for data clean-up after segmenting into test and reference areas.
Test Surface **TestX Surface**	Selects the surface to subtract from the histogram data prior to calculating results on the applicable test surface. This is only a temporary data set, the remove is not reflected in the final data. Settings are Plane, Sphere, and Cylinder.

(continued)

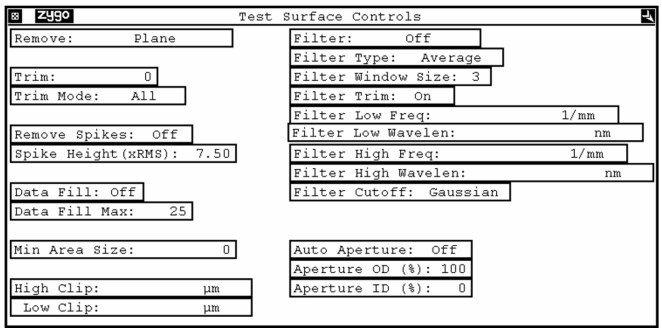
Test/Reference Controls (continued)

Control	Function
Test Mask High **TestX Mask High**	Specifies the higher height limit used in defining the test mask. When Segmenting Mode is Histogram, the limit is in relation to zero (the best fit surface specified by the Remove control). When Segmenting Mode is Peaks Relative, the limit is in relation to the center of the reference peak area. This control is used along with the Test Mask Low and Test Mask Mode controls to determine the applicable test mask area. To view this control, use the New Control → Segmentation → Test menu.
Test Mask Low **TestX Mask Low**	Specifies the lower height limit used in defining the test mask. When Segmenting Mode is Histogram, the limit is in relation to zero (the best fit surface specified by the Remove control). When Segmenting Mode is Peaks Relative, the limit is in relation to the center of the reference peak area. This control is used along with the Test Mask High and Test Mask Mode controls to determine the reference mask area. To view this control, use the New Control → Segmentation → Test menu.
Test Mask Mode **TestX Mask Mode**	Determines how the Test Mask High and Test Mask Low controls are applied to the data when creating the applicable test (1-4) mask. Settings are Unfill or Fill. When set to Fill, the data points above Test Mask High and below Test Mask Low are deleted. When Set to Unfill, the data points between Test Mask Low and Test Mask High are deleted. Not applicable when the Segmenting Mode control is Editor or Islands. To view this control, use the New Control → Segmentation → Test menu.
Test Max Area Size **TestX Max Area Size**	Specifies the maximum or the largest contiguous number of data points in a valid applicable test (1–4) area region. It is useful for eliminating the effect of large data areas that are not meant to be included in the data. To view this control, use the New Control → Segmentation → Test menu.
Test Min Area Size **TestX Min Area Size**	Specifies the minimum number of contiguous data points in a valid applicable test (1–5) area region. It is useful for eliminating isolated data areas that are not meant to be included in the data. To view this control, use the New Control → Segmentation → Test menu.
Test Trim **TestX Trim**	Specifies the number of pixel layers to remove from edges and from isolated obscurations on the applicable test (1–5) surface after the histogram operation. To view this control, use the New Control → Segmentation → Test menu.
Trim	Specifies the number of pixel layers to remove from edges and from isolated obscurations on the data before the histogram operation. Works in conjunction with the Trim Mode control.
Trim Mode	Selects where trimming is applied; settings are Outside or All.

Test Surface Controls

These controls act only on the corresponding test data window. This section describes only the controls unique to all four Test Surface Control windows.

Test Surface Controls select how data is analyzed and displayed in the test windows

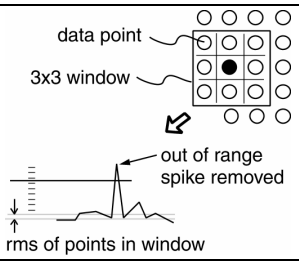


Many controls have an identical function to those found in Test/Reference Controls but act only on the data within the corresponding Test Surface Data Window. For controls not described, see the previous section.

Control	Function
Aperture ID (%)	Specifies the inner diameter of an automatic round aperture mask. The size is specified as a percentage of the data set. Data inside this diameter is excluded from the analysis. The Auto Aperture control must be On.
Aperture OD (%)	Specifies the outer diameter of an automatic round aperture mask. The size is specified as a percentage of the data set. Data outside this diameter is excluded from the analysis. The Auto Aperture control must be On.
Auto Aperture	When On, an automatic circular mask(s) is created based on the settings of the Aperture ID (%) and Aperture OD (%) controls. The mask is centered over the data. This is applicable to the Test data window only, not to Test 2, Test 3, or Test 4 windows.
Filter	Activates data filtering options. Filtering is used to highlight the roughness (high frequency components) or waviness (low frequency components) of a test part. Settings are Off, Low Pass, High Pass, Band Pass, and Band Reject. Off disables data filtering; all other filter controls are ignored. The affect of filtering varies based on the settings of the Filter Type and Filter Window Size controls.
Filter Cutoff	This control is activated when the Filter Type control is set to FFT Auto or FFT Fixed. The settings are Sinusoid and Gaussian. These are two methods of attenuating the frequency components.
Filter High Freq and Filter High Wavelen	Specifies the frequency (or wavelength) of the higher cutoff point between roughness and high frequency data. Applicable Filter control settings: Low Pass, Band Pass, Band Reject. Applicable Filter Type control settings: FFT Fixed.
Filter Low Freq and Filter Low Wavelen	Specifies the frequency (or wavelength) of the lower cutoff point between waviness and roughness data. Applicable Filter control settings: High Pass, Band Pass, Band Reject. Applicable Filter Type control settings: FFT Fixed.

(continued)

Test Surface Controls (continued)

Control	Function
Filter Type	Selects the filtering algorithm when the Filter control is activated. The choices are: Average, Median, 2 Sigma, FFT Auto, and FFT Fixed. For the Average, Median and 2 Sigma settings, see the explanation under Test/Reference Controls. *FFT Auto* and *FFT Fixed* use a Fast Fourier Transform algorithm; and the Filter Window Size control is ignored. FFT Auto automatically selects filter cutoff points based on the test data; it should be used as a starting point only. FFT Fixed sets filter cutoffs based on the entries in the Filter High/Low Wavelen (or Freq) controls.
High Clip	Specifies a vertical cutoff plane through the data, relative to zero. All data is removed above the entered value. The zero location is specified by the best fit surface with the Remove control. High Clip serves as a simple filter to remove spikes in the data.
Low Clip	Specifies a vertical cutoff plane through the data, relative to zero. All data is removed below the entered value. The zero location is specified by the best fit surface with the Remove control. High Clip serves as a simple filter to remove valleys in the data.
Remove Spikes	When On, spikes are removed from the data based on the setting of the Spike Height control. When Off, data spikes are not removed.
Spike Height (xRMS)	For each point, the rms height of the surrounding points is calculated; if the point height is greater than the entered value times the rms it is removed. An entry is ignored unless the Remove Spikes control is On. 

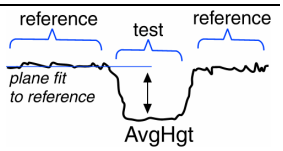
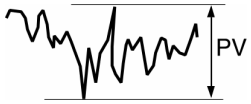
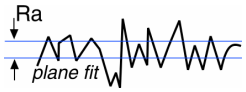
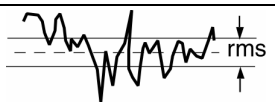
Other Control Windows

For details on these controls, refer to the Microscope Application booklet, OMP-0360.

Control Window	Function
Focus Controls	These controls are for using auto focus and auto tilt, which is only applicable for microscopes with programmable stages. Auto focus controls drive the motorized z-axis to find the optimum location for fringes and focus. Auto tilt controls drive the roll and pitch (tip and tilt) motorized stages to minimize the number of fringes. These functions are licensed as option “Scan Focus and Tilt” in the MetroPro Edit/View Licenses window.
Sequence Controls	These controls automating the capture of data over time. A variety of parameters can be controlled, from the number of measurements, to time delays, and auto file naming.
Stage Controls	Controls used when creating and working with programmable motorized stages.

Results

The results shown in the MultiSurf Application are explained below. For results not listed, or for greater detail, refer to the *MetroPro Reference Guide*.

Result	Description
AngleX results	Angle X results show the angle in the x-axis (horizontal on the screen) between two surfaces, regardless of the setting of the Remove control. The letters RT, TT2, TT3, TT4, T2T3, T2T4, and T3T4 in the result name identify the two surfaces: RT is Reference and Test TT2 is Test and Test2 TT3 is Test and Test3 TT4 is Test and Test4 T2T3 is Test2 and Test3 T2T4 is Test2 and Test4 T3T4 is Test3 and Test4
AngleY results	Angle Y results show the angle in the y-axis (vertical on the screen) between two surfaces, regardless of the setting of the Remove control. See the explanation of result names under AngleX results.
AvgHgt	AvgHgt (Average Height) is the average height of a test data area in relation to a reference data area in the instrument's z-axis. 
AvgHgt (Test#)	The vertical offset between the reference area and the corresponding test area (labeled as Test, Test2, Test3, Test4, and Test5).
N Peaks Found	The number of peaks found by the histogram function.
Points	The number of valid data points in a particular data set. Points (Test) is the valid number of pixels in the area defined as test. Points (T+R) is the valid number of pixels in the reference and test areas together.
PV	The height between the lowest and the highest point on the test part surface. PV (All) is the PV in the reference and test area together. PV (Ref) is the PV in the reference area. PV (Test) is the PV in the test area. 
Ra	The average roughness, or the average deviation, of all points from a plane fit to the test part surface. 
rms	The root-mean-square deviation of all points from a plane fit to the test part surface. rms (Ref) rms (Test) 
Size X	The dimension of the test data in the x-axis (horizontal on the screen). Size X (All) is the size for the reference and test area together.
Size Y	The dimension of the test data in the y-axis (vertical on the screen). Size Y (All) is the size for the reference and test area together.

Other Operations

Operation	How to
Save data	Click the Save Data button. In the File Handler, click the Current Selection box, enter a name for the file, ending with ".dat", and press [Enter], then click Done.
Print results	Click the word "zygo" in the window you want to print or select the Print command from the window's menu. In the Print Panel, click the Print button.
Save changes made to controls, plots, results, and windows	You must save the application under a new name. Select the Save Application command from the Application Window menu. In the File Handler, click the Current Selection box, enter a name for the file, ending with ".app" and press [Enter], then click Done.
Define a mask	Click the Mask Data button. Use the Mask Editor to define areas to include or exclude from the test part measurement. See "Mask Editor" in the *MetroPro Reference Guide*.
Turn off the system	**Warning!** *Improper shutdown may damage the instrument.* Select the Quit command from the MetroPro menu; turn off power after you have shut down from within Windows.

Troubleshooting

Error	Possible Cause and Solution
Too few peaks in histogram	The combination of Histogram Filter Window and Histogram Threshold (%) do not detect enough peaks to find the reference and test areas. Try setting the Expected Peak Number to 0.
Break up of data into more than one level	The part may be sloped or there are phase discontinuities. Try a larger Histogram Filter Window Size, a larger Min Peak Separation, and a smaller Expected Peaks.
Not as many levels found as expected	The dynamic range of the surface may be too large. Try increasing Histogram N Bins and decreasing Min Peak Separation.

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