

# ProSEM

What's New in ProSEM 3.5

## ProSEM 3.5 Key News

- General
  - Notes on OS support
  - New noise reduction filter
  - Image meta data for various SEM formats
  - Measurement data accuracy settings
- Feature Detection and Measurements
  - Slice measurement for edge and fit
  - Pixel calibration based on array vectors
  - Advanced Package: *Find-Modified* for rotated and scaled features
  - Advanced Package: edge roughness for fitted 2D Shapes
- Layout Integration/ SEM Automation
  - Display and project convenience
  - Automatic image naming
  - SEM interfaces for JEOL and Hitachi

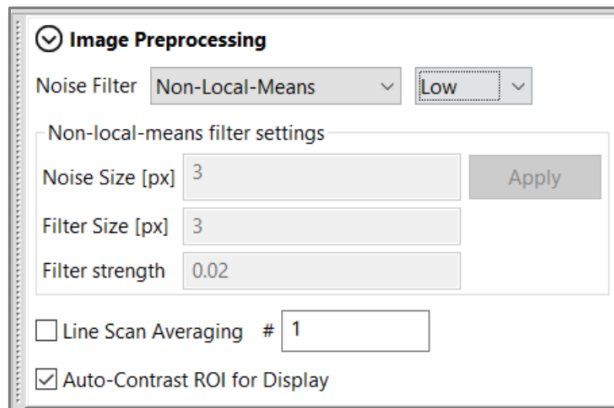
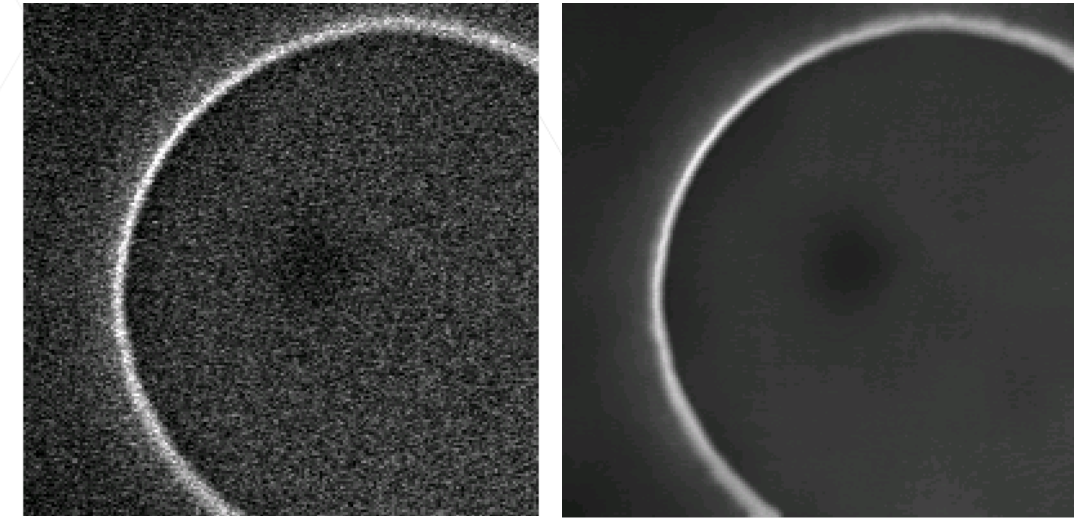
# General

## Operating system supported by ProSEM

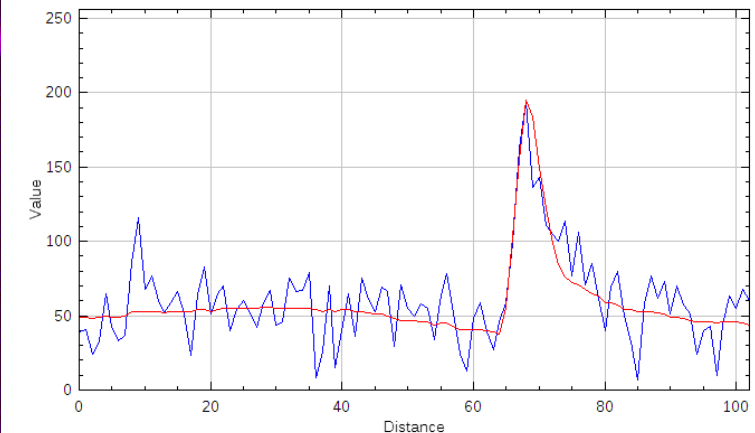
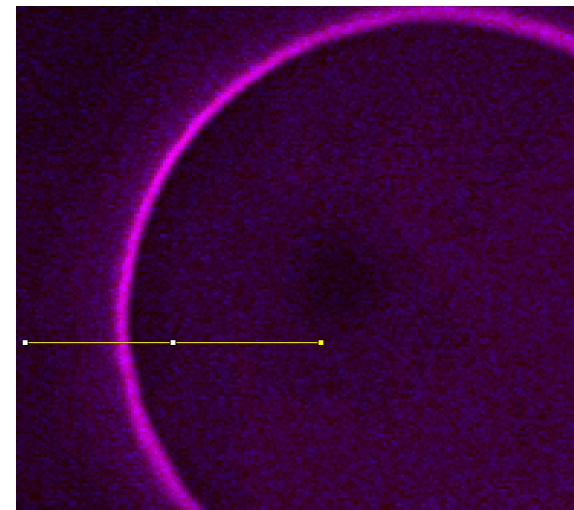
- Release 3.5 (no changes)
  - Windows 10 or 11, 64-bit
  - Redhat/Centos Linux: 7 or 8, 64-bit
  - Ubuntu Linux: 18.04 or 20.04, 64-bit
- Note on next release
  - Redhat/Centos Linux: 7 stopped and 9 will be supported
  - Ubuntu Linux: 18 stopped and 22 will be supported

## New filter for images

- Noise reduction filter “NL Means” (non-local)
- Available in image pre-processing panel
- Based on pixels with (weighted) similar gray levels
- Preserves well the edge peaks and positions
- Note: implementation not yet performance optimized



- More robust edge detection for low SNR
- Better comparability of CDs



Blue: original  
Red: filtered

## New and reworked SEM image meta data implemented

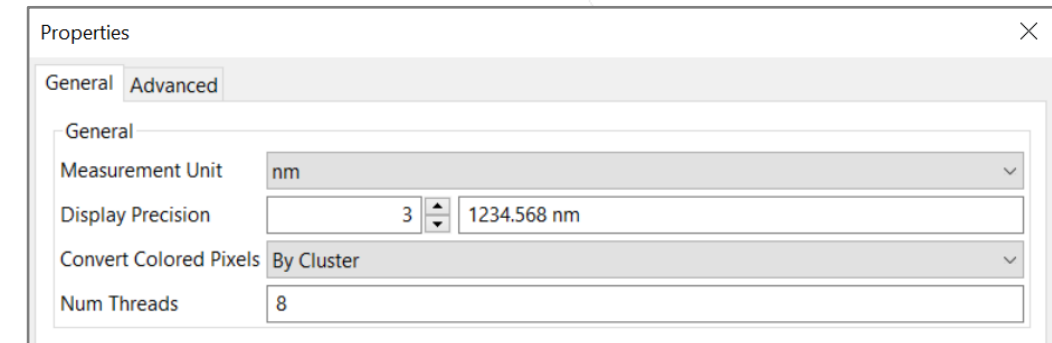
- JEOL image format updated
- Hitachi SEM image format extended
- Tescan image format (hdr) updated
- Hitachi CD-SEM image format added

→ Please contact the GenISys team for additional SEM image formats!

## Measurement unit and data precision

- Internal data precision fully available for user now
- Results down to nominally 1 pm
- Measurement unit can be selected:  $\mu\text{m}$  or nm
- Number of displayed digits can be set

- Maximum theoretical precision accessible
- Easy control of display precision



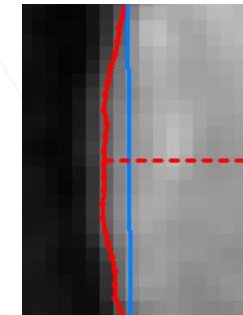
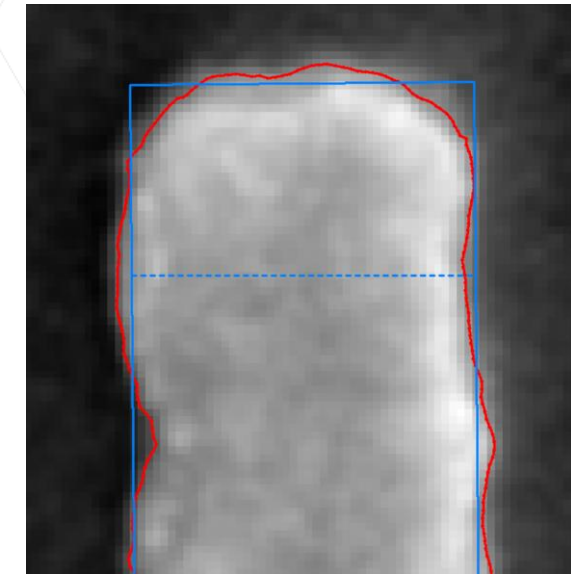
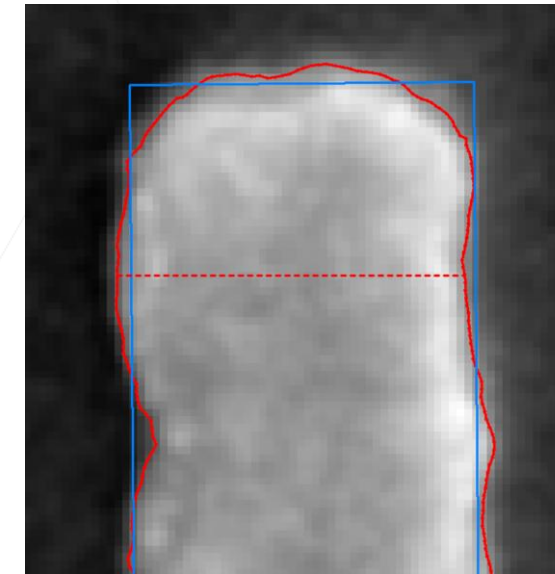
# Feature Detect & Measure



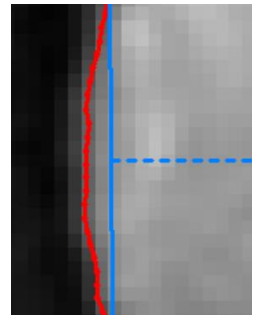
## Slices for contour and feature fit

- Measurements can be on edge or fitted points
- Color code displays the selected mode
- Red: edge points/ contour is measured
- Blue: fitted feature is measured

→ More possibilities and control of measurements  
→ Clear visualization



Name	S_1	S_2
Orientation	Horizontal	Horizontal
Reference box	Bound. Box	Bound. Box
Position [%]	90	90
Measure	Edge	Fitted
Length [nm]	86.443	85.432

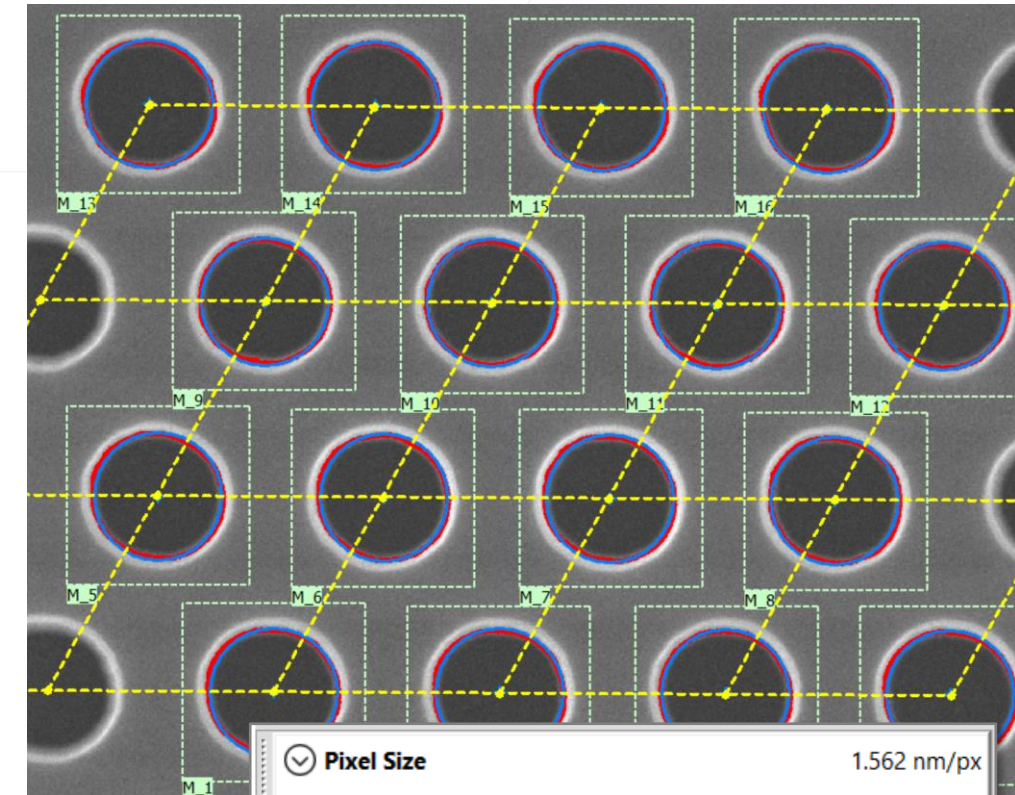


## Improved pixel calibration with arrays

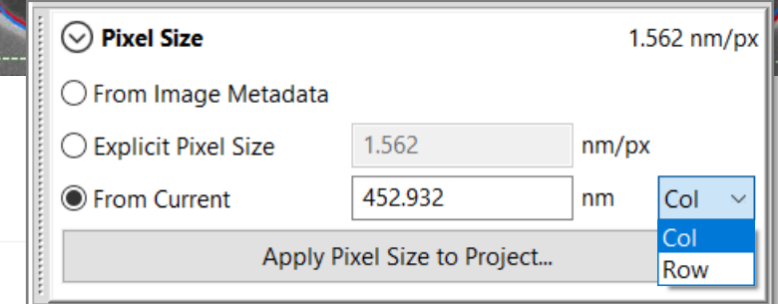
- Pixel size calibration with gratings is extended
- Using array vectors now possible as well
- Array results reported with vector in polar coordinates

→ Improve the image calibration also by arrays

→ Use layout or device data



H_Array_Hex   Group_1   Summary								
Array Vector[nm]	: Col X	= 452.9	Col Y	= -2.7	Row X	= 218.4	Row Y	= 390.1
Polar Array Vector[nm/deg]	: Col Length	= 452.9	Col Angle	= 359.65	Row Length	= 447.1	Row Angle	= 60.76
Jitter[nm]	: Col	= 1.4	Row	= 1.4	Radial	= 1.8		
Major Axis Direction[deg]	: Mean	= 0.00	Min	= 0.00	Max	= 0.00	StdDev	= 0.00 N = 16
Major Diameter[nm]	: Mean	= 255.9	Min	= 254.4	Max	= 257.6	StdDev	= 0.9 N = 16
Minor Diameter[nm]	: Mean	= 255.9	Min	= 254.4	Max	= 257.6	StdDev	= 0.9 N = 16
Aspect Ratio	: Mean	= 1.000	Min	= 1.000	Max	= 1.000	StdDev	= 0.000 N = 16
Fitted Area[nm^2]	: Mean	= 51418.9	Min	= 50829.7	Max	= 52118.9	StdDev	= 348.3 N = 16
BBox Width[nm]	: Mean	= 261.2	Min	= 258.7	Max	= 263.8	StdDev	= 1.5 N = 16
BBox Height[nm]	: Mean	= 251.7	Min	= 248.9	Max	= 253.4	StdDev	= 1.4 N = 16
Area[nm^2]	: Mean	= 51417.4	Min	= 50828.2	Max	= 52118.5	StdDev	= 348.5 N = 16

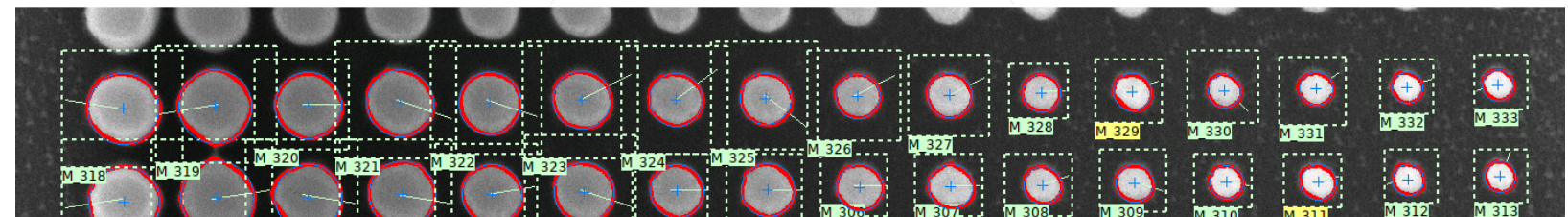
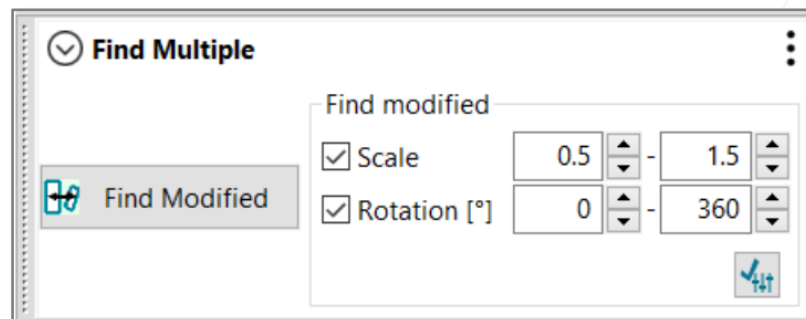
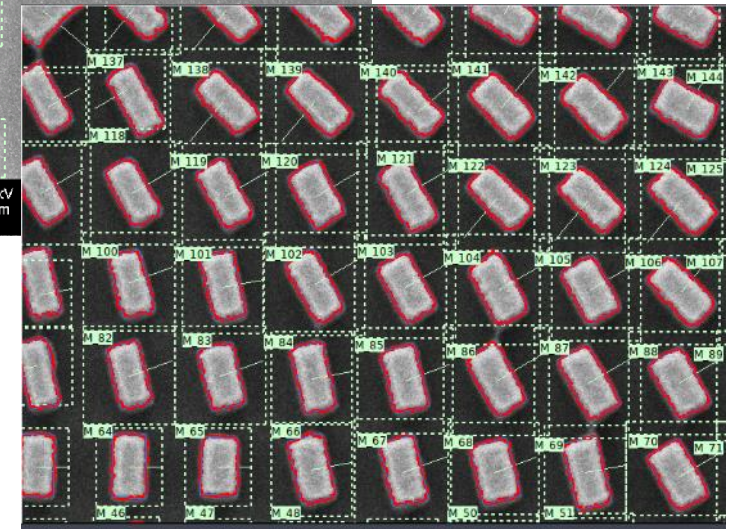
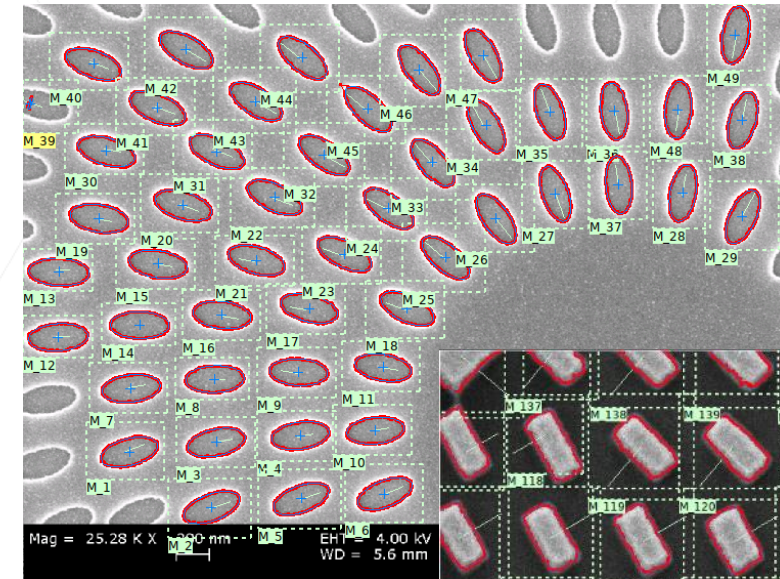




# Measure Rotated or Scaled Features

## Advanced algorithm for *Find-Modified*

- Measures modified shapes: with rotation and/ or scaling
  - Excellent tool for meta optics, 2D/ meta materials etc.
  - Automated detection and measurement of all related features
  - User can define type and range of modification
  - Available in separate panel (for Advanced Package and higher)
- Advanced functionality for automatic metrology of numerous features
- Not yet performance optimized (e.g. large arrays)

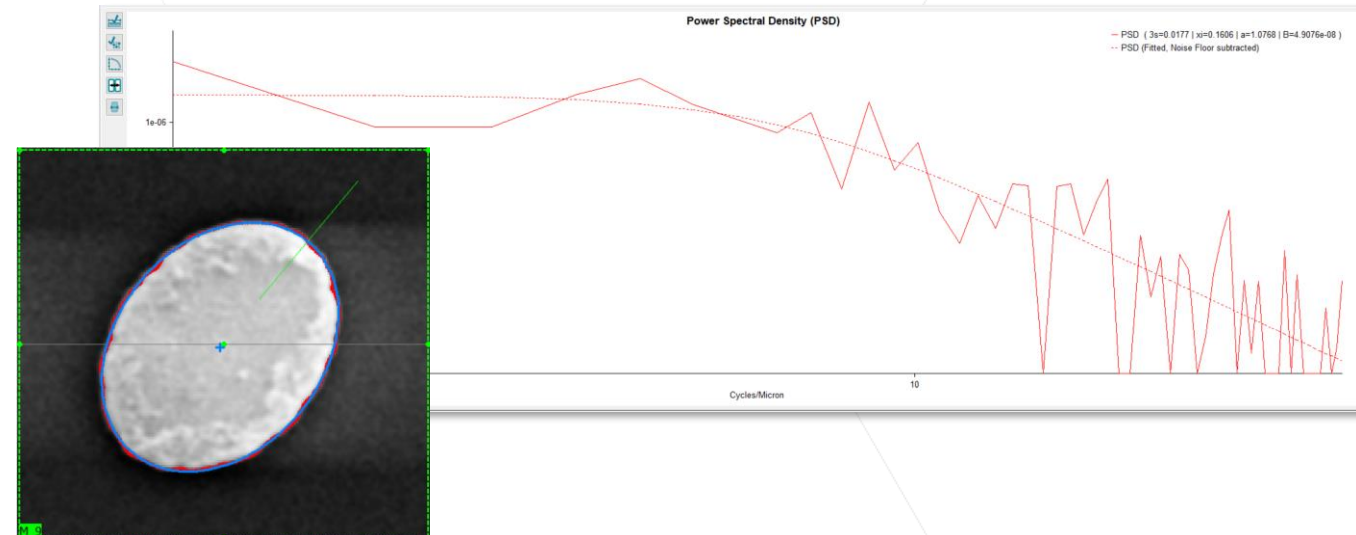
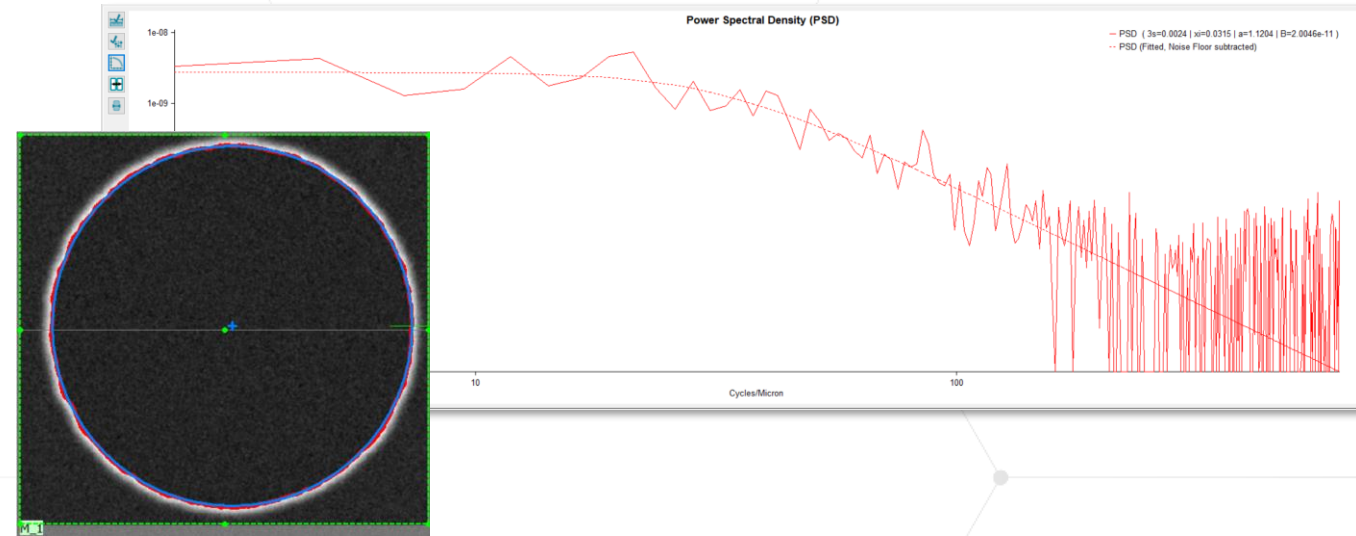


# “LER” extended for 2D Shapes

## Edge roughness analysis for 2D shapes

- LER extended to fitted 2D features
- Circles, ellipses, rectangle, and triangles
- Standard deviation ( $3\text{-}\sigma$ ) relative to fitted shape
- Power Spectral Density plot (PSD) without noise floor
- Deviations at corners are excluded
- Correlation length ( $\xi$ ) and roughness exponent ( $\alpha$ )

→ Available for Advanced Package and higher



# Layout/ Automation

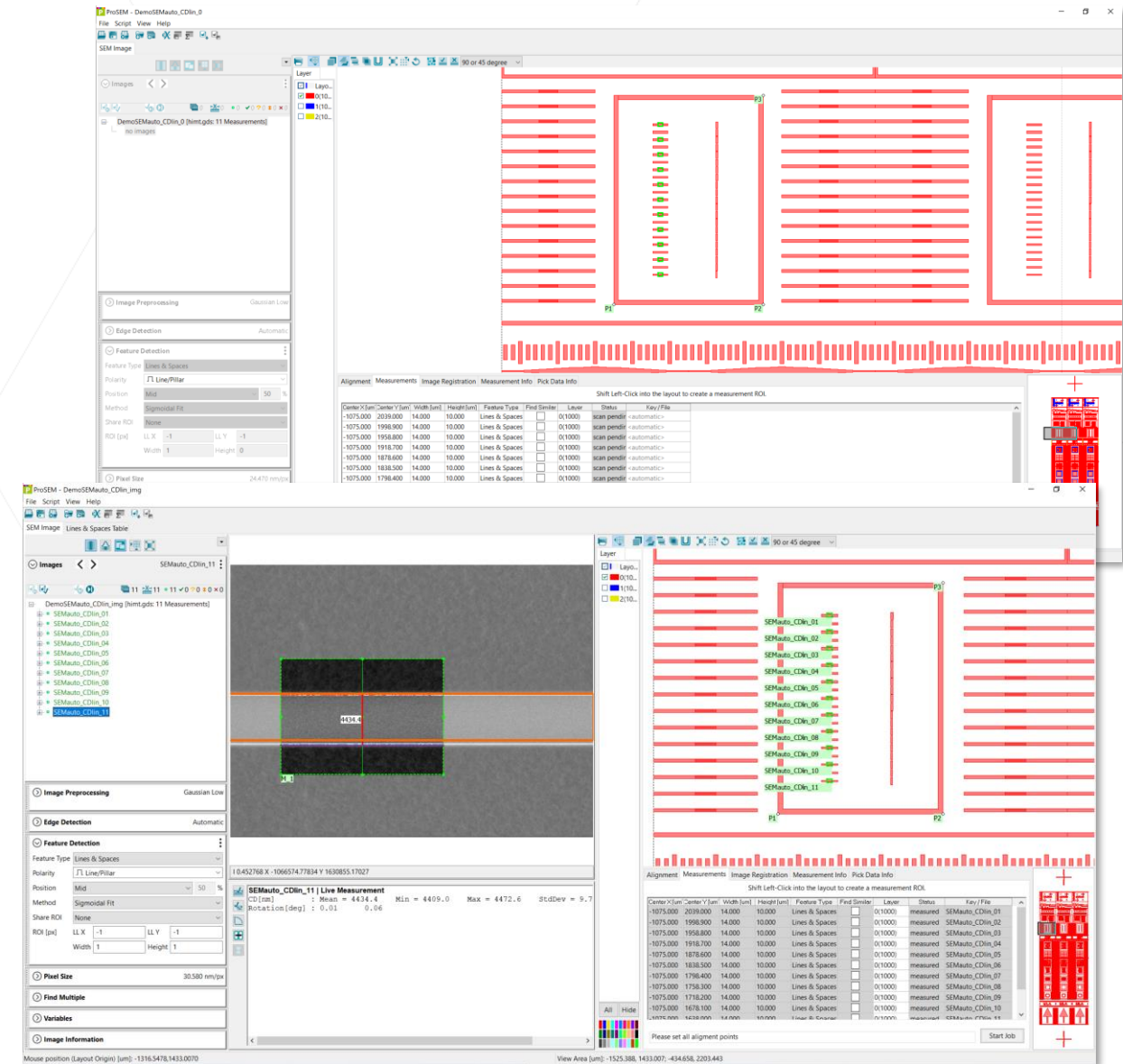


# Layout/ Image Display and Project

## Layout/ image convenience improvements

- UI display area adapts to project content
- Layout only and layout projects automatically show corresponding display (layout only or image+layout)
- For layout projects all images can be removed now

→ Better overview and convenience

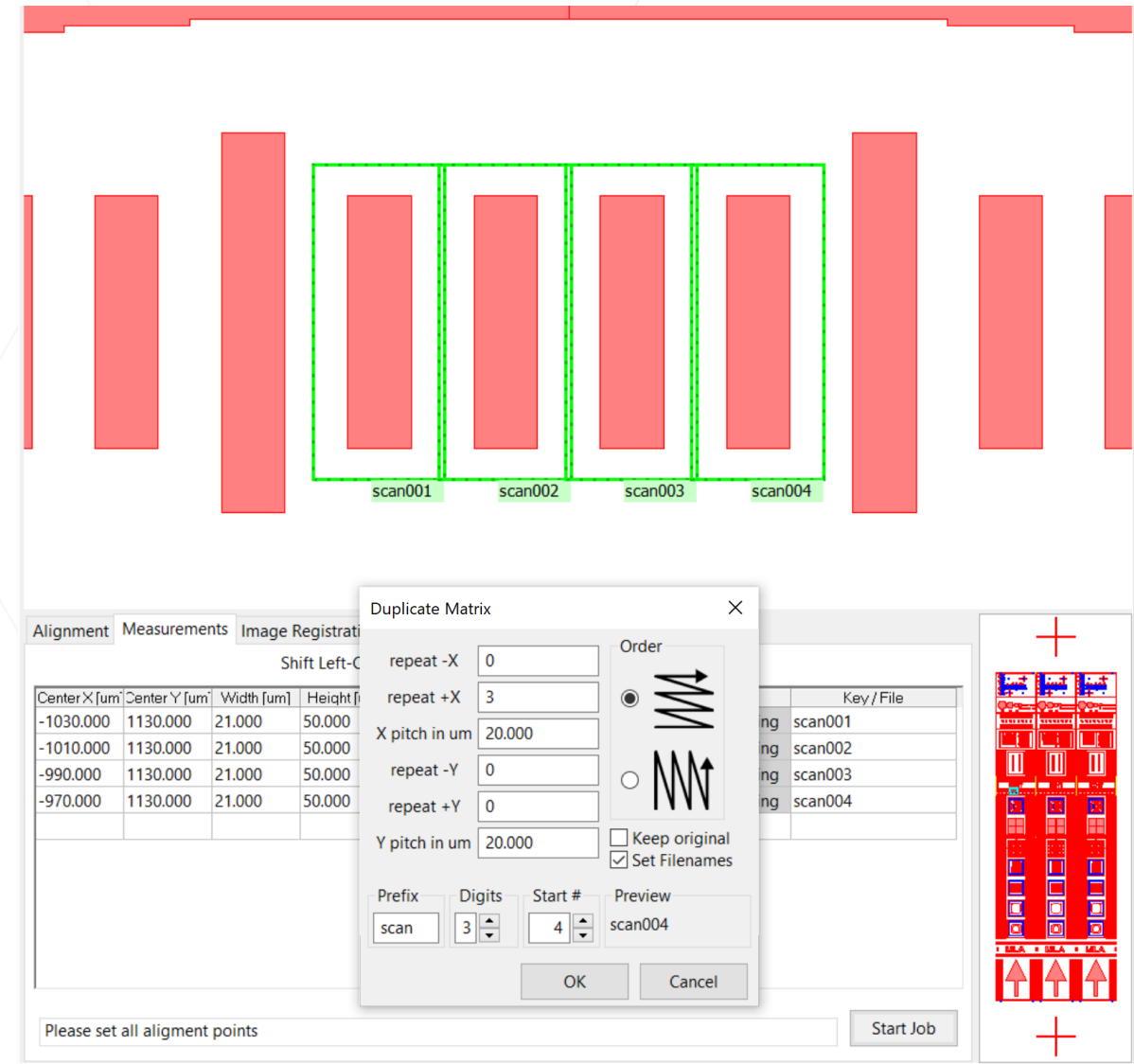


# Automatic Image Naming

## Various features for naming of images

- With existing name do auto fill
- For new entry and copy/ paste
- Special dialogue for auto naming
- Combination with duplicate matrix
- General: show labels in layout view

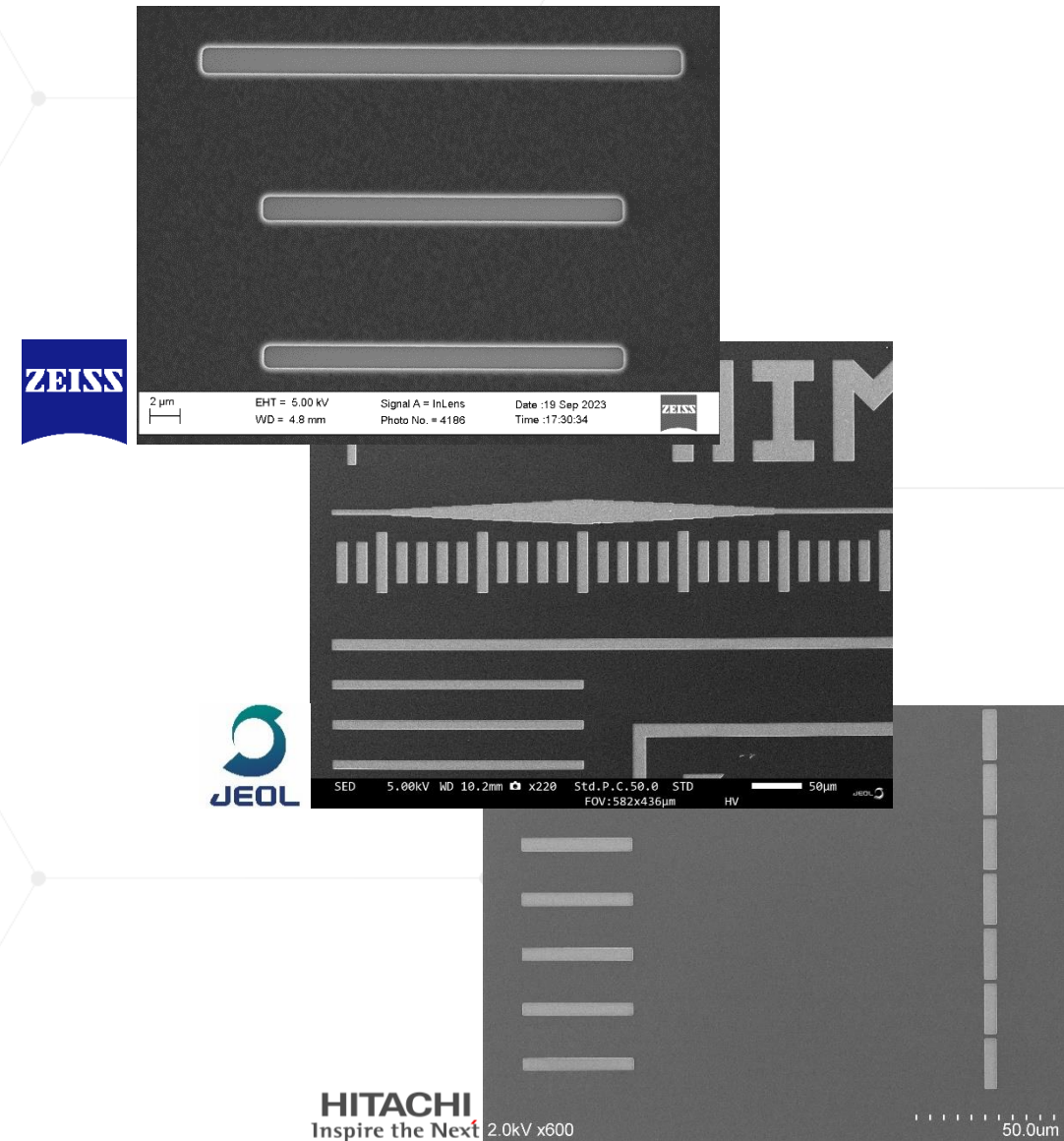
→ Convenience especially for large jobs



## List of supported SEM interfaces

- ZEISS serial interface
- JEOL ethernet interfaces
- Hitachi interfaces
- Other vendors: technology available, test sites welcome

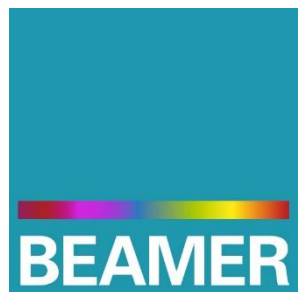
- Continuously extending the supported interfaces
- Installation Guide available
- Contact the GenISys team for details





# Thank You!

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