

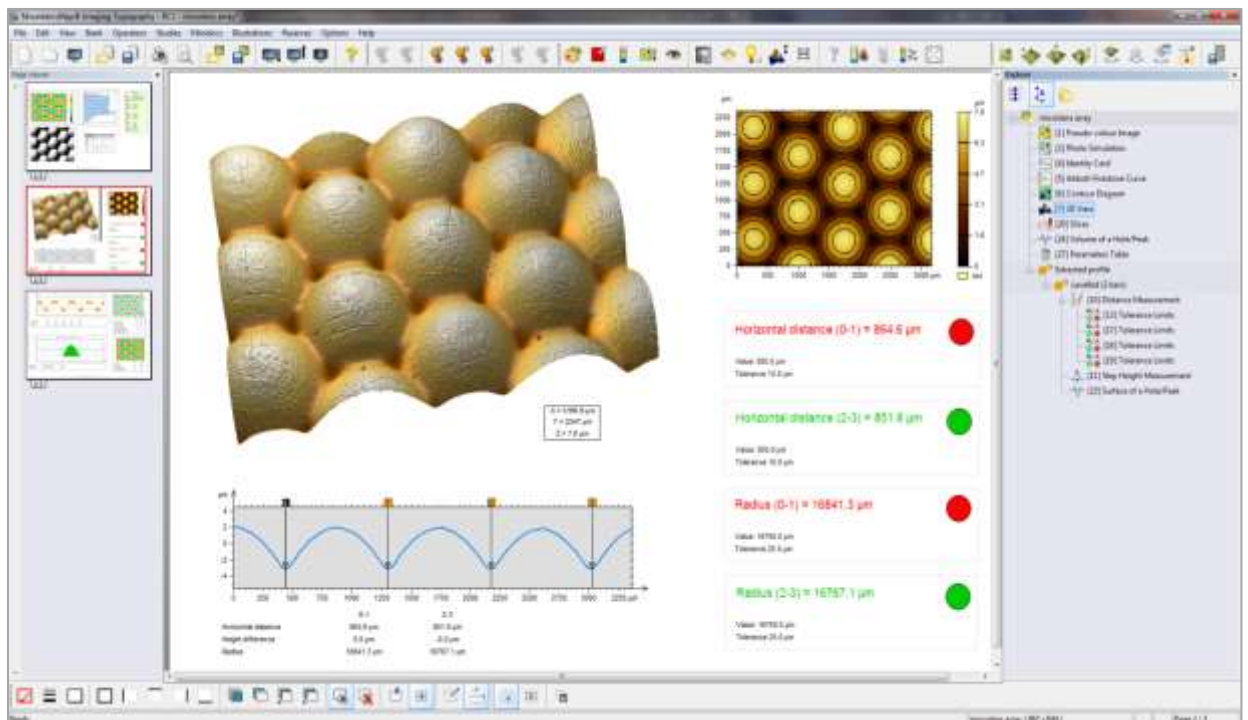


## State of the art surface analysis with visual metrology reports

Powered by industry-standard Mountains Technology®, MountainsMap® Imaging Topography is a best in class solution for laboratories, research institutes and industrial facilities that design, test or manufacture functional surfaces. The software provides a comprehensive solution for visualizing and analyzing surface texture and geometry and for generating detailed visual surface metrology reports. It is dedicated to 3D optical microscopes including confocal microscopes and optical interferometric microscopes (white light interferometers) as well as infinite focus and digital topographic microscopes.

You can use MountainsMap® Imaging Topography to visualize 3D surface topography in real time, assemble multiple surfaces into a single surface to increase field of view, analyze sub-surface layers in the same way as full surfaces, and generate the latest ISO 25178 3D parameters. With the 3D color image optional module you can input multi-channel topography, color and intensity images, manipulate them simultaneously, and view the topography in true color. There are also optional modules for advanced surface texture analysis, contour analysis, grains and particles analysis, spectral analysis, statistical analysis and more.

Visualize Analyze Report





## Highly intuitive desktop publishing environment

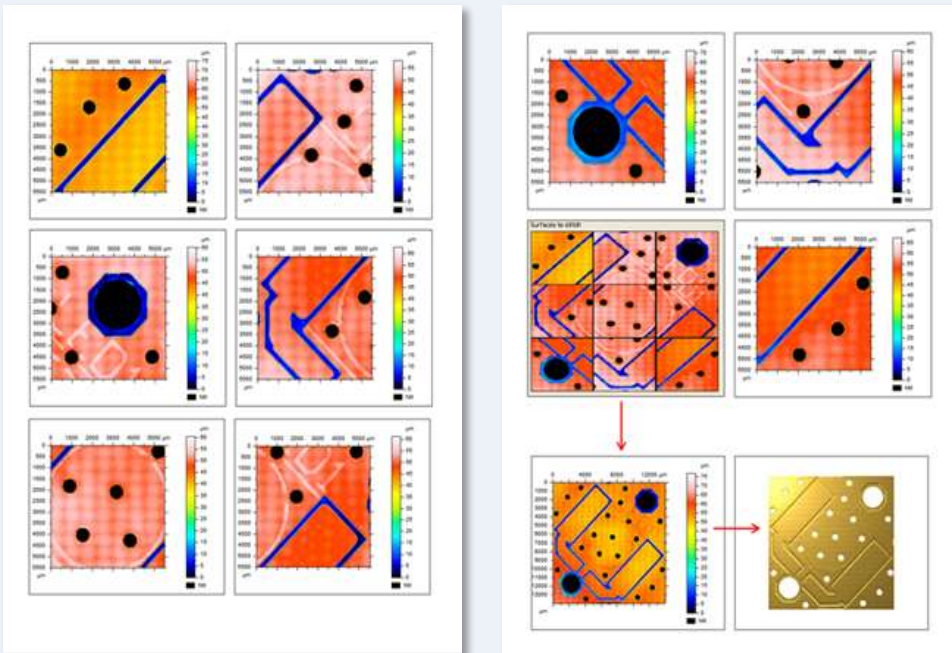
### Full metrological traceability

#### Visual analysis reports

Working in one of six European languages, Japanese, Korean or Mandarin Chinese, you build a visual analysis report frame by frame, page by page, carrying out graphical and analytical studies of the surface under study, applying filters, calculating ISO and national parameters, inserting measurement identity cards, adding comments and illustrations. Every analysis step is recorded in a hierarchical analysis workflow to assure full metrological traceability. You can navigate to any frame by clicking on it in the workflow or in the page viewer. Numerical results can be exported in an Excel .csv file, frames and pages can be exported as bitmaps, and finished reports can be exported as PDF files for easy circulation.

#### Powerful automation features

Any step can be fine tuned at any time and all of the dependent steps are recalculated automatically. Common sequences of steps can be saved in a library and inserted into any document at any time to gain time. Once an analysis report has been completed it can be applied as a template to automate the analysis of multiple measurement data files. Pass/fail criteria with tolerances can be defined for any parameter. Green/red pass fail traffic lights are displayed automatically together with instructions on how to handle failures.



Two page document showing automatic stitching which is a standard feature in MountainsMap® Imaging Topography

## Visualize surfaces and sub-surfaces

### Real time 3D imaging

#### See all topographical features in 3D

When you visualize a surface topography in 3D you can zoom in on it and rotate it in real time, apply different renderings, control the lighting level and select the height amplification. You can define a flight plan and fly over a surface taking in all of the features of interest. Any standard or user-defined palette can be selected for the vertical scale and fine tuned automatically or interactively to highlight surface features, taking into account the distribution of data points on the surface. There are photo simulations and contour diagrams of a surface. In addition you can extract 2D profiles from a 3D surface for analysis.

#### Sub-surface analysis

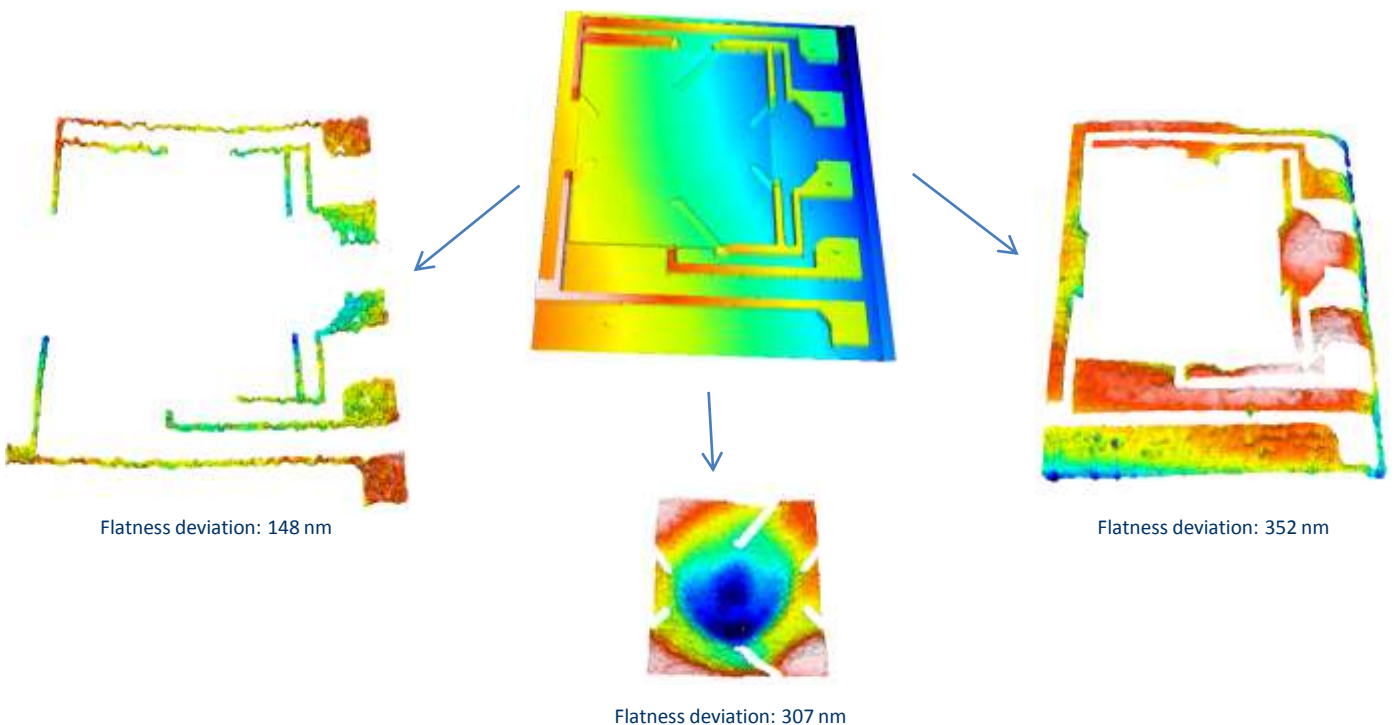
With MountainsMap® Imaging Topography you can extract a sub-surface (for example from a measurement of a MEMS, mechanical or electronic component) and analyze it in exactly the same way as a full surface. You can also remove the upper or lower slice of a surface by thresholding and then visualize and analyze the sub-surface that remains (for example when analyzing the roughness of a valley area).

#### Normalization and correction

MountainsMap® Imaging Topography includes a full set of tools for normalizing surfaces and removing artifacts prior to analysis. They include leveling, flipping in the horizontal or vertical axis, rotation, thresholding to remove spikes, retouching of isolated anomalies, filling in missing data points, surface smoothing, and resampling to increase image resolution.

#### Increase your field of view virtually

When the microscope's field of view is too limited to measure the whole surface MountainsMap® Imaging Topography stitches or assembles multiple measurements together to form a single surface that is ready for analysis.





## Analyzing surface geometry and texture

### Roughness, bearing ratio and the latest ISO 25178 3D parameters

#### Geometric analysis

MountainsMap® Imaging Topography contains a full set of tools for studying surface geometry. You can measure distances, angles, areas of peaks and valleys, volumes of bumps and holes, and step heights on surfaces and profiles. Step height measurements can be used to check for coplanarity of contact surfaces, for example on electronic and mechanical components.

#### Roughness analysis

Following form removal, surfaces are separated into their roughness and waviness components by applying the latest advanced filtering techniques defined in ISO 16610, including robust Gaussian and spline filters.

#### Functional analysis

Analytical studies facilitate the assessment of friction and wear in automotive engineering, medical engineering and other applications. They include the Abbott-Firestone bearing ratio curve and depth distribution histogram, the subtraction of one surface from another, and the calculation of the material/void volume ratio and thickness of up to three vertical slices of a surface.

#### ISO parameters

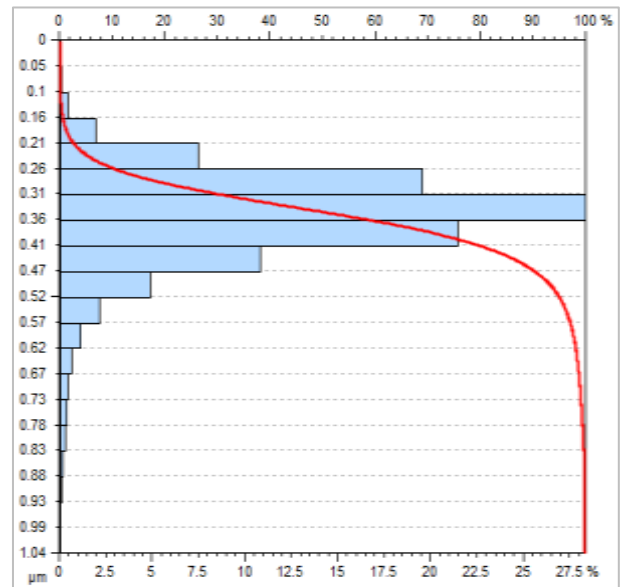
MountainsMap® Imaging Topography calculates ISO 25178 height and bearing ratio parameters ( $S_a$ ,  $S_q$ ,  $S_{sk}$ ,  $S_{ku}$ ,  $S_z$ , etc., and  $S_{mr}$ ,  $S_{dc}$ ,  $S_{xp}$ ), ISO 4287 primary and roughness parameters ( $R_a$ ,  $R_q$ ,  $R_{sk}$ ,  $R_{mr}$ ,  $R_{dc}$ ,  $R_{dq}$ ,  $R_{Pc}$ , etc.).

#### The right standards wherever you are

Wherever you are, with MountainsMap® Imaging Topography you can work with your national standards and international standards at the same time. MountainsMap® Imaging Topography not only calculates ISO parameters, it also calculates ASME B46.1 2D and 3D parameters (USA), displays GB/T (China), DIN (Germany), JIS (Japan), NF (France), BSI (UK), UNE (Spain) and UNI (Italy) equivalents of ISO parameters when they are available, and calculates the older EUR 15178 3D parameters.

#### Advanced analysis and parameters

More advanced functional analysis and additional parameters are available in optional modules.



Abbott-Firestone curve and depth distribution histogram

#### ISO 25178

##### Height Parameters

<b>Sq</b>	0.1	μm	Root mean square height
<b>Ssk</b>	-1.3		Skewness
<b>Sku</b>	7.6		Kurtosis
<b>Sp</b>	0.4	μm	Maximum peak height
<b>Sv</b>	0.7	μm	Maximum pit height
<b>Sz</b>	1.0	μm	Maximum height
<b>Sa</b>	0.1	μm	Arithmetic mean height

##### Functional Parameters

<b>Smr</b>	100.0	%	Areal material ratio
<b>Smc</b>	0.1	μm	Inverse areal material ratio
<b>Sxp</b>	0.2	μm	Extreme peak height

ISO 25178 3D areal surface texture parameters

## Optional modules

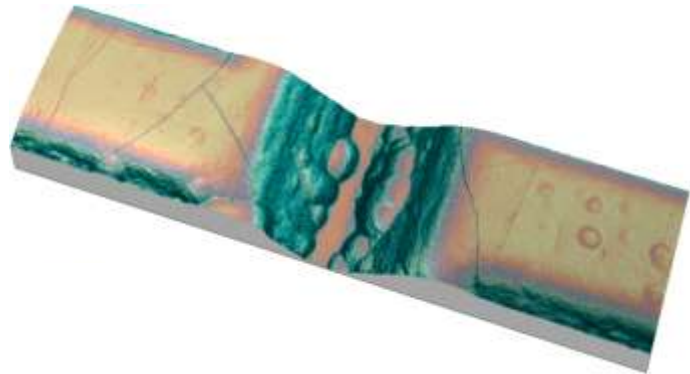
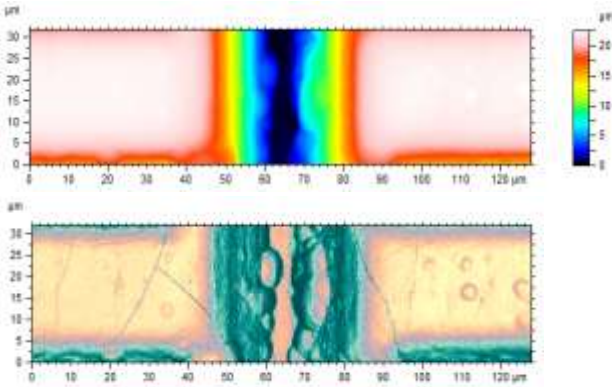
### Visualizing topography, color and intensity

#### Simultaneous manipulation of multi-channel images

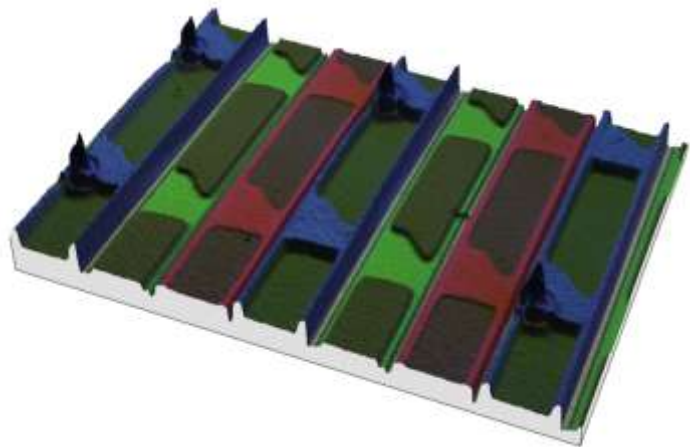
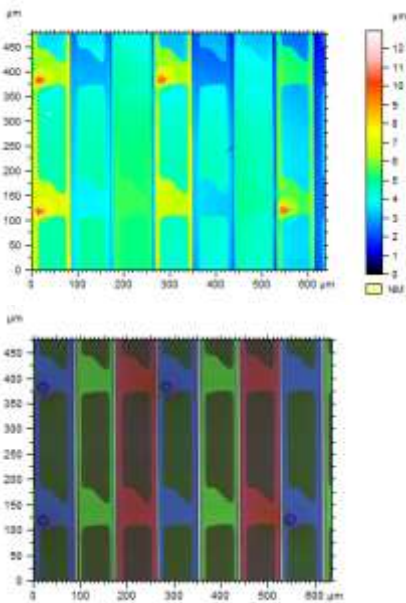
With the additional **3D Color Imaging** optional module you can input, visualize and analyze multi-channel topography, color and intensity images generated by confocal and other microscopes. You can manipulate all of the images simultaneously, zooming in on them, rotating them to any angle, and extracting profiles between the same points on each image. You can also extract individual images for visualization and analysis.

#### See surface topography in true color or intensity

Color and intensity images can be overlaid on the 3D topography to make it easier to locate features and find defects.



Topography image (with vertical scale), intensity image and intensity overlaid on 3D topography.



Topography image (with vertical scale), color image and color overlaid on 3D topography.



## Optional modules

### Everything you need for advanced surface analysis

#### Grains, particles, islands and motifs

The MountainsMap® Imaging Topography **Grains & Particles** module separates grains (particles, islands) from the horizontal background by binarization and it also detects them above a specified threshold height. Grain parameters are analyzed statistically. Motifs analysis partitions a surface into motifs using segmentation by watersheds. It includes parameters for spheres fitted to motifs (for example in optics applications) and calculates ISO 25178 features parameters (*Spd*, *S10z*, *Sda*, etc.).

#### Advanced surface texture analysis

The **3D Advanced Surface Texture** module provides advanced functional volume analysis of burn-off peaks, core and lubrication valleys for automotive applications. It calculates ISO 25178 volume and hybrid and spatial (*Vmp*, *Vmc*, *Vvv*, etc., and *Sal*, *Str*, *Sdr*, etc.) parameters, ISO 12781 flatness parameters (*FLTt*, *FLTp*, *FLTv*, *FLTq*). It includes a graphical study of the functional volume parameters, analytical studies of surface isotropy, directionality and periodicity, and fractal analysis.

The **2D Advanced Surface Texture** module provides advanced analysis of 2D profiles including roughness / waviness filters from 2RC to ISO 16610, the creation and statistical analysis of series of profiles, and more.

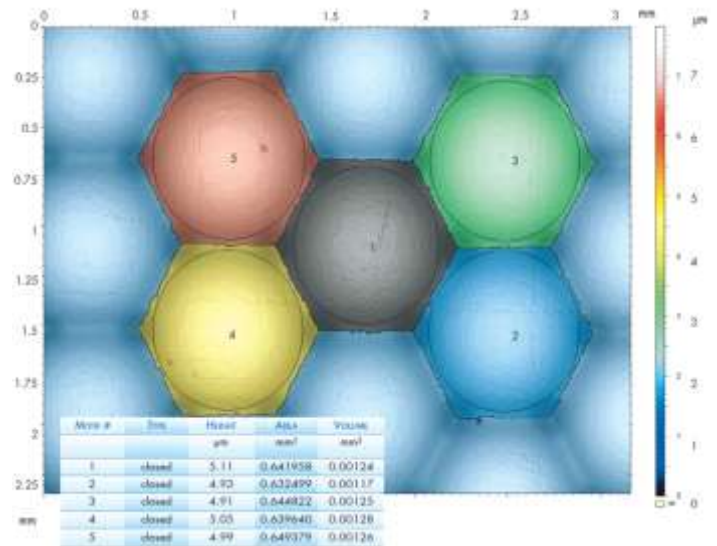
The two modules are MATLAB™ compatible, making it possible to apply user-defined operators including filters.

#### Spectral analysis and denoising

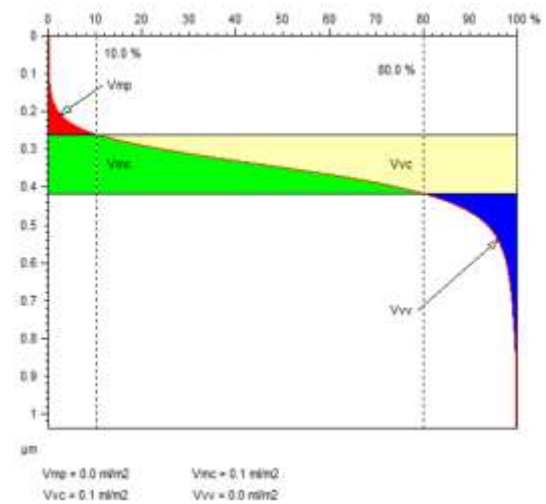
The **3D Fourier Analysis** module is used to analyze machine-surface interactions and to denoise surface images by direct editon of the FFT. It includes studies of the frequency spectrum, power spectrum density, isotropy, directionality, periodicity, autocorrelation and intercorrelation.

#### Image Co-localization

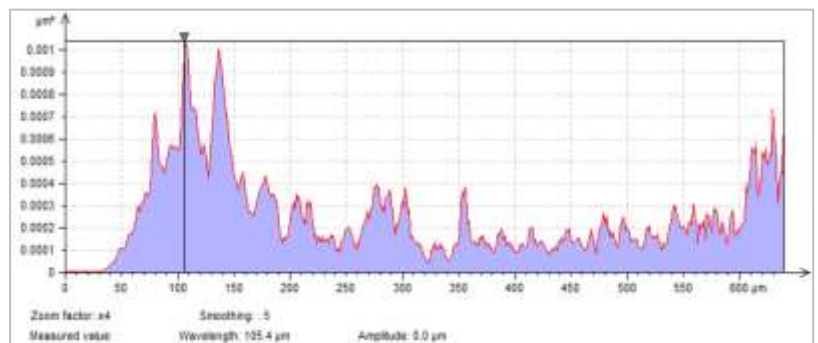
The **Image Co-localization** module automatically co-localizes images from different instrument families for example 3D topography measured by profilometers, confocal microscopes or SPM's with SEM or fluorescence images.



Grains & Particles module: motifs analysis (with spherical caps)



3D Advanced Surface Texture module: graphical study of ISO 25178 functional volume parameters



3D Fourier Analysis module: PSD (power spectrum density) plot

## Optional Modules

### Everything you need for advanced surface analysis (continued)

#### Contour analysis

The entry-level **Contour Analysis** module provides geometric dimensioning for profiles extracted on the Z axis and the XY axis. Geometric elements are associated with segments on the profiles and dimensions are calculated using auto-dimensioning and interactive tools.

The **Advanced Contour** module compares profiles with CAD models (DXF) or user-defined nominal forms, which can include large positional tolerances. It provides comprehensive form deviation analysis, displays magnified form deviation graphics, calculates form deviation parameters and generates a full analysis report.

#### Dynamic statistics

The **Statistics** module analyzes numerical results from static or dynamic measurement populations. Control charts provide visual feedback on the manufacturing process and Cpk parameters describe its capability to repeat itself. Statistics on selected metrological parameters are shown in tables, histograms, box charts and scatter plots.

#### Analysis of surface evolution

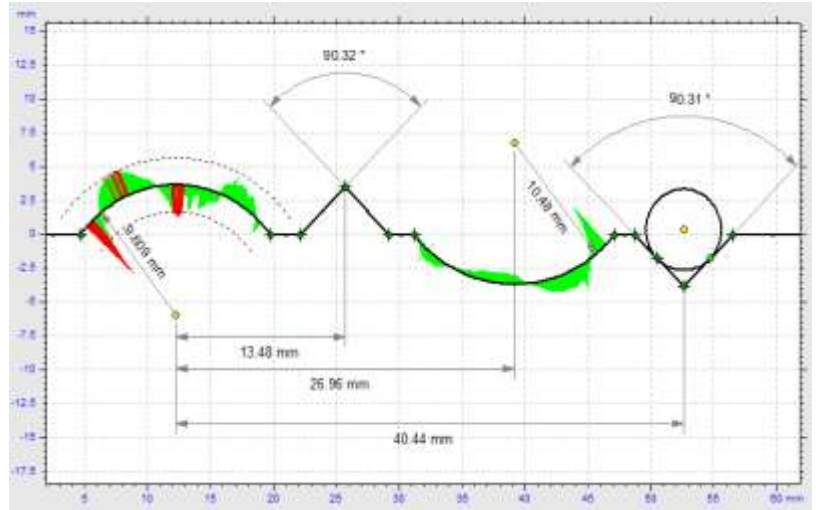
The **4D Analysis** module allows you to fly over a 3D surface as it changes with respect to time, temperature or another physical dimension. It generates statistics for monitoring selected metrological parameters and highlights areas of preponderant change using principal components analysis.

#### Wavelets analysis

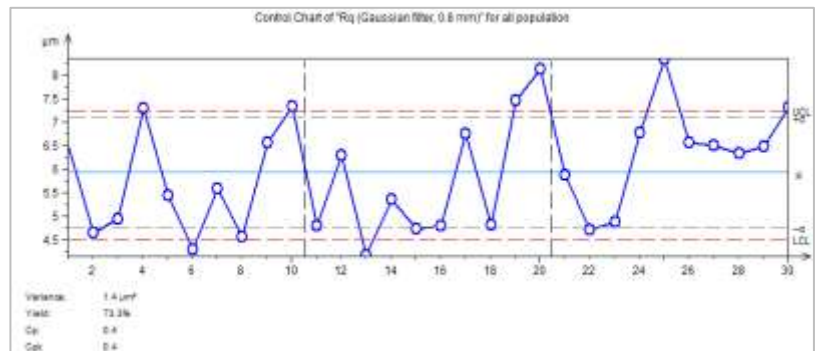
The **Wavelets Analysis** module makes it possible to visualize and analyze both the scale levels and spatial locations where phenomena occur. It includes discrete wavelet filtering (3D surfaces and 2D profiles) and continuous wavelet decomposition (2D profiles).

#### SPM Extension

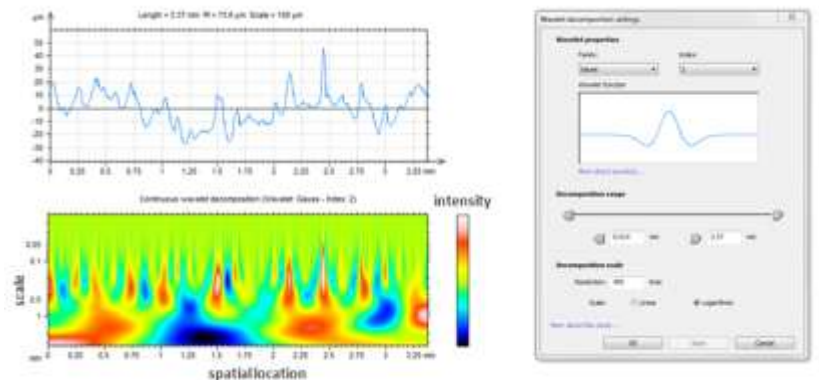
The **SPM Extension** module makes it possible to work with multi-layer SPM measurement data (topography, phase, deflection, current, etc.) and to carry out line by line correction, scan line removal and tip deconvolution.



Advanced Contour module: form deviation analysis



Statistics module: control chart for 3 small populations



Wavelets Analysis module: continuous wavelet decomposition



## Selected standard and optional features

### MountainsMap® Imaging Topography

Desktop publishing environment	Visual metrology reports - User interface in 6 European languages, Japanese, Mandarin Chinese or Korean - Save common sequences of analysis steps for reuse - Automatic analysis of series of measurements using templates - Single-click in-document navigation via page viewer - Analysis workflow for full metrological traceability - Pass/fail traffic lights and messages for any parameter - Excel-compatible ASCII data export - Auto-save
Surface visualization	3D surface topography manipulated in real time - selectable rendering, lighting and height amplification - standard and user defined z-axis color coding with data point distribution histogram - Contour diagrams - Photo-simulations - Surface flyovers with movie output - Patching of measurements made at different heights into a single surface - 2D profile extraction
Data preparation	Leveling - XY or Z inversion - Rotation - Form removal - Thresholding - Filling in missing points - Retouching - Resampling - Smoothing - Stitching of multiple overlapping measurements made on the horizontal plane into a single analysis-ready surface - Patching of multiple measurements made at different heights into a single analysis-ready surface
Analysis	Measurement of distances, angles, areas, volumes, step heights - ISO 16610 3D roughness/waviness filters - Bearing ratio curve and depth histogram - Material/void volume and thickness of vertical slices - Surface subtraction - Sub-surface extraction and analysis
Parameters	ISO 25178 3D height and bearing ratio parameters and ISO 4287 2D primary and roughness parameters with national equivalents - ASME B46.1 3D parameters, EUR 15178 amplitude and area and volume parameters

### MountainsMap® Imaging Topography Optional Modules

3D Color Image Overlay	Input multi-channel topography, color and intensity images - manipulate them simultaneously - overlay color on 3D topography - overlay intensity on 3D topography
3D Advanced Surface Texture	Graphical study of functional volume parameters - ISO 25178 volume, hybrid and spatial parameters - ISO 12178 flatness parameters - isotropy, directionality and periodicity - fractal analysis - MATLAB™ compatibility for user-defined operators
2D Advanced Surface Analysis	ISO 16610 2D roughness/waviness filters - 2D bearing ratio and depth distribution - 2D spectral and fractal analysis - Create and analyze series of profiles, generate statistics - MATLAB™ compatibility
3D Fourier Analysis	Filtering by direct edition of the FFT - Frequency spectrum - Power spectrum density - Fourier modulus - Autocorrelation and intercorrelation - Isotropy, directionality and periodicity
Grains & Particles	Grains analysis on horizontal axis - 3D grains (islands) analysis - 3D motifs analysis (applying segmentation by watersheds and Wolf pruning) and ISO 25178 features parameters - Statistics
Wavelets Analysis	Discrete wavelet filtering (2D profiles and 3D surfaces) - Continuous wavelets decomposition (2D profiles)
Contour Analysis	Associate geometric elements with vertical (Z) and horizontal (XY) profiles - calculate dimensions using auto-dimensioning and interactive tools
Advanced Contour Analysis	Comparison of profile with CAD model (DXF) or user-defined nominal form - definition of tolerances including large positional tolerances - magnified form deviation graphics - form deviation parameters
4D Analysis	View or fly over a surface changing with respect to time or another physical dimension - generate statistics on selected parameters - locate areas of preponderant change
Statistics	Monitor numerical results on one or more static or dynamic measurement populations - control charts - parameter tables - histograms - box charts - scatter plots - Cpk capability parameters.
Image Co-localization	Automatically co-localize measurement data and images generated by instruments of different types (for example co-localize surface topography with fluorescence images, SEM images)
SPM Extension	Line by line correction - Line removal - Tip deconvolution - Axis editor - operators on multi-layer SPM data (topography, phase, deflection, current, etc.)

### MountainsMap® Imaging Topography Upgrades

MountainsMap® Universal Upgrade	MountainsMap® Universal is compatible with scanning probe microscopes (SPM's), optical and tactile single-point profilometers and other surface metrology equipment in addition to 3D optical microscopes. Additional optional modules are available for 2D Automotive Analysis, Lead (Twist) Analysis (automotive industry), Force Spectroscopy (for SPM's).
MountainsMap® Premium Upgrade	MountainsMap® Premium is a top of the line package compatible with almost all surface metrology instruments that contains all of the MountainsMap® Imaging Topography optional modules with the exception of Advanced Contour, Statistics and Image Co-localization. Additional optional modules are available for Force Spectroscopy (for SPM's) and Lead (Twist) Analysis (automotive industry).



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