Surface imaging, analysis & 3D topography software
for scanning 3D surface profilometers

- profilers that measure 3D topography by lateral scanning with a single point distance sensor: stylus, chromatic confocal, laser triangulation, …

- Visualize 3D surface topography in real time
- Remove measurement artifacts
- Increase vertical range virtually in software
- Analyze 2D and 3D surface geometry
- Analyze surface texture in accordance with the latest standards
- Add optional modules for advanced applications
- Automate analysis and publish results easily
See everything that you measure
Visualize 3D surface topography in real time

- Zoom in on 3D surface topography, rotate it and change height amplification in real time.
- Apply image enhancement tools.
- Choose the best lighting conditions and renderings.
- Select renderings, define your own optimized color palette for the vertical scale and optimize it.
- Define a flight plan, fly over features of interest on a surface and save your flight as a video for presentations.
- Display contour diagrams and photo simulations.
- Extract 2D profiles from a 3D surface for visualization and analysis.

Normalize & correct surface data
Pre-analysis tools

MountainsMap® Scanning 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 in one degree increments.
- Zone extraction.
- Correction or removal of anomalous scan lines.
- Thresholding to remove spikes.
- Retouching of isolated artifacts.
- Deconvolution to minimize tip impact on the measurement data.
- Filling in missing data points.
- Surface smoothing.
- Resampling to increase image resolution.

Using "Line by line level" operator in MountainsMap® Scanning Topography you can eliminate most cases in which there is a vertical misfit between the successive scan lines. This is especially useful with single point 3D scanning profilers built from 2D profilers that provide a highly accurate datum line in X but use a motorized stage to move the sample in Y.
MountainsMap® Scanning Topography assures the fast and accurate analysis of surface geometry with tools for measuring:

- Distances.
- Angles.
- Areas of peaks and valleys.
- Volumes of bumps and holes.
- Step heights on surfaces and profiles.
- Coplanarity.

Left:
Calculation of multiple distances, angles and point coordinates – all in a single frame.

Upper right:
Step height measurements.

Lower right:
Hole volume calculation.

Assemble surfaces
Increase vertical range virtually and overcome instrument limitations

The vertical range of a 3D profilometer may be too limited to scan the whole of a surface. In this case the answer is to scan the surface at different heights and then use MountainsMap® Scanning Topography tools to patch the scans together into a single surface.

Patching of two scans of a lens at different heights.

Analyze surface geometry
From distance, area, step height and volume calculation to full dimensional analysis
Surface texture characterization in accordance with international standards
Advanced ISO 16610 filtering techniques and ISO 25178 3D parameters

From Gaussian to advanced ISO 16610 filtering techniques
The roughness and waviness components of surfaces are separated using the latest ISO 16610 advanced filtering techniques, including robust Gaussian and spline filters. Older filtering techniques are also supported.

From Ra to ISO 25178 3D parameters
MountainsMap® Scanning Topography includes a basic set of ISO parameters:
✓ 3D parameters defined in ISO 25178 including height (Sa, Sq, Ssk, Sku, Sz, etc.,) and functional (Smr, Smc, Sxp) parameters.
✓ ISO 4287 primary and roughness parameters (Ra, Rq, Rsk, Rmr, Rdc, Rdq, RPc, etc.).
More parameters are available with optional modules.

The right standards, wherever you are
In addition to ISO parameters MountainsMap® Scanning Topography 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.

Functional analysis
Functional studies include:
✓ Abbott-Firestone bearing ratio curve and depth distribution histogram.
✓ Subtraction of one surface from another (wear).
✓ Calculation of the material/void volume ratio and thickness of up to three vertical slices of a surface.
Sub-surface analysis

Extract a region of interest and analyze it just like a complete surface

With MountainsMap® Scanning Topography you can also extract a sub-surface and analyze it independently.

**Sub-surface extraction methods**

There are several methods for extracting sub-surfaces:

- Extract a rectangular or non-rectangular zone.
- Remove a slice from a surface by thresholding.
- Automatically partition a surface into motifs (texture cells), then use the Partition and Level operator to extract a sub-surface and level it.

**Calculate parameters for a sub-surface only**

Once a sub-surface or region of interest has been extracted it can be analyzed in exactly the same way as a full surface - parameters are calculated on the sub-surface only. This makes it possible, for example, to study the roughness, flatness and coplanarity of planes on MEMS and mechanical and electronic components.

MEMS: extraction of leveled sub-surface and flatness parameters for sub-surface only
(Note: the 3D Advanced Surface Texture optional module is required to generate a full set of flatness parameters)
Highly intuitive desktop publishing environment

Full metrological traceability, automation, fine tuning on the fly

Visual analysis reports
In MountainsMap® Scanning Topography you build a visual analysis report frame by frame, page by page, working in a comfortable desktop publishing environment. Frames contain 3D and other views of surface data, the results of applying filters, analytical studies, ISO and national parameters, measurement identity cards, comments and illustrations. You can navigate to any frame in a report by selecting it in the page viewer.

Smart user environment
The smart user environment - with logical top-down organization of all functions and contextual object-oriented ribbons - means that you can go from idea to action with minimum effort. A full screen mode provides maximum comfort when you are carrying out a specific analytical study. Moreover you can work in your own language thanks to the fact that the user interface - including expanded graphical tooltips that provide a first level of help - is available in ten languages (EN, FR, DE, ES, IT, PL, BR, JP, CN, KR). In addition, a complete reference manual (EN, FR, DE, JP) with illustrations and examples can be accessed simply by pressing the F1 key.

Full metrological traceability
Every analysis step is recorded in a hierarchical analysis workflow to assure full metrological traceability. Analysis steps in the workflow can be fine tuned at any time. All dependent steps are recalculated automatically.

Powerful automation features
Once an analysis report has been completed it can be applied as a template to automate the analysis of multiple measurement data files. In addition common sequences of analysis steps can be saved in a library for insertion into future analysis reports to save time.

Pass/fail with tolerancing
Pass/fail criteria with tolerances can be defined for any parameter. Green/red pass/fail traffic lights are displayed automatically and the parameter value and tolerance limits are shown graphically.

Data export
Frames and pages can be exported as bitmaps up to 1200 dpi for poster sessions. Finished reports can be exported in PDF and RTF formats for easy circulation. All numerical results, including pass/fail status, are accessible in the Results Manager panel and can be exported in Excel-compatible text files for interfacing with 3rd party software, including quality management software.

Page format
Pages in analysis reports have standard or user-defined portrait, landscape or onscreen formats. A master page can be set up with elements that will be repeated on all pages (company information, logo, page number, etc.).
MountainsMap® Scanning Topography Optional Modules
For advanced and specialized applications

+ 3D advanced surface texture module
Advanced 3D studies, parameters and filters
- Calculate advanced 3D surface texture and form parameters – ISO 25178 functional volume (Vmp, Vmc, Vvc, Vvv), spatial (Sal, Str, Std) and hybrid (Sdq, Sdr) parameters - ISO 12178 flatness (FLTt, FLTp, FLTv, FLTq) parameters.
- Study functional volume parameters graphically - visualize friction, core and lubrication zones on tribological surfaces.
- Study surface isotropy, directionality and periodicity - view dominant surface directions on a compass rose and calculate parameters.
- Apply morphological filters to surfaces - erosion, dilation, opening, closing, and sequential filters.
- Analyze furrows - visualize furrows and calculate furrow parameters.
- Analyze fractal dimensions of surfaces using the enclosing boxes and morphological envelopes methods.
- Study circular profiles – with the abscissa in degree units.
- MATLAB™ compatibility - use MATLAB™ scripts to define custom filters for 3D surfaces - execute the scripts in MountainsMap®. (Note: MATLAB™ and MountainsMap® must be installed on the same PC.)

+ Grains and particles analysis module
Study isolated surface features
- Automatically detect and count grains, particles, islands, bumps, holes and motifs (texture cells) using multiple methods:
  
  2D grains and particles with respect to a selected horizontal plane - separate grains from the background by binarization on a selected horizontal plane - sort grains into subsets with respect to any parameter.
  
  3D grains (islands) with respect to a selected height.
  
  Motifs in accordance with a configurable ISO 25178 segmentation by watersheds algorithm and Wolf pruning.

  - Calculate morphological parameters for individual grains, etc.
  - Generate statistics for all grains, etc. and subsets.
  - Calculate ISO 25178 features parameters (Spd, Spc, S5p, S5v, S10z, Sha, Shv, Sda, Sdv).
  - Special features for microlens arrays - display spherical caps, calculate spherical parameters.
### 3D Fourier & wavelets analysis module

Analyze process-surface interactions

- **Frequency analysis** – interactive frequency spectrum, interactive power spectrum density, autocorrelation and intercorrelation.
- **Calculate isotropy, directionality and periodicity** - view dominant surface directions on a compass rose and calculate parameters.
- **Denoise surfaces** using the FFT plot editor.
- **Discrete wavelet filtering** (3D surfaces and 2D profiles) - visualize a surface or profile at multiple scale levels – select roughness and waviness scale levels.
- **Continuous wavelet decomposition** - study scale levels and spatial locations where phenomena occur.

### Contour analysis module

**Straightforward component dimensioning**

- **Extract** a vertical \((x,z)\) or horizontal \((x,y)\) contour (profile) from a surface.
- **Define nominal form** using straightforward interactive tools to associate geometric elements with contours.
- **Calculate dimensions** (including distances, radii, diameters and angles) using autodimensioning and interactive tools.

### Advanced contour analysis module

**Form deviation analysis with tolerancing**

- All of the features in the Contour Analysis module.
- Compare measured contours with CAD data (DXF) or user-defined nominal form.
- Specify tolerances including large positional tolerances if required.
- Visualize form deviations easily with magnified graphics.
- Automatically generate a table of results including pass/fail status.
- **Gothic arch analysis** of bearings.

### Statistics module

**Multiple static/dynamic surface data populations**

- **Prepare data automatically using templates** - include all parameters for statistical analysis in a predefined analysis workflow - use it as a template for automatically generating analysis reports.
- **Generate statistical reports** - select the static or dynamic population(s) to be analyzed and create a report with parameter tables, control charts, histograms, box plots and scatter plots as required - statistics for dynamic populations are updated automatically.
- **Monitor key metrological and process parameters** - control charts include standard deviation limits (1 to 3 sigma), control limits and vertical bars separating different populations, together with yield, capability (Cpk) and other parameters.
### 2D advanced surface texture module

**Advanced 2D analytical studies & filters for profiles**

- Apply advanced 2D filtering techniques - remove form and apply roughness/waviness filters from Gaussian to ISO 16610 - apply morphological filters - denoise profiles using the FFT plot editor - profile subtraction
- Correct measurement anomalies - use data correction tools (thresholding, retouching, resampling) to eliminate anomalies and improve resolution prior to analysis.
- 2D Fourier analysis - frequency spectrum - power spectrum density - autocorrelation - intercorrelation.
- Analyze fractal dimensions of profiles using the enclosing boxes and morphological envelopes methods.
- Overcome measurement limits virtually - join overlapping profiles.
- Generate statistics on series of profiles - the profiles in the series can be extracted from a series of surfaces or from the same surface.
- MATLAB™ compatibility - use MATLAB™ scripts to define custom filters for 2D profiles - execute the scripts in MountainsMap®. (Note: MATLAB™ and MountainsMap® must be installed on the same PC.)

### 2D Automotive module

**2D functional parameters and studies**

- Study Rk parameters associated with wear and lubrication graphically - visualize friction, core and lubrication zones on tribological profiles.

### Lead (twist) analysis

**2nd generation lead analysis (automotive industry)**

- Automatically generate a lead analysis report (for manufacturing efficient radial seals that reduce oil consumption) in accordance with the Mercedes-Benz 2009 engineering standard - including lead parameters and visualization of dewobbled measured surface structure and lead surface topography.

Right. 2nd generation lead (twist) analysis report in accordance with the Mercedes-Benz engineering standard.
4D series module

Visualize, filter & analyze series of surfaces

- Combine a series of 3D surfaces (z axis height) for 4D analysis with respect to time, temperature, magnetic field or another dimension.
- Visualize surface, profile and point evolution, even fly over a surface as it changes and record a movie for presentations.
- Generate statistics on surface texture parameter evolution.
- Filter out noise and highlight areas of different kinetic behavior using the Karhunen-Loève transform (principal component analysis).
**MountainsMap® Scanning Topography**

### Compatibility

- 3D surface profiling systems – contact stylus - non-contact chromatic confocal, auto-focusing, laser triangulation, single point WLI profilometers - with optional upgrades compatibility with 3D optical microscopes, scanning probe microscopes, scanning electron microscopes and other instrument types.

### Smart desktop publishing user environment


### Surface visualization

- Real time imaging of 3D surface topography (2 axis in height units) - selectable rendering, lighting and height amplification - color coded Z-axis palettes with data point distribution histograms - surface flyovers with video export – contour diagrams - photo-simulations - 2D profile extraction.

### Data normalization & correction

- Leveling - XY or Z inversion - rotation – zone extraction - thresholding - filling in missing points - retouching - resampling - tip deconvolution - scan line correction – patching of measurements at different heights into a single surface

### Filters

- Form removal (surfaces) - roughness/waviness filters (Gaussian to ISO 16610) - spatial filters (including smoothing) - surface subtraction

### Analysis

- Distance, angle, area, volume, step heights measurement – bearing ratio curve and depth histogram - material/void volume and thickness of vertical slices - sub-surface extraction and analysis

### Parameters


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**MountainsMap® Scanning Topography Optional Modules**

### 3D Advanced Surface Texture


### Grains & Particles Analysis

- Automatic detection of grains, particles, islands, bumps, holes and motifs (texture cells) using multiple morphological parameters – statistics – ISO 25178 features parameters – spherical parameters (microlens arrays)

### 3D Fourier & Wavelets Analysis

- Frequency spectrum – power spectrum density – surface autocorrelation and intercorrelation – FFT plot editor – discrete wavelet filtering (surfaces and profiles) – continuous wavelet decomposition (profiles)

### Contour Analysis

- Extraction of vertical (x,z) and horizontal (x,y) contours (profile) from surfaces – nominal form definition by association of geometric elements with contour – geometric dimensioning

### Advanced Contour Analysis

- Comparison of measured contours with DXF CAD data or user-defined nominal form – tolerance specification – magnified form deviation graphics – table of pass/fail results – Gothic arch bearings analysis

### 2D Advanced Surface Texture

- Form removal - ISO 16610 2D roughness/waviness filters – morphological filters – 2D Fourier analysis including frequency spectrum and power spectrum density - FFT plot editor – profile data correction tools – profile subtraction – profile joining – 2D fractal analysis - series of profiles creation and analysis with statistics - MATLAB compatibility (custom filters)

### 2D Automotive


### Lead Analysis

- Automatic 2nd generation lead (twist) analysis report (for manufacturing efficient radial seals that reduce oil consumption) according to 2009 Mercedes-Benz engineering standard

### Statistics

- Automated data preparation using templates – statistical reports on multiple static and/or dynamic surface data populations - control charts for monitoring metrological and process parameters

### 4D Series

- 4D visualization, filtering and analysis of series of surfaces and images (2 axis: height or intensity) - surface, profile and point evolution – surface flyover movie export – statistics on surface texture parameters – Karhunen-Loève transform (principal component analysis) for noise filtering and highlighting of areas with different kinetic behavior

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**MountainsMap® Scanning Topography Upgrade to MountainsMap® Universal & Premium**

### Universal Upgrade

- Upgrade to MountainsMap® Universal - compatible with 3D optical microscopes, scanning probe microscopes and form measuring systems – wider range of optional modules including modules providing compatibility with scanning electron microscopes and spectrometers (Raman, FT-IR)

### Premium Upgrade

- Upgrade to MountainsMap® Premium - top of the line package compatible with the same instrument types as MountainsMap® Universal and containing all MountainsMap® Scanning Topography modules except for Advanced Contour Analysis and Lead Analysis
## Requirements

### PC requirements

<table>
<thead>
<tr>
<th>Minimum requirements</th>
<th>Operating system</th>
<th>Windows 8 (64-bit or 32-bit) or Windows 7 (64-bit or 32-bit) or Windows Vista (64-bit or 32-bit)</th>
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<tr>
<td>RAM</td>
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<td>Graphics board</td>
<td>Hardware accelerated OpenGL or Direct3D</td>
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<td>Resolution</td>
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<td>Other</td>
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<table>
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<th>Recommended</th>
<th>Operating system</th>
<th>Windows 8 (64-bit) or Windows 7 (64-bit)</th>
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<tr>
<td>Processor</td>
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<tr>
<td>Resolution</td>
<td>1600 x 1024 in thousands of colors</td>
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