FALL 2025

Newsletter

SURFACE

Surface imaging, analysis & metrology news from Digital Surf

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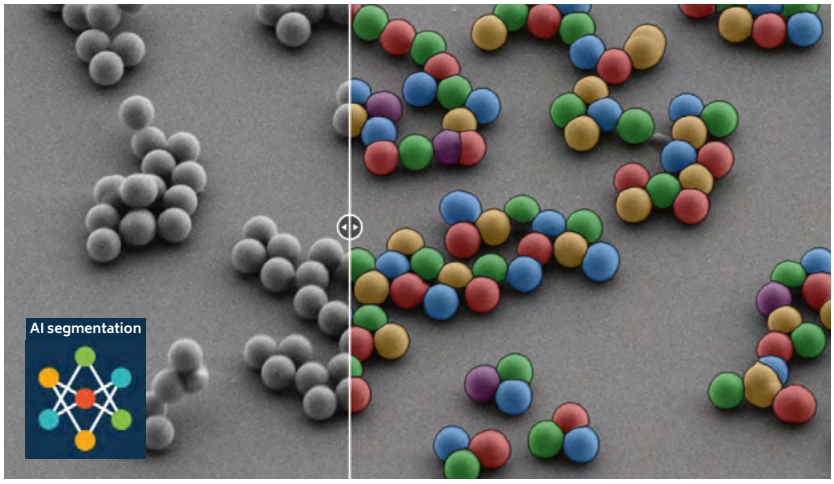
IN THIS ISSUE

YOUR NEW LAB ASSISTANT: AI-POWERED ANALYSIS WITH MOUNTAINS® 11.1



Mountains® 11.1 introduces cutting-edge AI-powered particle segmentation for profilometry and microscopy, detecting round and irregular particles with precision, even under challenging imaging conditions.

From SEM to optical microscopy to topographic analysis, this smart tool reduces manual work and boosts productivity. And that's only the start: version 11.1 also brings a whole host of other powerful new features to give your analysis that extra boost.

... Turn to page 2 ...

Watch a
WEBINAR

Did you know there is a whole host of free webinars waiting for you on the Digital Surf website?

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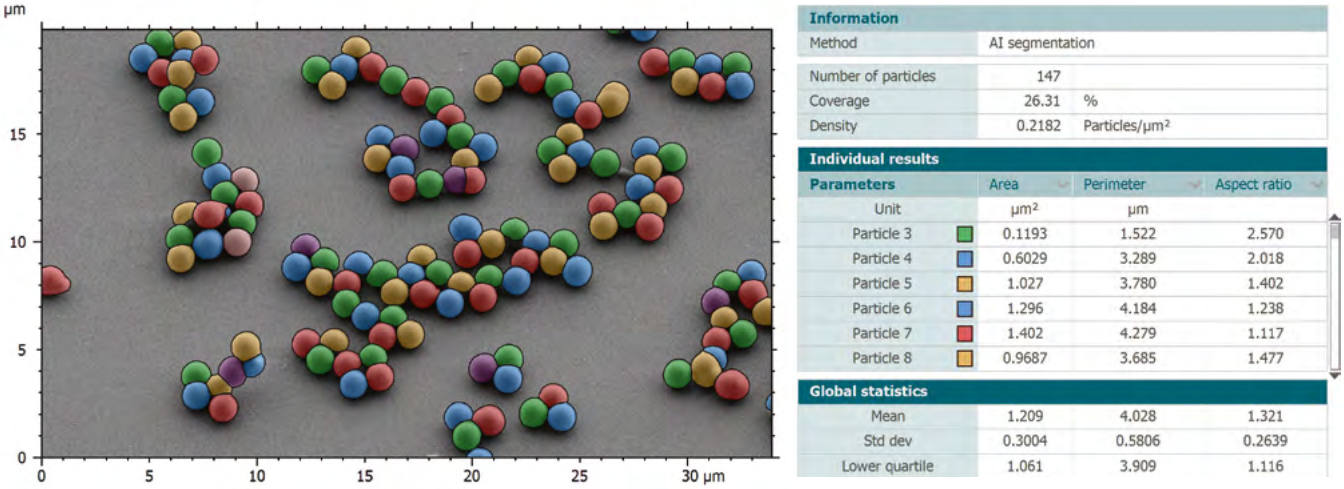
MOUNTAINS® 11.1 A SMARTER, SMOOTHER EXPERIENCE

Digital Surf is set to release **version 11.1 of its Mountains® software platform** on November 18, 2025, bringing a host of refinements and new AI-driven features designed to make surface, image and spectral analysis more intuitive, consistent and powerful across all instrument types. From profilometry to spectroscopy and microscopy, this latest update focuses on boosting productivity, improving visualization and delivering smarter automation.



Above. *Bringing AI-based particle segmentation to SEM, optical microscopy & profilometry analysis.*

CROSS-TECHNOLOGY ENHANCEMENTS

Version 11.1 introduces several updates benefiting all users, regardless of instrument type. The new **Free orbit camera mode** allows full 3D rotation of surfaces for greater visualization freedom, complemented by an **orthographic projection** option for distortion-free top views. **Automatic color adjustment** for study elements ensures optimal contrast, while **"quick close without saving"** simplifies the manipulation of multiple open documents.

Particle analysis tools have also been expanded, with new parameters such as **Min Feret** and **Perpendicular Feret** diameters improving standardization between laboratories and clickable particle labels to make navigation easier. A new **input-selection interface** makes loading multiple studiables more intuitive.

PROFILOMETRY: MORE PRECISION AND PERFORMANCE

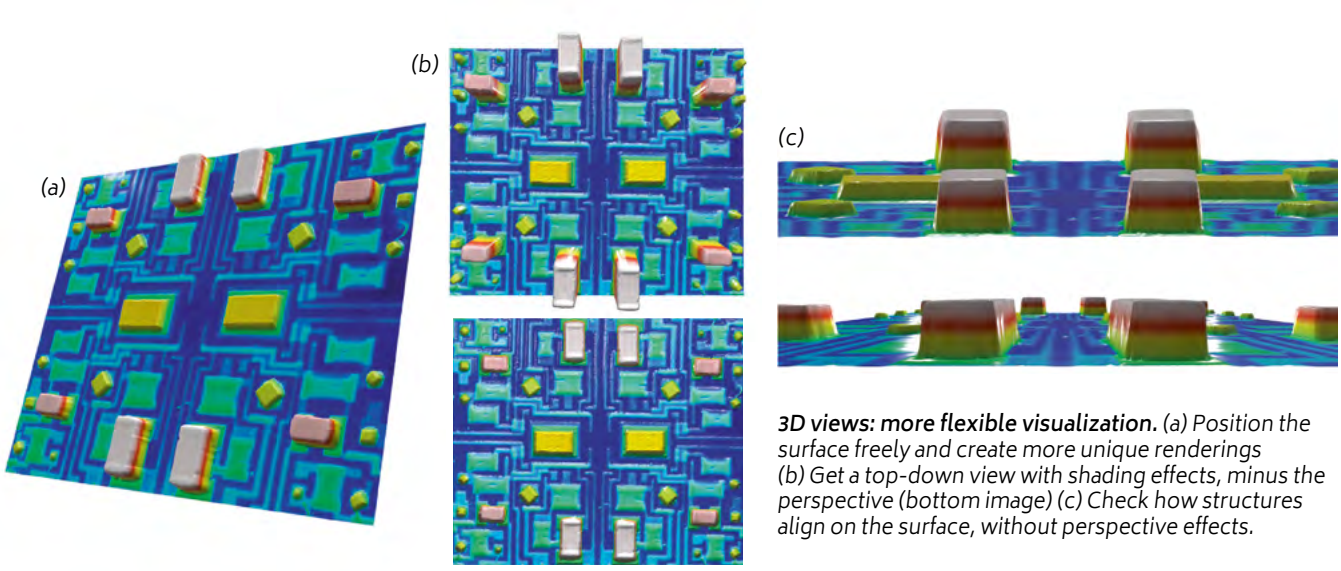
For users working with topographic data, Mountains® 11.1 introduces an **AI-based particle segmentation** method capable of detecting both round and irregular particles, outperforming traditional methods in challenging cases.

Enhancements to the **Extract Local Contour** and **Remove Outliers** operators offer greater robustness and control, while the ability to **preserve profile length in circular form removal** ensures more consistent results.

Point Cloud and Shell operators also benefit from **faster meshing**, **more accurate pre-alignment**, and a **redesigned interface** for easier control of settings - valuable improvements for users handling large 3D datasets.

SEM AND LIGHT MICROSCOPY: AI SEGMENTATION IS HERE!

Reflecting the expanding role of AI in microscopy, version 11.1 introduces advanced segmentation tools for both SEM and optical images, representing a major step forward in automated image analysis. The new **AI-driven method** delivers accurate detection of both round and irregular particles, even in images affected by uneven lighting, contrast variations or overlapping features. By significantly reducing the need for manual



3D views: more flexible visualization. *(a) Position the surface freely and create more unique renderings (b) Get a top-down view with shading effects, minus the perspective (bottom image) (c) Check how structures align on the surface, without perspective effects.*

threshold adjustment and cleanup, it helps users save valuable time.

In **SEM-BSE analysis**, a redesigned segmentation interface further streamlines the workflow. Users can now manage and exclude classes more intuitively, while color mapping on the histogram provides immediate visual feedback linking classes to intensity ranges.

Together, these advances bring a new level of precision and efficiency to particle analysis in electron and optical microscopy.

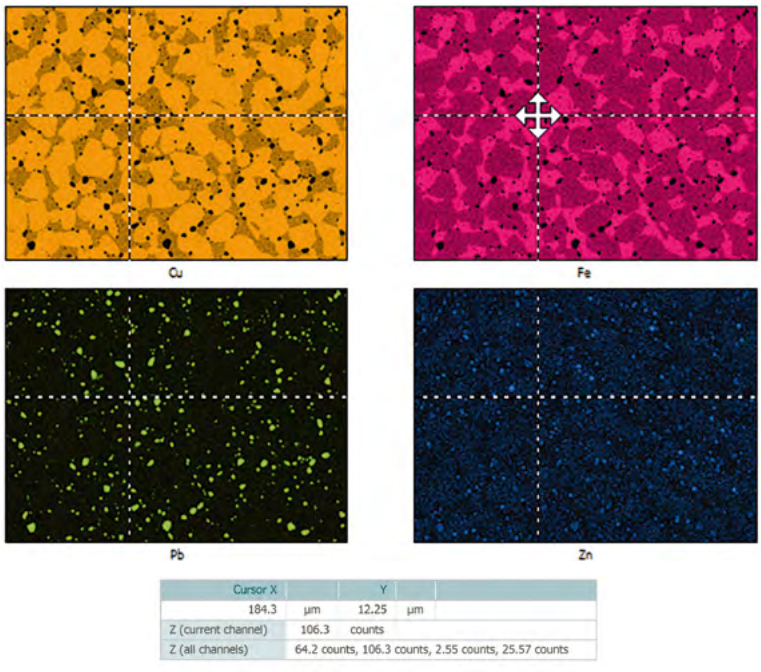
SPECTROSCOPY: ENHANCED NAVIGATION AND PEAK ANALYSIS

Users working with spectroscopy data will find a smoother and faster experience throughout. A **synchronized cursor in Grid view** enables linked exploration across studies, while a **spectral axis cursor** is now available in all spectral study types. The update introduces **Single Harmonic Oscillator (SHO) modeling** and **Quality Factor** calculation for nanospectral applications such as AFM-IR or nanoIR.

Usability also sees major improvements, including **optimized spectrum scaling**, **consistent keyboard shortcuts** for scrolling and slice navigation and a **faster cinema mode** for hyperspectral image browsing.

ANALYSIS BOOSTED

In conclusion, by expanding AI-driven segmentation to multiple instrument families and refining everyday analysis tools, Mountains® 11.1 continues to strengthen Digital Surf's cross-platform vision. The result is a unified, flexible software environment that helps researchers and engineers extract more insight from their surface and image data faster and with greater confidence.



Above. *Synchronized cursor in Grid view.*

LEARN MORE & UPDATE

Check www.digitalsurf.com for full details of the v11.1 release (available Nov 18, 2025). Access to the new version is included for users with an active **Mountains® Software Maintenance Plan**. To find out more about your Maintenance options, please contact sales@digitalsurf.com

EUROPEAN STUDY ADVANCES **AFM NANOMETROLOGY ON SILICON NANOWIRES**

Nanowires (NWs) are of great interest for their useful electrical, electromechanical and thermoelectrical properties and, in past decades, many R&D efforts have focused on their development. In this study, an inter-laboratory comparison of AFM dimensional and surface roughness characterization on silicon NWs, involving different national metrology institutes in Europe, is reported by researchers Alexandra Delvallée and Luigi Ribotta. The work was led by the Nanometrology and Surface Metrology group at **INRiM, the Italian National Metrology Institute**, which has several decades of experience in quantitative analysis at the nanoscale.

A PROTOCOL FOR NANODIMENSIONAL MEASUREMENTS WITH AFM

Nanometrology plays a crucial role in ensuring the traceability and reliability of measurements through the development of methods specifically tailored to instrumentation at the nanoscale. The use of multiple, well-assessed characterization methods is a growing and essential practice to enable a broader comprehension of structural, physico-chemical and functional properties of nanomaterials.

As well as providing the roughness properties of the wires, with their uncertainties evaluation, the results of this study also helped demonstrate the comparability of the measurement results obtained with various instruments.

The diameter and roughness parameters are extracted as explained in the caption of Figure 1. Experimental data shows good consistency, with a standard deviation of 15% relative to the mean top-height diameter. Moreover, combined standard uncertainties given are included in a range from 2.2% to 2.9%.

Concerning NW roughness, no standard or guide exists for assessing the uncertainty associated with it. We propose a methodology, based on Monte Carlo approaches and the results are consistent (combined standard uncertainty results ranging from 0.3% to 5.0% for Ra values and from 0.3% to 4.4% for Rq values).

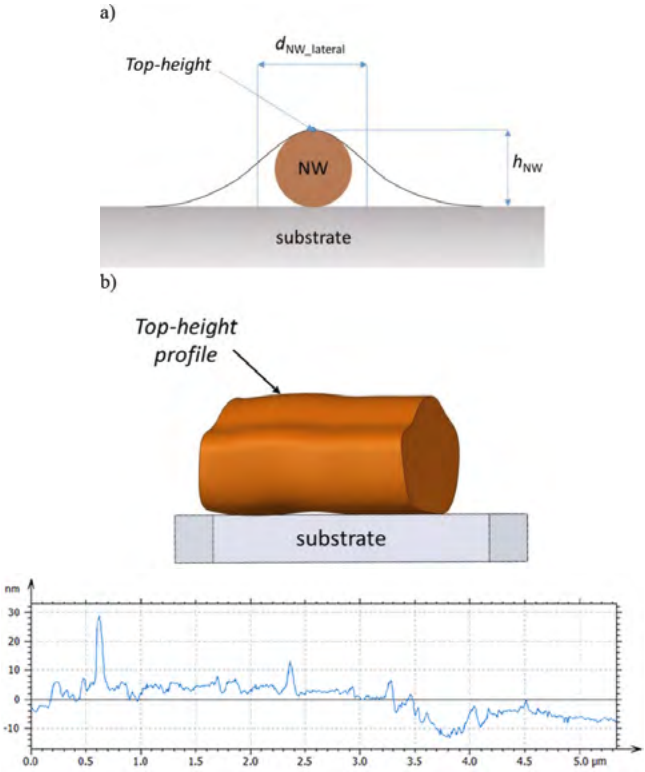


Figure 1 (a) Cross section of a nanowire deposited on a surface. The gray line is a profile achieved by the tip: the lateral diameter ($d_{NW\_lateral}$) is enlarged by convolution between the tip and the NW. The diameter can be extracted from the height of the NW h_{NW}. The height of the nanowire is defined as the vertical distance between the 'top height' and the substrate. (b) Along the total length diameter, variations of a few nanometers can occur due to the continuous immersion in the etching solution during fabrication. Because of this, the top-height point had to be extracted on several profiles along the NW, ideally on each line of the AFM image. As a result, a profile all along the NW can be determined and can also be used to determine the roughness parameters all along the NWs, extracted by using MountainsSPIP® software.

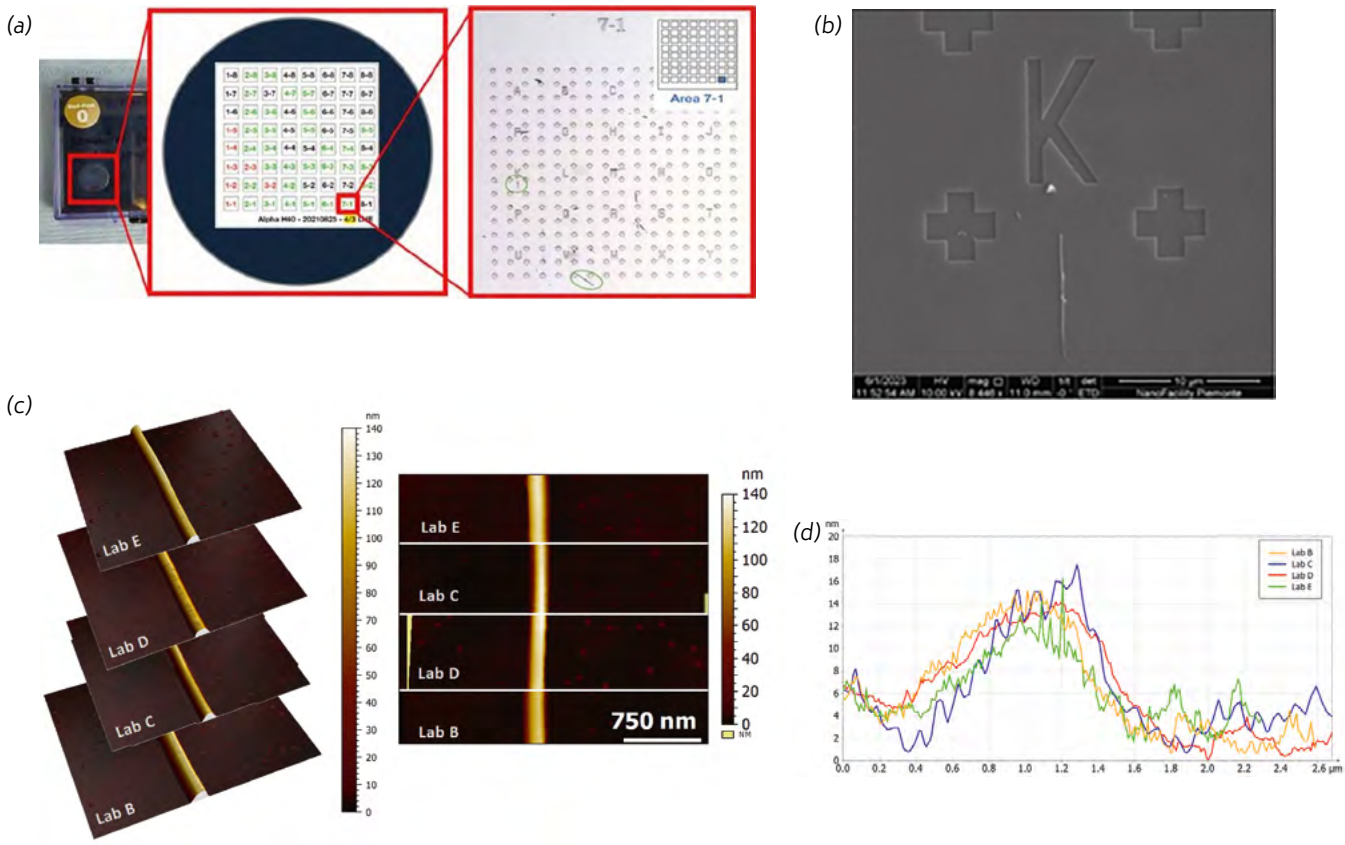


Figure 2 (a) (left) One of the three samples used for the study, (center) schematic view of the different numbered zones on a substrate, (right) optical microscope view of a numbered zone (here zone 7–1) on a marked silicon substrate (9 mm x 9 mm) where nanowires are deposited. The green regions indicate the presence of isolated NWs while the red regions indicate the presence of bundles not approached with the AFM tip. (b) SEM image of an area with NW deposited on marked silicon substrate. (c) Colocalized AFM images of the same nanowire acquired by four different laboratories using MountainsLab® software (d) Comparison of the extracted roughness profiles from the different labs.

COLOCALIZING NANOWIRES MEASURED BY DIFFERENT AFMS AROUND EUROPE

In a recent study led by the LNE (Laboratoire National de métrologie et d'Essais, France), it has been demonstrated that characterization on exactly the same nano-objects using different instruments can reduce measurement uncertainties. The idea here is, using dedicated marked substrates (Figure 2), to locate a region of interest (ROI) and to image these ROIs with the various AFMs of participating European countries.

Firstly, each image was processed independently, i.e. here leveled. Then, the "Colocalization" tool was used to combine the data from the different images and to ensure that strictly the same area was compared by each European laboratory.

In order to extract the roughness profile from the NW acquired with the AFMs, we used a MATLAB routine integrated into MountainsLab® software to extract the highest point from each line. The results are shown in Figure 2 (d). The mean trough Ra value the different laboratories measured was 0.7 nm with a standard deviation of 0.2 nm.

INSTRUMENTS & SOFTWARE USED

Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), MountainsSPIP®& MountainsLab® software.

READ MORE

AFM interlaboratory comparison for nanodimensional metrology on silicon nanowires. Luigi Ribotta, Alexandra Delvallée, Eleonora Cara, Roberto Bellotti, Andrea Giura, Ivan De Carlo, Matteo Fretto, Walter Knulst, Richard Koops, Bruno Torre, Zineb Saghi, Luca Boarino. Measurement Science and Technology, Volume 35, Number 10, 2024, doi.org/10.1088/1361-6501/ad5e9f

“ WITH VERSION 11, 3D VISUALIZATION **REACHES A WHOLE NEW LEVEL**

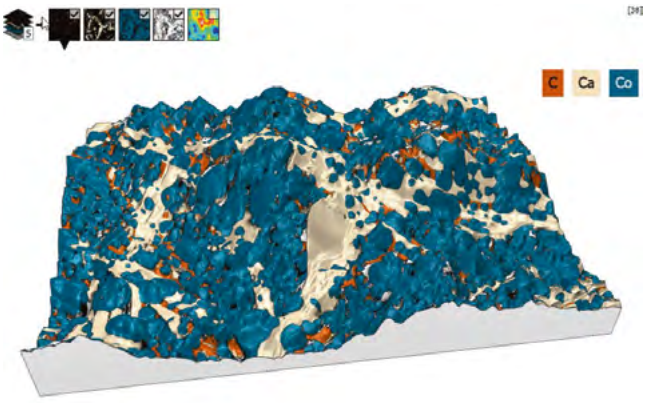
In this issue, **Christophe Mignot, CEO of Digital Surf**, takes us behind the scenes of the company's latest innovation: the new **3D visualization experience in Mountains® version 11**. He reflects on Digital Surf's pioneering role in bringing surface metrology from 2D to 3D and how the new release makes 3D analysis more powerful and intuitive than ever.

DIGITAL SURF, A PIONEER IN THE SHIFT FROM 2D TO 3D

The first profilometer, developed in 1941, could only measure 2D profiles. It wasn't until 1978 that the university researchers whose work led to the creation of Digital Surf proposed a breakthrough idea: to move from 2D profiles to full 3D surface measurements.[1] Over the following decades, they developed mathematical tools that continue to shape the science of surface analysis today.

When Digital Surf was founded in 1989, one of its first products was a 3D surface analysis software, quickly adopted by key players in the field of metrology. By 2010, 3D surface measurement had earned its own ISO standard (ISO 25178), with Digital Surf actively contributing to its creation[2] (the company continues to contribute to this day).

Since version 9, Mountains® has also made it possible to calculate roughness parameters on freeform surfaces (known as "shells" in the software). With Mountains® version 7, we extended our expertise in 3D to scanning electron microscopy (SEM) by inviting the scientific community to "take SEM from 2D black-and-white to 3D color." The message resonated: today, all major SEM manufacturers offer topography reconstruction powered by MountainsSEM®.



***Above.** 3D and color in SEM: overlay of chemical composition (EDX maps) on a 3D reconstruction performed with MountainsSEM®.*

NEW 3D RECONSTRUCTION FOR MICROELECTRONICS

Earlier this year, version 11 of Mountains® brought a new evolution: updated, more precise algorithms for 3D reconstruction of SEM images, specifically designed to enhance observation of microelectronic structures. For engineers working at the micro and nanoscale, this means clearer visualization of complex topographies and better insights into how materials behave at these scales.

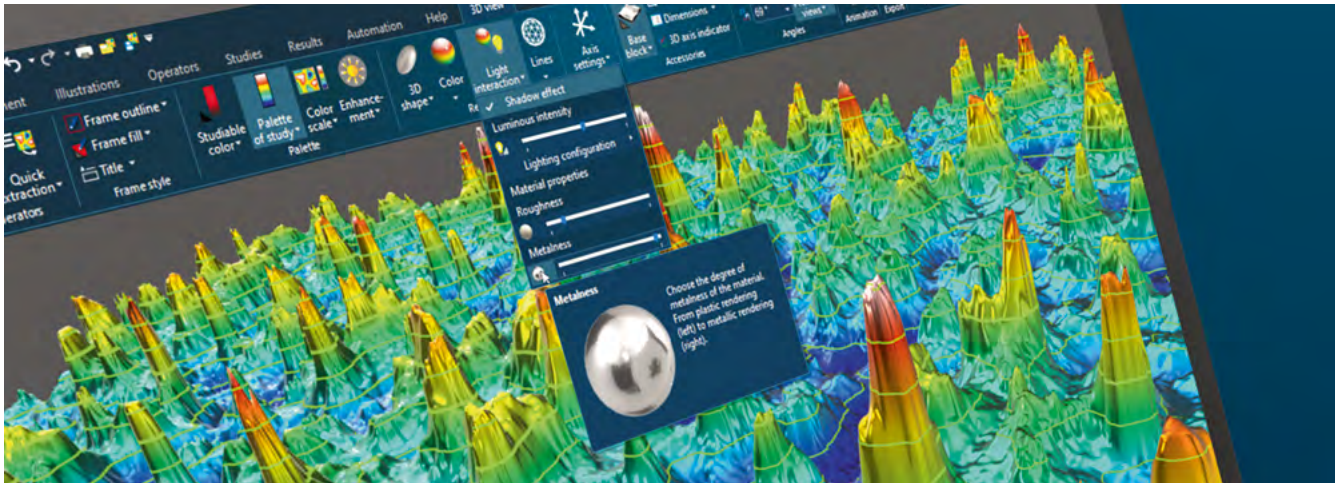
You could say that, at Digital Surf, 3D is part of our DNA. Indeed, our innovations have continuously shaped its evolution. The story, however, is far from over. In recent years, we have made major investments to push the boundaries even further, developing our own high-performance 3D rendering engine.

THE MOUNTAINS® RENDERING ENGINE (MRE)

The new Mountains® Rendering Engine (MRE) fully harnesses the power of modern graphics cards to deliver faster, smoother and more realistic 3D views. It's one of the cornerstones of version 11, designed to allow us to progressively unlock new visualization capabilities in upcoming releases.

[1] *Tribological study of rough surfaces: influence of topography on friction and wear*, J. Mignot, T. Roques-Carmes, A. Boulanger. Revue de Tribologie et de Génie des Surfaces, 1978, 1(1), 45–60.

[2] *New 3D parameters and filtration techniques for surface metrology*, F. Blateyron, Quality Magazine White Paper, 2006. www.qualitymag.com/QUAL/Home/Files/PDFs/New3DParametersandFiltrationTechniquesforSurfaceMetrology.pdf



Above. *New version 11 settings allow users to define how light interacts with 3D surface models.*

Users can already experience the benefits of MRE in several operators. For example:

- **The 3D preview in the "Threshold" Operator** helps simulate wear on a contact surface at a chosen bearing ratio, a powerful feature for mechanical engineers.
- **The 3D preview in filtering** enables users to visualize the waviness layer semi-transparently over the raw surface and instantly see how filter type and cut-off choices affect the result.

MORE 3D OPTIONS, MADE SIMPLER

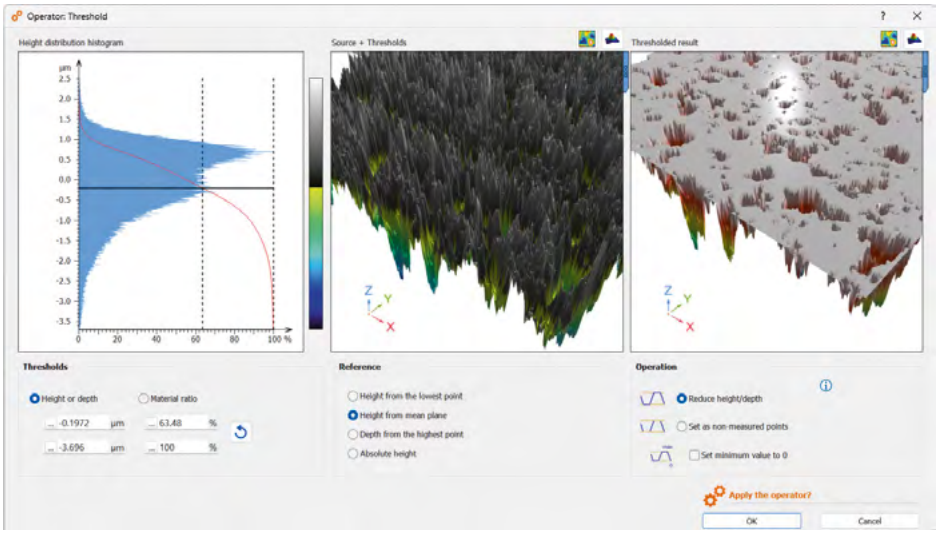
Our expert users often request more visualization options, while newcomers want an intuitive interface that makes finding the right settings effortless. Meeting both expectations was a real challenge: one that version 11 successfully meets.

Thanks to the redesign of the 3D interface, users now enjoy a cleaner, more logical experience with expanded creative control. MRE introduces a wider range of visual effects (matte, glossy, metallic) allowing users to tailor the look of their surfaces for clearer interpretation or more impactful presentation.

The new interface is structured around four simple, independent questions:

- **Shape**: How should my 3D object look? (relief amplification, mesh density etc.)
- **Color**: What "wallpaper" will I use? (image, topography layer, color map)
- **Lighting**: How should light interact with the surface? (matte, shiny, metallic)
- **Lines**: Do I want to overlay meshes or contour lines?

The result: more functionality, presented more simply. That's the philosophy behind the new 3D interface and, more broadly, the entire Mountains® product line.



Above. *Wear simulation using the new 3D preview in the "Threshold "Operator.*

WANT TO SEE YOUR OWN DATA IN 3D?

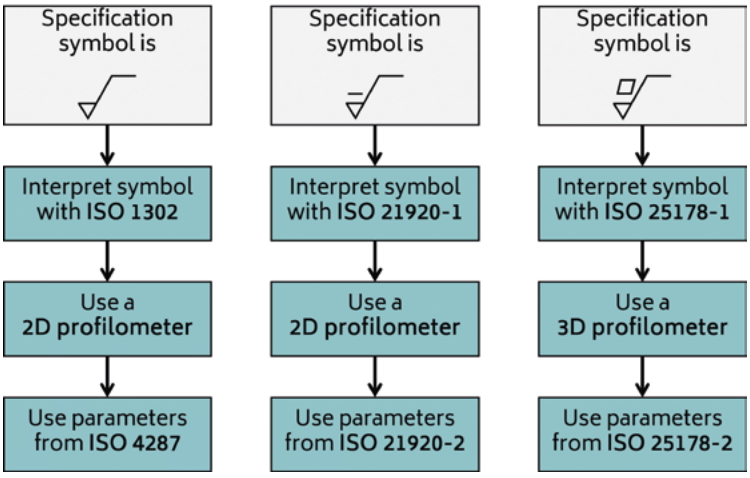
Try it yourself! Download a free trial of Mountains® version 11 and explore your own data with the latest 3D rendering and analysis tools. Get started here: www.digitalsurf.com/free-trial

“ HOW SHOULD I CORRECTLY **MEASURE A SURFACE?**

Many manufacturers in the mechanical industry face the challenge of **verifying the surface finish of the parts** they produce. Researchers working on **new materials or processes** often face a similar problem and don't always know how to assess surface texture properties. A lack of knowledge or resources can easily lead to poor choices regarding the instrument, measurement protocol or analysis. And these mistakes can cost time, money and potentially compromise quality. So, should you measure a profile or a surface? Should you use a contact profilometer or an optical profiler? In this article **François Blateyron, Digital Surf's senior surface metrology expert**, offers practical advice and outlines good measurement practices.

VERIFYING A SPECIFICATION

Are you verifying a tolerance on a technical drawing or exploring a new material? The answer determines the right measurement and analysis method. If you need to check a specification provided on a drawing, the goal is simple: just follow the specification. However, interpreting the root symbol, identifying default parameters and choosing the instrument configuration can be more complex.



Further reading:

- Guide to ISO 1302 surface finish symbols bit.ly/4qOpykr
- Video: How to interpret surface finish symbols bit.ly/47CfbXT
- Default specifications guide bit.ly/4nCycja

EXPLORING A NEW SURFACE

When investigating new materials or surface treatments, the first decision is what type of measurement to use. Modern engineered surfaces are often structured or textured to achieve specific functions such as improving adhesion, reducing friction or enhancing hydrophobicity. In these cases, the choice between profile and areal measurements depends on the surface's complexity.

Surfaces can be classified along a continuum from stochastic (random, isotropic) to deterministic (structured, anisotropic).

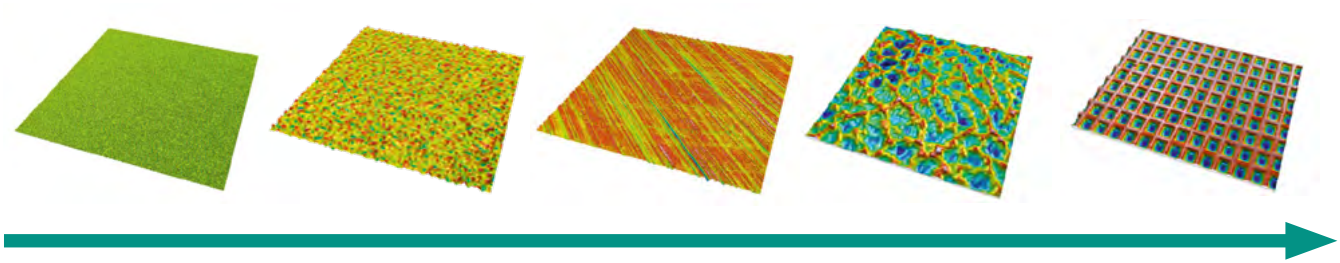
Stochastic surfaces behave the same in all directions, so a single profile may represent the whole surface adequately. Deterministic surfaces, however, include repeating patterns or directional features. These require areal measurements to properly capture texture directionality, periodicity or local variations.

Further reading:

- Stochastic vs deterministic surfaces bit.ly/43N5HrN

CHOOSING THE RIGHT INSTRUMENT

2D contact profilometers are still widely used: they are simple, affordable and reliable for metallic parts. However, they may not be suitable for fragile, brittle or soft materials, as contact can cause damage to the sample, or to the stylus itself.



Isotropic (stochastic) — **Non-isotropic (deterministic)**

Measure profiles — **Measure surfaces**

Non-contact instruments such as optical profilers or those featuring single point probes with a lateral scanning system are often better suited for sensitive surfaces.

Areal optical profilers can handle most surface types but typically have a limited field of view, requiring stitching for large areas. Instruments using lateral scanning (profile or areal) can cover wider parts but may suffer from straightness or flatness errors.

Understanding the metrological performance of your instrument and maintaining regular calibration routines are essential for reliable results.

Further reading:

- Stylus profilometers guide: bit.ly/4hN2L4s

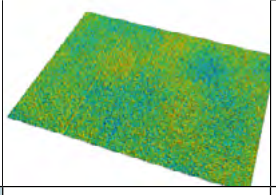
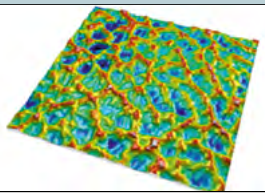
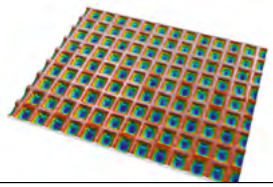
CHOOSING THE RIGHT ANALYSIS

Surface texture analysis is not just about calculating Ra. The choice of parameters (amplitude, spacing, hybrid or feature-based) depends on the function of the surface. Correct filtering is equally important.

When verifying specifications, follow the defined parameters and default settings. When exploring new surfaces, choose analysis methods consistent with the surface's structure and complexity. Always report the analysis conditions, especially the filtering used

Further reading:

- What cut-off should I use? bit.ly/4qEuBnc
- Five common surface analysis mistakes bit.ly/3WzZStZ

	Stochastic surfaces	Stochastic-deterministic surfaces	Deterministic surfaces
			
Rough	• **Profile** is enough • Any position / Any direction • Reproducibility is good • Use **Field parameters** (Ra, Rq, Rsk, Rku, Rmr, Rdq) • Surface is **isotropic**	• **Profile** and **areal** are possible • Use **Field parameters** • Profile perpendicular to the lay • Feature parameters are possible • **Stabilize results** by averaging multiple profiles	• Use **only areal** analysis • Prefilter surface (denoise) • Use **Feature** parameters • Watershed segmentation • Field parameters not reliable
Smooth	• **Profile** is possible • Use **Field parameters** (Wt, Wa, Wq, Wsk, Wmr, Wdr) • Areal is also possible	• **Areal** analysis is preferable • Use **waviness field parameters**(Sz, Sq, Sdq, Sdr) • Cut-off < 5x dominant wavelength	• **Only areal** analysis • Use **Feature** characterization • Threshold or Watershed • Avoid Field parameters • Report statistics on parameters calculated on each feature

CONCLUSION

Accurate surface texture analysis requires both technical insight and metrological rigor.

Before measuring, always define your objective: are you verifying a specification or exploring a new material? Choose the right instrument and parameters, note the measurement conditions, and interpret results in the context of the surface's function.

Ultimately, understanding a surface means understanding the process that created it, or the factors that changed it.

TRADE SHOW REVIEW

Our experts team visited Stuttgart (DE) from May 6-9 for the **Control international trade fair**. This exhibition dedicated to quality assurance presents the latest new technologies & products for industrial quality assurance. Mountains® software was showcased by the Digital Surf team providing live demos of the new version 11 on our booth. The software was also presented on our partners' booths throughout the exhibition halls. See you in 2027 for the next edition!

Our profilometry experts then headed to the University of Zaragoza (ES) to attend the **25th EUSPEN international conference**. This event gathers industrialists and academics for exchanges on precision engineering & nanotechnology, allowing insight into the latest advances in these fields.

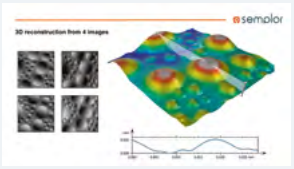
We were also proud to attend and sponsor the 1st **In-situ & correlative electron microscopy conference & workshop (ICEM)**, taking place from June 2-4 in Brno (CZ). The Digital Surf team provided the attendees with a live workshop to showcase Mountains® features dedicated to scanning electron microscopy image analysis.

Digital Surf was pleased to be exhibiting at the classic **JASIS show** in Tokyo early September. On a brand-new booth, the Digital Surf team, along with our valued interpreter Sato-san, was thrilled to meet our Japanese partners and customers to discuss their applications and give them live demos of Mountains® software.

Closer to home, we were honored to sponsor the **Nanoscientific Forum Europe** held at the Paris-Saclay University in Orsay (FR) mid-September. This event was dedicated to advanced techniques in atomic force microscopy (AFM) and nanotechnology applications in material and life sciences.

To complete this busy trade show season, our team participated in the **SciX conference** which took place October 6-8 in Covington (USA). This event is the annual meeting of the spectral analysis community where they discuss the latest trends in analytical chemistry and spectroscopy analysis. Our experts were pleased to represent Digital Surf and its dedicated software for correlation and spectroscopy analysis, MountainsSpectral®.

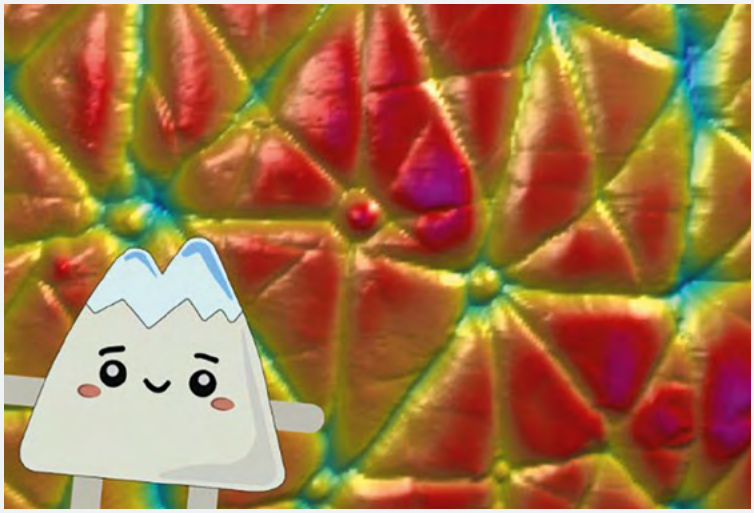
LATEST PRODUCT NEWS



In October, Semplor and Digital Surf proudly announced the launch of the **Semplor Explore Apps**, a new analysis suite designed to unlock advanced characterization directly within the NANOS tabletop SEM.

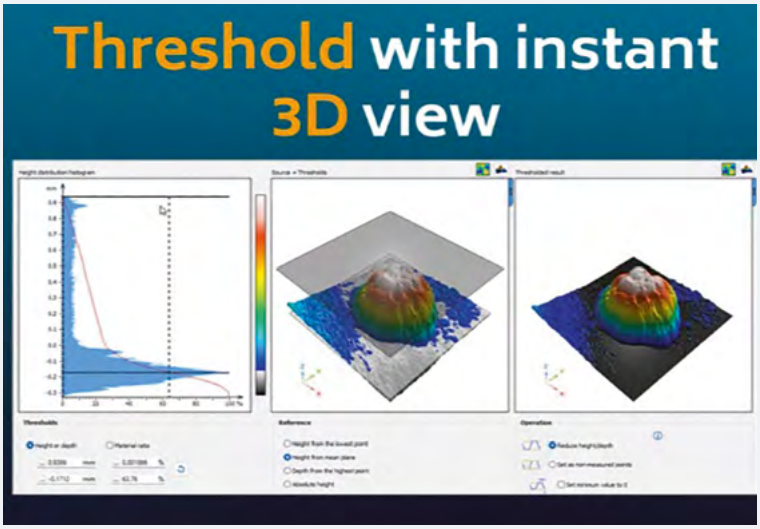
Three modules enable precise measurement of particles, fibers and 3D morphology, leveraging segmentation methods, orientation distributions and height-map reconstructions. Fully integrated into the Semplor Discover software for seamless workflows, the modular apps empower users to tailor analysis to application needs.

WHAT'S HOT ONLINE



POPULAR ON LINKEDIN

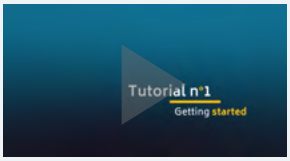
Pico has been sending us postcards from his latest travels exploring the world of the infinitely small. Can you guess what surface he's exploring here? See more on our page: bit.ly/49qNns8



LOVED ON FACEBOOK

The latest Mountains® version comes with an amazing 3D update and new applications. Learn more about this update and the new tools available here: bit.ly/3WRCA2V

Have you been to our YouTube channel?



We have lots of quick, helpful videos, as well as tutorials on Mountains® software basic and advanced features, check them out: bit.ly/2U2I2za

Surface Newsletter

Know a friend or colleague who would be interested in receiving the *Surface Newsletter*?
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The newsletter is available for download on our website
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CATCH UP WITH US

2025 MRS Fall Meeting & Exhibit | Booth 716
Dec 2-4, 2025 | Boston, MA, USA

Journées Annuelles des Utilisateurs d'AFM Bruker 2025
Dec 3-4, 2025 | Tours, France

Pittcon 2026 Conference + Expo | Booth 1122
Mar 7 - 11, 2026 | San Antonio, TX, USA

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