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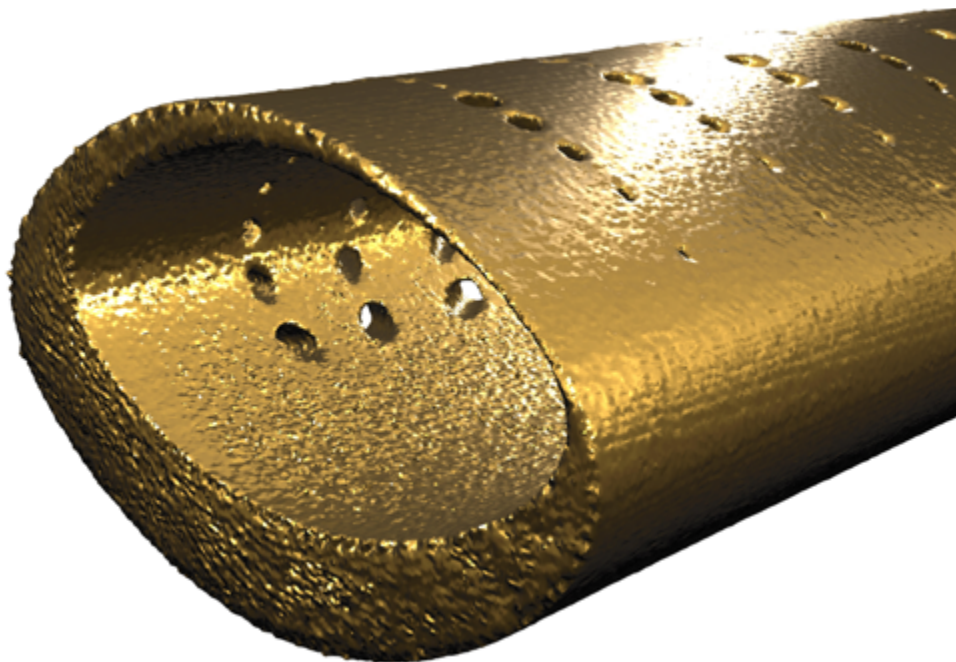
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WHAT'S NEW MOUNTAINS® 8 IS HERE



The wait is over!

Mountains® 8, the next generation of surface and image analysis software will be on demonstration at the Control 2019 show to take place in Stuttgart, Germany May 7-10 and made available to users early June.

Bringing tailored solutions for engineers, metrologists and scientists working with profilometers, scanning electron microscopes (SEM), scanning probe microscopes (SPM) and other instruments, this major new release promises to live up to and even surpass its predecessor Mountains® 7, the gold standard in industry and research for metrology and analysis.

[... Turn to page 2 ...](#)

Meet us
EVENTS



We look forward to seeing you at:

- ▶ Control - stand #3408 - May 7-10, 2019 - Stuttgart, Germany
- ▶ E-MRS Spring Meeting - stand #14 - May 28-30, 2019 - Nice, France
- ▶ Met & Props - July 3-5, 2019 - Lyon, France

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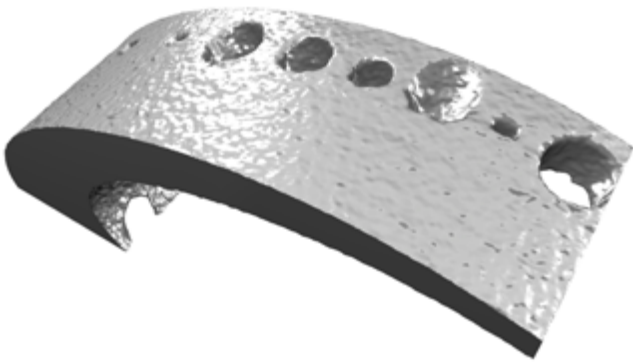
MOUNTAINS® 8 IS HERE 11 REASONS TO UPDATE NOW

Digital Surf is proud to announce the official release of Mountains® 8, available to customers from June 2019. *Surface Newsletter* looks at some of the changes and improvements made to the software and how to get the most out of them. Don't forget to update!

1. INTRODUCING SHELLS

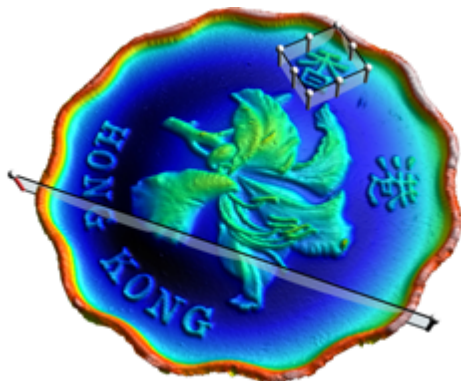
Support for shells (or freeform surfaces as they are also known) has been added, making it possible to analyze data produced by profilers with multiple scanning axes. Useful for applications where you need to see data from all angles (objects produced by additive manufacturing and scanned using X-ray tomography etc.)

=> READ MORE ON PAGE 8



2. CONTROL OPERATORS DIRECTLY

Users can now apply "Quick pre-processing operators" directly in the document without opening a dialog. Similarly "Quick extraction operators" (extract profile, area etc.) can also be implemented directly. Extracted profiles and areas can be visualized directly on data (for example in 3D view - see below).



3. IMPROVED INTERACTIVITY BETWEEN FRAMES

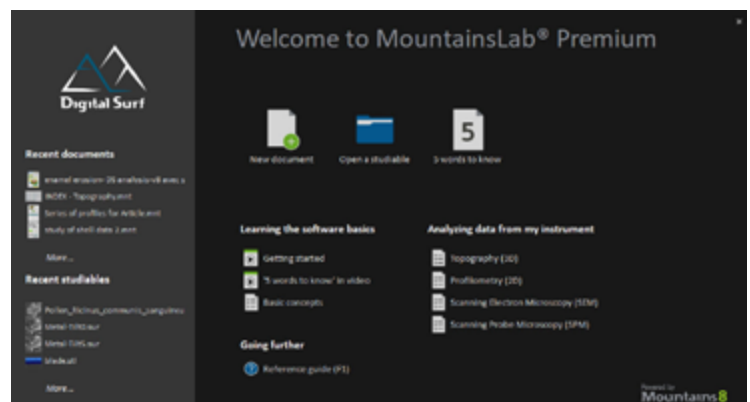
Analysis frames can be grouped, making it easy to apply attributes and even operators to several frames at the same time. Zoom and cursors can also be synchronized.

4. TABBED DOCUMENT INTERFACE

In Mountains®, the "document" refers to the pages on which you can generate and edit studies. A document can have several pages and now you can display several documents simultaneously, in tabs. This is useful for comparing documents as well as working with statistics and Minidocs.

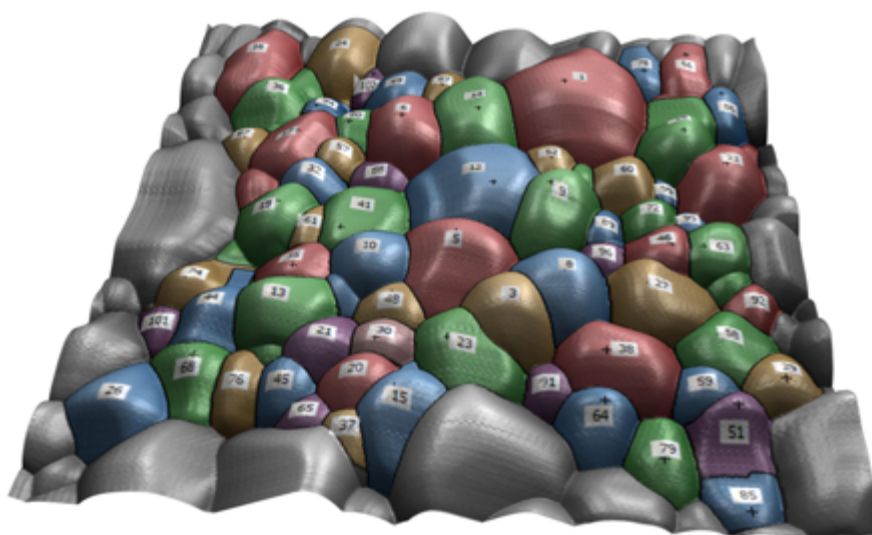
5. ENHANCED FILE EXPLORER

The Mountains® File Explorer just got a serious upgrade! Quicker than before, it becomes a dockable floating window that can be expanded to full screen. In the case of multi-layer open files, you can see layers and choose which to open.



6. WELCOME HOME

Get started faster and return to the Home Screen to quickly access files, tutorials and templates based on your instrument technology.



Information				
Method	Watershed segmentation			
Number of motifs	67			
Parameters	Height	Area	Volume	Z-extremum
Unit	nm	µm²	nm³	nm
Grain #1	45.5	1.73	26019403	124
Grain #3	20.7	0.382	1709633	122
Grain #5	30.8	0.646	4581616	117
Grain #6	36.8	0.586	6258210	117
Grain #8	15.4	0.507	1247785	116
Grain #9	18.4	0.571	1777247	114
Grain #10	30.8	0.394	3797076	114
Grain #12	17.2	0.970	2938121	113
Grain #13	27.5	0.445	3166412	113
Grain #14	27.7	0.756	5973593	111
Grain #15	18.0	0.335	1390282	110
Grain #16	20.7	0.635	2318337	106
Grain #17	23.7	0.607	2776316	105
Grain #18	28.6	0.659	3169504	103
Grain #19	22.4	0.428	1954349	102
Grain #20	9.73	0.189	296294	101
Grain #21	17.5	0.204	824261	99.9
Grain #22	24.8	0.678	3185011	99.7
Grain #23	8.52	0.412	348132	98.1
Grain #24	5.60	0.472	191932	95.0
Grain #26	22.9	0.366	2013327	93.1
Mean	12.2	0.322	1375913	84.5
Std dev	9.60	0.262	3342134	19.7

Above. New and largely improved tools for Particle Analysis.

7. USABILITY IMPROVEMENTS

A collection of little things to make your life easier:

- ▶ **Undo/redo** on all actions that modify the document and on actions in the workflow
- ▶ **Better compatibility** between versions (Mountains® 8 documents can be opened in Mountains® 7 and vice-versa)
- ▶ You can save and apply **custom settings** for any operator or study
- ▶ and more.

8. PARTICLE ANALYSIS RELOADED

Mountains® 8 takes particle analysis to a whole new level. Combining all the best Mountains® and SPIP™ features, the new tool lets users easily detect features of any shape and size on virtually any surface.

Choose which layer of data to use for feature detection then select from four detection methods. Access over 70 parameters (area, perimeter, diameter etc.) for quantification. Analyze all particles or click on any individual particle to see parameters instantly displayed!

9. HIGHLY-SPECIALIZED TOOLS FOR SPM DATA ANALYSIS

With the merging of the Mountains® and SPIP™ platforms (see *Surface Newsletter*, Fall 2018 edition), many new exclusive tools have become available. In particular "Correlation averaging" (for revealing details of the unit cell in patterns of self-assembled molecules), "Lateral calibration" and force spectroscopy tools will be of great

benefit to those working with data from scanning probe microscopy (SPM).

10. NEW ACTION BUTTONS

Add hyperlinks and buttons in your document to perform actions: open URLs, jump to next page etc. You can even add a button to show/hide any comments/explanations you need to share with others. That way, they can hide comments in just a click and re-use the same document as a model!

11. SMART PARAMETERS TABLES

Choosing the right filtering options and parameters to apply to your data just got simpler! All parameters tables can now be set to display form removal and filtration settings already applied. Warnings (with explanations) are also shown when an error is detected (i.e. filters applied twice) or when parameters are not suitable for the data to which they are calculated.

KEEPING MOUNTAINS® UPDATED



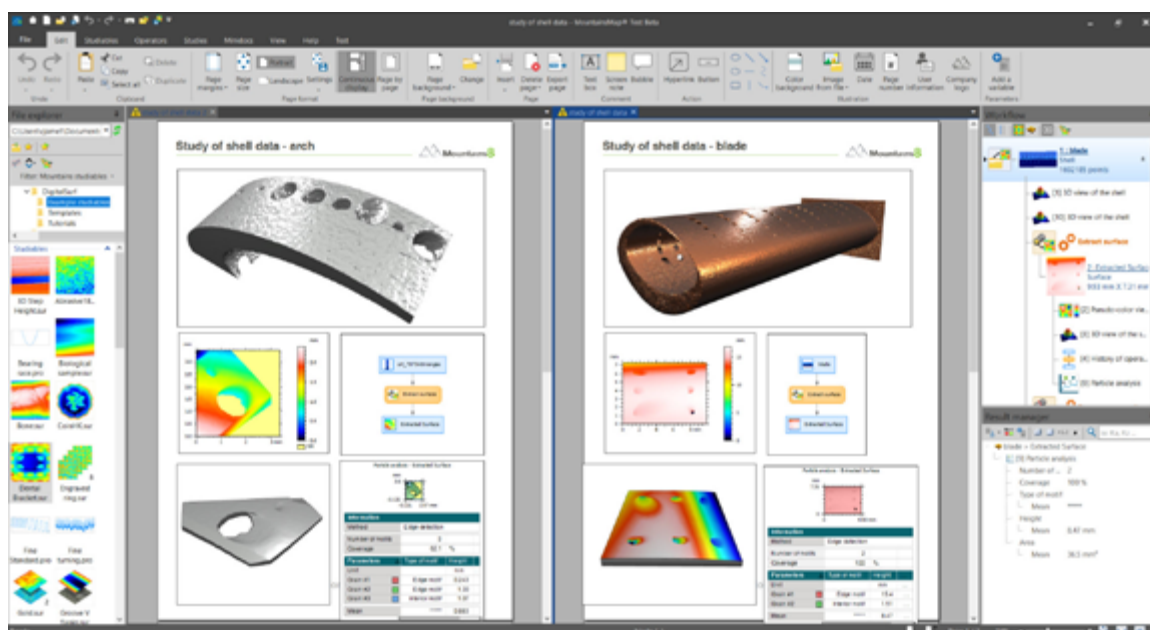
Keeping your Mountains® software up-to-date will ensure you have all the latest features and bug fixes as well as improving the overall security of your computer.

If you are using Mountains® 7 or an earlier version or SPIP™, please contact sales@digitalsurf.com to talk about an update.

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MOUNTAINSMAP® 8 PROFILOMETRY MADE PERFECT

With the release of version 8, the MountainsMap® product range refocuses on tools for analyzing data from 2D and 3D profilometers.* The software interface as well as many existing features have received a significant overhaul. More than ever before, this highly-specialized yet easy-to-use software is an indispensable asset for engineers, researchers and metrologists in a wide variety of sectors.



RENOWNED EXPERTISE IN SURFACE ANALYSIS

Digital Surf has 30 years experience developing surface imaging & metrology software for the global industrial and scientific communities. The company is an active member of the ISO working groups who establish surface texture standards. The majority of national metrology institutes (NIST in the USA, NPL in the UK, PTB in Germany, LNE in France and many others) trust the expertise and precision of Mountains®.

NO ONE KNOWS SURFACE METROLOGY LIKE MOUNTAINS®

Surface metrology is an ultra-precise science where nothing is left to chance. It is also a living, evolving subject. Using Mountains® ensures you have access to the very latest ISO and national standards (our COO contributes to defining them!)

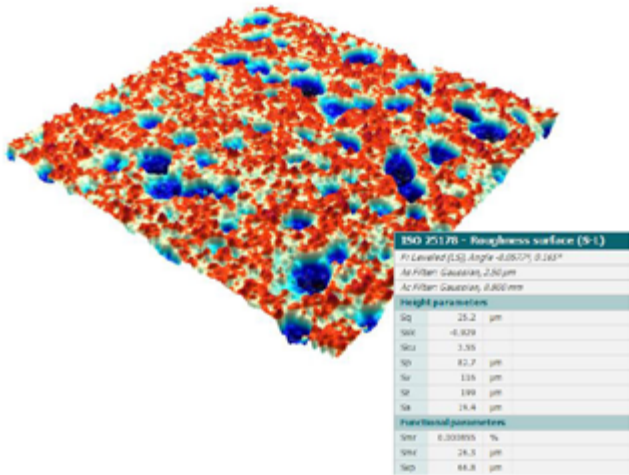
Thanks to a wealth of guides and other resources made available by Digital Surf, we aim to help users adopt relevant correction and calibration routines in order to get meaningful results from their data analysis. MountainsMap® includes processing tools for overcoming instrument restrictions (outliers, non-measured points and range limitations) thus guaranteeing you get the most out of your measured data.

ADVANCED TOOLS FOR ADVANCED APPLICATIONS

Go beyond the basics of surface texture analysis and unleash the full potential of your data.

With easy-to-use, interactive tools, carry out pore and particle analysis on structured surfaces, Fourier & wavelets analysis to study surface-process interactions or advanced contour analysis with comprehensive geometrical dimensioning and tolerancing tools.

*Similarly the MountainsSEM® product range serves the needs of Scanning Electron Microscope users and the MountainsSPIP® range those working with Scanning Probe Microscopy. MountainsLab® provides multi-instrument compatibility.



MountainsMap® also gives users access to industry-specific analysis methods, for example 2D parameters for automotive manufacturing.

TOTAL TRACEABILITY

Thanks to the MountainsMap® workflow, more powerful than ever in version 8, keeping track of analysis steps already applied to data has never been easier. Users can instantly revert back to any step in the process, edit or delete it. As a result, all dependent steps are automatically recalculated.

SOFTWARE TRUSTED BY THE MANUFACTURERS

The majority of leading instrument manufacturers integrate MountainsMap® with their instruments (look for the "Powered by Mountains®" label). Today, 15,000+ Mountains® software licenses are installed worldwide.



EASY PUBLISHING & REPORT CREATION

As you carry out analysis on your data using MountainsMap®, the different processes are organized in document layout. This makes it easy to save your work in PDF and Word formats and

thus share it with colleagues, students, clients etc. What's more, all parameters and results can be exported to Excel at the touch of a button.

CREATE SYNERGY BETWEEN INSTRUMENTS

Using the MountainsMap® colocalization feature, data from 3D optical profilers, AFM, SEM, fluorescence, Raman, IR or other microscopes, can be managed with the same software and overlaid, thus facilitating the correlative study of features.

AN INTERNATIONAL TEAM OF EXPERTS READY TO ASSIST

We believe it is our job to help our customers get the most out of MountainsMap®. Our technical support team answers your questions and offers professional advice on client applications.

To make life easier for our users, the MountainsMap® user interface is available in 11 languages, a printed reference guide is available and training and seminars can be organized on request.



SAVE TIME AND GAIN IN PRODUCTIVITY

Working with large quantities of data? No worries. MountainsMap® can easily process it! And no need to create complicated scripts. In just a few clicks, save any analysis sequence as a template and reapply to large batches.

New features in version 8 speed things up even more by allowing you to apply operators (tools) directly as you work in the document or in the workflow.

Sounds good? Ready to try for yourself?

=> See full features: digitalsurf.com/profilometry

=> Email sales@digitalsurf.com for a quote now!

“

DETECTING TOOTH ENAMEL EROSION WITH MOUNTAINS®



Surface metrology is a discipline embraced by more and more sectors of science than ever before. Researchers in tissue engineering & biophotonics at King's College London (UK) seeking to attain better understanding of tooth enamel erosion recently applied its methods to bring to light micro-scale surface changes over time.

Dental erosion (erosive tooth wear) is a widely recognized dental health problem. Most commonly caused by acidic foods and drinks, it involves the etching away of enamel from the tooth surface, giving the tooth a dull yellow appearance and resulting in tooth sensitivity and pain.

Petros Mylonas is part of a team of researchers at King's College London working on ways to improve understanding of dental erosion in order to find new, innovative solutions for clinicians dealing with the problem.

"The research we've been conducting utilizes two types of enamel samples: flat and unpolished," explains Petros. "Each sample was measured using a 3D profilometer then subjected to acid erosion. New measurements were performed after 5, 10 and 15 minutes."

"For the flat samples it was very simple to evaluate erosion by examining differences in step height over time as we have a flat datum either side of the eroded lesion. However, the results could not be considered clinically relevant because humans do not have artificially flat teeth! The use of unpolished natural enamel is therefore much more relevant.

That said, the problem we found was that the surface of unpolished enamel varies randomly and the topography of the erosion lesion itself also varies randomly. It seemed very difficult to define a zero height-value (or baseline) and so at first we thought we would be unable to use step height to determine erosion. Another problem was, for the measurement taken after 5 minutes, the evolution of erosion height was very small (sub-micrometer scale).

Despite these difficulties, with the help of the Mountains® support team, we were able to find a method based on surface metrology and

ISO standards, to achieve accurate step height comparison.

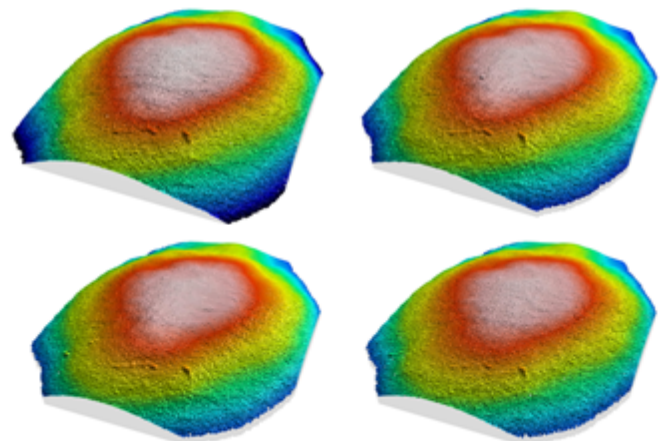
1. CORRECTING AND ALIGNING DATA USING THE SHIFT TOOL

The biggest challenge was to position the different surfaces exactly at the same level before subtracting their heights from that of the original sample.

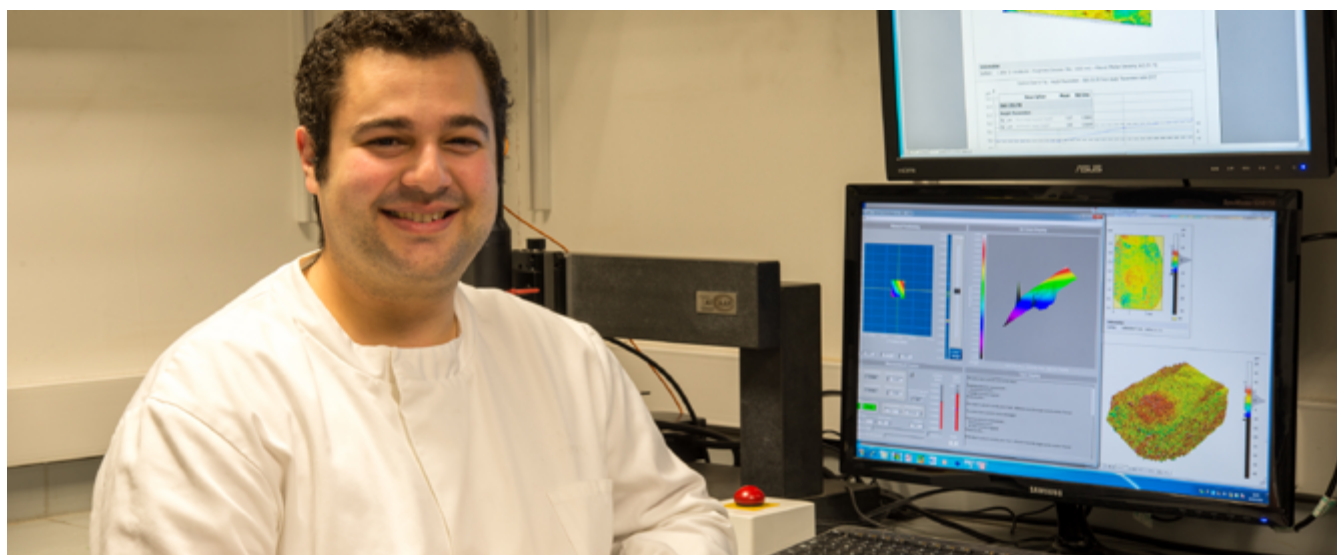
When we first observed our data using the "4D view" feature, it became clear that there was a slight shift between the measured surfaces. Using Mountains® we were able to align the surfaces at the same XY location.

Gaussian filtration (cut-off 0.8mm) according to ISO 16610 was applied in order to obtain surface roughness and better see the differences and position of the measured samples.

Then the Shift surface operator was used to correctly align surfaces on the XY plane. At this stage, there was no visible erosion when watching the 4D view series.



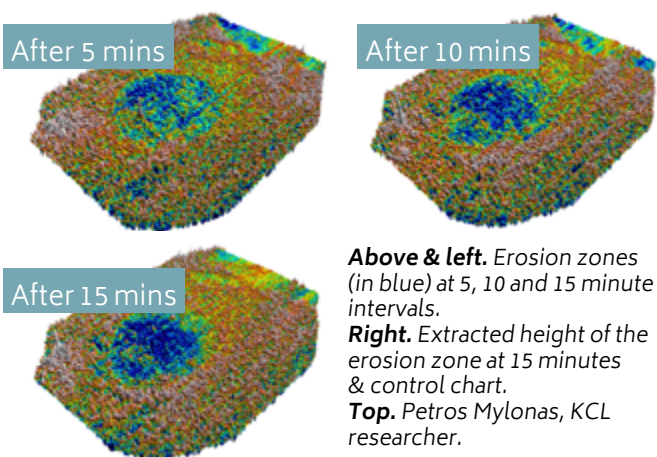
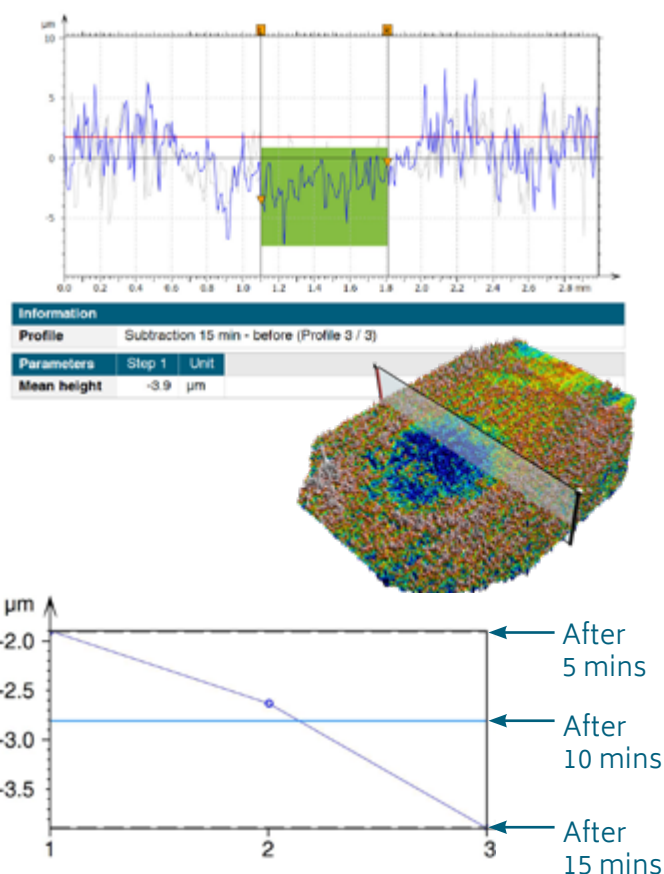
Above. The measured surfaces were correctly aligned with the Shift surface operator and ready for further analysis.



2. FROM 4D VIEW TO STEP HEIGHT HIGHLIGHTING CHANGE OVER TIME

From the shifted series, we extracted the surfaces in order to perform height subtraction from the original and thus detect erosion zones.

We applied leveling - at the same time excluding the eroded circular zone - and we were able to define the plane obtained as our Z-axis origin (or baseline).



The final step was to measure the difference of height between steps. Using the Step height study in Mountains® we were able to accurately visualize and quantify sub-micrometer height differences between measurements.

Please note: all series showing surface evolution with respect to time can be visualized in animated view in Mountains®. See animated examples: www.digitalsurf.com/stories/detecting-tooth-enamel-erosion



READ MORE

- **In vitro evaluation of the early erosive lesion in polished and natural human enamel.** P. Mylonas, RS. Austin, R. Moazzez, A. Joiner, DW. Bartlett. In: Dental Materials, Vol. 34, No. 9, 09.2018, p. 1391-1400. <https://doi.org/10.1016/j.dental.2018.06.018>
- **Detection Threshold of Non-Contacting Laser Profilometry and Influence of Thermal Variation on Characterisation of Early Surface Form and Textural Changes in Natural Human Enamel.** P. Mylonas, T. Bull, R. Moazzez, A. Joiner, & DW. Bartlett. In: Dental Materials, 1 Apr 2019 (Accepted/In press).

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WHAT IS A "SHELL" OR FREEFORM SURFACE?

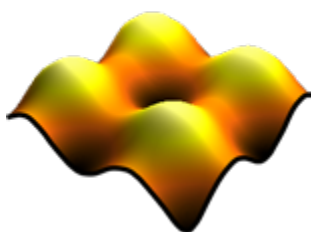


With the release of Mountains® 8 comes the possibility to load and visualize a new kind of data, known as "Shells" or "Freeform surfaces".

Christophe Mignot, Digital Surf CEO takes a closer look at this new data type and explains how it's different from standard surface data.

TO BEGIN WITH, WHAT IS A "STANDARD" SURFACE?

Nowadays, most surface texture and form analysis is based on what we call "surface topography". The type of data which corresponds to this is simply referred to as a "surface" in Mountains® software.



A surface is stored as data of type $z=f(x,y)$. The expression $z=f(x,y)$ just means that the height depends ("is a function of") the lateral position (x,y) .

Rule 1 : data is regularly spaced over X and Y directions.

Hence there is no need to store X and Y values. In fact, one could say that a surface is a kind of Excel table where the height is the content of the cells, rows and columns representing the X and Y coordinates. (Spacing between two successive rows and between two successive columns is constant and each is only stored once in the object header).

Rule 2 : There can only be ONE height for any given X,Y position.

This is fundamental. An "Excel cell" can be empty (we call it a "non-measured" point) but in no case can there be two or more values in the same cell.

Let's see the consequences by taking a concrete surface texture example. Suppose for instance, you want to study the average heights of the bumps of a pickle.

A standard "surface" will only let us characterize an extracted, relatively flat, portion of the pickle's external surface. As there can only be one Z height



value (or Excel cell) for a given X,Y horizontal position, this type of data cannot manage both the top and bottom side of the pickle. So using only standard "surface" data, it is impossible to calculate the average roughness of the common pickle!

This is also true for:

- ▶ **Vertical slopes.** As there is only one Z value for any given X,Y horizontal position, a vertical surface cannot be encoded. In order to be measured and studied, it must be rotated.
- ▶ **Overhangs.** Same problem. If there is an overhang, there is more than one Z value for some X,Y positions.
- ▶ **Deeply porous surfaces.** These contain many small overhangs. For instance sponges or agglomerated grains such as objects produced using additive manufacturing are not "standard surfaces".
- ▶ **Internal cavities** such as those visible using X-Ray tomography.

Using surfaces has of course brought great service to many over the years. Digital Surf has pioneered surface analysis since 1989, offering topography analysis at a moment when the industry was only using profiles, i.e. height along a single line segment $z=f(x)$, (equivalent of a single row in Excel).

"Surfaces" are sufficient for many applications, and remain a core part of Mountains® software. However, it is time to go a step further. Among other new types of studiable, Mountains® 8 introduces freeform surfaces or "shells".

SO WHAT IS A "SHELL" AND WHY IS IT DIFFERENT?

In order to be able to describe the whole surface around (or even inside) objects, mathematicians usually describe the surface as a long list of small

triangles (known as «facets»). Each triangle is defined by three summits. Contrary to standard surfaces, there is no grid and no natural order. Two facets are neighbors when they share two summits, end of story.

Mountains® 8 can now manage these “freeform surfaces”. This name is meaningful but quite long and so to fit nicely in Mountains®, we found a shorter one. We simply call our freeform surfaces, “shells”. Check out this image of a peanut shell and you will understand why.

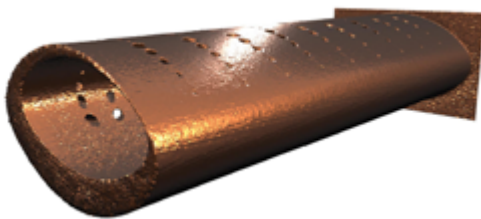


We chose the peanut shell as the new icon for the “shell” studiable in Mountains®. It is reminiscent of the existing icon for surfaces, but clearly express the new ability to go all the way around the object.

WHAT CAN I DO WITH SHELL DATA IN MOUNTAINS® 8?

Implementation of the new “Shell” data type implies the “basic” services (as for all studiabls):

- **Load** main types of file formats for freeform surfaces (.STL, .OBJ, .PLY)
- **View data**
- **3D-Print:** Mountains® 7 is already able to 3D-print standard surfaces; the feature is now extended to shells. The main application for this is producing accurate centimetric/inch-scale objects that can be manipulated from data at the sub-millimeter scale. This is of obvious educational and scientific interest.



Above. 3D view of shell studiable in Mountains® 8. **Right.** Extracted surface and parametric profile (contour), ready for further analysis.

Since Mountains® software is already expert in standard surface analysis, we also decided to develop a way of obtaining surfaces and profiles from shells, so that users could benefit from already existing tools.

A small zone of the surface of a shell can be extracted and analyzed the same way as standard topography. A cross section can be extracted from a shell and analyzed just like a standard contour (parametric profile allowing loops).

WHAT ARE THE MAIN APPLICATIONS OF SHELL DATA?

In Mountains® 8 users can open data produced by profilers with multiple scanning axes which produce complex shapes (gears etc.)

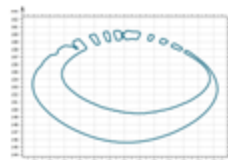
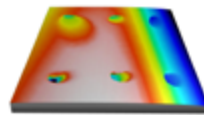
They can input (external and internal) shapes and textures of objects produced by additive manufacturing and scanned using X-ray tomography.

It is also possible to view and manipulate such objects as you please, and extract any external or internal face or cross-section at any angle. The extracted data can then be analyzed using Mountains® numerous surface and contour analysis tools for dimensional control and surface texture analysis.

WHAT'S NEXT FOR SHELLS?

Ultimately, our goal is to be able to offer surface texture parameters for shells. Remember the pickle? This would correspond to an R_q value calculated all around the pickle that would assess the global average roughness of the pickle surface (as opposed to extracting a surface first in order to calculate standard surface roughness parameters).

However, today there is no standard for such parameters. Along with other members of the scientific community, we are still at work on the subject. So at this time there are no “Parameters for shells” in Mountains®... but stay tuned!



RESOURCES

- Scott, P. J., & Jiang, X. (2014). **Freeform surface characterisation: Theory and practice.** *Journal of Physics: Conference Series*, 483(1), [012005]. <https://doi.org/10.1088/1742-6596/483/1/012005>
- Leach, R., De Groot, P. & Haitjema, H. (2018). **Challenges of high slopes and complex features in the metrology of structured and freeform surfaces.** Conference paper (Euspen Structured & Freeform Surfaces).
- Surface Metrology Guide: www.digitalsurf.com/guide





EVENTS & PRODUCT HIGHLIGHTS

A LOOK BACK AT ANOTHER BUSY SHOW SEASON

The 2018 MRS Fall Meeting & Exhibit took place November 27 to 29 in Boston, MA, USA. This new edition registered over 6,600 attendees from 60 countries and was the opportunity to have a look at the future of materials science.

This edition was a special one for Digital Surf and its Danish subsidiary Image Metrology as the two companies were exhibiting on the same booth for the first time.



Digital Surf and Image Metrology exhibited together at MRS 2018

Arnaud, François P., Jan and Nicolas, sales team members from both companies, were on hand to present the new MountainsSPIP® 8, the next generation of SPM image analysis software resulting from months of hard work by our development teams.

Digital Surf was also thrilled to participate at the NanoTech Exhibition & Conference, the world's largest event for nanotechnologies, held late January in Tokyo, Japan. Damien and Arnaud were present on the EU-Japan Centre for Industrial Cooperation booth to give live demos of Mountains® software and version 8 new features.

A little closer to home, Digital Surf exhibited at the DPG Spring meeting of the Condensed Matter Section that was held this year at the University of Regensburg, Germany from April 2 to 4. With a wide conference program and more than 100 companies presenting their products during the exhibition, this event is the largest scientific physics conference event held in Europe, with the tradition of always being held at universities.

Arnaud and Nicolas were pleased to meet the European scanning probe microscopy community and provide visitors with a demo of MountainsSPIP® 8 features.

PRODUCT NEWS

BE THE FIRST TO TRY MOUNTAINS® 8!

With the release date of Mountains® 8 set for early June, our development teams are currently hard at work bringing the finishing touches to the new version.

If you'd like to be one of the first users to try out the new version, make sure you visit our website and sign-up to be notified as soon as the release happens.

Please visit www.digitalsurf.com, leave us your details and we'll be in touch!



WHAT'S HOT ONLINE



SEEN ON FACEBOOK

Feb 7, 2019: The ISO Technical Committee 213 Working Group 16 meeting on areal and profile surface texture took place at CERN in Geneva, Switzerland.

Digital Surf was proud to sponsor this event during which the company was represented by our surface metrology expert François Blateyron.

bit.ly/2D1J7PW



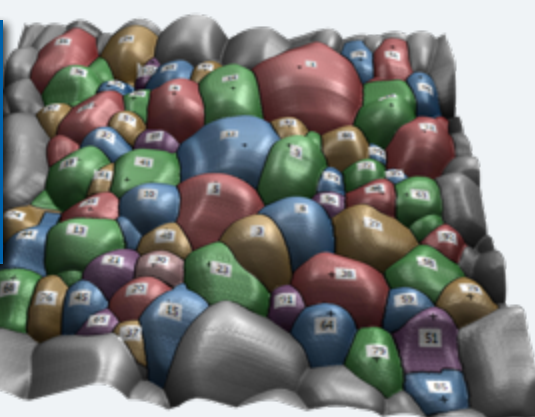
Have you visited our YouTube channel recently?



Check out new Mountains® 8 features such as Particle Analysis.

We'll be posting more videos as the June release approaches!

<https://youtu.be/ODU69uqNQHk>



POPULAR ON LINKEDIN

Feb 26, 2019: In the February issue of the Materials World Magazine published by The Institute of Materials, Minerals and Mining (IOM3) Isabelle Cauwet, Applications Engineer at Digital Surf, writes on the benefits of using specialized software to analyze data from scanning probe microscopy.

Read the article: bit.ly/2uQhMM0



Surface Newsletter

Know a friend or colleague who would be interested in receiving the *Surface Newsletter*?

Let us know:

contact@digitalsurf.com

The newsletter is available for download on our website

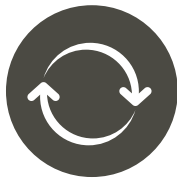
www.digitalsurf.com

Useful LINKS



TRY MOUNTAINS® 8

Sign-up to be amongst the first to take Mountains® 8 for a test drive. Visit www.digitalsurf.com (release scheduled for early June).



CONTACT US FOR AN UPDATE

Contact sales@digitalsurf.com for information about updating Mountains® 7 or earlier versions to the latest Mountains® 8



WATCH A MOUNTAINS® TUTORIAL

Get the most out of Mountains® software by watching one of our tutorial videos www.digitalsurf.com/tutorials



LEARN SURFACE METROLOGY

Dive into our free online surface metrology guide and learn about characterizing surface texture in 2D and 3D www.digitalsurf.com/guide



MEET DIGITAL SURF

Control - stand #3408

May 7-10, 2019 - Landesmesse Stuttgart, Germany

E-MRS Spring Meeting - stand #14

May 28-30, 2019 - Acropolis Congress Center, Nice, France

Met & Props - July 3-5, 2019

Lyon Marriott Hotel Cité, France



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Surface Newsletter, April 2019

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Huddersfield, UK

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