SD Mechatronik
Dental research equipment

Laser Abrasion Measurement System

LAS-20

APPLICATION NOTE

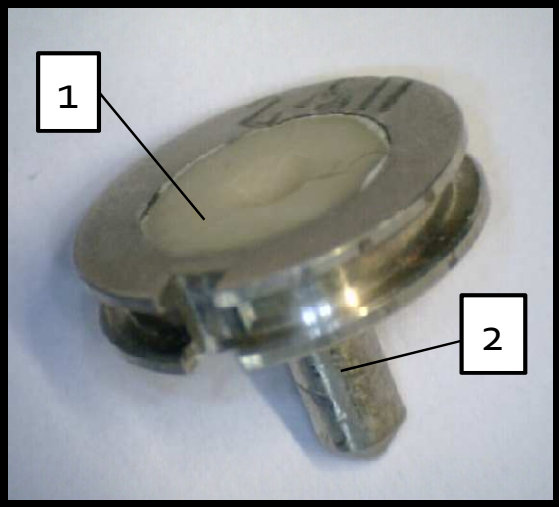
210313-001

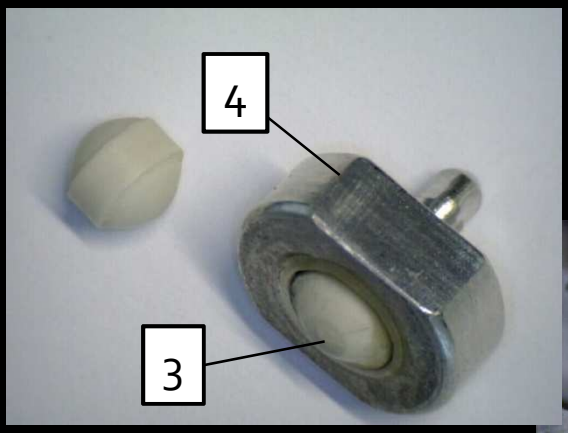
ABRASION VOLUME ON A COMPOSITE SURFACE

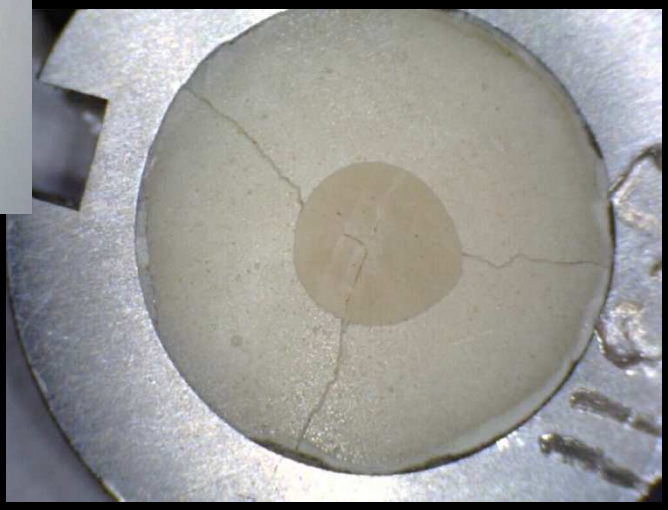
In this application note, the abrasion volume on a composite surface is measured with the LAS-20 abrasion measurement system.

In chewing simulation, composite material [1] is embedded into small holders [2]. A steatite ball [3] is acting as an antagonist. These balls can also be embedded into special holders [4] using Technovit or PMMA. After 1.2 Mio. cycles, the sample is removed from the chewing simulator and inspected with the Laserscanner.

A significiant loss of material can be seen on the surface. To compare different materials we need to know the maximum abrasion depth and the volume loss.







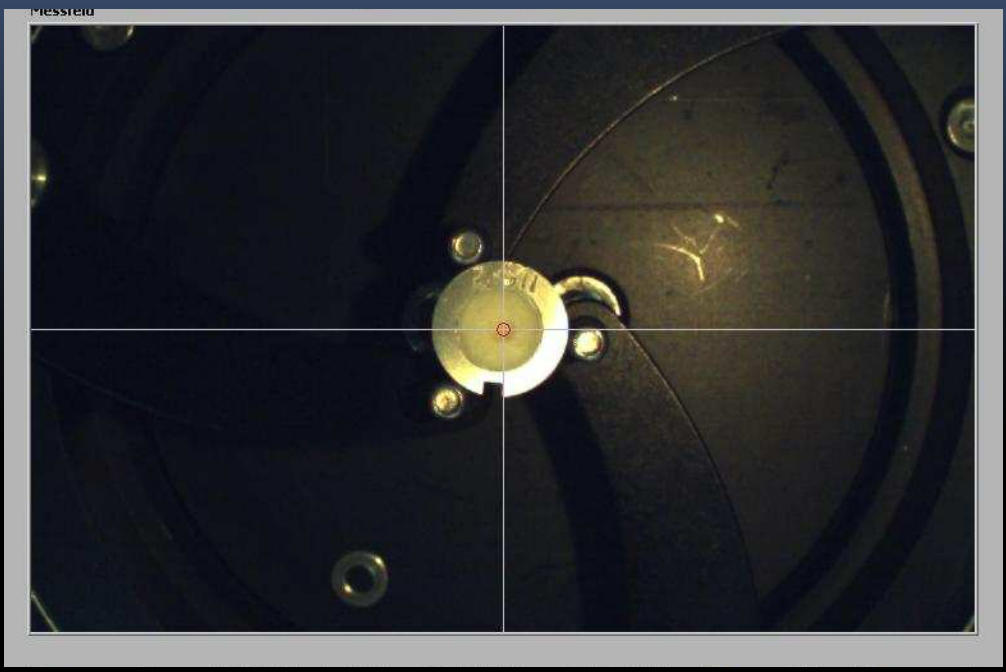
With the LAS-20 measurement system, nearly all material and surfaces can be scanned directly without any treatment or creating a stone replica. This improves accuracy and saves time for preparation.
We will follow these steps to get the result:

- Mounting the sample into the Laserscanner
- Defining the field of measurement on the surface
- Setting sensing parameters and scan the sample
- Analyzing the result with Geomagic

The overall time to perform these steps is approximately 15 minutes.

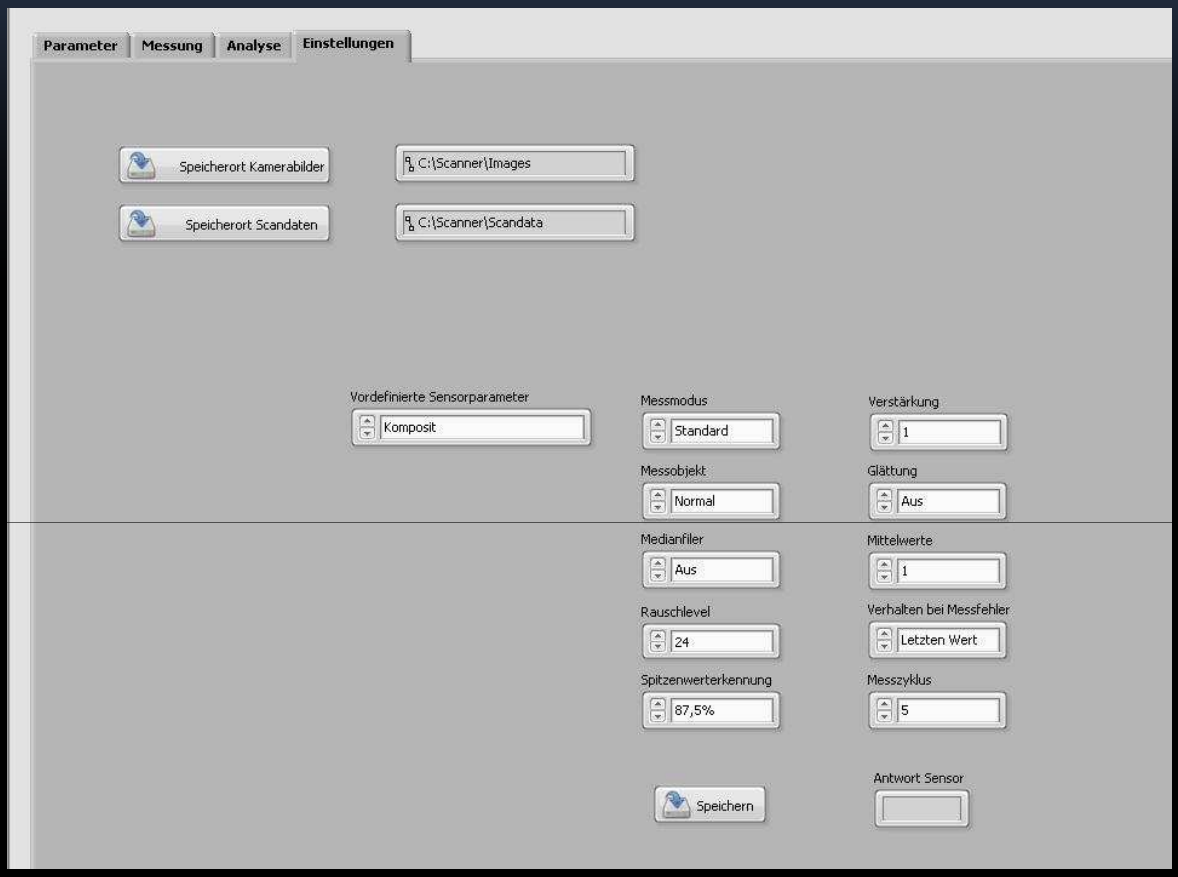
Mounting the sample is easy, quick and exact enough even for serial examination of samples of the same type. The spring-loaded mechanism keeps various samples in place during scanning.

Once the sample is attached in the fixture, the surface can be seen on the screen to define the field of measurement.



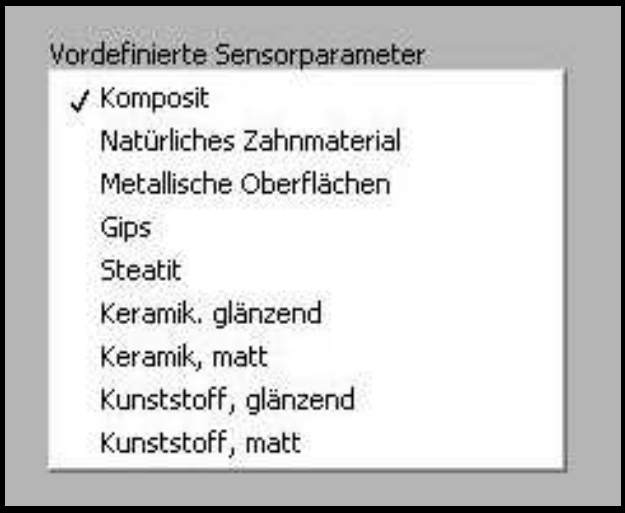
The field of measurement is defined by setting the top-left and bottom-right point of a rectangle. This rectangle is diveded into several hundred lines. The number of lines depends on the size of the rectangle and the selected resolution. Each line consists of many data points.
Typical resolution is 0.01mm for composite material. This means the distance between 2 data points is 0.01mm. This is also the distance between the lines.
The resolution can be set by the user in a wide range. Beginning with 0.001mm for small fields of measurement up to 0.1mm for larger objects like jaw models every application is covered.

In the next step, the sensing parameters should be adjusted to the material. We have pre-defined 9 different typed of material you can choose. This eliminated the need to find the optimum parameters by yourself. Of course, it is possible to define and save your own parameter sets.

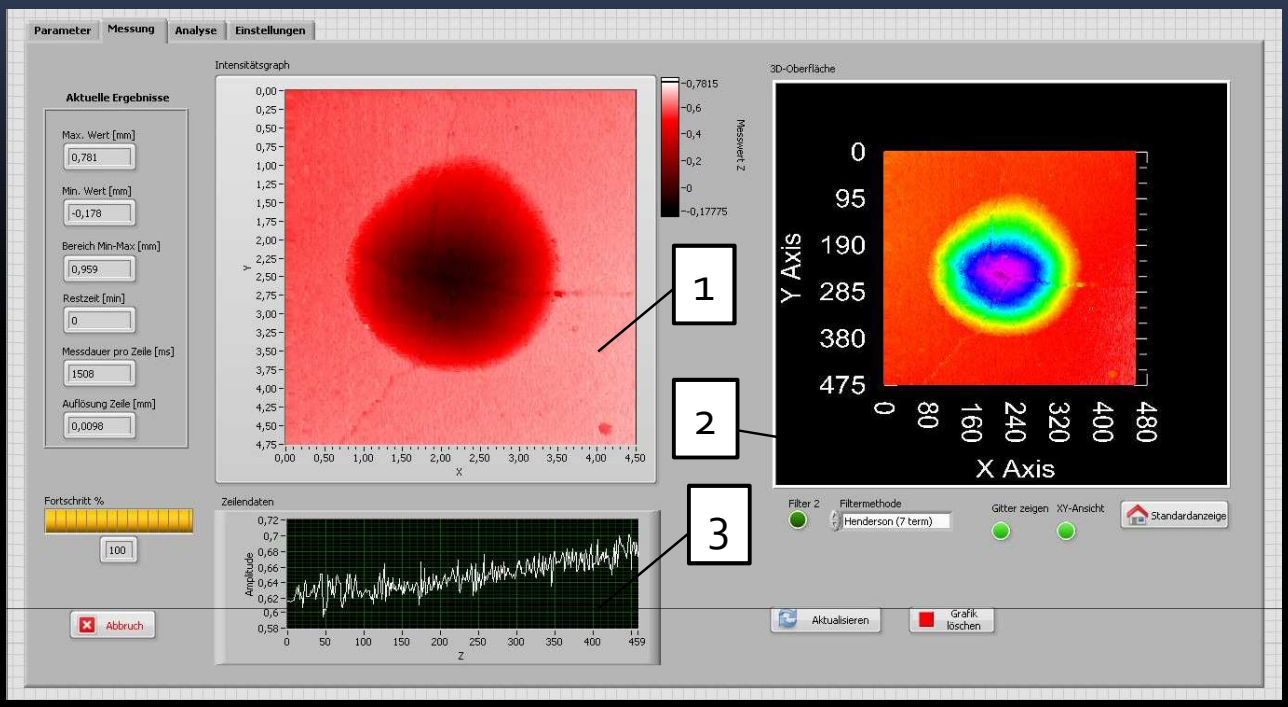


We have pre-definitions for these materials:

- Composite
- Natural teeth
- Metal surface
- Dental stone
- Steatite
- Ceramics, glazed
- Ceramics, matt
- Plastics, shiny
- Plastics, matt



Now we are able to scan the sample. While scanning, you will see the image grow line by line. You are informed about the remaining time and you also get imformation about the maximum and minimum values which are aquired.

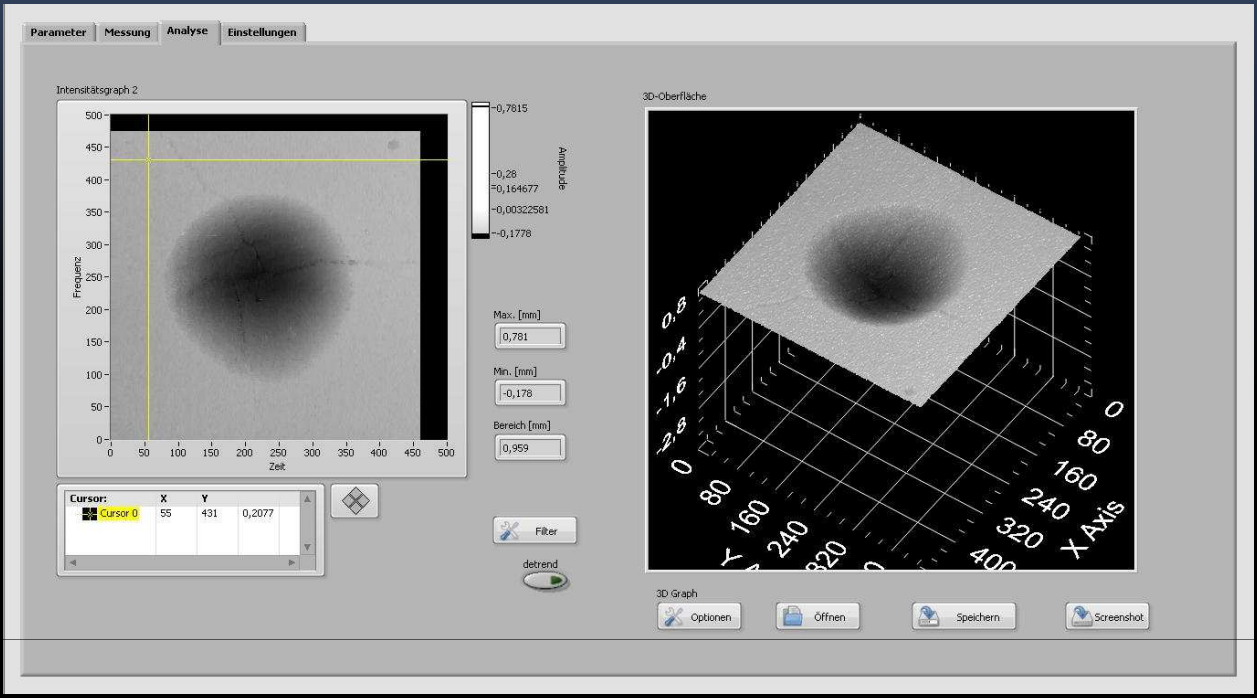


On the screen, you see 3 graphical displays:

- Intensity chart [1]
- 3D Display [2]
- Single line data [3]

The intensity chart shows a detailed image of the surface. The X and Y axis represent the dimension of the measurement field, the measured value (Z-axis) is represented by a color.
The image in the 3D Display can be moved and rotated with the mouse. The surface is usually drawn with a color spectrogram.
The single line data is the cross-section of the sample at the measured line. Here you can see how many data points are sampled per line.

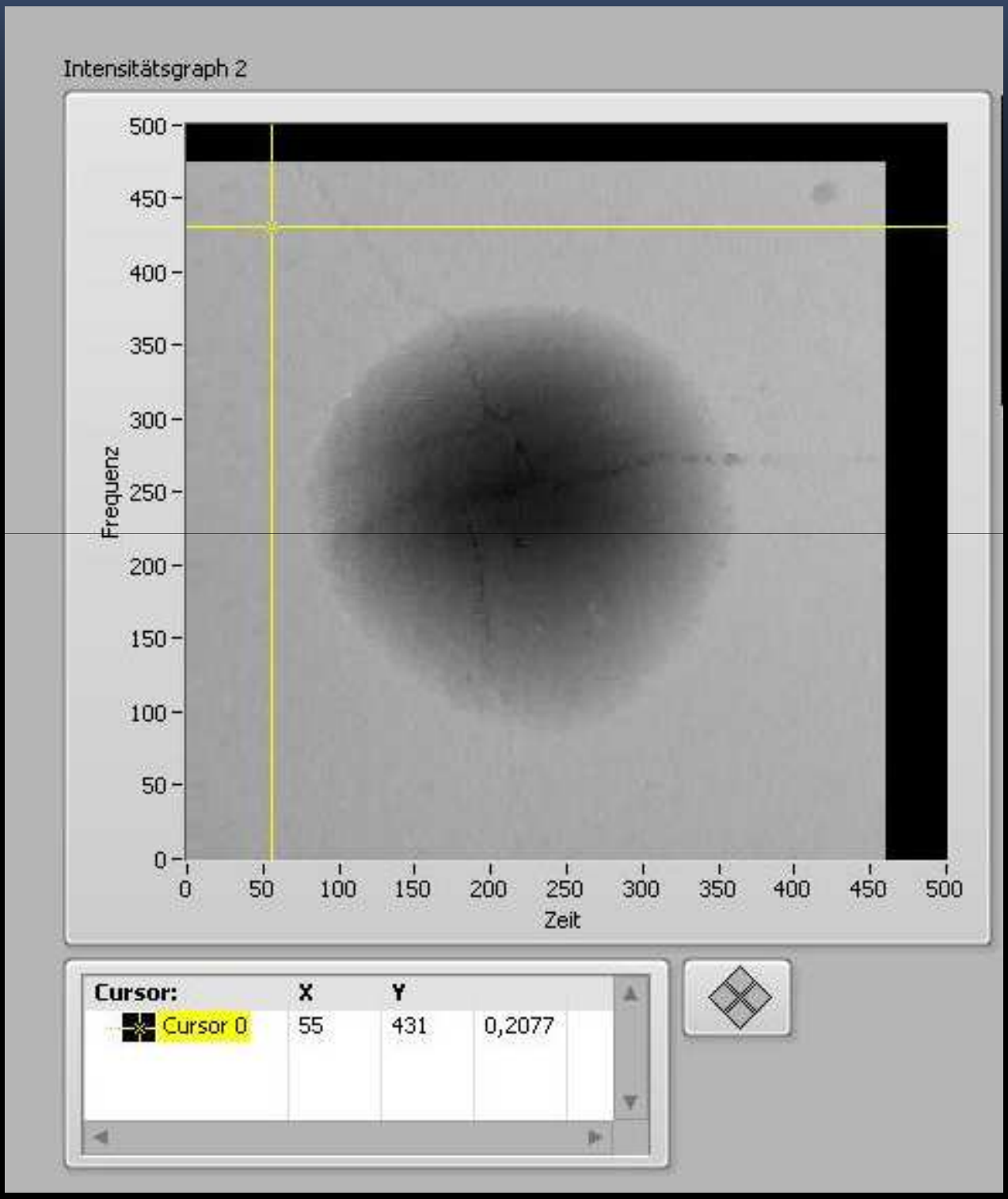
The scanned data will be saved automatically to a file. You can open and view these files at any time with the build in analysis tool.



Here you have some basic analysis functions:

- Maximum value
- Minimum value
- Range between Min-Max
- Selecting different filter functions
- Cursor to read X/Y/Z vallues of specific points in the graph
- Save data to Excel
- Screenshot

This is a detail view of the scanned surface. The cracks in the material are approx. 0.04mm in width.



Using *Geomagic Qualify* for analysis

Now we can start detailed analysis with *Geomagic Qualify*.

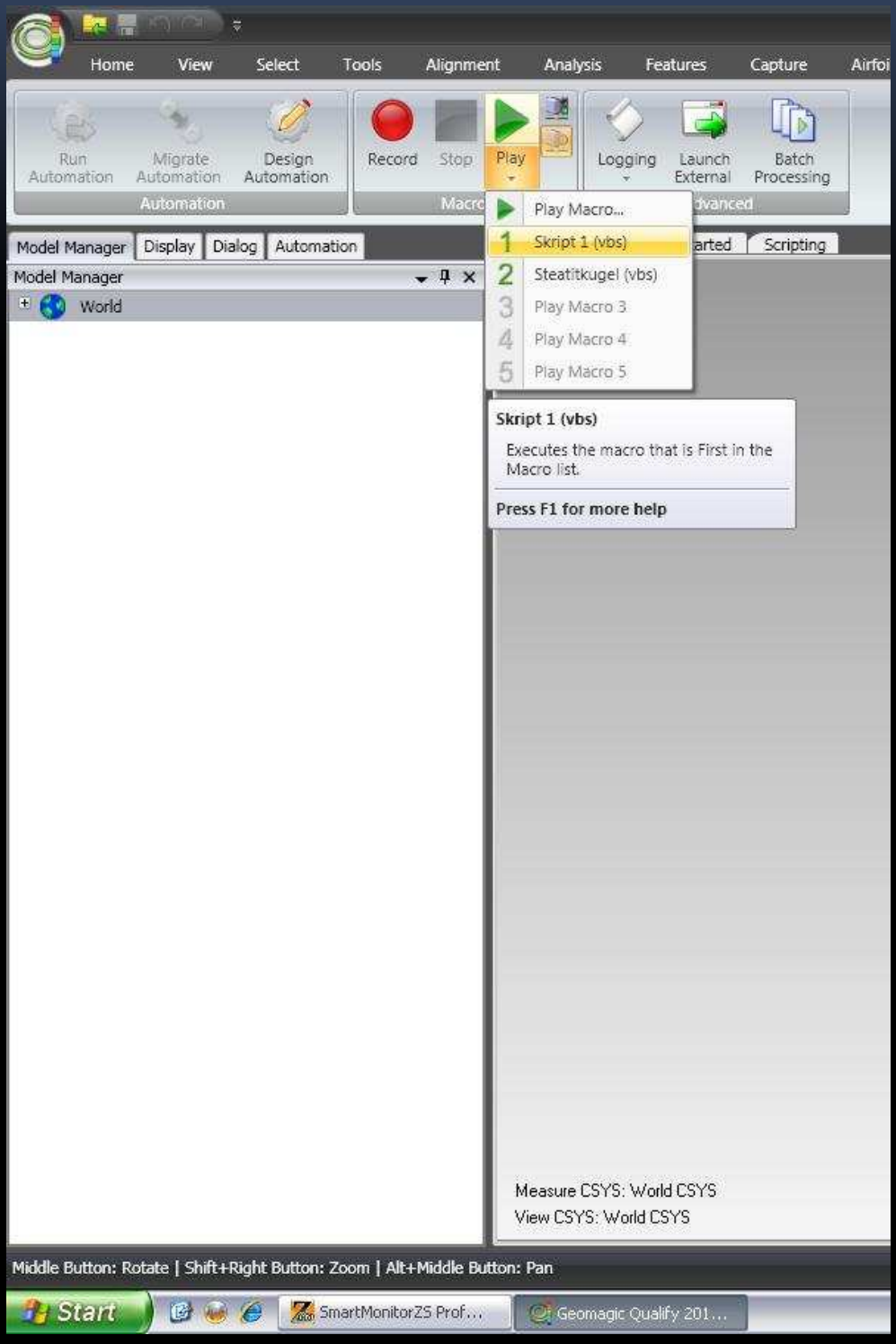
With Geomagic we are able to perform many operations related to point-clouds, surfaces and 3D objects:

- Rendering of point-clouds to surfaces
- Various measurements like distance, volume, curvature
- Saving data to many CAD-readable file formats (STEP,STL)
- Perform before and after comparison
- We have included skipts for convenient import of scanned data. With these scripts, many steps are automatically performed and no user action is required.
- A standard script imcludes:
  - Import of point-cloud
  - Wrap the points to a surface
  - Remove noise
  - Median filtering to eliminate single peaks

Our aim is to calculate the volume loss on the composite surface. To achieve this, you should follow these steps:

- Import data using a script
- Adding a reference plane on the surface of the sample
- Calculating the volume below the plane
- Create a report

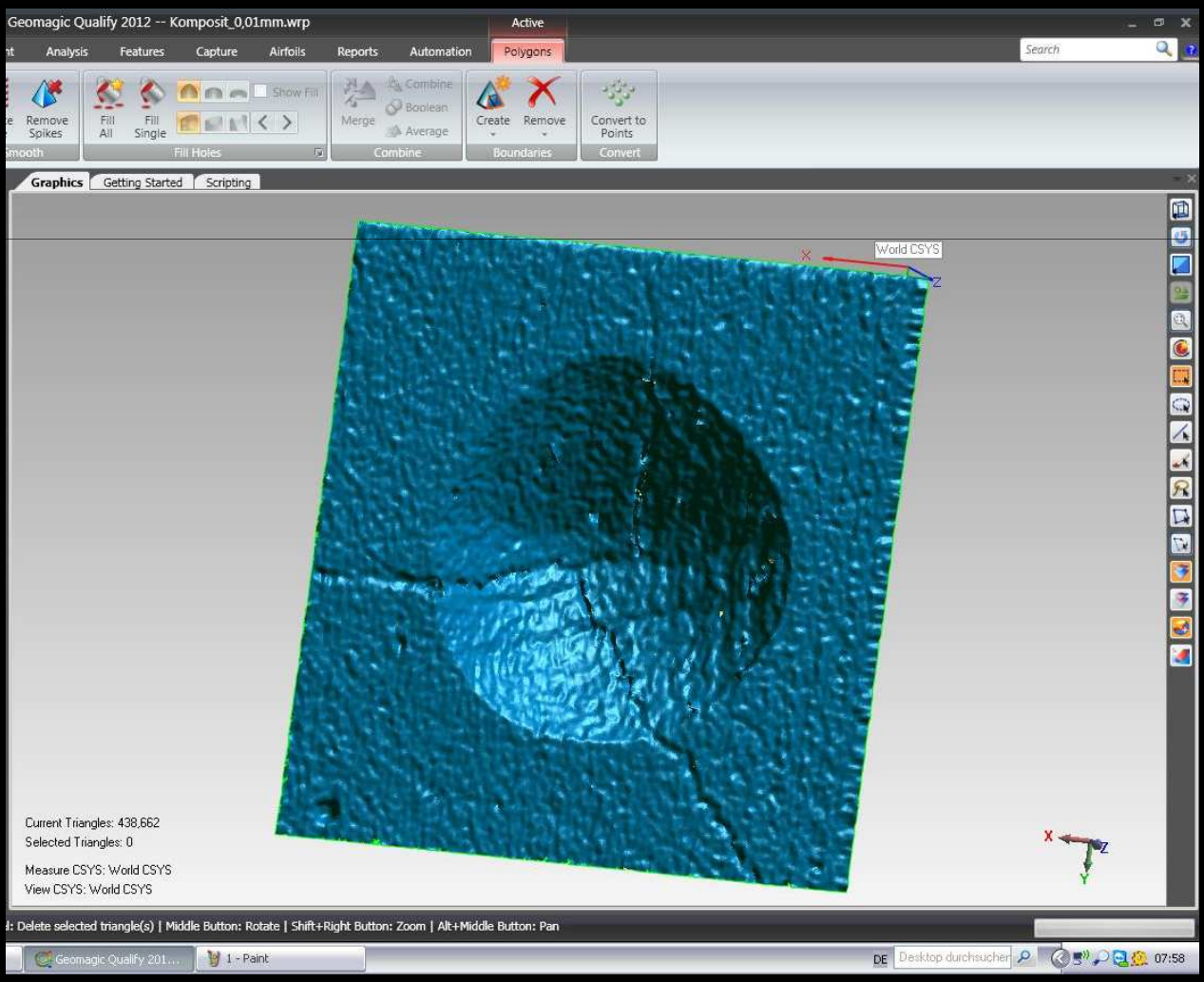
In a first step, we open the predefined script to import the point-cloud.



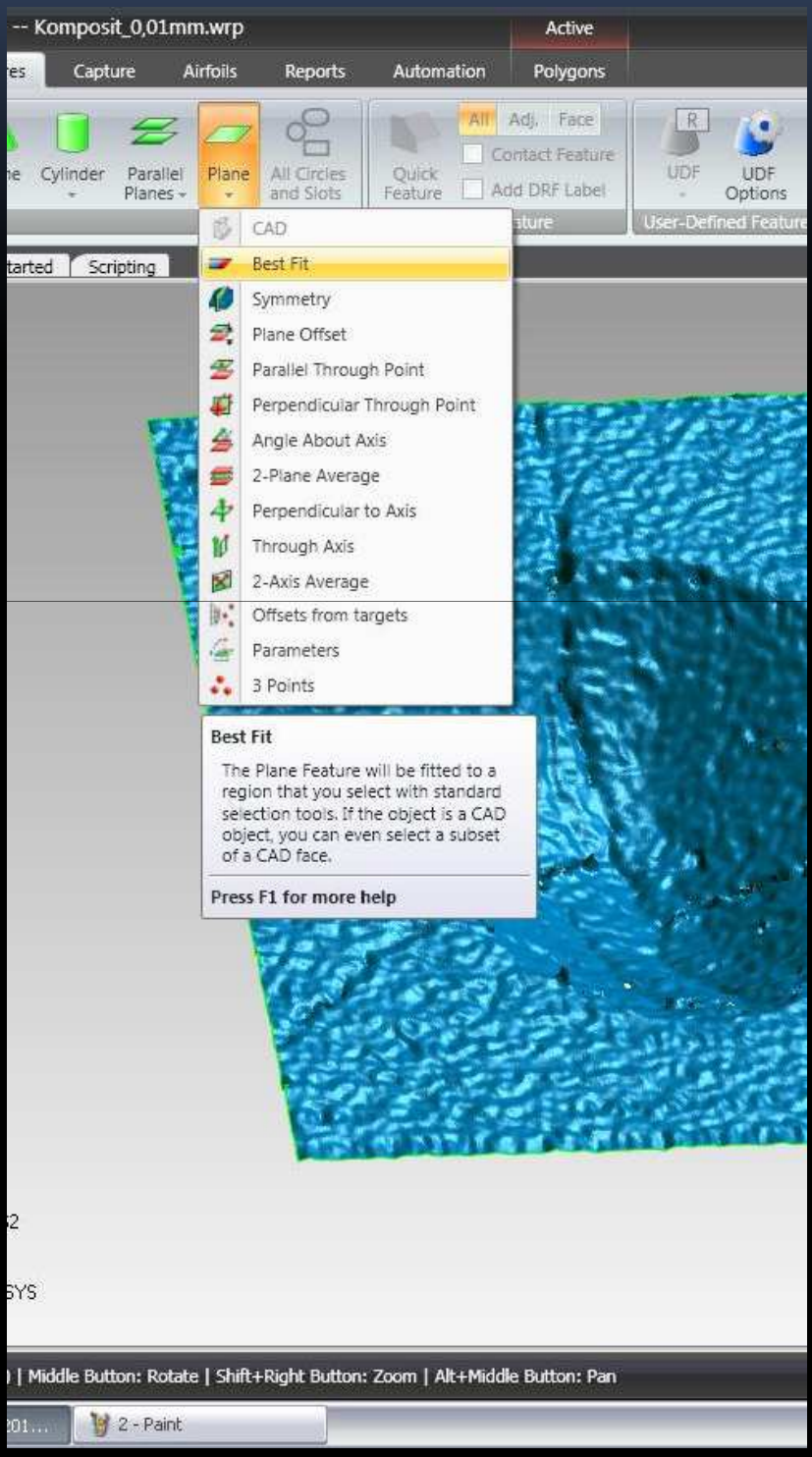
These steps run automatically when opening the script:

- Import point-cloud from the Scanner directory
- Remove noise
- Remove spikes
- Fill holes if needed

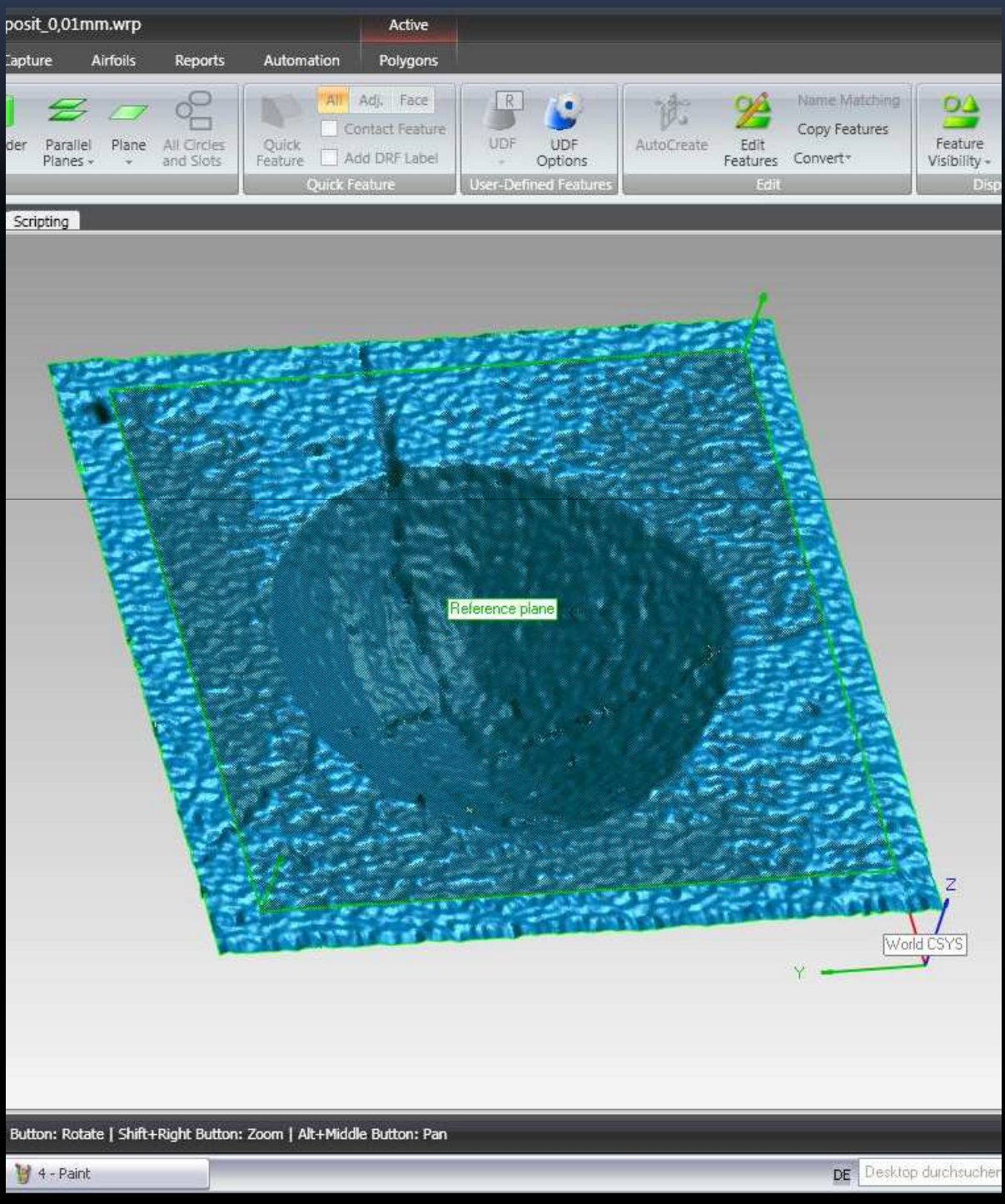
The result can be seen in the display window.



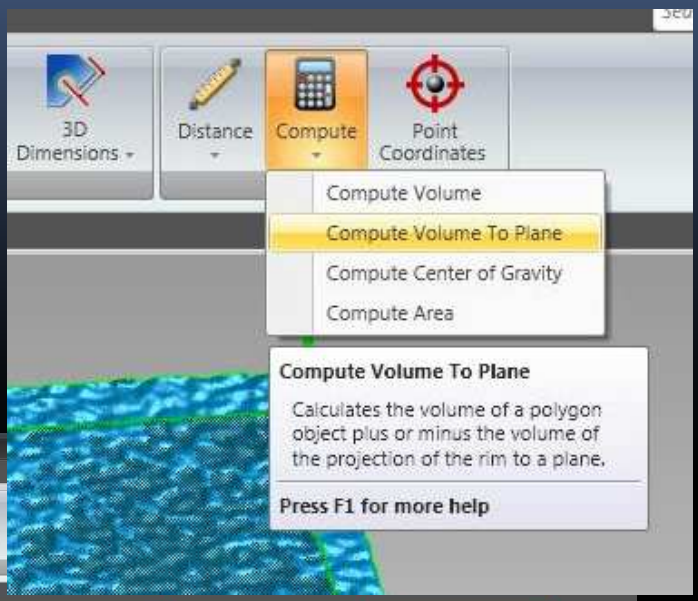
In the next step, we have to define a reference plane. We create this Plane parallel to the surface of the sample. We can use the *best fit* function which provides a mechanism automatic positioning of this plane.

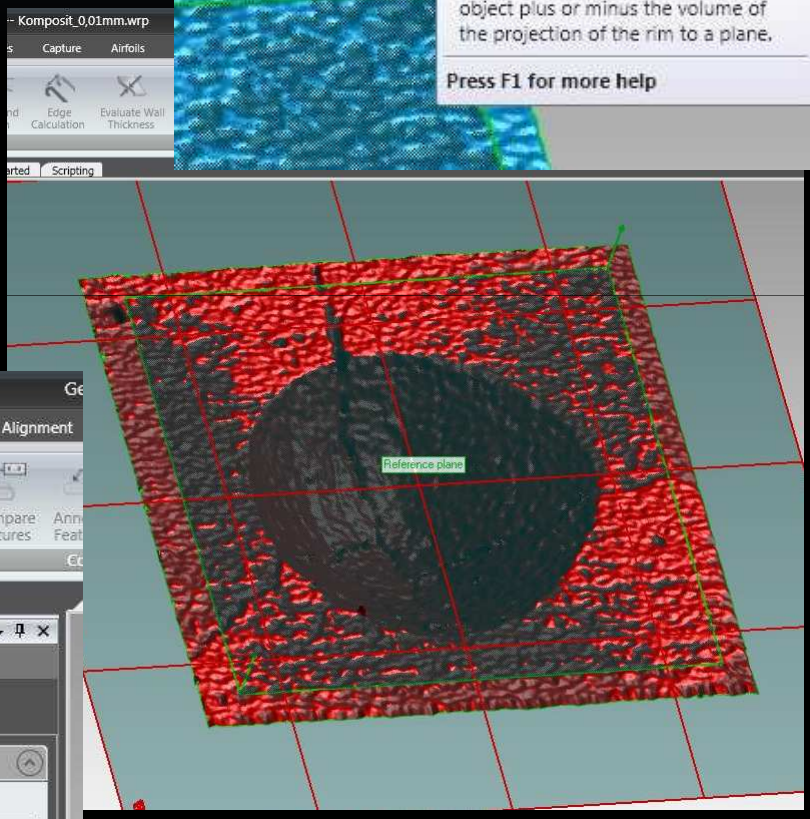


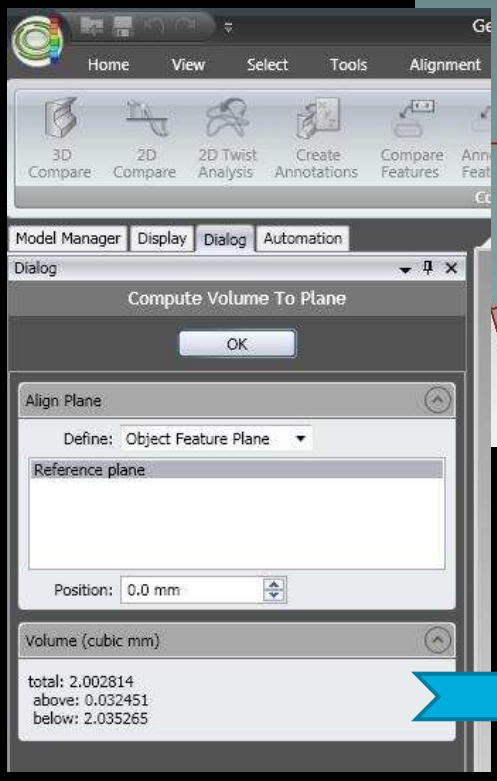
The new reference plane is positioned on the surface of the sample. Only very few peaks are above the plane. It is parallel to the surface.

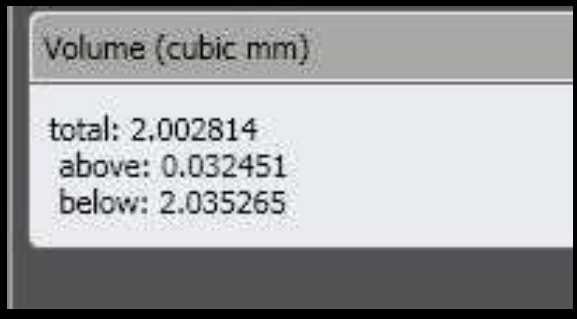


We choose now Analysis->Measure->Compute Volume to Plane and see the result.









It is also possible to perform a 3D comparison between the scanned data and the reference plane. The result is a color shaded image where the colors represent the deviation between the two 3D elements. This can be saved as a 3D-PDF report. You can download this report and additional files from our website.

3D comparison Report
www.cs-4.de/AN_210313_001/report.pdf

3D PDF of scanned composite sample
www.cs-4.de/AN_210313_001/Komposit_001mm.pdf

Tips on settings in Adobe Acrobat to view 3D PDF files
www.cs-4.de/AN_210313_001/3D_PDF_Settings.pdf

You are welcome to contact us with any questions.

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