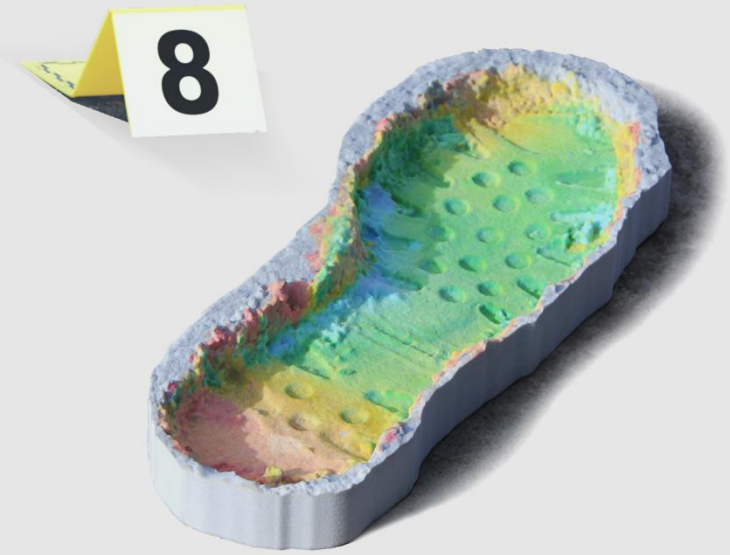
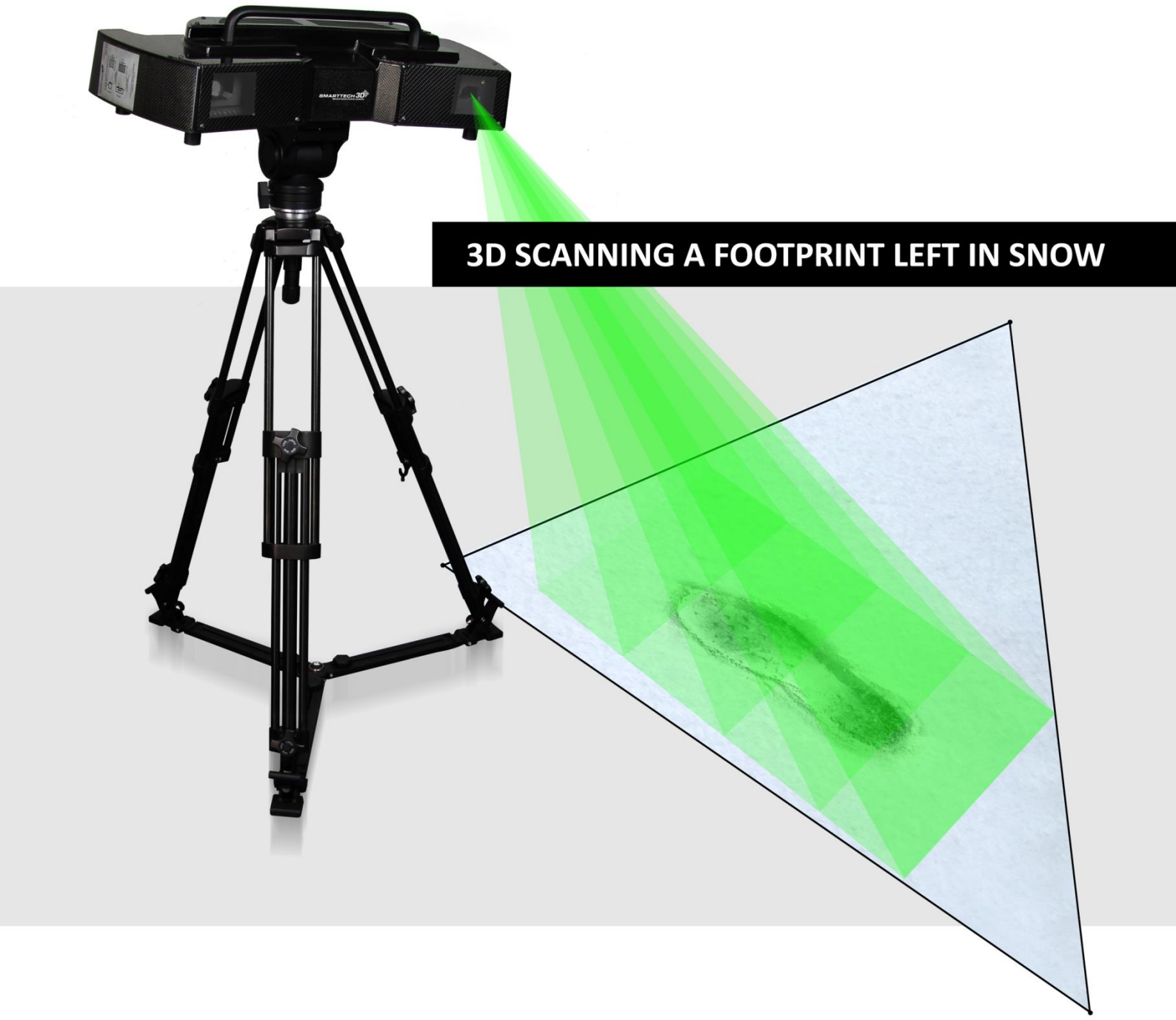
THE USE OF NEW SMARTTECH 3D SCANNING TECHNOLOGY IN FORENSICS

The traditional form of footwear impression recovery that is popular in police investigations allows you to create a cast of the impression that can be later used for closer examination.

The substances used in the collection of the evidence are usually liquid silicone or plaster. The evidence recovery can be vastly improved through the use of a SMARTTECH 3D scanner.



CASE STUDY

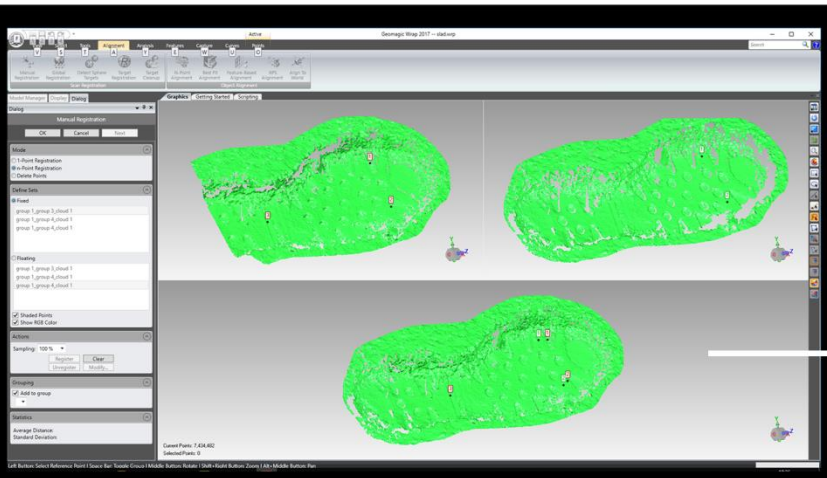


Maximum caution must be exercised when securing evidence. Obtaining a precise cast of the foot impression left in snow while using a traditional method requires the use of melted sulphur. Once poured into the snow impression it will rapidly cool and crystallise creating a cast, which can, however, damage the shape of the impression in the process. Another possible option of securing evidence is taking a photograph. While the first method carries the risk of altering the characteristics of the impression the second doesn't allow us to acquire all the important information such as the precise depth or angles. And that is why the help of new technologies is really useful – the use of a 3D scanner allows you to archive the impression along with all of its unique characteristics, which is usually difficult or impossible using traditional methods.

The company SMARTTECH decided to verify the accuracy of the process and the quality of the CAD model of the footprint acquired in this way. A scanner used for this purpose was the MICRON3D green 10 Mpix with a measuring volume 300 x 400 x 300 mm and 0,041 mm accuracy. It means that using a single scan we can scan a surface of 30 x 40 cm and depth of 30 cm. It is worth noting that the MICRON3D green uses green LED light that is up to 30% more accurate compared to older methods of measurement using the white light.

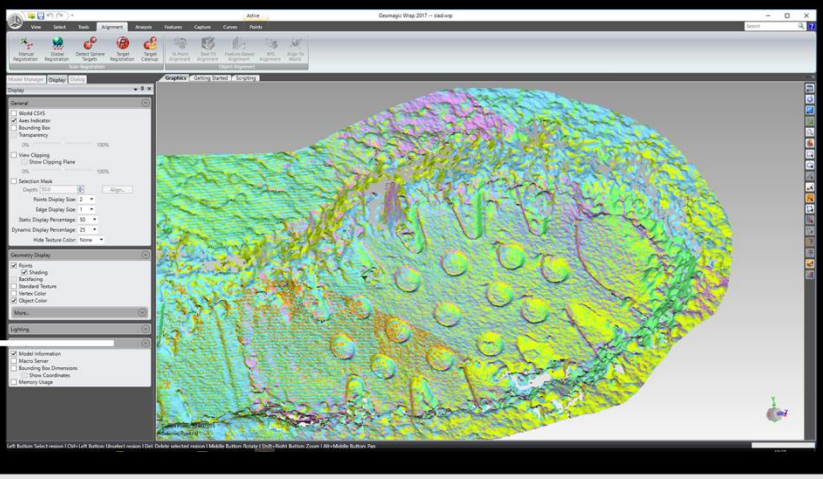
The study was conducted in January at a **temperature of -3°C**. At first, the footprint left in snow was covered with a thin layer of dry powder thus preventing reflections and allowing the optical measuring device to function properly. One of the challenges in footprint scanning is the fragility of the object. There is no physical possibility of moving a patch of snow without damaging the foot impression and that is why single measurements were used during the footprint recovery process. There were six measurements performed overall and they covered the entire imprint. In order to obtain a comprehensive 3D model of the impression the single scans that were performed from different directions were then aligned using the **3-point method.**

The user applying this method selects three common points for every two single scans that he wants to align and thus merging them into one. The 3D scanner also has alternative measurement options using automated alignment based on a rotary stage or positioning markers.



PRELIMINARY SCAN ALIGNMENT USING THE 3-POINT METHOD

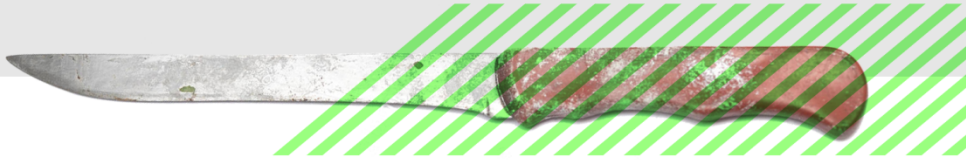
THE SCANS AFTER ALIGNMENT ARE VERY DETAILED



During the scanning process the measuring head projects a pattern of light on the object and, using a detector, analyses the deformation of the pattern once the light is displayed on the object. That change in the shape of the pattern is the information about the object's geometry. That data is supplied to the software, **SMARTECH3Dmeasure v2017**, which converts it to a cloud of points that can contain up to 10 million points with x, y, z coordinates.

This gives you the opportunity for an incredibly detailed reproduction of the foot impression in the 3D model form allowing you to do a comparative analysis with footwear outsole database or direct evidence acquired from a suspect.

SCANNING PROCESS



The scanner MICRON3D green was designed to work in difficult environment. The reliable housing of the scanner is made of carbon fiber, which guarantees stable and high quality measurements regardless of temperatures changes. The housing is also able to mitigate vibrations thanks to the use of the internal shock absorber system. The protection of the delicate interiors is provided by a filter, which does not allow even the smallest of particles to get inside. The professional factory calibration of the MICRON3D green is certified by a man facturer in accordance with the German VDI/VDE 2634 standard. The measurement accuracy can also be confirmed with a certificate by an independent certified measurement laboratory.

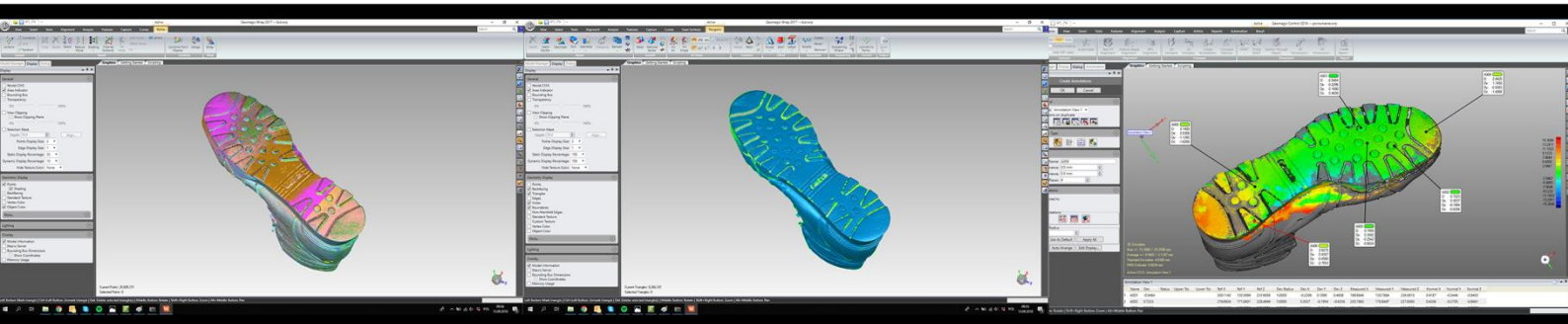
The MICRON3D green does not require specially adapted rooms and provides great measurement results regardless of your workplace. The standard scanner equipment includes: a sturdy tripod with a pan & tilt head, positioning lasers that ensure trouble-free positioning of the measuring head relative to the object as well as an easy-to-carry transportation case providing mobility while maintaining complete safety of the device.

After finishing the scanning process you need to do the post-processing of the impression's 3D model.

The software **SMARTTECH3Dmeasure** v2017 enables the editing of point cloud with the use of operations such as the removal of noises, that is, unnecessary parts of scans or interferences caused by external light sources. For the purpose of the study a decision was made to eliminate loose groups of points that can interfere with later analysis. The final result of the work done in the software **SMARTTECH3Dmeasure** is a triangle mesh that fully and accurately reflects the geometry of the scanned surface. The triangle mesh was used in the comparative analysis of the foot impression's scan and the model of the shoe sole. By using the Geomagic Control software we can quickly and easily obtain the result of a very information-rich comparative analysis.

The result of the analysis is a colour deviation map that clearly demonstrates the differences while at the same time allows to perform a full 2D analysis on a chosen cross-section. The data indicates that the surface scanned in the vicinity of the toes overlaps with the model of the sole. Some discrepancies appear only near the heel, which is due to the fact that the force applied on the sole never spreads evenly during walking.
It results in the deformation of the impressions left in snow.

The differences did not prevent us, however, from making the comparison and assigning the scanned footprint to a specific shoe sole. The scan of the impression turned out to be so precise that it reflected even slight scratches and cuts unique to that particular sole. The scan of the impression turned out to be so precise that it reflected even slight scratches and cuts unique to that particular sole. In addition, having an accurate three-dimensional model allows to prepare a 3D print design for Canon 3D printer. Among the benefits of ColorJet Printing (CJP) technology are low 3D printing costs, fast build time and 3D printing in color.



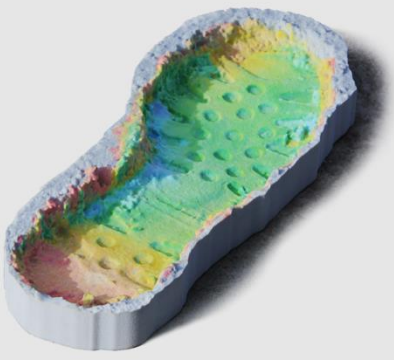
COMPREHENSIVE COMPARATIVE ANALYSIS REPORT OF THE IMPRESSION WITH THE SHOE SOLE

All of the advantages of CJP technology are important to forensics as there is a need in police forces for 3D printing multiple models with reflected the color map of deviations. Investigators have to have a possibility to make a direct comparison between the shoe and the track. In addition, they can print a few similar tracks and compare printed models even in the field. Precision of 3D printing technology also outweigh the accuracy of traditional methods such as plaster casting.

The study showed that 3D scanners and printers can not only support polices activities but are also one of the best tools that modern police investigation forces can have in their equipment. Unlike the more traditional methods of archiving, the 3D scanner operates completely noninvasively and does not expose the footwear impression evidence to the risk of damage. At the same time it is much more precise and allows you to collect even the smallest of details of the examined object. Additionally, the resulting scans in the form of a model can be added to the database and compared with other foot impressions around the world, even if the crime scene is no longer available. If you need physical imprints, then 3D printing based on a pre-made model will not only ensure a precision that surpasses traditional methods, but also allows you to copy the imprint without exposing the imprint itself. In addition, 3D printing can be used for creating a visualization of the proof.

PROJET 660PRO 3D PRINTER

3D PRINT WITH DEVIATIONS MAP



MORE ABOUT US AND OUR PARTNERS:

SMARTTECH – is the world's leading manufacturer of 3D scanners. The company has been involved in the manufacturing and sales of specialised 3D scanners for over 16 years. SMARTTECH is constantly improving its products and adapting them to various industries such as manufacturing, medicine or archaeology. Thanks to numerous international distributors the company has global sales on all continents from both Americas, through Europe, all the way to Asia.

Among our customers you can find names like Volvo Buses, Whirpool & Bosh , Lubiana Tableware , GE Electric, National Institute of Advanced Industrial Science and Technology in Japan, Regional Center of Engineering in Perm/ Russia, BMP Chaudronnerie Plastique in Caen/France, as well as many well known Universities in Poland, Belgium,Netherlands Russia, Colombia, China and Kazakhstan.

CANON – is a Japanese multinational corporation specialized in the manufacture of imaging and optical products, including cameras, camcorders, photocopiers, steppers, computer printers and medical equipment. The company is also official distributor of 3D printers designed and produced by **3D Systems**.

More information at: **www.smarttech3d.com**
More information at: **www.canon.com**