APPLICATION NOTE

3DIMETIK: Taking a look inside the part – Nondestructive inspection of complex plastic parts using computed tomography

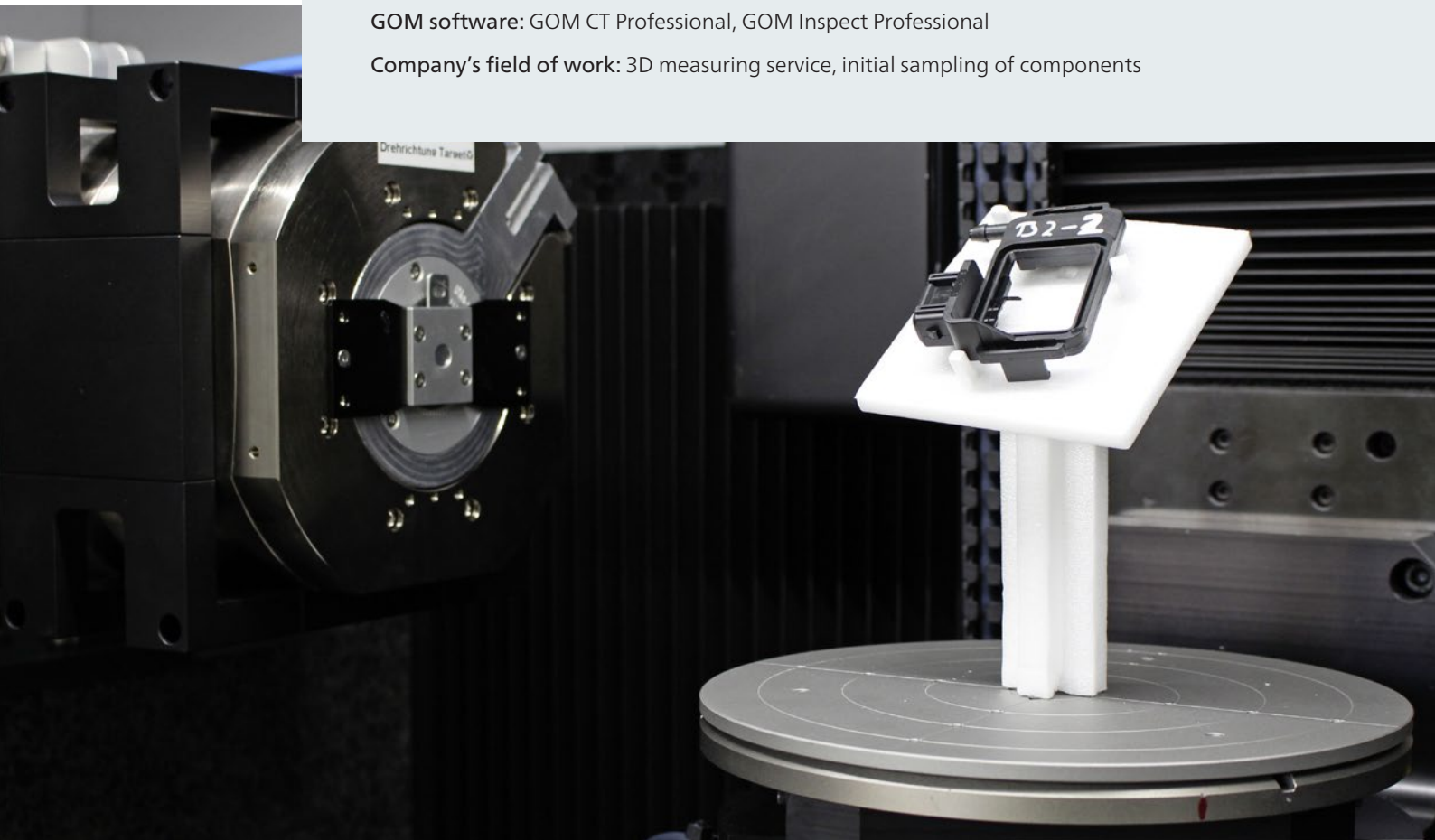
Internal structures, undercuts, deep bores, angled edges: plastic parts sometimes feature such complex geometries that nondestructive testing seems almost impossible. It is for such cases that measuring service provider 3DIMETIK now uses a GOM CT computed tomography system. Based on X-ray scans, the measuring system generates high-resolution 3D data of all internal and external part structures – "seamlessly and with an extraordinary level of detail," states 3DIMETIK Managing Director Pascal Mohr.

Location / Country: Kassel, Germany

GOM system: GOM CT

GOM software: GOM CT Professional, GOM Inspect Professional

Company's field of work: 3D measuring service, initial sampling of components



As experts for initial sampling, the team at 3DIMETIK handles all sorts of plastic parts that at first appear to be impossible to measure – at least without first breaking them down into several pieces.

Impossible to measure? Not for the CT

"We are commissioned to perform measuring tasks for injection-molded parts to which there is literally ‚more than meets the eye': some can be just a few centimeters in size but still have complex interior structures and challenging shapes. If your task as a service provider is to digitize this, conventional measuring equipment will soon be at its limits," says Pascal Mohr. "Let's take a concrete example from the medical industry: cannulas are a part of hospital routine. But they give measurement engineers a headache. The cannulas have very small openings, which need to be accurately measured. Only a measuring device with high resolution is capable of achieving this. At the same time, there are deep convolutions into which I have to look with the measuring device in order to obtain all geometry information, while the measuring device must be capable of coping with the transparent material of the cannula. Looking at these requirements together, both CMMs and fringe projection scanners are unsuitable for measuring. Only by using computed tomography can a complete digital image be produced in a nondestructive way."

The GOM CT digitizes complex parts including the internal geometries at the finest level of detail. (Image source: GOM GmbH)

Pascal Mohr shows a typical plastic part that is "just perfect" for CT scanning: The molded part, which is small enough to fit between thumb and index finger, has complex inspection characteristics that are invisible to the naked eye. (Image source: GOM GmbH)

The GOM CT delivers razor-sharp images

But not all CTs are the same, says Pascal Mohr. He picks up a transparent part, which is closed with a small green lid and is about 1 × 1 cm in size. "On the lid alone, we have 200 inspection positions in an extremely confined area. Customers expect us to provide them with a precise metrological evaluation – and I can only offer this if I record the measurement data with a very high-resolution computed tomography system. The CT needs to see things that are invisible to the naked eye." According to Mohr, the GOM CT is leading the field in this respect. The system uses a 3k X-ray detector (resolution: 3008 × 2515 pixels) with an extremely fine pixel grid (pixel size 100 µm).

This results in razor-sharp images showing the part in finest detail. Mohr adds that even with complex geometries, the measurement data set is 100 percent closed. "More than once we have received calls from delighted customers who wanted to find out how we managed this nondestructively. The 3D models generated from the measurement data exceed expectations." The experienced measurement engineer adds that he currently knows of no system that produces better STLs for small plastic parts than the GOM CT.

Manufacturer comparison in favor of GOM

Was it just the high resolution of the system that convinced Pascal Mohr to buy it? "Definitely not! At the Control trade fair, we spoke to various manufacturers and compared their computed tomography systems with each other. Finally, we ended up with GOM for a number of reasons: we are familiar with the powerful GOM fringe projection scanners and knew that GOM does not do things by halves when it comes to product development. That's why we were confident that the same would apply to the GOM CT. The GOM CT stands out from the competition at first glance," says Mohr. "The build quality is the first difference you notice compared to other manufacturers. Just have a peek into the interior of other CT devices and then into the GOM CT – then you will see what I mean." Other manufacturers would prefer to rest on their laurels. In a direct comparison, GOM made the most innovative impression, states Mohr. When asked about specific examples of the degree of innovation, he mentions features such as automatic centering of the part in the measuring room, which ensures that each part is always acquired in the optimum measurement position.

Automatic centering of the part

The optimum measurement position depends on the shape and size of the part and is a decisive factor for the quality of the measurement data. Pascal Mohr explains the dilemma: "I like to measure with the highest possible resolution in order to capture as many details as possible. I achieve the highest possible resolution if I position the part very close to the X-ray source. Because the closer the part is to the X-ray source, the larger its displayed representation on the X-ray detector. But the closer I get to the X-ray source, the greater the risk that individual elements of the part are outside the detector surface and are therefore not captured." With some CT systems, the search for the best possible measurement position becomes an endless trial-and-error process. This is not the case with the GOM CT, where determining the best possible measurement position has been automated.

The measuring room of the GOM CT contains a sophisticated motion unit, a 5-axis kinematics with integrated centering table. In addition to the rotation axis, the system includes a magnification and stroke axis for positioning as well as two further axes for centering the part. The user simply places the part to be measured on the centering table and closes the door to the measuring room. The GOM CT software then displays a live image of how the X-ray detector would capture the part in its current position. To optimize the measurement position, it moves the virtual positioning aid over the object and leaves the positioning to the CT software. Anyone who prefers to make virtual changes themselves can type the desired axis changes into the software's input fields and send the command to the motion unit. "As far as setting up the measurement is concerned, the GOM CT is worth its weight in gold," concludes Pascal Mohr. "The part is in a perfect position and is captured at the highest possible resolution."

3DIMETIK has been using the GOM CT since April 2018, making the company one of the first users of the system. (Image source: GOM GmbH)

Several parts in the measuring room at the same time

For particularly urgent jobs, the professionals at 3DIMETIK can save time by simultaneously measuring several workpieces in the GOM CT. "As mentioned earlier, the size of the part determines the level of resolution. We evaluate the level of detail on the basis of the drawing and assess it in relation to the tolerance. Based on this evidence, we determine how many parts we can potentially measure at the same time," explains Mohr, adding that the company currently has a project that requires the simultaneous measurement of 32 plastic parts. No problem for the GOM CT. "No conventional scanning system can compete," says Mohr.

Measurement data provides information on the condition of the part

The measurement data generated with the GOM CT can be used in a variety of evaluations. Pascal Mohr lists some examples: "Based on the data, we perform shrinkage cavity, crack and functional analyses, for instance. Plus, we can also check for vacuoles." Assembly analyses are also frequently in demand.

Only one correction cycle required thanks to CT measurement data

In addition, the measurement data of the part provides information regarding any necessary tool corrections. "Speeding up tool correction is one of our greatest strengths," says Pascal Mohr, stressing the excellent performance of the GOM CT. "Customers send us their initial samples, we digitize them with the GOM CT and analyze the measurement data. If we discover problems on the workpiece, we can use reverse engineering to define the exact point at which the tool must be modified." Instead of running four to five correction cycles, the tool can now be finally optimized in just one correction cycle.

Pascal Mohr is convinced that computed tomography will become increasingly important because plastic is gaining in popularity as a material – and the complexity of the parts is constantly growing. "With our GOM CT, we are ideally equipped for the challenges of the future."

3DIMETIK GmbH & Co. KG

In 2016, the experienced measuring engineers Pascal Mohr, Benjamin März and Daniel Wilhelm founded the measuring service provider 3DIMETIK. Currently the team consists of 9 employees. The offered services range from reverse engineering and design to the measurement of prototypes and series. The tools of the trade in 3D metrology include optical, tactile and surface measurements as well as measurements using a 3D computed tomography system. The company is based in Kassel, Germany. Customers come from all over Europe. The company has completed an assessment according to DIN EN ISO/IEC 17025 and currently expects the accreditation certificate.

www.3dimetik.de

GOM GmbH

GOM specializes in industrial 3D coordinate metrology, 3D computed tomography and 3D testing. From product development to production and worldwide distribution, GOM offers machines and systems for manual and automated 3D digitizing, evaluation software, training and professional support from a single source. In industries such as automotive, aerospace, energy and consumer goods, more than 17,000 GOM system installations are in use internationally. At more than 60 locations and with more than 1,200 measurement technology specialists, GOM guarantees profound advice and first-class service.