

# ATOS



## **Industrial High-End 3D Digitizer**

3D Coordinate Measurement Machine  
CAD Comparison and Inspection  
Digitizing of Models and Tools

# ATOS

## Industrial High-End 3D Digitizer

The ATOS 3D Digitizer delivers three-dimensional measurement data for industrial components such as sheet metal parts, tools and dies, turbine blades, prototypes, injection molded and casted parts. Instead of measuring single points, full part geometry is captured in a dense point cloud or polygon mesh describing the object's surface and primitives precisely.

3D digitizing with the ATOS delivers for different object sizes and complexities:

- Highly accurate 3D coordinates
- Full-field deviation to CAD
- Section-based analysis
- Complete measuring reports

### Challenges solved ...

Problem: no CAD data

Solution: ATOS captures complete object surfaces providing a high-resolution polygon mesh. This data is converted to CAD data using reverse engineering techniques.

Problem: product improvement

Solution: ATOS delivers full color inspection reports. These easily readable reports allow an understanding of tendencies and communication of optimization strategies.

Problem: process optimization

Solution: ATOS data enables regular monitoring of product quality. Understanding the as-built conditions helps adjust production machinery, increasing process security.

Problem: actual shape of production tools

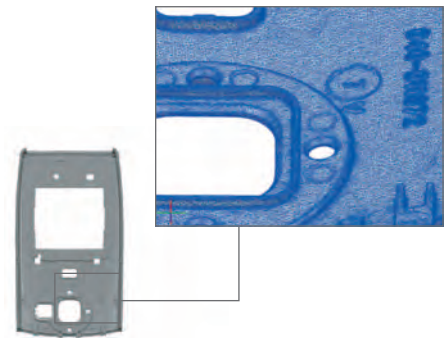
Solution: ATOS aids determination of tool changes. The high-quality 3D data allows direct milling on points or reconstruction of CAD surfaces.

The ATOS 3D Digitizer is an accurate and cost-effective solution in a number of different application areas:

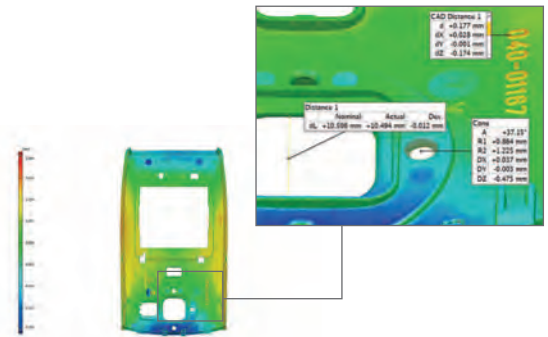
- Quality Control
- Reverse Engineering
- Rapid Prototyping
- Rapid Milling
- Digital Mock-Up



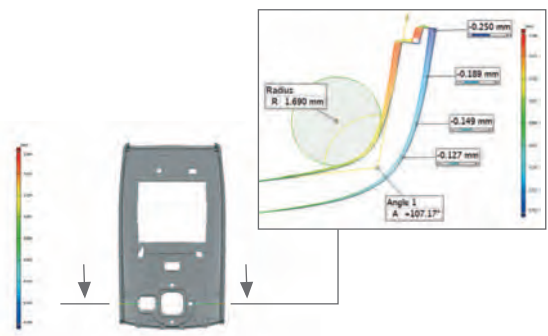
Component



Polygon Mesh



CAD Comparison



Sectional Analysis

## Fringe projection for high-precision 3D coordinate measurement

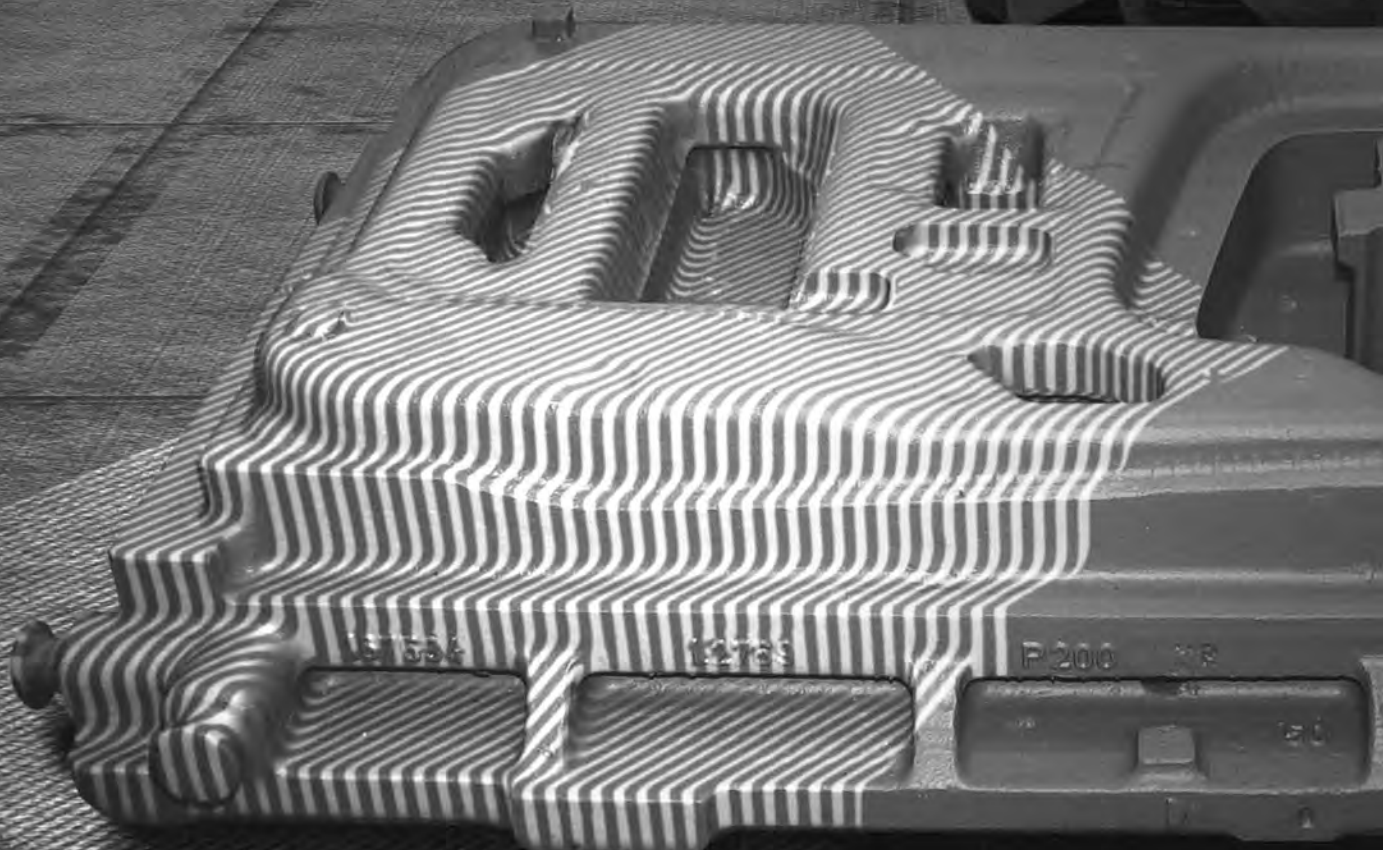
The ATOS 3D Digitizer is based on the principle of triangulation using a stereo camera setup. This stereo camera setup and a projection unit are integrated in the compact and robust ATOS sensor head.

The sensor projects different fringe patterns onto the object's surface. These patterns are recorded by the two cameras, forming a phase shift based upon sinusoidal intensity distributions on the CCD chips. The ATOS uses multiple phase shifts in a heterodyne principle to achieve highest sub-pixel accuracy. Based on the optical transformation equations, independent 3D coordinates are automatically calculated for each camera pixel. Depending on the camera resolution, a point cloud of up to 4 million surface points results for each measurement.

The geometrical configuration of the ATOS sensor and lens distortion parameters are calibrated using photogrammetric methods. ATOS' proven stereo camera technique delivers, for each measurement, an overdetermined system of equations. This technique allows the ATOS to guarantee process security by:

- Detection of sensor/part movement
- Verification of transformation accuracy
- Identification of environmental changes
- Online tracking of 3D sensor position

Each ATOS system is certified according to the guideline VDI/VDE 2634 Part 2 for optical 3D measuring systems based on area scanning.



## Three-step workflow

Measuring with ATOS is a basic three-step workflow:

- **Sensor positioning and measurement:** The sensor head is freely positioned in front of the component. After each measurement, the sensor or part is moved to obtain areas not captured in the initial scan process. All individual measurements are automatically transformed into a common coordinate system immediately providing the complete 3D point cloud.
- **Evaluation:** The polygon mesh and features such as edges, holes, etc. are mathematically transformed into the coordinate system of the component using RPS, 3-2-1 or Best-Fit registration. The measured and aligned data is used for STL export, CAD comparison, verification of shape and position tolerances, verification of specifications from drawings or files.
- **Reports and results:** The results of the detailed analysis, such as dimensions, sections, primitives and nominal / actual comparison are exported in reports or a number of different data formats.

## Industrial advantages for industrial processes

More than 10 years ago, the automotive industry was the driving force for the development of the ATOS full-field digitizing systems. These systems were utilized to capture form information from cars and components for the reverse engineering process to generate CAD models.

Today, the ATOS is used for many industrial measuring applications. Inspection, root cause analysis and quality assurance of sheet metal stampings, machined and formed parts, composite lay-ups, assemblies, interiors and entire vehicles and aircraft are typical applications in the automotive, aerospace and consumer sectors. Other high return on investment areas are prototyping, mold making, tool making, injection molding, die-casting, precision casting, and blow molding applications.

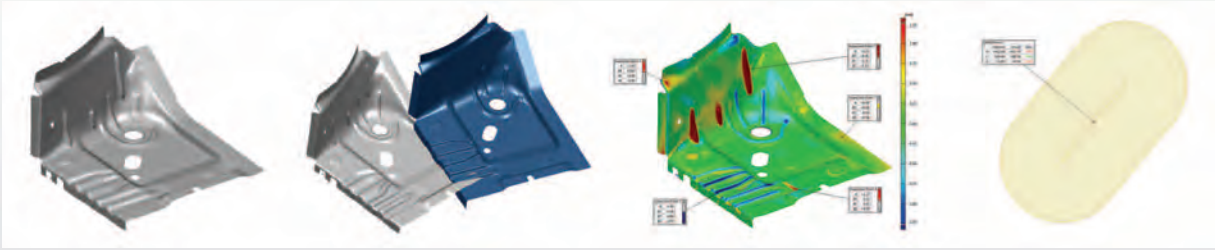
These industrial processes are improved by:

- Complete product control
- Improved quality
- Reduced manufacturing time
- Earlier identification of tendencies
- Higher quantities by product introduction
- Faster from idea to finished product

The industry thus benefits from the ATOS solution by:

- Reduction of product development times
- Enhancement of the process security
- Optimization of production procedures





## Complete workflow in one software application

GOM completely develops the ATOS hardware and software in house. The software is used to run the sensor head, to process the 3D point cloud and to edit and post-process the data.

Through a simple graphical user interface, the ATOS software supports today's tasks in quality control, manufacturing processes and reverse engineering.

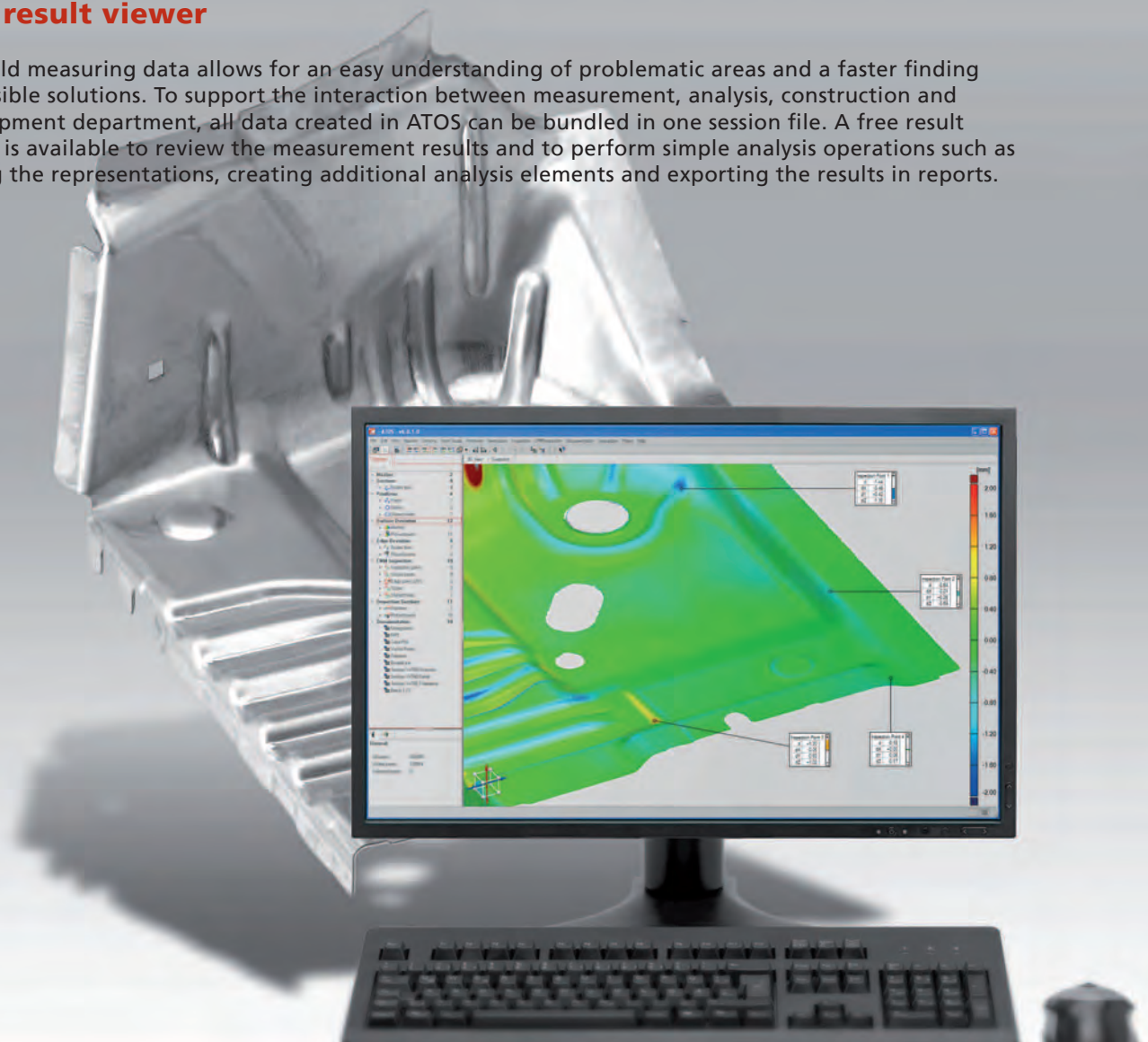
Sensor control, polygon mesh generation and editing, sectioning, feature line detection, primitive generation are basic software functions. For quality control and result analysis, tools such as CAD data import; import of measuring plans; registration; full-field deviation plots; section-based analysis; deviation of individual points; GD&T; calipers, angles and diameters; report creation are available.

These built-in features enable ATOS to:

- Integrate in automation processes
- Communicate with analysis tools
- Batch process multiple projects

## Free result viewer

Full-field measuring data allows for an easy understanding of problematic areas and a faster finding of possible solutions. To support the interaction between measurement, analysis, construction and development department, all data created in ATOS can be bundled in one session file. A free result viewer is available to review the measurement results and to perform simple analysis operations such as editing the representations, creating additional analysis elements and exporting the results in reports.



# ATOS

## Sensor Technology

ATOS 3D Digitizers have been produced and constantly developed since 1995.

The ATOS 3D Digitizer is a flexible optical measuring machine. With more than 2000 installations in measurement and analysis rooms as well as factory and production halls worldwide, the ATOS has been for a long time an accepted measurement method beside the mechanical measurement machines.

In all sensor generations, GOM applied latest technology and knowledge. A strong development team within GOM is responsible for transforming market experience and customer requirements into a sensor technology meeting high application demands.

The ATOS sensor combines high data quality in short measurement time with flexibility and stability for industrial environments.

## Accuracy

The camera support bar which carries the two measurement cameras guarantees high mechanical stability due to design and Finite Element optimization. The carbon fiber construction makes a robust camera setup to achieve highest measurement accuracies even when measuring directly in production environments with uneven floor levels, heavy machinery and rough conditions.

The camera support bar, which has integrated laser pointers for easy stand-off control, can be exchanged by opening four screws and thus offering a complete new range of measuring areas.

## Speed

Two million accurate 3D coordinates are measured per second by combining a high-speed slide moving device with the heterodyne fringe projection technique. The slide movement is precisely adjusted during the sensor production within GOM to use maximum camera frequency. Results are available quickly supporting fast problem analysis and a higher project throughput with the same manpower.



## Robust

4500 ANSI-Lumen are projected by a high performance light source to achieve strong fringe contrasts even on dark objects. The ATOS can thus measure in harsh environments like production halls and factories with difficult lighting conditions.

This light intensity is also used to properly illuminate very large measuring areas of up to 2 m x 2 m. The lighting can be controlled in such a way that during one measurement cycle different surface colors can be measured without special adaptation.

## Process security

The ATOS constantly controls the sensor setup and environmental conditions and informs the user in case of any influence on measurement quality and accuracy. The use of GOM's proven two camera technology provides this information within each measurement and even before invoking the measurement.

## Measurement of small to large objects

The measuring area of the ATOS sensor can be changed within a few minutes to meet optimum resolution for each application.

Simply exchanging the lenses provides the full amount of measurement points in a different area and thus an increased scan data resolution or increased measuring field of view. The software also handles different measuring areas within one project to combine highest resolution in high detail areas with a quick scanning.



## Optically Tracked Touch Probe

The GOM Touch Probe is available as an Add-On to the ATOS 3D Digitizer, combining full-field and touch probe 3D measurement. The GOM Touch Probe allows among other things the measurement in difficult to access areas, comparison directly to CAD, measurement of primitives, quick measurement of individual points and online alignment.

ATOS and Touch Probe measurements are carried out with one system and are evaluated with one software package. No extra hardware or tracker is required, enabling quick measurement procedures and easy interchange between surface and single point measurement and analysis.

## Industrial environments and notebook operated sensor

Instead of moving the measurement component to the measuring machine, the ATOS sensor comes to the object. To easily handle and transport the sensor in metrology and analysis rooms as well as production and factory facilities, the controller device is integrated into the sensor head and light-weight and robust cables are used.

As an alternative to a quadcore high powered rack mount PC, the ATOS can be operated directly using a notebook PC. The notebook-based solution combined with a light-weight stand and the transporting suitcase that also holds all other accessories allows easy traveling.

ATOS HR



ATOS II / II SO



ATOS I / I SO



ATOS Std



ATOS HR SO



ATOS IIe / III



ATOS II / II SO  
ATOS IIe / III



# ATOS

## Sensor Variations

The ATOS 3D Digitizers are available in different variations to meet application requirements perfectly. Each sensor type is combined with the full ATOS software providing the quality polygon mesh and extensive post-processing functionalities.

## ATOS II

The ATOS II with its compact light sensor head and fast measurement procedure has been developed for the highest degree of flexibility. The available measuring areas span over a large range and can even be extended by switching to the „SO“ configuration.

The ATOS II captures the data from the two 1.4 million pixel cameras within 1 second.

## ATOS IIe

The ATOS IIe provides an extremely bright light source (4500 ANSI-Lumen) which enables measurements in difficult ambient conditions. Two 1.4 million pixel cameras deliver 3D coordinates even on dark surfaces in rough environments.

The integrated controller reduces the overall number of components and provides a streamlined measuring device.

## ATOS III

The ATOS III combines the high performance light source with two 4 million pixel cameras. It allows measuring smallest details with highest resolution and realizing largest measuring areas of up to 2 m x 2 m.

Using 4 million 3D coordinates in a single measurement provides a time efficient data capture as larger measuring areas with high resolution can be used.



## Automation using robots and kinematics

Increasing demands for a higher throughput and reduced cycle time for process optimization require the automation of measurement and evaluation.

For an efficient automation, GOM develops, supplies and supports:

- Measuring hardware
- Sensor and robot control
- Scanning software
- Data handling and editing
- Import of nominal data and measuring plans
- CAD comparison
- Inspection reporting

For repeated measurements, automation devices like robots, rotation tables or linear units are used to handle the sensor head or measurement object. A macro is recorded within the ATOS software containing the device's positions, sensor controls and all processing steps. Additional measurements of the same part geometry are repeated automatically by invoking the measurement macro with the play button.

ATOS macros are based on a scripting language. The standard use is a record and play procedure. For advanced applications, an editing level is available to perform e.g. conditional loops, sub-macro calls and operating system actions.



<b>Technical Data</b>			
<b>System Configurations</b>	<b>ATOS II</b>	<b>ATOS IIe</b>	<b>ATOS III</b>
Measured Points	1 400 000 in 1s	1 400 000 in 1s	4 000 000 in 2s
Measurement Time	1 second	1 second	2 seconds
Measuring Area (min.)	175 x 140 mm <sup>2</sup>	175 x 140 mm <sup>2</sup>	150 x 150 mm <sup>2</sup>
Measuring Area (max.)	2000 x 1600 mm <sup>2</sup>	2000 x 1600 mm <sup>2</sup>	2000 x 2000 mm <sup>2</sup>
Point Spacing	0.12 - 1.4 mm	0.12 - 1.4 mm	0.07 - 1.0 mm
Stand-Off	730 - 2000 mm	730 - 2000 mm	760 - 2800 mm
Brightness	400 ANSI-Lumen	4500 ANSI-Lumen	4500 ANSI-Lumen
Camera Pixels	2 x 1 400 000	2 x 1 400 000	2 x 4 000 000
Sensor Dimensions	490 x 260 x 170 mm <sup>3</sup>	490 x 300 x 170 mm <sup>3</sup>	490 x 300 x 170 mm <sup>3</sup>
Sensor Weight	5.2 kg	7.0 kg	7.4 kg
Positioning Pointers	•	•	•
High-End PC	•	•	•
Notebook	•	•	•
Sensor Controller	external	integrated	integrated
Automation	•	•	•
Variable Workstation	•	•	•
Cable Length		up to 30 m	
Transport Case		550 x 800 x 300 mm <sup>3</sup> , 32 kg	
Operating Temperature		0° - 40°C	
Humidity		non-condensing	
Power Supply		90 - 230V AC	



# ATOS SO

## High-End Digitizer for Small Objects

The ATOS SO („Small Objects“) series is a dedicated solution for precisely measuring small objects such as injection molding components, medical parts, smallest turbine blades.

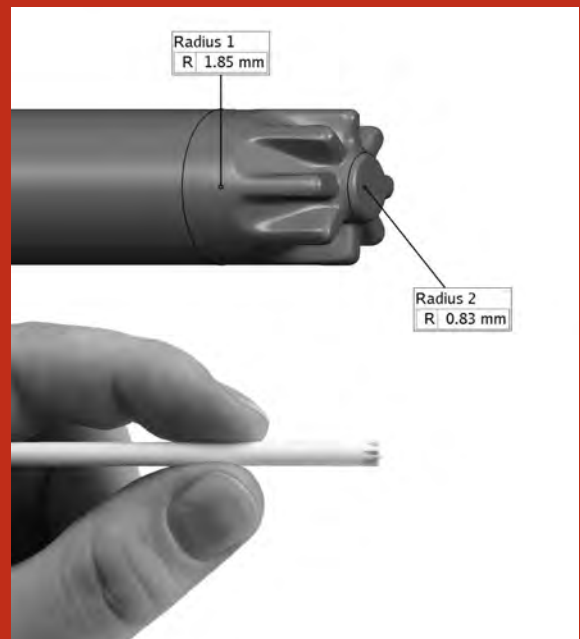
The SO systems are mainly used for complex small parts with high demands on accuracy and data quality. With point distances of less than 0.02 mm even smallest details can be measured.

The ATOS SO systems are typically used as a table-top device. The sensor head is positioned together with the measuring object in a stable setup, the two measuring cameras are mounted in front of the sensor head. Combining camera positions and focal lengths of camera and projection lenses create an optimized triangulation for smallest measuring areas.

The ATOS SO sensor head is mounted on a vertical translation unit to quickly adjust the working distance to the measurement object. A motorized rotation table, macro programming and an interchangeable object holder lead to the automation of the complete workflow including part positioning.

## From small to large objects

The ATOS SO series is fully compatible with other ATOS solutions. Changing the camera support bar, allows to switch from smallest measuring areas to the largest measuring area within a few minutes.



### Technical Data

#### System Configuration

	ATOS II SO	ATOS SO 4M
Measured Points	1 400 000 in 1s	4 000 000 in 2s
Measurement Time	1 second	2 seconds
Measuring Area (min.)	30 x 24 mm <sup>2</sup>	30 x 30 mm <sup>2</sup>
Measuring Area (max.)	250 x 200 mm <sup>2</sup>	300 x 300 mm <sup>2</sup>
Point Spacing	0,02 - 0,17 mm	0,015 - 0,15 mm
Stand-Off	280 - 390 mm	280 - 430 mm

Camera Pixels	2 x 1 400 000	2 x 4 000 000
Sensor Dimensions	300 x 260 x 170 mm <sup>3</sup>	300 x 300 x 170 mm <sup>3</sup>
Positioning Pointers	•	•

## Development, construction, support all in one

The „Gesellschaft für Optische Messtechnik“ (GOM) develops, produces and distributes optical measuring equipment for the three-dimensional measurement and deformation measurement of components. The measuring systems are based on digital image processing and are used in product development, quality assurance, material and component testing.

All over the world, companies of the automotive, aviation and space industries, their suppliers and various manufacturers of consumer goods use GOM systems.

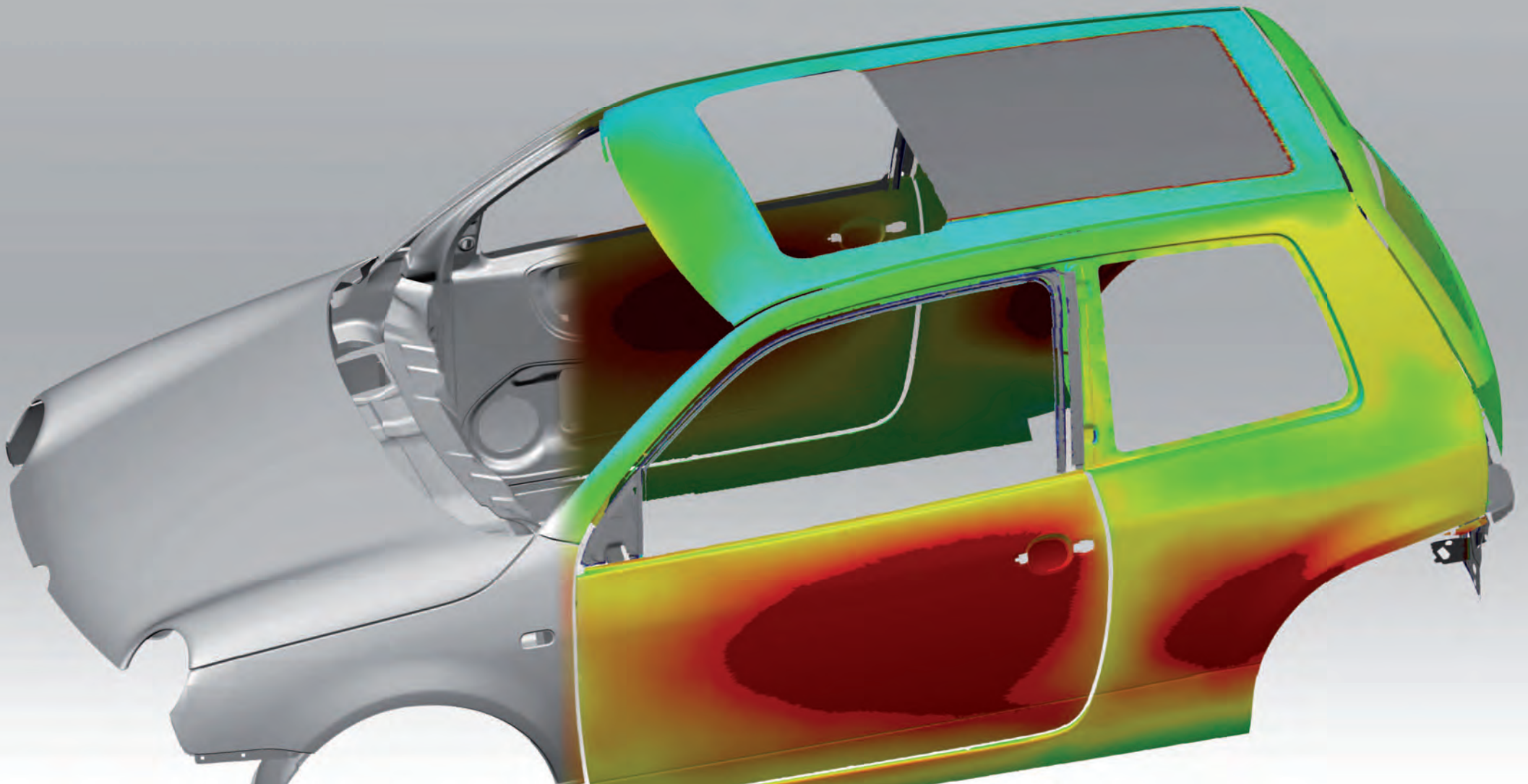
GOM was founded in 1990 as spin-off of the Technical University Braunschweig, Germany. The company owns subsidiaries in Switzerland, France, Great Britain, Italy and Belgium. Worldwide, more than 30 committed and competent partners install, support and market GOM products.

Today, GOM offers a complete in-house solution covering hardware, software, technical support and training.

## GOM customers (extract)

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Worldwide support network

**Argentina**  
ROBTEC ARGENTINA  
Phone +54 11 4787 6800  
info@robtec.com

**Australia**  
MOSS Pty Ltd  
Phone +61 3 9946 1086  
scan3d@iprimus.com.au

**Austria**  
Westcam Datentechnik GmbH  
Phone +43 5223 5550 90  
office@westcam.at

**Belarus**  
MCP Technology  
Phone +375 17 262 5612  
mcp@technology@mcp.by

**Brazil**  
ROBTEC DO BRASIL  
Phone +55 11 3318 5100  
info@robtec.com

**China**  
Pro-Technic Machinery Ltd.  
Phone +852 2428 2727  
atd@protechnic.com.hk

**Columbia**  
USM Columbia S.A.  
Phone +57 4279 9000  
gerencia@usm.com.co

**Croatia, Slovenia**  
Topomatika d.o.o.  
Phone +385 91 5046 239  
info@topomatika.hr

**Czech Republic**  
MCAE Systems s.r.o.  
Phone +420 549 128 811  
mcae@mcae.cz

**Denmark**  
Zebicon  
Phone +45 7650 9152  
info@zebicon.com

**Finland**  
Cascade Computing AB  
Phone +358 40 515 3341  
info@cascade.fi

**Greece**  
EXPERTCAM  
Phone +30 210 2757 410  
exp@expertcam.com

**Hungary**  
R-Design Studio Ltd.  
Phone +36 1 365 10 89  
info@r-design.hu

**India**  
APM Technologies  
Phone +91 11 4163 1416  
apmtech@vsnl.net

**Indonesia**  
PT Henindo  
Phone +62 21 489 9675  
henvgs@attglobal.net

**Iran**  
Fadak Sanat Gostar (FSG)  
Phone +98 21 88 730 735  
info@fadaksanat.com

**Israel**  
Globus Technical Equipments Ltd.  
Phone +972 9 9560444  
nir@globus.co.il

**Japan**  
Marubeni Solutions Corp.  
Phone +81 3 5778 8571  
Sato-Yoshiyuki@marubeni-sys.com

**Malaysia, Singapore**  
First High Tech Sdn Bhd  
Phone +603 7665 2188  
info@1st.com.my

**Mexico**  
CIM Co.  
Phone +52 55 5565 6633  
info@cimco.com.mx

**Pakistan**  
Ultimate CAD Solutions Ltd  
Phone +92 51 5467572  
shakir@ucs-int.com

**Poland**  
ITA  
Phone +48 61 843 6344  
info@ita-polska.com.pl

**Portugal**  
S3D  
Phone +35 12 4457 3100  
suporte@s3d.pt

**Romania**  
SPECTROMAS SRL  
Phone +40 21 3105190  
info@spectromas.ro

**Russia, Kazakhstan**  
NIAT  
Phone +7 495 3111198  
info@niat-ntk.ru

**South Africa**  
RGC Engineering Pty  
Phone +27 11 531 0766  
info@rgcengineering.co.za

**South-Korea**  
OMA Co.  
Phone +82 42 822 9501  
support@omagom.co.kr

**Spain**  
Metronic S.A.  
Phone +34 943 121400  
comercial@metronicnet.com

**Sweden**  
Cascade Computing AB  
Phone +46 31 84 0870  
info@cascade.se

**Taiwan**  
Road Ahead Technologies  
Phone +886 2 2999 6788  
marcel@rat.com.tw

**Thailand**  
Mentel Co., Ltd.  
Phone +662 719 6969  
info@mentel.co.th

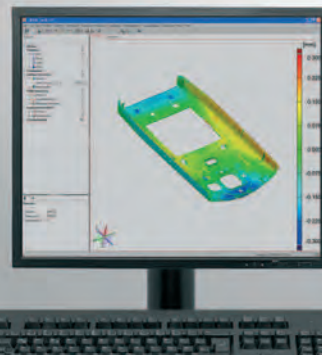
**Turkey**  
Cadem A.S.  
Phone +90 216 557 64 64  
gom@cadem.com.tr

**USA**  
Capture 3D Inc.  
Phone +1 714 546 7072  
jgout@capture3d.com

**USA**  
Trilion Quality Systems LLC  
Phone +1 215 710 3000  
info@trilion.com

**Venezuela**  
AT Group Software Inc  
Phone +58 212 9432 446  
dkinz@atgroup.com.ve

**Vietnam**  
AIE  
Phone +84 43 7345 435  
aie@vnn.vn



**gom**  
Optical Measuring Techniques

**GOM mbH**  
Mittelweg 7-8  
38106 Braunschweig  
Germany  
Tel +49 531 390 29 0  
Fax +49 531 390 29 15  
info@gom.com

**GOM France SAS**  
10 Quai de la Borde  
91130 Ris Orangis  
France  
Tel +33 1 60 47 90 50  
Fax +33 1 69 06 63 60  
info-france@gom.com

**GOM International AG**  
Bremgarterstrasse 89B  
8967 Widen  
Switzerland  
Tel +41 5 66 31 04 04  
Fax +41 5 66 31 04 07  
international@gom.com

**GOM Branch Benelux**  
Interleuvenlaan 15 F  
3001 Leuven  
Belgium  
Tel +32 16 408 034  
Fax +32 16 408 734  
info-benelux@gom.com

**GOM UK Ltd**  
Business Innovation Centre  
Coventry, CV3 2TX  
United Kingdom  
Tel +44 2476 430 230  
Fax +44 2476 430 001  
info-uk@gom.com

**GOM Italia Srl**  
Via Lomellina 10/6  
20090 Buccinasco (MI)  
Italy  
Tel +39 02 457 01 564  
Fax +39 02 457 12 801  
info-italia@gom.com

[www.gom.com](http://www.gom.com)