



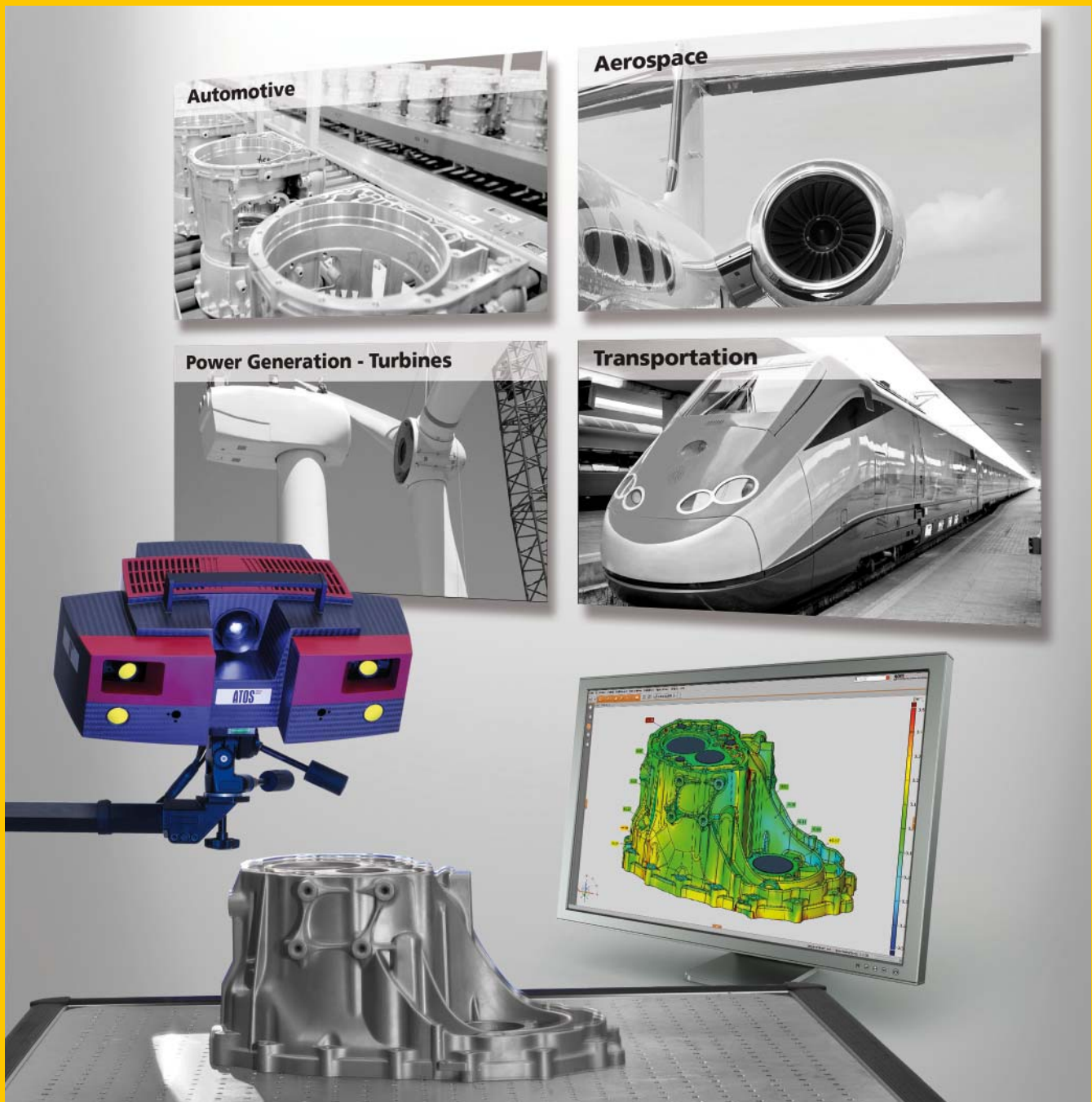
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Quality Assurance

Full surface 3-D measurements facilitate pattern making



Atos triple scan 3-D coordinate measuring system for complete surface measurement of castings (Photos: GOM)

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Full surface 3-D measurements facilitate pattern making and provide numerous benefits to foundries

Optical 3-D coordinate measuring technique enables consistent process control

Already before the first article inspection (FAI) of the casting, 3-D shape and dimensional analyses provide reliable information for quality control and targeted process optimization. Foundries and forging shops the world over use the Atos 3-D digitizer from GOM mbH,

Braunschweig/Germany, for surface measurements in shape and dimensional control of patterns, sand cores and castings. GOM also offers inspection software, training and support – all from a single source. Longstanding users above all appreciate GOM’s in-

tegrated solutions of non-contact and tactile measuring within one system.

The Atos optical 3-D measuring system

Full-surface measurement by means of Atos guarantees rapid evaluation

of complete and complex surfaces of components (see figure on page 42). On the basis of the triangulation principle, the system projects a fringe pattern onto the surface of the object and scans the pattern by two cameras. The computer automatically computes the 3-D coordinates for each camera pixel of the scanned surface with highest resolution and precision. A single measurement takes only 1 to 2 s. It is automatically transferred into a common system of coordinates. By combining the fringe projection with the stereo camera system, each single measurement is permanently checked during the measurement for correct calibration, sensor movement and any changes in the environmental conditions that may influence the measurements. By turning the component or shifting the sensor, the surface can be captured in its entirety and measured from different perspectives [1]. The acquired STL data set is immediately available for other purposes such as quality control or reverse engineering. A pattern plate of simple geometry can be completely digitized and compared with CAD data by means of GOM inspection software in just about 15 min. This markedly speeds up component inspection procedures. An easy-to-understand colour display of the deviations provides enhanced visualization and localization of problematic areas [2].

Inspection software for shape and dimensional control of 3-D data

The parametric GOM Inspect Professional software entails numerous functions specially tailored to the foundry industry (Figure 1). This provides consistent quality assurance without the need for any additional evaluation packages. Alongside full-surface shape and dimensional analyses and the comparison with CAD data, the software comes with features for the computation of material thickness for checking wall thicknesses and ensuring sufficient allowance for downstream processing. In addition to checks of the position and size of standard geometries and the use of

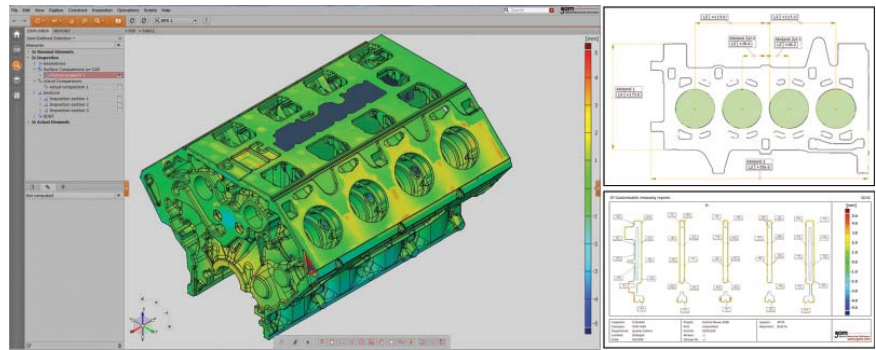


Figure 1: GOM Inspect Professional software is specifically designed to evaluate 3-D data for casting industry applications. Features include comparison of actual data versus CAD and inspection plans, wall thickness analysis and classical 2-D evaluations

calipers, inspection sections with tolerance band and classical 2-D dimensioning tools are available. With the Atos reference point system, parting planes can be checked for offset, and die/mould halves for proper fit and locking. For documentation and further processing of the data, the GOM Inspect Professional software provides multiple reporting and documentation functions for editing standard reports or customized 3-D measuring reports. Additionally, interfaces are available for exporting traditional charts and reports with CMM inspection points as tables. The results and deviations can be exported in different formats, e.g. Excel, PDF, HTML or Word. Thanks to the parametric kernel of the software, there is no difference in terms of time between single evaluations and multiple evaluations in the case of recurring measuring tasks. For easy and compact exchange of the measured data with customers or colleagues from other departments, the openly accessible and free GOM Inspect package is available. The GOM inspection software is also often used as a stand-alone package for evaluating 3-D measuring data from laser scanners and computer tomographs (CT).

Optical 3-D coordinate measuring technology: controlling the entire process

Optical measurements are not only relevant for the inspection of castings. Integrating optical measuring systems also improves process security in almost all stages of the production pro-

cess. These systems cut production times and costs, enabling shorter lead times and reduced reject rates. Whereas companies initially often mainly concentrate on the dimensional validation of castings, optical measuring systems can also be used to support and accelerate operations in almost all areas, from pattern and tool making, mould and core making through to first article inspection and optimization of CNC machining (Figure 2).

Atos 3-D Digitizer

The flexible, optical 3-D coordinate measuring system, Atos, is produced since 1995 and has been continuously further developed ever since. Being available in various designs, the system captures several million measuring points in a matter of seconds and in a measuring range from 30 mm x 30 mm to 2,000 mm x 2,000 mm.

Atos delivers three-dimensional measuring data. Atos systems are used in the process chains of pressure and gravity die casting, investment casting and sand casting. The quick and robust measuring solutions are employed in quality assurance, reverse engineering and rapid manufacturing. Rather than measuring a few individual points only Atos captures the entire geometry of a component in a dense high-resolution point cloud. This polygon mesh provides an exact description of a component's free formed surfaces and standard geometries. The system generates precise 3-D coordinates, full surface deviations to CAD data, inspection sections and complete measurement reports.



Figure 2: Optical measurement supports and speeds up virtually all processes from pattern and tool making via mold and core making through to first article inspection (FAI) and optimization of CNC machining

“Many of our customers first contact us for a specific problem related to a certain component”, explains Carsten Reich, head of the automation team at GOM mbH. “Once in use, an optical measuring system will soon turn out to be beneficial in multiple ways. Integrated at an early stage into the production chain, it can also help reduce development times and streamline production processes. Users of our systems then often start to explore more and more of the potentials provided by our optical measuring equipment and the 3-D software, eventually even leading to the introduction of a completely new quality assurance strategy,” continues Carsten Reich. Applications may range from design verification, measurements of prototyping tools and prototype castings, validation of series tools and the production part approval process through to measurements of sand cores and wear analyses of series production tools. Solutions provided by GOM are in use along the complete process chain. In summary, the versatile use of optical measuring equipment along the complete production chain of casting greatly increases efficiency.

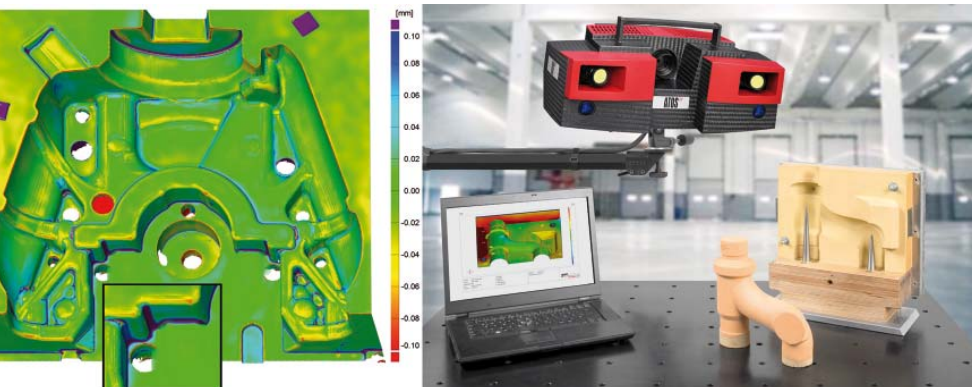


Figure 3: Flexible use of optical 3-D measurement: checking the milling result of a core making tool by comparing nominal and actual data, clearly reveals which edges of the tool (blue) still need to be re-machined

Validation of patterns, dies and moulds

Validating the forming contours of patterns, core moulding tools, moulds, dies, etc by optical measuring techniques provides 100% control. It is actually the pattern and mould maker’s assurance that everything is in order. Whereas tactile methods measure only individual points, optical measurements capture the complete surface. Moreover, the high scanning speed lowers costs and leads to much shorter interruptions to the work flow.

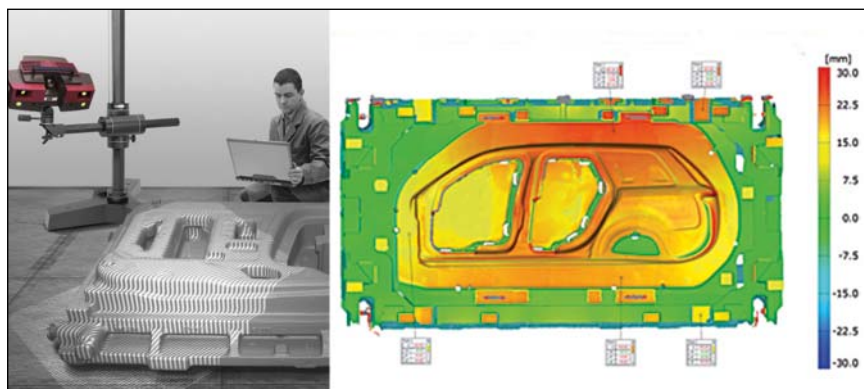


Figure 4: Castings, tools and patterns too big or too heavy to be moved into the measuring room are measured and inspected right in the foundry or in the workshop

For example, the verification of the milling results enables possible faults in pattern plates, moulding equipment or cores to be detected and corrected at a very early stage. The comparison of the milling result to CAD data of a core moulding tool may reveal that there is still too much material in the internal radii, for example, due to too short a radius of the milling tool. The operator easily sees which coreprint areas still need re-machining

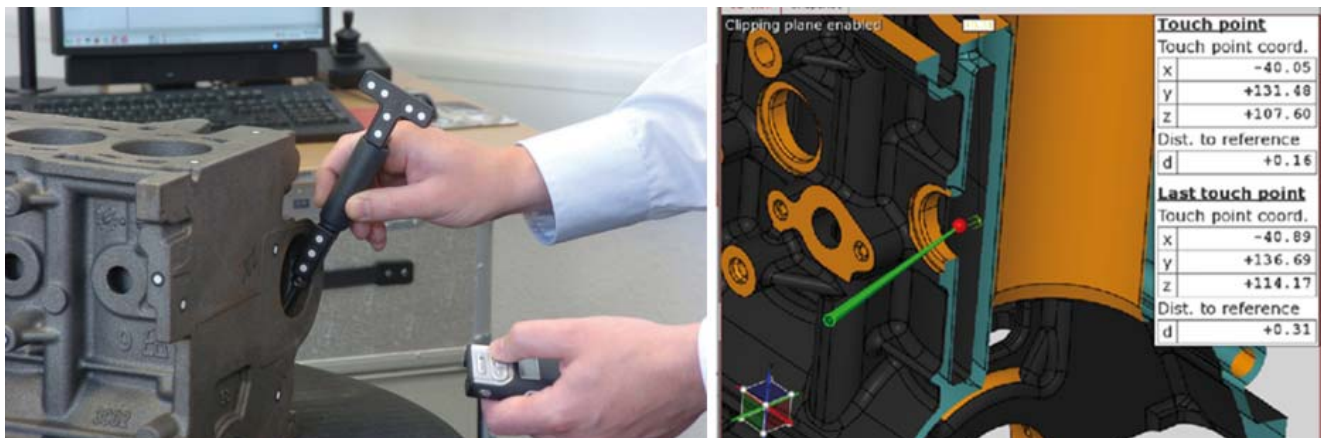


Figure 5: The GOM touch probe combines full surface non-contact measuring and tactile measuring in a single system. This allows for the first time the fast analysis of single points and standard geometries as well as the point-wise online comparison versus CAD even in areas inaccessible by optical systems

in order to receive the properly edged contours. (Figure 3).

Surface inspection of castings

The capability of measuring the entire surface of castings provides a further benefit to the foundry industry. Due to the dense measurement data it is possible to represent deviations to CAD data in form of colour graphics. Thus the inspection reports are easy to understand and the necessary correction measures are self-explanatory due to the use of colours. This approach reduces conventional inspection reports with reams of 2-D digits on hundreds of pages down to a few images with functional dimension only. This is an invaluable benefit both during the development phase and during the part approval process. The Atos measuring system is not limited to stationary use. It can easily and quickly be moved close to the object to be measured and is ready for use within 15 min. This makes it possible to measure and inspect castings, tools and patterns too big or too heavy to be moved into the measuring room right in the foundry or in the workshop (Figure 4). Due to its robust design, the sensor is ideally suited to be used in harsh industrial environments. The measurement volume can be adapted to the specific measuring task and object size by selecting the corresponding lenses. A lens change takes just a few minutes. Thus a single system can measure all objects – from

filigree investment castings through to voluminous engine blocks.

Non-contact and tactile measurements in a single system

Certain areas of a casting, such as cooling water jackets, oil ducts or deep cylinder bores, used to be inaccessible to optical systems. In such cases, the analysis was made by classical coordinate measuring machines. This was a time-consuming procedure, as the castings first had to be properly aligned and clamped. As a solution the GOM touch probe was developed. It is an optional accessory of the Atos system, combining non-contact surface measurement and tactile measurements of individual points in one system (Figure 5). With the hand-held touch probe, the operator can quickly switch between optical, 3-D scanning and tactile measurements of individual points, without having to reset the measuring arrangement. The touch probe enables online alignment of the castings but is also capable of inspecting online individual points for direct comparison with CAD data and of quickly checking standard geometries.

A single-source system with unmatched performance

The Atos 3-D digitizer is used along the complete process chains of foundries as a time-saving and robust measuring solution for patterns, sand cores, sand moulds/dies and castings. For automat-

Free software package GOM Inspect

With its free GOM Inspect software, GOM offers universal free access to 3-D data processing. GOM Inspect has been tested and certified by PTB & NIST. It serves as a mesh processing tool, as a tool for analyzing the shape and dimensions of 3-D point clouds and as a 3-D viewer.

With the free version, users in RP, CAD/CAM, CAE and CAQ can visualize, process and evaluate 3-D data provided by fringe pattern projection systems, laser scanners, CT and other measuring systems. GOM Inspect users also benefit from an individualized training concept including tutorials, training videos, sample data and a knowledge database.

Free download and test data at: www.gom.com

ic measurements of castings, turntables, robots and movable multi-axes units are available. The captured 3-D data can be analyzed by means of the GOM inspection software featuring a broad range of functions for professional shape and dimensional analysis. These solutions incorporating hardware, software, training and support have convinced many forward-thinking companies.

References:

www.giesserei-verlag.de/cpt/references

www.gom.com