KissSoft User Conference

Industrial
3D Measurement Techniques with ATOS

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GOM – Precise Industrial 3D Metrology

**GOM is a technology company**
Global industrial partner with over 20 years experience in the development and production of optical 3D metrology solutions

Source: LiA, University Paderborn
GOM – Precise Industrial 3D Metrology

Projected pattern  Regular pattern  Stochastic pattern  Point markers

**Know-how:**

- Digital image processing
- 3D coordinate measurement techniques
- Quality control
- Material parameters
- Automation
GOM – Precise Industrial 3D Metrology

**GOM Network**

GOM Group with 9 companies and branches

Continuous growth to over 350 employees within GOM Group

36 sales and support partners with over 55 offices worldwide

700 employees in worldwide network
GOM – Precise Industrial 3D Metrology

Optical metrology has become a standard in the development and production of industrial products

GOM measurement systems are used worldwide in industry, research institutions and universities

Automotive industry  Aerospace industry  Consumer goods industry  Research and Universities
GOM – Precise Industrial 3D Metrology Customers (Extract)

**Automotive**
Audi, Avtovaz, Bentley, BMW, Chrysler, Daihatsu Motor, Daimler, Fiat, Ford, GM, Honda, Hyundai, Isuzu, Jaguar, Kia, Land Rover, McLaren, Modenas, Naza, Nissan, Opel, Porsche, PSA, Renault, Seat, Skoda, Subaru, Suzuki, Tata Motors, Toyota, VW, Volvo, Temsa, ...

**Automotive Suppliers**
Automotive Lighting, Batz, Bertrandt, Bosch, Bombardier, Bridgestone, Carcoustics, DAAZ, Dräxlmaier, Faurecia, Georg Fischer, Gienanth, Goodyear, Hella, Johnson Controls, Kautex Textron, Michelin, Notherfer, Pininfarina, Siemens, Thule, ThyssenKrupp, ZF Sachs, ...

**Aerospace**
Airbus, Air Force Research Labs, Aselsan, Boeing, Cessna, Chrom Alloy, DLR, DNV, EADS, Eurocopter, FAA, FOI, Goodrich, Gorbynov Aviation, Hansen Transmissions, Hydro, IMPO, JAXA, Lockheed Martin, NASA, NLR, Northrop Grumman, ONERA, Vulcan Air, VZLÚ, ...

**Turbines**
ABB Turbo systems, Alstom, Aviadvigatel, BTL, Chromalloy, Elbar Sulzer, E.ON, Gorbynov Aviation, Honeywell, Howmet, IMA Dresden, MTU, Pratt & Whitney, Rolls Royce, Salut, Saturn, Siemens PG, Snecma, Solar Turbines, Triumph, Turbine Services, ...

**Comsumer Goods**
Adidas, Asics, ASUS, Blaupunkt, Bosch, Braun, Ching Luh Shoes, Ecco, FisherPrice, Foxconn, Fuji, Gillette, Greenpoint, Hilti, Lego, LG Electronic Mattel, Microsoft, Motorola, Nautor, Nike, Nokia, Philips, Reebok, Samsung, SANYO, Siemens, Sony, Stihl, Villeroy+Boch, Walt Disney, ...

**Material Supplier**
ACTech, Alfa Laval, Alcan (Alusuisse), Arcelor, BASF, Bayer, Corning, DuPont, EXXON, Hydro (VAW), Pierburg Kolbenshmidt, Salzgitter, Shell, Tata Steel, Thyssen Krupp, Thyssen Nirosta, Tokai Rubber Industries, Voest Alpine Stahl, ...
GOM – Precise Industrial 3D Metrology

GOM solutions simplify complex measurement tasks in product development and production

Improving product quality and production throughput

Shortening of development processes

Improving quality assurance throughout the entire product life cycle

Cost reduction

Improvement of competitiveness
How ATOS works?

Full-field component measurement

3D Data for follow-on processes

Functionality and measurement process

Inspection software: Evaluation workflow
Full-field component measurement

Optical 3D scanner for three-dimensional component measurement and inspection

Any object size, surface characteristics and component complexity

Full-field, precise 3D coordinates

Non-contact
3D Data for follow-on processes

**ATOS provides 3D Mesh (STL)**
High resolution for finest details
Measurement of small radii

- Reverse Engineering
- Additive Manufacturing
- CNC Machining
- Quality Control
3D Data for follow-on processes

ATOS provides 3D Mesh (STL)
High resolution for finest details
Measurement of small radii

Data for follow-on processes

Reverse Engineering
Additive Manufacturing
CNC Machining
Quality Control
3D Shape and Dimension Analysis with ATOS

Measurement process in three basic steps

Step 1
Measurement

Step 2
Evaluation

Step 3
Inspection Report/Table
3D Shape and Dimension Analysis with ATOS

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Functionality and measurement process

Fringe projection supplies precise 3D coordinates for each pixel.
Functionality and measurement process

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2. Approx. 2 seconds for each individual measurement of 16 million points.
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4. Automatic transformation of single measurements.
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5. Polygonization of individual measurements to eliminate overlapping areas
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6. The result a complete 3D point cloud (STL triangular mesh)
Functionality and measurement process
3D Shape and Dimension Analysis with ATOS

Measurement process in three basic steps

Step 1
Measurement

Step 2
Evaluation

Step 3
Inspection Report/Table
Basic Concept of the Inspection Software

Evaluation workflow

Nominal data
(CAD/STL = nominal part, measuring plans, FTA)

Actual data
(meshes, point clouds)

Alignment of actual data to nominal data
(RPS, 3-2-1, best-fit)

Comparison/inspection
(surface, sections, coordinates, GD&T, tolerances)

Inspection reports
(diagrams, tables, free viewer)
Basic Concept of the Inspection Software
ATOS Technology

- ATOS system overview
- Stereo camera setup
- GOM reference point system
- Process safety
  - Dynamic referencing
  - Integrated monitoring
- Blue Light Technology
- Triple Scan Technology
- GOM Touch Probes and adapters
- Tracking and back projection
- Certified precision
- Calibration by user
- Flexible sensor concept
- Mobile - stationary - automated
- ATOS ScanBox series
- GOM Software
- Industries
3D Scanner of the ATOS Series

Today, optical 3D measuring technology and full-field surface measurement systems have become a standard tool within virtually all industries worldwide. ATOS is engineered with advanced hardware and software providing precise measurement results for industrial applications.
Basic Concept of ATOS

Stereo Camera System

Using the triangulation principle in conjunction with the fringe projection technique, precise 3D coordinates are captured by the stereo camera system.
GOM Reference Point System

Strategies for transformation of single measurements
Both variants can be used in the GOM software

Measurement Without Reference Points
Only possible with sufficient object geometry
No process reliability

Measurement with Reference Points
Also possible on continuous surfaces
Process-safe measurement strategy
Process Reliability in Measurement Operations

Dynamic Referencing

The combination of the stereo camera technology with GOM's reference point system delivers for each measurement an overdetermined system of equations.
Process Reliability in Measurement Operations

**Integrated Monitoring**

The combination of all these checks during the measurement leads to a process-safe measurement strategy in the current measurement operation and ensures the accuracy of each individual measurement.

- Unique transformation of single measurements
- Online tracking of sensor position
- Online monitoring of sensor/object movement and ambient light
- Online monitoring of sensor calibration

- Measurement data captured without user intervention
- Free positioning of part to sensor
- Prevention of measurement errors
- Verifiable measurement accuracy
Blue Light Technology

- Blue LED light source
- Low bandwidth/narrowband blue light
- Digital and calibrated projector
- Scanning in any ambient light
- Less reflection and picture noise
- Better data quality
- Back projection of elements from the software such as lines, points, isolines
Triple Scan Technology

3-in-1 Sensor Concept

Right and left camera, each combined with the projector

Three different views of an object during a single measurement process

Measurement Results

Reduces the number of individual scans: faster overall measurement thanks to fewer single scans, even on complex components

Improved measurement of shiny surfaces, through avoidance of 'hot spots'

Better measurement of deep pockets
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Measuring Difficult-to-Access Areas

- GOM reference point system
- CT data inspection with GOM software
- GOM Touch Probe
GOM Touch Probe and Adapters

The ATOS Sensor serves as a tracker for the reference point group on the GOM Touch Probe and adapters

**GOM Touch Probe**

Measurement of hidden/partly hidden surfaces

Measurement of primitives

Comparison of measurements with CAD data

Quick measurement of individual points

Online alignment
Optical and Tactile in a Single System

GOM Touch Probe combines full-field and pointwise measurement

- Fast process, since all measurements are made with one system
- All evaluations (full-field and tactile) performed directly in the ATOS software
Optical and Tactile in a Single System
Tracking and Back Projection

**Tracking**
Enables component alignment and positioning as well as transfer of the optimum virtual alignment to the real/physical world.

Applications in industry:
- Component positioning for CNC machining on a machine tool
- Assembly analysis of molds and tools
- Meisterbock & Cubing
- Online positioning of a component in the nominal position or in an assembly
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**Back Projection**
Enables direct projection of elements onto real physical components in order to support machining and/or visualization.

Applications in industry:
- Fast marking of workpiece
- Marking for positioning in the milling machine
- Verification of inspection results on the physical workpiece
- Marking of machining areas
Tracking and Back Projection
Tracking and Back Projection
Certified Precision

GOM acceptance test of system accuracy according to VDI guideline 2634, part 3, with the title "Optical 3D-measuring systems - Multiple view systems based on area scanning"

Verification goes beyond the requirements described in the VDI/VDE guideline

Re-verification of the system accuracy is possible at the customer site at any time
Calibration by User

ATOS is pre-calibrated and ready for operation on delivery and thus requires only low maintenance.

During the measuring process, GOM systems automatically monitor their accuracy.

Re-calibration by the user or automatically by using a robot.
Flexible Sensor Concept

From small to big – stationary and mobile

From small to big

Flexibly scalable measurement fields

... in the office

... in production
Mobile – Stationary – Automated

One sensor head | modular design

Mobile measurement system  Stationary system  Automated measuring cell
**ATOS ScanBox**

**Automated Full-field 3D Metrology**

Standardized robotic measurement cell

Fully automated 3D digitizing and inspection

For different component sizes and applications
GOM Software

All 3D software solutions are part of GOM's industrial measuring systems.

GOM Scan

Software for simple scanning tasks with ATOS Core provides high-quality 3D polygon meshes in STL format.

ATOS Professional

Numerous features for control of ATOS measuring systems with extensive shape and dimension analysis.

GOM Inspect Professional

Inspection of 3D point clouds from white light scanners, laser scanners, CTs and other sources.
Industries

ATOS is used in automotive, aviation, aerospace and consumer goods industries, their suppliers as well as research institutions and universities.
Case Studies Gear Applications
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Surface Comparison

[Graphs showing case studies]
Case Studies Gear Applications

360 degree section with virtual probe sphere with 8mm radius, gear A / II
Case Studies Gear Applications
Case Studies Gear Applications
Case Studies Gear Applications

Deformation of the assembly at 205 Nm
Case Studies Gear Applications

Deformation of the assembly in the different load stations (preload 7.5, 105, 180 and 205 Nm)
Case Studies Gear Applications

Deformation with Rigid Body Motion Compensation (RBMC) by the frame. Vectors 2500x enlarged
Thanks for your time
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