Vtech User Meeting 2018

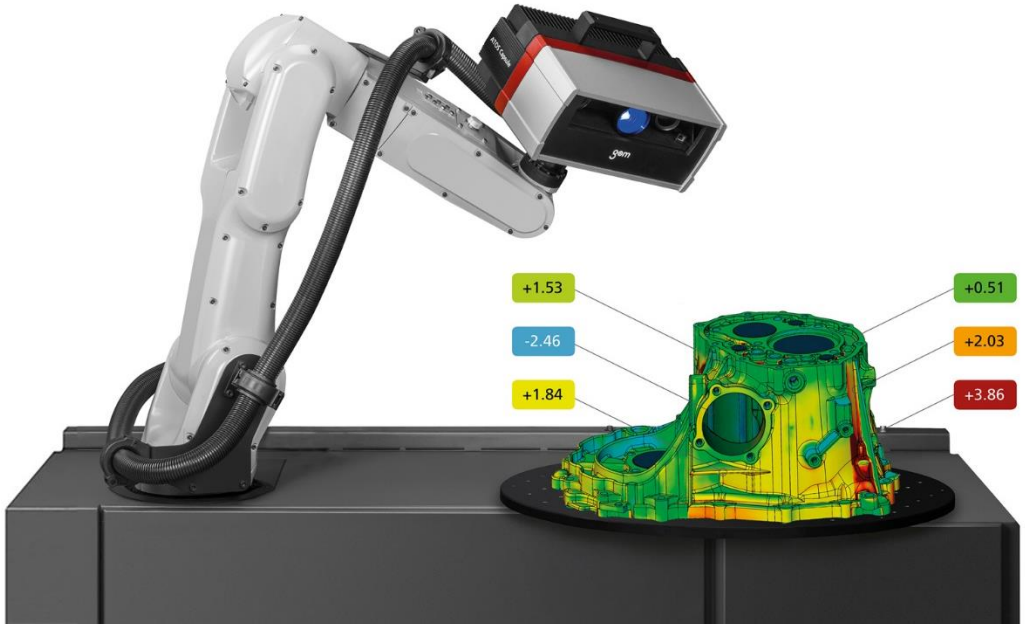
GOM –

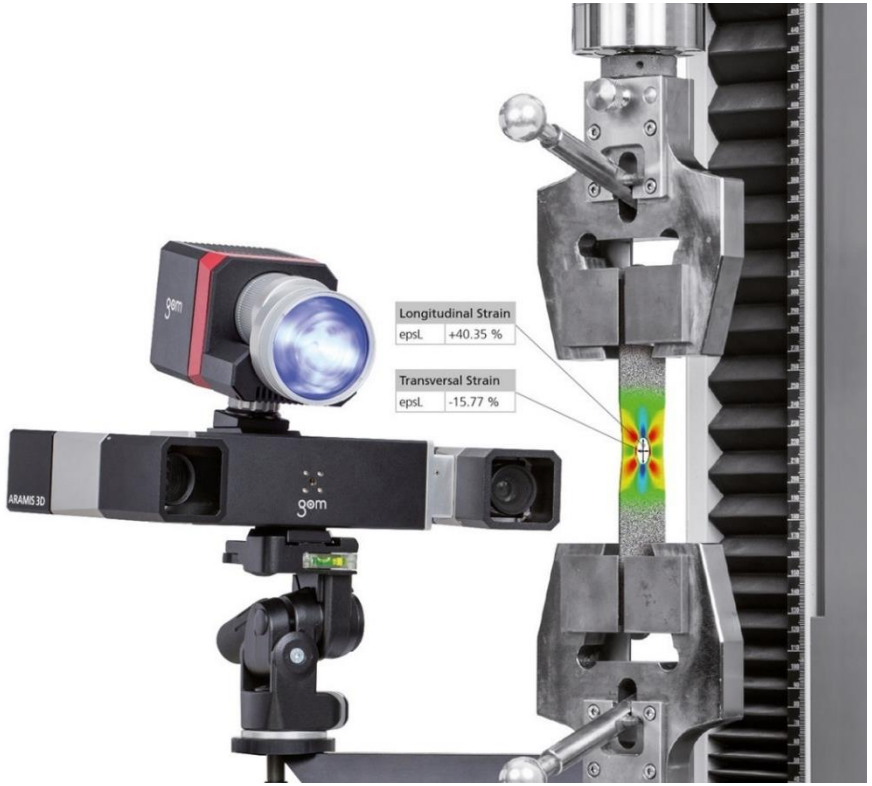
Precise Industrial 3D Metrology

S. Hoheisel | Sales Manager Americas

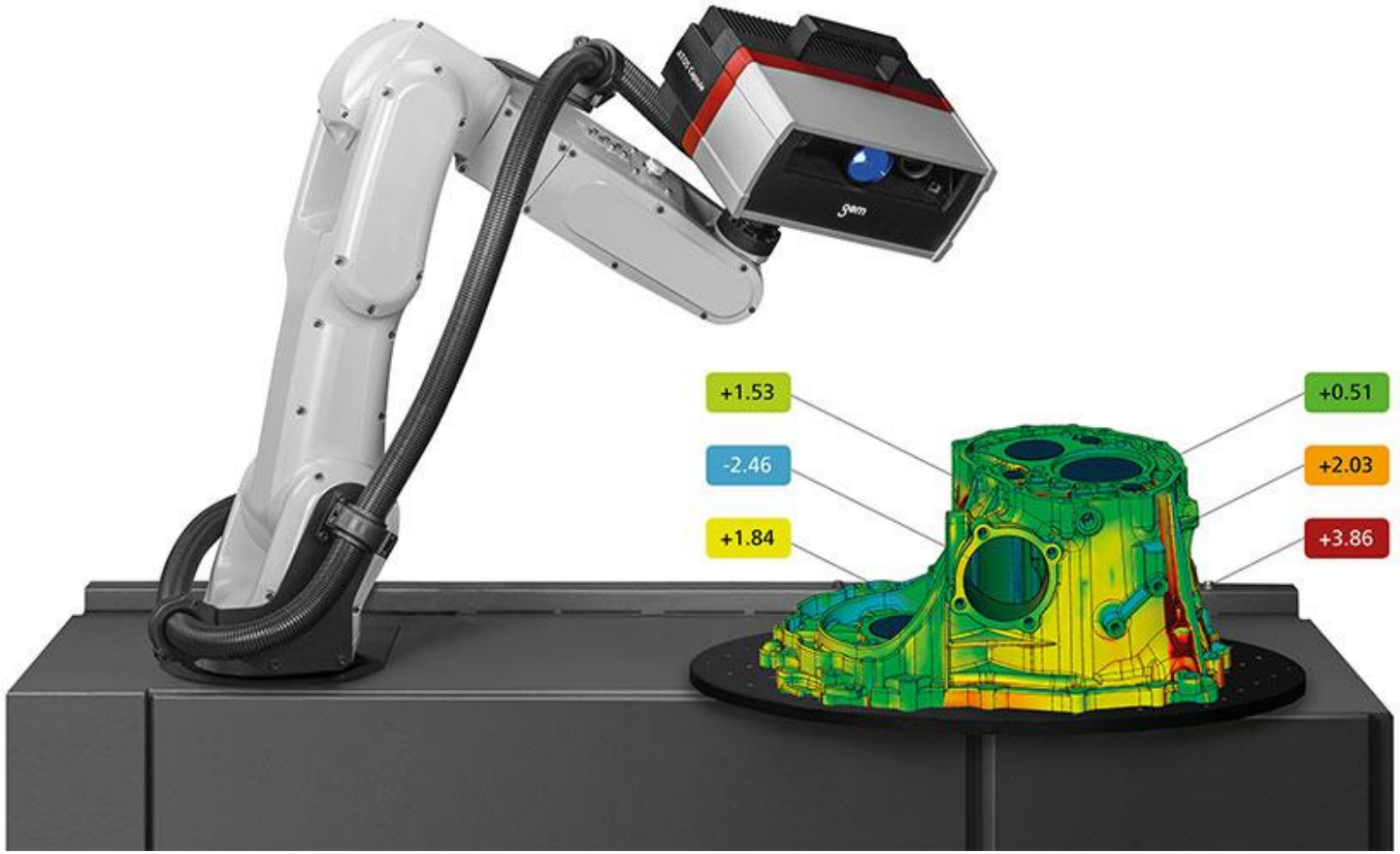
3D Coordinate Measuring / 3D Testing

GOM develops, produces and distributes software, machines and systems for industrial and automated 3D coordinate measuring technology and 3D testing

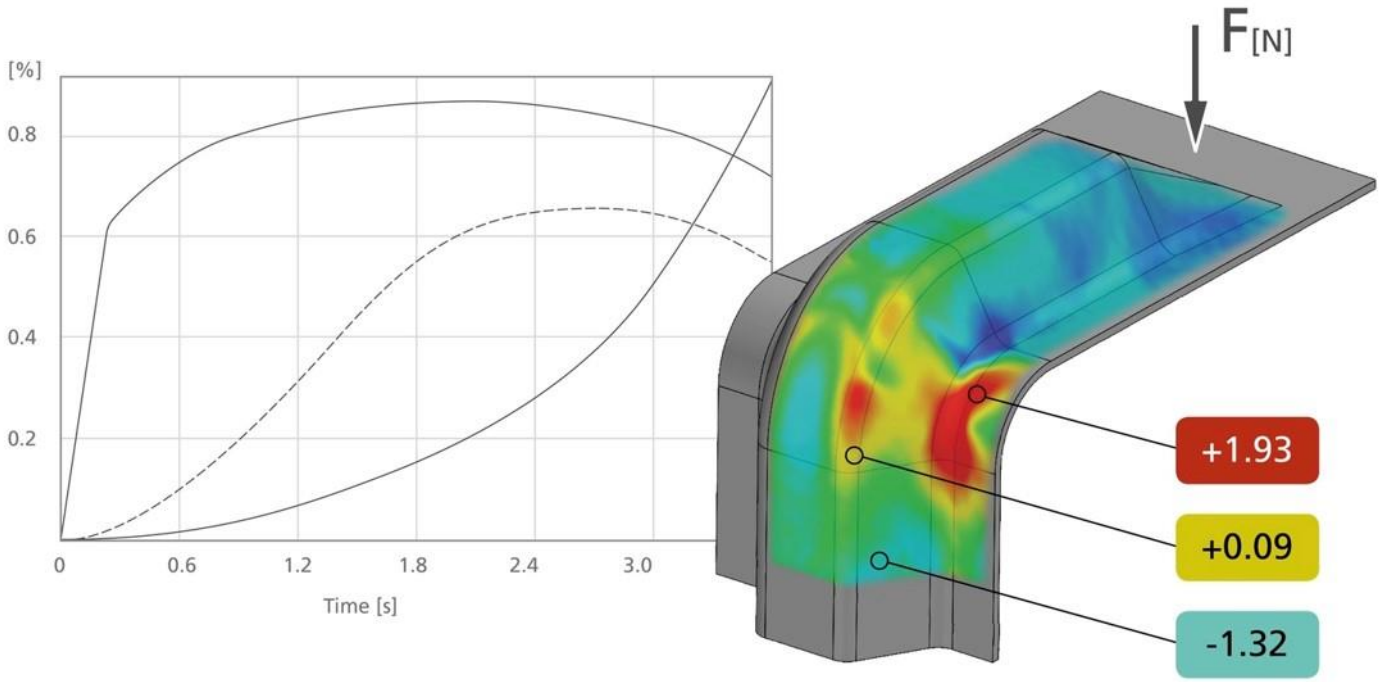




3D Coordinate Measuring



3D Testing



GOM Headquarters

Founded in 1990

Private, owner managed company

Research and development, production and administration in Braunschweig, Germany

GOM Metrology Network

60 sites worldwide

1,000 metrology specialists

GOM Group with 8 companies and branches

Continuous growth to over 500 employees in GOM Group

GOM Metrology Network

GOM Support Hubs

Braunschweig, Germany
Shanghai, China
Charlotte, USA

Products


GOM Inspect Professional
GOM Software
License Dongle
gom


gom


ATOS
SCANBOX
gom

ATOS

Optical 3D Coordinate Measuring Machine

For measuring room and production

Series 4 Series 5 Series 6 Series 7 Series 8

Setting Standards

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 – 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, Nothelfer, 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, …

Over 14,000 system installations worldwide

Turbines

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

Consumer 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 Kolbenschmidt, Salzgitter, Shell, Tata Steel, Thyssen Krupp, Thyssen Nirosta, Tokai Rubber Industries, Voest Alpine Stahl, …

Why are we all here today?

Measurement technology is currently in a state of transformation

We think that many of today’s metrology workflows are obsolete for modern production metrology

Previously, the typical metrology setup was a CMM integrated in a measurement room

CMM Measurement Room is Optimized for Repeatable Measurements

Controlled temperature

Simplified feature measurement
- same probing points
- few probing points

Only sub-sample of geometry gets inspected

Reality in Production

Temperature changes
Imperfect feature geometries
Hidden process errors

Main targets in production

High output and low rework/scrap

Are CMM measurement room reports the best way to

identify, analyze and fix

the production process and quality problems as quickly as possible?

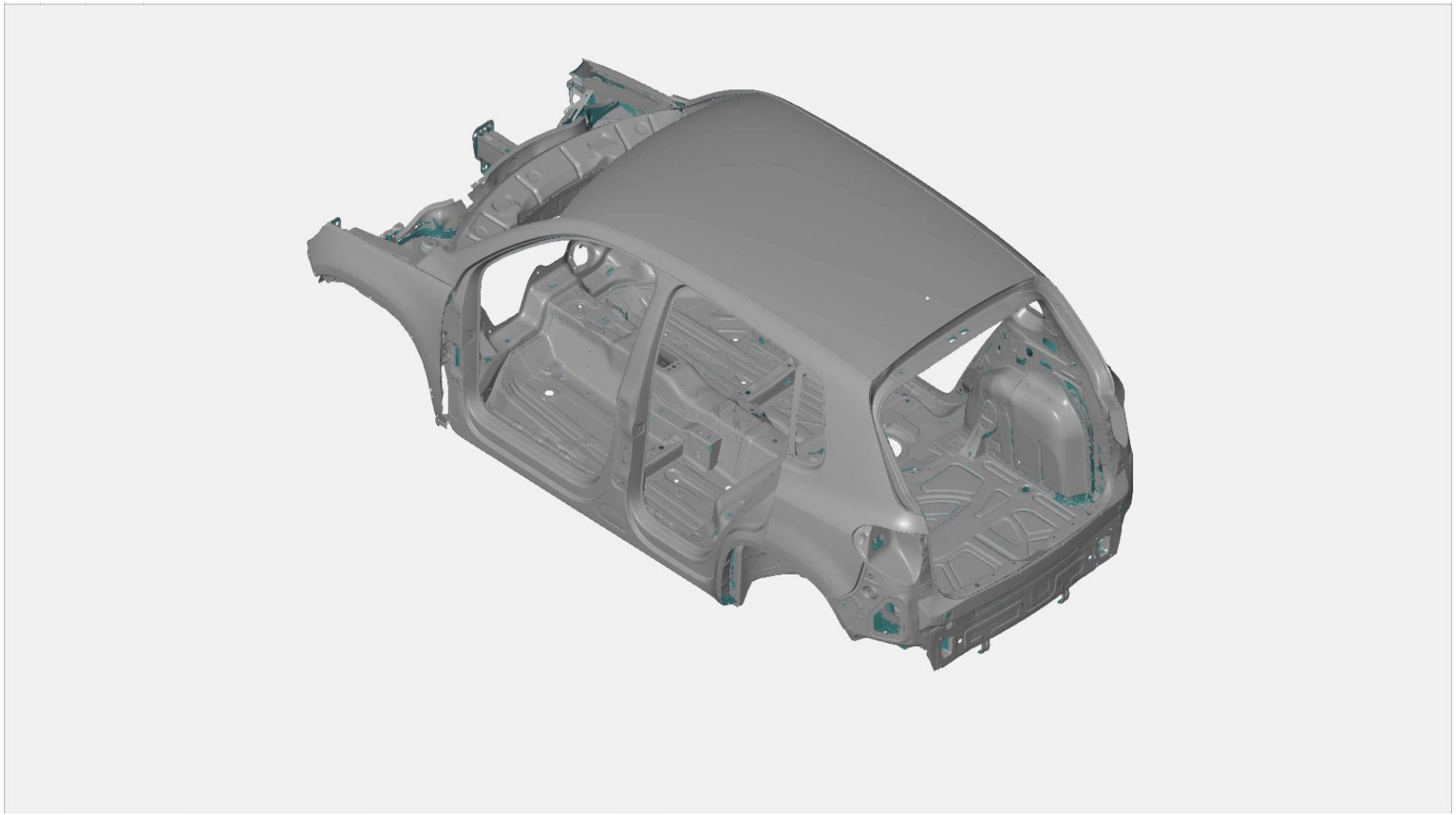
We need the **complete** information to do that

We need a complete 3D model as a

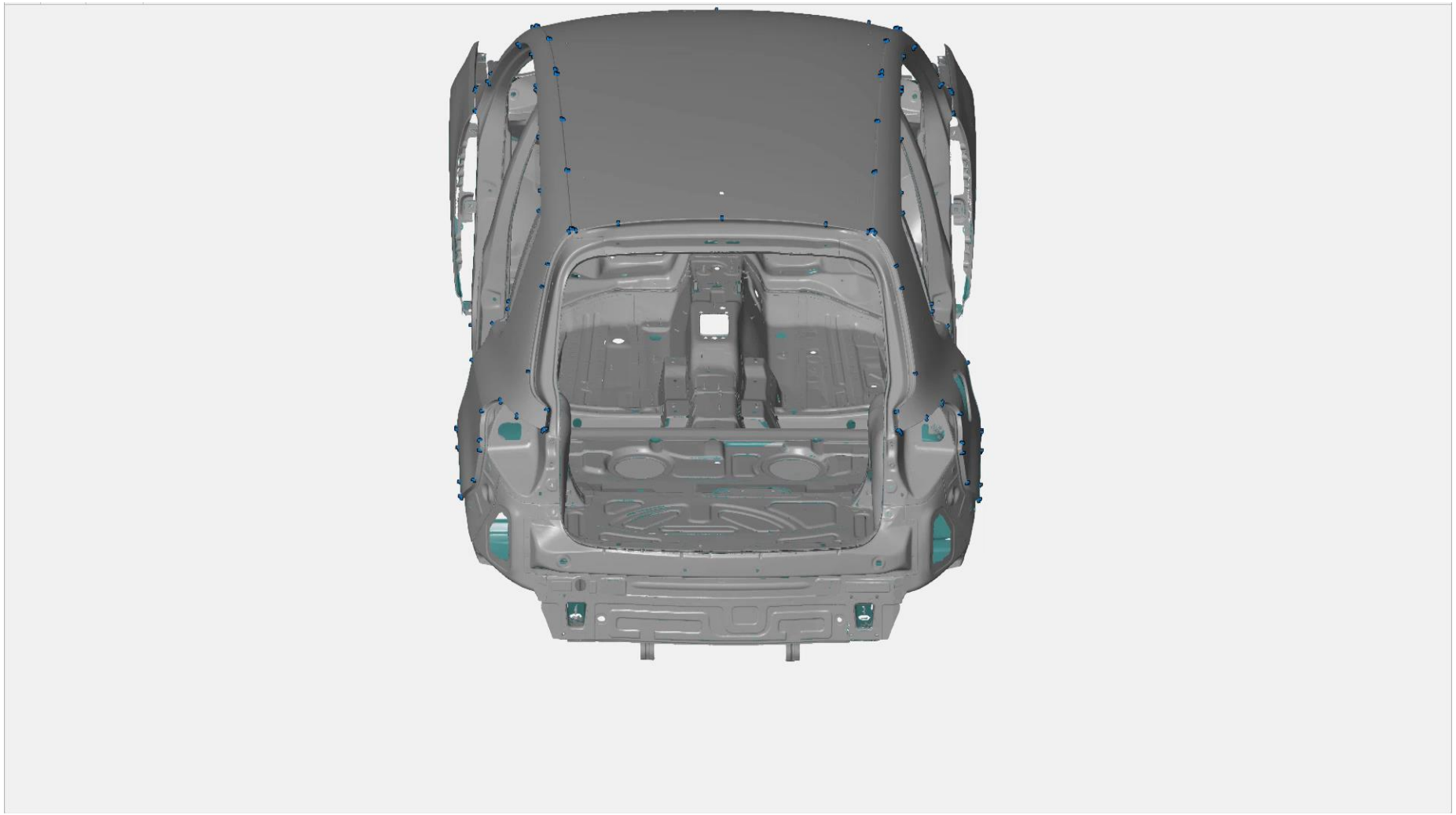
digital twin

of the real part in production

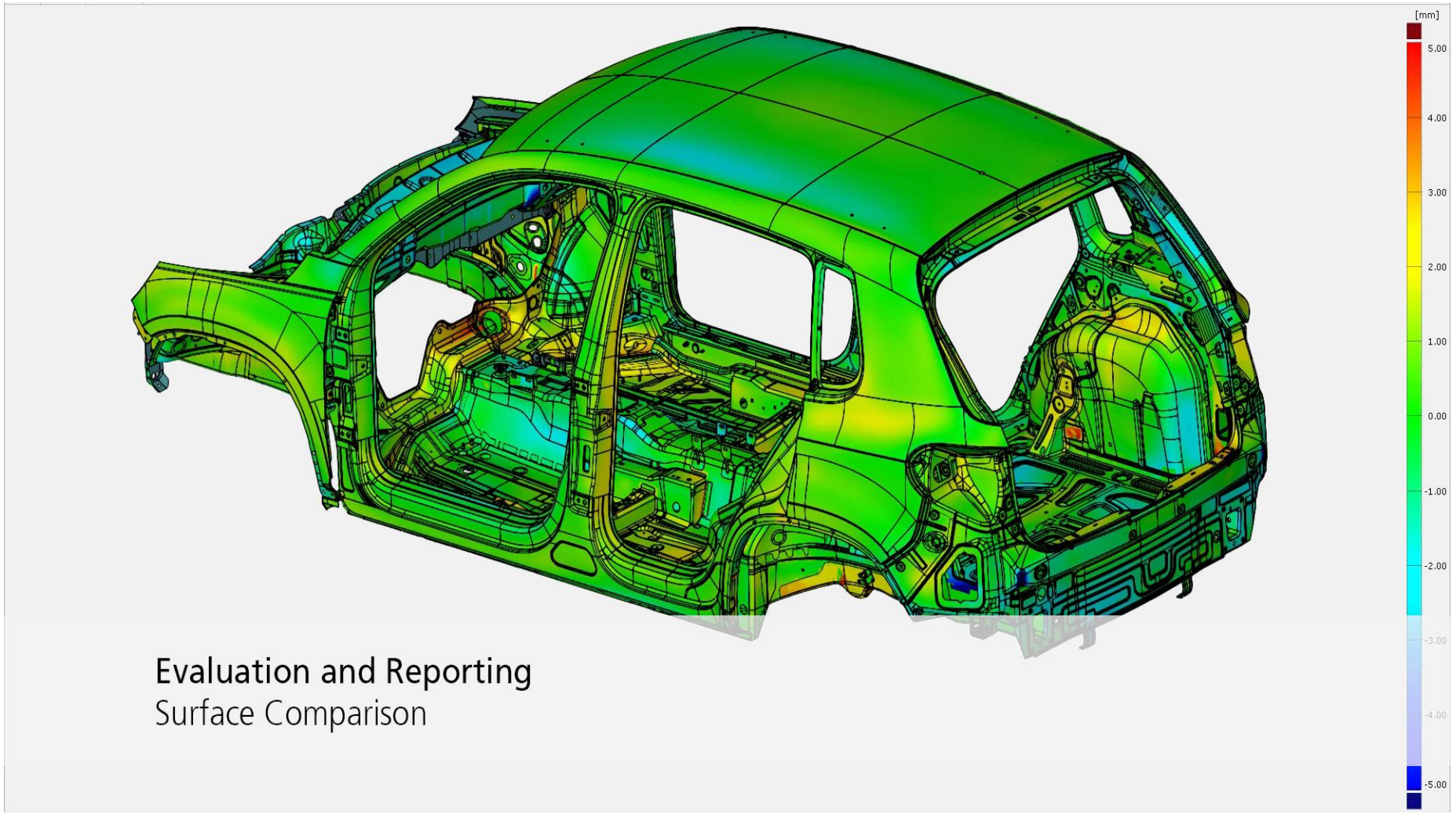
Digital Twin: Complete Virtual Copy of the Real Part



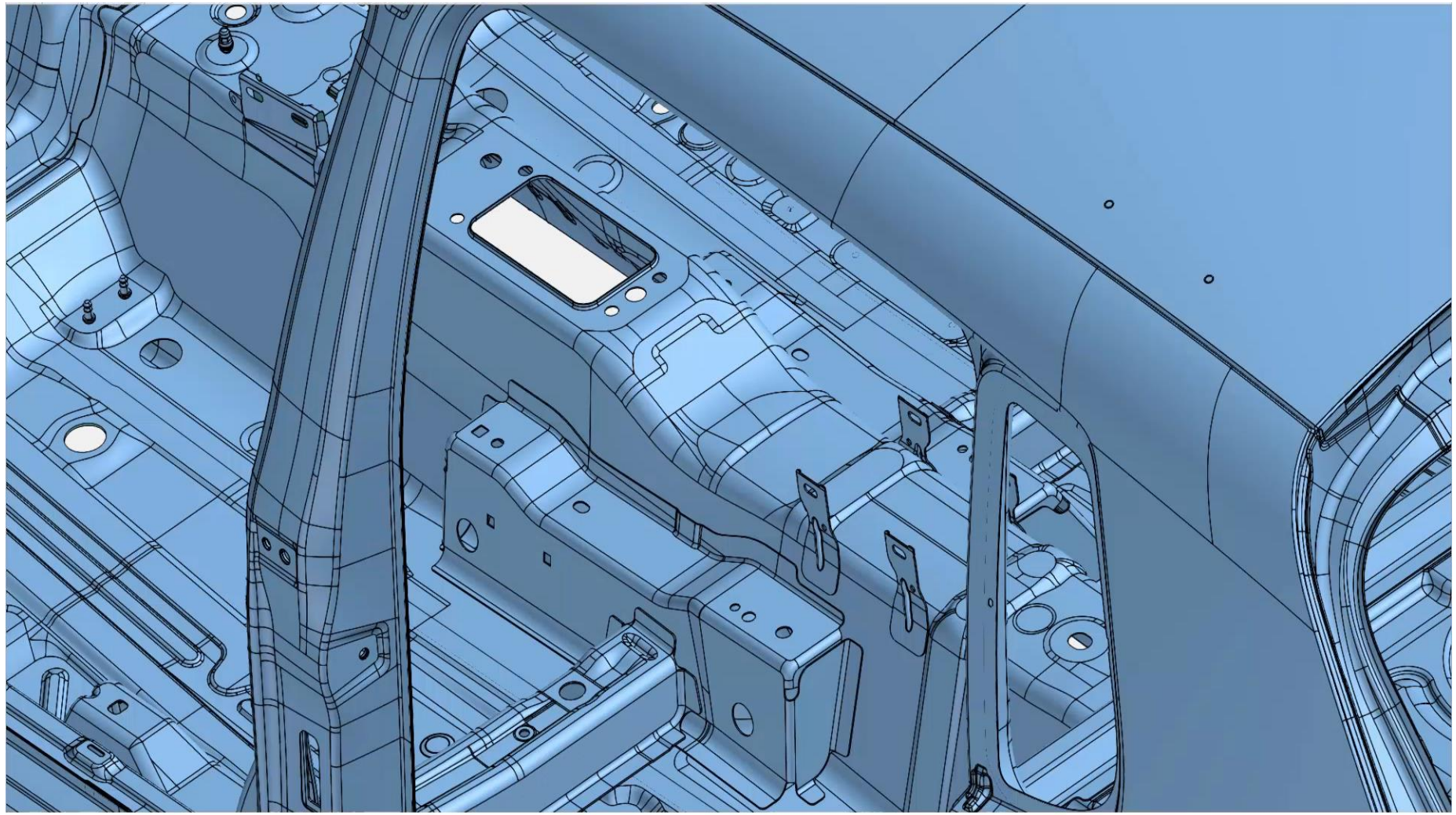
Process Control without Physical Checking Fixtures



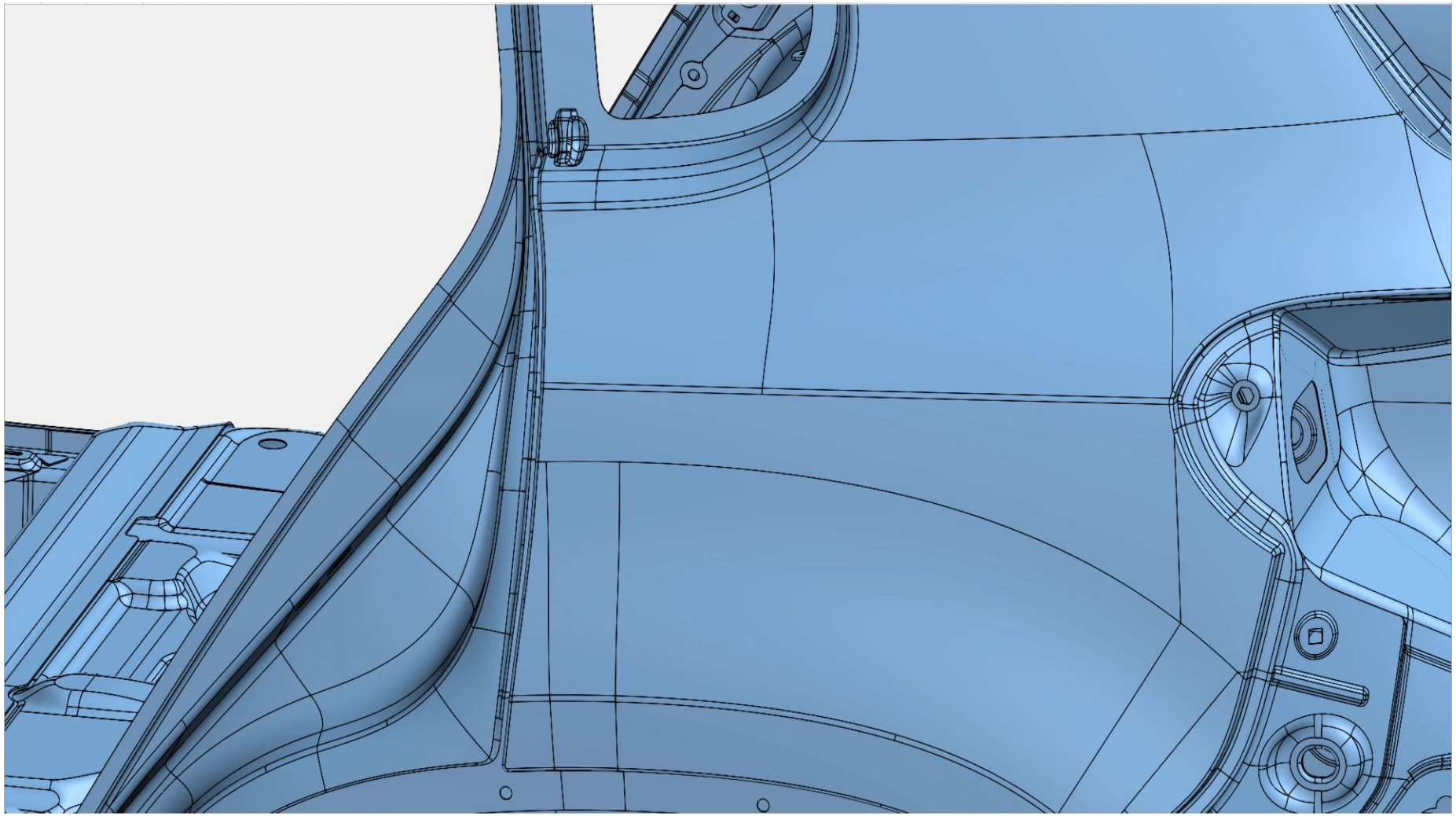
Full-Field Quality Control



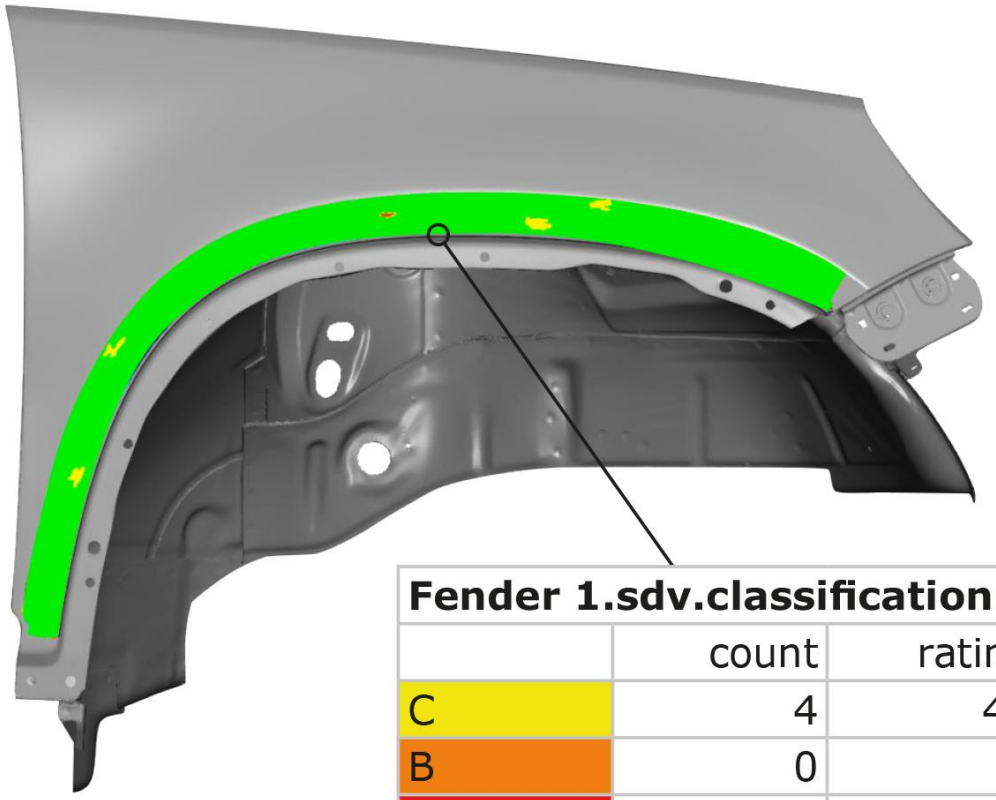
Curve-Based Evaluation



Digital Assembly without Physical Cubings, Mock-Ups or Meisterbock



Surface Inspection and Classification without Manual Processes



Fender 1.sdv.classification		
	count	rating
C	4	40
B	0	0
A	1	100
total	5	140

Technology Preview 2019

Surface Inspection

What Kind of Surface Defects Are We Looking for?

Bulges

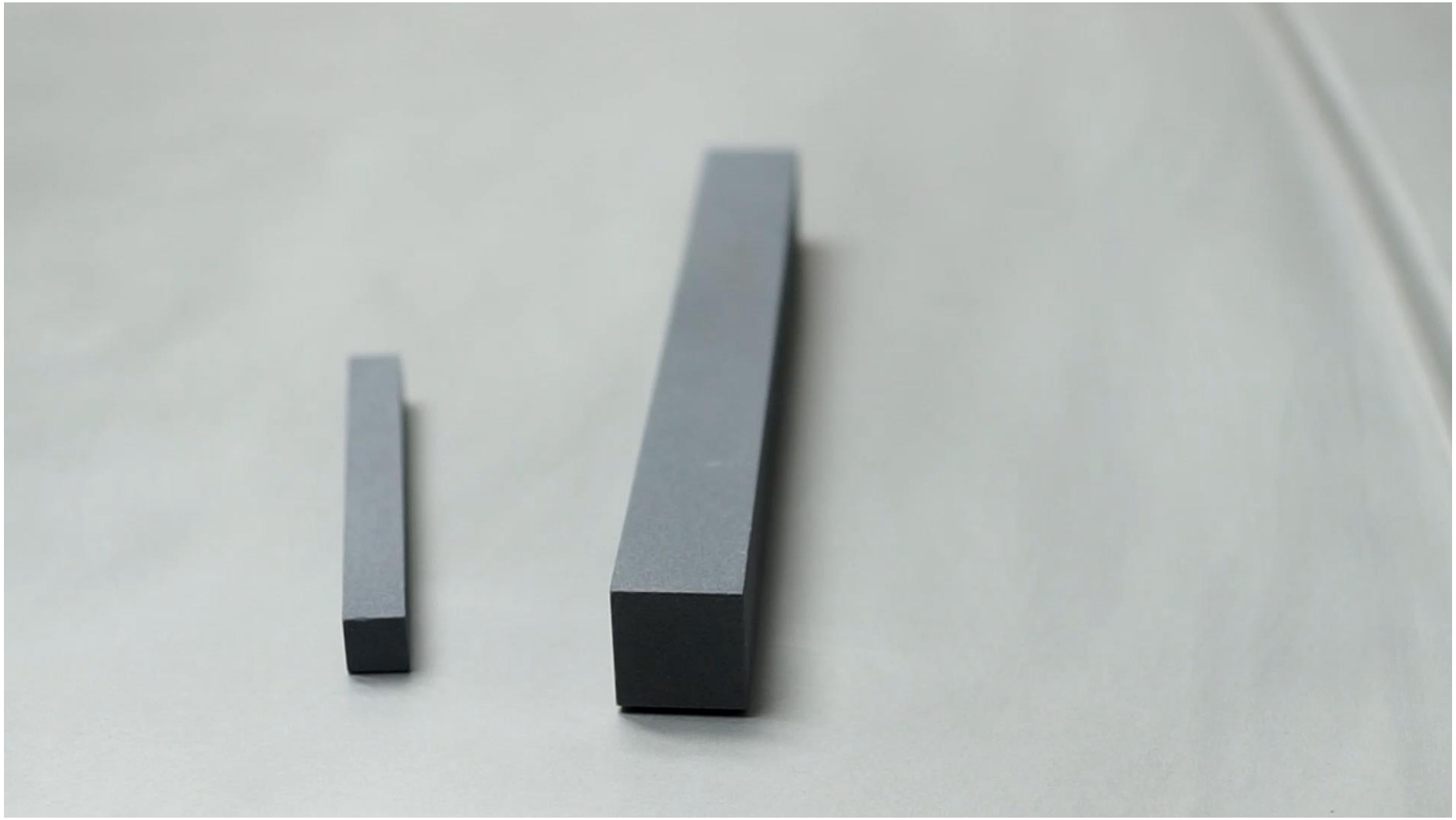
Dents

Scratches

Rests of glue

Weld spatters

The Manual Approach



Why Do We Need a New Solution?

Manual approach is slow
If a defect occurs, all following parts will have that defect.
If you can inspect faster, less parts will fail.

Manual approach is subjective
Depending on the auditor, the same defect can be ranked into different classes.

Manual approach is expensive
Many people are working on the part inspection.
If a defect was found, many parts passed already without inspection.

Manual approach is not fully traceable
If there comes a claim in the future

The GOM Approach

Based on absolute, dimensional measurement

Evaluate triangulated meshes with software

Adjustable parameters like in the manual approach

Parametric project templates

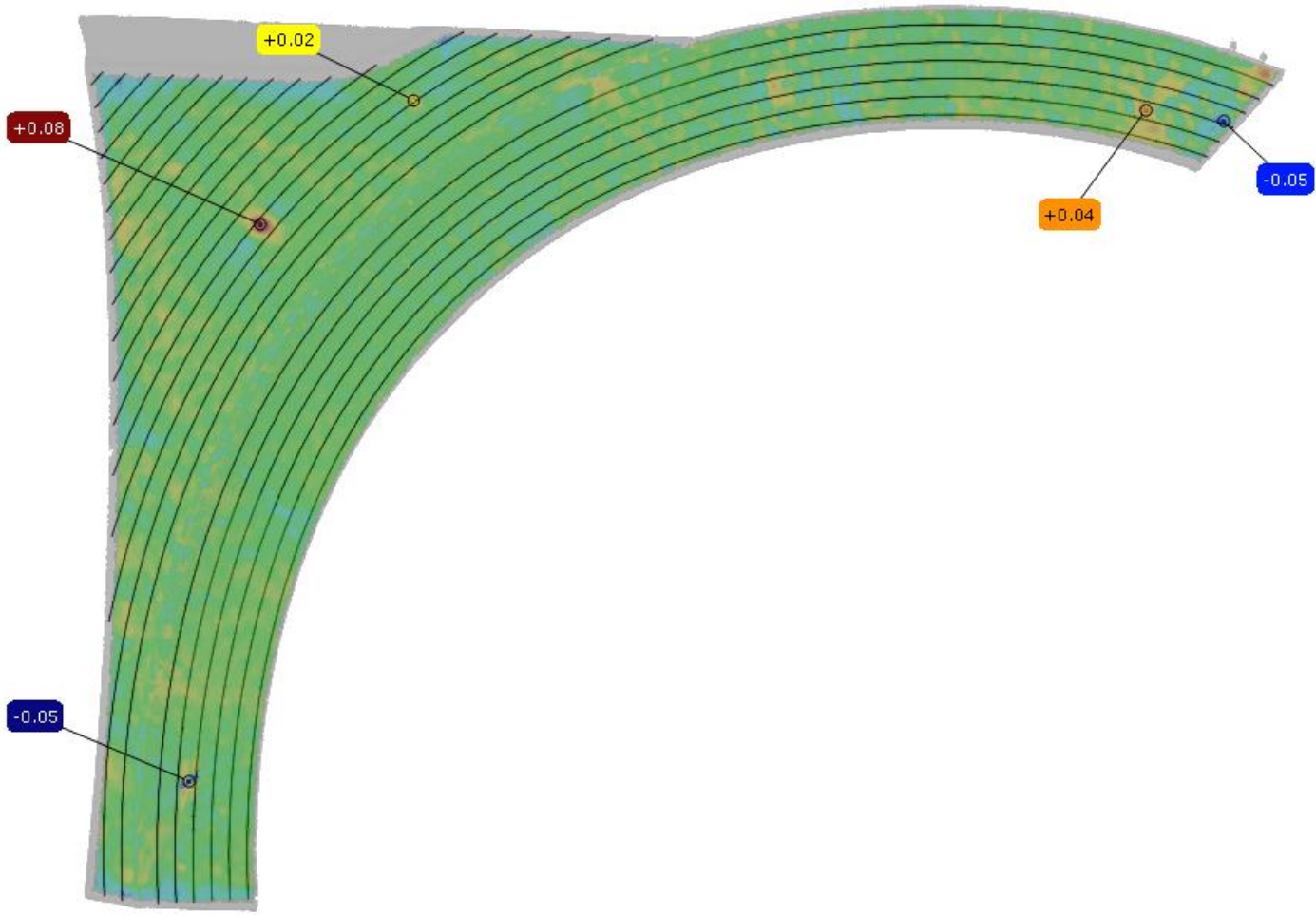
Classification based on defect properties

The GOM Approach

Create sections parallel to the physical grinding direction

Calculate deviations against a local adjusted reference geometry

Show the results in a color map



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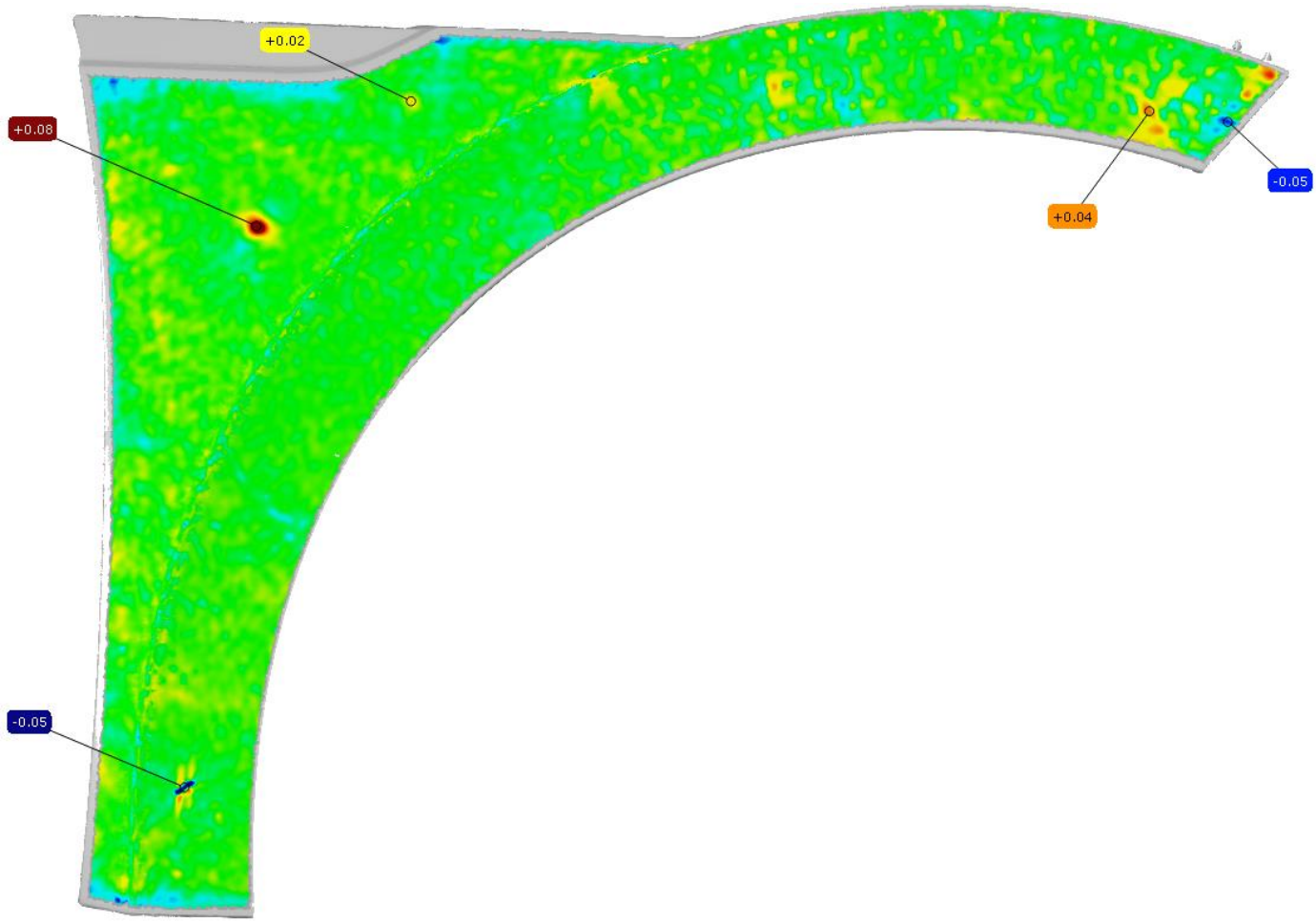
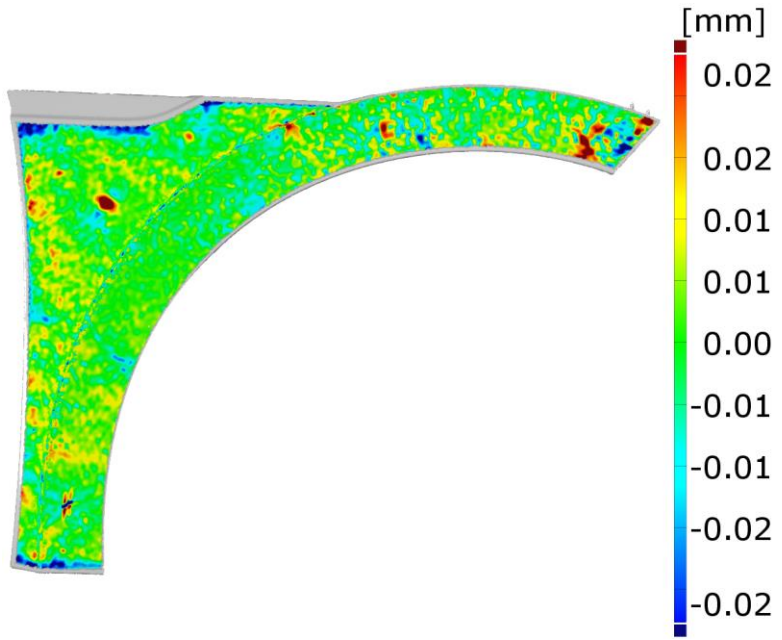


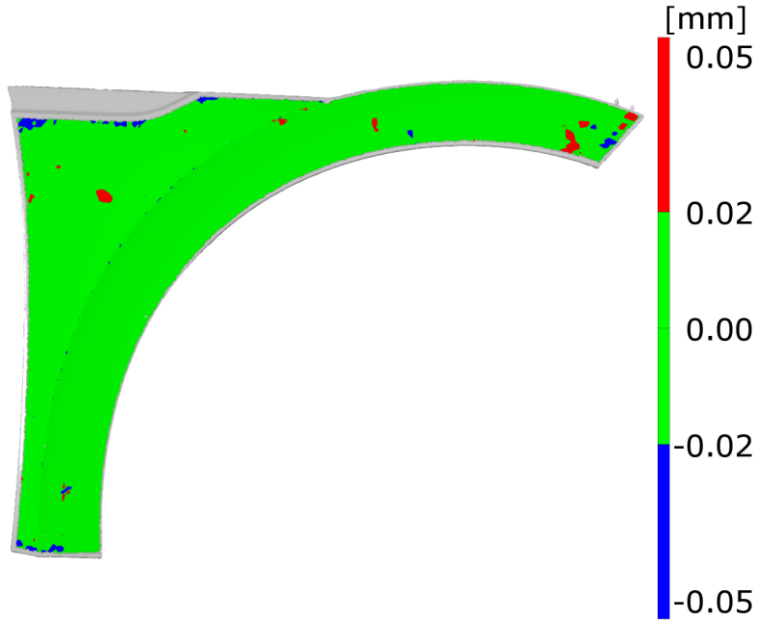
Preview: Defect Classification

Is the limit value to identify defects.

A defect is a region of the surface where the defect map values exceed a certain limit.

Each defect is isolated and some characteristics are computed:





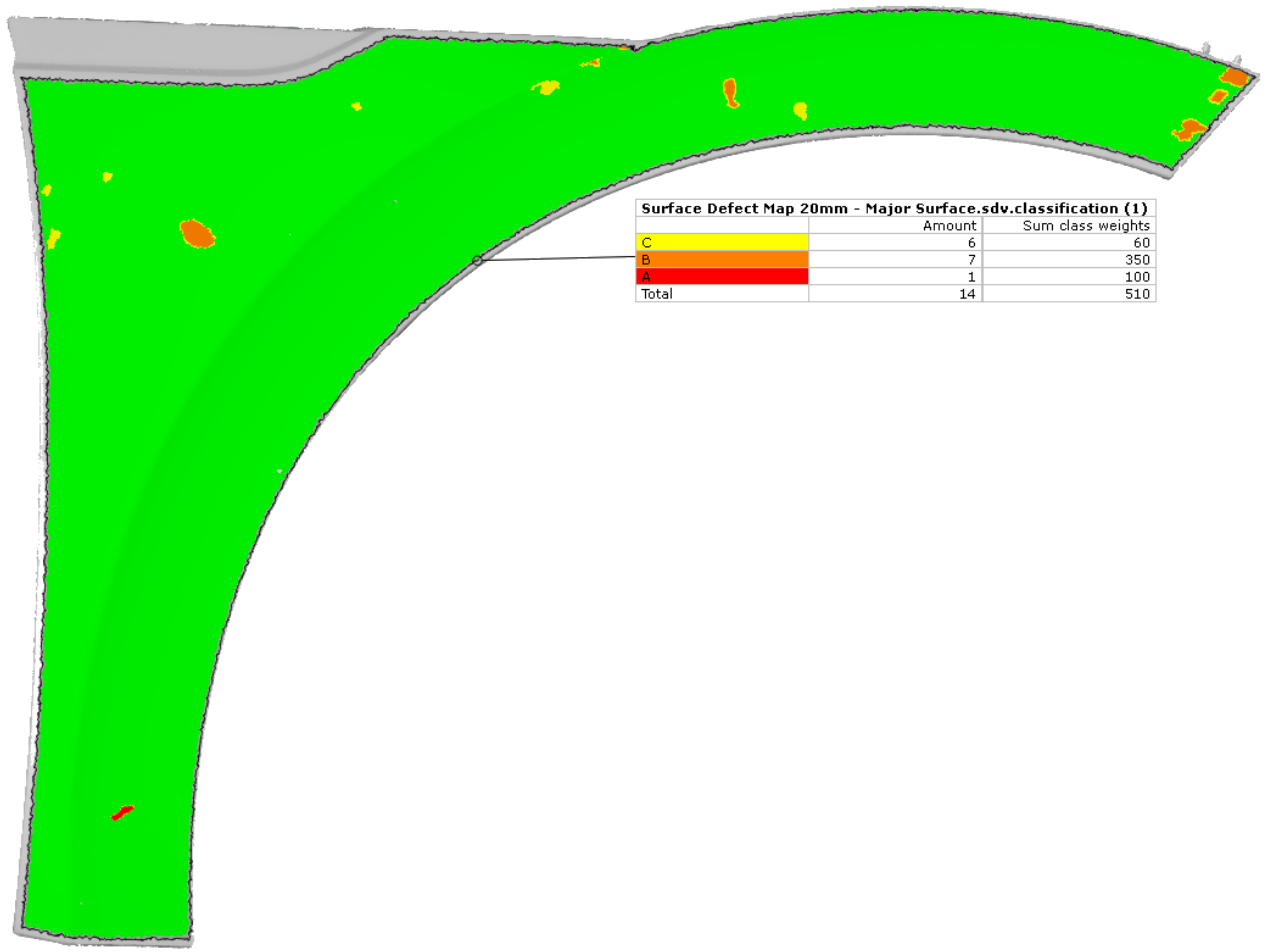
Preview: Defect Classification

Classify the results inside of the color map based on the properties of each defect

Each class can have a weight to assess the quality of a part by one single number

Unlimited amount of classes can be defined

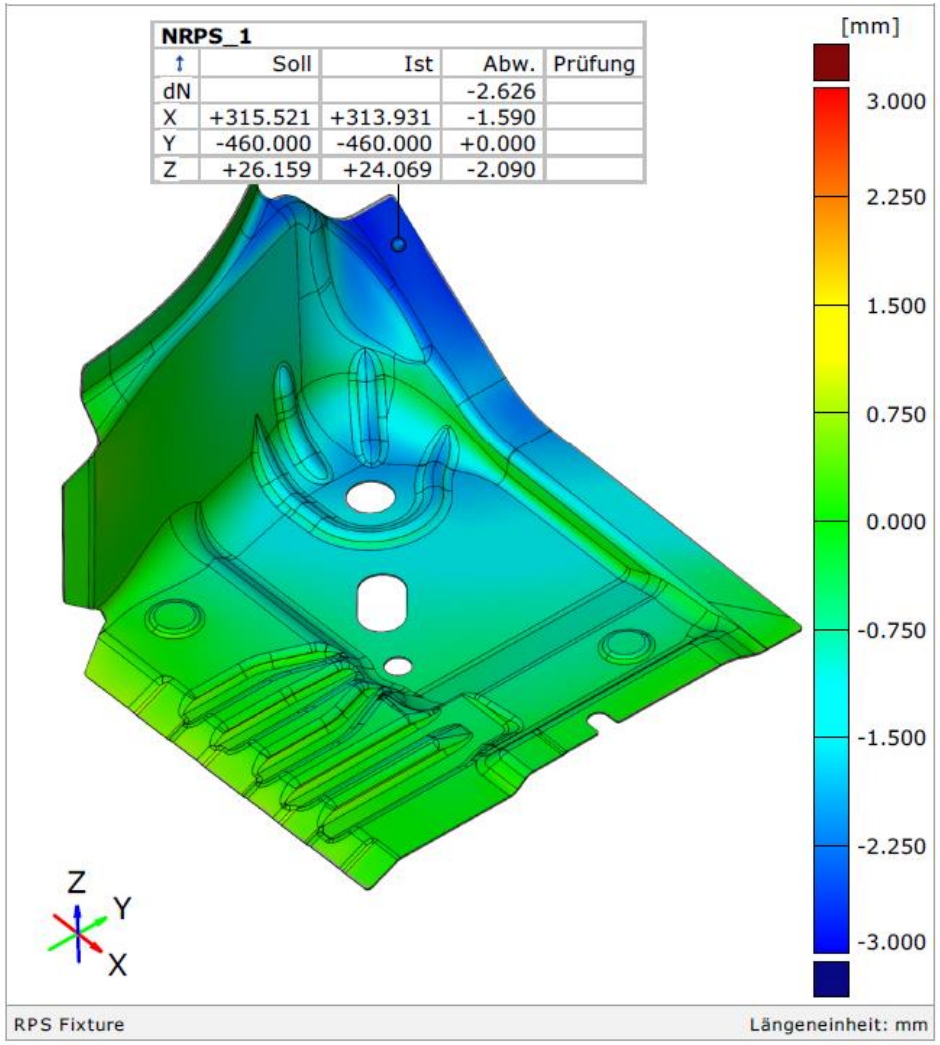
Available with GOM Software 2019

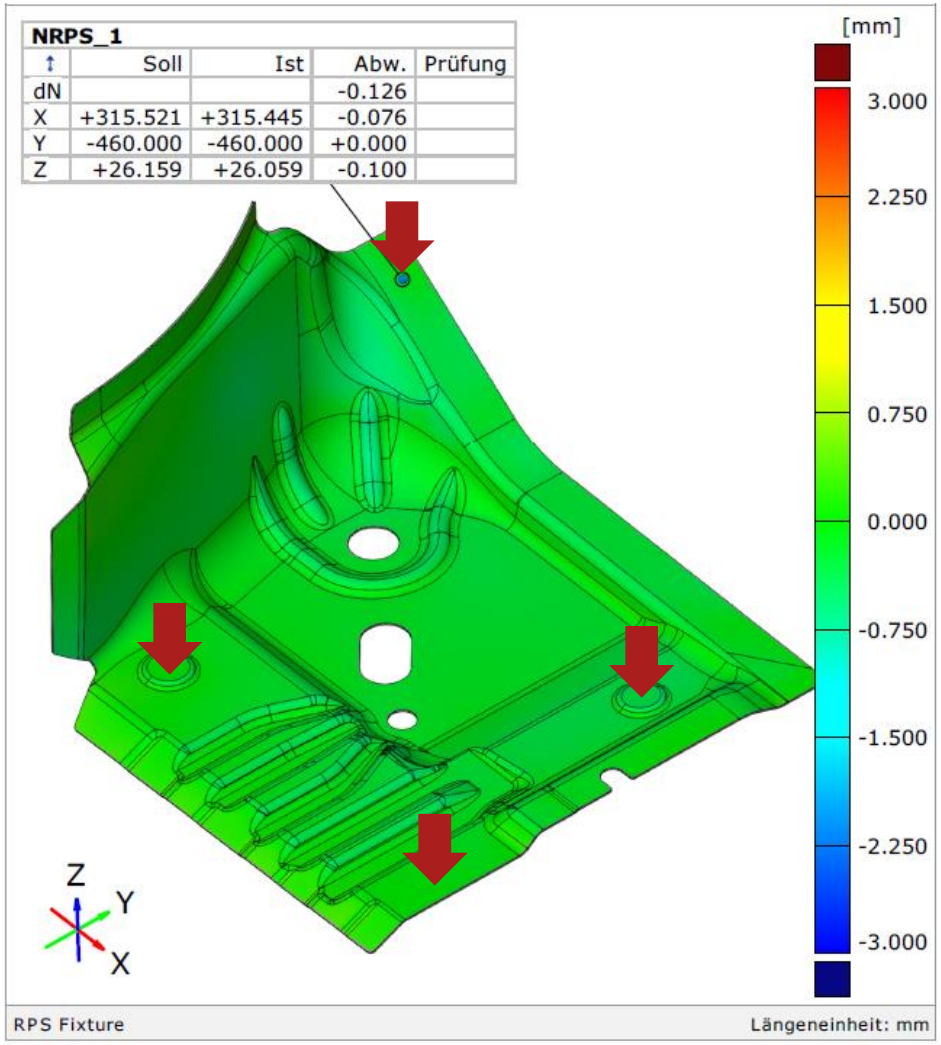


Technology Preview 2019

Virtual Clamping

Virtual Clamping without Physical Clamping Fixtures





Why Using Clamping Fixtures for Measuring Non-Stiff Parts?

Toolmaker tries to produce parts with as low warpage as possible

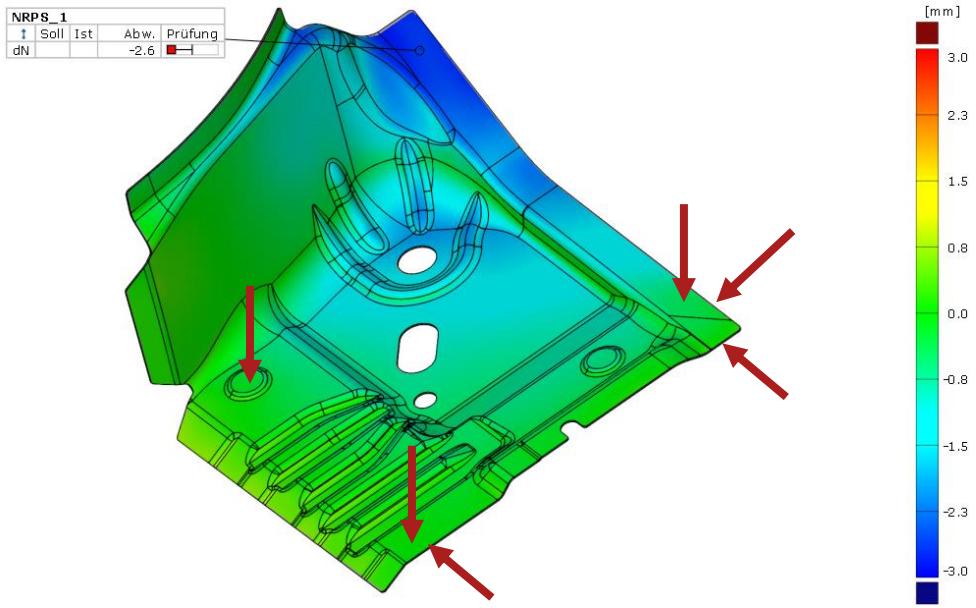
Warpage within an acceptable range will be eliminated later when assembling the part (e.g. by welding)

Relevant functional tolerances have to be checked **after** removal of warpage

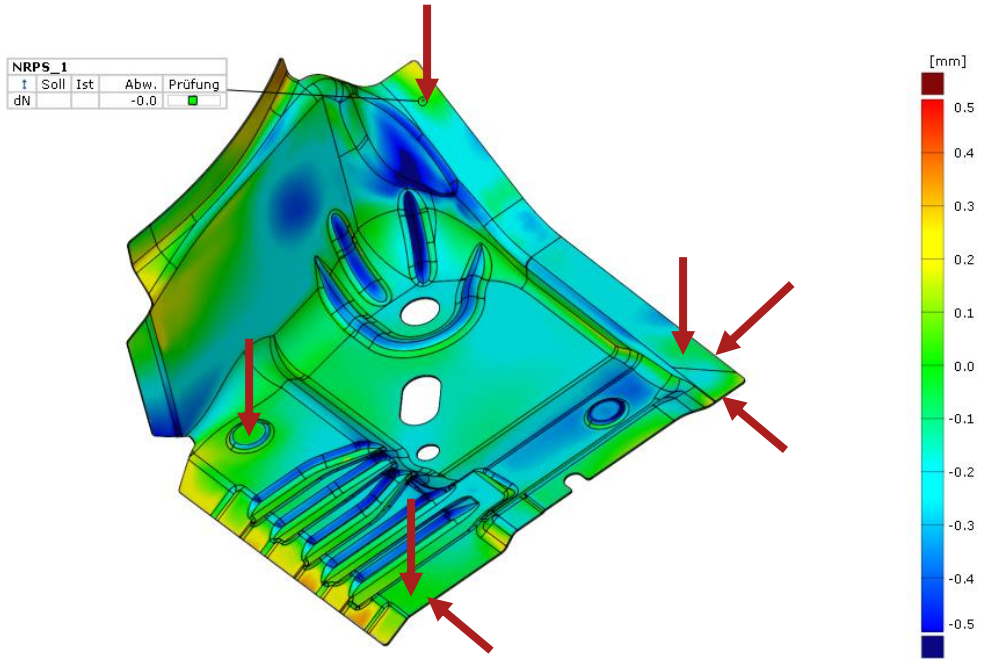
Measurement has to be performed in a constrained state – as close as possible to the real assembly condition

Why Using Clamping Fixtures for Measuring Non-Stiff Parts?

Measurement in free state will be superimposed by global warpage → result usable for toolmaker only



Measurement in constraint condition shows the relevant local part deviation



Measurement Fixtures – Drawbacks

Costs
Clamping fixtures are expensive to build. Some fixtures have to be calibrated. Fixtures need storage space.

Accuracy
Non-perfect clamps and supporting points (not describing the real assembly situation) will influence the measurement conclusion

Reproducibility
Some clamping fixtures are not highly reproducible because of friction, clamping order, user influence

Effort
Common strategy: clamps will be adjusted after a pre-measurement → multiple measurements needed

Accessibility
Potential of measuring method will not be tapped completely as clamps always avoid a free accessibility

Idea of Virtual Clamping

Compensate warpage mathematically, not physically

Procedure

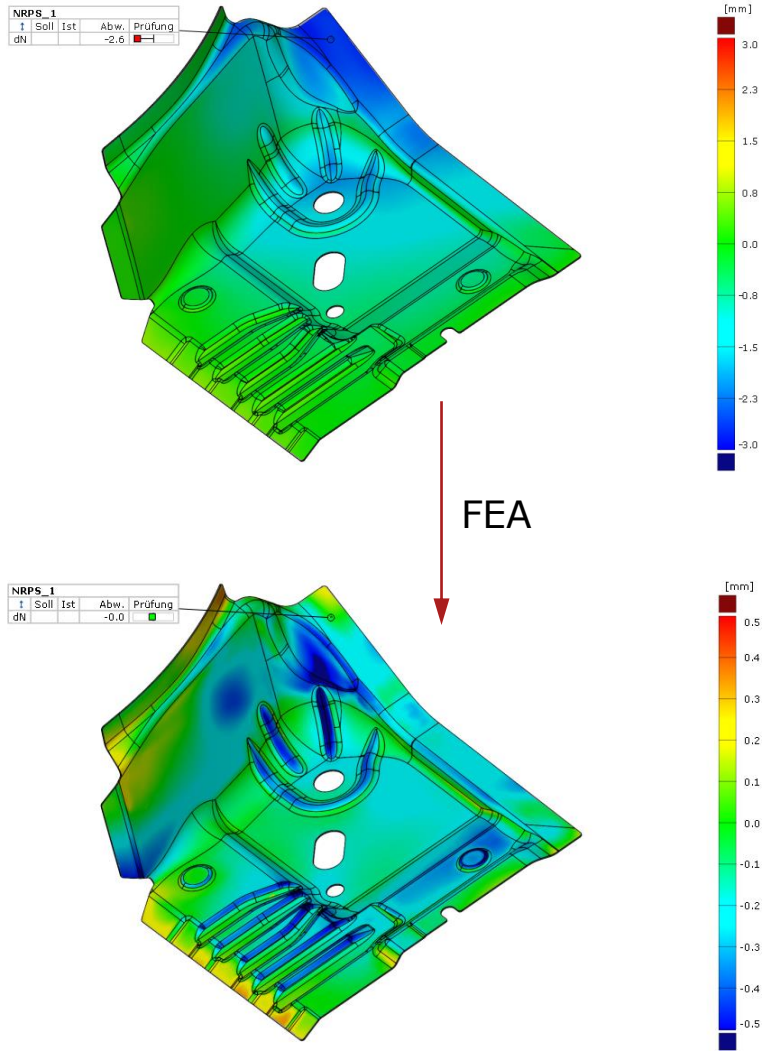
Original measurement (free state, unclamped)

Statically defined alignment with 6 constraints

Collect deviation at clamping points

FEA simulation → displacement field

Morphing of original measurement



Idea of Virtual Clamping

Compensate warpage mathematically, not physically

Procedure

Original measurement (free state, unclamped)

Statically defined alignment with 6 constraints

Collect deviation at clamping points

FEA simulation → displacement field

Morphing of original measurement

Benefits

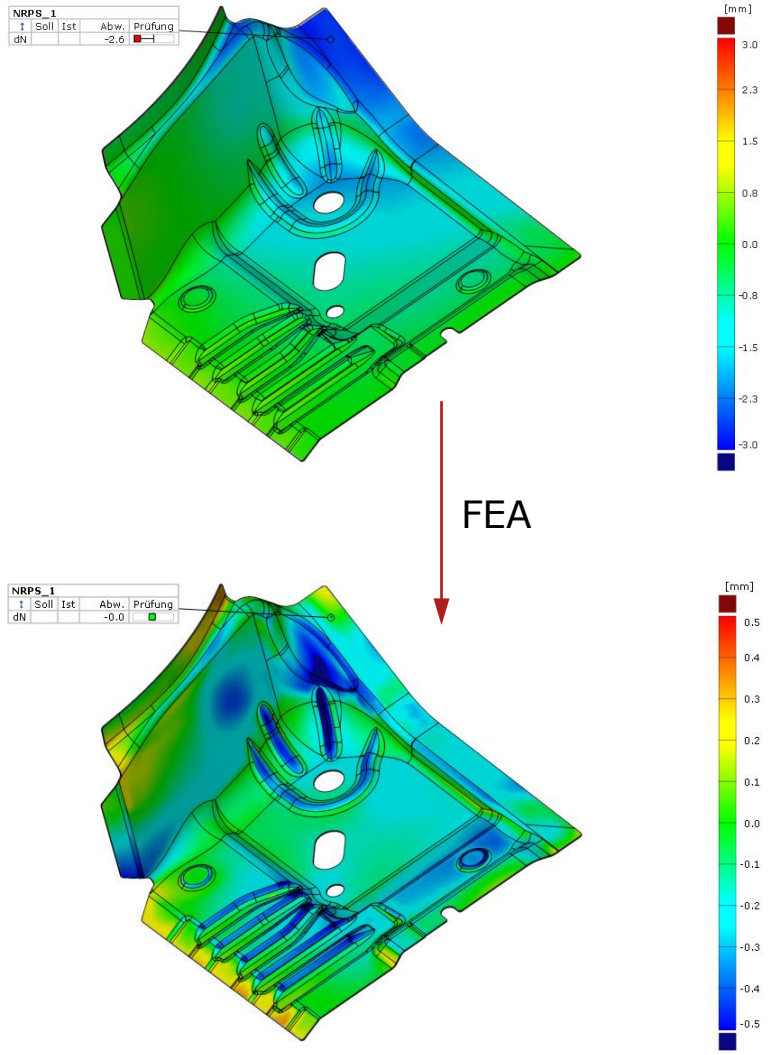
Fixture gets more simple

One measurement for two states (unclamped/clamped)

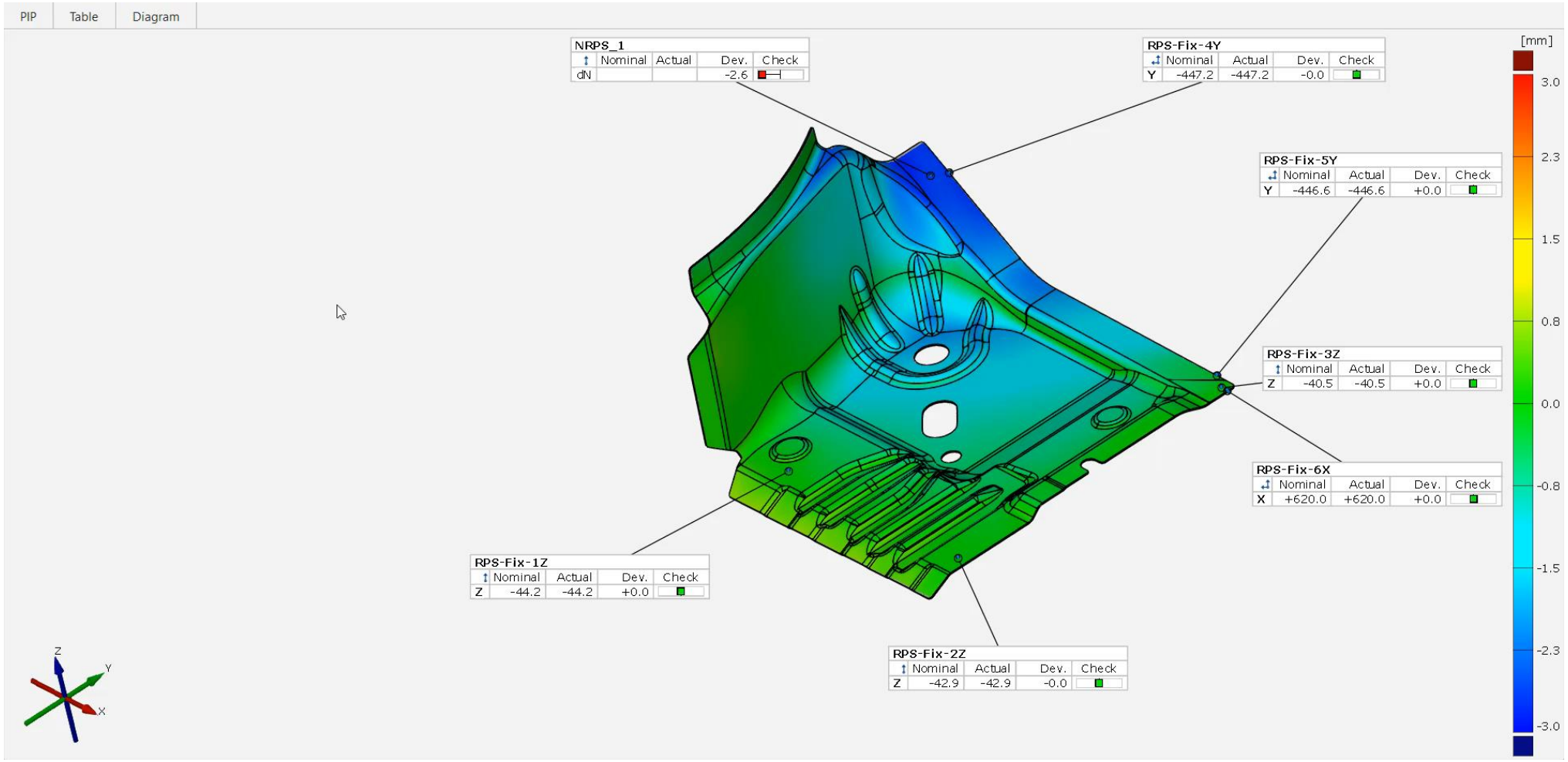
Good accessibility

Mathematically exact constraints

High reproducibility

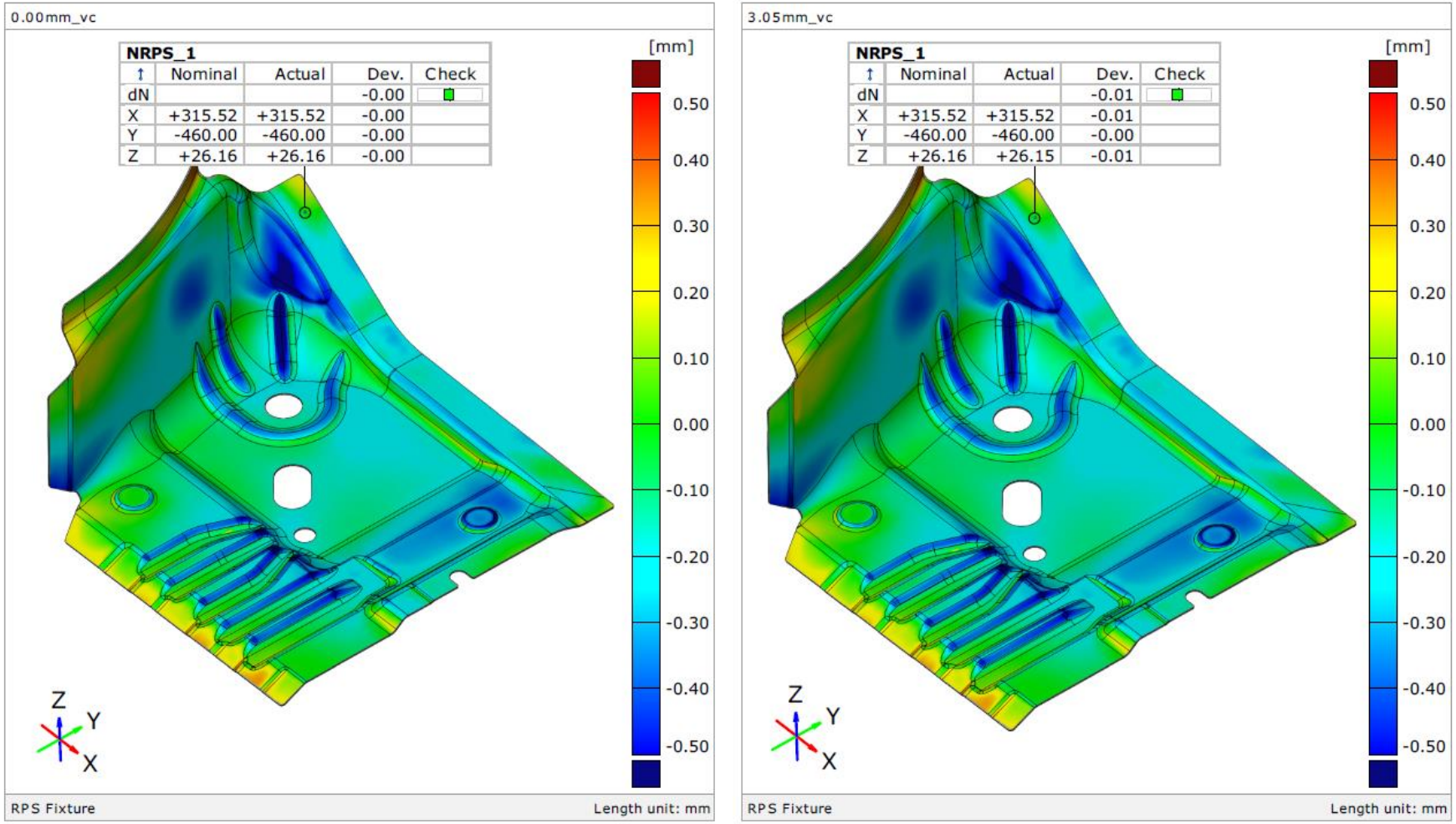


Virtual Clamping – GOM Software



Virtual Clamping: Verification

(physically undeformed / physically deformed) and virtually clamped



Virtual Clamping: Outlook

Virtual clamping module planned to be released mid of 2019

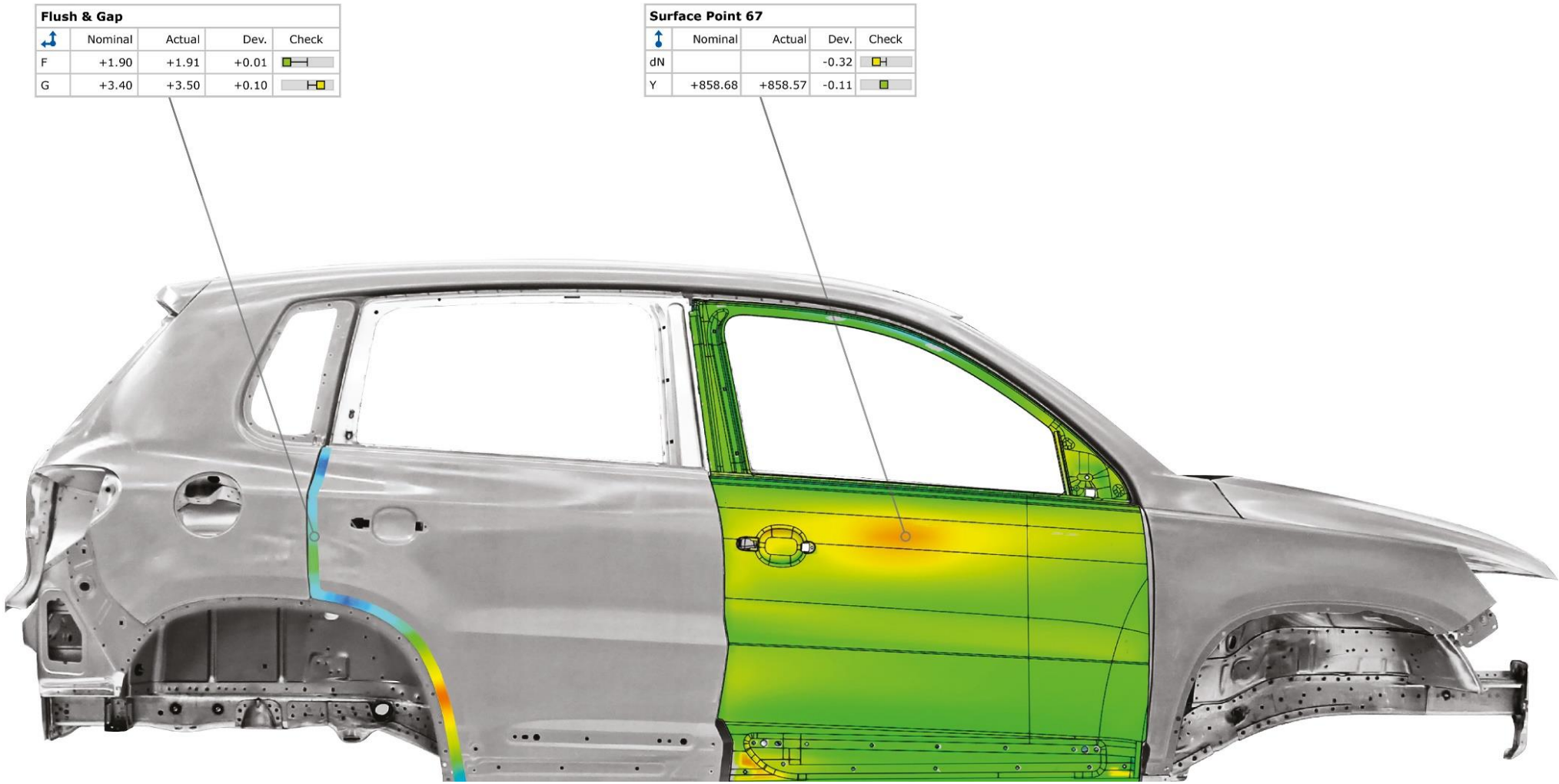
Generation of FEM geometry model (pre-processing) has to be performed externally

Gravity compensation in development

Technology Preview 2019

Augmented Reality

Augmented Reality for Result Visualization



GOM is constantly pushing innovation

to serve the manufacturing industry

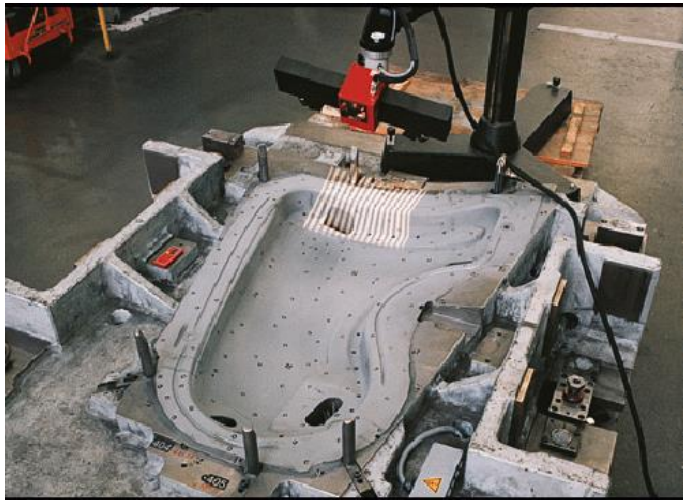
The First Generation

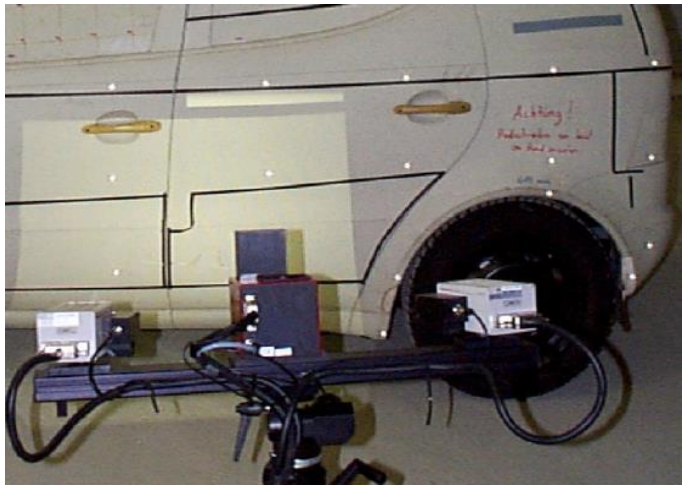
1995–2000

ATOS STD
ATOS HR

Stereo camera system
Slide with phase shift/gray code
Reference points
Combination with photogrammetry

ATOS – mobile 3D digitizer





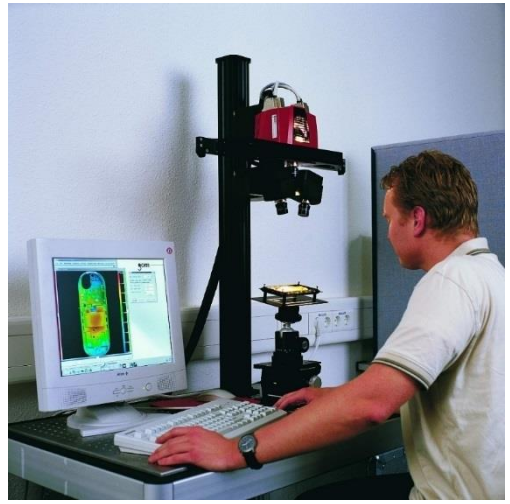
The Second Generation

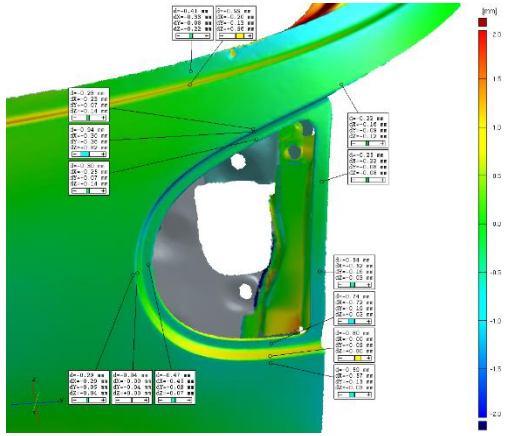
2000–2005

ATOS II
ATOS IIe
ATOS III

Heterodyne phase shift
Titanar optics for ATOS III
4M camera resolution for ATOS III
Accuracy and data quality
VIP light source for ATOS III/IIe
From small to large

Entering quality control

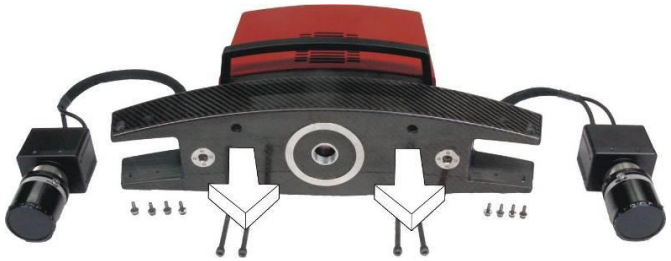




The Third Generation

2005–2010

ATOS I
ATOS II Rev. 01
ATOS IIe Rev. 01
ATOS SO 4M Rev. 01
ATOS III Rev. 01



FireWire: laptop operation
Carbon fiber structure
4500 ANSI Lumen (ATOS III / IIe)
Touch probe

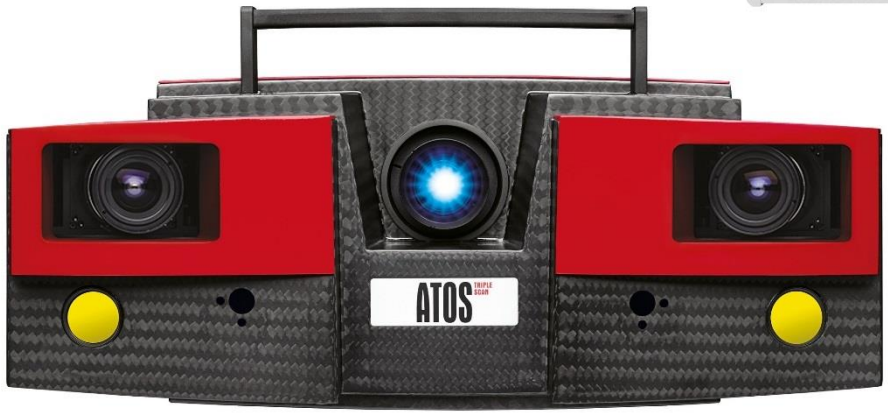
Stability and flexibility for diverse applications

The Fourth Generation

2010–2018

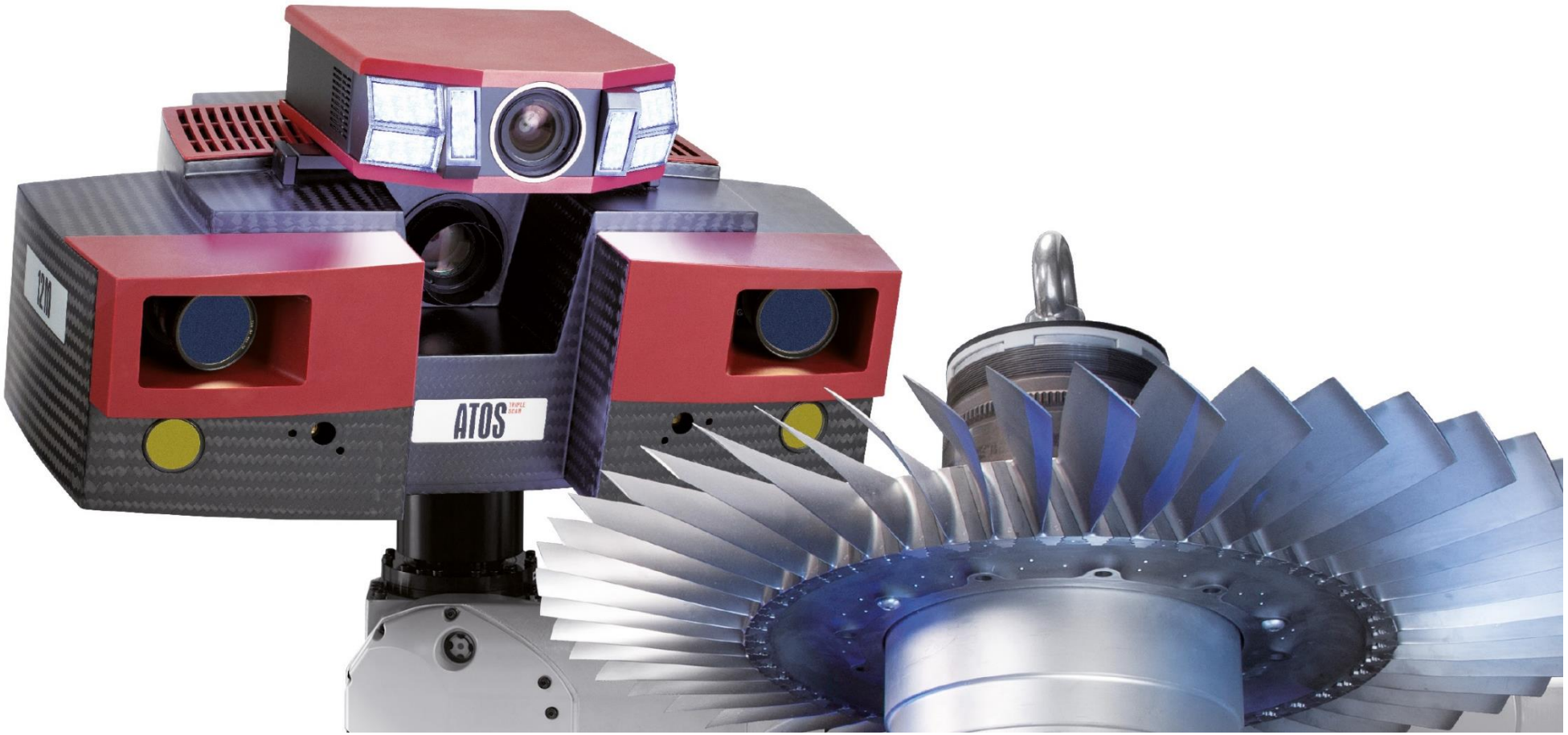
ATOS Triple Scan
ATOS Compact Scan
ATOS Core
ATOS Capsule

GigE data transfer
LED: Blue Light Technology
DLP: Triple Scan, reflection detection
CP40: Precision calibration
ATOS ScanBox

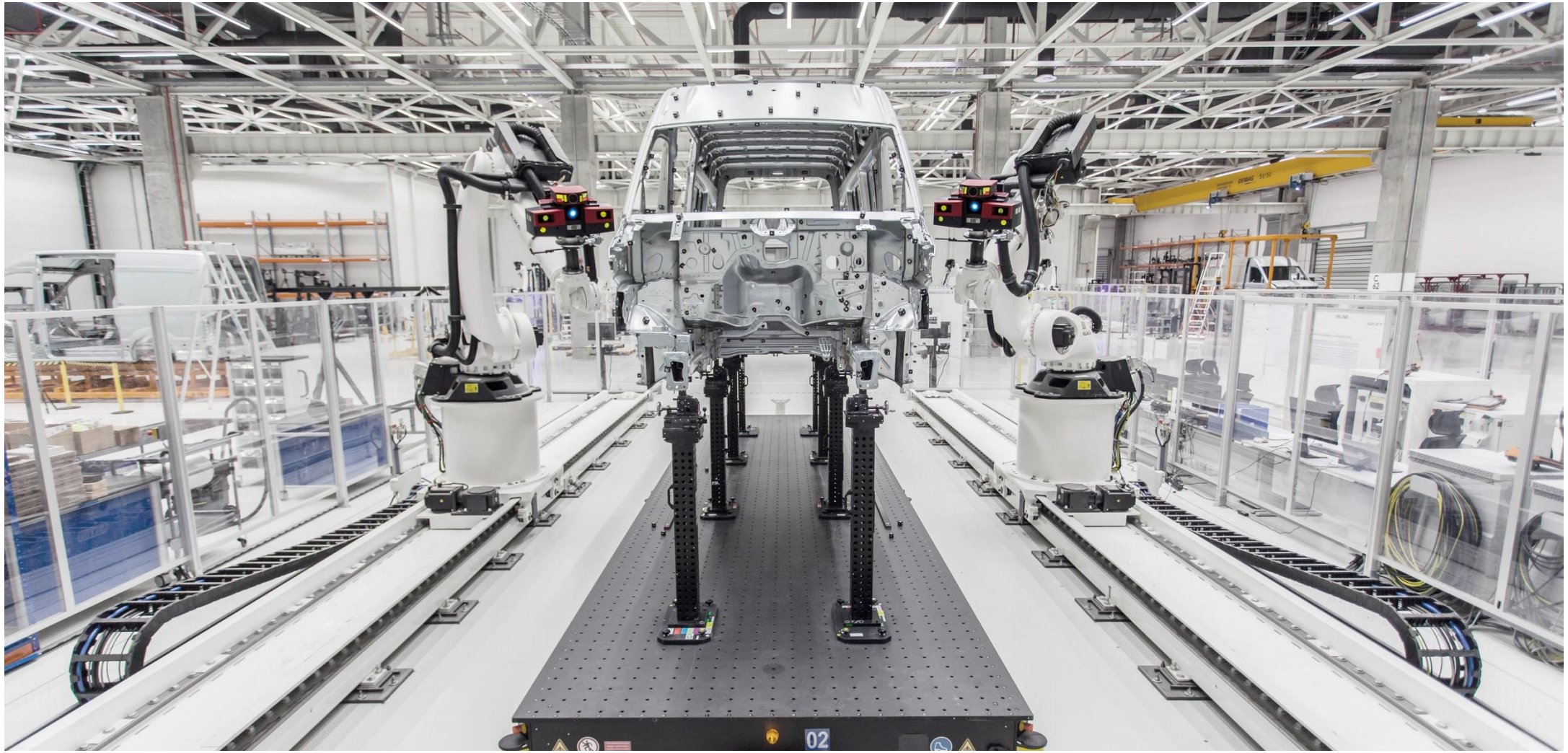


Optical CMM

State-of-the-Art Metrology



State-of-the-Art Metrology



ATOS Technology – Keeping the Good Things

Triple Scan principle

Stereo camera system

Precision calibration

Self-monitoring system

Tracking

Back projection

Changeable measuring volumes

Photogrammetry with ATOS Plus, TRITOP

GOM Touch Probe

Manual and automated

The Fifth Generation

ATOS 5 | ATOS 5X

ATOS 5
LED light source

ATOS 5X
Laser light source

ATOS Innovations

High-speed scanning

Blue Light Equalizer

Laser Light Compressor

Large-Field 3D Scanning

Fiber optical connectivity

Robust precision

Shop floor Metrology

ATOS 5 | ATOS 5X

High-speed scanning
0.2 seconds per scan

Blue Light Equalizer
Highest data quality

Laser Light Compressor
Extremely bright light source

Large-Field 3D Scanning
Measuring areas up to 1000 mm

Fiber Optical Connectivity
Fast data processing

Robust Precision
Process safety in industrial applications

NEW ATOS ScanBox 6235

GOM CT

GOM CT

Industrial computed tomography

225 kV X-ray source

3k-detector

Measuring area:
d: 240 mm h: 400 mm

Photogrammetric calibration

Temperature Balancing

5-axis kinematics

GOM CT

Applications for the GOM CT

The GOM CT is suitable for small and complex injection molded parts with:

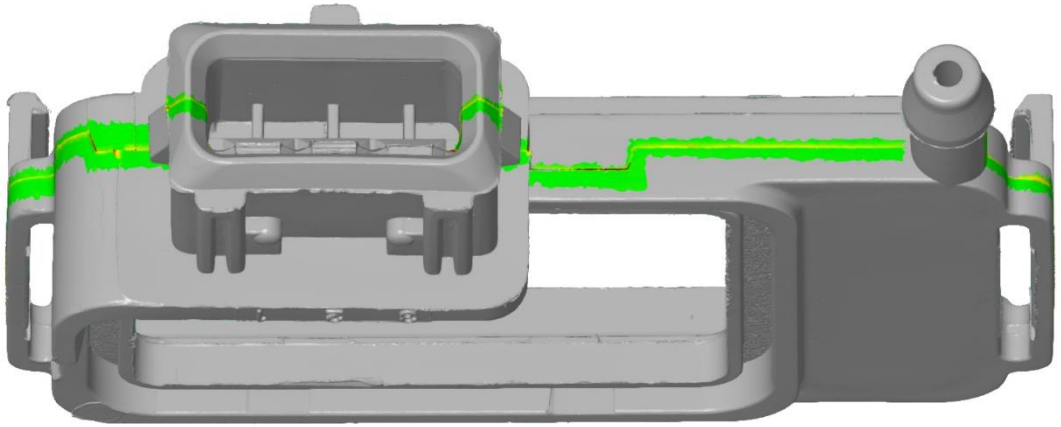
Tool dividing lines

Undercuts

Complex geometries

Internal geometries

…



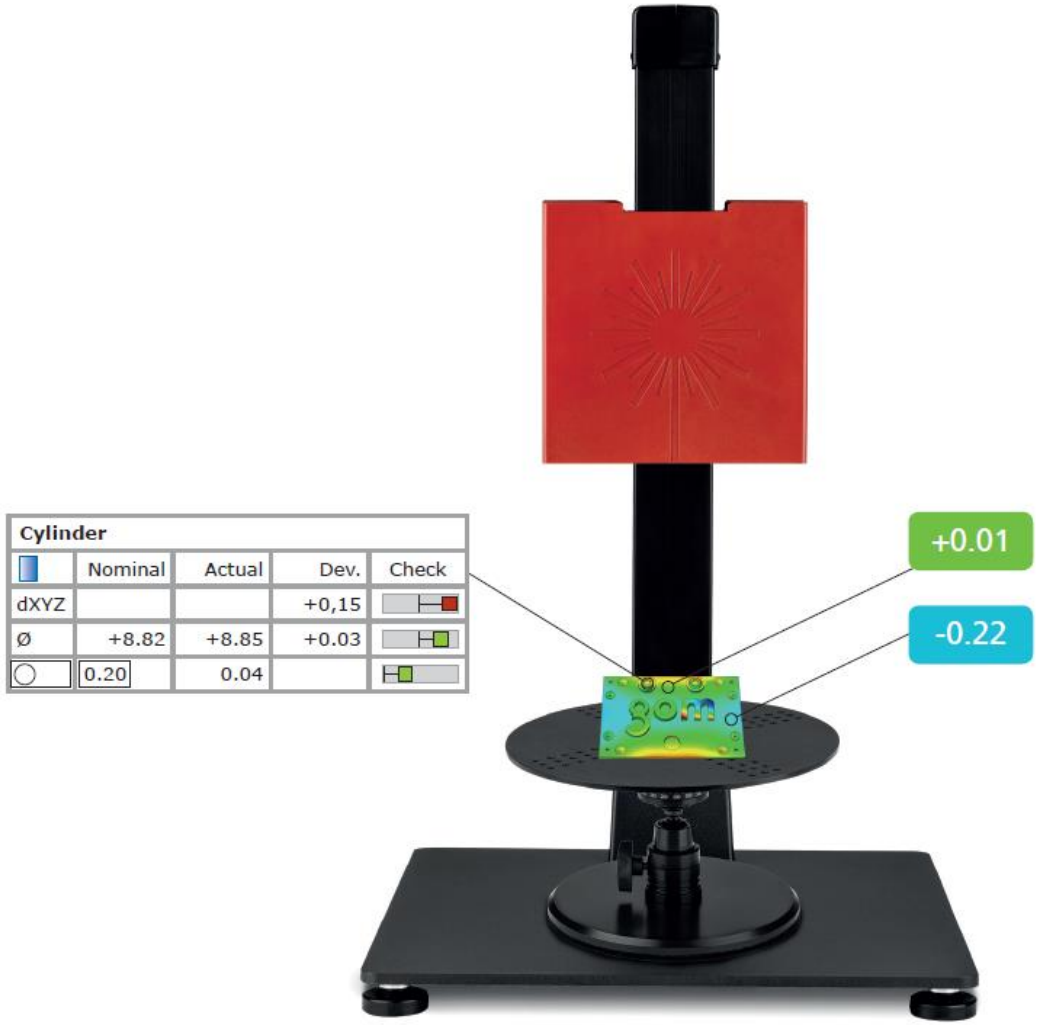
GOM CT is a Metrology CT

GOM CT

Complete product will be available in 2019

ATOS for Education

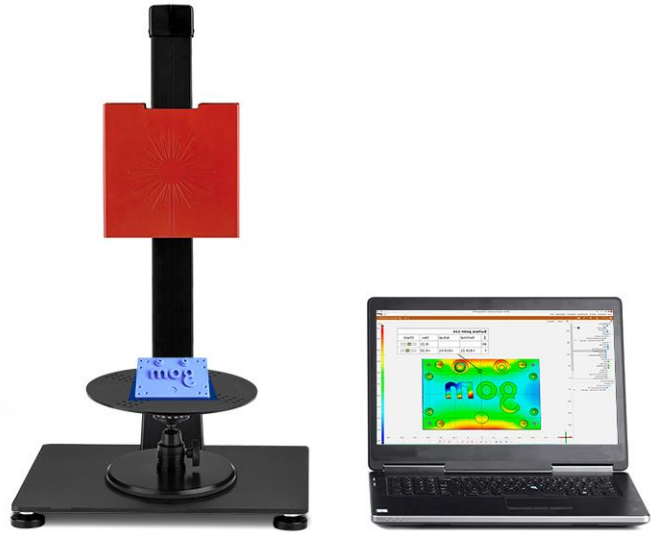
3D Scanning and Inspection Package for Teaching and Training



Complete Package

Complete package for theoretical and practical teaching at:

- Schools
- Higher education institutes
- Universities



Content

Industrial hardware and software for 3D scanning and inspection

Ready-to-use laboratory experiments

Lecture material

- With detailed background information

Inspection software for students

- With available sample data sets and video tutorials

Support

- Expert support from experienced engineers
- Practical training for instructors

Lab Experiments and Lecture Material

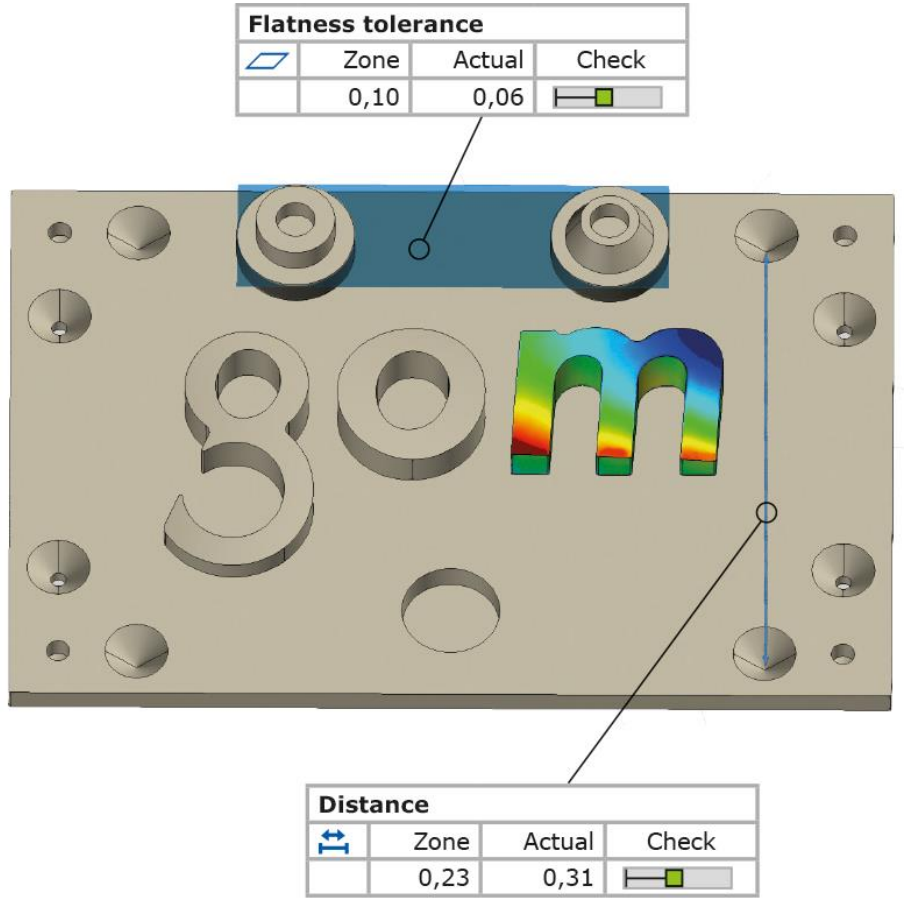
GOM Modules for an Easy Integration in Individual Curricula

Step-by-step introduction to optical metrology
- Preparation of a measurement object
- Inspection
- Reporting

Accompanying lecture material

Detailed background information

Building of new learning modules



ARAMIS for Education

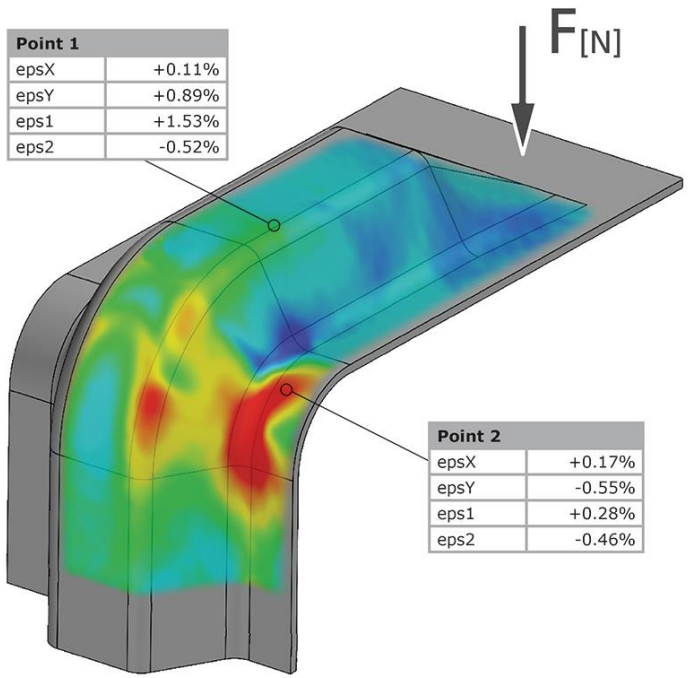
Easy expansion of the ATOS for Education package for materials and component testing

In addition to 3D scanning and inspection applications, it is also possible to implement measuring tasks in the field of materials and components testing with only minimum resources

- Using the same hardware
- Additional digital image acquisition and image correlation software
- Another training object ("Chemnitzer Haken")

Furthermore, the ARAMIS for Education package includes:

- Complete laboratory experiments
- Lecture material
- Detailed video tutorials



ATOS Technology Days 2018

Advanced Inspection for
Automotive Car Body Manufacturing

ATOS Technology Days 2018 – Global Event Locations

Advanced Inspection for Automotive Car Body Manufacturing

Americas

August 1

Michigan

USA

Asia

August 22

Shanghai

China

Europe

September 27

Braunschweig

Germany

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