Precise Industrial 3D Metrology

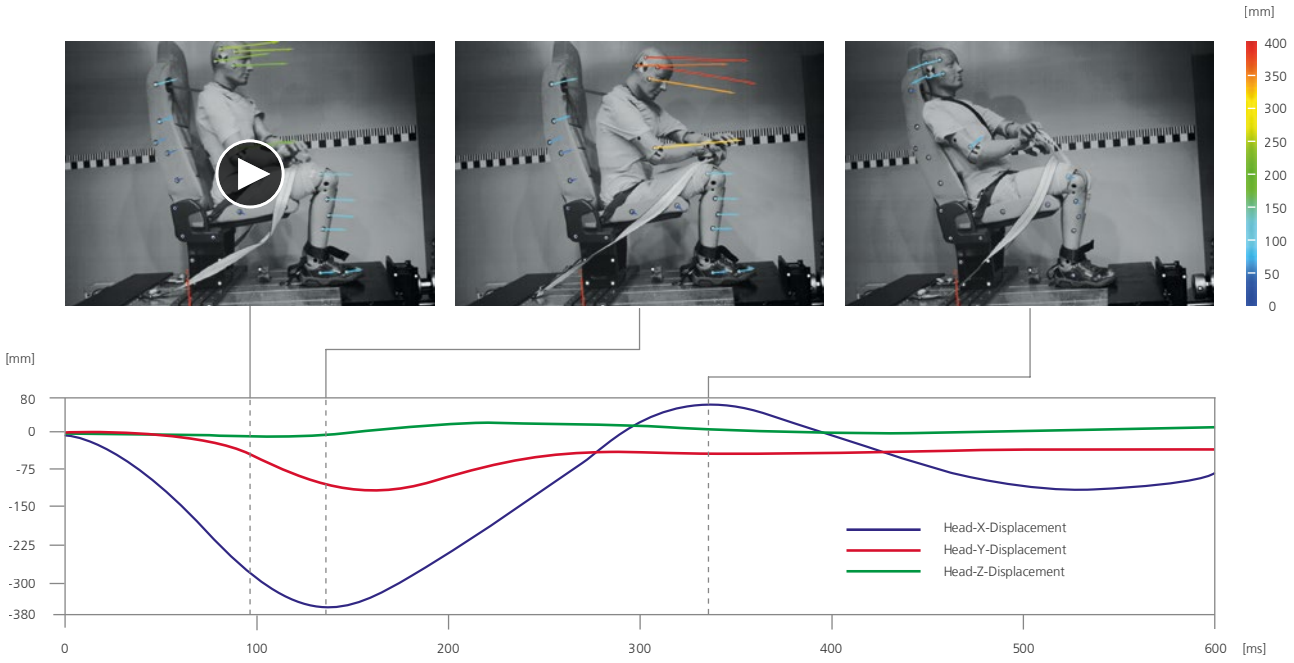
ARAMIS

3D Motion and Deformation Sensor

Materials testing
Deformation analysis of parts
Crash and 6DoF evaluation

ARAMIS

Optical 3D Deformation Analysis



3D Measuring Data from Digital Stereo Images

ARAMIS provides accurate 3D coordinates, 3D displacements, velocities, accelerations, strains and measurements of 6 degrees of freedom (6DoF) for static or dynamically loaded specimens and components. Based on this measuring data, material characteristics are determined, finite element calculations are verified, component collisions recorded, motion trajectories checked and component deformations analyzed.

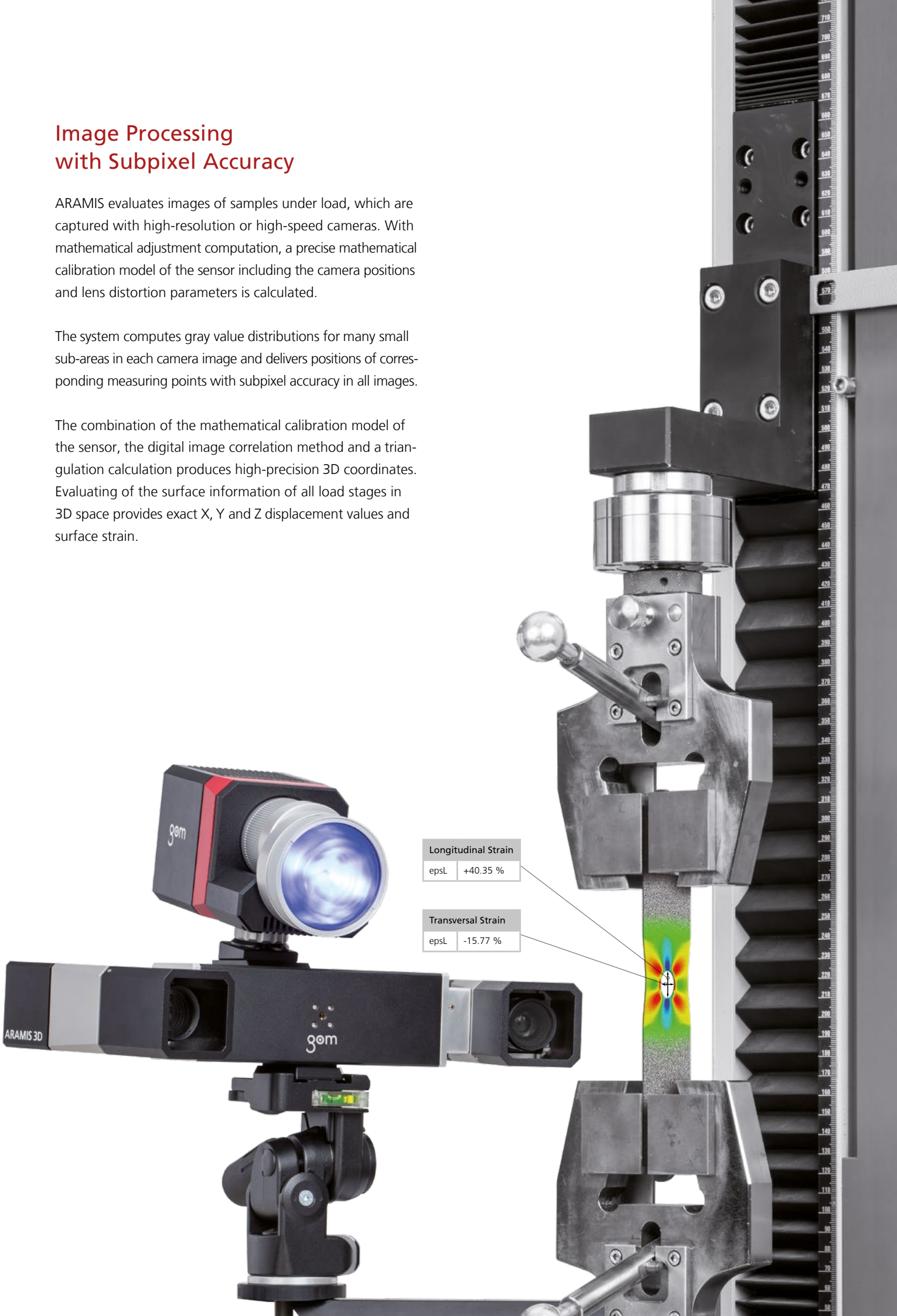
ARAMIS is a non-contact and material independent measuring system that is based on the principle of digital image correlation. ARAMIS offers a stable solution for full-field and point-based analyses of test objects of just a few millimeters up to structural components several meters in size. Measurements are conducted independent of the specimen's geometry and temperature, without time-consuming and expensive preparation. With high-precision measurements, 3D measurement resolutions into the sub-micrometer range are achieved.

Image Processing with Subpixel Accuracy

ARAMIS evaluates images of samples under load, which are captured with high-resolution or high-speed cameras. With mathematical adjustment computation, a precise mathematical calibration model of the sensor including the camera positions and lens distortion parameters is calculated.

The system computes gray value distributions for many small sub-areas in each camera image and delivers positions of corresponding measuring points with subpixel accuracy in all images.

The combination of the mathematical calibration model of the sensor, the digital image correlation method and a triangulation calculation produces high-precision 3D coordinates. Evaluating of the surface information of all load stages in 3D space provides exact X, Y and Z displacement values and surface strain.



ARAMIS 3D Camera

Sensor Technology for Motion and Strain Measurement

Sensor Technology

Materials research and component testing play an important role in product development. The ARAMIS 3D Camera provides information about the properties of the materials used and the behavior of the products under load. These results form the basis for product durability, geometrical layout and reliable numerical simulation and validation.

3D camera – The ARAMIS 3D Camera is a stereo camera system which delivers precise 3D coordinates based on triangulation and using stochastic patterns or reference point markers. The preset and certified lenses are installed in an industrial housing, which guarantees high stability and reduces the requirements for sensor calibration. Measuring volumes can easily be adapted by the user, allowing objects from small to large to be measured – ranging from samples for component testing through to sub-assemblies.

Controller – The integrated GOM Testing Controller not only controls the stage acquisition but also the light management. Furthermore, a software-based programming interface is integrated for preset or user-defined measuring sequences. The GOM Testing Controller fully supports the integration into existing test environments using external triggering and analog data acquisition. Moreover, it allows specific dependencies to be defined between test parameters such as the recording speed and trigger elements.

Live

The Live functions of ARAMIS permit online measurement, positioning and motion analyses and they are supported by measurements with touch probes and adapters.

Online component testing is used, for example, in durability tests, fatigue tests as well as in wind tunnel tests and vibration analysis. At the same time, the measuring results can be viewed online or transferred to other programs using digital and analog interfaces and can be processed live by these programs.

In the online measurement, parts and their movements are specifically aligned and positioned to CAD. A typical application, for example, involves transforming the coordinate system of the simulation to the real measuring setup.

Touch probe – The GOM Touch Probe is a tactile measuring system extension that is optically tracked by the ARAMIS system. It is used for tactile measurements and makes it possible to measure coordinates on areas that are difficult to access optically.

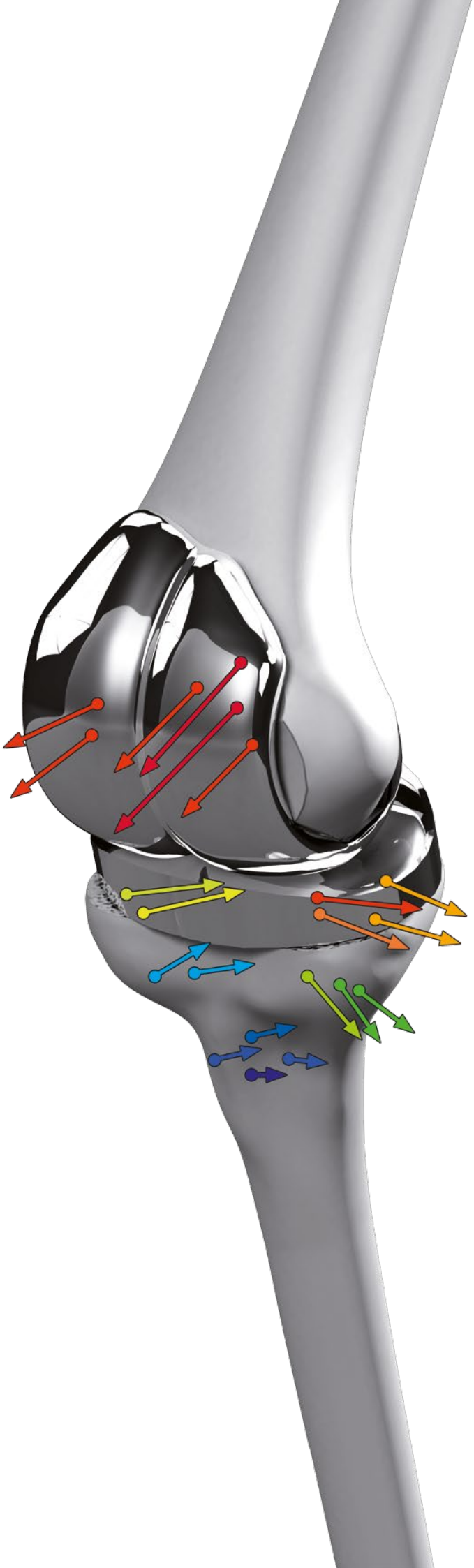
Adapter – The GOM Adapters offer extended opportunities for live measurement, such as component alignments or measurements of regular geometries and edges.

TRITOP Photogrammetry

In complex or large applications with dimensions up to several tens of meters, digital photogrammetry makes it possible to transform several ARAMIS projects into one common coordinate system. This means different local ARAMIS measurements of one large component can be combined into an overall evaluation.

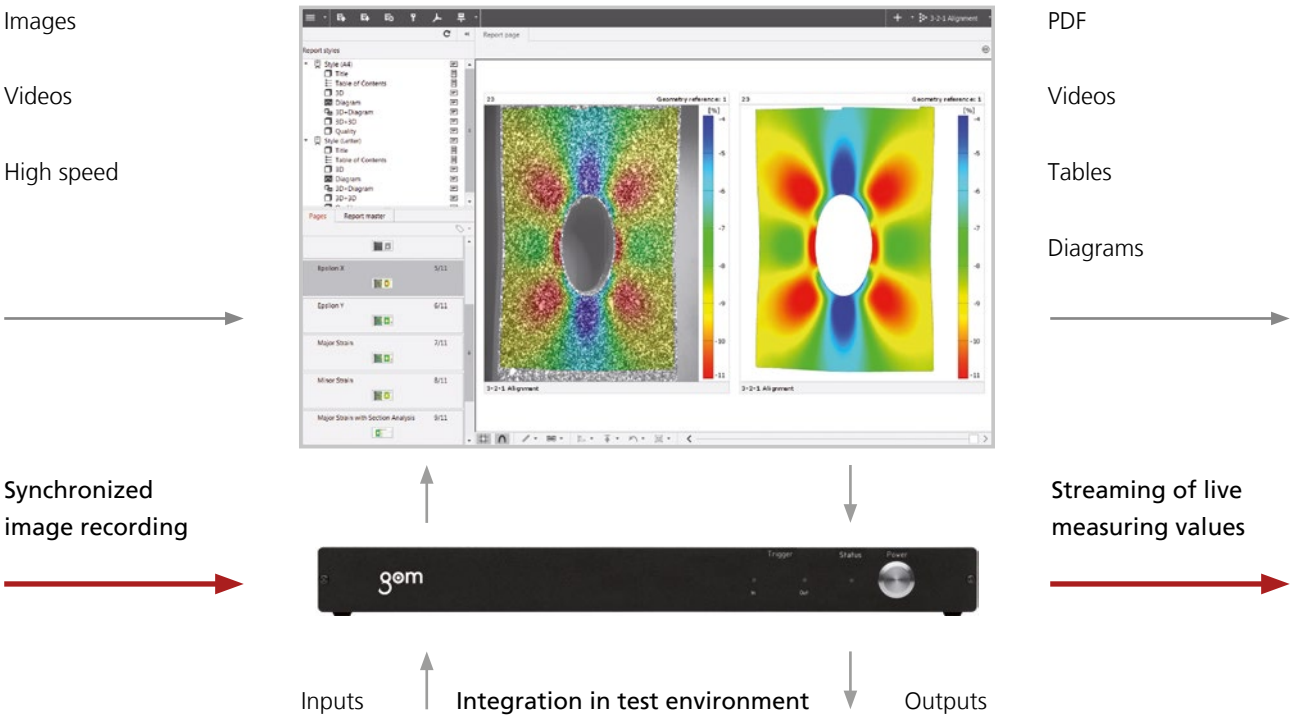
In addition, TRITOP offers the possibility of linking several sensors and measuring areas together. This method is used, for example, to record the deformation behavior of a part from all sides simultaneously and to evaluate it in a common coordinate system.

TRITOP is an additional and independent optical coordinate measuring system for large components or complex ambient conditions, such as in climate chambers.



ARAMIS Professional Software

Digital Image Correlation – 3D Motion Analysis



Measurement, Analysis, Measuring Reports

Parametrics – With GOM's parametric approach, every single element retains its creation path within the software structure. All actions and evaluation steps are fully traceable and interlinked. This means they can easily be modified and adapted. At the push of a button, all relevant elements are automatically updated after having been changed.

Timeline – A timeline integrated into the graphical interface ensures a clear management of multi-stage projects, such as for deformation analyses. Among other things, the user can switch back and forth between stages within a project or exclusively display relevant stage ranges.

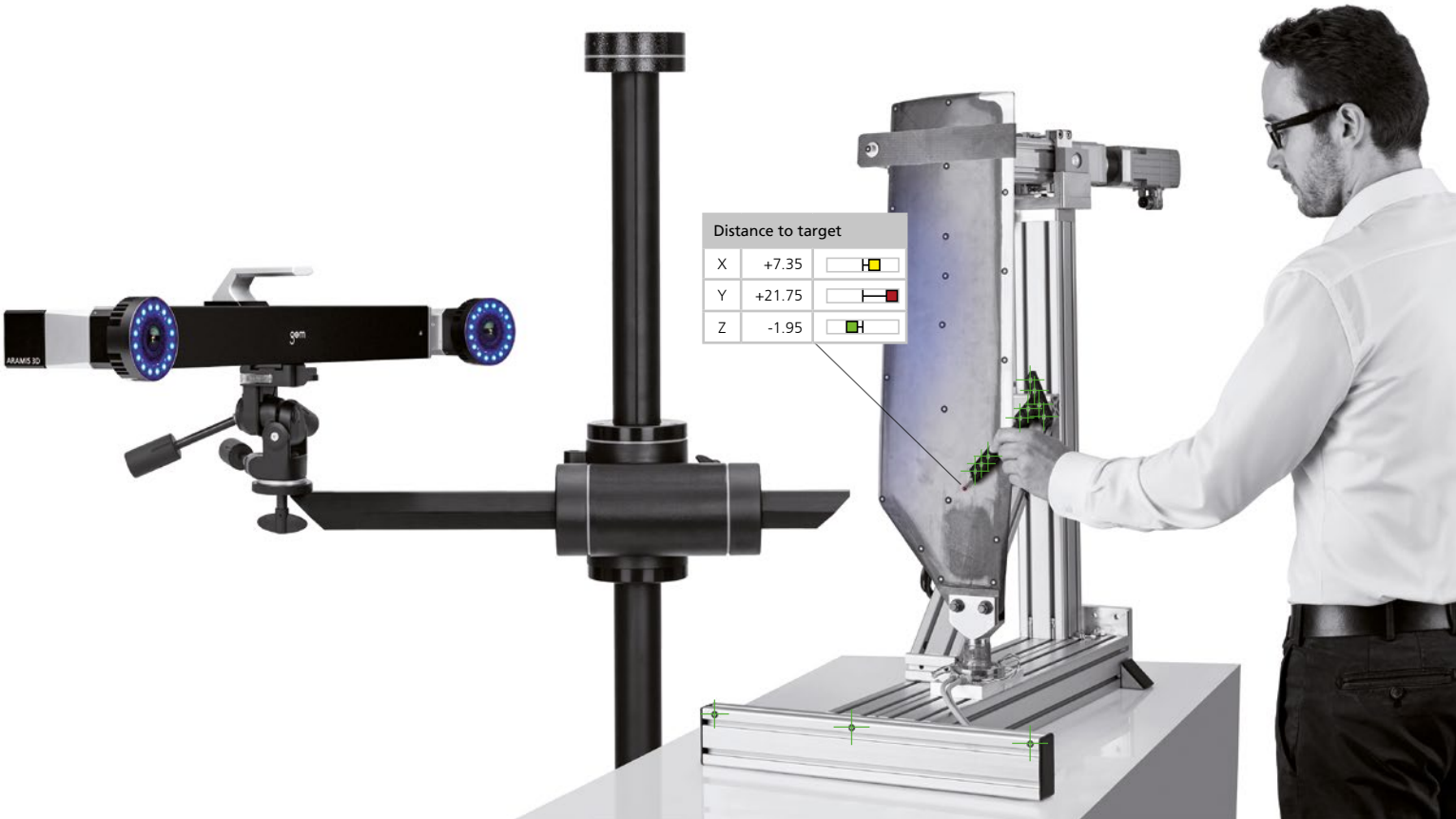
I-Inspect – The I-Inspect control element stands for intelligent inspection and guides the user through the inspection process. Depending on which element is selected, I-Inspect performs a preliminary selection of the available measuring principles and inspection criteria. User-defined measuring principles are also available. Even complex inspection tasks can be carried out quickly and easily.

Digital image correlation – DIC is a non-contact measurement technique for determining 3D coordinates, 3D motion, surface deformation and strain. This measuring method is primarily used in materials and component testing. It delivers locally high-resolution and full-field measuring results of the specimen's surface, which describe the complex 3D motions and deformations.

Motion and deformation analysis – Motions and deformations are analyzed by the component concept. For this purpose, points on rigid bodies are grouped together into components. Transformations or rigid body movement corrections can be calculated on these components. The 6DoF analysis can be applied to determine the translatory and rotatory movements in all directions in space. Furthermore, vector fields help to visualize point movements and deformation over time.

Customizable mathematics – Many result parameters such as displacement and strain in all three spatial directions are calculated by predefined inspection principles and sequences in the software. For highly complex analyses that are not integrated as standard, ARAMIS Professional offers an interface for creating user-defined values and using individual formulas.

Image mapping – Image mapping offers the possibility of showing measuring results and inspection elements directly overlayed with the images, displaying the data in a simple and easy-to-understand way. In this way, the measuring values can be interpreted more effectively than with conventional measuring data, e. g. results tables from strain gauges and transducers. Image mapping provides users with an intuitive way to understand their tests.

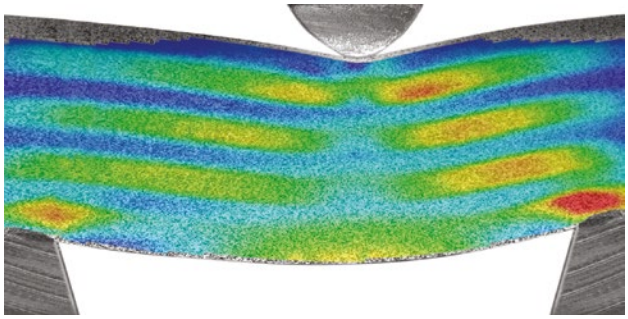


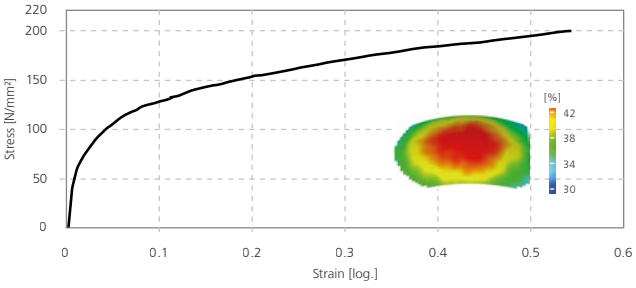
Materials Research and Component Testing

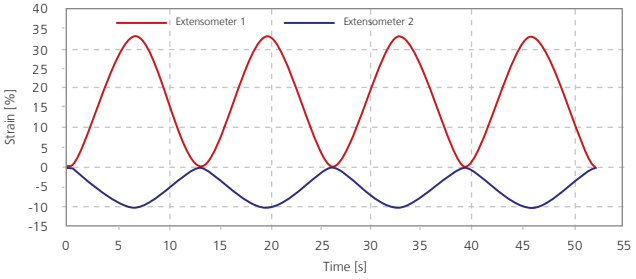
Applications

Materials Testing

The precise full-field ARAMIS results improve the accuracy of material properties. Existing evaluation processes such as determining flow and forming limit curves are optimized, making them more reliable. Some inspections become possible only because ARAMIS measures non-contact and provides results with a high local resolution. They are used in tensile, shear, compression and three-point bending tests as well as in high-speed and temperature tests.







Today, ARAMIS is an established measuring system that is used worldwide by hundreds of materials research institutes for:

- Stress-strain evaluations
- R values
- Poisson's ratio (lateral contraction coefficient)
- Young's modulus
- Forming limit curves (FLC)
- Residual stresses
- Shear modulus

Real-time measurement – ARAMIS provides real-time results for user-defined measuring points on the specimen's surface. These are transferred directly to testing machines, data loggers or analysis software (e. g. LabView, DIAdem, MS Excel, etc.).

- Control of testing machines
- Long-term tests with low memory requirements
- Vibration analyses
- 3D video extensometer

Component Testing and Analysis

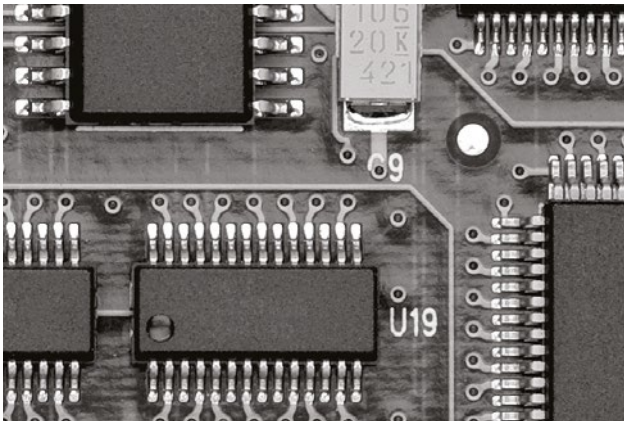
ARAMIS is the perfect tool to provide an optimum understanding of the component behavior. Results can be obtained regardless of the material, geometry and under real application conditions.

ARAMIS measures the real part geometry, which is not possible with traditional measuring devices such as strain gauges, transducers, vibrometers, etc.

3D measurements are required because parts have non-linear deformation characteristics. ARAMIS uses the CAD data for transformations, direct comparisons and visualizations.

ARAMIS supplies all results for static and dynamic tests, even at high speeds, for

- Strength analyses
- Vibration analyses
- Fatigue strength investigations
- Crash tests



Finite element calculations – Products and manufacturing processes are designed and optimized with numerical simulation methods. Material properties and component deformation characteristics have a significant influence on the accuracy of simulation computations and their reliability.

ARAMIS verifies numerical simulations by comparing experimental measurements and FE data.

Automotive

Product development in the automotive business is characterized by significant competitive pressure, reflected in shorter development cycles and cost reductions. In modern vehicles, numerous parts are developed and optimized with high requirements on function, safety and stability.

Parts undergo numerous tests before they are released for series production:

- Behavior under thermal or mechanical load
- Vibration and oscillation behavior
- Creep and aging analysis
- Crash behavior
- Wear analysis
- Climate chamber analysis

ARAMIS makes it easier to understand static and dynamic part properties, and in doing so, it assists the root cause analyses of faults, e. g. disruptive noise, vibration and complex movements. The insights that are gained make a significant contribution to improving parts and components.

ARAMIS is the instrument for all kinds of testing applications in the automotive sector:

- Slam tests (doors, engine covers, trunk lids)
- Behavior of engines and transmissions
- Tests on manifolds and decoupling elements
- Wind tunnel tests
- Pedestrian safety analyses
- Stiffness analyses

Aerospace

Developing and producing a modern aircraft is an extremely complex process in the course of which it is necessary to balance the technical possibilities, design requirements, available technologies, and costs against one another carefully.

As a result, engineers from various fields of technology and disciplines such as aerodynamics, power train, materials technology, structural engineering and production work together to develop aircraft and space vehicles.

During the development phase, component and structural tests are highly important constituents in the stability assessment and safety certification.

ARAMIS is used in the aerospace industry for component and structural analyses:

- Deformation measurements (wings, flaps, etc.)
- Fuselage shell structural tests
- Vibration analyses
- Component testing (e. g. buckling test)

Biomechanics

Developing biomechanical products is not significantly different from other development processes such as those familiar from the automotive or aerospace industries. Biomechanical research involves not only approaches for numerical simulation but also determining material parameters and studies into the reaction behavior of human systems.

ARAMIS enables the determination of 3D motions and 3D deformations when loads are applied to

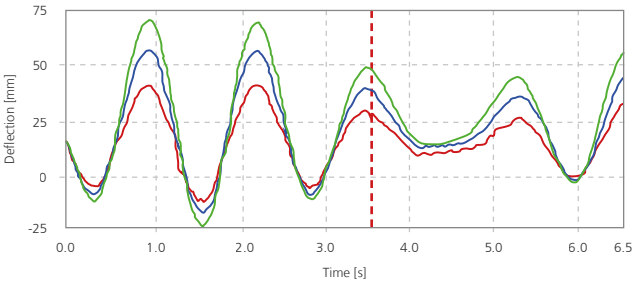
- Bones and soft tissue
- Implants
- Osteosynthesis
- Orthoses
- Micromotions in the fracture gap

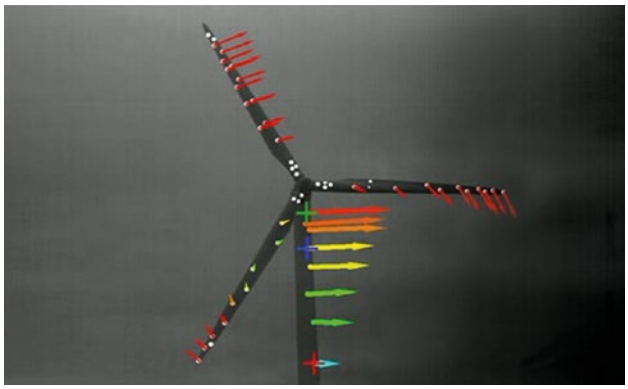
Research and Development

Nowadays, numerical simulations are used in almost all branches of research and industry as standard tools to predict the behavior of parts and components. Component testing on test setups is thus essential to optimize these numerical simulations.

Using the ARAMIS measuring system right from the development phase for components leads to a significant reduction with regard to the

- Number of iterative cycles
- Development time
- Development costs





The Complete ARAMIS System

Components and Accessories

Sensor

- Stereo camera system
- Protected industrial sensor housing
- High stability with low requirement for sensor calibration
- Exchangeable camera frame
- Integrated light management
- Integrated cable guide
- Laser pointer for sensor positioning
- CCD and CMOS cameras
- Different image resolutions
- User-defined recording speeds
- Integrated control from software
- Certified calibration objects

Lenses

- Certified lenses
- Pre-set
- Fast adjustment to measuring tasks

Light Projector

- Blue Light Technology
- Narrow-band LED light source
- Revolver optics
- Uniform illumination due to aspherical lenses
- High luminous intensity

Tracking Spots

- Ring illumination with narrow-band blue LED light
- Directional illumination
- Maximum use of light illumination
- Short exposure times

GOM Touch Probe and Adapter

- Tactile 3D measurement
- Part alignment based on touch probe elements
- Adjustment of fixtures
- Measurement of areas that are difficult to reach optically

GOM Testing Controller

- For complex stage acquisition
- For integration in the test environment
- Sequence control in real time
- Signal recording, calculation and filtering
- Signal transfer and export of calculated values
- Synchronization of various measuring systems using NTP
- Simultaneous signal transmission
- Streaming interface for unbuffered measuring data
- Measuring sequences via programming interface
- Templates for measuring sequences including fixed rate, slow-fast with ring buffer, fast-slow test, external trigger
- Simple programming of user-defined measuring procedures

Image Processing Computer

- Industrial quality and certified components
- Local ProSupport available on a 24/7/365 basis
- On site service

Marking Material

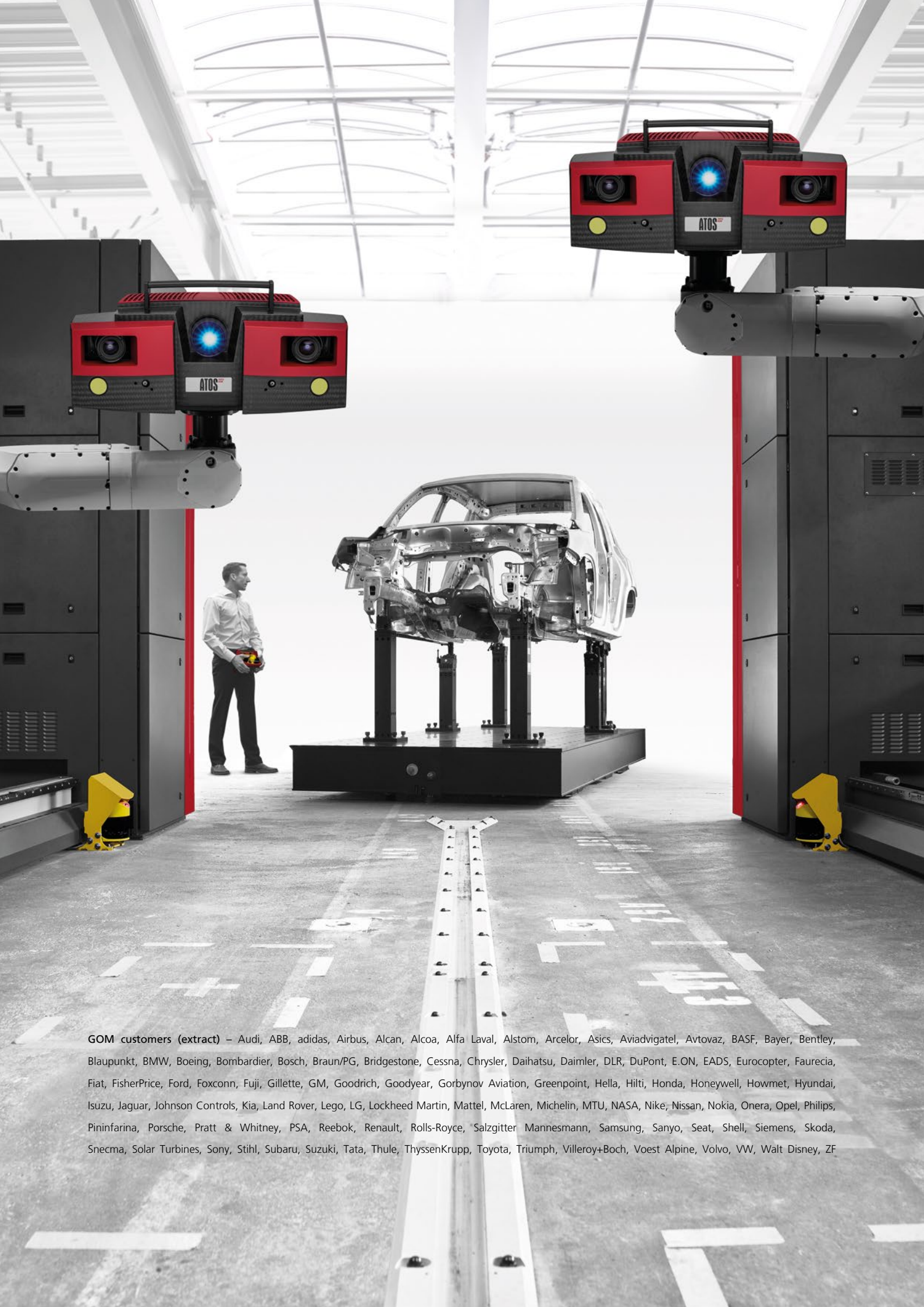
- Marking paints for stochastic patterns
- Coded and uncoded reference point markers
- Different adhesive strengths
- Special markers for high-temperature tests

Software

- Certification in accordance with PTB and NIST
- Real-time correlation of full-field measuring results at full measuring frequency
- Output of measured values in real time via digital and analog interfaces
- Evaluation and analysis of point and surface data in one project
- Live deformation tracking with data streaming
- Live tracking for positioning components
- CAD import: IGES, VDA, STEP, JT open, STL
- CAD import of native formats: Catia, NX/UG, Pro/E
- Nominal/actual comparison with CAD data and geometrical elements

TRITOP

- Global coordinate transformations
- Linking several measuring projects
- Combination of several sensors and measuring fields
- Climate chamber tests



GOM customers (extract) – Audi, ABB, adidas, Airbus, Alcan, Alcoa, Alfa Laval, Alstom, Arcelor, Asics, Aviadvigatel, Avtovaz, BASF, Bayer, Bentley, Blaupunkt, BMW, Boeing, Bombardier, Bosch, Braun/PG, Bridgestone, Cessna, Chrysler, Daihatsu, Daimler, DLR, DuPont, E.ON, EADS, Eurocopter, Faurecia, Fiat, FisherPrice, Ford, Foxconn, Fuji, Gillette, GM, Goodrich, Goodyear, Gorbynov Aviation, Greenpoint, Hella, Hilti, Honda, Honeywell, Howmet, Hyundai, Isuzu, Jaguar, Johnson Controls, Kia, Land Rover, Lego, LG, Lockheed Martin, Mattel, McLaren, Michelin, MTU, NASA, Nike, Nissan, Nokia, Onera, Opel, Philips, Pininfarina, Porsche, Pratt & Whitney, PSA, Reebok, Renault, Rolls-Royce, Salzgitter Mannesmann, Samsung, Sanyo, Seat, Shell, Siemens, Skoda, Snecma, Solar Turbines, Sony, Stihl, Subaru, Suzuki, Tata, Thule, ThyssenKrupp, Toyota, Triumph, Villeroy+Boch, Voest Alpine, Volvo, VW, Walt Disney, ZF

GOM

Precise Industrial 3D Metrology

GOM develops, produces and distributes software, machines and systems for industrial and automated 3D coordinate measuring technology and 3D testing based on latest research results and innovative technologies.

With more than 60 sites and an employee network of more than 1,000 metrology specialists, GOM guarantees professional advice as well as support and service to operators on-site in their local languages. In addition, GOM shares knowledge on processes and measurement technology in training courses, conferences and application-based workshops.

GOM has been developing measuring technology in Braunschweig since 1990. In the respective research and development departments, more than 100 engineers, mathematicians and scientists shape the measuring technology of the present and the future.

Today, more than 17,000 system installations improve product quality and accelerate product development and manufacturing processes for international companies in the automotive, aerospace and consumer goods industries, their suppliers as well as many research institutes and universities.

GOM headquarters in Braunschweig, Germany

www.gom.com