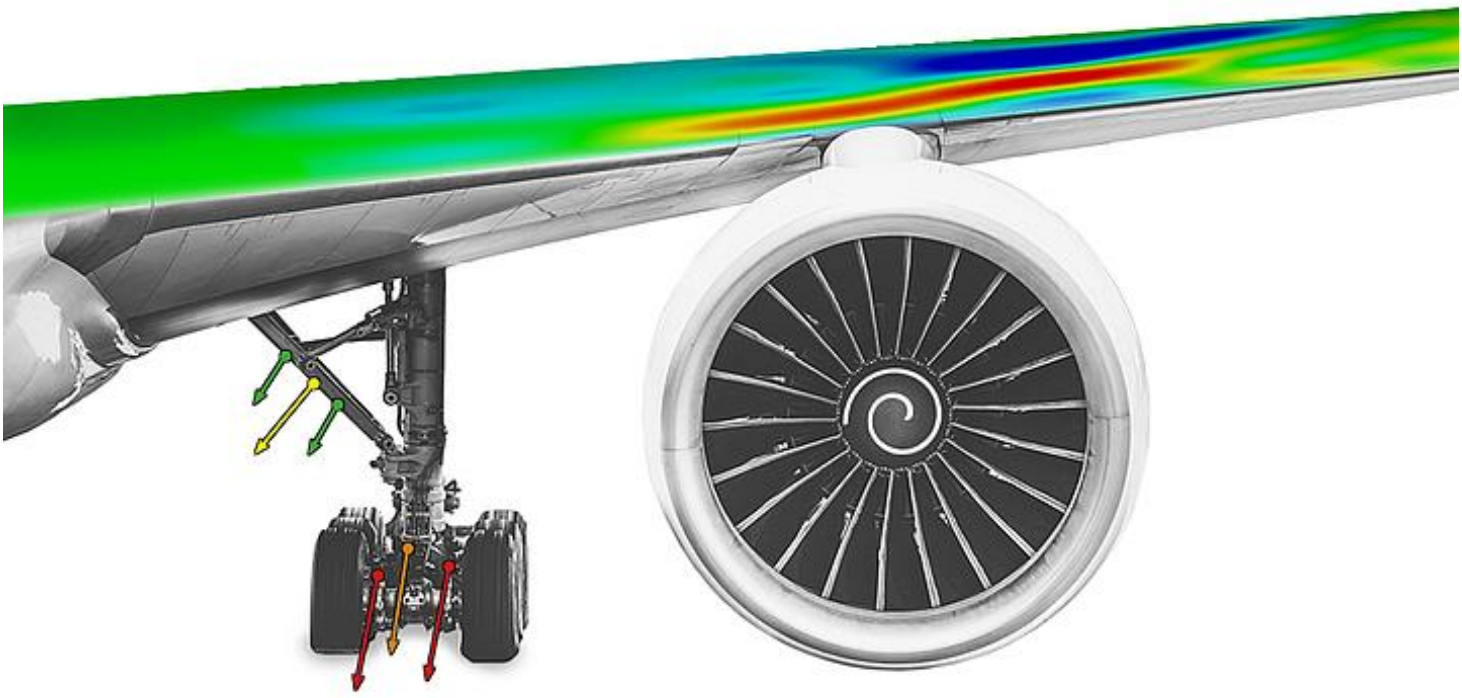
trilion

gom | certified partner

Industry 4.0

Aerospace Test & NDE

Materials & AM
Components & Structural
Vibration & SHM



Next Gen Testing for CAE Validation

Non-Contact Capability.

The Power of Optical Metrology.

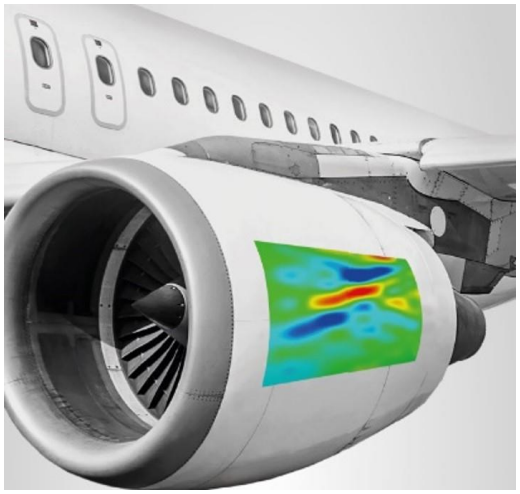
Aerospace Testing

Digital Image Correlation (3D-DIC) and Dynamic 3D Photogrammetry provide precision measurements of real, complex materials and structures, making it the perfect tool in aerospace testing. These full-field optical measurements with the same highly versatile equipment, provide the critical data for accurate measurement and precise validation of computer models. Our goal is to provide our customers with cutting-edge capabilities with high measurement accuracy and highly efficient controls, and the wraparound training and services to support them.

Design and manufactured in Germany for over 30 years, ARAMIS is our 3D-DIC and Dynamic Photogrammetry tool and is ideal for measuring dynamic structure response of your aerospace testing. It takes tens of thousands of measurement points, yet requires a fraction of the set-up time of a single mechanical sensor, i.e. strain gage or draw wire displacement sensor. ARAMIS provides a holistic understanding of components under test. Like a FEM (Finite Element Model), each measurement captures everything in the measuring volume in front of the cameras, including the areas of concern, and the areas that you do not know are a concern are measured, simultaneously.

Advanced composite designs cause complex issues with load transfer and shear forces, which make full-field optical measurements critical.

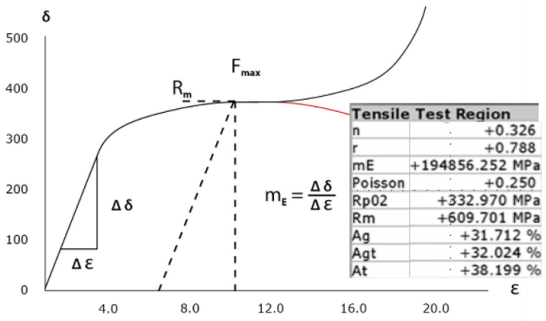
ARAMIS 3D DIC Photogrammetry makes Finite Element Measurements with 10,000 nodes in three axes of deformation, with 6-DOF (degrees of freedom), and the full strain tensor at each point. From materials to complex components to entire aircrafts, this is the ideal tool for CAE model validation.



ARAMIS Automation using robots to move the stereo sensor to many different areas provides percision access to all points on critical structures and across entire vehicles.

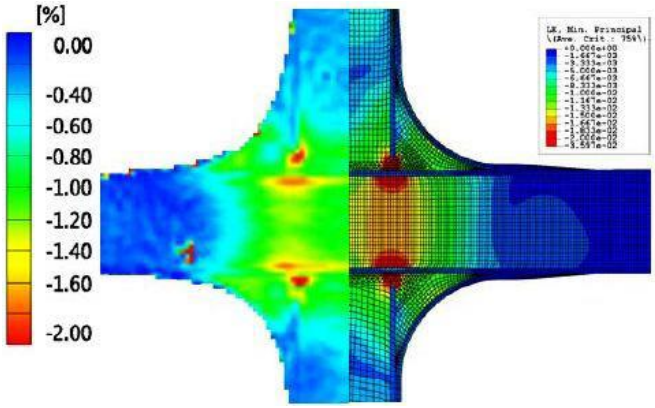
Material Testing

Material Properties are one of the most important parameters to understand in your advanced product design. Characterization of materials establishes the basis for your computer models and of all your process data. ARAMIS 3D-DIC is the ideal tool for measuring material properties. It is fully non-contact, full-field, and provides rapid, holistic understanding of the materials under test.



ARAMIS 3D-DIC can provide any desired virtual measurement, matching any clip gauge, strain gage or extensometer. Measurements always provide thousands of data points in all three axes, providing the greatest accuracy for your material properties evaluation. 3D-DIC, being fully 3D, corrects for the measurement errors of laser and video extensometers, as well as 2D-DIC systems.

ASTM/ISO Standards templates and ARAMIS's automated tools, allow you to automatically determine all your material properties, directly to Industry standards, simply and efficiently. Customers automate their materials properties measurements saving on time and schedule, reducing costs and getting substantially better data.



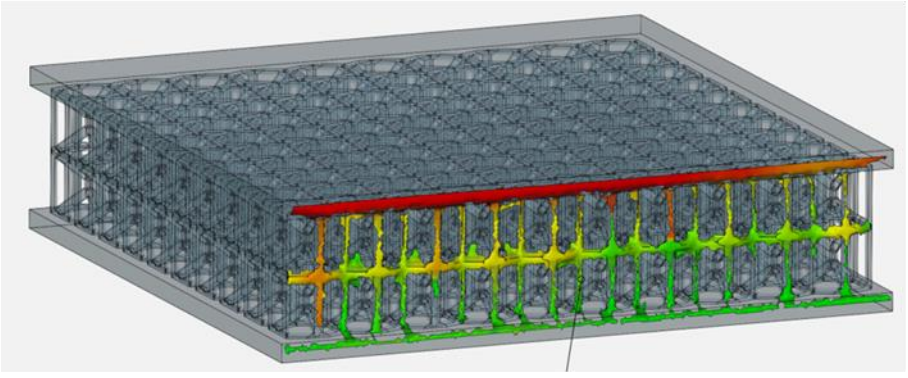
Biaxial loading of composite joint, (left) reality ARAMIS measurement, versus FEA model (right)

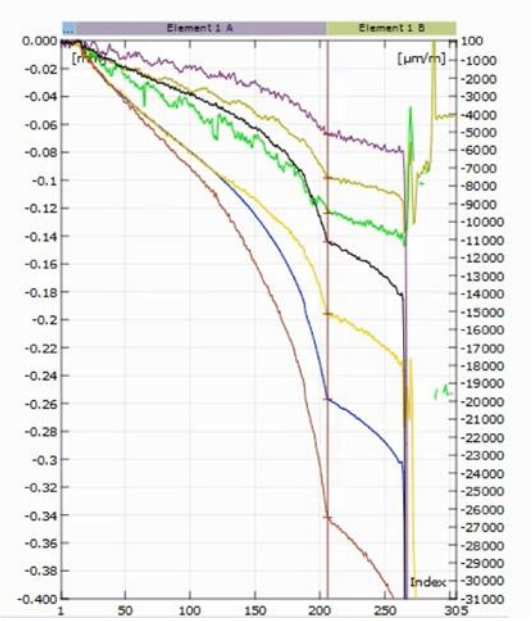
Additive Manufacturing

Trilion strives to make sure your products have the highest structural integrity and quality. Industry 4.0 Additive Manufacturing Quality Assurance (AM QA) achieves this with our suite of products, designed specifically to validate the quality of your builds.

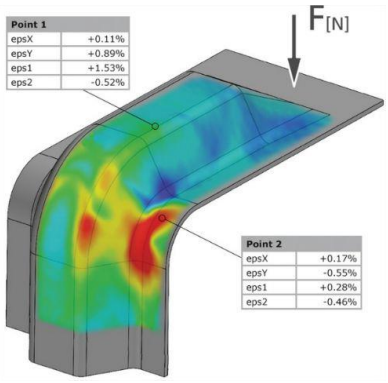
GOM CT is the state-of-the-art metrology Computed Tomography (CT) system. The GOM CT is able to volumetrically measure your entire part, confirming build measurements to CAD, as well as SPC build variability, and detect and measure void content. ARAMIS 3D DIC (Digital Image Correlation, Photogrammetry) provides holistic non-contact, full-field measurement of the 3D structural response of your witness coupons, and of your entire component under stress.

ARAMIS Industry 4.0 Additive Manufacturing Quality Assurance lab couples GOM CT and ARAMIS 3D-DIC to fully validate your witness coupons, as well as validate your builds for material quality, dimensional conformity, and application strength validation. These tools are utilized in industries such as automotive, aerospace, biomechanics, microelectronics, civil structures, defense, for composite, molding, and AM QA.

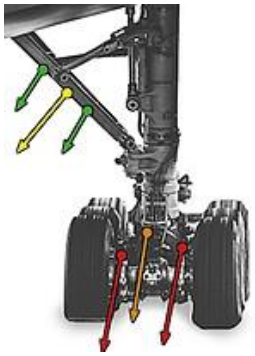




Component Testing

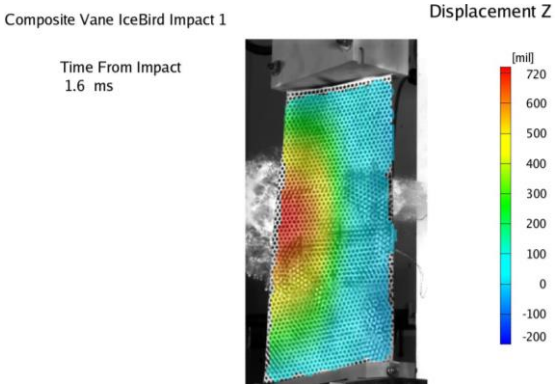


ARAMIS 3D-DIC provides full-field component testing, measuring all points, not just the areas that you believe to be an issue; truly adding value to Finite Element validation Measurements. Composites experts say that ARAMIS provides them the true response of the structural loading, critical for understanding your complex, and low deformation composite structures. That, you can not really know your composite structures without these full-field measurements.



ARAMIS 3D Photogrammetry is stereo photogrammetry imaging for full 3D analysis of any motion captured in 6-DOF (Degrees of Freedom), dynamic 3D displacements, and strains unlike traditional measurements which are just flat in 2D space.

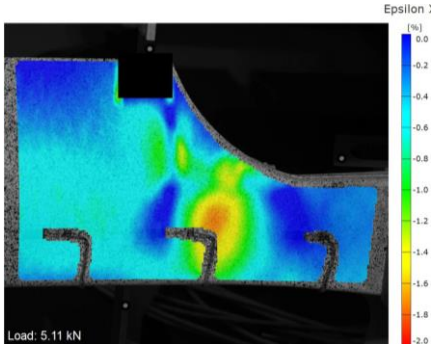
ARAMIS 3D High-Speed 3D-DIC Photogrammetry measures parts and components at any speed for GVT (ground vibration testing), modal analysis and impact testing, using ARAMIS High-Speed cameras from thousands to millions of fps (frames per second). Typical measurement of 100 Hz, for FFT analysis, are typically performed at 500 fps and full waveforms and modal analysis at 1.5Kfps or more. Standard high-speed cameras run at 6Kfps and up to 50Kfps, while ultra-high-speed cameras, can go up to 5Mfps.



ARAMIS FEA Validation allows CAD model import for precision design orientation and coordinates, and FEA simulation import to directly compare 3D displacements and strains, point-by-point, comparing the computer model with the real structural responses.

Structural Testing

Structural Testing is a core to the power of ARAMIS, allowing you to holistically understand your structure's response. Currently, most aerospace structural testing uses ancient methods. CAE validation requirements, with the precision of their models, have grown to far exceed these capabilities. Companies like Boeing have shown that ARAMIS is 10x cheaper than traditional mechanical gauges, 50x faster to implement and provide 100x more critical data, providing the Finite Element Measurements required to validate CAE models.



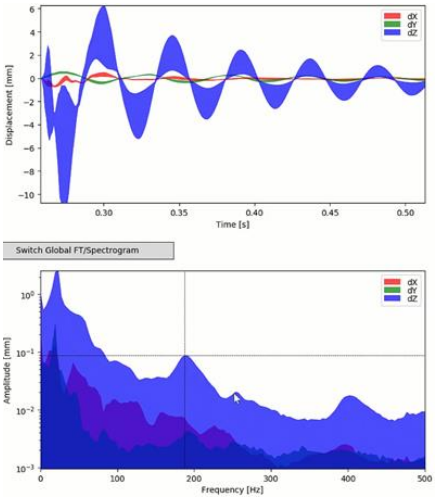
ARAMIS Automation, being a fully non-contact optical method, allows ARAMIS to have unique abilities in advanced structural testing. Robots can amplify the power of ARAMIS, allowing it to cover larger areas during quasi-static structural tests, taking seconds per measurement area. Portable or mobile robots are commonplace, and are designed to be easily implemented for large area measurements, with high accuracy and local resolution. ARAMIS Automation is ideal for landing gear, wings or entire vehicles.

ARAMIS Thermography is the key to precision strain measurement in red-hot environments, and for NDT (NonDestructive Testing) providing thermal data in precise 3D coordinates. The full-field thermal data allows the ARAMIS strains to be corrected for thermal expansion, providing true mechanical strains, as well as full-field temperature in CAD coordinates. Developed for thermal fatigue failure of B-2 Aft Deck, the technology is broadly used for materials, microelectronics, engines and vehicles.

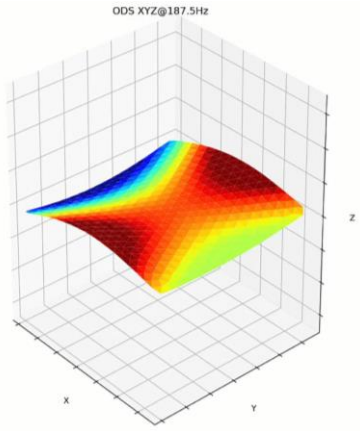
Structural Health Monitoring using ARAMIS Thermography NDE provides Enhanced Visual Inspection, with the power of millions of strain gages. ARAMIS remembers every measurement of every inspection area and can detect slight variations in shape, deformation, strain and NDE. The implementation of this capability provides weight reduction, predictive maintenance and life extension.

Vibration

Vibration Analysis of structures with ARAMIS provides non-contact, massless acceleration vibration data with minimal set-up time, providing precision FFT and vibration waveforms at any point on the structure. We have matched 50 accelerometers, taking two weeks to setup and calibrate, with one ARAMIS system ready to go in 2 hours. ARAMIS High-Speed, originally developed for the NASA Space Shuttle Return-to-Flight ballistic impacts, has become the mainstay of the Industry 4.0 vibration industry.



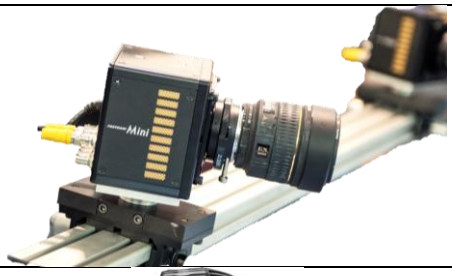
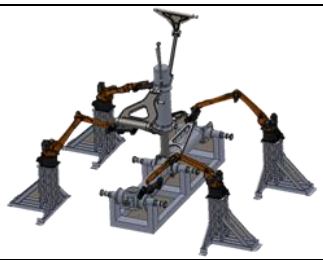
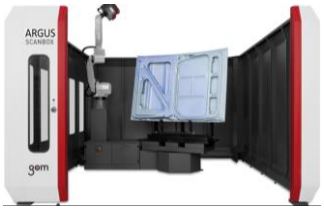
Modal Analysis with ARAMIS High-Speed captures the dynamic 3D shape of the component. The ARAMIS FAST frequency analysis module displays FFT and the operation defection and mode shapes at each frequency. Since all points are captured synchronously, the full phase relationship on the modal response is highly accurate, unlike single point measurement systems.



Ground Vibration Testing (GVT) for the entire vehicle is the power of our full-field methods, providing the global 3D displacements, local buckling and modal response, across the entire vehicle. TRITOP aligns every ARAMIS result into CAD coordinates providing seamless full-vehicle measurements.

TRITOP Photogrammetry coordinate measurement and CAD alignment during set-up, allows every ARAMIS measurement to be automatically stitched together for the measurement of large components or entire vehicles.

Aerospace Toolbox

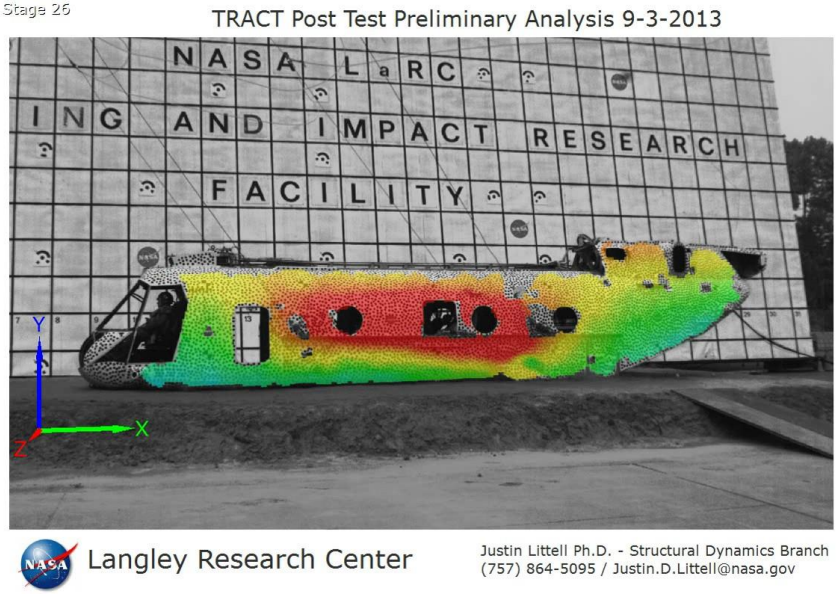
ARAMIS		ARAMIS is a non-contact & material-independent measuring system based on digital image correlation photogrammetry.
ARAMIS High-Speed		ARAMIS High-Speed is the perfected 3D optical sensor for a wide range of high-speed measurements for vibration, acceleration, model analysis etc.
TRITOP		TRITOP system portably measures 3D coordinates of complex objects precisely and provides large area stitching for ARAMIS.
RVAT		RVAT (Real-time Virtual Assembly Tooling) is the digital manufacturing capability for the Aerospace Digital-Twin.
GOM CT		GOM CT is a state-of-the-art metrology CT scanner capable of the highest accuracy and resolution in the industry, for internal measurements, SPC, AM QA, etc.
ARAMIS Automation		ARAMIS Automation is the optimum tool for automated structural testing, bringing the full functionality of ARAMIS for less man hours and less testing effort.
ARAMIS ScanBox		ScanBox brings full automation to aero test measurements, for repeatable precision measurements every time.

Benefits and ROI

Industry 4.0 Aerospace Test brings 21st century imaging technology power to the aerospace test engineer, allowing him to meet the testing needs of the advanced CAE computer modeling. Testing with single point sensors no longer provides the quality of data necessary for precise model validation. Composites particularly have pushed components and assemblies to the design limits, so all points of the structure are needed to be verified.

Engineering Design looks to have their models validated accurately, as well as quickly and efficiently. This is more and more critical every year, especially with increasing competition. ARAMIS is reported to be 10X cheaper than traditional gauges, 50X faster to use, and 100X more data for better model validation {Boeing}. The aerospace companies now want their models precisely validated, so that they can rely more on them. Testing with ARAMIS will always be needed to do this critical work.

Lightweighting Designs and assemblies are super-critical in their design and function. ARAMIS provides full-field and integrated measurement of all components working together. Multiple materials, component assemblies and systems are difficult to model; ARAMIS sees precisely how they work together, from fit (3D Shape) to 3D displacements, to interface strains to vibrational responses, making ARAMIS a critical tool for the aerospace test.



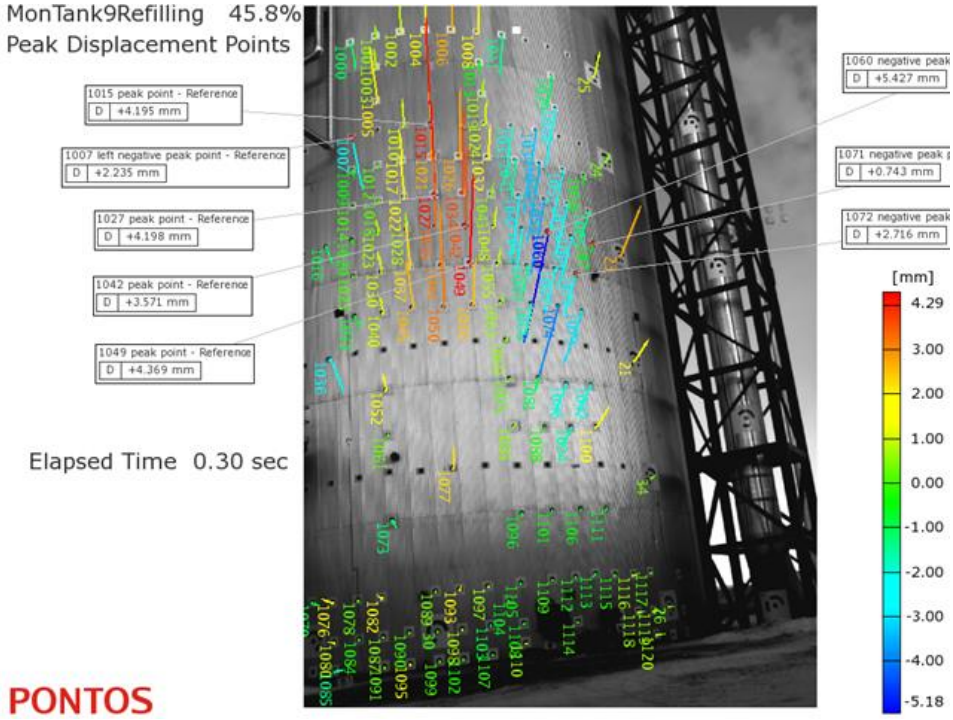
Trilion Engineering Services

Trilion Engineering Services are the perfect solution for solving a complicated application or developing a justification for a critical measurement system. We provide experienced engineers, with industry specifice experience from material characterization, to testing, in aerospace and many other industries including automotive, microelectronics, and power generation.

Some examples of our engineering Services include:

- Full field 3D displacement map during component testing
- Strain field for FEA validation
- High-speed measurements and vibration analysis
- Large scale structural testing

We look forward to supporting our customers and are excited by the prospects of applying our technologies to solve problems. We get professional results every time.



All-in-One Solution

Trilion Quality Systems has been an industry leader in Optical Metrology for over 20 years, developing and supporting unique applications throughout North America. Finally, optical metrology brings long-awaited advanced Factory 4.0 capabilities to the manufacturing industry.

Trilion Engineering Services is the perfect solution for companies who have a complicated application or are not ready to acquire a system. We will send an experienced engineer and system to get professional results every time.

A manufacturing revolution, reducing costs and improving quality!

ARAMIS is the tool of choice for industry leaders!

Trilion customers are industry leaders, and their operations are the best proof of the importance of this optical metrology in manufacturing.

For more information, visit:

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