METRIS NEWS

CASE STUDIES AND PRODUCT NEWS

VOLUME 3

NEW!
DIGITAL LC60D
LASER SCANNER

K-SCAN MMD SPEEDS UP VIP VEHICLE DESIGN AT CARAT

LASER RADAR CAPTURES WIND TURBINE BLADE GEOMETRY

K-SERIES QUALIFIES CHASSIS FOR RCR RACING TEAM

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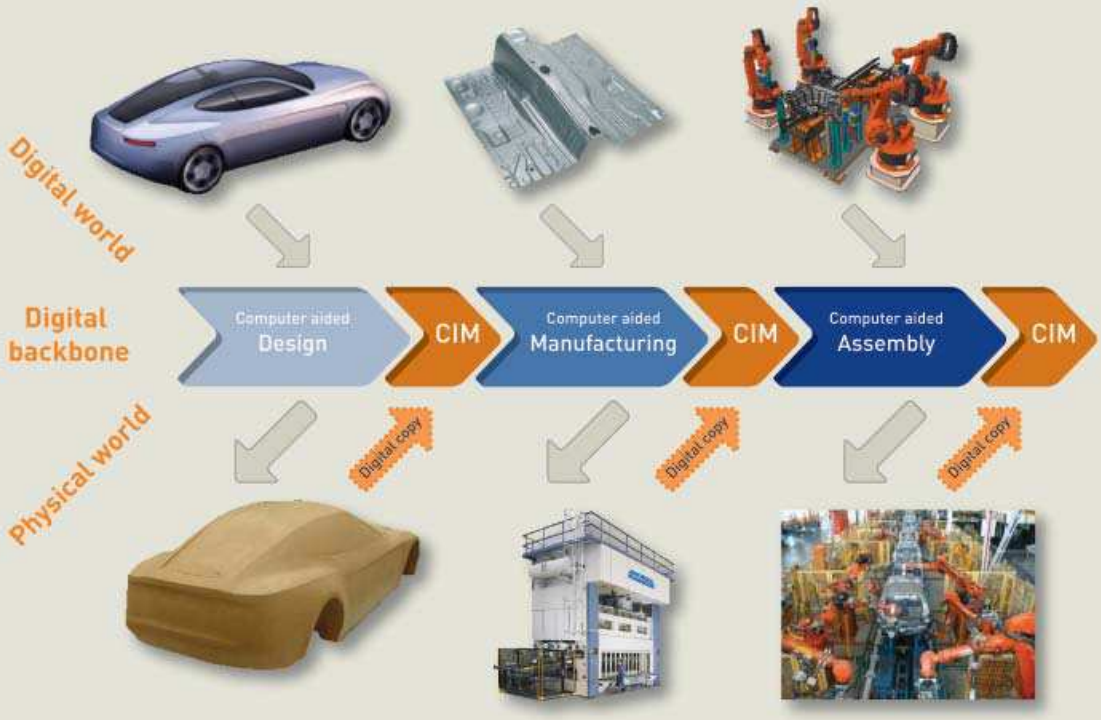
Metris news reports on Metris product releases and updates and publishes case studies that show innovative and reliable metrology solutions in action at customers. These customer testimonials explain first hand how Metris metrology equipment increases product quality, compresses throughput time and saves resources.

DIGITAL INSPECTION INCREASES METROLOGY PRODUCTIVITY AND FLEXIBILITY



As a pioneer in non-contact metrology solutions, Metris has brought to market a broad range of handheld and CMM laser scanners. New innovations in point cloud software and laser scanning technology – including Focus Scan Off-line and LC60D laser scanner – are key enablers of an entirely digital inspection process. The concept of digitizing test samples up-front and running inspection on the digital copies of the samples, streamlines metrology operations and embeds them into the digital CAD-centric development process.

A DIGITAL CAD-BASED DEVELOPMENT PROCESS

Today, digital information streams guide and monitor development operations – from design through manufacturing. Designers shape new product innovations on digital drawing boards and analysis engineers rely on simulation to optimize product performance. Process engineers try out production methods and procedures in the virtual world, including off-line programming of production line equipment. Manufacturing companies implementing a digital development process have been more successful than others in compressing time-to-market and controlling development costs.

At the heart of the digital development process is undoubtedly the CAD model, which is the backbone of today's design-through-manufacturing process. CAD encapsulates all relevant and up-to-date information of a new product under development. Initially looking merely like a rough sketch, the CAD model of a new family car, private jet, cargo ship or drilling machine gradually evolves into a fully fetched model that is ready for serial production.

THE DITIAL INSPECTION PROCESS

The concept of digitizing test samples up-front and running inspection on the digital copies of the samples, streamlines metrology operations and embeds them into the digital CAD-centric development process.

- ✓ Digital metrology solutions – such as 3D laser scanners - provide the touch with reality at several stages across the digital development process.
- ✓ Compared to inspection performed directly on the physical part, "digital inspection" first digitizes the test part and subsequently runs inspection on the acquired digital model data.
- ✓ The digital inspection process takes advantage of the typical automation capabilities and flexibility benefits of a digital workflow, saving time and money.

THE TOUCH WITH REALITY THROUGH DIGITAL INSPECTION

A critical factor throughout the entire digital development process is metrology, which consequently provides the touch with reality.

Digital geometry measurement actually inserts physical information in the digital development world. Designers manually refine clay models or rapid prototypes, and expect the CAD model to be updated accordingly. Similarly, sheet metal engineers compare simulation results with pre-serie samples to check the validity of their simulations. Non-contact metrology technologies – such as laser scanning, white light or computer tomography (CT) – generate 3D point cloud information, which represents a truly digital copy of the physical test part.

Metris delivers on its vision of realizing a digital inspection process. Compared to executing inspection directly on the physical part, "digital inspection" first digitizes the test part and subsequently runs inspection on the acquired digital model data. As such, the digital inspection process – from measurement preparation to final report – takes advantage of the typical automation capabilities and flexibility benefits of a digital approach. The concept of digital inspection streamlines metrology operations and embeds them into the CAD-centric development process, saving time and money. As the complete digital copy of the test part remains available, full flexibility is offered to run other or more detailed analysis at any time and place.

FAST PREPARATION OF CMM LASER SCANNING JOB

Creating a digital duplicate of the test part is a fairly straightforward job that does not require specific metrology know-how. Collecting data for CT analysis using predefined machine settings is like cooking dinner in a microwave oven. Digitizing a surface using a handheld scanner is as easy as a paintbrush job. It requires less effort to program a CMM for laser scanning than to specify individual touch sensor points for tactile inspection purposes. Moving the laser scanner along linear or polygon motion paths is sufficient to keep part surfaces within the boundaries of the field-of-view depth of the laser scanner probe. However, in case of complex freeform surfaces, manual teach in of laser scanner motion paths can still be a cumbersome job.

With the introduction of Focus Scan Off-line, this is not the case anymore. Once the user has selected the surfaces to be digitized on the CAD model, the program will automatically generate an optimized sequence of scan paths and probe head angles. As a result, Focus Scan Off-line provides full coverage of selected surfaces and adapts scanner motion speed to local geometry. Scanner motion automatically slows down around local curvatures or when more measurement points on the circumference of smaller features need to be captured. Following this automatic procedure, scanning of freeform surfaces can start minutes after the CAD file has been loaded.

When feature inspection is involved, Focus Inspection offers the possibility to read in product manufacturing information (PMI) from the CAD file in order to automatically retrieve the features from the point cloud and calculate the tolerance information. This avoids manual entry of dimensions and tolerances, which is time consuming and represents a major source of errors. Setting up the inspection program does not require any programming skills or command knowledge whatsoever.

LC60D Line Scanner

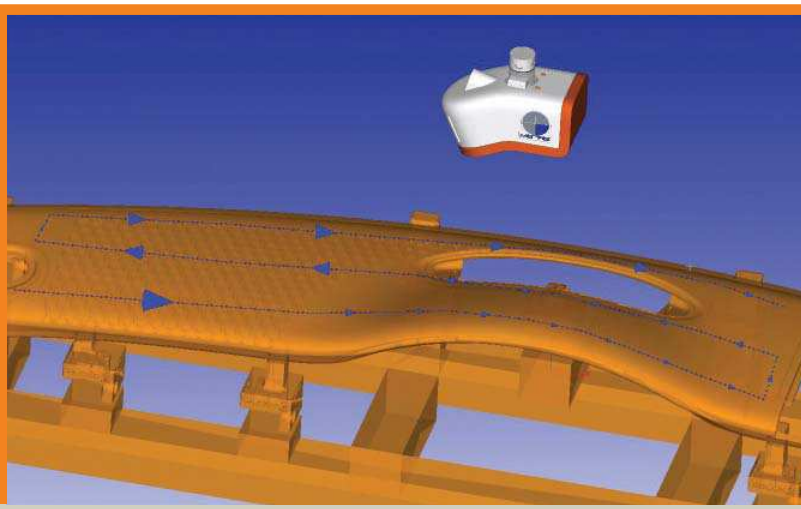
XC50-LS Cross Scanner

Preparing a CMM for laser scanning requires less effort than programming individual tactile inspection points. Digitizing a surface using a handheld scanner is as easy as a paintbrush job.

ModelMaker handheld scanner

K-scan MMD walk-around scanner

From measurement preparation to final report, the acclaimed Focus software suite helps you take advantage of the typical automation capabilities and flexibility benefits of a entirely digital workflow.



Focus Scan Off-line automatically generates an optimized scan path and probe head angle sequence, and adapts scanning motion speed to local geometry.

SCAN-AND-GO WITH THE NEW LC60D LASER SCANNER

Focus Scan software runs on all Metris LK and C3 CMMs and on most third-party CMMs. Once the appropriate scan program is loaded and the datum features are scanned to align the test part, no further operator interaction is needed to complete the scanning job. By using the revolutionary LC60D laser scanner, digitizing productivity increases up to a factor of 4. A major leap forward compared to its LC50 predecessor line scanner is the image acquisition frame rate that is increased from 25 to 75 Hertz. In combination with 15% wider laser stripe and 17% higher point resolution, the scan speed of the LC60D reaches a stunning 75,000 non-interpolated points per second.

Enhanced scanning performance technology of the third generation (ESP3) adapts scanning parameters point by point in real-time, eliminating manual parameter tuning and part spraying altogether. No operator interaction means uninterrupted scanning and operator-independent data collection. The massive amount of measurement points that are acquired radically increases the surface area the scanner is able to capture and process. This enables manufacturers to drastically compress the inspection cycle time for freeform parts, or boost the number of features that can be scanned in the same time frame.

MAXIMUM FLEXIBILITY TO DRAW INSPECTION CONCLUSIONS

After digitizing the test part through laser scanning, the inspection program can be automatically started so that the report immediately pops up on the screen. Focus Inspection reports include part-to-CAD comparison plots with color-coded areas marking local geometry deviation, which can be interactively analyzed using the free downloadable Focus Viewer. Anyone who receives the digital report can evaluate the inspected part from any preferred viewpoint and click locations of interest to consult the underlying metrology data. The dazzling number of measurement points provides a higher degree of measurement confidence that forms a solid basis for well-informed quality decision making.

As laser scanning delivers a true digital representation of the actual test part, inspection engineers are offered full flexibility as to where and when they execute inspection. Digital inspection even allows alternative or more detailed analysis to be performed at any convenient time or place, without requiring the availability of the physical test part.

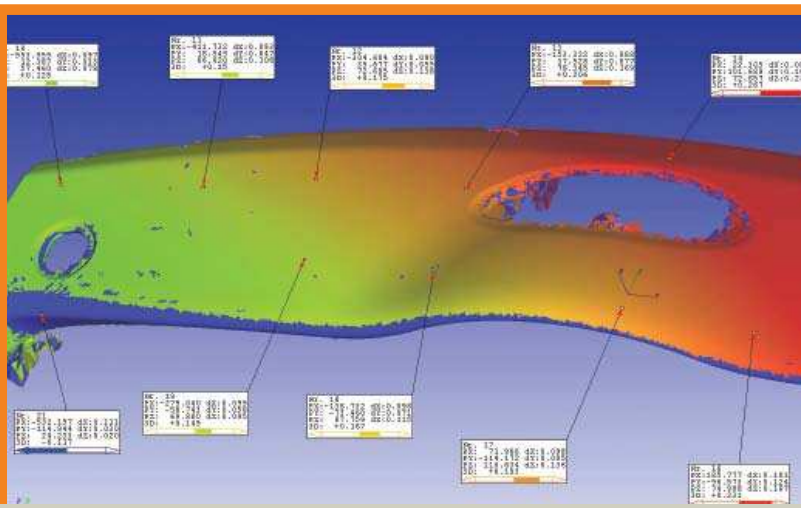
Focus Inspection offers a complete set of functions for both surface and feature inspection, including full geometric dimensioning and tolerancing (GD&T). Through close collaboration with major car OEMs, Focus Inspection integrates unique sheet metal functions, ranging from user-configurable calipers for flush & gap analysis to hard-to-measure diamond pin, T-stud and christmas tree 3D features. For the digital inspection of turbine blades, Focus Inspection offers a dedicated analysis module that generates the typical inspection reports that are currently used in the turbine blade industry.

SOLUTIONS FOR LARGE CORPORATIONS AND SMALL WORKSHOPS

In global automotive manufacturing companies, with distributed engineering and production sites and lots of supplier interaction, digital inspection is essential in streamlining metrology operations. Focus Scan Off-line makes it possible to efficiently prepare both scanning and inspection programs centrally, starting from the CAD model. With Focus Scan running on a wide range of CMM brands, the same programs can be run at different company and supplier sites. The LC60D laser scanner compresses CMM inspection cycles and restricts operator interaction on the shop floor to absolute minimum.

In case components are manufactured at different production locations, virtual assembly in Focus Inspection helps trace and solve production issues before production has even started. Also when systematic production quality checks detect out-of-tolerance parts, production engineers rely on the digital model to retrieve the source of the problem and propose appropriate countermeasures.

Focus is today's software reference for acquiring and analyzing point cloud data, which embody a truly digital copy of the physical test part.



Focus Inspection reports include part-to-CAD comparison plots with color-coded areas marking local geometry deviation, which can be interactively analyzed using the free downloadable Focus Viewer.

MONITORING MATERIAL SHRINKAGE AND SPRING BACK ISSUES

Beyond the automotive industry, digital inspection using laser scanning is beneficial to manufacturing companies of any size across many industries. In particular when dealing with freeform components, digital inspection overcomes all limitations of tactile inspection. Casted or stamped metal parts or injection molded plastic components are proven production methods, but shrinkage and spring back issues may set specific production quality issues. For these reason, CMM or handheld laser scanning perform detailed verification on both molds and first parts. During production, inspection is applied to monitor tool wear or detect other changes in the production process.

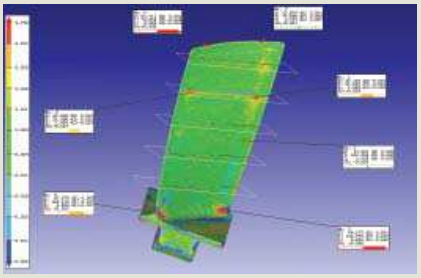
Inspection is also crucial for tool & die shops, as they have little time and few resources available. They need a powerful inspection solution that enables machine operators to perform the inspection job themselves. Yet, digital inspection powered by laser scanning and the Focus metrology software suite, is again the right choice. Here too laser scanning inspection using the Focus suite with LC60D is a perfect solution. Automatic CAD-based generation of scan paths and probe head angles speed up laser scanning preparation. The LC60D digitizes the complete tool – including shiny sections – in one go, without operator interaction. This digital inspection process compresses metrology time spending, and delivers graphic reports providing powerful CAD deviation insight. The final tool can be delivered with a detailed inspection report that serves as a Metris quality stamp.

PRODUCTIVITY AND FLEXIBILITY BENEFITS OF DIGITAL INSPECTION AT A GLANCE

1 **Quickly generate a digital copy of test specimen**
Digitize the test part by scanning features and freeform surfaces.

- Automatic generation of CAD-based scan path and probe head (Focus Scan Off-line)
- Fast scanning throughput to quickly obtain point cloud data (LC60D)
- Point-to-point laser intensity adaptation eliminates user interaction (LC60D)

2 **Perform digital inspection with full flexibility benefits**
Get the desired inspection output from the point cloud data.



- Run any type of inspection at any time and place (Focus Inspection)
- Instant graphic point cloud data comparison with CAD (Focus Inspection)
- Routine quality check or more in-depth inspection to drive development or troubleshooting (Focus Inspection)

METRIS LC60D LASER SCANNER REVOLUTIONIZES DIGITAL INSPECTION

LC60D is Metris' next-generation digital 3D line scanner that demonstrates superior scanning productivity, ease-of-use and robustness. Equipped with state-of-the-art digital technology and powerful on-board data processing, the LC60D CMM scanner more than triples today's common scan rates. LC60D strengthens and accelerates the digital inspection process by making the digitizing process faster and more straightforward.

REALIZE UP TO 300% PRODUCTIVITY GROWTH

Metris is recognized as the reference for CMM-based laser scanning, building on the success of its LC single-stripe and XC multi-stripe scanners. With the release of LC60D, Metris further extends its tradition of introducing ground-breaking scanner innovations. A major leap forward compared to its LC50 predecessor line scanner is a significant increase in productivity, which is achieved by speeding up the image acquisition frame rate from 25 to 75 Hertz. In combination with 15% wider laser stripe and 17% higher point resolution, the scan speed of the LC60D reaches a stunning 75,000 non-interpolated points per second.

The massive amount of measurement points acquired at 15 micron accuracy radically increases the surface area the scanner is able to capture and process. As a result, LC60D operators can complete scanning jobs up to 4 times faster. This allows manufacturers to drastically compress the inspection cycle time for freeform parts, or boost the number of features that can be scanned in the same time frame.

BENEFITS OF LC60D

The digital LC60D scanner accelerates the digitizing process and makes it more straightforward.

- ✓ Complete scanning jobs up to 4 times faster through revolutionary scanning technology
- ✓ No manual parameter tuning or part spraying through point-per-point laser intensity adaptation
- ✓ Robust and temperature-stable operation requires minimum warm-up time

POINT-PER-POINT LASER INTENSITY ADAPTATION

To effectively scan surfaces with varying color or reflectivity, Metris introduces third-generation Enhanced Sensor Performance (ESP3). ESP3 adapts scanning parameters point by point in real-time, eliminating manual parameter tuning and part spraying altogether. No operator interaction means uninterrupted scanning and operator-independent data collection.

ESP3 functionality not just provides automatic real-time adjustment of sensor settings between successive laser stripes, but for each individual point of the laser stripe. This

LC60D radically increases the surface area the scanner is able to capture and process per second.

is achieved through rolling shutter imaging technology that ensures maximum data coverage on all surface materials and shapes, irrespective of surface finishing and lighting conditions. In case of highly reflective surfaces, a new reflection filter removes fictive scattered points resulting in clean scan data. ESP3 is a unique capability that even allows glossy convex surfaces to be captured in a single movement.

PREMIUM STABILITY AND RELIABILITY GUARANTEED

The LC60D bundles over 10 years of 3D laser scanning expertise. Metris development engineers optimized scanner design for maximum operational stability and robustness. Critical in this regard is that principal scanner components are mounted in an ultra-stiff stress-free aluminum housing.

Metris paid special attention to temperature stability by design and temperature compensation algorithms in order to minimize warm up time and guarantee reliable accuracy under shop floor conditions. By docking the LC60D in the ACR3 heated rack when not used, the scanner even has zero warm-up time resulting in maximum productivity.

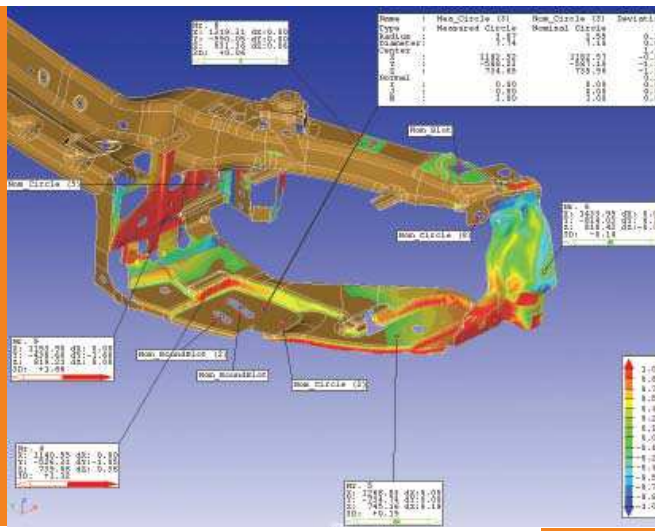
FULLY INTEGRATED PROPRIETARY METRIS SCANNING SOLUTIONS

Metris Focus is the software that drives LC60D operation on CMMs. The acclaimed software suite accelerates the entire workflow, from off-line preparation to final reporting. The LC60D scanner is tightly integrated with Metris LK/C3 CMMs as well as Metris CAMIO CMM driver software, creating a complete all-digital Metris CMM laser scanning solution. As such, Metris serves as a one-stop-metrology-shop supplying CMM, LC60D and software. The digital LC60D laser scanner fits a variety of CMMs, both from Metris and other 3rd party manufacturers. Economically relevant is that LC60D scanners can be exchanged between CNC-based and handheld scanning solutions. This provides customers the opportunity to use their LC60D on both CMMs and manual localizers.

KEY ENABLER OF THE DIGITAL INSPECTION PROCESS

In essence, the physical measurement data captured by LC60D is fed into today's digital CAD-centered information streams. In many cases, the analysis of point cloud data is performed to simply flags go/no-go status for dimensional quality control in production. When needed, however, more in-depth inspection data are available to gain critical engineering insight for product development or troubleshooting purposes.

ESP3 ensures maximum data coverage for sheet metal, turbine blade, plastic and machined metal part and many other applications.



CARAT-DUCHATELET EMPLOYS METRIS K-SCAN MMD TO INTEGRATE LIFE PROTECTION INTO PRESTIGE VIP VEHICLES

As the world leader in armored prestige vehicles, CARAT-Duchatelet counts sheiks, kings, presidents, CEOs and other wealthy VIPs among its customers. Before stretching and armoring luxury vehicles, CARAT-Duchatelet engineers remove seats and trim, and scan the entire vehicle body using Metris K-Scan MMD. The geometric 3D scan acquired by this portable metrology solution forms the basis for drastic vehicle modifications and detailed craftsmanship. The portable Metris K-Scan MMD enables them to ergonomically capture vehicle interior and exterior in one go.

ADDING SECURITY AND LUXURY TO PRESTIGE VEHICLES

Far away from mass and series production, CARAT-Duchatelet integrates the highest level of security and luxury into prestige sedans, limousines and off-road vehicles. Currently, over 40 Heads-of-State from Africa, Europe, Middle East, Far East and former Soviet Republics are driven in CARAT-Duchatelet vehicles. Next to integrating armoring into VIP vehicles, CARAT-Duchatelet engineers and craftsmen stretch vehicles both in length and height, and create personalized luxury interiors. Today, the Belgian company is recognized as the world leader in armor integration and the manufacture of specialty vehicles in the automotive industry.

At CARAT-Duchatelet, the armor development and integration process starts with crafting armor component shapes in wood. As wood is easy to manipulate, engineers quickly gain a rough idea of how new armoring will fit into a particular vehicle brand or type. This is the point where reverse engineering comes into play. "Using Metris K-Scan MMD, we scan the entire vehicle body, one time with the wooden parts attached and one time without," says Eric Appelmans, R&D engineer at CARAT-Duchatelet in Liège, Belgium. "This approach allows us to accurately digitize the vehicle body and generate digital CAD information. Detailed CAD data provides the insight we need to create some sort of invisible bullet-tight cage by optimizing the design of steel plate and glass armor parts."

METRIS K-SCAN MMD @ CARAT-DUCHATELET

K-Scan MMD scans vehicle body exterior and interior in preparation of drastic vehicle redesign.

- ✓ Laser scanning yields much more information than tactile measurements
- ✓ All required geometry information captured in one go
- ✓ Ergonomic operation – no mechanical constraints

OPTICAL CMM PROVIDES UNMATCHED SCANNING COMFORT

The setup of the Metris K-Scan MMD system is fairly straightforward. The engineer positions the camera of the Optical CMM module next to the vehicle body. The three high-resolution CCD cameras of the Optical CMM dynamically track the precise location and orientation of the handheld 3D Metris MMD laser scanner. "The absence of mechanical constraints creates a superior comfort level when scanning the surfaces of the body," explains Eric Appelmans. "The scanner is equipped with a laser stripe of 100 mm, which enables us to acquire measurement points at a rate of tens of thousands per second. With Metris K-Scan MMD, we easily and consistently reach the required measurement accuracy of 100 micron. But most important for us is the ergonomic handgrip of the scanner and the unmatched ease-of-use delivered by the system's optical CMM technology."

When scanning is ongoing, it is important for the user to

CARAT-Duchatelet integrates the highest level of security and luxury into prestige vehicles.

see the point cloud being acquired develop on the laptop screen in real time. Metris KUBE software manages the captured point cloud of the vehicle body, which typically consists of hundred thousands or even millions of accurate measurement points. To conveniently access all locations inside the car body, CARAT-Duchatelet engineers carefully select optical CMM positions that provide optimum coverage

"K-SCAN MMD HELPS US A GREAT DEAL IN STREAMLINING ALL OUR VEHICLE MODIFICATION ACTIONS, PROVIDING TOP QUALITY IN THE SHORTEST POSSIBLE TIME FRAME."

- Eric Appelmans, R&D engineer of CARAT-Duchatelet

of the scan area. To compensate for any vehicle movement during measurement, the operator applies the Optical CMM's unique dynamic reference feature. 3 to 6 small LEDs sticked to the car body and dynamically tracked by the Optical CMM ensure that all movement is compensated accurately. Using this information, the K-Scan MMD system is able to dynamically relocate the laser scanner position, avoiding leap frogging or part re-alignment altogether. K-Scan MMD additionally supports multiple standpoints for the Optical CMM. Data acquired from different Optical CMM locations refer to the same reference axes system and contribute to a single unified point cloud.

POINT CLOUD DATA DRIVES THE CAD GENERATION PROCESS

To reduce the amount of measurement data, CARAT-Duchatelet engineers apply curvature-based filtering algorithms to eliminate obsolete measurement data in flat plane surface areas. "After point filtering, we export the point cloud in IGES or ASCII format, and import the file in CATIA V5 software. On the basis of the point cloud data, we create a surface mesh and generate CAD surfaces. For us, the process of fitting freeform CAD surfaces through measurement points represents a largely automatic procedure. Only for particular edges and roundings that are deemed critical, we manually fit surfaces and select the optimum level of smoothening. This kind of flexibility enables us to take control of the CAD generation process and obtain high CAD definition quality."

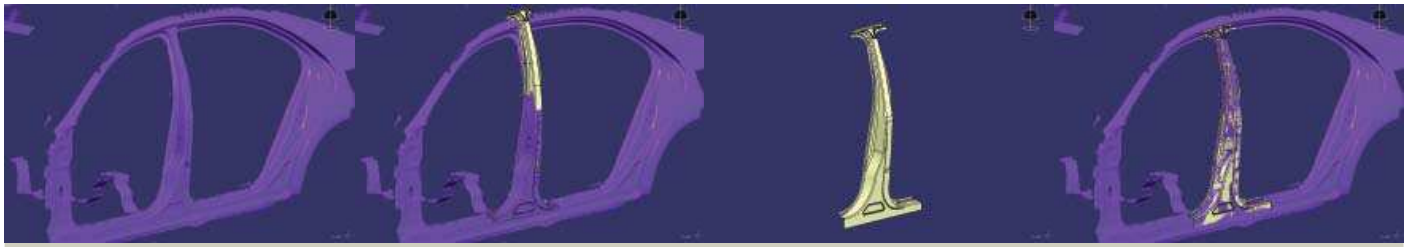
According to Eric Appelmans, scanning with K-Scan MMD provides better insight in a shorter time frame compared to taking manual touch probe measurements using an articulated measurement arm. "K-Scan MMD offers a comfort level and data acquisition rate that are simply beyond comparison. Our approach of digitizing a complete car in one go at the start of the project avoids many costly and time-consuming iterations later on the process. This enables us to design and develop all different vehicle modifications in the most effective way."

SCANNING STREAMLINES ALL VEHICLE MODIFICATION ACTIONS

Starting from the CAD data they generated, the R&D team of CARAT-Duchatelet specifies detailed requirements for steel and glass armoring and interior design. For radical vehicle modifications – such as vehicle extension and raised roof – a pre-scan may be executed to design adaptations to body, doors, hinges and windows, and driveline transmission. "The K-Scan MMD helps us a great deal in streamlining all our vehicle modification actions, providing top quality in the shortest time frame possible. With accurate and complete CAD data, we minimize the risk for development surprises that may introduce expensive rework and process delay."

Reverse engineered steel armoring parts make up a bullet-tight cage around the interior of a vehicle body.

The comfort and number of scan points provided by Metris K-Scan MMD are beyond comparison.



Scanned surface captured by Metris K-Scan MMD

Scanned surface with B pillar CAD overlay.

The CAD model of the original B-pillar.

Stretched pillar design for raised vehicle roof.

K-SERIES QUALIFIES RCR CHASSIS FOR NASCAR VICTORY

In 2007, all three Richard Childress Racing (RCR) teams qualified for the Chase for NASCAR's Nextel Cup. On top of this great accomplishment, RCR won the famous Daytona 500 and finished third overall in the Chase. To cut seconds off lap times, RCR engineers use Metris metrology equipment to optimize and tune the chassis/suspension performance of their premium race vehicles. Metris K-Series allows a complete chassis build to be referenced from a single common coordinate system, increasing data capture efficiency with over 40%. In addition, RCR recently opted for Metris MMD laser scanning to capitalize on fast, accurate and non-contact digitizing of suspension components to drive FEA and CFD vehicle simulation.

FACING TIGHTER STRUCTURAL AND DIMENSIONAL NASCAR REQUIREMENTS

"The recent introduction of the Car of Tomorrow (COT) concept represents the biggest change in NASCAR race vehicle regulation in the last 20 years," says Chris Hussey, Director of Engineering. "COT further tightens overall NASCAR race car requirements and forced racing teams to re-think their vehicle engineering processes. This basically means that all teams start off from scratch with COT when developing next-generation race cars for the 2008 NASCAR Homestead season and servicing them all season. In terms of chassis/suspension engineering, geometric inspection and verification plays a key role throughout the entire development process. Our choice for Metris K-Series' fast and accurate metrology capability enables us to reduce time spending for routine measurement and free up surplus engineering time."

Chris Hussey and his team are responsible for RCR chassis/suspension engineering and production. "When verifying NASCAR-mandated body and suspension points, Metris K-Series assists us in efficiently acquiring high-precision geometric data," Chris Hussey explains. "And beyond certification, we use the same equipment to acquire RCR-determined critical performance points to engineer as much competitive edge as we can in getting a potential winner at the start grid." All it takes to set up the system is to position its optical CMM (Coordinate Measuring Machine) next to the vehicle and immediately start measuring using the handheld SpaceProbe. The linear CCD cameras built into the system's optical CMM module apply triangulation to accurately track the tip position of the SpaceProbe. Among NASCAR mandated chassis characteristics are tube thickness, tube locator points as well as the rigidity and torsional stiffness of the chassis frame. For the suspension section, NASCAR-specific verification testing focuses on upper/lower controller arms and spindle drop/offset values in addition to camber, toe and other suspension-specific characteristics.

INTRODUCING METROLOGY WITH HIGHER MEASUREMENT TURNAROUND

"As the working volume of the Metris system easily fits an entire RCR chassis, Metris K-Series allows all measurement points to be measured in one go using a single coordinate system, eliminating leap frogging altogether," Chris Hussey explains. "Where final verification of an entire chassis assembly previously took almost an entire day, a single RCR engineer now completes the same metrology job over 40% faster!" In the past, RCR performed this kind of measurement using an articulated arm based measurement setup. The limited reach of the arm required multiple setup positions around the vehicle, which in many cases kept two operators busy and ultimately delivered inaccurate and/or inconsistent data due to potential misalignment.

While tight regulation applies to most parts of the vehicle chassis, the suspension system represents a relatively unrestricted zone that leaves plenty of opportunity to engineer inherently faster race cars. After establishing subtle compromises between vehicle aerodynamics and

METRIS @ RICHARD CHILDRESS RACING (RCR)

K-Series touch sensor measures chassis/suspension geometry to develop faster racecars

- ✓ 40% higher inspection turnaround
- ✓ Operator can freely walk around the test object
- ✓ Complete chassis build is referenced from a single coordinate system

handling performance, detailed suspension design and tuning begins. Chris Hussey explains that consistent tire patch contact with the track can be maintained under all racing circumstances, by adapting suspension characteristics to align the driving behavior of the car to the size and banking of the oval track. "Besides focusing on designing for lighter vehicle weight, we modify the suspension design, all within the design boundaries imposed by NASCAR. We tune caster and camber in the asymmetric suspension along with toe, and design the right amount of toe out that can be gained on the inside tire in a turn. Following our strategy to bringing more engineering in-house, we take full control over chassis/suspension engineering and safeguard our technical expertise."

"METRIS K-SERIES ENABLES US TO REDUCE TIME SPENDING FOR ROUTINE MEASUREMENT AND FREE UP SURPLUS ENGINEERING TIME"

- Chris Hussey, Director of Engineering at RCR

BETTER ENGINEERING DECISIONS BY NARROWING DOWN TECHNICAL OPTIONS

Lessons learned from acquiring more in-depth engineering information support RCR engineers in developing chassis design innovations that step up race chassis performance. Chris Hussey says that in the limited time frame in between races and in the off-season, accurate and repeatable metrology helps quickly narrow down technical options and make the right engineering choices. "Accurate, consistent and repeatable data ultimately makes RCR's yearly production of 40-50 chassis/suspension builds truly identical. This is essential in building the capability to compare engineering information, irrespective of the chassis/suspension unit being considered. We insert all acquired 3D measurement information into our company-wide engineering knowledge base, to strengthen our capability to understand the complex physics that are involved in top-level NASCAR racing."

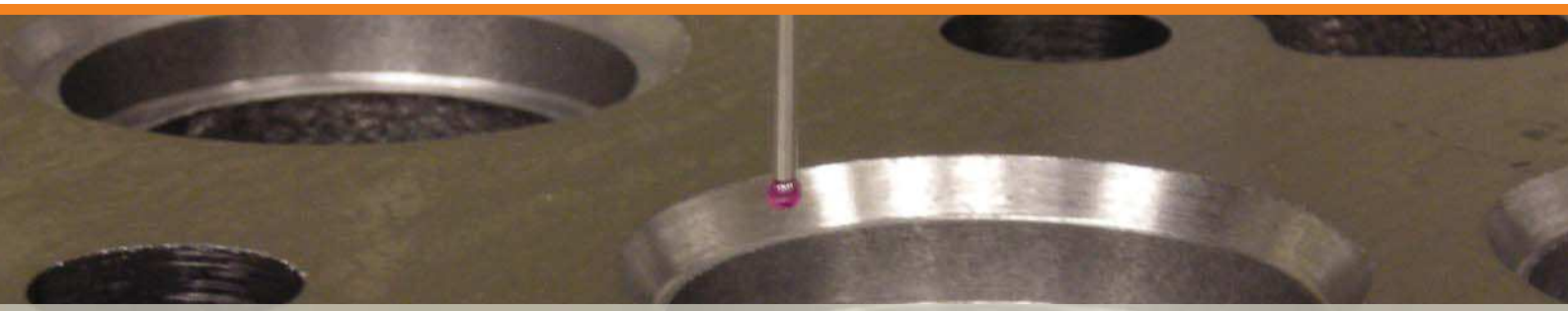
Metris K-Series allows complete chassis/suspension verification to be completed over 40% faster!

The hectic pace of a NASCAR racing season calls for fast action, especially when considering post race and damage analysis. Hussey indicates that due to the frantic NASCAR race schedule, he only has Mondays through Thursdays to deliver race-ready vehicles. "As soon as race cars become available after a race, our engineers use Metris K-Series to assess torsional twisting of the vehicle chassis and run other specific tests. We noticed that accurate and predictable measurement results show clear trends in terms of mechanical vehicle wear and collision damage. This enables us to promptly define countermeasures and complete repair in time. Fast and in-depth investigation avoids trial-and-error analysis and reduces the turnaround for similar chassis/suspension builds in the future."

EVOLVING FROM MEASUREMENT EQUIPMENT TO ENGINEERING AID

RCR clearly sees premium metrology solutions more as engineering aid than measurement equipment. In this regard, RCR recently extended its metrology capability with Metris MMD, a powerful non-contact laser scanning solution. Featuring a wide laser stripe and all-digital operation, the arm-mounted MMD allows complete detailed geometric scans of small to large vehicle body parts to be captured in record time. Scanning at a rate of multiple thousands points per second creates a detailed digital 3D copy of the scanned surface, which easily adds up to millions of measurement points. RCR uses the Metris MMD to reverse engineer chassis/suspension to quickly create virtual FEA and CFD component and assembly models. These digital models are leveraged to run simulations in different engineering fields, including dynamic motion, durability and aerodynamics.

Major breakthroughs in manufacturing capabilities are generally preceded by major breakthroughs in metrology. "Metris brought us dimensional accuracy and manufacturing consistency that clearly exceeds NASCAR Car of Tomorrow certification requirements," Chris Hussey concluded. "More importantly, Metris metrology helps us lay bare the root causes of race car limitations, which enables us to create that extra competitive advantage that separates winners from the pack."



METRIS 24/7 QUALITY CONTROL AT CUMMINS ROCKY MOUNT ENGINE PLANT

To maintain premium manufacturing quality and repeatability for powerful on-and-off-road diesel engines, Cummins Rocky Mount Engine Plant (RMEP) runs 24/7 inspection using 11 Metris LK CMMs. In the manufacturing process of cylinder blocks, connecting rods and cylinder heads, Metris CMMs automatically verify dimensions and features through touch probing and scanning. To respond to even more demanding precision and productivity requirements, Cummins RMEP recently invested in a Metris XC laser scanning probe for non-contact 3D feature and free-form inspection.

ESTABLISHING HIGHER DIMENSIONAL ACCURACY MEANS BETTER ENGINE

Established in 1980, Cummins RMEP manufactures diesel engines and components. Engines from the company are shipped worldwide to power agricultural and industrial applications, as well as buses, trucks and boats. At its 110,000m2 facilities in Whitakers, North Carolina USA, Rocky Mount Engine Plant (RMEP) counts approx 1,750 employees who turn out 600 engines per day, ranging between 70 and 00 horsepower. RMEP's non-stop metrology operations dedicate 4 Metris CMMs to four-valve cylinder head production, 4 to cylinder blocks, 1 to connecting rods and 2 for two-valve cylinder heads. For key engine parts, RMEP production personnel apply all their manufacturing excellence to obtain tighter geometric tolerances, which in turn further increase horsepower and reduce engine emission.

When production began, RMEP used as its primary measurement tools manual gauges and fixtures. Although these gauges provided immediate pass or fail status, it required a lengthy and costly process to modify these structures according to latest design changes. "A much higher degree of flexibility, and live electronic SPC, are needed to efficiently set up and run routine metrology tests in order to monitor the quality of our daily manufacturing operations," states RMEP's Quality Engineering Manager "At the time when Cummins introduced four valve engines, and steadily increased the number of engine configurations, we incorporated Metris CMMs as an integral part of our manufacturing process."

ACQUIRE, SHARE AND LEVERAGE ENGINE METROLOGY DATA

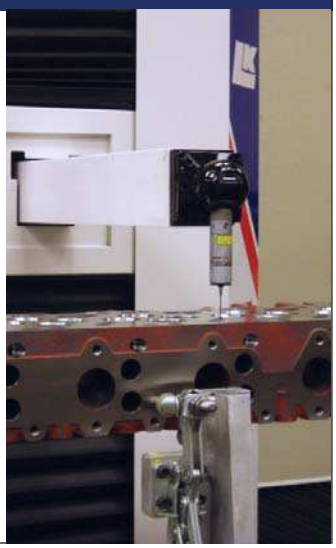
Located adjacent to production lines, Metris CMMs are set up for fast execution in separate temperature controlled rooms, away from dust and dirt. After clamping machined engine components or manufactured engine subassemblies on the CMM, a trained technician selects the appropriate metrology routine and starts the measurement run. It is a full-automatic routine that picks the right probe and points and scans numerous positions to evaluate milled surfaces and the position and profile of other features. The Metris CMMs consistently guarantee accurate measurement, as they monitor tight dimensional tolerances: 6 microns on connecting rods bores, 10 microns on valve guide diameters, and 25 microns of flatness on finished faces.

Every day, hundreds of parts pass CMM inspection. The Metris Camio software platform manages the operation of the CMMs and streamlines the data flow of the acquired geometric data. A technical specialist of the Rocky Mount Engine Plant explains that in order to keep track of all measurement data, RMEP made sure that the data are automatically processed and maintained in a dedicated Visual SPC database. "Over 300 operations managers, manufacturing and product engineers and quality professionals

METRIS LK CMMS @ CUMMINS

11 LK CMMs and Camio software run non-stop inspection on diesel engine parts, including cylinder blocks, connecting rods and cylinder heads.

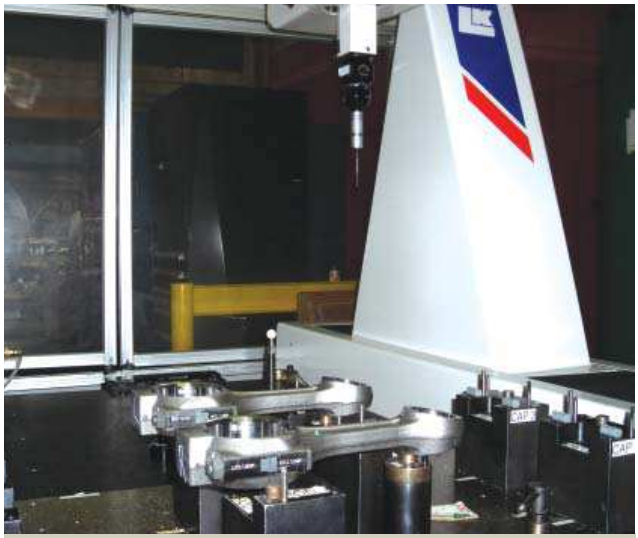
- ✓ Full off-line simulation of automatic inspection routine
- ✓ High degree of flexibility and live electronic SPC
- ✓ Service and support fit specific customer needs
- ✓ Metris identified as critical enabler to enforce tighter tolerances



regularly use this structured RMEP knowledge base to consult measurement reports or look up specific data items. As CMMs acquire massive amounts of measurement data, we opted for concise reports for the production operators that only show the measurements that are outside of tolerance limits. It is important that we maintain the link between the inspection of engine parts and the production workers who manufactured the parts. Discussing key test results motivates our production people, because it maintains their involvement and allows them to improve their production practices. Over the years, Metris CMMs helped us develop manufacturing skills to machine characteristics at a capability we were unable to measure, let alone maintain, in the past.

METRIS CMMS INCREASE MANUFACTURING QUALITY AND PRODUCTIVITY

"To support the 1000+ engine configurations that we currently offer, Cummins RMEP strategically opted for high-performance quality control. "To keep our 11 CMMs going around the clock in 3 shifts with minimum operator intervention, we allocated a full-time programmer to create and simulate hundreds of inspection programs off-line," clarified the technical specialist. "We are satisfied with the Metris Camio software, which provides full simulation capability of all machine moves, probe touches and probe head indexing. The software also manipulates the position and orientation of the CAD model and runs full off-line collision detection."



Connecting rods measurement includes bore diameter measurement at 6 micron accuracy.

RMEP's non-stop metrology operations dedicate 4 Metris CMMs to cylinder block scanning.

"WE INCORPORATED METRIS CMMS AS AN INTEGRAL PART OF OUR MANUFACTURING PROCESS."

- RMEP's Quality Engineering Manager

Cummins runs many touch sensor inspection tasks, including the scanning of surface valve cover sealing.

To cash in on the trend to capture geometry faster and with greater data density, RMEP recently purchased a Metris CMM laser scanner device. It is a multi-stripe Metris XC cross scanner that offers superior 3D scanning efficiency by enabling non-contact scanning over clamped parts, digitizing freeform surfaces as well as areas inside holes and deep pockets. Compared to the programming effort that is required for tactile probing sequences, the definition of scan paths for the CMM mounted laser scanner is fairly straightforward.

UP TO TIGHTER PART SPECIFICATION AND HIGHER DAILY OUTPUT

Although RMEP was convinced about the quality and accuracy of Metris CMMs, the company ultimately selected Metris for its service and support package that fitted its specific needs. Metris provided in-depth CMM training at RMEP to compress the learning phase for programmer and users, and remained available for extra assistance. On the hardware level, Metris organized a local support engineer who periodically calibrates the systems and is available in case a machine needs repair. "Yearlong experience at RMEP demonstrates that this way of working guarantees nearly 24/7 operation on 11 CMMs, and reduces standstill time to an absolute minimum," concludes the Quality Engineering Manager of Cummins RMEP. "As part of our ambitious plans for the future, we identified Metris CMMs as a critical enabler to produce components to even tighter specification and increase our daily output to over 750 engines."

CT SCANNING HELPED REVEAL COMPLEX MYSTERIES OF ANTIKYTHERA MECHANISM

In an exciting link-up between high-tech industry and international universities, the secrets of a 2000 year old astronomical calculating device – the Antikythera Mechanism – were unraveled. Researchers counted on the unique 400kV microfocus computed tomography (CT) system. The outcome not only led to an astonishing new theory of how the mechanism worked, but also to the reading of inscriptions that remained unseen for more than 2000 years.

SALVAGED 100 YEARS AGO FROM A SHIPWRECK

Named after its place of discovery in 1901 in a Roman shipwreck, the Antikythera Mechanism is technically more complex than any other device for at least a millennium afterwards. The team of scientists behind the Antikythera Mechanism Research Project succeeded in solving the puzzle of its purpose. Project results confirm that the mechanical computer was designed to track the movements of heavenly bodies, specifically the sun, moon and planets.

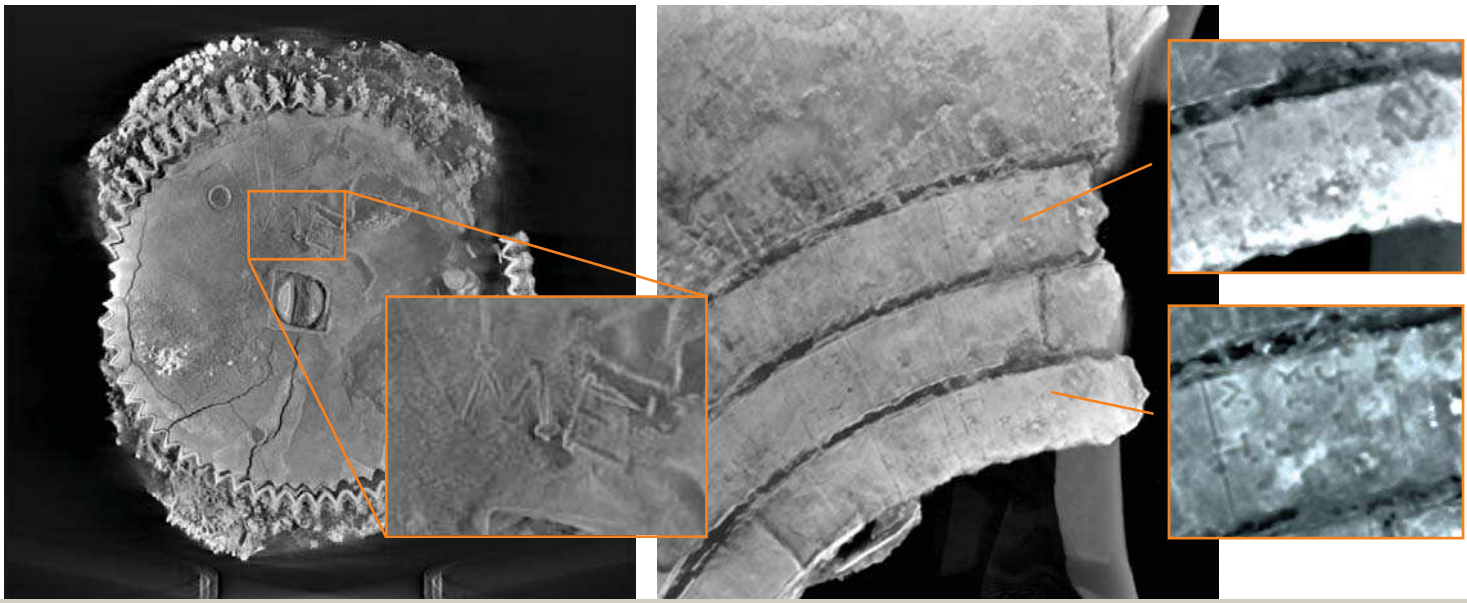
The extraordinary mechanism is an agglomeration of bronze gearwheels, dials and inscriptions that has puzzled and amazed scientists for more than a hundred years. It consists of myriad gears, cogs and differentials to accommodate the eccentricities of the wandering stars. The Antikythera Mechanism is now understood to operate as a complex mechanical "computer" that is designed to track the cycles of the solar system and calculate calendars or astrological events.

The Antikythera Mechanism Research Project aimed at resolving the riddle once and for all. Cardiff University, the National and Kapodistrian University of Athens, the Aristotle University of Thessaloniki and the National Archaeological Museum of Athens teamed with imaging specialists Metris / X-Tek and Hewlett-Packard to focus the latest imaging technologies on the mechanism.

ASTONISHINGLY DETAILED 3D X-RAY IMAGES

Although the mechanism is no bigger than a shoe box, it is too priceless and unique to leave the National Archaeological Museum in Athens, so a major expedition in late 2005 brought a 400kV microfocus Metris tomography machine – weighing over 7.500kg – to examine the artifact in Greece.

Originally designed to search for imperfections in turbine blades and other industrial devices, the Metris machine creates astonishingly detailed 3D X-ray images. The imaging



CT scanning resulted in high-resolution digital radiographs that revealed textual and other details.

equipment has been instrumental in advancing our current understanding of the mechanism. It was originally thought that the CT results would be vital in producing good images of the gear train, allowing researchers to obtain good teeth counts for the mechanism's gears, and finally resolving any arguments regarding the relationships between the gears. The CT results have achieved this, and much more.

The results have revealed many more details of the mechanism, including the so-called 'pointer follower' in Fragment B, which allows the back dial to be interpreted as spiral dials, not circular dials as previously thought. 3D CT images have also revealed the pin and slot mechanism that has allowed researchers to discover that the mechanism models the first anomaly of the Moon's motion.

REVEALING DETAILS OF INSCRIPTIONS AND GEARING

However, the great surprise has been the ability of the CT results to show the hidden inscriptions in many of the Fragments. The CT images, viewed at various angles, enabled the research project to read 932 characters, far more than any previous attempt. Looking at the data with X-Tek, academic principal investigator Professor Mike Edmunds commented. "The outstanding results obtained from X-Tek's 3D X-rays enable us to make a definitive investigation of the Antikythera Mechanism. I do not believe it will ever be possible to do better."

Using CT scanning, the researchers have managed to read all the month names on a sophisticated 19-year calendar on the back of the Mechanism. Really surprisingly was the discovery that the corroded and calcified Antikythera Mechanism also showed the four-year cycle of ancient Greek games, including the Olympic Games. Technology-driven research has opened a remarkable window on microscopic internal details of inscriptions and gearing at a resolution better than one tenth of a millimeter! It seems Antikythera's mysteries are finally revealed – thanks, finally, not to deciphering the apparatus, but the manual that came with it. The latest project results have been published in the magazine Nature.

The Antikythera Mechanism is technically more complex than any other device for at least a millennium afterwards.
© The Antikythera Research Mechanism Project

METRIS XT H 450 AND XT H 225 X-RAY AND CT INSPECTION SYSTEM

Metris is able to supply custom X-ray solutions with sources up to 450 kV, as shown in the picture below.

The Metris standard system is the XT H 225, a real-time inspection and CT system that features both fully programmable and manual operation. This versatile X-ray system with CT as standard is designed to deliver high-quality results quickly and easily with minimal user intervention. With its powerful 225kV source, high-resolution, high-contrast imaging and measurement volume of ø250mm and 600mm height, the XT H 225 is ideally suited to a wide range of applications, ranging from inspection of small plastic parts (low density) to metal castings (high density).

- Source, detector and software optimized for real-time visualization and processing
- Market-leading CT reconstruction into 3D volume dataset
- In-house micro-focus source with 3 µm focal spot size
- Extra tilt axis for easy recognition of internal features
- Simple integration with industry standard post-processing applications
- Customizable macros automate measurement workflow
- CT wizard guides an operator through the data acquisition
- Open X-ray tube allows local maintenance for low cost of ownership
- Full protective enclosure requires no need for special badges or protective clothing
- Compact, low-weight design that is easily maneuverable

Metris XT H 450LC

DGA/BASSIN DES CARÈNES RUNS METRIS IGPS TO MEASURE SHIP HYDRODYNAMICS IN LARGE GYRATION WATER TANKS

To engineer the stability and maneuverability of larger ships, DGA measures the dynamic motion performance of free-running model of ships in large gyration water tanks under simulated naval conditions. DGA selected the large-scale Metris iGPS metrology solution for its superior dynamic measurement capability and accuracy. Metris iGPS – featuring portability, scalability and a unique laser-based 3D measuring concept – successfully completed acceptance testing at a 63-meter diameter rotation tank.

A RELIABLE PARTNER FOR NAVAL METROLOGY APPLICATIONS

Metris offers a broad range of measuring solution, including K-Series Optical CMM systems and iGPS, both suitable for dimensional and tracking measurement. In the naval field, these systems can be used for studying the roll and pitch motions of ships in waves, or for studying the manoeuvrability by following the trajectory and the motion of free-running model ships.

Based on superb acceptance test results, DGA in Paris, France, recently decided to move forward with the unique laser-based Metris iGPS technology.

PRECISE TRAJECTORY CAPTURE OF FREE-RUNNING SHIP MODEL

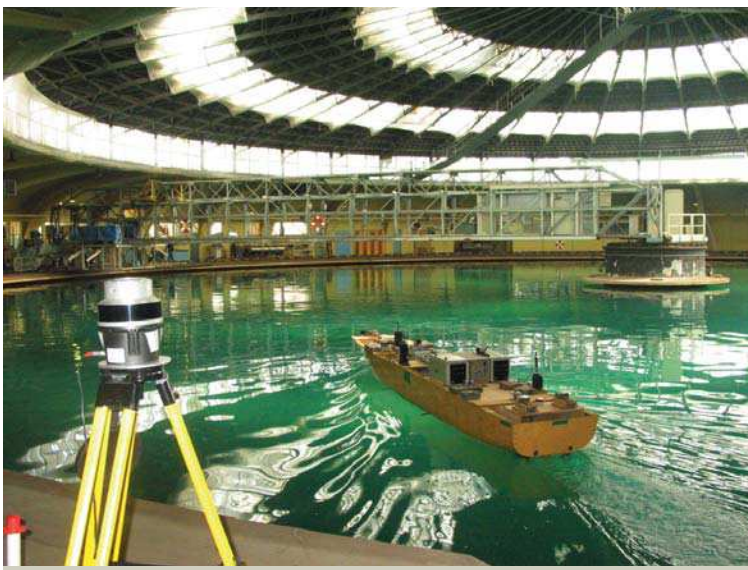
Metris iGPS mimics global positioning system (GPS) functionality to a large extent. A typical test setup at DGA consists of 6 infrared iGPS transmitters positioned around a circular gyration water tank and 4 iGPS receivers mounted on the free-running model of a ship. The transmitters activate a metrology-enabled area that spans the entire 63-meter diameter water reservoir. The sensors on the boat capture the transmitted signals, and calculate their individual elevation and azimuth angles with respect to each iGPS transmitter, based on the timing of the arriving invisible laser pulses.

"Monitoring the precise position of a free-running model during zig-zag and gyration tests is quite a challenge," stated Hervé Dispa, Chief of Measurement Department at DGA/Bassin d'essais des carènes. "While the self-powered boat attacks the curve, Metris iGPS accurately measures the precise trajectory of the boat by concurrently acquiring sensor data at an impressive sampling rate of 30 Hertz. Real-time software processing and wireless data communication make sure that the acquired angle data is accurately converted into x, y, z sensor coordinates and made available to all involved colleagues. Metris additionally synchronizes iGPS signals with other data being acquired on-board. Metris Workspace software manages the Metris iGPS data stream that has been acquired with a uniform precision

METRIS iGPS @ DGA/BASSIN DES CARÈNES

Metris iGPS dynamically measures the precise trajectory of free-running ship models in large gyration water tanks.

- ✓ High positional accuracy and data sampling rate
- ✓ Scalable system setup and straightforward use of proprietary software
- ✓ Portable solution for indoor and outdoor use at different water tanks



The transmitters around the gyration tank activate a metrology-enabled area that spans the entire tank.

of approximately 1mm speed-dependent. The obtained metrology are also post-processed to obtain the motions of the model; roll, pitch and yaw. In this way, the data provide the exact position and orientation of the vessel at any given time, forming a solid basis for studying the hydrodynamic behavior of the vessel."

FEEDING RELIABLE DATA INTO NAVAL ENGINEERING PROCESS

Hervé Dispa explains that DGA sees Metris iGPS as a very good investment for trajectory measurements. Before taking on-board measurements, test engineers use the system to define the reference plane for zig-zag and gyration tests by measuring 3 positions on a fixed steel rail around the water tank. Besides running hydrodynamic tests, Metris iGPS is used to measure key points on the scale model of the ship itself. The iGPS system is also used for verification of ship model geometry with a precision of a few hundred micron, although this capability was not required.

"METRIS IGPS FEATURES STRAIGHTFORWARD, YET ACCURATE METROLOGY OPERATION THAT FEEDS RELIABLE INFORMATION INTO OUR NAVAL ENGINEERING PROCESS."

- Hervé Dispa, Chief of Measurement Department at DGA/Bassin d'essais des carènes

"Boat maneuverability is among critical design performance characteristics that enable DGA to achieve the targeted dynamic motion behavior," concluded Hervé Dispa. "The innovative laser technology of Metris iGPS features straightforward, yet accurate metrology operation that feeds reliable information into our naval engineering process. We value the flexibility that allows us to set up the portable system at water tank installations at different sites to take measurements, even under varying brightness, temperature and humidity conditions. In addition, we anticipate adding more transmitters when using Metris iGPS at water tanks of larger sizes. Overall, Metris iGPS is the metrology solution that fits best our needs, as it passed every single criterion of our extensive acceptance testing program, and demonstrated positional accuracy that is 5 times better than required."

ABOUT DGA/BASSIN D'ESSAIS DES CARÈNES

The Bassin d'essais des carènes based at Val de Reuil (Normandie, France) – part of the ministry of defense – is in charge of hydrodynamic studies performed on surface vessels and submarines for the French Navy.

Metris iGPS accurately measures the boat trajectory by dynamically and concurrently acquiring sensor data.

The Bassin d'essais des carènes employs 120 staff members and possesses a range of test and calculation facilities that altogether make it the largest naval hydrodynamics laboratory in France.

The rotation arm tank is capable of leading model test for free gyration testing or forced gyration testing. In free gyration, the model, self-propelled and radio-controlled, can perform rotation, zigzag or berthing at the dock.

More information can be found on www.bassin.fr.

	DGA requirements	**Metris iGPS characteristics (6 transmitter and 4 receiver setup)**
Measurement range	70m	Unlimited, as more transmitters can be added
Motion tracking and measurement	Yes	Yes
Indoor and outdoor use	Yes	Yes
Real-time process	Yes	Yes
Synchronization	< 50ms	Approx. 25ms
Static positional accuracy	< 1mm	0.3mm
Dynamic positional accuracy	< 5mm	1mm (speed-dependent)
Sensor information	5DOF (2 x 3DOF synchronized)	6DOF (4 x 3DOF synchronized) : x, y, z, r_x, r_y, r_z
Data sampling rate	> 20Hz	Approx. 30Hz
Horizontality	0.05 degrees	0.00001 degrees
Line of sight	Not sensitive	Not sensitive

Table : Metris iGPS system characteristics versus DGA system requirements

LASER RADAR SUPPORTS DETAILED ENGINEERING OF WIND TURBINE BLADE AERODYNAMICS

At a leading worldwide wind turbine manufacturer, Laser Radar successfully performed a detailed automatic scan of the 37-meter turbine blade prototype. Metris Focus Inspection software processed the point cloud data, and generated graphic part-to-CAD comparisons using different point cloud fitting methods. Insight into global and local turbine blade geometry deviation serves as critical engineering information that supports the development of premium wind turbine blade aerodynamics.

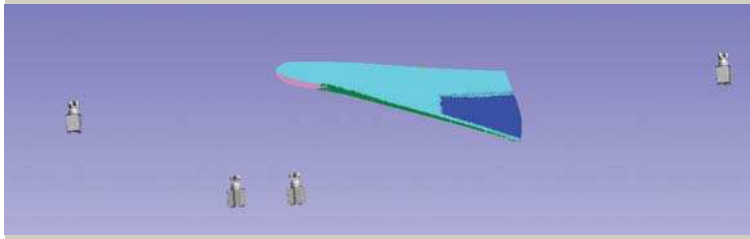
WIND ENERGY OUTPERFORMS OTHER RENEWABLE ENERGY SOURCES

As Europe sets ambitious targets for energy that is clean and inexhaustible, wind energy is predicted to meet approximately 25% of Europe's power demand in 25 years time. Today's wind turbines measure 70-150 meter and feature bladed rotor diameters of 100+ meter, translating into a swept air area of 8,000-10,000 square meter! Wind turbines convert wind power into bladed rotor mechanical torque and subsequently into 1.5-4 Megawatt electrical power.

Blade aerodynamic forces responsible for power production must be augmented to maximize energy capture, while adverse aerodynamic loads that fatigue turbine components need to be mitigated to extend machine service life. "To reconcile low weight and high strength, wind turbine blades are made of reinforced plastics," states Francky Demeester, Business Development Director at Metris Continental Europe. "However, the immense size of blades and slight material shrinkage that occurs when working up reinforced plastics make it a real challenge to keep blade shape within tolerance. Metris Laser Radar assists engineering teams in developing wind turbine blade prototypes by inspecting blade surfaces and reporting where and to what extent geometry deviates from CAD."

"METRIS LASER RADAR TIMELY DELIVERS THE DETAILED GEOMETRY SIGNATURE OF COMPLETE TURBINE BLADES, FOR BOTH DEVELOPMENT AND PRODUCTION PURPOSES."

- Francky Demeester, Business Development Director at Metris Continental Europe



6 zones – with overlaps of at least 20cm – were automatically measured in 15 hours from 4 different Laser Radar positions

GEOMETRY INSPECTION SUPPORTS BLADE AERODYNAMICS OPTIMIZATION

Recently, a 37-meter blade prototype of one of the world's leading wind turbine manufacturer's was investigated using Metris Laser Radar. During operation, the Laser Radar system directs a linear infrared laser beam and processes the timing of the reflected laser beam. Accurate fiber optics technology and beam angle verification allow the metrology solution to precisely determine the 3D coordinates of the surface point being inspected.

The blade was positioned horizontally with the trailing edge directed upward. To keep the blade in position, it was clamped at its rotor connection side and supported half way. As blade

METRIS LASER RADAR @ WIND TURBINE MANUFACTURER

Metris Laser Radar runs automatic non-contact geometry inspection on 30+ meter wind turbine blades in order to optimize blade aerodynamics.

- ✓ Higher precision and faster execution of inspection jobs
- ✓ Single-person operation without retroreflectors and other remote devices
- ✓ Powerful Turbine Blade analysis module in Metris Focus Inspection software

prototype construction started off from on an existing blade, only the outer 15.5 meter of the blade required detailed geometry verification. Francky Demeester explains that Metris Laser Radar and Spatial Analyzer software execute individual point measurements on the concave and convex freeform blade surfaces along a predefined pattern of parallel lines. Measurement resolution increases towards the tip of the blade: inter-line measurement resolution (span direction) from 10 to 5mm and intra-line resolution (chord direction) from 10 to 1mm. The previous-generation part of the blade was measured using 500mm measurement resolution in both directions.

EXECUTING THE MOST SUITABLE PART-TO-CAD COMPARISON

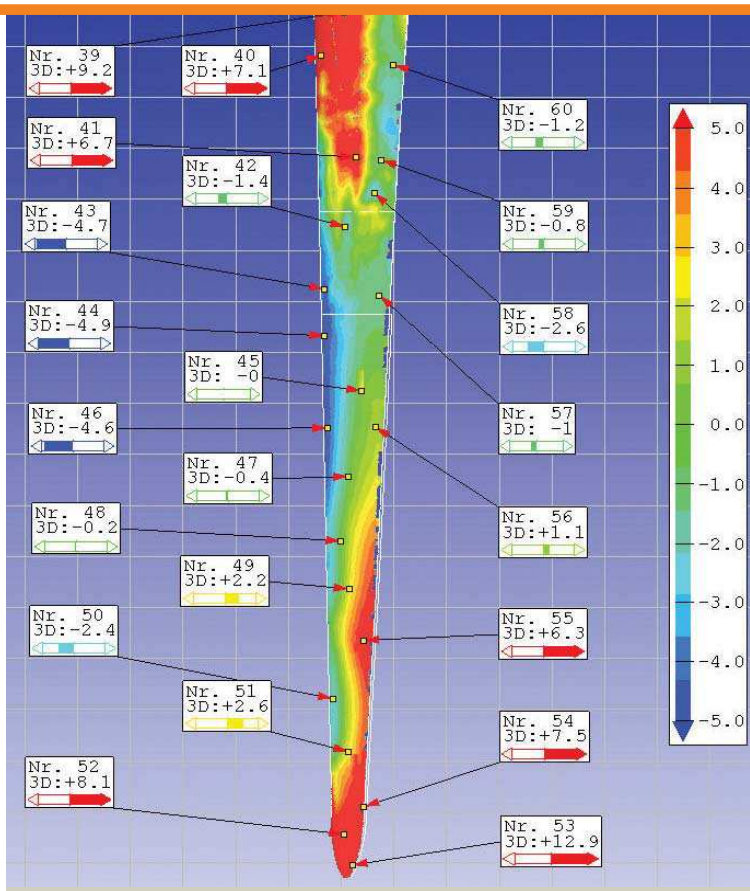
The blade was divided into 6 perimeters, governed by the depth of focus of the Laser Radar. Francky Demeester explains that, altogether, these 6 zones were automatically measured in 15 hours using 4 different Laser Radar positions. "This resulted in a single point cloud of approximately 5 million measurement points. Using Metris Focus Inspection software, a so-called global best fit was performed by fitting the low-density measurement data to blade CAD data. The acquired transformation matrix was applied to the high-density point cloud, and a mesh was created. Graphic reports of the blade's pressure and suction sides indicate that geometry deviation increases towards the blade tip while opposite deviation characterizes the trailing edge."

In addition to a global best fit, engineers completed a more comprehensive local best fit. The difference with global best fit is that the high-density measurement data is fitted to CAD instead of the low-density measurement data. As such, the graphic representations of pressure and suction sides provide a much more detailed view on blade geometry deviation. To focus on specific regions on the blade, Focus Inspection even made it possible to calculate a best fit for the leading, central and trailing areas within each 500mm region in the span direction of the blade. To accomplish these sectional local best fits, they divided the high-density blade point cloud into 33 sub-datasets, which they individually fitted to CAD.

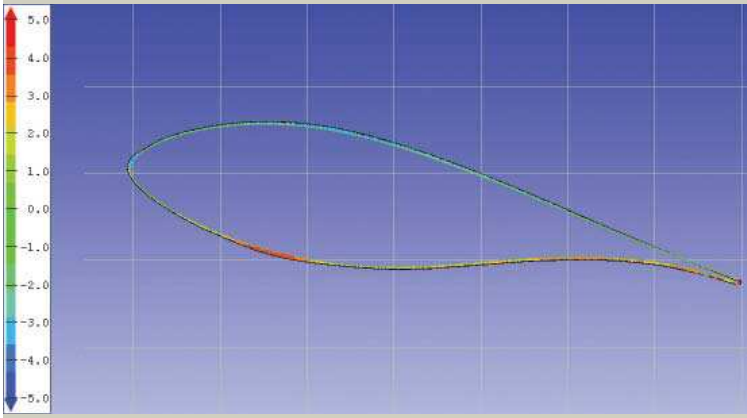
DEEPER INSIGHT SUPPORT BETTER-ENGINEERED BLADE AERODYNAMICS

According to Francky Demeester, the dedicated Turbine Blade analysis module of Focus Inspection software offers

When standing in front of a wind turbine, its impressive size is striking.



Engineers completed a comprehensive local best fit that provides a detailed view on blade geometry deviation.



Cross section diagrams show cross section contour deviation using color codes that indicate the degree of local geometry deviation.

plenty of other means that allows engineering teams to gain deeper insight into the geometry of the measured blade. "Cross section diagrams show the comparison between measured and nominal cross section contour lines by applying color codes that highlight the degree of deviation perpendicular to the blade surface. In this test campaign, engineers chose to incorporate higher measurement resolution along the leading and trailing edge on cross section contour line. Focus Inspection software is very helpful in identifying the leading edges and trailing edge thickness at any given percentage of the calculated chord line. Another chart type shows blade twist, i.e. the degree of twist along the span direction of the blade."

LOOKING INTO SOIL AND ROCK AT NGI

Recently, Metris installed an XT H system at NGI – Norwegian Geotechnical Institute – an internationally leading center for geosciences research and consulting. NGI researchers use this high-performance industrial computer tomography (CT) scanner to run in-depth non-destructive investigation of large rock and soil samples. Voids, inclusions and disturbances in soil samples are key characteristics when investigating stability issues in the design and construction phases of large infrastructure, such as buildings, pipelines and offshore platforms.

CT SCANNING SERVES A WIDE APPLICATION SPECTRUM

Companies and public authorities seek NGI expertise on design and construction of infrastructure to obtain maximum stability on local soil structure and rock formations. NGI assists the oil, gas and energy industry with expertise regarding exploration, development and operation of offshore fields. Soil geotechnical expertise also supports international building and construction markets.

CT scanning results will complement the characterization of geological heterogeneities and fractures in rocks. By monitoring aspects like evolution of fractures and fluid flow inside rock samples, the stability and operation of reservoirs and wells can be addressed.

"To profoundly examine samples of soil and rock in the laboratory, we opted for the industrial Metris XT H225 CT system," explains Magnus Soldal, Laboratory Technician at NGI headquarters in Oslo, Norway. "The purchase of this premium equipment fits in our strategy to acquire as much information as possible on expensive onshore and offshore rock and soil samples using non-destructive inspection technologies. Our choice for Metris is based on the system's fine image resolution along with optional convertible roof and extra-large cabinet that allow additional instrumentation to be placed inside the machine."

METRIS XT H @ NGI

Industrial CT scanner runs in-depth, non-destructive investigation of voids, inclusions and disturbances in onshore and off-shore soil samples.

- ✓ Easy access to spacious cabinet for installation of additional instrumentation
- ✓ Supreme image resolution for detailed inspection of inhomogeneous sample sections
- ✓ Fast and safe system that is easy to install and operate

A smaller sample installed for inspection

CAPTURING DYNAMIC TESTS AT HIGH IMAGE RESOLUTION

Cylindrical rock and soil samples in plastic or metal tubes come in different sizes. They typically have diameters between 50 – 150 mm and lengths up to 1 meter. Magnus Soldal says that for the longer samples, the system is equipped to move the rotating sample up or down to subject different parts of the sample to three-dimensional CT scanning. "For the smaller samples, the plan is to be able to use the CT scanner in combination with triaxial loading cell to monitor the evolution of fractures and fluid flow".

"For large soil samples as well as detailed rock investigations, the intrinsic image quality of the Metris XT H system is impressive," states Magnus Soldal. "We opted for a panel detector that features a larger size and higher image resolution. This is particularly important when performing detailed investigation of inhomogeneous sample sections and areas that can only be detected through CT scanning. Voids, inclusions and fracture planes are key features when characterizing the sample. On the basis of the inspection results, we pick the sample sections that will be subjected to geotechnical testing for stability evaluation."

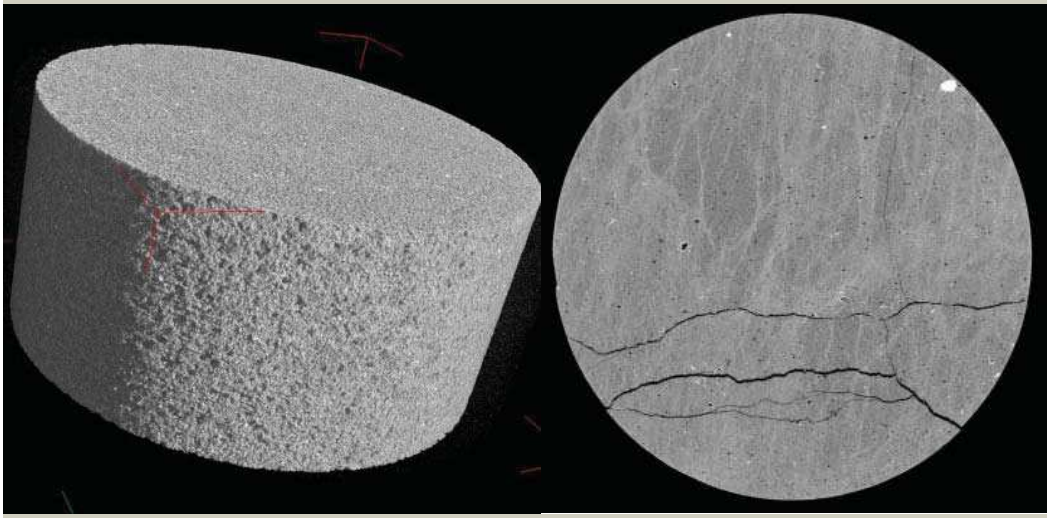
A TRULY SAFE SYSTEM REQUIRING LIMITED TRAINING

Magnus Soldal testifies that inspection times are relatively short. "On average, detailed rock samples approximately take 30 minutes for X-ray and 15 minutes to generate the three-dimensional CT reconstruction of the sample. The inspection of offshore clay or other larger samples go faster, as less attention is given to the reconstruction of 3D volumes." After calibrating the relation between material density and image grey scales, NGI researchers will be able to map various types of features and materials in the rock and assess their importance.

Overall, NGI operators perceive the use of the XT H system as fairly straightforward. "To be able to activate the optimum settings for a particular inspection task, we received three days of training and two more to follow shortly. In addition to intuitive system operation, the Metris CT scanner is an instrument that can be installed without requiring special floor conditions. Even more important is operator safety with regards to radiation. Although the system meets strict safety standards, we had its radiation measured here in Norway, confirming the safety-proof status of the equipment."

"FOR LARGE SOIL SAMPLES AS WELL AS DETAILED ROCK INVESTIGATIONS, THE INTRINSIC IMAGE QUALITY OF THE METRIS XT H SYSTEM IS IMPRESSIVE."

- Magnus Soldal, Laboratory Technician at NGI



CT image of a sandstone sample section

X-ray image of a chalk stone sample section

Voids, inclusions and disturbances in soil samples are key characteristics when investigating stability issues in the design and construction phases of large infrastructure, such as buildings, pipelines and offshore platforms.

CMM-MANAGER : FULLY-FEATURED CMM METROLOGY SOFTWARE

CMM-Manager is a highly intuitive, task-oriented CMM software package for both manual and CNC CMMs. It is a fully integrated environment that incorporates many smart time-saving functions that allows the user to concentrate on measurement and reporting instead of spending hours on CMM programming.

EASY TO USE, EASY TO ANALYZE

Using CMM-Manager's intuitive user interface, the operator is able to complete complicated feature measurement in minutes. After the operator picks the feature on the screen, the software's click-n-measure capability automatically calculates the proper probing angle and generates a collision-free path. One click on the Measure button confirms and the CMM measures the feature rapidly. CMM-Manager provides comprehensive graphical programming tools for the operator to easily create inspection program directly from CAD model. These part programs can be easily modified and visually simulated to verify correct execution. CMM-Manager organizes part program using clear, easy-to understand icons that represent Measure, Construct or Report tasks, eliminating lengthy text-based part programming.

SMART FEATURES FOR ACCURATE INSPECTION

To inspect difficult-to-measure features such as deep pockets and through holes, CMM-Manager automatically selects multiple probing angles, if needed. The software allows the operator to easily define a cutting plane for cross section scanning or to pick a freeform surface for digitization.

CMM-Manager has a built-in best-fit analysis engine to compare measurement data with the CAD model. This powerful best-fit function eliminates the influence of misalignment and cosine errors in tolerance evaluation in order to achieve the best inspection accuracy.

QUICK RESULTS, FLEXIBLE REPORTING

CMM-Manager provides intuitive and easy-to-use graphical dimensioning tools. The operator can quickly snap measured features on the screen to display.CMM-Manager highlights reporting and datum features for easy feature identification. The comprehensive analysis illustrates reporting dimensions and tolerances in the graphics window for easy visual confirmation. CMM-Manager provides drag-n-drop function for easy graphical report creation. The operator can simply drag a report item from the report database tree to the graphics report window to instantly create a graphics report table. CMM-Manager allows the operator to quickly create a web-ready HTML report which can be emailed to customers or published on a company's intranet for information exchange and sharing.

True click-n-measure capability. The operator picks the feature on the screen (1) and clicks the Measure button (2) to confirm probe angle and motion path. Then the CMM measures the feature rapidly (3).

METRIS 5-AXIS SCANNING SYSTEM DRASTICALLY IMPROVES QUALITY CONTROL FOR POWERTRAIN MANUFACTURERS

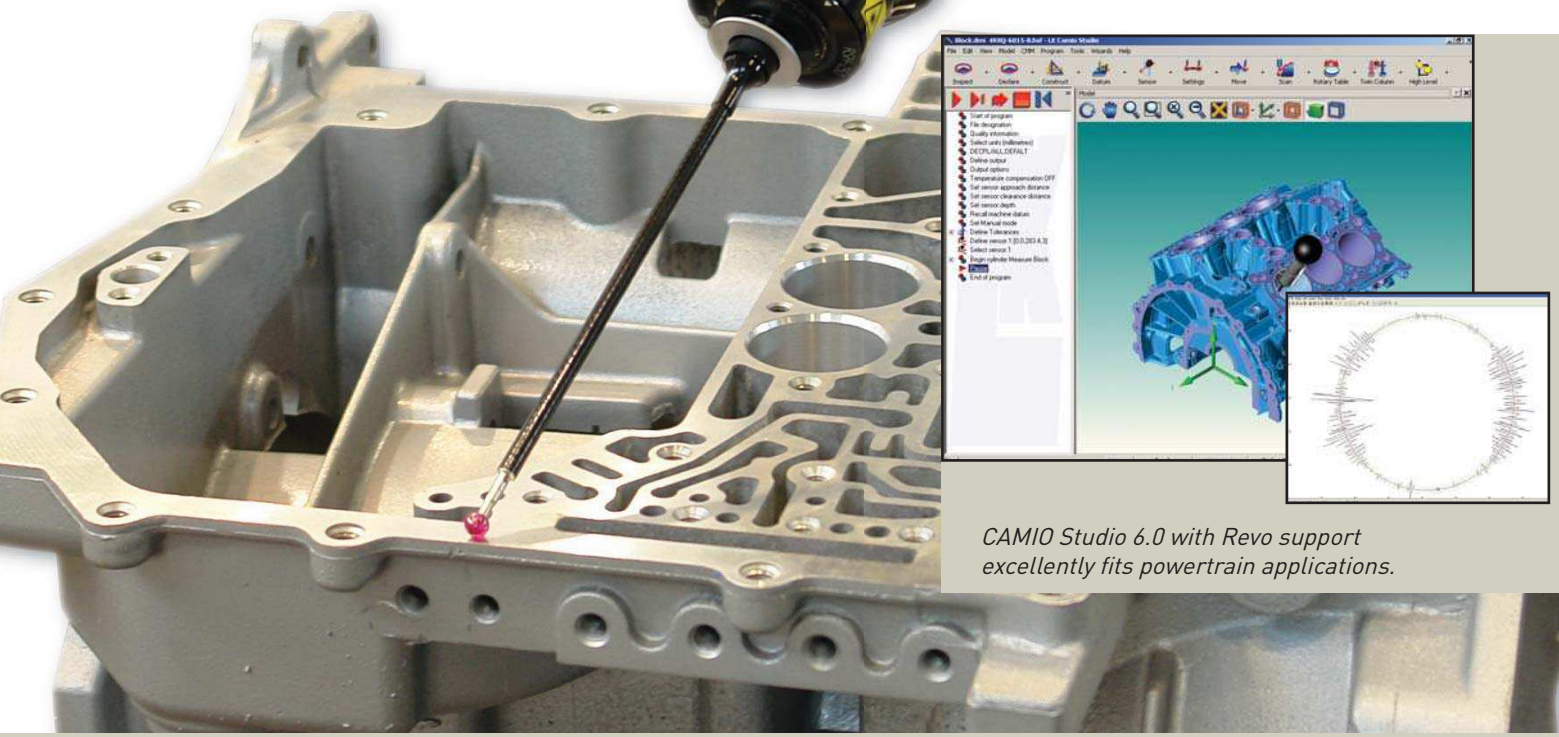
Camio Studio 6.0 coupled with the acclaimed LK V-SL ceramic CMM and revolutionary new 5-axis scanning probe sets the benchmark for CMM performance.

A FASTER AND MORE RELIABLE METHOD

5-axis scanning can overcome the limitations of other tactile inspection methods. High speed, high resolution scanning dramatically improves CMM productivity and prevents known bottlenecks. Significant advances in accuracy and repeatability, even with long styli, improve confidence in inspection data. Not only is the cycle time improved but the setup time has been reduced to a single calibrated position per probe build. The infinite positioning probe head, with dynamic stylus correction, maintains the perfect stylus to features alignment, no matter how the part is positioned.

BENEFITS

- **Impressive accuracy and repeatability** – even with stylus lengths up to 500mm.
- **Increased productivity** – 50 times faster than other tactile scanning systems, scanning speeds of 500mm/second. Continue scanning even when the probe head is moving.
- **Infinite probe head positioning** – improved access for difficult-to-reach features or when clearance is limited.
- **High resolution** – 10 times more date acquisition than other tactile scanning systems, collect 4000 points per second.
- **Improved confidence** – dynamic probe head positioning compensates for part misalignment and reduces the risk of stylus shanking.
- **Improve in-process control** – inspect more parts and more features per part.



CAMIO Studio 6.0 with Revo support excellently fits powertrain applications.

5-axis scanning speeds up inspection of a higher number of measurement points

CAMIO 6.0 EXPANDS ITS APPLICATION REACH

With new enhancements in 3D laser scanning support, Camio 6.0 strengthens its position as a multi-sensor software platform for off-line programming and on-line inspection. Camio's multi-sensor portfolio covers laser scanning on CMM and the new Robot CMM Arm (RCA) as well as tactile 3 and 5-axis CMM scanning. In addition to extensive sensor support, Camio 6.0 allows part program creation to be performed independently from the selected sensor type(s). This enables operators to select the most appropriate sensor for each feature to be inspected.

Camio 6.0 supports the brand new LC60D laser scanner, and incorporates more extensive laser scanning capability. It is now able to tackle a broader range of complex feature types, such as fir trees (christmas tree) connectors used on automotive sheet metal.

The new Metris CMM handbox offers a wealth of functionality and is extremely user friendly. The ergonomic design can be held in one hand and is suitable for left and right handed users. A single 3-axis joystick allows the user to move all 3-axis of the CMM using just one hand. The speed regulator can be used to control the speed of the CMM when the program is running. A keypad of 18 multi-function buttons provides access to, and control over, various aspects of the software without returning to the mouse or keyboard and LEDs indicate the status of the CMM and software.

CADfast provides users of Camio Studio with access to the very latest revisions of CAD, often before they are available in Camio Studio. CADfast always supports the latest revisions of CAD and is able to read the file and save it to a revision compatible with Camio Studio.

To improve the experience of Camio users with any level of experience, Camio 6.0 now incorporates a number of "ease-of-use" improvements. A new Datum Wizard has been greatly improved and now supports 8 features and over 20,000 datum combinations. A new development, "Touch & Go", automatically initiates a new program, sets the datum or measures a feature whenever the user takes a touch using the handbox and overcomes the need to keep returning to the PC. Sensor management has been streamlined and now includes a new sensor explorer tree with powerful context menu. Improved simulation sees the fully simulated introduction of the rotary table as part of the CMM table furniture.

METRIS PROPELS UMICORE SOLAR TEAM TO SUCCESS

Without a single drop of fuel, this revolutionary solar-driven racecar won the silver medal at the 2007 World Solar Challenge in Australia. Last year, Metris provided specialized metrology assistance to Belgian Solar Team's engineering students who developed the Umicar Infinity. And just recently, Metris hosted the Umicar Infinity and the Solar Team crew at its premises in Belgium. Groep T Engineering School students in Belgium developed the Umicar Infinity in conjunction with Belgian high-tech companies.

Belgian Solar Team relied on a Metris K-Series system to accurately identify the positions of all suspension attachment points on the frame structure. This allowed all connections between space frame and suspension units to be welded with much higher positioning precision. K-610 measurements also resolved wheel misalignment, which would otherwise cause mechanical friction and excess tire wear.

To get most out of limited solar cell power, Umicar Infinity is engineered for low weight, little aerodynamic resistance and high energy efficiency of vehicle driveline mechanisms. This one-seater only weighs 175 kg and features dynamic wind resistance that is roughly six times better than premium serial-produced sports cars. With the electrical power of a vacuum cleaner, the Umicar Infinity is capable of reaching speeds higher than 140 km/h!

This one-seater only weighs 175 kg and features dynamic wind resistance that is roughly six times better than premium serial-produced sports cars.

REQUEST FOR INFORMATION

Yes, I would like to receive specific information regarding Metris and its products and applications

1. Tick the products and applications of your interest

- ☐ Coordinate Measuring Machines (CMMs)
- ☐ Articulated measuring arms
- ☐ CMM laser scanners
- ☐ Handheld laser scanners
- ☐ RCA - Robot CMM Arm
- ☐ X-ray and Computed Tomography
- ☐ Laser Radar for large volume metrology
- ☐ iGPS for company-wide tracking and positioning
- ☐ WheelTracker
- ☐ Motion measurement
- ☐ CMM retrofits
- ☐ Service work / Integration services

2. Tick the items you would like to receive

- ☐ Metris Demo CD including company brochures, product information, movies and case studies
- ☐ Metris News magazine featuring case studies and product news

3. Please print your personal contact information

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Company _____

Job title _____

E-mail _____

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Zip _____ City _____ State/province _____

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Please fax this page to +32 16 74 01 03,
or submit your information request on www.metris.com.

METRIS

THE METRIS COMPANY

Metris designs, develops and markets a unique range of 3D hardware and software inspection systems servicing design and manufacturing industries. The company's reliable and innovative metrology solutions cover the full range of measurement volumes required by automotive and aerospace customers, in both fixed and portable configurations and with optical and touch sensors.

Metris provides best-in-class precision equipment and metrology solutions for precise measurements featuring **classical CMMs** and **articulated arm CMMs**.

Metris is the market leader for CMM based laser inspection, with the **Metris LC and XC laser scanners** offering full surface and feature measurement.

Metris Optical CMMs are portable, handheld coordinate measuring machines, with a proven track record in engineering, pre-production and quality control applications. The Optical CMMs can also be used in motion analysis and robot calibration applications.

Metris ModelMaker 3D scanners are the best-in-class articulated arm scanners for inspection and reverse engineering.

The **Metris Laser Radar** is the top solution available to the manufacturing industry that provides a fully automated, non-contact measurement and inspection capability for large volume applications of up to 60 meters.

The **Metris iGPS** is a modular, large volume tracking system enabling factory-wide localization of multiple objects with metrology accuracy, applicable in manufacturing and assembly.

The **X-ray and CT inspection** systems provide a detailed insight in the internal structure of the part. Typically used for inspection of PCB electronics, small casting, plastics, these systems facilitate detection of material defects, assembly and interconnectivity issues

Metris also provides a full range of complementary **software solutions** for CMM and point cloud based inspection and reverse engineering applications.

Metris completes its product portfolio with a vast range of **support**, **metrology** and **integration** services.

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