FMI runs iNexiv inspection on medical silicone parts

HN-6060 non-contact multi-sensor 3D metrology

CAMIO7 redefines 3D tactile and laser CMM inspection

X-ray and CT push innovation at Philips Lighting

Solar energy
Laser Radar adds precision to SENER’s Gemasolar power plant
NIKON HN-6060
HIGH PRECISION TRUE MULTI-SENSOR METROLOGY SYSTEM

FAST, NON-CONTACT INSPECTION OF COMPLEX SHAPES WITH TACTILE ACCURACY
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Instead of getting partial inspection results from different metrology systems, Nikon combines multiple non-contact 3D technologies in a revolutionary single inspection system. Equipped with the newly developed high-precision laser scanner measurement head, the HN-6060 system digitizes components at a rate of 120,000 points per second. To access the complex geometry of a spiral bevel gear or any other sophisticated part, the 5-axis CMM can synchronously position the head and tilt and turn the specimen exactly as desired. Furthermore, the multi-sensor head incorporates proven optical image processing with built-in LED illumination, Shape From Focus (SFF), laser autofocus and zoom. The HN-6060 is designed to acquire and process the full point cloud data of complex automotive molded and machined components, toothed wheels, medical devices, etc. with diverse surface colors and textures.

As components get smaller and more complex, manufacturing companies face a hard time turning out high-quality products in a shorter time. Relying solely on tactile inspection requires excess overhead in terms of measurement preparation and execution, covering only a small portion of the entire part surface. This creates the necessity to use other metrology systems for additional geometry information gathering, not exactly the ideal recipe for error-free data consolidation and fast automated inspection. Therefore, Nikon Metrology incorporated several of its leading non-contact 3D technologies into the brand new HN-6060 system.
“The HN-6060 multi-sensor system fits well in the Nikon Metrology portfolio of 2D and 3D solutions.” comments Kenji Yoshikawa, CEO of Nikon Metrology, “It addresses the market need for fast, high accuracy 3D inspection of complex shapes by combining innovative non-contact optical technology with highest precision measurement hardware.”

Higher accuracy through improved 3D laser scanning optics

To make sure laser scanning meets the highest precision standards being implemented by advanced part manufacturers, Nikon further enhanced its non-contact sensor optics. The company achieves unprecedented measuring accuracy by developing a new cylindrical lens for the laser emitter and an image-side telecentric optical system directing the object image to a detector with high precision. The hardware mechanism is designed to suppress magnification variations resulting from temperature changes. The hinged optical system allows surface data to be acquired by the CCD with a constant focus. The dramatically improved smear resistance of the CCD in tandem with the bright optical system allows glossy as well as low-reflectivity part surfaces to be captured without spraying or other manual preparation.

“Nikon engineers developed HN-6060 laser scanning optics and motion control with highest precision as the prime design objective.” adds Kenji Yoshikawa, “Every second, the laser scanner captures up to 120,000 points, each at 5 micron accuracy and with a line pitch of 20 micron. In specific gear measurement benchmarks we have already achieved less than 1 micron repeatability with non-contact measurement, which is comparable with the performance of contact type CMMs.”

The multitude of inspection points captured provides much valuable information compared to a touch probe pointing a handful of points. The data accurately describe the waviness of freeform surfaces and the shape of geometric features.

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Powerful video measuring and Shape From Focus (SFF) sensing

Complementary to 3D laser scanning, the Nikon HN-6060 features the proven high-NA zoom optical system from the Nikon NEXIV VMR series CNC video measuring systems. This enabling vision technology now exclusively uses LED illumination as well as image processing developed in-house by Nikon. Advanced edge detection by image processing is one of the many capabilities that increase measuring speed and confidence. In addition, the system is equipped with the very latest Shape From Focus (SFF) inspection sensor. Using an active texture pattern projection mechanism, the system can perform high-precision shape acquisition of very reflective surfaces including mirrors, while TTL laser AF enables level difference and profile measurement. To catch the finest details, Nikon optics provide crystal-clear and pinpoint-sharp 15x image magnification.

HN Metrology software managing multi-sensor measurements

Regardless of the technology used to collect the data, the Nikon HN Metrology software manages the acquisition of point clouds through laser scanning and SFF sensor. It also integrates a whole range of image-processing and touch probe related measurement tasks. The HN Metrology software is an evolution in multi-sensor metrology software based on the dimensional inspection software used on the NEXIV VMR. The graphic feel of the software supports straightforward setup, macro-based teach in, quick shape and distance measurement, and insightful 3D part-to-CAD comparison. The optional Focus Inspection software offers the edge in point cloud processing, providing the most detailed analysis and reporting capabilities.
To take full advantage of the benefits of non-contact 3D inspection, the HN-6060 features full 5-axis synchronized head and specimen motion. The test specimen is positioned on a 2-axis rotary stage. This high-precision and very rigid unit can dynamically apply the optimum rotation and tilt angles in combination with the concurrent movement of the measuring head to scan around ribs and flanges and capture pockets, slots and notches in full. A system console provides easy control over full 5-axis synchronized head and specimen motion. It features a straightforward configuration that includes switches for changing between sensors and buttons for carrying out simple inspection.

The adoption of 5-axis synchronized hardware control is particularly useful for spur, helical, spiral and other gears. By continuously adapting the orientation of a gear, the HN-6060 is able to fully digitize the faces and flanks of all gear teeth as well as the geometry in between them. As it successfully deals with the most complex gears, the system can accurately and fully digitize any intricate component. This makes the HN-6060 the preferred inspection system for machined (toothed) rotating parts, composites and smaller stamped or cut sheet metal components. It is equally suitable for plastic and metal devices made using (injection) molding or additive technologies. This covers a huge amount of parts used in automotive, aerospace, medical, industrial, etc.

After setting up an inspection routine that involves sampling complex shapes, the HN Metrology software offers a practical way to simulate system operation prior to taking actual measurements. The operation function simulator reads in the CAD model data and completes the taught measuring process in software. It is a unique feature that predicts potential collisions and shows how geometry data capturing proceeds and checks whether full surface coverage will be obtained. The choice is offered to run the simulator either in on-line or off-line mode. When switching from simulation to real operation on the HN-6060, the user can monitor the measurement of the part surface through the finder camera built into the system. This allows measurement programming to be carried out in the video window of the host PC while monitoring inspection in real time.

As the HN Metrology software deals with 3D point cloud data, the data can optionally be used for various reverse engineering purposes. This technology is typically applied to create CAD from handmade models, to regenerate CAD data from existing parts when the original CAD data is missing, to update designs from part surface data produced by high-yield dies and molds, or to serve as input for rapid prototyping of freeform parts and products.

Focus Inspection can be used for advanced Part-to-CAD comparison and creation of detailed 3D deviation reports.

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Kenji Yoshikawa, CEO Nikon Metrology

Full 5-axis synchronized head and specimen motion control

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Nikon Metrology added new digital laser scanners to its range of CMM and handheld scanner families, featuring top performance and stripe width up to 200 millimeter. The LC50Cx is a new all-digital entry-level CMM laser scanner of the top-line class including flagship product LC60Dx. The handheld ModelMaker series features two additional digital models: the MMDx200 and the MMCx80/160. All these scanners incorporate Enhanced Sensor Performance (ESP3), to automatically digitize hard-to-scan shiny or multi-color surfaces without special preparation of the test object. The entire portfolio of premium 3D laser scanners underlines Nikon Metrology’s unique capability to successfully respond to so many market-specific metrology challenges.

Digital handheld or CNC laser scanners form the foundation of the Digital Inspection Process by capturing the entire geometry of vehicle doors, aerospace parts, smartphone covers, wheel rims, turbine blades, engine castings and plastic parts. By digitizing the part and subsequently running inspection on the acquired digital data, customers realize vast automation and flexibility benefits, saving both time and money.

The next-generation LC line scanners set new accuracy and productivity standards by capturing a multitude of accurate measurement points that digitize freeform parts of any shape. The LC60Dx, the reference in CMM laser scanning released in 2010, is now also supported on MCAII articulated arms. It represents the ideal dual-use solution for customers owning both a CMM and an articulated arm. To meet the demand for entry-level scanners, Nikon Metrology offers the LC50Cx that shares the same revolutionary digital scanner technology. It includes real-time laser intensity adjustment (Enhanced Sensor Performance) to scan nearly all surface types, and an advanced reflection filter to avoid capturing scattered reflection points.

In the digital ModelMaker range of handheld laser scanners, Nikon Metrology announced the MMDx200 next to the existing MMDx100 and MMDx50 models. Compared to these scanners, the MMDx200 with its 200-millimeter laser stripe doubles or even quadruples the surface space that can be captured in a fixed time period. The attractively priced

MMCx80/160 scanners also share the same high-end technology, including Enhanced Sensor Performance, advanced reflection filter and practical plate qualification. The MMDx/MMCx scanner series are designed for effortless handheld scanning of hard-to-scan surfaces consisting of materials of varying color and reflectivity.

Nikon Metrology’s extensive offering allows them to pick the 3D laser scanner that precisely matches the metrology requirements of the inspection or reverse engineering application at hand. Customers can opt for manual or automated laser scanning and trade off productivity versus accuracy in the selected budget category to speed up their measurement process and gain more detailed geometry information.
FMI masters silicone molding of critical medical components using iNexiv

iNexiv adds speed and quality to ultra-clean molding of silicone components that go into lifesaving medical devices

FMI in the Chicago area produces molded silicone components for medical applications. Intricate features and key dimensions of tiny silicone prototype and (pre-)production parts are measured optically using an iNexiv system. FMI engineers say that investigating parts under Nikon optics and illuminations result in superior digital imaging that guarantees high accuracy and R&R numbers, despite the typical light glow covering the transparent silicone material. Automatic iNexiv inspection jobs triple measurement productivity, slash operator overhead and eliminate human error, resulting in a payback time of less than three months. According to FMI, Nexiv’s solid reputation in the medical device industry increase the trustworthiness of the qualification/validation reports they generate for the FDA and OEMs.

A world-class medical silicone company

At its stand-alone manufacturing facility in Elk Grove Village, Illinois, FMI produces diverse implant grade and disposable molded silicone parts. Long-term implantable silicone parts are used in medical devices (pacemakers, defibrillators, heart valves, etc.) designed for prolonged or extended service. Other silicone items are used in sealing systems, manifolds, connectors, stoppers and other devices. As 90% of FMI silicone products are implanted in the body, the FMI facility houses ISO 5, 6 and 7 clean rooms, fully equipped for silicone mixing, molding, inspection and packaging operations.

As a medical silicone company, FMI complies with qualification processes that ensure silicone material cleanliness, part shape integrity and the lowest failure rates. Important in this regard is FMI’s choice for the table-top iNexiv system from Nikon Metrology, a high-performance CNC precision video measuring system. FMI demands an optical system because silicone parts are too soft to be measured using a touch probe. Fairly large specimens can be measured with the Nexiv system because it features a 250 x 200 millimeter stage and a 200 millimeter z stroke.
Clear and pinpoint sharp images

“It is night and day compared to our other vision system,” said Harold Sant, Engineering Manager for FMI, Inc. in Elk Grove Village, IL, when looking at the first images taken by the iNexiv vision system. “The new Nikon inspection system generates overwhelmingly clear and pinpoint sharp images of difficult-to-measure silicon samples. Silica-based elastomeric rubber material attracts light and has a characteristic mystifying glow, but the iNexiv sees right through it. We have quickly come to trust the system, because it generates a superior digital image to measure from.”

Inspection is key in FMI’s Part Development & Prototyping (RPD) programs. Recently, FMI was contracted for a silicone header part of a pacemaker system to shorten the time between prototype and production. The header part goes on top of a pacemaker assembly and bundles all leads and connections. “Based on elaborate iNexiv measurements performed on different cuts, our engineers fine-tuned the header part concept to ensure optimum moldability. Low-distortion optics and high-intensity white LED illumination provide superb imaging that leaves no room for any operator misunderstandings. Even the header’s intricate features could be investigated easily without requiring any re-checks. We used image magnification up to 20x, which is way below iNexiv’s maximum magnification of 120x.”

The economics of automatic inspection

Measurement throughput used to be the bottleneck when dealing with prototype qualification batches. Harold Sand says that instead of inspecting header parts manually, FMI engineers teach the iNexiv system to perform a number of dimensional measurements fully automatically. “Defining an inspection job following our own measurement techniques is easy and very similar to setting up a macro. Automatic inspection takes a jump start with intelligent search capabilities and pattern recognition, which automatically spots the header part position and orientation. In the automatic inspection job we also included wall thickness measurements, a unique capability offered as part of the Nikon AutoMeasure software. Thanks to automatic iNexiv inspection using fast stage controls, we were able to reduce the start-to-shelf time for the pacemaker header part from 4 days to 1 day and a half!”

Sand says that pre-production and production operations at FMI probably benefit even more from automatic inspection. “iNexiv proves to be a major timesaver, considering the millions of silicone parts we produce every year. The shift from manual to automatic inspection led to a 3 month payback time for our system, just in labor alone.”
High-precision measurements you can trust

The complexity of the parts has increased tremendously. FMI invests in state-of-the-art processes and equipment to deliver the sophisticated ultra-clean silicone product required for surgical implantation. Based on expertise built up over the years, FMI is recognized as a leader in insert molding and bonding of silicone to various substrates.

“High precision is key in the medical device business, to make sure critical silicone parts can be confidently incorporated into lifesaving medical devices and state-of-the-art laboratory equipment,” remarks Sant. “The Nikon Metrology iNexiv system is ideal to measure any of our silicone molded parts, including micro-precision parts manufactured to the tightest tolerances. It outperforms our previous manual video measuring system in terms of measuring accuracy and speed as well as repeatability and reproducibility. We notice that leading medical device manufacturing firms trust our inspection qualification and validation reports better, because the majority of them are Nikon users themselves who know the system we are using.”

FMI is also a long time user of many stereomicroscopes from Nikon and NIS Elements software to characterize the detailed features of molding tools. The iNexiv CNC video measuring system was purchased after concluding a detailed comparison study including demos and benchmarks involving different brands. “All along, we felt that Nikon better understands our business, and that iNexiv hardware and software are better aligned for inspecting medical device components,” Sant clarified. “We would definitely recommend Nikon to any of our business partners, also because we are very satisfied with the provided training, support and advice.”

“High-precision measurements you can trust”

Harold Sant, Engineering Manager for FMI, Inc

FMI houses clean rooms, fully equipped for silicone mixing, molding, inspection and packaging operations.
SMZ745/745T microscopes
Stereomicroscopes offering powerful imaging capabilities at an economical price

Featuring a zoom magnification of 7.5x and a long working distance of 115 millimeter, Nikon SMZ745/SMZ745T microscopes are well suited for both industrial and biomedical applications. The adoption of a new total reflection prism produces brighter images with higher contrast.

This permits direct mounting of any Nikon DS Series digital camera and simplifies the process of digital imaging, image capture and observation via monitor. In addition, this model incorporates an optical path switching lever that enables easy switchover between eyepiece and camera.

ESD protection and airtight design is standard to prevent samples from being damaged by electrostatic discharge and to prevent contamination from dust, drops of water, or other contaminants. Additionally, the anti-mold design (molds are sort of fungi that grow in the form of multicellular filaments) in the zoom body interior allows the microscope to be used in high temperature and humidity environments.

The targeted industrial applications include metal and plastic manufacturing in automotive and other sectors, diverse medical devices and micromanufacturing (micromechatronics, microelectronics, optoelectronics, etc.)

The zooming knob is equipped with a click stop for each magnification. At 115 millimeter, the working distance is very long, providing enough room for fabrication and manipulation of the sample.

The newly developed SMZ745 is a strong addition to the Nikon stereo zoom microscope line up. The SMZ745, with its 7.5x zoom, has a total magnification range of 3.35x to 300x for comfortable operation, when the auxiliary objective lens and eyepiece lens are combined. The SMZ745T stereoscopic microscope is equipped with a trinocular type camera port and a built-in 0.55x c-mount adapter.

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Trinocular head
The SMZ745T includes a trinocular camera port and a built-in 0.55x c-mount adaptor, permitting direct mounting of Nikon DS series digital cameras.

High-resolution optics
The stereoscopic microscope’s optimized Greenough optical system delivers a 7.5x zoom and a total magnification from 3.5x to 300x.

115 millimeter working distance
The long working distance provides ample room for fabrication and manipulation on the sample.
SENER has giant heliostats for its Gemasolar thermal plant produced using Laser Radar

Construction works are currently ongoing to complete Gemasolar, the world’s first commercial plant with central tower and heliostat array technology to include a thermal storage system. The high-precision heliostats mirror structures precisely reflect the sun beams toward the sunlight receiver located at the top of a 140 meter high tower. SENER’s heliostat assembly subcontractor Moncobra uses Laser Radar to precisely position flat mirror panels arrays on giant heliostats. Laser Radar completes automatic non-contact and gauge-free inspection of a single heliostat in a matter of minutes, allowing Moncobra to turn out 22 heliostats every day using a single Laser Radar. This is one of the many technology innovations SENER introduced to maximize the output of its concentrated solar power (CSP) plant portfolio, supplying electricity in line with demand.

Laser Radar helps Moncobra assembly team finetune the mirror positioning of 2,650 Gemasolar heliostats
Laser Radar helps achieve the slightly parabolic reflective shape that is different for each heliostat.

Innovation drives the thermosolar power industry

Gemasolar is a milestone project from Torresol Energy, a joint venture between SENER and financial partner Masdar. SENER – a large engineering, construction and systems integration company – started up Torresol Energy to build the world’s first CSP plant featuring tower technology with a molten salts receiver. Its thermal storage concept allows Gemasolar to continue producing electricity also when a cloud passes over. Although the use of a tower surrounded by flat-mirror heliostats is less matured than parabolic trough technology (long parabolic mirrors), it potentially offers a higher energy yield. Starting in 2011, Gemasolar will supply clean and safe energy to 25,000 homes and reduce CO2 emissions by more than 30,000 tons a year.

The 2,650 heliostats surrounding the tower are moved around two rotation axes to reflect sunlight towards the receiver in the tower. The Laser Radar instrument from Nikon Metrology has been selected to ensure accurate panel positioning during heliostat manufacturing. This ensures that reflected sun beams precisely point to the sunlight receiver in the tower up to 1 kilometer away. Accurate heliostat mirror positioning allows Gemasolar to capture as much heat as possible and distribute it evenly across the outer receiver surface to avoid damage due to overheating.

Abrox-Sariki, Nikon Metrology’s reseller for large-scale metrology in the Iberian region, introduced Laser Radar as a suitable system for measuring heliostat mirror surfaces.

With thousands of 11 x 12 meter heliostats targeting the sunlight receiver, the salt substances heat up and descend to the hot salts tank where they are stored at more than 500 degrees Celsius. From here, the salts are transferred to heat exchangers and subsequently to the turbine and electrical transformer, before adding electricity to the net grid.

Non-contact inspection performed in a fraction of the time has been the main driver for SENER to opt for the Laser Radar inspection system.

SENER
Automated mirror panel inspection using Laser Radar

The first step in building a Gemasolar heliostat is the automatic laser inspection that takes place after finishing heliostat construction. To measure heliostat mirror surfaces from above, the Laser Radar instrument has been tilted and mounted on a post. A rotary table has been integrated to easily switch measurement between four transportable heliostat assembly decks.

The Laser Radar is a productivity multiplier. Measuring heliostats with a Laser Radar is faster and more practical than any other well-known measuring system. It saves a lot of time because it allows for measuring mirror points without having to manually touch the points. The control system, developed by SENER, runs measurement routines that have been programmed off-line so that the Laser Radar can be used to automatically inspect one heliostat after the other.

When an operator starts the inspection routine, the Laser Radar system sequentially measures the required points. All produced heliostats are inspected in Enhanced Metrology mode. For every point of a heliostat, the Laser Radar scans a 5 by 5 millimeter region to search the precise position to take the measurement.

The only metrology system fit for the job

All heliostats are designed to exhibit a different slightly parabolic reflective shape, depending on the position of the heliostat in relation to the tower. Immediately after completing inspection, the measurement report rolls out of the printer and is automatically saved on the network and sent to SENER for verification. The implemented control system decides whether the required curvature for each heliostat mirror array is achieved within specification. Based on the mirror deviation values specified in the inspection report, assembly workers properly modify the orientation of the mirror panels. After tuning the mirrors, the Laser Radar runs final inspection verification to confirm accuracy before turning out a new heliostat.

Measurement routines have been programmed off-line to free up the Laser Radar for serial heliostat inspection.
The heated salt substances descend to the hot salts tank where they are stored at more than 500 degrees Celsius.

It takes roughly 5 minutes to measure a single heliostat in Enhanced Metrology mode. This is much shorter compared to a laser tracker system that was considered for purchase before the Laser Radar system was selected. And also much less cumbersome because the laser tracker requires a crane to precisely position a large gauge with spring-loaded targets on top of a heliostat’s reflective surface. With the Laser Radar, it is possible to avoid the complexity of taking measurements using laser trackers. Non-contact inspection performed in a fraction of the time has been the main driver for SENER to opt for the Laser Radar inspection system. The Laser Radar is a key component in realizing SENER’s objective to precisely assemble the solar field of heliostats, and as such generate electricity with greater efficiency and higher thermal storage capacity than parabolic trough technology. Gemasolar is an international reference and a starting point in the cost-cutting strategy of the thermosolar power industry, paving the way for similar plants around the world.

The official Gemasolar video can be consulted by clicking the “Gemasolar plant video (2010)” link on http://www.torresolenergy.com/TORRESOL/gemasolar-plant/en
Although similar from the outside and in achievable measurement accuracy (0.025 millimeter), a Laser Radar and laser tracker house completely different technology. Incorporated into the first is frequency modulated coherent laser radar technology (FM CLR). The Laser Radar instrument directs a focused laser beam to

Nikon Metrology introduced the Laser Radar MV330/350 large-scale metrology system. New electronics double measurement speed and performance, and improved signal-to-noise ratio yields better range measurements on composite materials. The new Laser Radar further enhances hole and edge measurement, and offers higher reliability. Its propriety laser reflection technology obsoletes tedious positioning of targets at difficult-to-access locations, as is the case with laser trackers or photogrammetry systems. Through accurate non-contact measurements running manually or fully automatically, Laser Radar is a productivity multiplier that is very appealing to manufacturers in aerospace, energy, communication satellites, casting and many other markets.

Unique technology for automated large-scale metrology

Although similar from the outside and in achievable measurement accuracy (0.025 millimeter), a Laser Radar and laser tracker house completely different technology. Incorporated into the first is frequency modulated coherent laser radar technology (FM CLR). The Laser Radar instrument directs a focused laser beam to
a point on the part to be measured and recaptures a portion of the reflected light. The single large-aperture optical path maximizes signal strength and stability. As the laser light travels to and from the target, it also travels through a reference path of calibrated optical fiber in an environmentally controlled module. Heterodyne detection of the return optical signal mixed coherently with the reference signal produces the most sensitive radar possible. The two paths are combined to determine the absolute range to the point. Combined with the measured horizontal and vertical laser beam angles, the 3D coordinates of the acquired points are determined in real time.

Equipped with more powerful electronics, the Laser Radar MV330/350 drastically increases the measurement speed from 500 to 2000 points per second. This means that manufacturers can proceed twice as fast with their large-scale metrology workload, while acquiring higher-quality data. The Laser Radar G3 allows them to double productivity when they align large parts during assembly, certify tooling and then monitor its repeatability during production, and measure metal, plastic, and composite parts and compare them to their CAD models.

**Outperforming laser tracking and photogrammetry**

The productivity gains that can be achieved with the new Laser Radar system are impressive. A wind turbine blade project encompassed the surface inspection of the 45m blade, which was required to be completed in a single shift. The Laser Radar automatically measured 48,000+ inspection locations with 0.025mm single point uncertainty in the requisite 8 hour time period. Completing the same single-shift inspection assignment using laser tracking technology would require at least 3 laser tracker systems and operators as well as large overlay templates and additional tooling.

The comparison between Laser Radar and photogrammetry was the subject of a recent study. The conclusion was that Laser Radar significantly reduced the recurring labor required to characterize the surface profile of medium sized carbon fiber reflectors. In addition to matching the required accuracy, the Laser Radar system achieved significant cycle time reduction through automated inspection.

**Laser Radar MV330/350, a winning product in every aspect**

The non-contact and target-less Laser Radar system is a winning product in every aspect. First of all, the metrology system requires only one operator to set it up, and then it runs unattended. It requires no special environment or expensive tooling. The system works indoors or out, in any lighting, and on any material or finish surface with a reflectivity of even less than 1 percent. Laser Radar is capable of measuring both freeform surfaces and geometric features. Regarding hole inspection, the MV330/350 system further increases inspection speed, accuracy and reliability. To measure critical sharp edges with superior accuracy, MV330/350 has a dedicated edge measurement mode available. The major strength of Laser Radar is undoubtedly that it can scan complex geometry that was impossible to scan before because it was too large, too hard to reach, too complex, too delicate or too labor-intensive.
Laser Radar’s capability to accurately and efficiently measure supersize parts used in aerospace has garnered interest from many leading manufacturers. Aircraft fuselage section inspection with Laser Radar systems is three to five times faster compared with laser trackers, and requires up to ten times less personnel. Other aviation metrology applications include fuselage, wing, wing/body connections, landing gear door and jet engine blade and inlet cowl. A space application example covers the measurement of a space telescope’s mirror features and large mechanical structures holding sensitive flight hardware.

In response to composite manufacturing challenges, Laser Radar serves as an award winning metrology component in the production of right-first-time composite parts. The integration of Laser Radar into innovative composite manufacturing methods illustrates the impact of metrology assisted production on composite part production quality and throughput.

The successful adoption of Laser Radar metrology by the aerospace community has assured acceptance throughout many other industries, including nuclear, solar and wind energy, shipbuilding, large castings and antennae. E.g. In the fast-growing solar energy business, Laser Radar is used to check the geometric integrity of parabolic and flat solar mirrors to accurately and efficiently trace incorrect bending and misalignment.

**Laser Radar serves a wide array of applications**

As a versatile metrology system offering unique measuring capabilities, Laser Radar supports numerous applications.

- Quality assurance applications, including part-to-CAD comparison, feature and gap & flush inspection
- Routine and event driven inspection such as first-article inspections, incoming and outgoing inspection, troubleshooting, failure investigations
- In-process applications, such as component alignment and robotic positioning
- Tool building and alignment, including locating and adjusting tool features in real time
- Tool digitalization and documentation of as-built tools and die surfaces
- Model digitalization, including scanning artistic models and performing design layups in-process and outgoing quality assurance
- Routine maintenance, including static and dynamic inspections of aircraft, automotive and heavy-equipment tooling assemblies

**Frequency-modulated coherent Laser Radar technology (FM CLR)**

As the invisible eye-safe laser light travels to and from the target, it also travels through a reference path of calibrated optical fiber in an environmentally controlled module. Heterodyne detection of the return optical signal mixed coherently with the reference signal produces the most sensitive radar possible. The two paths are combined to determine the absolute range to the point, and the high modulation bandwidth makes precise measurement possible in a millisecond. Combined with the measured horizontal and vertical laser beam angles, the 3D coordinates of the acquired point are determined in real time. As the measuring laser is invisible, the Laser Radar additionally emits a red laser pointer.

“By doubling the inspection speed, MV330/350 sets new standards for automated, non-contact large volume metrology.”
Chesapeake Testing ordered the most powerful industrial microfocus CT system in North America

A combined 225-450kV microfocus X-ray and computer tomography (CT) system has recently been ordered by Chesapeake Testing. The company selected this powerful inspection system primarily for its highly accurate source, the only microfocus X-ray source at this energy. The system’s powerful source, walk-in bay and Panel Shift capability allow Chesapeake Testing to scan large objects up to 39 inches wide made of dense materials such as metals, ceramics and composites. The system perfectly fits in Chesapeake Testing’s strategy to further extend the experimentation and testing services it provides to defense, aviation and automotive customers.

Chesapeake Testing in Belcamp, Maryland, USA, provides ballistic experimentation and testing services in support of protection systems research, certification and compliance testing. A key application Chesapeake Testing plans using the new X-ray and CT system for performing inspection on ballistic-resistant personal body armor. “To meet our clients’ testing requirements, we needed a CT system capable of having X rays penetrate through thick armor specimens,” says Jim Foulk, Chesapeake Testing’s President/CEO. “This is only possible using a walk-in system that incorporates a 450kV X-ray source.”

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Jim Foulk, Chesapeake Testing’s President/CEO

There are a number of high-power sources out there on the market, but Chesapeake Testing opted for Nikon Metrology’s proprietary 450kV microfocus source. The spot size of this X-ray source is orders of magnitude finer than competitive minifocus sources, offering users superior resolution and accuracy as well as a wider array of measurable parts. This is essential for Chesapeake Testing’s CT imaging facility that is available to partners and 3rd parties. The facility is expected to attract an increasing number of customers, in particular companies active in automotive and aviation. Foulk says: “Armed with the new industrial X-ray and CT system, we are able to offer our customers unmatched capabilities in non-destructive testing, 3D inspection and reverse engineering applications. Applications are diverse, ranging from inspection of small precision machine components to large ceramic and composite structures. We are already partnered with the SURVICE Metrology Center on an important Air Force research grant to use this new facility for the inspection of gas turbine engine blades.” To support the inspection of turbine blades, the system is equipped with a proprietary curved detector that minimizes X ray scatter. The winning combination of a powerful microfocus source and a curved detector produces unmatched accuracy, which now becomes a benchmark in North America.

The new system to be installed at Chesapeake Testing captures detailed X-ray images using a premium 16 inch x 16 inch imaging panel. Subsequently, a 3D CT volume is reconstructed that you can navigate as if you are walking through the specimen. “Following this intuitive approach, companies using our CT facility instantly trace otherwise invisible assembly errors or structural material imperfections,” explains Foulk. “The detailed insight they acquire helps them optimize their products and realize higher quality standards in less time.”

Chesapeake Testing customers are not restricted to run CT on parts up to 12 inches wide, as it is the case with a standard system. “Thanks to the system’s walk-in bay and Panel Shifting capability, our customers are able to take CT scans of parts up to 39 inches wide, providing over 30 times the default scan volume. In fact it is the first commercial CT system in the US that deals with specimens of this size.”
ShuttlePix
A revolutionary portable digital microscope

The new ShuttlePix P-400R digital microscope is developed for observation, inspection, measurement and recording of high-resolution images. For on-site analysis of samples, it serves as a handheld microscope that shoots high-resolution images just as easily and quickly as taking pictures with a digital camera. For laboratory or tabletop analyses, the ShuttlePix microscope interfaces seamlessly with a motorized stand.

Grab it and go!

The versatility of the battery-powered ShuttlePix system means the user can bring the microscope to on-site objects, such as an aircraft airframe, turbine casting or pipe work that often cannot be reached with a standard microscope. The unique ShuttlePix technology supports a wide range of inspection tasks in automotive, electronics, aerospace and other industries. The combination of superb imaging capabilities and digital camera style operation makes the ShuttlePix a multi-purpose and self-explanatory piece of equipment.

ShuttlePix head and stand

For tabletop usage, the ShuttlePix head interfaces with a hand-controlled motorized Z-axis stand. The operation of the stand is simple, allowing extended depth of focus (EDF) image capture with the touch of a button. Using the 17-inch touch screen monitor, it is easy to control the microscope, and analyze, measure or print images. The microscope also connects to a standard PC or laptop that runs image analysis and 3D image reconstruction software.

Crystal-clear images

The ShuttlePix blends Nikon’s technological excellence in the domains of microscopes, photo cameras and digital image processing. ShuttlePix offers a unique 20x optical zoom with a magnification range between 20x and 400x on a 17-inch monitor, which doubles the capability of today’s common models. To acquire crystal-clear images in any indoors or outdoors light circumstances, the zoom head is equipped with a built-in 4-segment LED ring illumination.
20x optical zoom
ShuttlePix’s observation magnification of 20x to 400x* spans low to high magnification without the trouble of changing lenses. Magnification information is linked to scale functions and simple measurement functions.

* Magnification on dedicated monitor used with Motorized Focusing Stand.

4-segment LED ring
ShuttlePix’s new illumination technology achieves consistent brightness at all levels of magnification. Capture shaded images as well, through split-half illumination switchable among top, bottom, left, and right.

Maximum optical performance
Nikon’s proprietary optics achieve precise observation and imaging with NA up to 0.2 (at 400x magnification) and 20 millimeter diagonal wide field of view (at 20x magnification). Changing of Resolution Preferred Mode and Depth-of-Focus Preferred Mode is also possible.

Motorized focusing stand plus touch panel monitor
ShuttlePix is equipped with a vertical-movement Motorized Focusing Stand and 17 inch, 1280 x 1024 pixels color LCD Touch Panel Monitor. Through the intuitive operation of touching icons or using the screen stylus, precise image capture and simple measurement are effortless and convenient.

Scene mode
Ensure optimal settings for image capture through four types of Scene Mode: wafer/IC chip, metal, printed circuit board, and flat panel display.

One-touch EDF
EDF image is easily available by pressing the button at any lower and upper position of the sample on the screen. All operations are performed from the Stand. The addition of a PC and dedicated software further enable 3D display and height display based on EDF data and height data.

Simple measurement
Add comments and markers to key measurements such as distance, angle, and area. Measurement results can be output in tabular form.

3D display
Use a 3D bird’s eye view to display EDF images and height data taken with ShuttlePix. Rotation, zoom in/out, scale display, color-based heightmaps, and other image display operations are available.

Height data cross-section measurement
Display cross sections at specified positions based on height data embedded in EDF images. Perform simple measurements of the cross section including height, angle, and width, with measurement data displayable and recordable in tabular form.
Archeological recording made easy

iSpace is an industrially proven metrology system that can greatly reduce archeological drawing and data-gathering times. Its patented laser technology concept has been developed to quickly make probe measurements within a large working area. Within this geo-referenced “invisible metrology lab” archeologists can use probes to acquire highly accurate data. 3rd party CAD or GIS software can generate digital 2D or 3D line drawings on the spot for verification by the excavator before downloading to the site computers.

Since less time is spent drawing and acquiring point coordinates, the duration of commercial excavations can be reduced and the productivity of fixed-term research excavations can be raised considerably.

Quick iSpace setup and fast data capture

Setting up iSpace on site involves placing 3 or more battery-powered transmitters up to 40 meters apart around the working area. Power options also include generated or mains power. After quick and simple calibration and geo-referencing routines, iSpace is ready to record.

Within this working area, archeologists need only to pick up a probe, apply it to the terrain and start recording. This could be grabbing single point...
Trials at Mont Beuvray in France have shown that iSpace acquires this data significantly faster than by traditional drawing methods.

At excavations in Mont Beuvray, France, the data for these digital line drawings were acquired 50% to 90% faster than hand-drawn plans and sections.

Digital line drawings generated on site using off-the-shelf CAD software from accurate, geo-referenced point coordinates from iSpace (e.g. ArcheoCAD – ArchTron GmbH).

Trials at Mont Beuvray, France, have showed that iSpace acquires this data significantly faster than by traditional drawing methods.

When a lot of recording is required, iSpace offers the flexibility to add more probes. The system even allows to have 20 or more probes recording data simultaneously within the working area. When dealing with very large excavation areas, more transmitters can be added to increase the size of the working space.

Modular system with instant drawing display

iSpace data is immediately available for viewing in a number of ways. The geo-referenced iSpace data can be fed straight into a CAD or GIS package, or reviewed using an iPhone, iPad or iPod Touch.

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Setting up iSpace on site involves placing 3 or more battery-powered transmitters up to 40 meters apart around the working area.
With fewer mouse clicks and instant access to programming functions from a single ribbon toolbar, the programming experience is both faster and easier than previous versions of the software. CAMIO7 users are able to program many features of different types within a single operation, and graphically step around the measurement path before committing to the part program or CMM. By packaging powerful capabilities into such an uncluttered user interface, CAMIO7 metrology software makes CMM programming an altogether more flexible and productive experience.

CMM inspection is faster and easier with CAMIO7

The standard for CMM programming

CAMIO7 is a major software release in many ways. The multi-sensor CMM software now reflects the latest standard in Microsoft Windows featuring the ribbon style toolbar. This serves as the central location where all software functions are logically grouped into tabbed sections, each containing all the required operations. This setup avoids the need to search through long menu structures and navigate between groups on the ribbon. For example, GD&T tolerances are located within the Inspect group so that feature output is always available.

The CAMIO7 programming environment is developed with every user profile in mind. It took a lot of development effort to keep the functionality extremely powerful yet providing workflows that are very easy to use. Users can select any combination of features to measure by using ‘teach and learn’ from the handbox, picking from a CAD model, or typing coordinates from the component drawing. CAMIO7 automatically programs the touch points for each feature, however specific touch points can be defined if required. When highlighting a group of multiple features, their properties are automatically filtered down to allow global modifications to all the remaining common properties from within this group in a single operation. There is no faster way to modify the nominal coordinates, measurement mode, fitting algorithms or add GD&T tolerances, etc.

Regardless of whether inspecting stamped, molded, fabricated or machined parts, CAMIO7 drives accurate and efficient inspection programs for geometric features or full surface analysis with CAD compare.
Offering true multi-sensor capability

Laser scanning with CAMIO7 is now easier to use for feature inspection. The new software interface allows both feature related measurement and reporting to be defined in the same effort. Such improvements reduce programming time drastically, in particular for more complex parts exhibiting hundreds of features.

For measuring surface areas, CAMIO7 users can choose to simply cover the target area with a configurable grid to automatically define the measurement points. Alternatively, CAMIO7 includes full support for laser scan area definition, leaving the possibility to use the scan data for reverse engineering or surface analysis. CAMIO7 offers true multi-sensor capability and simplified probe management to change between contact and non-contact probing within the same measurement program. In this way the best CMM inspection routine can be achieved for the application at hand.

Comprehensive off-line programming

CAMIO7 planning provides the ability to open inspection plans either directly from CAD (Product Manufacturing Information) or a customer specific format. The plan data can then be used to easily create a DMIS program including planned inspection routines and the application of GD&T tolerance data. In this regard, the software supports the latest versions of all popular CAD formats available on the market. To support the off-line programming environment, the software provides full machine simulation and collision detection. CAMIO7 creates true DMIS output without translation, which also makes it the ideal stand-alone solution to create programs to run in compatible 3rd party DMIS software including PC-DMIS and Metrolog.
Philips Lighting in Turnhout, Belgium, recently took delivery of a XT V system for X-ray and computer tomography (CT) inspection. Engineers investigate electrodes and other parts of high-intensity discharge (HID) lamp prototypes, to push the boundaries of lamp performance, lifespan and ecological material usage. They inspect lamps from every angle, and repeat the inspections on the same units after extended lighting periods. Deeper insight into the progression of glass corrosion, component wear and deposit formation allows Philips Lighting to reduce extensive life testing, thus saving tremendously on energy cost.

**A tradition of X-ray inspection carried forward**

The Philips Lighting business division produces billions of bulbs a year. Philips Lighting kicked off X-ray inspection in 2003 to support the design-through-manufacturing process of high-intensity discharge (HID) lamps. The multinational’s division in Turnhout, Belgium, manufactures long-lasting HID lamps from 20 to 4000 Watt offering high light output and premium light quality. These innovative illumination solutions raise comfort standards in offices, public buildings and factory halls; enhance traffic safety through street lights and passenger car headlights; and add entertainment value with splashing light shows toning up rock stars’ performances.

“There is no doubt that X-ray inspection presents the best strategy to study the feasibility of new technologies, assemblies and materials and maintain high production quality,” says Chris Dries from Philips Innovative Applications in Turnhout. “For this reason we decided to further increase and sharpen our non-destructive testing (NDT) capability. To select a new system, we performed a thorough evaluation involving systems from most major X-ray and CT system vendors. Ultimately, the benchmark resulted in the purchase of a Nikon Metrology XT V 160 machine. We use the new system for critical measurement tasks and automated inspection jobs whereas the older system is still suitable for visual checks.”
Getting a grip on performance-critical aspects

The ability to literally look inside HID lamps is a great asset for Philips Lighting. X-rays penetrate the lamp and subsequently hit a 13 inch x 13 inch Varian flat panel, which generates radiography images with different shades of gray depending on material and geometry. On these translucent images, all the lamp’s constituent components are displayed in their entirety. The proprietary X-ray source incorporated into the system is equipped with a 1 micron transmission target. The XT V 160 is a high-precision imaging system that recognizes hidden features as tiny as 500 nanometer, ideal for engineers to deduce structural, dimensional and connectivity related facts.

HID lamp electrodes are performance-critical components that undergo detailed X-ray research. Chris Dries explains that electrode characteristics influence the light the lamp produces by passing an electric arc through a compact tube filled with a high-pressure mixture of gases. “We measure the size and shape of electrodes contained in lamp prototypes as well as the distance between both electrodes. Inspect-X software allows us to automatically measure the distance between the electrodes’ tip planes. X-ray helps Philips Lighting to successfully respond to the tight electrode requirements imposed on HID lamp engineering.”

Chris Dries mentions that submicron image resolution provides great insight into other internal lamp phenomena, such as wall corrosion, glass frit, crazes, and salt and mercury fillings. The XT V 160 system also supports the reconstruction of a CT volume, generated on the basis of hundreds of X-ray images. “By navigating CT volumes, we are able to locate and investigate crazes that may develop in ceramic discharge tubes. Similarly, we change position, angle and zoom as desired to take a close look at the otherwise invisible welds connecting electrodes with their supports. High image quality and magnification make it even possible to detect minuscule cavities in salt particles, something we were unable to do in the past.”

NDT insight allows Philips to reduce the number of prototyping rounds and downside life test activity.

X-ray inspection presents the best strategy to study the feasibility of new technologies, assemblies and materials.

Chris Dries, Philips Innovative Applications in Turnhout
Metrology. In addition to high-quality imaging, the system’s proprietary open-tube X-ray source is almost maintenance free compared with conventional closed-tube microfocus sources. Nikon Metrology is renowned for controlling all aspects of the technology, and in the unlikely case of failure, service engineers come on site and solve the problem.

A resolute choice for extended NDT

“The Nikon Metrology system is part of a strategic decision of Philips Lighting to make X-ray and CT an integral part of internal processes,” says Dries. “Angled views in highest resolution prove technical facts that are indispensable in stretching the performance limits of HID lamps. Important in this regard is studying the use of environmentally friendly materials and their impact on light, yield and reliability. With the insight gained, the number of prototyping rounds can be reduced and life test activity can be downscaled to some extent, saving both time and money. The resulting decrease in power consumption also contributes to greener economics. By extending NDT capabilities, Philips Lighting underlines its position of leading innovator and supplier of high-quality illumination solutions.”

Automation and off-line inspection

To allow engineers to focus on their research and production work, most measuring tasks are delegated to system operators. They slide a tray with an array of lamps in the X-ray and CT system and start automatic data capture. The tray is indexed from one lamp to the next in order to subject all items to the same X-ray imaging routine. “Zoom level consistency and flux normalization maximize the repeatability of X-ray imaging, generating output that is truly operator independent,” says Dries. “This offers us the possibility to reliably set up macros for X-ray jobs that can run unattended at any time.”

All acquired imaging data can be sent to an offline station that runs Inspect-X software for inspection and macro preparation purposes. Engineers analyze X-ray graphics or navigate a CT volume to drill down on a particular detail, while having all relevant numerical information available at their fingertips. They value the fact that they can easily include X-ray shots and CT sections in their engineering reports.

Philips Lighting benefits from decades of experience in X-ray and CT system design, development and production that is present at Nikon Metrology. In addition to high-quality imaging, the system’s proprietary open-tube X-ray source is almost maintenance free compared with conventional closed-tube microfocus sources. Nikon Metrology is renowned for controlling all aspects of the technology, and in the unlikely case of failure, service engineers come on site and solve the problem.

“Insight gained through X-ray and CT allows us to reduce the number of prototyping rounds and downscale life test activity to some extent.”

Chris Dries, Philips Innovative Applications in Turnhout

Nearly all Olympic Game sports stadiums use Philips high-intensity discharge (HID) lamps.
New Focus software release increases the accessibility and performance of laser scanning

Nikon Metrology introduces Focus Scan 5.5 and Focus Inspection 9.3. The software suite for point cloud data acquisition and inspection supports Windows 7, and successfully handles a nearly infinite number of measuring points on a Windows 64-bit operating system. It is able to exchange information with the latest versions of leading CAD software packages, and interacts with more CMM/scanner combinations than ever before.

Focus Inspection 9.3 introduces tighter feature detection integration and easier GD&T tolerances assignments. Regarding gap and step measurements, Focus improved the robustness of caliper positioning. The semi-automatic scan definition in Focus Scan 5.5 now includes improved closest qualification and lasso selection. Quite important is that during on-line scanning the reflection angle is also taken into account.

Focus’ subtract mesh functionality is extended to retain certain parts of the mesh that surround solids under a specific distance and inclination range. For point cloud comparison tasks, the choice is now offered to specify a maximum search distance option. Related to reporting improvements, Focus Inspection fully supports Excel 2010 and allows reporting settings to be specified during automation playback.

Focus Handheld Scanning API

To provide flexible and reliable access to premium handheld Nikon Metrology laser scanners, Focus offers 3rd party software vendors an application programming interface (API). With the new API, it becomes very straightforward for them to integrate Nikon Metrology 3D laser scanners. The API manages point cloud acquisition by controlling all interaction between the laser scanner and the handheld localizer of choice. By handling all interfacing with the scanner, such as scanner parameter modifications or running a qualification routine, the Focus handheld Scanning API ensures highest accuracy and reliability of the acquired data. The resulting point cloud data is fed directly into the point cloud processing application in real time, ready for further processing.

The plug-in offers design and manufacturing engineers fast-lane access to their favorite handheld Nikon Metrology laser scanners, while enjoying the convenience of the point cloud software environment they know inside out. Users of PolyWorks, Geomagic, Rapidform, Verisurf, Spatial Analyzer, PowerINSPECT* and Metrolog* software can take advantage from the Focus Handheld Scanning API.

*(Under development)
CMM-Manager 3.0 for Windows 7 is by far the most value-for-money tactile inspection software that runs on nearly all CNC and manual CMMs. The modern and intuitive Windows 7 graphical interface makes the software even more informative and interactive. Get more work done with CMM-Manager, by automating serial inspection or by easily taking a few points on the spot. And when combined with Renishaw’s 5-axis PH20 probe head, CMM-Manager 3.0 turns around inspection jobs up to 3 times faster.

**Versatility to get the most out of your CMMs**

The dashboard has been upgraded with intuitive new icons and a ribbon bar style layout. CMM-Manager 3.0 for Windows 7 also incorporates touch screen and multi-touch support and intuitive navigation paths. Simply walk up to the CMM, quickly align the part, and immediately measure geometric features and points on planes. When CAD is available, you can even take snap point measurements on the screen to eliminate manually probing the work piece – and automatically create dimensional charts with color-coded point deviations.

Docking and sliding panels provide a more open and simplified workspace, and inspection tools are simple to use. To create a serial inspection routine that runs on any CMM brand, you simply click points and features on a 3D part view and drag-and-drop them as icons on to a part program representation. CMM-Manager automatically converts the icon program into a collision-free touch probe motion path. Automated inspection results in graphic part-to-CAD comparison, a digital communication tool providing all the answers.

Measurement points can be taken automatically when the probe crosses the selected guidance feature (e.g. plane) within the specified tolerance zone.
PH20 support triples CMM productivity

CMM-Manager 3.0 for Windows 7 supports the new Renishaw PH20 probe head that drives fast, infinite, rotary positioning for high-speed point measurement with minimum CMM movement. The new probe head brings five-axis inspection capability to smaller CMMs by optimizing the working volume of the measurement platform. Through PH20 support, CMM-Manager 3.0 for Windows increases touch-trigger CMM inspection throughput up to three times. CMM-Manager software operates on a PC or laptop running a 32-bit or 64-bit Microsoft Windows 7 operating system.

“...I would recommend CMM-Manager to any metrology system user who cares about measurement productivity.

George Croll, Quality Manager for BTM Corporation

Michigan-based tool maker BTM Corporation opted for the user-centric CMM-Manager software to automate serial inspection on different CMM brands. BTM quality technicians also rely on the software’s walk-in measurement capability to quickly take points on prototype and first-part articles.

CMM-Manager supports manual CMM inspection using an MCAII measuring arm or a K-Series Optical CMM with SpaceProbe for large volume measurement.