LASER RADAR
NEXT-GENERATION SHOP FLOOR CMM

FLEXIBLE INSPECTION, UNBEATABLE PRODUCTIVITY

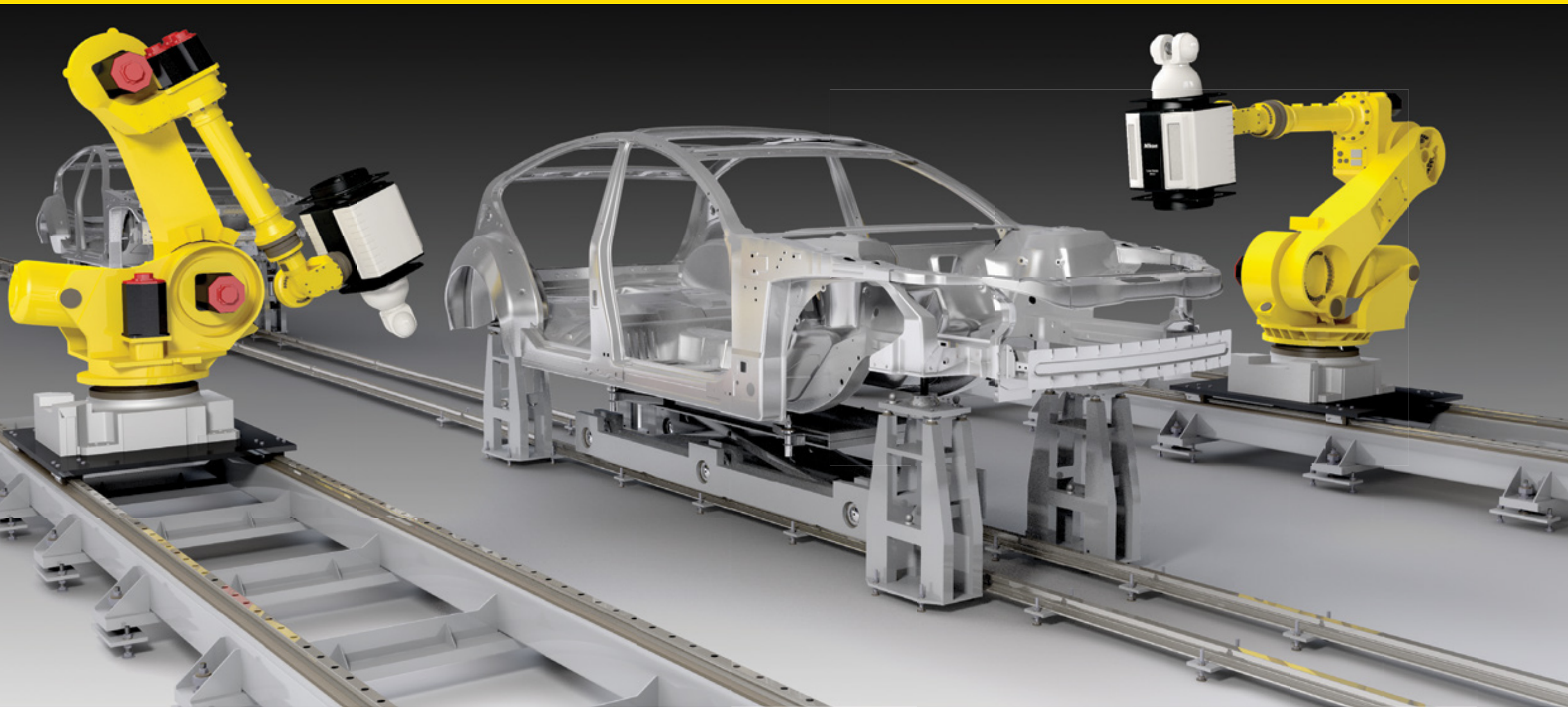
NIKON METROLOGY | VISION BEYOND PRECISION

RICH FEATURES, ABSOLUTE BENEFITS

KEY BENEFITS

- **Repeatable measurements** – Measuring the exact same points on every part without human interaction enables better process control
- **Automated measurements** - Completely automated inspections dramatically reduce inspection time required to perform measurements of large parts
- **Improved safety** – Parts are measured without an operator standing on the part or ladder to hold a target / probe
- **Inspecting new materials** - Contactless measurements inspect uncured carbon fiber and other delicate surfaces without damaging risk
- **Optimized measuring uptime** – Create and prove out inspection plans completely offline using CAD
- **Seamless integration with today's manufacturing processes** – In-process inspection using Laser Radars on robots and integrated on large machining tools

INNOVATING SHOP FLOOR INSPECTION



There is an increasing importance for automotive assembly plants to continuously monitor process quality throughout the production process. This need is driven by OEMs pushing the limits of design by using complex shapes, new materials, and cutting edge processes. Locations of holes, slots, studs, and welding lines along with flush & gap of doors, hoods, deck lids, and other hangers need to be measured and monitored throughout the assembly process. These inspections ensure that vehicles are built within the ever more stringent tolerances set by automotive manufacturers.

Nikon Metrology – in close cooperation with key automotive OEM and integration partners- addresses these challenges by introducing an innovative approach to body-in-white (BIW) inspection based upon its non-contact Laser Radar system. Unlike a horizontal-arm CMM, the Laser Radar high-speed measurements fit within short production cycle times. The new MV331/351 Laser Radar doubles surface scanning speed and drastically increases feature measurement performance. New usability features such as an integrated robot mount, removable air filters and positive air pressurization make the system even better suited for robotized inspection on the shop floor.

TRADITIONAL BODY-IN-WHITE INSPECTION IS UNDER PRESSURE

In the recent past body-in-white measurements have been performed in two phases - on the production line with low accuracy sensors to monitor process and in a CMM room where a sample of parts are sent to be inspected offline by large horizontal arm CMMs for more accurate measurements and to correlate the data from the inline sensors.

Although CMMs can provide highly accurate absolute measurements, they tend to be slow and require an expensive, dedicated metrology room. Vehicles need to be removed from the production line and then

Flush and gap measurement on finished vehicle

Features such as holes, slots, pins, studs can be quickly inspected using the Laser Radar

taken to the metrology room, manually fixtured and aligned to the CMM. The CMM then starts its measurement process, which is also very time-consuming. Taking into account the setup and measurement time, at best two vehicles can be inspected per shift on a CMM, but often only one vehicle is measured. This is a very small sample considering that over 1,000 vehicles of various styles can be built each day on a single production line. This is certainly not a large enough sample to monitor the production process.

Inline systems typically measure every vehicle but can require over 100 individual fixed sensors to inspect the required features. Although these sensors are very quick to measure, they are demanding to install and maintain. Also they do not provide measurements directly in the car's coordinate system. In addition, most assembly lines now are 'flexible', meaning that they can produce more than one type of vehicle. Fixed sensors cannot be used across different vehicles styles; every vehicle requires its own custom set of sensors making them even more expensive and onerous to maintain.

Recently inline inspection systems have been moving towards robotic based solutions which are flexible, but rely on the robot's positional precision which limits the overall accuracy. These systems typically have four or more robots with a sensor located on the end effector of each robot that is re-positioned to measure each of the features that need to be inspected. Hundreds of locations need to be programmed making them time-consuming to set up, difficult to maintain and they still do not provide the required accuracy and correlation to a CMM.

A NEW APPROACH: FLEXIBLE INSPECTION, ABSOLUTE MEASUREMENT

Innovative inspection stations are being installed today, both lineside and in-line, by major automotive OEMs using Nikon Metrology's Laser Radar. The Laser Radar has been used for many years in the aerospace and renewable energy sectors and is now providing a unique alternative to the shortcomings of traditional automotive metrology systems like CMMs and inline sensor systems. The new MV331/351 Laser Radar is further optimized for car body shop floor inspection. The Laser Radar's high speed vision scans at rates of 2.000 points per second – enables fast measurement of surfaces, sections and complex features.

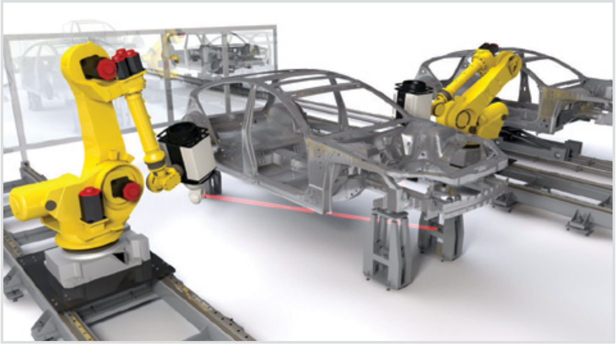
WHAT CUSTOMERS GAIN

With the need for shorter and more flexible production cycles, automotive manufacturers are continuously looking to cut time and costs whilst maintaining quality. For automotive inline inspection, the automated Laser Radar on a robot offers the right capabilities to meet the need for flexible and absolute measurements directly on the shop floor. For car manufacturers this results in:

- **Shorter startup of new production line or upon vehicle model changes:** During the startup phase of a production line, the first produced vehicles can be completely measured and compared to CAD in a short time. This provides better insight into product conformance and enables faster fine tuning of the production process.
- **Reduced scrap:** By closely monitoring the production quality, the manufacturing process can be instantly adjusted when variances occur over time.
- **Future proof data:** Measurements in absolute coordinates fit in the digital manufacturing process where big data is used as a reference to compare data over time and enabling enhanced insight, decision making, process automation and to speed up future product development.

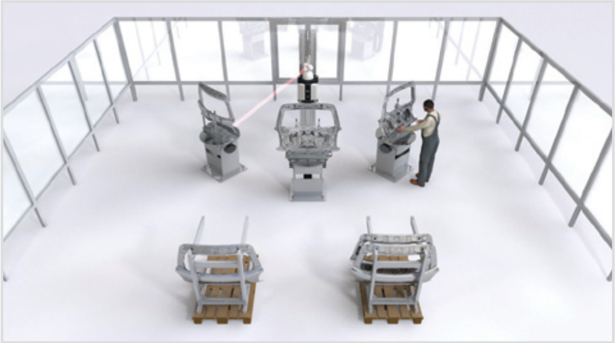
LASER RADAR IMPROVES SPEED AND QUALITY

Inline car body inspection: On every car body, several features are inspected in the takt time of the line. After a series of passing cars, all critical features are measured.



Line-side inspection: A car body is taken from the line and fully inspected. Two or four robots guarantee the highest inspection productivity. After inspection the body is re-inserted into the production line.

Line-side inspection with rotating table: A car body is taken from the line onto a rotating table. A Laser Radar on a fixed lift inspects the body from different sides.



Component inspection: a single Laser Radar on a lift inspects front and back of multiple components on rotate tables.

The Laser Radar performs automated, highly accurate, contactless measurements in the car coordinate system by using a focused laser that is controlled by a precision azimuth and elevation system. The Laser Radar requires a fraction of the reflected signal to make accurate measurements, enabling it to inspect almost any material, color or surface texture, such as bare sheet metal, coated BIW or painted cars.

The measurement accuracy and repeatability of the Laser Radar is comparable to measurements taken with a traditional horizontal arm touch probe, while it is many times faster. Two Laser Radars working in parallel can measure 700 features on a BIW vehicle in less than one hour; this can take a full shift for traditional CMM.

The configuration of a Laser Radar inspection station can vary based on the specific needs of the OEM, but typically consists of one or more Laser Radars that are manipulated by 6-axis industrial robots. The industrial robots are used to automatically reposition the Laser Radar to enable it to inspect areas that are not visible from a single location.

After repositioning the robot, the Laser Radar automatically realigns to the part by measuring alignment (such as tooling balls) on the vehicle or tooling. Unlike other inline robotic measurement systems, this guarantees that all measurements are collected in the vehicle coordinate system and ensures feature accuracy is independent of the robots ability to accurately locate the Laser Radar.
Laser Radar has a spherical field-of-view, meaning it has visibility to large sections of the vehicle at any time and dozens of features on the vehicle can be measured from a single location. Just like a CMM, measurements are pre-programmed directly from the vehicle's CAD model using the inspection software. After the initial programming, data collection and reporting is fully automated. Specific inspection scripts can also be written for each vehicle style and model being built on the production line making the Laser Radar inspection station completely flexible for changes to inspection plans and even new vehicle styles. Changing the features to inspect or adding in new vehicle styles is completely software based and does not require any physical changes to the setup or new hardware.

The application software takes care of the interaction of the Laser Radar, robot, and data processing; inspections are completely automated and do not require manual intervention during runtime.
As a conclusion, the automated Laser Radar has all capabilities to improve speed and quality of the measurements compared to the traditional methods. For customers this will result in faster go-to-market with new or updated models, reduced scrap and ownership of future-proof data.

SPECIFICATIONS

		MV331	MV331 HS	MV331p HS	MV351 HS
Range		30 m	30 m	30 m	50 m
Measurement speed	**Scanning***	2000 pts/s	2000 pts/s	2000 pts/s	2000 pts/s
	Surface points	0.5 sec	0.2 sec	0.2 sec	0.2 sec
	Tooling ball	7 sec	2 sec	2 sec	2 sec
	Feature (hole)	20 sec	2.2 sec	2.2 sec	2.2 sec
Environmental		Replaceable filters	Replaceable filters	Replaceable filters + attachment for air pressurization	Replaceable filters
Designed for		Cost-efficiency	Performance	Continuous inline operation	Long range

* Measurement speed depends on hole size and settings

Laser

	Measurement laser (infrared)	Pointing laser (red)
Wavelength	1,550 nm	700 nm
Power	<10 mW	<1.0 mW
IEC Class	Class 1	Class 2

Environmental

	Operational	Storage
Temperature	5° to 40°C	-10° to 60°C
Altitude	-400 to 3,000 m	-400 to 11,000 m
Humidity	10 - 90% (non-condensing)	

Distance measurement performance

Measurement accuracy (2σ)	10 μm + 2.5 μm/m
Maximum data rate	4000 pts/sec
Working range	MV331: 2-30 m MV351: 2-50 m

Angle measurement performance

Azimuth uncertainty (2σ)	6.8 μm/m
Elevation uncertainty (2σ)	6.8 μm/m
Azimuth working envelope	±360°
Elevation working envelope	±45°

Combined 3D Uncertainty

Range (m)	2	5	10	15	20	30
2σ Volumetric uncertainty (μm)*	24	53	102	152	201	301

* Tooling ball target grade 25 or less
* Laser Radar must be calibrated and operating in a stable environment

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