Quality 4.0 in car body inspection is happening today

Laser Radar provides absolute, accurate measurement on the shop floor

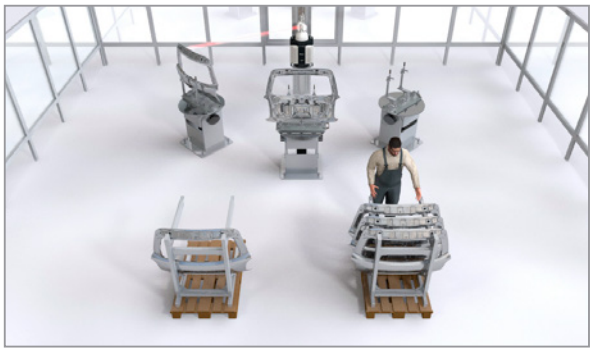
High-end manufacturing has always required feedback of reliable measurements to adjust parameters precisely and keep components within tolerance. The better and more regular the data provided, the more tightly a production line can be controlled. Nikon's Laser Radar technology - capable of providing fast, automated, accurate, absolute measurements - clears the way for faster feedback of quality information, leading to exceptional levels of accuracy, high manufacturing efficiency, reduced rework and less scrap.

At the heart of Quality 4.0, a subset of Industry 4.0, is the interconnection of inspection and production. The goal is to enable manufacturers to make better products at lower cost, speed up their response to changes in demand, shorten time to market and achieve greater competitiveness. This is especially true in car plants, where the increase in quality and repeatability is effective not only in production but also in, prototyping and ramp-up phases, leading to a much shorter time to market for a new vehicle.

The key is to challenge the traditional concept of inline, relative sensors, correlated and backed up by horizontal arm CMMs and replace it with a shop floor based inspection solution, such as Nikon's Laser Radar; a next-generation CMM that provides accurate, point-cloud based feature measurements in absolute coordinates. Used directly on the shop floor or in the measurement room, it provides quality information many times faster than a traditional CMM, greatly improving measurement productivity.

A twin robot-mounted Laser Radar system in the production line performs full, accurate, absolute measurements in minutes.

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.



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

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There is minimum disruption to the sequencing of production and no the need for manual movement to a CMM room. Offline, the same system can be used as an alternative to a CMM, allowing complete BiW (body in white) measurements in less than two hours compared to up to eight hours for a conventional touch-probe CMM.

Laser Radar takes specific point cloud data at 500 points per second with CMM accuracy and without the need for any specific part surface preparation. Individual holes and slots in sheet metal can be measured in less than three seconds, with specific surface points (vectors) measured at a rate of over three per second. Even traditionally troublesome features such as studs can be scanned and measured in seconds.

Offline versus inline quality control

The move from an offline metrology strategy to an inline one is a challenging jump. Traditional CMMs are a trusted, well-known technology providing the master reference for all measurements throughout production. Traditional inline measurement systems (fixed or robot mounted scanners) are a fast way of getting relative measurement data from every car going down the line.

So why change?

A large automotive OEM had the same question. Using CMMs and traditional inline inspection solutions, it was a struggle to achieve its goal of a faster quality ramp-up in pre-production and breaking through a barrier into very high-performance dimensional quality during production.

Implementation of traditional CMMs was costly and effective throughput was low. The first process adjustments were carried out based on very little CMM data, so iterative changes were constantly needed as a result of a lack of complete and relevant feedback information. With the relative inline measurement system they were able to acquire a lot of data, but they could not make it fully functional until after production started. Also much of their sheet metal and other hang-on components were bought-in and limited detailed evaluation was carried out in-house.

Optical inspection as paradigm to increase productivity

The company was insistent upon adopting optical inspection, moving away from tactile probing. Additionally, it wanted to remove the bottleneck of the offline CMM room to make a paradigm change to achieve breakthrough improvements. The ultimate goal was better metrology performance yielding faster feedback of data during the initial phases before a new vehicle enters full production. Laser Radar was the solution to achieve this goal.

Laser Radar was implemented in 2 key areas:
Shop floor – inline and bypass measurement cells were installed in the production line to give absolute measurement data right from day one of pre-production. This allowed them to measure 50% of the bodies produced in pre-series (in previous launches less than 10 were measured) and fewer adjustments are needed during full production to maintain tolerance.

Offline – Laser Radar on lift and rotate cells were installed to perform

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

component, sub-assembly and full body checks in the CMM room. Multiple turntables can be tended from a single Laser Radar reducing measurement dead-time while loading or changing fixtures. This approach optimizes productivity and reduces the traditional CMM room bottleneck.

The ability to provide accurate, absolute inline measurements during pre-production not only allowed to exceed their goal of bodies in tolerance by start of production, but also helped to significantly reduce the pre-production time.

Also during production, the highest levels of quality are achieved and maintained due to the amount of good quality measurement data directly from Laser Radar cells at the production line. The number of features measured inline has gone from 190 (relative measurements) to 1,500 (absolute measurements) achieved through a sampling measurement strategy and automatic bypass stations resulting in precise process decisions down to 0.1 mm.

Performance quantified

Interestingly, an important advantage is the ability to measure studs. Previously, approximately 20 of the 300 studs on a car were measured inline. Now, with the Laser Radar, all 300 studs are measured using a sampling strategy, 4 times per day without the need to move the car body to a separate CMM room. This has also allowed to create an automatic correction process for the stud application robots feeding back the errors to correct for them in almost real time.

Another benefit is that the accuracy of the inline data has removed the pressure on the CMM room to measure production cars for process control, allowing them to concentrate on troubleshooting and problem analysis. The increased throughput of the CMM room itself allows for faster problem solving.

Conclusion

With low production rates during pre-series, Laser Radar enables inspection all of the points on a car inline to the same standard as on a CMM, generating many times more data than before. This allows much faster ramp-up to higher quality products saving time and ultimately money.

Using the same technology, the offline facility ceases to be a bottleneck due to faster acquisition of more features. Parts do not need to be moved to the CMM room for systematic measurement only troubleshooting, relieving sequencing issues and greatly improving measurement productivity.

Having the same program running offline and inline produces consistency of results. Set-up is quicker, as is programming, increasing throughput and reducing bottlenecks.

Taking measurements in absolute coordinates using Laser Radar technology, together with enhanced data collection and reporting, are ideal for integration into a digital manufacturing environment. It allows the advantages of Quality 4.0 to be leveraged, with 'big data' used to control the process better and to compare information over time, facilitating enhanced insight, improving decision making, and speeding product development.

The content of this article is further expanded upon in an AMS webinar entitled 'Increasing process quality and repeatability with Laser Radar CMM', accessible from:
https://automotivemanufacturingsolutions.com/webinars-podcasts/increasing-process-quality-repeatability-laser-radar-cmm