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Robotic Uncategorized

AI To Drive Future In-Line Metrology Systems

November 12, 2018

Artificial Intelligence (AI) technologies have made significant contributions to many products and conveniences. The adoption rate of these technologies has taken a steeper curve than anticipated. The machine learning solutions are proving to be successful in many industries, either by identifying patterns in data to solve critical problems or by guiding autonomous vehicles.

3D machine vision AI is expected to be a product differentiator in the near future and is being predicted to grow at CAGR of almost 50% in the period 2018 to 2025. The automotive segment is expected to dominate the market and to continue this trend till 2025.

In-line metrology is in a unique position to utilize AI as a growth opportunity. Automotive companies have an install base with over 10 years of automotive dimensional data repository in its servers world-wide. A significant portion of in-line vehicle body inspection systems currently use statistical pattern recognition methods and industrial robotics and already aligned with the necessary skills needed for adopting AI technologies.

The strategy for in-line metrology could utilize a two-pronged approach by utilizing AI to maintain differentiation and also use AI to keep cost under control. Implementing an AI strategy should be a gradual adoption of AI technologies along with a focus in creating an ecosystem that collects data to foster many more future AI applications.

Automated Systems:

Automated robotic based inspection systems integrated with sensor technologies produce 3D feature data at fast cycle times (< 30 seconds) with many inspection stations collecting 3D measurement data during manufacturing process and analyzed through statistical tools for process control (SPC).

Third party SPC tools have enabled many small regional robot system integrators, along with global 3D sensor suppliers, to provide competitive solutions. Competition has led to erosion of automated systems' prices with significant system costs being attributed to robot programming, updating robot paths due to specialization, and creating customized reports.

Adoption rate of robotic inspection systems in automotive final assembly has been slow since robots have to work in tandem with humans in an assembly line. The final assembly line also has significant space constraints making installation of a robot cell with its safety systems a challenge in many automotive plants. Solving robot cell space constraint provides a significant opportunity for growth.

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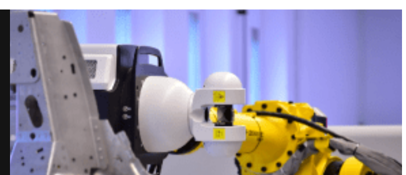

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External conditions are driving organizations to look for technologies that enable the following:

1. Automated system to provide additional value and differentiation from products offered by small regional vendors
2. Reduced installation costs globally

AI tools provides technologies that meet the above goals.

AI as Product Differentiator:

3D automated inline metrology solutions provide dimensional data on every vehicle-body inspected. The measured data is stored on servers, both as inspection point data as well as compressed point cloud data. However, this data is rarely utilized as feedback in a meaningful way to a design team. Hence, there is churn during a new product's introduction process, rework of tooling, and unexpected costs to the OEM. OEM's have access to this dimensional data from all their installed servers, which is a great resource for AI implementation. Creation of an AI framework that uses this 3D stored data to create predictive churn models could be used to simulate 'what-if' scenarios during the product design phase so that the overdesign of tools and churn during product launches are minimized. The two process that can benefit from this AI frame work would be:

Part Tolerancing: Part tolerancing is often guided by the what a design would entail and what processes can provide. Any changes to design often affects tooling. The proposed *AI churn-predictor* would rely on data from past product introductions. The *AI coordinator* would then apply learnt what-if scenarios to a proposed new vehicle design, identify churn-potential and cost excursion paths. Thus, guiding vehicle and tool designers to improve these designs up-front. The goal of the tool being to reduce product and tooling cycle churn by 30-40%. The AI tool would guide designers to reduce both tolerancing and tooling cost relying on AI's ability to learn abstractions of what-ifs from measured 3D data resulting in changes to tooling due to design changes.

Predictive Tool: Predictive tool, using the 3D information from data would learn 3D pattern outcomes in the final vehicle assembly process. The AI application would use 3D data from body build and chassis along with 3D

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data from the tier-1 frame manufacturer as input and 3D data from final assembly as an outcome. Using these data, a predictive model is generated. This *AI predictor* identifies potential final assembly issues stemming from body and chassis data. The goal of this AI predictor is to reduce final assembly quality issues and inspection cost.

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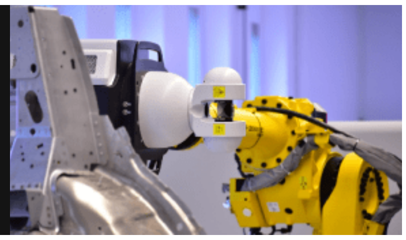

This differentiator matches well with digital manufacturing initiatives at auto-manufacturers. The AI utilities proposed relies on migration to cloud computing and access to three-dimensional data from a plant and across plants sharing the same platform. These two technological initiatives have enabled availability of massive amounts of shop floor data called digital thread.

AI to Improve profit margins:

This AI *path optimizer* learns changes made to robot paths on the shop floor by using the data from previous robot programs and changes to them during new product introduction. A deep learning tool, which uses the current data and current robot path modifications to develop and validate an AI engine. AI will learn best installation practices and create automated collision free robot paths using vast amount of path data from previously installed bases (> 10 years), so that the installation team can focus on needed specialization..

Implementation

Any implementation plan relies heavily upon available data from the installations worldwide, along with an organization that implements and evangelizes AI deployment internally, as well as, to its supplier base. An AI task team would require experts in deep learning methods along with a robotics expert with in-house experts in 3D point cloud analytics, and robot programmers.

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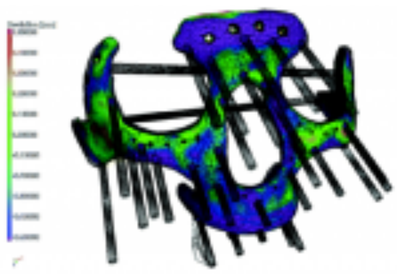

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