3D SMART SENSORS INTO THE SMART FACTORY SETTING

Canadian-based LMI Technologies talks about 3D Smart Sensors, Robots and the Advancement of Automated Mixed-Model Production

The introduction of robot-driven 3D smart sensors into the smart factory setting is driving the advancement of automated mixed-model production across a wide range of industries.

Robotic systems are being used for a variety of assembly and inspection applications, which is enabling the operation of lean, efficient, and automated systems where more than one product type or model can be produced on a single production line.

3D smart sensors provide these systems with both robot vision-guidance and flexible measurement capabilities for inline assembly and inspection processes.

Fig.1 Illustration of gap & flush inspection on a single model production line.

SINGLE MODEL PRODUCTION LINES

In early automotive manufacturing layouts, single model, batch production lines were common. This approach consisted of a set of workstations arranged in a linear fashion, with each station connected by a material handling device.

In this layout, each station performs a fixed function in the production of a single product type or model. In order to manufacture a different product type or model, the entire line has to be changed over on a fixed schedule.

Single model production lines often require rebalancing with different stations and task assignments, which leads to disruption and downtime on the line. Most importantly, because they are made up of fixed workstations, single model lines are unable to adapt to upstream demand variability.

Fig.2 Illustration of gap & flush inspection on a mixed-model production line.

INTRODUCTION OF MIXED-MODEL PRODUCTION

Mixed-model production increases productivity and profitability through a more efficient use of time, floorspace, and resources. As a powerful complement to single model batch production, mixed-model manufacturing allows the factory to create products according to specific customer demands and specifications.

As opposed to a single model approach, the assembly line is now organized into multiple, smaller work cells where each cell is able to produce either a single model or several models with a high degree of part commonality. Some (or all) upstream fabrication can be carried out in each of these cells to increase efficiency and output. Fabrication equipment for each model can be combined with respective assembly operations in a cell or sub-cell––providing

even closer coordination and corresponding improvements in quality and inventory.

The result is a smoothing of demand at fabrication, which eliminates the need for a large inventory buffer between fabrication and assembly. A similar inventory reduction occurs on the finished goods side, since the production line is scheduled to synchronize with demand.

THE INTRODUCTION OF ROBOTS

The mixed-model approach to assembly is not new. Automotive companies have known of its advantages and been adopting this method for more than a decade now. What is relatively new, however, is the possibility of fully automating this process through the use of robotic systems.

Fig. 3 Windshield nsertion using a vision-guided robotic arm.

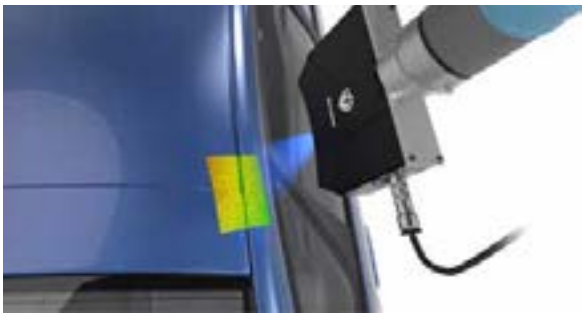

Fig. 4 Gap & flush measurement using a Gocator 3210 snapshot sensor mounted onto a robotic arm.

Robotic systems allow manufacturers to partially or completely automate what was previously an error-prone and potentially dangerous manual operation. Today robots are used for everything from automated windshield and door insertion to seam welding or glue bead application to gap and flush and underbody inspection.

SYSTEMS DRIVEN BY 3D SMART SENSORS

3D smart sensors provide critical machine vision guidance and measurement capability. This allows robotic systems to execute an array of tasks in a variety of specialized work cells, with a high degree of accuracy and repeatability - ensuring each product model is assembled on-time and to specification.

Depending on the application, system engineers can choose from laser line profilers for guidance and inspection of moving parts in an inline process, or snapshot (fringe projection) sensors for full-field inspection of objects with start/stop motion.

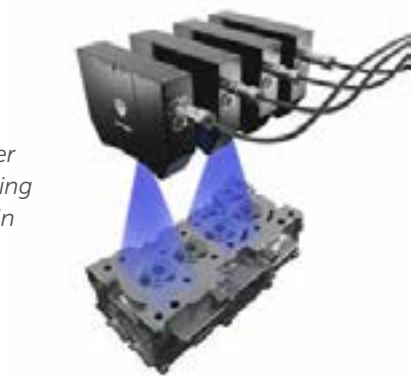

Fig. 5 Gocator laser line profiler scanning automotive parts in an inline process.

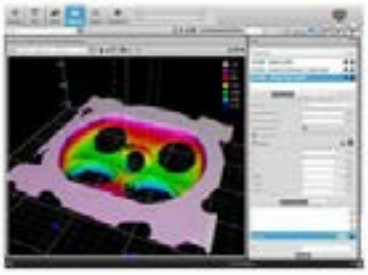

Fig. 6 Gocator Volume Checker scanning engine cylinder heads.

ROBOTIC VISION-GUIDANCE (RVG) SYSTEMS AND FLEXIBLE ROBOTIC MEASUREMENT

Smart sensors can be mounted on robots in order to pick up and guide parts to critical locations for insertion.

For the majority of applications, however, the 3D smart sensor is not only responsible for guiding the robot to its correct position, but also for detecting and inspecting finished assembly features. In automotive, 3D smart sensors are used for a multitude of inspection applications such as verifying panel gap and flush tolerances; seat insertion on studs; door mounting; wire hanging location; holes for light insertions; hood and decklids, panel mating and more.

In these types of measurement and inspection applications, all-in-one smart sensors execute real-time control decisions based on the acquired data––all from inside the sensor.

ALL-IN-ONE SOLUTION WITH SEAMLESS INTEGRATION

One of the key advantages of an all-in-one smart sensor like Gocator is that it provides the robot

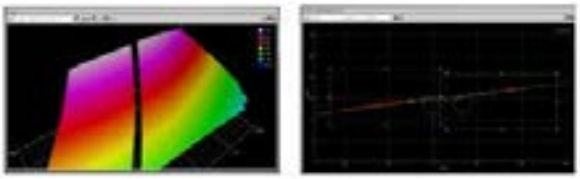

Fig. 7 Real 3D scan from gap & flush measurement on an automotive door panel.

Fig. 8 Badge inspection using Gocator 3210 snapshot sensor mounted on a robot arm.

with an all-in-one sequence of 3D scanning, measurement and control decision communication. In addition, it offers embedded support for directly communicating with robot controllers.

An all-in-one 3D smart sensor also has the capacity for seamless integration. This makes it an ideal fit for robotic applications––delivering simplicity and ease of use where standard 3D sensor solutions still require external controllers (both for mounting and interfacing), complicated cabling, additional coding and even proprietary PC solutions to operate.

REPROGRAMMABLE FOR ON-THE-FLY INSPECTION

On a traditional production line where only one model of product is being produced, it's acceptable for 3D sensors to only be fixed solutions (i.e., with no ability to adapt to task variation). In a multi-model production line, however, the solution has to be more agile––and this is another area where next generation 3D smart sensors hold an advantage over standard sensor solutions.

Gocator can be "reprogrammed" on-the-fly by loading different jobs that correspond to each product model. A job contains the specific configurations for taking measurements, setting exposures, and setting pass/fail criteria.

Gocator can be used as either a fixed (non-robotic) or flexible (robot-mounted) solution. In mixed-model systems, select Gocators are used to measure common features across models, while other Gocators are used to measure features on one model only.

NETWORK CONNECTED

All-in-one 3D smart sensors can adapt to changing inspection requirements in a multi-model production line because they are connected to the factory network and can be accessed directly over TCP/IP protocols. This means they can easily be reconfigured for different measurement jobs as well as updated with firmware to access new measurement algorithms.

FIRMWARE CUSTOMIZATION

In addition to regular firmware updates, all-in-one 3D smart sensors offer firmware customization to advanced users. This capability gives plant engineering the ability to develop and embed custom measurement tools onto the sensor itself, so that a new process or part can receive highly specialized inspection to meet tight tolerances.

QUICK AND EFFICIENT SYSTEM CHANGEOVER

Flexibility is the key. The smart sensors that are used for measuring the features on a door panel can be used for gap and flush inspection, and the changeover can be achieved seamlessly with little to no downtime or system disruption.

ROBOTS AND SENSORS - AN ESSENTIAL PAIR

Robot-driven 3D smart sensors enable multi-model production lines to respond to inline dynamic changes over the network through job changes while continuing to deliver the highest standards of product safety and quality.

THE FUTURE OF ROBOTIC INSPECTION

The trend toward multi-model production is expanding into many manufacturing environments, which means 3D smart sensor-driven robotic systems will continue to adapt and offer unique benefits to the customer and their individual manufacturing needs.

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