Efficient inline component inspection for the manufacturing industry

3D precision in line

Quality assurance plays a very important role in manufacturing companies. It is an important instrument for creating efficiency and transparency. In the factory of the future, an ever-increasing amount of measurement data will be generated for this purpose. Complex correlations can thus be recognized more and more quickly, valuable quality data can be obtained and processed in order, for example, to avoid errors in the future. With the development in Factory 4.0, however, the demands placed on quality standards in the manufacturing industry are also growing.
The technology company senseIT has specialised in the development of fully automatic 3D inspection cells that can be used directly on the production line. This increases autonomy and ensures enormous time and cost savings. The most important components of the inline inspection cells: Ensenso stereo 3D cameras. They literally take a close look at extremely complex components with the utmost precision and in less than 30 seconds. The system checks and validates the completeness of assembled products up to the size of a shoebox and is exceptionally precise in detecting faults: the software signals deviations in the tenth of a millimetre range.

This applies to all types of defects that can occur during production or transport: broken or missing parts, deformations, machining material, cavities or excessive burrs.

"During the development of the 3D inspection cell val-IT Flex, we optimally implemented the advantages of 3D metrology. We implemented three Ensenso stereo 3D cameras for this purpose. Thanks to Ensenso's 3D technology, we are able to detect deviations within a tenth of a millimetre. This is better than the human eye can do," explains Anouar Manders, software engineer senseIT.

The val-IT Flex cell consists of a turntable and three Ensenso N35 3D cameras. The component to be inspected is placed on the rotary table with a diameter of 440mm and a height of 240mm and recorded from all sides. During a pre-programmed, complete 360° rotation, the cameras generate a high-resolution point cloud of the component. The object is captured with different integration times in order to do justice to the variance of the component properties.
The Ensenso 3D cameras operate using stereo vision, which imitates human vision. Each Ensenso contains two 2D IDS cameras to view the scene from different positions. Although the cameras see the same scene content, there are different object positions according to the cameras projection rays. Special matching algorithms compare the two images, search for corresponding points and visualize all point displacements in a disparity map. This is then used to calculate depth information for the resulting point cloud. The light-intensive projector of the Ensenso cameras ensures that the component to be inspected is captured as accurately, quickly and reliably as possible.

A texture projection enables high-contrast imaging of smooth or reflective objects or objects with weak structures, even in difficult lighting conditions, which in turn increases accuracy during matching.

The integrated FlexView technology also allows minimal shifts of the projected texture on the object surface of the component, whereby the auxiliary structures vary. A piezo element is used to move the pattern mask in the light beam which shifts the texture on the object. The combination of several images of the same scene, taken with different structures, increases the number of pixels. This results in a higher resolution. All found points are combined into a complete, high-resolution 3D representation in the form of a so-called point cloud of the component.
Within the val-IT Flex inspection cell this is then compared with a CAD reference model and projections of the product. For the acquisition and processing of the point cloud senseIT uses the 3D machine vision algorithms of the HALCON image processing library from MVTec. In addition, the company has developed specific measurement and processing algorithms and integrated them into HALCON via extension packages. Hardware acceleration ensures that the entire processing time is within 30 seconds.

Finally, all data of the recorded component with possible deviations are displayed on a comfortable user interface. The deviations can, for example, be displayed per lot, article number or period. It is quick and easy to see whether the scanned components have repeated errors and which errors have occurred during production or transport, for example. This enables the user to react quickly and readjust the manufacturing or transport process.

All information about individually validated parts is stored in a large database. In this way the val-IT Flex is able to carry out statistical analyses which provides information about recurring errors in the manufacturing process. The results of the analysis are clearly presented in a secure online portal. Information about detected defects presented in real time reduces the feedback time and improves the delivery quality in the subsequent process. Insights into these repetitive errors help to optimize the entire manufacturing process. Quality costs, labour costs or penalties for non-compliance with quality standards are significantly reduced. In addition, the user can easily and intuitively teach the system new or modified components and make tolerance settings. This reduces product changeover times to a minimum and enables effective utilization of the system. The return on investment is achieved in just a few years.
Time savings and increased productivity through fully automated inline testing

Another advantage is that the scanning and validation process is fully automated and requires no human interaction. This eliminates human interpretation errors caused by fatigue and distraction. Fully automated inline inspection saves time by increasing the measuring speed and increases productivity by detecting faulty parts at an early stage. The manufacturing process can be modified early enough to prevent defects. This is particularly important in the production of large product batches. The inline inspection cells from senseIT make a diagnosis with the help of Ensenso 3D Vision technology and MVTec HALCON software - directly at the scene, space-saving and in the shortest way.

Ensenso N35. 3D vision, fast and precise.

The Ensenso N35 models are particularly suitable for 3D detection of standing objects and for working distances of up to 3,000 mm and are available with focal lengths of 6 to 16 mm. The cameras are pre-calibrated and supplied with an MVTec HALCON interface and object-oriented API (C++, C#/.NET). The high-precision digitization with 3D cameras from Ensenso and the subsequent image processing for object verification can significantly improve the quality of the produced objects for subsequent process steps.

Conclusion

The Ensenso technology (Stereo Vision) makes inline processing much faster and more accurate than was previously possible. Such an optimization of the quality assurance process thus contributes significantly to the reduction of quality costs in the factory of the future: Quality assurance 4.0 means intelligent automation with SenseIT and Ensenso Stereo 3D cameras.
Client:

senseIT

The Dutch technology company senseIT specializes in the development and production of fully automatic 3D inspection cells. The systems carry out inline 3-dimensional quality inspections and/or measurements at the workplace.

https://senseit.nl/home-en/

Camera:

Ensenso N35

- With GigE interface – versatile and flexible
- Compact, robust aluminum housing
- IP65/67
- Global Shutter CMOS sensors and pattern projector, optionally with blue or infrared LEDs
- Max. fps (3D): 10 (2x Binning: 30) and 64 disparity levels
- Max. fps (offline processing): 30 (2x Binning: 70) and 64 disparity levels
- Designed for working distances of up to 3,000 mm (N35) and variable picture fields
- Output of a single 3D point cloud with data from all cameras used in multi-camera mode
- Live composition of the 3D point clouds from multiple viewing directions
- Integrated FlexView technology for more detailed accuracy of the point cloud and higher robustness of 3D data on difficult surfaces
- "Projected texture stereo vision" process for capturing untextured surfaces
- Capture of both stationary and moving objects
- Free software package with driver and API for Windows and Linux
- One software package supports USB and GigE models
- HALCON, C, C++ and C# sample programs with source code
- Pre-calibrated and therefore easy to set up
- Integrated function for robot hand-eye calibration with calibration plate
- Integration of uEye industrial cameras on the software side, for example, to capture additional color information or barcodes
- Subsampling and binning for flexible data and frame rates