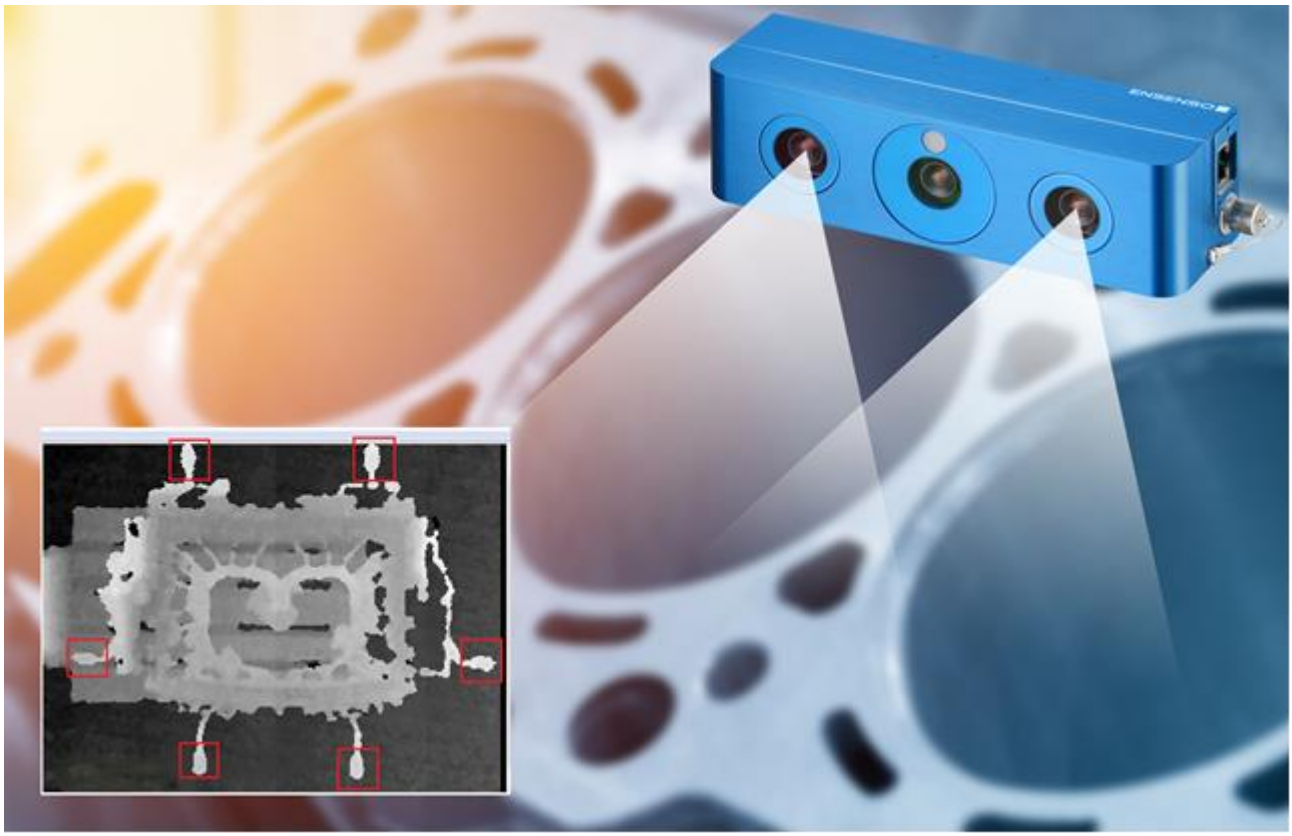
Defect-free cast components

Automatic visual inspection system for die cast parts for the automotive industry



Die cast parts made of aluminium and magnesium alloys are increasingly being used in the automotive industry since they ensure a considerable reduction in vehicle weight. Zero-defect quality at the lowest possible cost is an essential requirement for the cast components. Automation is therefore the magic word, especially in the areas of production and processing. A system from VisionTools Bildanalyse Systeme GmbH, Germany, with integrated image processing uses an Ensenso 3D camera to record the geometry of each individual cast component and check its condition and completeness.

Weight is a decisive factor for fuel consumption in vehicles with internal combustion engines and thus also for the emission of environmentally harmful exhaust gases. In the case of vehicles with alternative drive systems, lightweight construction helps to compensate for the weight of electric motors, batteries and other components. Die-cast parts made of aluminium and magnesium alloys have a low dead weight, can be formed into complex shapes and can be produced cost-effectively. Typical die cast parts made of these metals are engine components, transmission housings, chassis parts and tailgate frames. Since faulty components often cause malfunctions and expensive follow-up costs, built-in inspection systems, which check every comonent for completeness, will ensure a consistently high quality of the parts. At the same time, this system checks that the production tool is completely emptied after removal so that it is not destroyed the next time it is filled due to residual material and the high pressing force.

In most cases, component geometry testing has so far been carried out using several light barriers, reflection light scanners, inductive sensors or similar devices. Due to the small distance between these sensors and the component, there was not only a high thermal load due to heat, but also the

danger of collision with the workpiece. In addition, each type or tool change on the die casting machine usually required a reorientation or expansion of the existing sensor system.

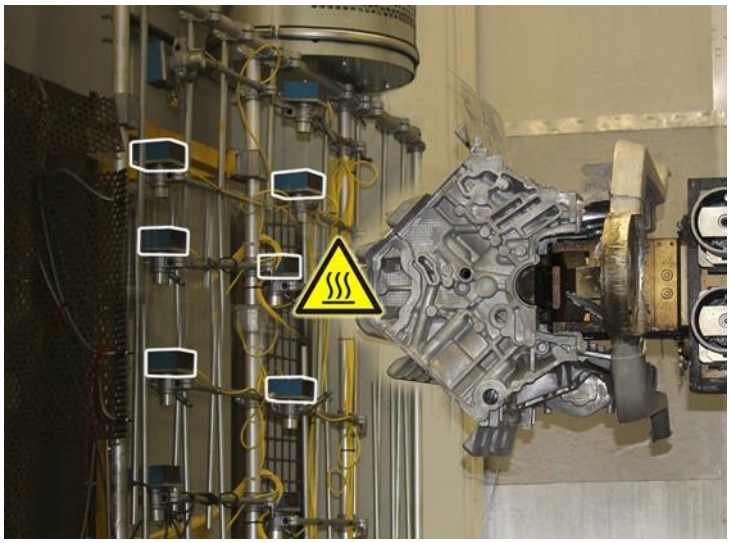


Figure 1 Thermal stress due to small distance between cast component and sensors

Application

The VisionTools automatic visual inspection system with integrated image processing provides a solution to these problems. Mounted directly in the production line, it enables the non-contact recording of the component geometry of a cast component from a safe distance. Using an Ensenso N35 3D camera from IDS, it checks the correct condition and completeness of all sprues, casting beans, runs, channels or feeders.

The evaluation is then carried out with the image analysis software VisionTools V60. Depending on the size and position of the component, several images are required to check all beans, slugs and sprues. For this purpose, the robot places the component in front of the 3D camera. The image acquisition and evaluation takes between 0.3 and 1.2 seconds per component position. The type and test position number are specified by the machine control system.

The system can manage an unlimited number of product variants. The VisionTools V60 image processing software ensures the implementation of type and tool changes without having to change the 3D camera. For this purpose, the software is used to define specific test characteristics for each component or test position once. These are compared with the images of the current cast component. The system issues an error message if there are variances. This eliminates the need for time-consuming retrofitting, accidental sensor adjustment or long downtimes.

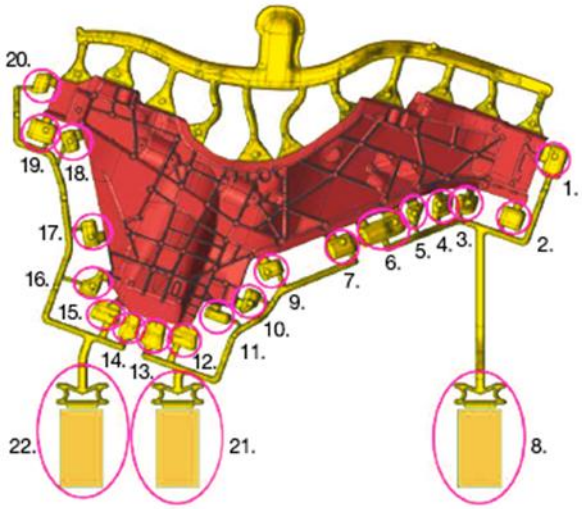


Figure 2: Example of a casting with cast beans

VisionTools uses an Ensenso N35 3D camera to distinguish the beans in the images from the background. However, different workpieces often have different gloss properties. The camera must be up to these challenges. Since the quality of stereo vision depends directly on the lighting conditions and surface texture of the objects to be inspected, Ensenso 3D cameras are particularly suitable for this application since they make use of the "Projected Texture Stereo Vision" method.

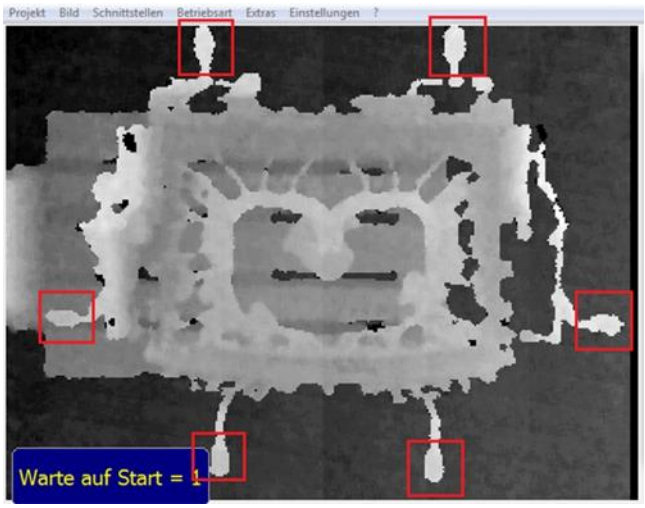


Figure3 Screenshot: runner beans 3D data in grey value levels

Each model uses two CMOS cameras and a projector that projects auxiliary light patterns onto the object to be captured (in this case the cast components), to increase the accuracy of the surface image. The two CMOS cameras view the respective component from different positions. Although the image content of both camera images seems to be identical, they show differences in the position of the component under consideration, e.g. the engine components or chassis parts. Since the distance and viewing angle of the cameras as well as the focal length of the optics are known, the Ensenso software can convert these differences into known lengths by triangulation and thus determine the 3D coordination of the object point for each individual image pixel and merge them into a 3D point cloud of the component to be processed. This not only improves the quality of the depth information but also achieves more precise measurement results.

The Flex View projection technology integrated in the N35 model further increases the accuracy of the measurement results. The position of the projector mask in the light beam can be shifted linearly in very small steps. Consequently, the projected texture on the surface of the component also moves and creates additional structure to help with the reconstruction. Acquiring multiple image pairs with different textures of the same object scene produces a lot more image points, resulting in an increase in resolution. In addition to the resolution, the robustness of the data on difficult surfaces also increases, as the shifted pattern structures apply additional information to shiny, dark or reflective surfaces. The Ensenso N35 thus meets the customer's requirements to make the beans in the photos distinguishable from the background and to be able to reliably test the workpieces which often have different gloss properties.

Figure 4: Machine terminal shows direct inspection results of 3D data of a cast part

VisionTools' camera-based image processing solution reduces part inspection errors to a minimum and the downtime of the die casting machines can be almost completely avoided. **This reduces manufacturing costs and ensures a smooth manufacturing process: with Ensenso N35!**

Client

VisionTools is one of the leading system houses for industrial image processing. Based on an extensive product range, the company offers its customers high-performance and efficient systems for all areas of industrial manufacturing technology, supported by state-of-the-art image analysis systems and robotics. https://www.vision-tools.com

Camera

Ensenso N35 - 3D vision, fast and precise

- 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

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