3D image processing with one camera opens up additional fields of application
One-eyed robots with 3D vision

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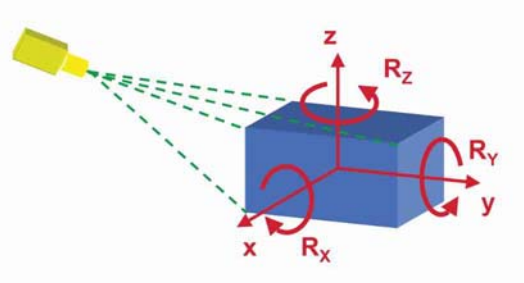
The positioning of robots in a room via image processing systems (3D robot vision) has considerably enhanced the industry's flexibility. However, because these processes were often complex and cost-intensive in the past, the use of 3D systems was mainly restricted to particularly sophisticated applications, such as the measurement of auto bodies in the automotive sector. This is why entirely new fields of application have been opened up by a recently developed 3D process that can precisely define all the six degrees of freedom of a three-dimensional object with only one camera. As a result, significant innovative progress has been made toward the cost-effective use of 3D image processing for robot guidance in all sectors of industry.

Flexible, automated production processes, in which many product variations are manufactured with production equipment that is as universal as possible, necessitate the assembly of components in undefined positions. This means that the position of the workpieces must be precisely defined so that the handling and assembly equipment can be accurately guided. If the position can be defined in 3D, this drastically reduces expenditure on product-dependent equipment and increases the flexibility of the production process many times over. In the past, the processes and systems for 3D object definition were too complex and expensive for many applications.

New fields of application for image processing can only be broached if innovative software solutions are developed. Several years ago, a breakthrough was made in the further development of the proven, extremely fast and contactless identification and 2D position recognition of workpieces and goods that are arranged in a defined level. The 2D system only enabled production line sorting, automatic placement, type identification or position definition. However, after consistent further development, it was also able to recognize objects at different levels and thus overcome the major challenge of independent position recognition at reasonable cost. In this process, the distance between a camera position and the mapped object is calculated in 2.5D, which is why it is called "2.5D technology". This contour-based recognition of all individually shaped objects offers extremely failsafe, robust and, at the same time, cost-effective solutions for palletizing, depalletizing and the problematic process of "bin picking".

Pictures



The principle of MONO3D robot vision

The entire 3D range

Naturally, wide ranges of “genuine” 3D processes are available today that can be adapted via three-dimensional image processing to the requirements of practically any task.

The 3D stereo sensor defines positions and measures objects in all six degrees of freedom by mapping edges, holes, 3D curves or objects that can be described in terms of distinctive points, corners, lines or contours. The sensor is either mounted in a stationary position or on the robot arm. An array of several sensors enables higher precision.

3D stereo systems facilitate the high-precision definition of position coordinates in six degrees of freedom. They are often used when simple attributes are not available, when large or several parts with high resolution must be mapped or when the quality and efficiency of highly-automated robot and handling systems must be enhanced by fast and precise position definition.

3D robot vision photogrammetrically links the information from several camera systems for the high-precision recognition of large objects in a room, such as entire auto bodies, in a matter of seconds. It maps deviations from a pre-defined target position in all six degrees of freedom. This enables extremely fast, contactless, three-dimensional measurement in the production process with any camera arrangements and low adjustment requirements. The short measuring times in this process make it especially suitable for high-speed robot guidance.

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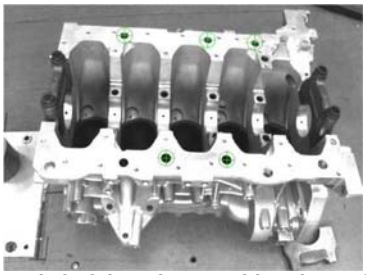

Crakshaft housing: Position determination using MONO3D Robot Vision

3D recognition of sand casting molds with MONO3D Robot Vision

The innovation boost

This range includes the latest development of a MONO3D process that constitutes the last stage of an important innovation boost for the time being. It is now possible, from one single captured image, to precisely define a three-dimensional object based on the measurement of only three criteria in all six degrees of freedom (position and orientation). The use of only one camera with the necessary peripheral equipment considerably reduces costs in the areas of equipment outfitting, space requirements, installation and commissioning. The system can operate without a problem at high production speeds, and it has a logically arranged user-interface for simple calibration and set-up.

Flexible, fast and precise

The MONO3D process is based on an evaluation of the real object's mapping properties on the camera's two-dimensional image detector. Since it is possible to define the object's position and orientation in all six degrees of freedom from only one camera image, installation costs and requirements of peripheral equipment are minimal. All object characteristics that are recognizable in the camera image can be used for measurement. This provides the maximum evaluative measuring volume. In the case of geometric inaccessibility, several camera positions can be combined. This method also makes it possible to restrict the measurement to any number of the six possible coordinates in the computation of results.

The process is distinguished by a high level of flexibility, which means it can be integrated in practically all production and control processes. This applies for both the various options for entering measuring criteria and the diverse range of measuring applications. MONO3D is based on recently developed software and has a modern user-interface. The process can be upgraded for high-speed applications and is also downwardly compatible because it can easily be switched over for one and two-dimensional measuring applications. Moving or stationary camera sensors can be used. The attainable levels of precision can be adapted by configuring the sensors to the relevant requirements.

Universal applications

Typical applications include the control of robots and handling equipment for the assembly of components, adhesive or sealant application and the screwing and welding of parts.

The system offers specific advantages when used for continual, automated assembly processes on moving workpieces. Tests confirm that the elimination of "stop and go" in the production process increases production efficiency and drastically reduces requirements of space in the production area.

Breakthrough of robots at all levels

It is impossible to predict what significance the effects of this innovation boost will have on the range of applications for robot vision systems in the industrial sector and other fields. In many industries, the new MONO3D technology will pave the way for the use of industrial image processing and three-dimensional object definition.

Author/Contact:

ISRA VISION SYSTEMS AG
Industriestraße 14
D-64297 Darmstadt
Tel. : +49 (0)6151-948-172
Fax : +49 (0)6151-948-140
info@isravision.com
www.isravision.com