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VISUALISATION IN ASSEMBLY

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Abstract

The article is aimed at visualisation types in assembly. Broad usage of artificial visualisation in assembly is held down mainly for economic reasons. One of the possible solutions is usage of the presented light visualisation method. This simple method of light visualisation is convenient when vibration orientation is not working properly and artificial visualisation is economically ineffective. Described principle of orientation is a technical solution of the author.

Key words

assembly, visualisation in assembly, raster, plane

INTRODUCTION

This paper will discuss problems in assembly visualisation. The next sections will describe the basic principles of artificial visualisation, and light visualisation will be described and presented as a possible solution to or a more precise replacement for expensive artificial visualisation options.

The performance in many companies is limited by the bottlenecks in the manufacturing and assembly processes. For this reason, bottlenecks are often the starting point of the improvement initiatives (7).

In automated assembly, a machine must recognize the location of objects in the plane and in space. Then the machine can generate a robotic program for the insertion of a part into the hole (1). Following are the examples of effectively introduced artificial visualisation (6).

APPLICATION OF VISUALISATION

Visualisation is being widely used e.g. for the devices collecting returnable bottles, or the machines reading barcodes on products and pallets etc.

Modularity and artificial visualisation are widely applied in microelectronics, where it is necessary to "find" a chip on a substrate and generate such a robot program that will place the chip in a desired position (2).

Another application of artificial visualisation is in electronics when assembling components to printed circuit boards where the wire leads of components are inserted into the holes in the circuit board. When orienting the end of the lead wire into the hole, the machine watches the hole and brings the wire exactly into the hole.

Artificial visualisation has been also applied in assembly of automotive plants for setting wheels on the hub bolts. One of the principles is that the automatic visualisation locates the holes for the wheel in order to generate a program for a robot grasping the wheel in openings.

The automatic visualisation also helps indicate the bolts on the car and navigates the robot to the oriented wheel so that the wheel is pushed onto the hub bolts.

Some assembly plants for cars automatically insert windscreens into the frames in the car body. Automatic visualisation indicates the position of the holes in space and generates the robot program which carries out the assembly.

BASIC TYPES AND PRINCIPLES OF ARTIFICIAL VISUALISATION

Raster visualisation

This principle is used in the reader of barcodes. A laser scanner scans black and white pixels on a line intersecting the barcode in a perpendicular direction. The number of black pixels means the line width, while the number of white pixels indicates the width of the gap. A computer can then generate the number entered in the barcode.

Plane visualisation

The principle of plane visualisation is shown in Figure 1, where a CCD camera generates a black-and-white image of a dark object placed on a white background. The image is made up of the black and white pixels with the dimensions of e.g. 0.01 x 0.01 mm.

A computer reads the images similarly to a human being, line by line from the left to the right. The first black pixel A is the first corner of the object (Fig. 1) and the last pixel B is the last corner of the object.

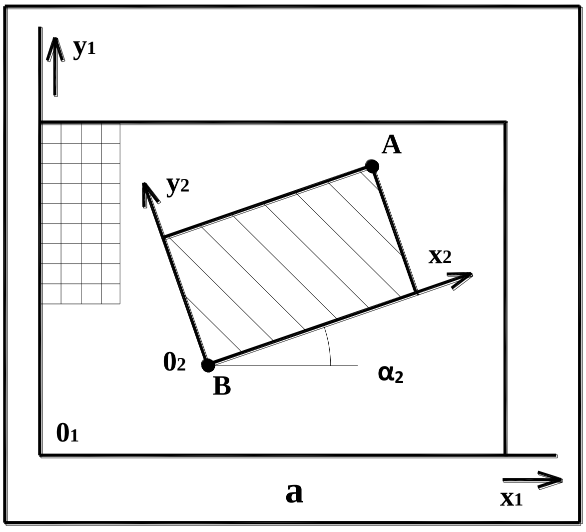

Fig. 1 *Visualisation in assembly. Principle of plane visualisation (4)*

From the position of points A and B, the computer can calculate the position of the object (coordinates of the beginning O_2 angle α_2). Based on the computed information, the computer then generates a control program for the robot which "knows" the exact location of the part and grasps the part properly. The part is then e.g. inserted into the cavity, which means additional equipment is needed to measure and calculate the location of the cavity (e.g. sliding the wheels on the hub bolts).

Space visualisation

Space visualisation uses three cameras to monitor the actual front view, layout and side view of an object, and the computer generates the program for the robot. Another option is method of a simple optical visualisation (so called light matrix) in the case of an unsuccessful vibration orientation.

Light visualisation

The principle of light visualisation is shown in Fig. 2.

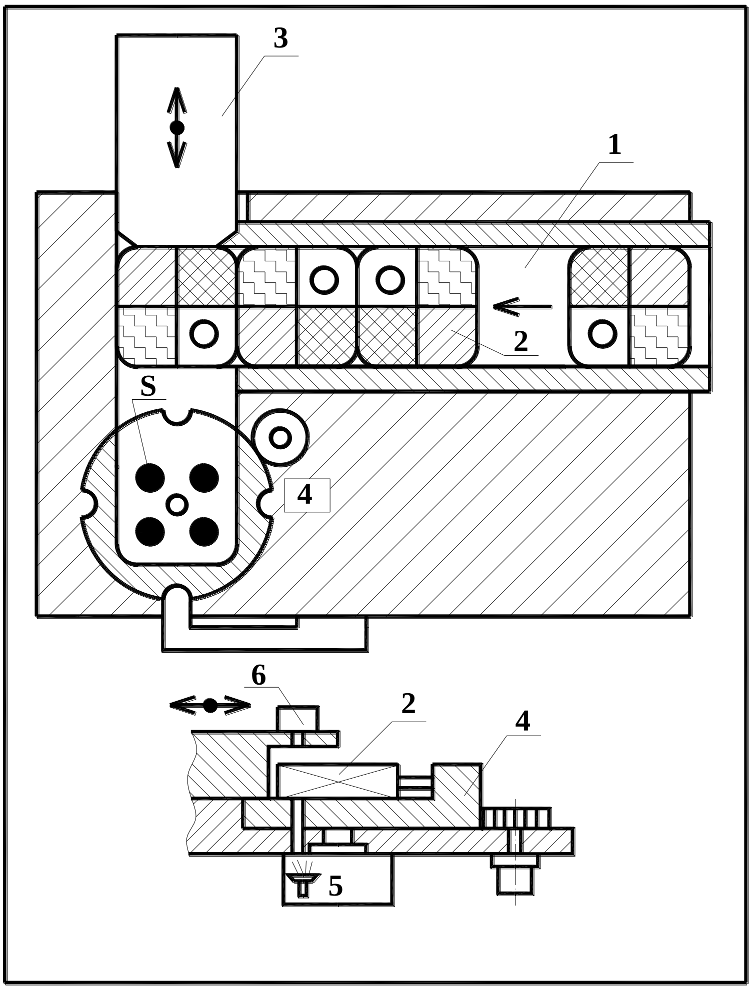

Fig. 2 *Principle of light visualisation (5)*

One of the possible applications is the light visualisation of prismatic components in position 2 with an opening in one corner, sliding in the vibration channel (Fig. 2, pos. 1).

Components can take four possible positions in the channel. The separator (pos. 3) moves the component to the rotor (pos. 4) which then rotates the component (pos. 2), until the light from the source (pos. 5) moves to the sensor (pos. 6). The component is oriented and ready for insertion into the product. The separator (pos. 3) then returns to the home position.

In the orientation of components using light visualisation, each component is oriented. The light visualisation can be used in different variations, e.g. in the single-purpose orientation machine designed for a particular shape of a pre-oriented component (3).

This simple method of light visualisation is suitable for the cases when the vibration orientation fails and artificial visualisation is economically inefficient. The above-described principle of orientation is a technical solution designed by the author of this paper.

CONCLUSION

Wider utilisation of artificial visualisation in assembly is hindered mainly by economic constraints. A complete orientation of a "general" component requires a camera with a computer and a robot with six degrees of freedom.

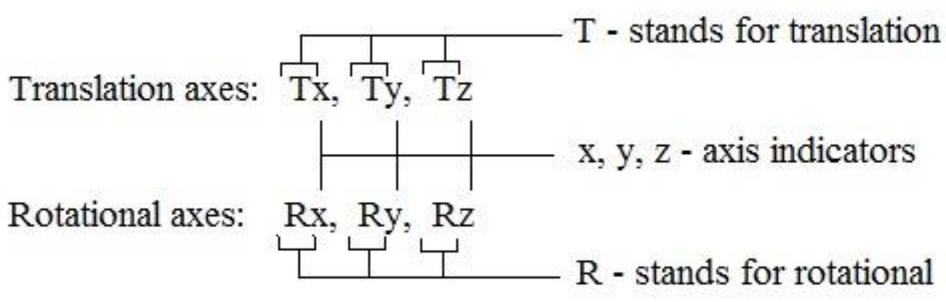

Fig. 3 *Complete orientation of component with camera, computer and robot with six degrees of freedom example*

Besides, another similar system is needed to insert the component into the cavity.

A very high precision of the inserting equipment and the cavity for the component is required to assure that the component be always inserted into the cavity.

Such devices are the hard, sequential and CNC machines with a hard non-adaptive program, or the systems with adaptive control.

The above-mentioned problem would not exist if, instead of falling freely from production machines, the parts were delivered to the assembly in the oriented position.

Expensive handling using artificial visualisation can be used in assembly only in cases of favourable economic conditions. In the current situation, the aforementioned simple method of light visualisation is a viable replacement for it.

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