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Three-dimensional Machine-vision Measurement System

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A machine-vision method was used to build a three-dimensional measurement system using a measurement algorithm and a perspective transformation. A three-dimensional measurement system for obtaining its feature points in the world coordinate system was used to calculate the measurement data. The experimental results were verified with a more precise measurement equipment, automatic transformer observation system. With the rapidly growing demand for industrial automation in the manufacturing sector, machine vision now plays an important role in many fields. Machine-vision technology is quickly becoming a widely applied micrometer, inside micrometer, vernier caliper, coordinate measuring machine (CMM), which all require direct physical contact. The advantages of a contact measurement are found in the high measurement method toward the quality inspection of a wide variety of products.

Geometric and size measurements are among the essential quality control processes that are performed to ensure that manufactured parts conform to specified standards in mechanical engineering. This type of inspection is normally done through the use of specialized instruments, such as a steel rule, accuracy and the general suitability for basic quantitative geometries. However, most contact measurement methods are usually limited by the size of the analysis and the high cost involved with time-consuming skilled labor. These drawbacks may be overcome by implementing a non-contact measurement

method, such as the use of laser measurement devices, ultrasonic measurement methods, machine-vision systems, automatic transformer observation system (ATOS) scanning measurement equipment.

The machine-vision method is based on the human visual system which can detect the dimensions of objects by means of light passing through an individual's cornea, pupil, and lens and then projecting images onto the retina. Then, the visual signals received through the optic nerve can pass into the brain. The analysis and integration within the brain can ascertain depth perception of those objects. The stereoscopic vision system of the human body can thereby determine the relative and absolute distance of observed objects, and even the thickness of the objects, as well as other features. With the machine-vision method, the visual information is transmitted to a personal computer (PC) through the signal line of a mainframe computer, and then the spatial position of the object to be measured; it is calculated according to its location in the world coordinate system.

A machine-vision system generally consists of five basic components: a light source, an image capturing device, an image capturing board (frame grabber), and an appropriate computer hardware and software system. In recent years, many authors have studied using machine vision in many fields, such as agriculture, manufacturing, and medical-related sciences. In addition, machine vision has been used to control the quality of products, for example, in estimating classifications of surface roughness, and in measuring hot-formed products. In agriculture, it has been used to detect defective eggs and fruit, as well as plant diseases.

Within machine-vision technology, the performance largely depends on calibration accuracy. Machine vision is used to establish a non-contact 3D measurement system using a measurement algorithm and a perspective transformation

method. Double CMOS cameras are used to capture the images of the objects. A real pattern is used to calibrate the coordinates. After capturing the images of the objects and calibrating the camera, a linear transformation between the image coordinate system and the world coordinate system is performed, thereby determining the real-world dimensions of the objects.

In summary, the experimental results have shown that the 3D measurement system is suitable for measuring the dimensions of various objects having complex geometries and oriented at oblique angles.