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technologytrends

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MEASUREMENT AND GAUGING

Cross-sectional scanning system speeds inspection of molded parts

a) To measure multicavity parts, they are first placed on a frame within a mold and urethane, hardener, and resin are used to fill the mold. b) To produce a 3-D model of the part, the system images slices of the part as they are machine using a fly cutter. c) After processing point cloud data obtained from multiple images, both the original CAD model of the part and the CAD model generated from the system can be digitally compared.

Manufacturers of plastic electronics and automotive assembly housings, connectors, and medical devices often must supply hundreds of thousands of parts to their customers. After designing these products using CAD software, metal molds are made to form the features of the part. Injection molding machines are then used to force thermoplastic and thermosetting plastic materials into the mold cavity to form the desired part.

After this process is complete, the manufacturer must measure how well these often complex, multicavity preproduction parts conform to the original CAD model. This process, known as first article inspection, determines whether the product meets acceptance and quality control requirements.

In the past, this process was performed using touch-probe CMMs or 3-D digitizers to measure specific points on the part. This process can be both time consuming and labor intensive.

CGI (Eden Prairie, MN, USA; www.gciinspection.com) has developed a number of proprietary 3-D scanning systems that use cross-sectional scanning to speed the first article inspection and analysis of these parts. One such machine, the Pearl-700, can be used to measure the characteristics of molded parts that fit into a scan envelope up to 2.5 × 1.75 × 3.5 in.

"To produce an accurate measurement of every aspect of complex injection-molded parts," says Craig Crump, CEO of CGI, "the parts to be inspected are completely encased in CGI's proprietary Encase-It encasing material" (see figure, part a).

After hardening, the potted part is then easily secured to a table within the Pearl-700. This part is illuminated using two banks of custom white LED panels that uniformly illuminate the surface of the device. To produce a 3-D model of the part, the system uses an end mill turning at 2500 rpm to machine away 0.001-in. layers of the potted device (see figure, part b).

After each thin layer is removed, the newly exposed cross-section is scanned using a 1.3-Mpixel A100 camera from Basler (Ahrensburg, Germany; www.baslerweb.com) that is interfaced to the system host computer using a FireWire interface. Positional *z*-data and image data are then stored on the PC's hard drive for processing. Because the original CAD data must be compared with data obtained from this array of 2-D image data and positional information, a 3-D point cloud must be created from the stored data.

To accomplish this, single images are first thresholded and an edge-detection algorithm is used to determine boundary coordinates on each layer. The *x-y* data coordinates of the 2-D images are then combined with *z*-positional data to generate a 3-D point cloud. From this data, surface models of the part can be generated as nonuniform rational basis spline (NURBS) computer graphics models or in parametric or STL format, allowing the operator to visualize the surface of the part.

The data can also be output from the system in IGES, ASCII, or as binary points, allowing it to be imported into third-party CAD packages such as Rapidform XOR (Seoul, South Korea; www.rapidform.com), Geomagic (Research Triangle Park, NC, USA; (www.geomagic.com), or Polyworks from Innovmetric (Québec, QC, Canada; www.innovmetric.com), which all enable complete CAD models to be created from the system's 3-D scan data. In this way, both the original CAD model of the part and the CAD model generated from the system can be digitally compared (see figure, part c).

Already a number of companies are using the system for first article inspection. At Matrix Tooling (Wood Dale, IL, USA), for example, the company has used CGI's larger CSS-1000 system to inspect parts that can fit within an envelope of 12 × 10.5 × 8 in. According to Gary Johansson, quality manager at Matrix Tooling, "If CMMs or optical gauges are used for this task, each measurement that is not accessible requires cutting of the part. Cross-sectional scanning also eliminates this time-consuming and inherently flawed task." ⊕.