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Application News

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Industrial X-ray Inspection System

Observations of Resin Connectors Using an X-Ray CT System

Introduction

Resin connectors are generally formed by injection molding. Injection molding is a typical molding method for plastics. In this method, thermoplastic resin is heated to a temperature at which it softens. Injection pressure is then applied, and the plastic is poured into a metal mold, filling it. The plastic is molded by cooling and hardening it. With injection molding, the obtained molded part may contain internal voids, and the external appearance and size may vary significantly depending on the molding conditions (including injection speed and temperature, and the temperature of the metal mold). Accordingly, X-ray CT systems have conventionally been used to evaluate the molding conditions for injection molding.
This article introduces an example of imaging with the inspeXio SMX-100CT X-ray CT system, using a resin connector as a typical sample of injection molded resin. An example of analysis and measurement using the Point Master reverse engineering software will also be introduced.

Observation of a Resin Connector

Fig. 3 shows the results of images of a resin connector (Fig. 2) taken using the inspeXio SMX-100CT Micro Focus X-Ray CT System (Fig. 1). Two isomorphic resin connectors with two poles each were prepared as samples, and were placed next to each other for simultaneous imaging.

Fig. 1 Overview of the inspeXio SMX-100CT Micro Focus X-Ray CT System

Fig. 2 Overview of a Resin Connector

Fig. 3 shows the MPR image. In an MPR display, multiple CT images are stacked up in a virtual space, so as to line up four images: a CT image (1); mutually orthogonal longitudinal images (2) and (3); and an arbitrary cross sectional image orthogonal to the longitudinal cross sectional image (4).
The top left MPR image (1) shows the cross section at right angles to the rotation axis. The cross secion of the two 2-pole connectors placed next to each other appears in this image. The one on the left is Product A, and the one on the right is Product B. Next, Fig. 4 shows a 3-dimensional display of this data.

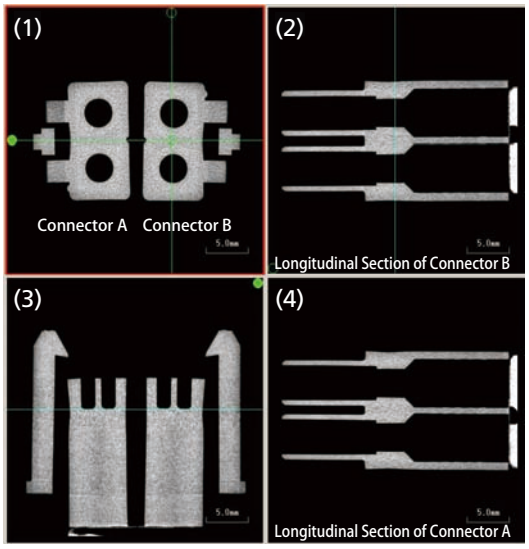

Fig. 3 MPR Images and 3D Images of Resin Connectors

Fig. 4 3D Image of a Resin Connector

Sample Analysis of a Resin Connector

Obtaining images with the X-ray CT system not only enables observation of the interior of the resin molded part, but also enables the thickness to be measured. The results of thickness measurements performed on resin connector A using the Point Master reverse engineering software are shown in Fig. 5. The thickness is expressed with colors ranging from red to green. The thinner parts are indicated in red, and the thicker parts are indicated in green. The same software can also be utilized for shape comparisons. Fig. 6 shows the results of an STL (polygonal) conversion of connectors A and B, followed by checking of the positions and comparison of shapes. In the shape comparison, the offset appears colored, with the green part indicating essentially no offset. Red and blue indicate significant offset. The difference between the red and blue represents a difference in the offset direction. In examining the data in Fig. 6, it is evident that there is little overall offset. However, a difference in shape is evident in the "prong" region. Utilizing this sort of shape analysis enables relative evaluations of the suitability of molded parts. Also, the shape comparisons can be performed not only with CT data (STL data) but also with 3D-CAD data.

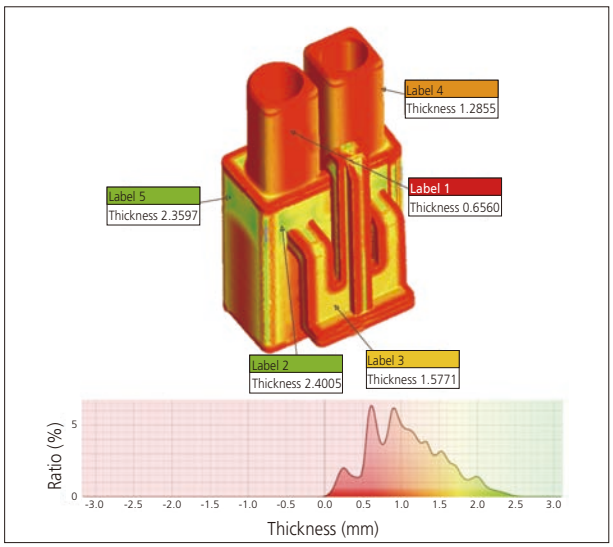

Fig. 5 Thickness Measurement (connector A)

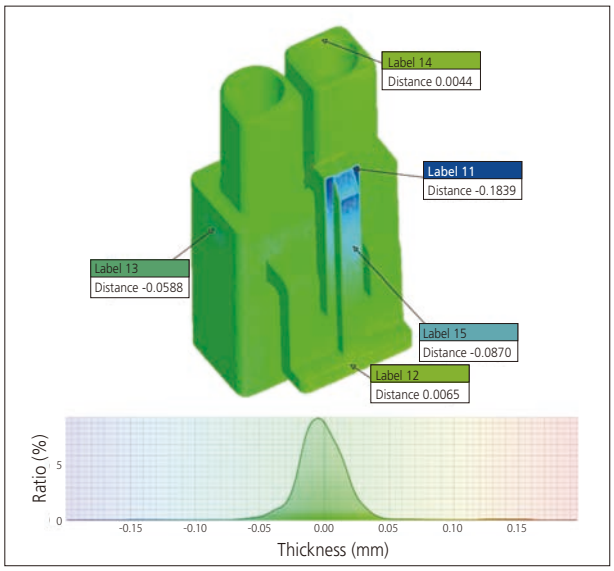

Fig. 6 Shape Comparison (connector A/connector B)

Conclusion

In this way, it is possible not only to volumetrically observe the structure of resin connectors, but to utilize reverse engineering software for thickness measurements, shape comparisons, and 3-dimensional shape measurements. This example focused on resin connectors, but imaging, analysis, and evaluation can be similarly performed on other resin molded parts. The results of thickness measurements, and shape comparisons with CT data and CAD data can be expected to serve as feedback to upstream manufacturing processes (design and manufacture). In addition, separate 3-dimensional analysis software can be used to analyze and evaluate internal voids that occur depending on the molding conditions.

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