A Web-based on-machine mould matching and measurement system based on CAD/CAM/CAI integration*

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Abstract: The purpose of this study is to develop a Web-based on-machine mould identification and measurement system. The Web-based mould identification system matches obtained vision information with CAD database. Developed Web-based system is to exchange messages between a server and a client by making of ActiveX control, and the result of mould identification is shown on Web-browser at remote site. For effective feature classification and extraction, the signature method is used to make meaningful information from obtained image data. For on-machine measurement of the matched mould, inspection database is constructed from CAD database using developed inspection planning methods. The results are simulated and analyzed using developed system to verify the effectiveness of the proposed methods.

Key words: E-manufacturing, CAD/CAM/CAI integration, On-machine measurement, Mould identification, Vision system

INTRODUCTION

Today, the manufacturing industry makes constant effort in order to construct an E-manufacturing system using information technology for effective production control, and then, it offers the integrated production control to the workers, the production managers, and the consumers, etc. (Lee, 2003; Choi, 2004). In the mould manufacturing industry, the process managers often request paperwork to know the information of the processes on CNC machine tools or they visit the shop floor (Cho et al., 2003). Those ineffective activities cause the worker’s complain, the delay of the processes, and the quality problems. Even the point of production control using the bar code technique also burdens the worker on the shop floor. Muto (2003) proposed the production control system by installing cameras on the shop floor, but, it only shows the machining status of machine tool. The detailed information cannot be acquired by his method. Though the reverse engineering system using 3D vision information can be used for the purpose, the amount of its data generated is too much to be dealt with in a real time Web-based system (Cho et al., 2000; Choi, 2003).

In the developed system of this research, a Web camera monitors the processing and takes an image of a machined mould, features are recognized from the image, and they are matched with the features which are acquired in CAD database, then, a mould can be identified. Using the system, the mould and its processing information can be shared with workers, the more appropriate decision making by the control manager is possible for the effective production, and the remote customer monitors the ordered mould parts visually through the Web.

After mould identification process is performed,
on-machine measurement for the mould can be performed to check the accuracy of the machined parts by request from the remote site. For this purpose, inspection planning database is constructed for each mould from CAD database.

Each feature is decomposed into its constituent geometric elements such as plane, circle, etc. Then, a series of tasks are processed such as (1) suitable number of measuring points, (2) their locations, and (3) optimum probing path, to minimize measuring errors and times. Finally, the proposed methods are simulated using developed system to verify their effectiveness in real process. Fig.1 illustrates the proposed system in this research.

FEATURE CLASSIFICATION AND DATABASE CONSTRUCTION

Database for mould matching

The developed system in this research constructs a database for the 3D CAD model and matches the feature information from visual image with the database. The visual image represents the top view from the orthogonal direction on the partitioned surface of the mould cavity. The database is comprised of the top views of the CAD data files of the mould cavities. The geometrical object information is extracted using UG API, and it is stored in a database according to the predefined feature standards. The standard features have to be simply defined geometrically in visual images and acquired in a CAD data file conveniently. The structure is represented in Fig.2. The information of its area, perimeter and the coordinates of the center are used in order to differentiate each geometric object in feature.

The structure of the database is constructed as an MDB (Manufacturing Database) in Fig.3. It consists of a main DB and its sub-DBs corresponding to moulds respectively. The types of the feature and their numbers are stored in the main DB. If the combination of the features of a mould is very different from that of the target mould, it would be ignored. The sub-DBs consist of the information of the area, perimeter and the coordinates of the center, and are used to match the candidate moulds selected using the main DB with the target mould. The matching process with the feature information from the visual image is performed using SQL.

![Fig.1 A Web-based mould identification and measurement system](image1)

![Fig.2 Classification of the matching features](image2)

![Fig.3 Structure of a database for mould matching](image3)

Database for OMM

For the measuring process using OMM, a touch-type probe is generally used, which performs point-to-point motions to get dimensional data of the target surface, usually one point at a time (Cho and