VISION INSPECTION OF MICRO-DRILLING PROCESSES ON THE MACHINE TOOL

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KEYWORDS
Burr, CCD camera, Edge detection, Hole quality, Illumination unit, Shape from focus

ABSTRACT
In order to inspect burr geometry and hole quality in micro-drilling processes, a cost-effective method using an image processing and shape from focus (SFF) methods on the machine tool is proposed. A CCD camera with a zoom lens and a novel illumination unit is used in this paper. Since the on-machine vision unit is incorporated with the CNC function of the machine tool, direct measurement and condition monitoring of micro-drilling processes are conducted between drilling processes on the machine tool. Stainless steel and hardened tool steel are used as specimens, as well as twist drills made of carbide are used in experiments. Validity of the developed system is confirmed through experiments.

INTRODUCTION
Micro-drilling processes have been widely used to produce micro holes such as micro dies and molds, fuel injectors, watches, bearings and printed circuit boards, etc. And it has more attention in a wide spectrum of precision production industries.

Burr geometry (height, width) and hole quality (oversize, location error) cause significant effects on assembly of precision components. Fast and accurate measurements of the burr geometry and hole quality are important for the condition monitoring of micro-drilling processes. Sugawara and Inagaki (1982) studied effects of workpiece structure and drill diameter on burr formation in micro-drilling processes. They analyzed burr size as a ratio defined by the cutting ability measured from the ratio between discharged chips and the ideal quantity of sheared material obtained from a hole.

Garbini et al. (1991) proposed a prototype system for the high speed in-process inspection of drilled holes in aerospace applications. They measured both the geometry of holes (diameter, roundness, taper etc.) and profile of the surface finish by using fringe-field capacitive sensors. Shan et al. (1998) studied an accurate positioning of holes of a PCB based on image processing technology. In order to measure burr and hole quality accurately, measurement systems such as SEM (Scanning Electron Microscope) and confocal microscopes have

Transactions of NAMRI/SME Volume 32, 2004