Synthesis of the measurement system on the machine tool

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The design methodology of a $2\frac{1}{2}$-dimensional measurement and inspection system realized on a machine tool using a touch trigger probe and measuring G codes is studied in this paper. The reliability of measuring results, the agility of measurement, and user friendliness are synthesized in the design process. Algorithms for calibration and compensation of measuring errors are proposed to ensure the measuring accuracy by using a laser interferometer and ring gauges. Classification of probing feedrates and a collision-check algorithm can reduce measuring time and implement stylus-fracture-free measurements. To improve the previous on-machine measurement processes, all functions required for measurement and inspection processes are constructed as measuring G codes with similar forms of machining G codes. The interactive measuring program generating tool, which can automatically generate measuring G codes, is developed and potted in a ROM of a CNC, and can be called to perform an operation by the CNC without interfacing with personal computers. The validity and effectiveness of the developed system are verified on a horizontal machining centre with a Fanuc 15MA.

1. Introduction

The need for higher accuracies on machined components is always increasing. In the conventional quality control system, a workpiece machined on a machining centre requires being moved to a coordinate measuring machine (CMM) to check its dimensional accuracy. To relieve bottlenecks of inspection processes on CMMs - due to measuring time, difficulty of capital investment, and time delay of material flow between CMMs and machine tools in the factory – on-machine inspection methodology is required. After developing touch trigger probes, probing allows manufacturers in many industries to inspect workpieces, install job set-ups, deliver precise components, minimize scraps, and maximize productivity. On-machine probing has found a broad range of applications on machine tools where it is vital to automated production processes. Efforts have been also devoted to developing measurement systems on machine tools (Kakino and Ihara 1990, Mou and Liu 1992).

The objective of this research is to reduce this time-consuming job and capital investment by developing a measurement and error compensation system usable on machining centres, called the On-Machine Measurement and Inspection System (OMMIS).

To develop an accurate and reliable OMMIS, identification of measuring error sources should be studied. Many kinematic reference standards and artefacts, such

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Revision received January 2001.

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International Journal of Production Research ISSN 0020-7543 print ISSN 1366-588X online © 2001 Taylor & Francis Ltd
http://www.tandf.co.uk/journals
DOI: 10.1080/00207540110048939