

Geometric errors identification on 5-axis machine-tool using both novel hole-bar standard design and laser tracer interferometer system

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Abstract

Manufacturing of freeform parts may be achieved on 5-axis machines tools currently considered as a common mean of production. To improve the quality of parts, the evaluation of the multi-axis structural loop, which is composed of components assembly maintaining the relative positioning between the tool and the workpiece, is mandatory. The deviations between the tool and the workpiece, namely volumetric accuracy, are principally caused by geometric errors.

In order to characterize the geometric errors of a RRTTT 5-axis machine tool by in-process measurements, two different methods, well-tried on CMM, are compared. The first method is based on the use of a new hole-bar standard design made with Invar material and is especially less sensitive to thermal drift. Its geometry is designed such as 3 intrinsic parameters can be identified, one linear positioning and two straightness. These parameters are obtained when measuring the cylindricity of 12 holes (bores), and 11 cylinders located on a perpendicular plane. The intersection of each hole axis with the least square plane passing through two perpendicular neighbour cylinders axes allows the identification of twelve 3D points coordinates.

Once the hole-bar calibrated on CMM by applying the Donaldson reversal technique, it was integrated in the machine tools to identify the volumetric errors. Measurements are carried out in real time and combine raw data collected from both Renishaw RMP600 touch probe and linear and rotary encoders.

The second method is based on the errors identification via an accurate laser tracer interferometer system. The recorded results are then compared to those obtained with the Invar hole-bar standard.

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