A new compensation method for geometry errors of five-axis machine tools

徐永源,王信舜
Mechanical Engineering
Engineering
janason@chu.edu.tw

Abstract

The present study aims to establish a new compensation method for geometry errors of five-axis machine tools. In the kinematic coordinate translation of five-axis machine tools, the tool orientation is determined by the motion position of machine rotation axes, whereas the tool tip position is determined by both machine linear axes and rotation axes together. Furthermore, as a nonlinear relationship exists between the workpiece coordinate and the machine axes coordinate, errors in the workpiece coordinate system are not directly related to those of the machine axes coordinate system. Consequently, the present study develops a new compensation method, the decouple method, for geometry errors of five-axis machine tools. The method proposed is based on a model that the tool orientation error only related to motion of machine rotation axes, and it further calculates the error compensations for rotation axes and for linear axes separately, in contrast to the conventional method of calculating them simultaneously. Namely, determine the compensation of machine rotation axes first, and then calculate the compensation associated with the machine linear axes. Finally, the compensation mechanism is applied in the postprocessor of a CAM system and the effectiveness of error compensation is evaluated in real machine cutting using compensated NC code. In comparison with previous methods, the present compensation method has attributes of being simple, straightforward and with no singularity point in the model. The results indicate that the accuracy of positioning was improved by a factor of 8~10. Hence, the new compensation mechanism proposed in this study can effectively compensate geometry errors of five-axis machine tools.

Keyword：Keywords: five-axis machine tools, error compensation, geometry errors, postprocessor, CAM