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Adjustment and Compensation Techniques for the Rotary Axes of Five-axis CNC Machine Tools

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Abstract : Five-axis computer numerical control (CNC) machine tools (three linear and two rotary axes) are ideally suited to the fabrication of complex work pieces, such as dies, turbo blades, and cams. The locations of the axis average line and centerline of the rotary axes strongly influence the performance of these machines; however, techniques to compensate for eccentric error in the rotary axes remain weak. This paper proposes optical (Non-Bar) techniques capable of calibrating five-axis CNC machine tools and compensating for eccentric error in the rotary axes. This approach employs the measurement path in ISO/CD 10791-6 to determine the eccentric error in two rotary axes, for which compensatory measures can be implemented. Experimental results demonstrate that the proposed techniques can improve the performance of various five-axis CNC machine tools by more than 90%. Finally, a result of the cutting test using a B-type five-axis CNC machine tool confirmed to the usefulness of this proposed compensation technique.

Keywords : calibration, compensation, rotary axis, five-axis computer numerical control (CNC) machine tools, eccentric error, optical calibration system, ISO/CD 10791-6
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