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Radial Throw in Micromachining: Measurement and Analysis

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Abstract

This paper presents a comprehensive approach for measurement and analysis of radial throw and the associated tool-tip trajectory in micromachining when using ultra-high-speed (UHS) spindles. The effect of radial throw on micromachining accuracy could be significant due to the strict absolute-tolerance requirements. However, accurately determining radial throw in micromachining poses challenges due to the micron-scale tool dimensions and high rotational speeds. In contrast to *run-out*, radial throw depends on the tool-rotation angle and dictates the instantaneous position (trajectory) of the cutting edges. This work first presents a mathematical framework to obtain the radial throw at the cutting edges by measuring radial throw at two locations on the tool shank. A laser Doppler vibrometry-based experimental approach is then described to accurately measure the radial throw from the tool shank in two mutually-perpendicular directions. Next, the variations on radial throw measurements are evaluated, the effect of spindle speed on the radial throw is analyzed, and

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