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# Surface form error prediction in five-axis flank milling of thin-walled parts

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## Abstract

The dimensional tolerance of flexible, thin-walled aerospace parts can be violated by the excessive static deflections during milling. This paper proposes a method to predict the dimensional surface form errors caused by the deflections of both flexible workpiece and the cutter in five-axis flank milling of thin-walled parts. The end-mill is modeled as a cantilevered beam. The stiffness of the thin-walled part varies as the metal is removed and the tool-part contact location changes. The time varying stiffness of the thin-walled part is predicted by an efficient structural stiffness modification method that only needs the FE model of the initial workpiece and avoids re-meshing the part at each cutter location. The cutting forces are distributed over both the tool and the part in the engagement zone, and the effect of deflections on the immersion is calculated. The effect of radial runout of the tool is considered in chip thickness, hence in the cutting force prediction. Finally, the cutter and the workpiece deflections are considered to predict the surface errors left on the finished part. The proposed method has been proven in five-axis blade milling experiments.

**Keywords:** Milling; thin-walled parts; five-axis flank milling; surface form error

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