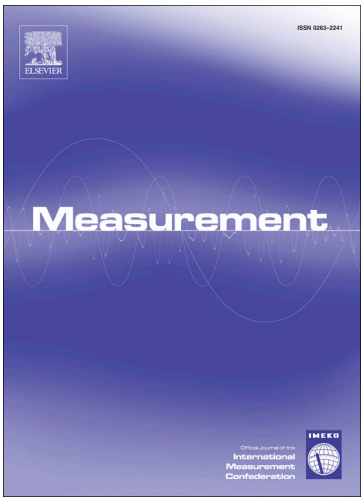

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Measurement and analysis of cutting force and product surface quality during end-milling of thin-wall components

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Abstract

Improving product quality during machining of thin-wall components has always been a challenging problem due to the low rigidity of work parts. Therefore careful selection of process parameters to obtain the desired performance is of utmost importance. Accordingly, this study aims to contribute to the existing literature by providing the latest experimental results based on a systematic measurement of process response parameters viz. cutting force and surface roughness. Full factorial 3^4 experiments were carried out on end-milling of aluminum alloy AL 2024-T351 using a set of judiciously chosen cutting parameters. Furthermore, analysis of variance (ANOVA) and regression analysis were carried out on the experimental datasets to study the influence of process parameters in achieving low cutting force and surface roughness. One of the important findings was that cutting tool of 8 mm diameter produces superior surface quality at moderate cutting power consumption when employed with lower values of feed per tooth, axial depth of cut and radial depth of cut. Three dimensional (3-D) surface topography of machined surfaces revealed that chatters are more prominent at the free end of the wall. Intermittent cutting teeth engagement with the workpiece also affects the quality of the surface. Experimental investigations provided robust mathematical models to accurately predict the cutting force and surface roughness for chosen process conditions. The prediction error (absolute) of these models varies from 3.72% to 8.70%.

Keywords Thin-wall milling, measurement of surface roughness, cutting force, aluminum alloy 2024-T351, tool diameter, precision machining

Abbreviations

ADOC	Axial depth of cut
ANOVA	Analysis of variance