

Experimental and Numerical Analysis of the Effects of Ball-End Milling Process upon Residual Stresses and Cutting Forces

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Abstract : The majority of ball end milling models includes only the influence of cutting parameters (cutting speed, feed rate, depth of cut). Furthermore, this influence is studied in most of works on cutting force. Therefore, this study proposes an accurate ball end milling process modeling which includes also the influence of tool workpiece inclination. In addition, a characterization of residual stresses resulting of thermo mechanical loading in the workpiece was also presented. Moreover, the study of the influence of tool workpiece inclination and cutting parameters was made on residual stresses distribution. In order to achieve the predetermination of cutting forces and residual stresses during a milling operation, a thermo mechanical three-dimensional numerical model of ball end milling was developed. Furthermore, an experimental companion of ball end milling tests was realized on a 5-axis machining center to determine the cutting forces and characterize the residual stresses. The simulation results are compared with the experiment to validate the Finite Element Model and subsequently identify the optimum inclination angle and cutting parameters.

Keywords : ball end milling, cutting forces, cutting parameters, residual stress, tool-workpiece inclination

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