THERMOMECHANICAL APPROACH OF DRILLING BASED ON A CAD DEFINATION

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Abstract

Drilling operation is one of the more complex cutting processes. Several problems are related to drilling such as tool wear, vibration, delamination in composite materials, etc. All these problems depend on the level of thrust and torque generated during the drilling operation. These components are function of drill geometry, workpiece material and machining conditions. The particular drilling kinematics and geometry are such as the cutting angle, the inclination angle and the cutting speed vary along the cutting edge. In a first step, a mathematical model based on a CAD drill definition is presented. A vector analysis is then established to calculate the evolution of cutting and inclination angles along the cutting edge. In a second step, the drill cutting edge is discretized to a series of linear elemental cutting edges. Each cutting element works in oblique conditions. An analytical thermomechanical model of oblique cutting is then applied on each element to calculate the elementary cutting forces. Finally, from these elemental forces the thrust and torque during drilling are determined. To validate the proposed approach, a serie of experimental tests were performed and the model results were compared to the measured forces. Results show that the thermomechanical model which gives good results in the case of turning should be modified to satisfay the drilling condition: the forced cheap flow must be considered.