Comparison of Material Constitutive Models and their Influence on Finite Element Modeling of Ti6Al4V Orthogonal Cutting Process

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Abstract. Titanium alloys such as Ti6Al4V are widely used and are well known as hard-to-machine material. The material behavior that is described by the constitutive equation plays a pivotal role in modeling and simulation of machining process. The Johnson–Cook material model is widely used for analysis of material flow stress, especially for those materials with a flow stress highly influenced by high values of temperature and strain rate. A continuous improvement on constitutive models for accurate prediction of the work material behavior under machining conditions is observed in the literature. The purpose of this study is to show the influence of the constitutive model by comparing and investigating Johnson-Cook constitutive model with calibrated or modified Johnson-Cook constitutive models that takes into account temperature dependent hardening factor and its coupled effects between strain and temperature. This paper deals with the simulation of cutting process with those constitutive models. The three constitutive models are included in Lagrangian cutting finite element model to highlight their influence on the results. Cutting force and chip morphology are mainly used in the comparison of the numerical results and their validation with an experimental reference.