

CENTER FOR MATERIALS PROCESSING AND TRIBOLOGY SEMINAR

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Grissom 316*

Simulating Ti6Al4V chip formation over a wide range of cutting speeds – and experiments too

Abstract Modelling and predicting the saw tooth chip formation in metal cutting of Ti6Al4V has a long history. Before the advent of finite element methods it was argued that thermal softening working against strain hardening catastrophically to reduce the flow stress in the shear zone was the cause. However finite element modelling has demonstrated that thermal softening alone does not account for the severity of saw tooth formation actually observed. It has led to proposals of strain softening and also shear weakening (ductile failure) to augment the thermal softening.

This presentation's thesis is that there are problems with both approaches as currently posed, and also with the implementation of chip / tool friction models. A new approach is put forward. The main novelty is that the saw tooth formation is triggered by shear failure but grows by thermal softening; further, in the compressive conditions in the shear zone, failure does not reduce flow stress to zero but to a fraction of the un-failed stress that depends on the pressure and temperature.

Simulation results from the modelling will be presented and compared with experiments.

About the Presenter Professor Childs gained his PhD from Cambridge University in 1968 on the subject of the friction of metals at very low temperatures, supervised by Professor Philip Bowden and funded by the US Air Force, interested at that time in materials for sliding use in space craft behind the Moon. His first employment was as a research fellow at Birmingham University where he carried out some of the first visio-plasticity experiments on metal cutting chip formation. His subsequent research career, first at Bradford University, then at Leeds University, has concentrated on putting dry friction to use, for example studying the magnetic fluid grinding process for ceramic ball bearing manufacture, and the mechanics of power transmission by flat, V- and timing belts, as well as continuing his contributions in the area of metal cutting chip formation. He is a co-author of a well-known book 'Metal Machining – Theory and Applications' that has been pirated and can be down-loaded free from the web. His current position is as an emeritus professor at Leeds.

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*For entry to Grissom Hall, please use the front entrance on Grant Street