# Abstract

Metal cutting or machining is considered as one of the most important and versatile processes for imparting final shape to the preformed blocks and various manufactured products obtained from either casting or forging. This is the only process in which the final shape of the product is achieved through the removal of excess material in the form of chips from the given work material with the help of a cutting tool. The technique by which the metal is cut or removed is highly complex as compared to other manufacturing processes. Although numerous researches are being carried out in the area of metal cutting both for its obvious technical and economical importance, machining still is sometimes referred to as one of the least understood manufacturing processes because of the complexities associated with the process.

The knowledge of the basic mechanism of chip formation should help to understand the physics governing the chip formation process. The age old techniques of trial and error experimental tests have, no doubt, laid the foundation stone in the area of metal cutting studies; but they are very time consuming and expensive. The availability of a precise model is, thus, crucial for the selection of optimal process parameters so that the metal removal process can be carried out more efficiently and economically. This motivates to develop a 2D finite element model of chip formation process and demonstrate its capability to predict the right kind of chip morphology during machining of three different workpiece materials (AISI 4340, AISI 1050 and Ti6Al4V) under varied cutting conditions. Various parametric studies such as, the effect of mesh size, the Johnson–Cook material constants and the friction models on various output variables have been performed to fine–tune the input parameters with the aim of producing results closer to the experimental results.

***Keywords:*** Orthogonal machining, finite element model, adiabatic shearing, cutting force, saw–teeth chip, segmentation frequency