Application of an Internally Consistent Material Model to Determine the Effect of Tool Edge Geometry in Orthogonal Machining

Roy J. Schimmel
e-mail: roy.schimmel@gm.com
William J. Endres
e-mail: endres@umich.edu
Dept. of Mechanical Engineering,
University of Michigan,
Ann Arbor, MI 48109-2125
Robin Stevenson
Enterprise Systems Laboratory,
General Motors R & D Center,
Warren, MI 48090-9055
e-mail: rstevenson@gmr.com

It is well known that the edge geometry of a cutting tool affects the forces measured in metal cutting. Two experimental methods have been suggested in the past to extract the ploughing (noncutting) component from the total measured force: (1) the extrapolation approach and (2) the dwell force technique. This study reports the behavior of zinc during orthogonal machining using tools of controlled edge radius. Application of both the extrapolation and dwell approaches showed that neither produces an analysis that yields a material response consistent with the known behavior of zinc. Further analysis shows that the edge geometry modifies the shear zone of the material and thereby modifies the forces. When analyzed this way, the measured force data yield the expected material response without requiring recourse to an additional ploughing component.