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Design and Validation of Cutting Performance of Ceramic Matrix Composites Using FEM Simulations

Authors : Zohaib Ellahi, Guolong Zhao

Abstract : Ceramic matrix composite (CMC) material possesses high strength, wear resistance and anisotropy thus machining of this material is very difficult and demands high cost. In this research, FEM simulations and physical experiments have been carried out to assess the machinability of carbon fiber reinforced silicon carbide (C/SiC) using polycrystalline diamond (PCD) tool in slot milling process. Finite element model has been generated in Abaqus/CAE software and milling operation performed by using user defined material subroutine. Effect of different milling parameters on cutting forces and stresses has been calculated through FEM simulations and compared with experimental results to validate the finite element model. Cutting forces in x and y-direction were calculated through both experiments and finite element model and found a good agreement between them. With increase in cutting speed resultant cutting forces are decreased. Resultant cutting forces are increased with increased feed per tooth and depth of cut. When machining performed along the fiber direction stresses generated near the tool edge were minimum and increases with fiber cutting angle.

Keywords : experimental & numerical investigation, C/SiC cutting performance analysis, milling of CMCs, CMC composite stress analysis
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