Cutting Force Mechanism Model of Plain Wove CF/PEEK Milling Considering Size Effect

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Abstract: Size effect caused by structural characteristics of workpiece is a new perspective in machining Carbon Fiber Reinforced Polymer (CFRP), as the radius of carbon fibers and cutting edge are in the same order of magnitude. Size effect causes two new cutting mechanisms including impact and workpiece self-action in CFRP machining, especially in wove CFRP. To this end, we presented a cutting force prediction model of high-speed dry (HSD) milling plain wove CFRP considering size effect, since the cutting force is the most direct reaction of cutting mechanism. Firstly, the pseudo-random model of carbon fiber distribution was established to describe the microstructure of the workpiece. Secondly, the main cutting mechanisms including bending, shearing, stretching and delamination, impacting, pressing and bouncing in machining plain wove CFRP were clarified based on size effect, structural characteristics of workpiece and different cutting position of cutting tool. The HSD milling force mechanism model was proofed with a high prediction accuracy of about 90.1%.