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A New Approach to Characterising the Surface Integrity of Fibre-Reinforced Polymer Composites during Cutting

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Abstract

The surface integrity of a machined component influences its performance. For a fibre-reinforced polymer (FRP) composite, fragments in machining can be pushed into fractured surfaces, causing difficulties in the integrity examination experimentally. This paper presents a new numerical characterization method with the verification of microstructural examinations experimentally. Both conventional cutting and vibration-assisted cutting of unidirectional FRP composites with different fibre orientations were investigated. It was found that the new approach is convenient to show the fibre/matrix fracture and fibre-matrix debonding. The application of the method also revealed that fibre orientation significantly influences the final surface topography and subsurface damage, and that the vibration-assisted cutting can largely minimise the subsurface damage. When fibre bending or fibre crushing dominates the fracture of fibres in cutting, the method showed the surface roughness and subsurface damage of the machined FRP composite decreases with increasing the fibre orientation, and that the surface quality is the best when the fibres are aligned in the cutting direction.