MICROMECHANICAL ANALYSIS OF INFLUENCE OF VOIDS AND INTERFACE PROPERTIES ON ULTIMATE STRENGTH OF COMPOSITE LAMINATES

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The influence of fiber-matrix interface fracture properties, fiber waviness, and voids on the response of fiber-reinforced composites are investigated in this paper via three dimensional finite element analysis. We specifically employ augmented finite element method (AFEM) to provide high-fidelity data on damage initiation and propagation along with micromechanical analysis. Stochastic process of model preparation is programmed in Python code and linked to the Abaqus software. Crack initiation and propagation in AFEM are autonomously determined based on the loading conditions, laminate configuration and properties, and distribution of defects and waviness. Within micromechanical analysis, the effects of fiber volume fractions, fiber shapes are also considered to capture the stochastic behavior of the composite under tensile loading. In order to investigate the effects of voids and defects on ultimate strength of composite, we carry out simulations with random voids and defects. These results strongly show the importance of including defects and voids in the finite element analysis. The results reveal that the response of RVE with constant interface properties overestimates the composite transverse strength. It is also seen that the damage initiation and propagation locations are controlled by the distributions of fracture properties, fibers' shapes, and defects.