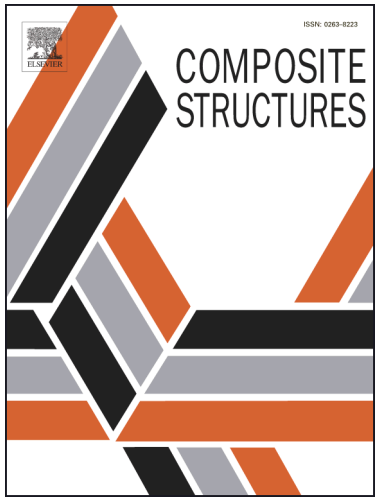

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Micromechanics Model for Three-dimensional Effective Elastic Properties of Composite Laminates with Ply Wrinkles

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Abstract

This paper presents an analytical micromechanics model for predicting the three-dimensional effective elastic properties of multidirectional composite laminates with ply wrinkle defects. A representative volume element (RVE) was chosen for analysis and the geometry of wavy plies in the wrinkled laminates was described by sinusoidal functions. The derivation of the effective elastic moduli was based on the mixed boundary conditions, and a two-step homogenization technique was proposed. The analytical predictions were compared with the published numerical and experimental results for unidirectional and cross-ply carbon/epoxy laminates. The model was also applied to quasi-isotropic laminates, and the effect of wrinkles on their effective properties was examined. The developed analytical micromechanics model was found to accurately predict the in-plane and out-of-plane effective properties of the wrinkled laminates, making it a useful tool for providing information on the relationships between wrinkle defects and the macroscale response of composite laminates and for designing composite structures.

Keywords

Micro-mechanics; Analytical modelling; Polymer-matrix composites (PMCs); Defects; Elastic properties

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