A Multiscale Simulation of Fiber Microbuckling in Long-Fiber Composite Laminates

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ABSTRACT

Fiber kinking (fiber microbuckling), due to the plastic shear failure of matrix material, is known as the most common failure mode of unidirectional fiber reinforced composites under compressive loads, and is regarded as the main cause for relatively low ratio of compressive to tensile strength of unidirectional composite laminates [1]. Numerical study of the kinking phenomenon is of great importance and many researches have been focused on numerical investigation of kink band formation and its impact on the compressive strength of composite structures. However, most of the effort has been devoted to microstructural modeling which is not able to capture the complete behavior of the composite structure undergoing one or multiple fiber kinking, which gives rise to the necessity of employing multiscale techniques. On the other hand, due to the localized effective domain of fiber kinking, application of multiscale homogenization methods is not practical. The aim of the present work is to apply a global-local multiscale method to model fiber kinking in fiber reinforced composite laminates. The method partitions the domain of problem into coarse scale and enriched parts. In the coarse scale domain, which is free from the effects of fiber kinking, the material behaves elastically while in the enriched domain a microstructural problem is being solved under the boundary conditions applied from the coarse scale, and the material tangent and the stresses are projected back to the coarse scale mesh [2]. The concurrent solution of the two scales is performed up to the formation of a kink band.

REFERENCES

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