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FAILURE PREDICTION FOR COMPOSITES MATERIALS BY THE HFGMC MICROMECHANICAL METHOD

Abstract

The use of laminated composite materials have increased over the last four decades spanning both aviation and space industries. Failure theories for an orthotropic layer within the laminated composite under multi-axial stress states have been extensively investigated and many macro-failure theories have been proposed. These failure criteria share the use of stress or strain invariants for the homogenized medium in order to generate failure envelopes, e.g Hashin[4], Tsai and Wu[7], Puck[6], Christensen [2], among several others. In fact, it has been previously argued, e.g. Hashin[4], that the complexity of damage at the microstructural scale offers little or no hope for using micro-mechanical methods for failure prediction of composite. However, the recent advances in computational and nonlinear micromechanical methods allow the use of failure predictions based on micromechanical theories using of the average stress and strain in the phases, e.g the SIFT[3] criteria.

This study utilizes the high fidelity generalized method of cells (HFGMC) micromechanical method, Aboudi[1], and its nonlinear and parametric extensions, Haj-Ali and Aboudi [5], in order to predict ultimate failures of fiber composite media. To that end, continuum damage models are implemented for the fiber and matrix subcells in order to generate the effective softening cause by damag. The formulation and the computational implementations will be discussed. The generated HFGMC failure envelops are compared with some well-known failure criteria.

References:

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