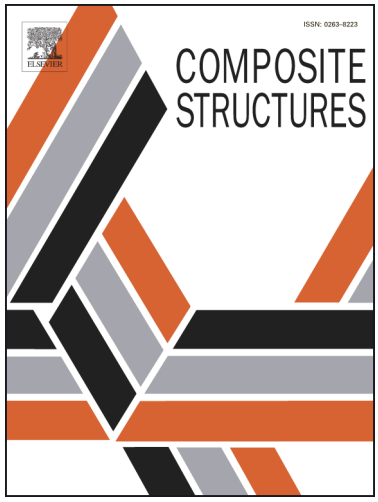

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Modeling of nonlinear response in loading-unloading tests for fibrous composites under tension and compression

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Abstract: Loading-unloading tests on unidirectional HTS40/PA6 carbon/polyamide laminates are performed in this study to identify the nature of off-axis nonlinear deformation of fibrous composites under tension and compression. Experimental results reveal the involved residual strain (plastic strain) and hysteresis loop during loading and unloading, and their dependence on stress level, fiber orientation, and tension or compression mode. The hysteresis behavior is assumed to be induced by a component of strain, which is considered as anelastic strain. This strain is recoverable like elastic deformation but dissipates work like plastic deformation. An approach is developed to predict the tension-compression asymmetry in plastic strain and anelastic strain, as well as the dependence of asymmetry on stress level and fiber orientation. The proposed approach is a modification of a strength differential model that considers the nonlinear deformation completely as plastic strain for monotonic tests. Predicted off-axis loading-unloading responses of unidirectional laminates are compared with the experimental results. The modified model is found to be effective for adequately describing the tension-compression asymmetry not only in plastic strain but also in complex nonlinear hysteresis behavior.

Keywords: unidirectional composites; loading-unloading; off-axis tension and compression; hysteresis behavior; plastic strain and anelastic strain

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