GRADUATE STUDENT RESEARCH SEMINAR SERIES (2020)

FUNCTIONAL DESCRIPTION FOR THICK BISTABLE CARBON FIBER LAMINATES WITH RAYLEIGH-RITZ, ABAQUS, AND EXPERIMENTS

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Composite laminates constructed in an asymmetric layup orientation of [0i,90i], i>0, exhibit two stable equilibrium positions and may be actuated to snap from a primary cure shape to an inversely related secondary stable shape. This study aims to develop a comprehensive functional description of thick bistable laminates, whose increased thickness risk the loss of bistability, through previously established analytical approaches, and verification via experimentation. The principle of minimum potential energy is applied to two materials and analyzed using the Rayleigh-Ritz minimization technique to determine the cure shapes of carbon fiber reinforced polymer laminates composed of DA409/8552 and TR50S-12 carbon fibers. These materials were modeled to act as square thick bistable laminated composites with sidelengths up to 36 inches. Visualizations of the out-of-plane displacements are shown with a description of the Rayleigh-Ritz analysis. Additionally, a finite element model (FEM) created in Abaqus 6.14 CAE and experiments using DA409/8552 and TR50S-12K/Newport 301 prepreg are used to further describe and develop the fundamental description for thick bistable laminates in terms of loss of bistability, actuation energy, and shape.

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