

Graduate Student Research Seminar

Fall 2024

Effects of Water Absorption on the Bistability of Carbon Fiber Laminates

Celia Hill (PhD student)

Advisor: Garrett Pataky

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3:00 pm (EST) – 132 Fluor Daniel Building



Abstract

Carbon fiber-reinforced polymer (CFRP) laminates have widespread use in many industries because of its exceptional strength-to-weight ratio. Carbon fiber laminates following an asymmetric layup orientation can exhibit bistability meaning the laminate can exist at two stable geometric configurations. The morphing characteristics of bistable CRFP has a growing level of interest because of its potential in various applications including space aircraft structures for easy repair, automotive structures for energy dissipation and ergonomics, robotics for flexible motion and energy harvesting. Existing research shows that both moisture and temperature affect the material properties and behavior of CFRP laminates, however, the influence of moisture absorption on the bistability of carbon fiber composites has not been well studied. This study investigates the effects of water uptake on the bistability of carbon fiber laminates by three methods including a dimensional analysis, moisture absorption tracking, and a snapthrough force analysis. This study aims to characterize the effects of moisture sorption through water bath immersion at temperatures of 2, 25 and 65 °C. Geometric and environmental factors such as thickness, size, and temperature have all been investigated. The experimental findings indicate that the temperature of the water bath impacts the amount of moisture uptake, the rate of the bistable curvature relaxation, and the snapthrough actuation force.



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