Geometry Alteration of Bistable Composite Laminates for the Development of a Satellite Capturing Device

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Abstract: The utilization of composite materials into functional designs has increased in recent decades because of the advantage of the materials' physical properties when compared to tradition materials. The layup geometry of a composite material can be controlled by determining the orientation, shape, and number of plies within the sample. Through proper design, a composite can be produced that displays bistability. Bistable laminates display two stable, equilibrium, curved shapes which can be switched between through the application of a force to the laminate. Variations in the laminate's aspect ratio as well as the number of plies affect the resulting curvature. Manufactured samples along with finite element simulations can determine the capability of a composite laminate to display bistability along with the respective curvature. A finite element simulation creates a simulation of a laminate that is unaffected by imperfections in material or environmental conditions; the simulation, though, can be utilized to predict the curvature of a physical sample. By altering and augmenting the geometry with symmetric and unsymmetric layups, a laminate's bistability and curvature can be controlled to allow for a laminate to be produced with specific behaviors and/or shapes of interest. Utilizing the above permutations, this research investigates the design and integration of bistable laminates to develop a mechatronic satellite capturing arm to encompass, grasp, and control its movement.