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Structural and Modal Analyses of an s1223 High-Lift Airfoil Wing for Drone Design

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Abstract : Structural analyses are commonly employed to test the integrity of aircraft component systems in the design stage to demonstrate the capability of the structural components to withstand what it was designed for, as well as to predict potential failure of the components. The analyses are also essential for weight minimization and selecting the most resilient materials that will provide optimal outcomes. This research focuses on testing the structural nature of a high-lift low Reynolds number airfoil profile design, the Selig S1223, under certain loading conditions for a drone model application. The wing (ribs, spars, and skin) of the drone model was made of carbon fiber-reinforced polymer and designed in SolidWorks, while the finite element analysis was carried out in ANSYS mechanical in conjunction with the lift and drag forces that were derived from the aerodynamic airfoil analysis. Additionally, modal analysis was performed to calculate the natural frequencies and the mode shapes of the wing structure. The structural strain and stress determined the minimal deformations under the wing loading conditions, and the modal analysis showed the prominent modes that were excited by the given forces. The research findings from the structural analysis of the S1223 high-lift airfoil indicated that it is applicable for use in an unmanned aerial vehicle as well as a novel reciprocating-airfoil-driven vertical take-off and landing (VTOL) drone model.

Keywords : CFRP, finite element analysis, high-lift, S1223, strain, stress, VTOL
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