A Study of the Effects of Incomplete Spiroids on the Drag Coefficient of an Airfoil

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Aircraft fuel consumption and carbon emissions can be reduced by improving aircraft wing efficiency. Drag inducing vortices form at the tips of aircraft wings and can be reduced by wingtip devices. Conventional wingtips are perpendicular to the tip of airfoil but more exotic winglets are possible. An incomplete spiroid winglet is a spiral shaped extension of the wingtip. Incomplete spiroid winglets were evaluated using computer models. This study hypothesized that if the pitch of an incomplete spiroid winglet increases, and the revolutions of the winglet approach 180°, the overall drag coefficient of the airfoil will decrease compared to contemporary wingtip devices. A total of fifteen incomplete spiroids were modeled alongside one conventional airfoil and three blended winglets. All of the models were tested in two different computational fluid dynamic (CFD) programs under the same conditions. The only variables modified were the pitch and revolution of the spiroids. Drag force and coefficient of drag (Cd) were measured for each model and compared to the each winglet design. All of the winglets performed better than the bare wing, however spiroid winglet 5-25 was found to have a calculated Cd of 0.03 and a drag force of 2597.706 N. This was the most efficient winglet tested, and was more efficient than the blended winglet 0-25 which had a calculated a Cd of 0.03 and a drag force of 2750.6 N. Increased pitch and revolutions were not associated with a reduction in drag and one incomplete spiroid winglet designs was found to be more efficient than the most efficient blended winglet.

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