# A Study of Novel Spanwise Modifying Incomplete Spiroid Winglets

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The efficiency of airplanes is constantly being improved as air travel has shifted from high performance aircraft to high efficiency and capacity vehicles. This study proposes a solution to wingtip vortices, a deficiency of conventional airfoils. Wingtip vortices form due to the pressure differential at the tip of a wing and wingtip devices (for example, blended winglets, wingtip fences and spiroid winglets) reduce these vortices. To maximize efficiency, the winglet must not add more surface drag than it takes away. Additionally, the winglet must not add excess stress to the wing root. This novel study aims to reduce wingtip vortices and to improve the overall efficiency of an airfoil. By exploring spanwise modifying incomplete spiroid winglets and complex geometry winglets, this study has found that spanwise modifying incomplete spiroid winglets add efficiency to conventional airfoils by maximizing the lift to drag ratio. The winglets are generated by studying the pressure distribution of previous airfoils and by modifying these airfoils to maximize efficiency. The airfoils are tested in Computational Fluid Dynamics (CFD) (Navier-Stokes based) and in physical wind tunnel tests. The data from these two tests is comparable and the results prove that spanwise modifying incomplete spiroid winglets increase the lift to drag ratio of an airfoil. By improving the efficiency of an airfoil the average fuel burn of a flight is reduced by 2%. Additionally, take off and landing distances are reduced, the service ceiling of an airplane is increased, and the Maximum Take-Off Weight (MTOW) is increased.

**Awards Won:**

National Aeronautics and Space Administration: Intel ISEF Best of Category Award of $5,000