Foiled: Testing Lift and Drag on Airfoils in a Wind Tunnel

Ayers, Chloe

In order for an aircraft to be able to leave the ground, lift must exceed the force on the aircraft due to gravity. Lift is created by the flow of air over an airfoil. The shape of an airfoil causes air to flow faster on top than on bottom, decreasing the surrounding air pressure and creating a resulting lift force. Drag is the force that resists the forward movement of the aircraft. This force is a result of differing pressures, wing tip vortices, and frictional forces. High drag has many effects on flight, one of which being lowered fuel efficiency. Wing tip vortices spread out behind a plane as a result of differing pressures above and below the wing converging at the tip. The turbulence from the vortices can cause increased drag and can potentially be dangerous to other aircraft. By understanding how to control the forces of drag and lift through the shapes of airfoils and the use of winglets, the safety and efficiency of flight can be optimized. In this experiment, a wind tunnel was constructed and a total of 24 combinations of airfoil shapes and winglet angles were 3D printed and tested for lift and drag forces in order to determine the optimal shape and winglet angle for lift and drag, whether winglets are beneficial in terms of these forces, and if the optimal winglet angle changes depending on the shape of the airfoil.

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