CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

35417

Project Title

Investigating the Effects of Camber on Airfoil Lift

Abstract

Objectives/Goals

The purpose of this project was to determine the effects of camber on airfoil lift. The upper surface of a cambered airfoil is longer than the lower surface. As air moves over a cambered airfoil, a difference in air pressure and velocity arises, which, by Bernoulli's principle, creates lift.

Methods/Materials

The five airfoils tested in my experiment had cambers of 0%, 2%, 4%, 6%, and 8%. These were the NACA 0015, 2415, 4415, 6415, and 8415 airfoils, respectively. A hot wire foam cutter was used to cut out the Styrofoam airfoils. The body of the wind tunnel was constructed out of wood and foam board. The fan was made from a quadcopter motor and blade. A servo tester and speed control were used to adjust the speed of the fan. The fan was adjusted to the lowest possible speed needed for the airfoils to create 20 centimeters of lift. At this time, the pulse-width of the fan was recorded. Twenty trials were run.

Results

The NACA 0015 airfoil created 20 centimeters of lift at an average pulse-width of the fan of 1.37 ms, the NACA 2415 airfoil at 1.32 ms, the NACA 4415 airfoil at 1.3025 ms, and the NACA 6415 airfoil at 1.2825 ms. The airfoil with the most camber, the NACA 8415 airfoil, created 20 centimeters of lift when the fan was running at an average pulse-width of 1.2675 ms. This was a 7.48% decrease of average pulse-width compared to the NACA 0015 airfoil with no camber.

Conclusions/Discussion

The airfoil with the most camber created the most lift, supporting my hypothesis. The real-world applications of this project include airplanes that use less fuel by using wings that create more lift. This would not only be good for the earth, but also lower ticket prices on commercial airlines. Wings that create more lift will also require shorter takeoffs. This project could be improved by building a new stand to fly the airfoils on with less friction, adding an air filter to reduce turbulence in the wind tunnel, and installing an anemometer and tachometer (which would allow different representations of the data). Further research could include testing more accurate airfoils cut by machine and testing airfoils with different thicknesses and cambers at different angles of attack.

Summary Statement

The purpose of this project was to investigate the effects of camber on airfoil lift.

Help Received

Mother helped gather materials, assemble backboard, and supervised construction of wind tunnel.