CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

36072

Project Title

Measuring Airfoil Lift/Drag Designs

Abstract

Objectives/Goals

The objective of my project is to study six aerodynamic attributes of airfoil design and understand how they affect lift and drag forces.

Methods/Materials

Overall project materials used were balsa wood, spring, guide tracks, a wind tunnel, and power tools. Using a spring, I measured the lift and drag of different airfoil designs in a homemade micro-scale wind tunnel. The wind tunnel simulated a flight of an airfoil. Mounting the airfoil in guide tracks allowed movement in specific direction - vertical tracks for lift and horizontal tracks for drag. The airfoil displaced the spring as it moved through the tracks, and using Hooke's Law, the lift and drag were be calculated.

Results

My results had six conclusions based off of testing. As the velocity doubles, the lift and drag increase. An airfoil with a 25% maximum thickness creates more lift and drag than a 50% maximum thickness. A smooth surface texture has a higher lift/drag ratio than a rough surface texture. A rough surface texture on the trailing edge creates a higher lift/drag ratio than a rough surface texture on the leading edge. A 15 degree angle of attack has the same amount of lift yet less drag than a 23 degree angle of attack. A greater chord creates more lift and drag. A supercritical airfoil creates less lift and drag force than a normal airfoil. Supercritical airfoils cannot create any lift at low wind speeds.

Conclusions/Discussion

Some variables had greater performance impact than others. Based on my experiment, the chord had the greatest positive impact on lift while the angle of attack had the most effect on drag. However, the angle of attack had the greatest effect when comparing lift/drag ratios. Therefore, the experiment suggests that future studies should focus on controlling and maintaining angle of attack rather than other aerodynamic variables, such as chord and maximum thickness, to best improve aerodynamic performance

Summary Statement

Lift and drag forces of different airfoil designs were tested in a homemade micro-scale wind tunnel.

Help Received

My teacher helped set deadlines for the project and reviewed my notebook. My high school mentor gave input on the wind tunnel. My dad taught me how to use power tools to build airfoils and wind tunnel. My mom reviewed my research paper and helped construct the board.