CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Patrick A. Lowe

Project Number
S0315

Project Title
Comparison of Fanwing Configuration Efficiency: Year II

Abstract

Objectives/Goals
This project was designed to continue research to find the best ducting configurations for a fanwing propulsion system in respect to its efficiency in lift and thrust. A fanwing works on Bernoulli#s principle which states that the velocity of a flow varies directly with its pressure. The fanwing embeds a squirrel cage fan along the leading edge of the wing. This enables it to take in a larger amount of air and therefore is more efficient. The fanwing system takes in air from the leading edge, accelerates it, and then expels it over the trailing edge, which creates lift. Ducting has been used to make existing propulsion systems more efficient. If designed incorrectly, however, ducting can be detrimental to a system. No one has applied ducting to fanwings to increase efficiency. In year I of this project, the feasibility ducting was confirmed. Year II of this project focused on finding the optimal ducting configuration to increase both lift and thrust.

Methods/Materials
A new wing was designed with lighter drive system, reducing weight by 50%. The functioning fanwing was tested in a subsonic wind tunnel. The fanwing was designed to fit into the cross section so that wing tip vortexes would not be a factor. The fanwing was tested in over 30 different configurations each with different ducting shapes, positions, and drive systems. Each was tested 12 times for lift and thrust. The inherent lift and drag of all configurations was measured and factored out of the raw data. Additionally, smoke tests were performed to gather qualitative data that revealed trends behind successful designs. All data was compared to the control of a ductless wing.

Results
The average lift of configuration C'5 at 2.25 was the greatest at 153.1 grams resulting in a 20% improvement over that of the control at 129.5 grams of lift. In addition, the average thrust of C'5 at 2.25 was the greatest with 21.6 grams resulting in a 100% improvement over that of the control at 11.7 grams of thrust.

Conclusions/Discussion
The data gathered shows that configuration C'5 at 2.25 was the best all-around. Even though C'5 at 2.25 was found to be the best out of all tested configurations, research is not over. Dynamic ducting, genetic programing, larger models, and other modifications could reveal better designs. This experiment, however, has determined trends that lead to efficient ducting and further reinforces the promise of efficiency through ducting.

Summary Statement
I designed ducting to improve the efficiency of the fanwing system by 20% in the amount of lift generated and 100% in the amount of thrust produced.

Help Received