CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

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Project Number

S0213

Project Title

Comparison of Fanwing Configuration Efficiency

Abstract

Objectives/Goals

This project was made to find the relation between ducting on a fanwing propulsion system and its efficiency in thrust and lift. A fanwing works on Bernoulli#s principle & the principle of high bypass engines. Bernoulli#s principle states that the velocity of an air flow varies indirectly with its pressure. One of the principles used in high bypass engines states that if more air is taken in more air is moved and thus more thrust is produced. This is done with less energy than an equivalent system with multiple smaller motors. The fanwing takes this further by embedding a squirrel cage fan along the front edge of the wing. This lets the fanwing take in a larger amount of air and thus have thrust to with less energy. The fanwing system takes in air from the front edge, accelerates it, & then expels it over the trailing edge. This creates lift by Bernoulli#s principle. Ducting has been used to make other propulsion systems more efficient. It adds weight, increases the cost of design & manufacturing, & can lessen the thrust to drag ratio. However if made well, ducting boosts thrust & decreases drag so that it overcomes drawbacks. No one has fully used ducting on a fanwing to make it more efficient.

Methods/Materials

The middle section of fanwing was designed to fit the width of the subsonic wind tunnel to eliminate wing tip vortexes. The fanwing was tested in 4 different configurations: configuration 2- ducting with an equal intake & exhaust area; configuration 3- ducting with an equal intake & exhaust area & vectored thrust; configuration 4- ducting with an intake area larger than exhaust area & vectored thrust; & configuration 5- no ducting. Each configuration was tested for lift & thrust.

Results

The average lift of configuration 4 was the greatest at 53.3 g, then configuration 3 at 43.2 g; configuration 5 at 37.4 g: & finally configuration 2 at 30.4 g. The average thrust of configuration 2 was the greatest at 24.0 g. Others measured significantly less: configuration 4 at 5.1 g: trailed by configuration 5 at 0.9 g: & configuration 3 at -6.1 g.

Conclusions/Discussion

The data shows that configuration 4 was the best overall. All of the ducted configurations improved efficiency over the unducted configuration in at least one trial. This experiment has narrowed the field, pointing the way for future experiments with configuration 4 to determine the best intake to exhaust area ratio & vectored thrust angle.

Summary Statement

To create a more effecient fanwing design than the conventional one by using ducting and vectored thrust.

Help Received

Father helped in part fabrication