CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

S0322

Project Title

LocFan: A More Efficient Way to Power a Jet Engine

Abstract

Objectives/Goals

I have studied various designs of jet engines, specifically Turbofans. Turbofan blades are rather simple in design; however, the efficiency could be increased.
HYPOTHESIS: I can design and build a fan blade that has a higher mass flow rate and tolerance rate than a traditional fan blade with the same surface area.
GOAL: Increase the efficiency of the blade by using these guidelines:
1. The surface area, volume, and weight of the new blade can not be larger than the original design.
2. The new blade must be able to handle its stress and impact loads without increasing blade displacement.
3. The blade must require less power to drive (be more aerodynamic in its design).
4. The new blade design must have a higher mass flow rate than the traditional design.

Methods/Materials

I will use AutoDesk Inventor (a CAD program) to design two different blade types: a traditional flat leading edge design and my own rigid scimitar design. These blades would be used on turbofan engines to power a commercial jet. Using Inventor's Stress Analysis Simulation, I will test and compare both blades in three categories: strain, displacement, and safety factor. After testing the blades on the computer, I will then print out the blades on our school's u-Print Plus 3D printer by Dimension which uses ABS plastic. The blades will be attached to a spinner (also made on Inventor and the 3D printer) and spun on our wood lathe at approximately 1200 RPM. While they are being tested on the lathe, I will use an Anemometer to measure and calculate the mass flow rate. To fully test the mass flow rate, I designed and built a fully functional model of a geared turbofan on which the blades will be mounted.

Results

My blade design proved to perform better than the traditional blade design in the test conducted using both the virtual stress analysis in AutoDesk Inventor and an actual physical test on the wood lathe. My blade decreased the strain by 5.3%, increased the safety Factor by 9.2%, decreased the stress displacement by 33.2%, and increased the air velocity and mass flow rate by 9.7%.

Conclusions/Discussion

My blade design performed better than the original blade design in all the tests.

Summary Statement

I built and tested a more efficient fan blade which performed better than a traditional fan blade design

Help Received

Teacher helped with CAD; professors from different universities helped me with my blade concept; studied designs on Pratt & Whittney and GE turbofans; reviewed designs with turbine blade engineers; used shop equipment at high school.