CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
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Project Number
S0329

Project Title
Turbopulse: A Hybrid Pulsating Turbine Jet Engine

Abstract

Objectives/Goals

Air transportation has become an integral aspect of today's society. The FAA Aviation Safety record documents hundreds of aircraft accidents that have resulted in thousands of fatalities caused by aircraft engine failures. Many of these accidents were caused by ingestion of birds, ice, precipitation, and volcanic ash leading to engine flame-out and numerous other malfunctions resulting in turbine failure.

The objective is to study the properties of jet engines and design a new engine concept that eliminates the common turbojet failures. In theory, the property of zero moving parts in a Pulse Detonation Engine (PDE) can be used to increase the resilience and safety of modern jet engines.

I plan to build a prototype of a hybrid pulsating turbine jet engine. Such a design would eliminate all failures caused by flame-out conditions. The new design should offer the following key properties:

-Allow safe landing after complete turbine air compressor failure

-Have the ability to recover from ingestion of foreign objects by transitioning from Continuous Combustion Engine (CCE) to PDE mode in flight

-Start the engine without turbine compressed air or an electric starter motor

-Minimize the number of moving parts.

Methods/Materials

I intend to build a jet engine prototype to demonstrate the new turbopulse concept. The prototype will be built from steel and carbon iron by machining each piece of the engine. I also plan to use some off-the-shelf components such as spark plugs and coils. The prototype will house four combustion chambers and two compression chambers.

Results

I was able to build a functioning prototype of a jet engine and use it to demonstrate fulfillment of the key objectives. The final revision of the prototype engine operates in both CCE and PDE modes. I was able to perform numerous measurements including thrust power, combustion temperature based on radiant frequency, combustion frequency based on Fourier Transforms, ambient noise, air to fuel mix, and compression ratios.

Conclusions/Discussion

The prototype experiments demonstrated the viability of building a safer turbojet engine that can operate with failed turbines and therefore tolerate flameout due to the ingestion of foreign objects and compressor failures due to bearing failure, engine seizure, and a number of other common jet engine malfunctions. The economics of deploying pulsejet engines in future aircrafts requires further study.

Summary Statement

I created a new design for a resilient jet engine that improves the safety of modern jet engines.

Help Received

Occasional help from experienced machinists operating metal machining tools.