Valveless Pulse Jet and Test Stand for Aero-Propulsion Research

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Client: Resono Pressure Systems

Project Description

This is the third iteration of the project designing a pulse jet engine and test stand for Resono Pressure Systems. Resono plans to use the pulse jet and test stand to simulate the conditions that their pressure sensors will be used in to ensure that the sensors and data models will function as intended. A previous valveless pulse jet body was selected to reduce machining costs and development time. The previous design lacked functional fuel delivery and ignition systems, and, as such, these systems will be implemented in the updated design.

What is a Pulse Jet?

A valveless pulse jet engine operates by alternately igniting fuel and expelling exhaust in a cyclical manner. It's a relatively simple design with no moving parts, relying on the pulsating combustion process to generate thrust. Due to their simplicity, pulse jets have been used in experimental aviation, in specific military applications, and by jet engine hobbyists. They're known for their efficiency at high speeds and altitudes. However, their intermittent combustion can make them loud and challenging to control, limiting their widespread use.

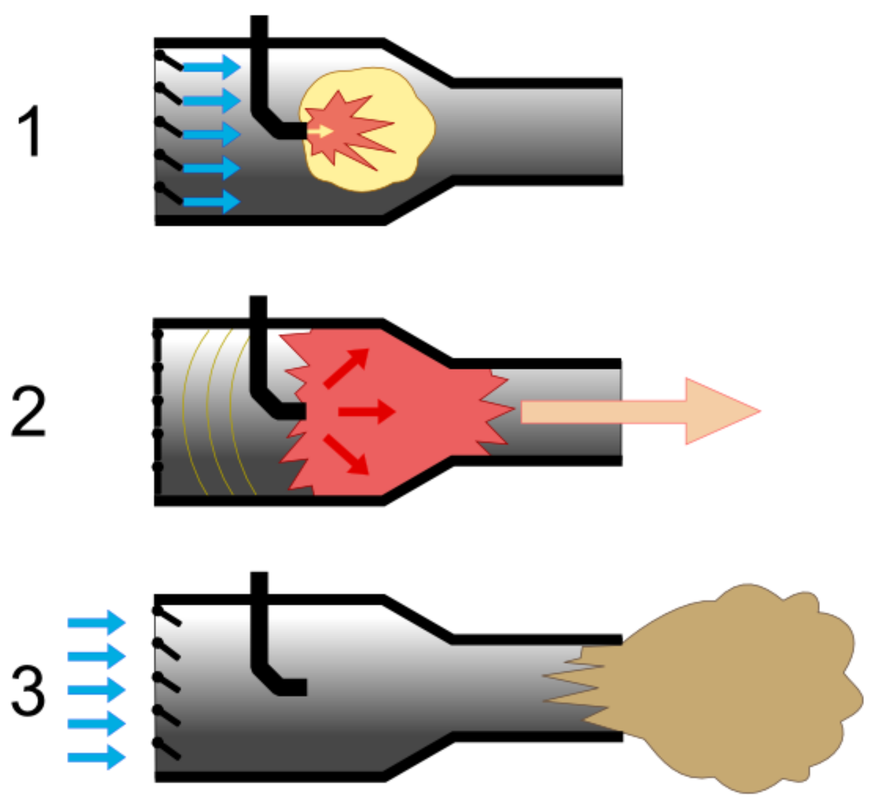

Figure 1: Diagram of pulse jet operation

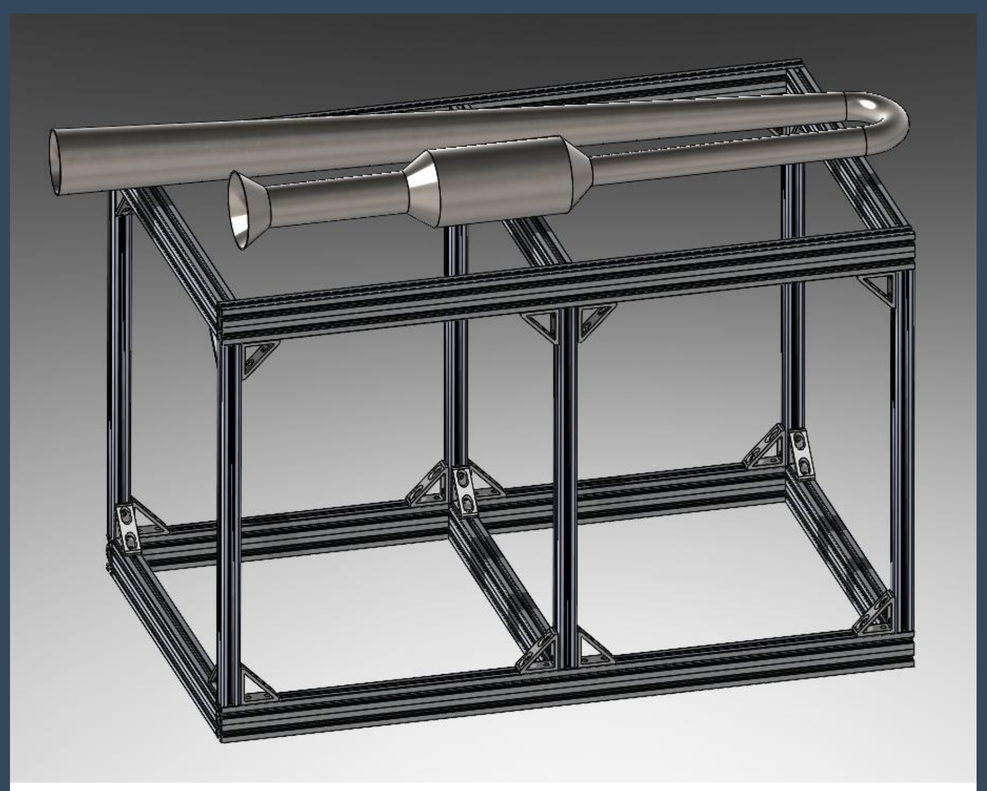

Figure 2: 3D SolidWorks model of existing pulse jet and test stand

Design Requirements

Requirements	Description	Priority
Pulse Jet Engine	Fully operational and reliable	High
Ignition System	Electronic	High
Fuel Delivery	Controlled and measured	High
Air Delivery	Controlled and measured	High
Test Stand	Professional mounting of components	High
Safety Systems	Fire and noise suppression	High
CAD Models	For major components	High
Sensor Ports	2 ports for pressure and plasma sensors	Medium
Operational frequency	Minimum 100 Hz	Low

Current Progress

The pulse jet stand currently includes a basic frame, pulse jet body, pulsed ignition system, rudimentary fuel and variable air delivery systems. Initial testing (two runs) revealed the need for improvements in fuel system adjustability to achieve optimal fuel flow and combustion efficiency. Additionally, the air delivery system requires fine-tuning to optimize air intake and maximize thrust output. Modifications to the stand frame will be necessary to securely mount and accommodate the new ignition system. While these initial tests highlight areas requiring further development and optimization, the overall performance of the pulse jet stand remains promising.

Going Forward

The next steps involve iterative testing of fuel system components to find the optimal air to fuel ratio by making measurements of air and fuel amounts to increase reliability. Optimal locations of air delivery system and fuel injection will be determined experimentally and fixtures for each of the systems will be added to the test stand. Additions of sensor ports and further testing to achieve an operational frequency of 100 Hz will also be done. Further modifications to the test stand frame will be made to minimize set up prior to use and improve stand's overall aesthetic.

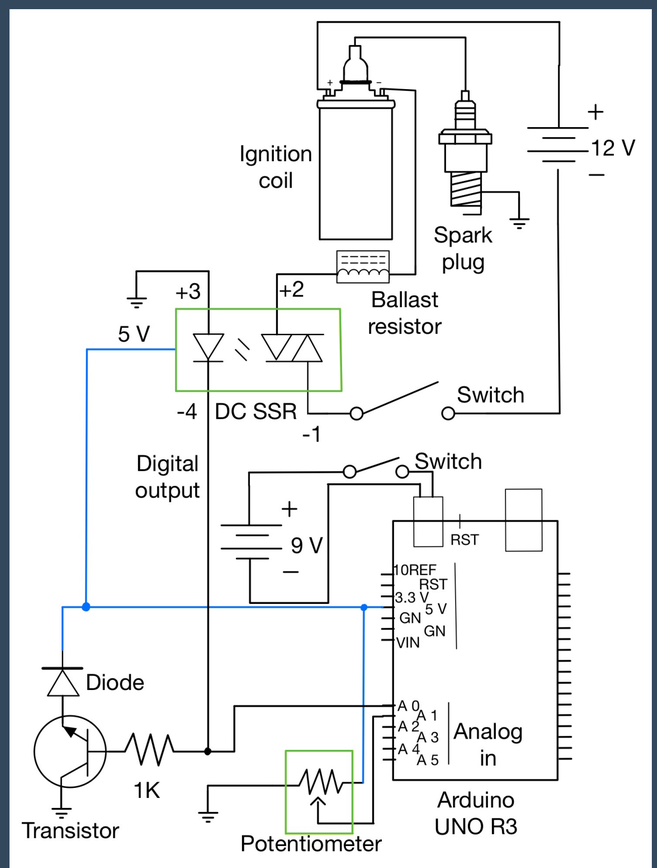

Figure 3: Circuit diagram of ignition system