Mitigating Risks Inherent to Student-Developed Small Satellite Missions

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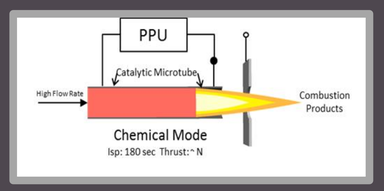
INTRODUCTION

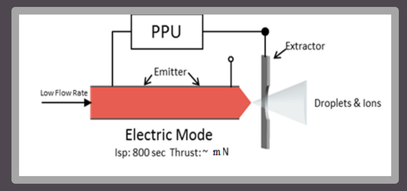
- Missouri S&T Satellite Research Team founded in 2003 by Dr. Hank Pernicka
- Actively working on three small satellite projects
- Won AFRL's University Nanosatellite 8 Program competition
- Two multi-mode micropropulsion missions sponsored by NASA's Undergraduate Student Instrumentation Project (M^3) and AFRL's UNP's Nanosat-9 Program (APEX)

Multi-Mode Micropropulsion

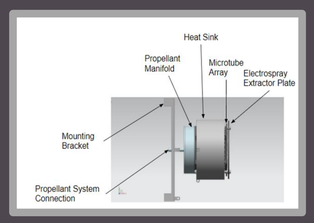
Definition: A propulsion system with a single propellant, feed system, and thruster that can operate in catalytic chemical and/or electrospray electric modes

Goal: To provide mission flexibility on orbit

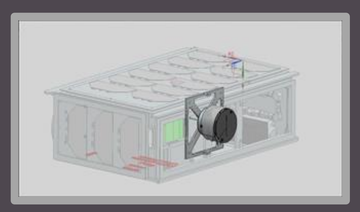




Chemical and Electric Modes



Thruster Diagram



Thruster Position in CubeSat

Mission

Technology demonstration of mulit-mode micropropulsion system.

Propulsion Feed System

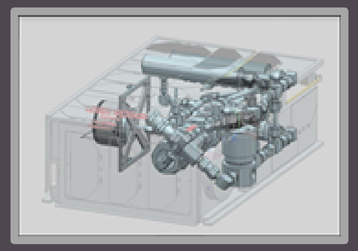
Risk:
- Student-built propulsion feed system

Challenges:
- Mass and volume constraints
- Qualifying hardware
- Using primarily off-the-shelf components

Design:
- Must supply heated propellant to multi-mode thruster at correct flow rate
- Pressure and temperature readings taken in the feed system, as well as voltage from the thruster, to quantify thruster performance

Performance Measurement	Expected Sensor Readings
Pressure	200 psi
Thermal Change	1875 K
Voltage	1.5 KV (thruster)

Risk Mitigation:
- Redundancy with inhibits (solenoid valves, in-line check valve, pressure relief valve)
- High factors of safety
- Collaborating with industry mentors



Propulsion System Position in CubeSat

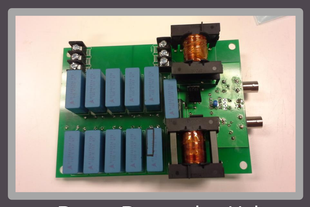
Power Subsystem

Risk:
- High Voltage

Challenges:
- 3400 V required for Electric Burn Mode

Design:
- Power Processing Unit (PPU) will step up voltage to thruster
- Power will not be supplied to PPU before separation

Risk Mitigation
- Multiple inhibits placed on power boards
- PPU is separated from power system



Power Processing Unit

Autonomy

Risk:
- Autonomous Design (M^3)

Challenges
- 3U Structure
- Primary power source
- No precise pointing

Design
- EyeStar Simplex radio
- Autonomous mission sequence

Risk Mitigation
- Limited uplink capability provides shut-off command
- Flight software will include error-control scheme
- Power budget limits mission to ~4 days

Globalstar Constellation

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