UNH SEDS

University of New Hampshire
College of Engineering and Physical Sciences

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SEDS USA

Who We Are

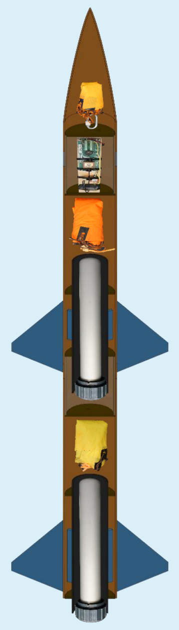
- A third-year engineering organization comprised of students of all classes and CEPS majors
- A primary engineering goal of pursuing the art of high-power rocketry with custom-made hybrid engines

Hot fire Test, March 2020

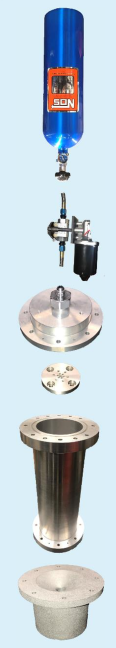
SEDS General Meeting, Spring 2020

The 3 Year Plan

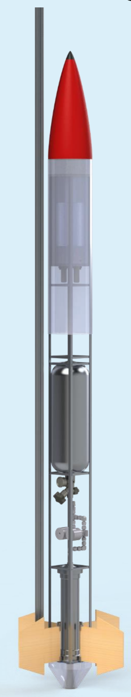
Year One
Rocket Building
Simulating
Launching
Optimizing



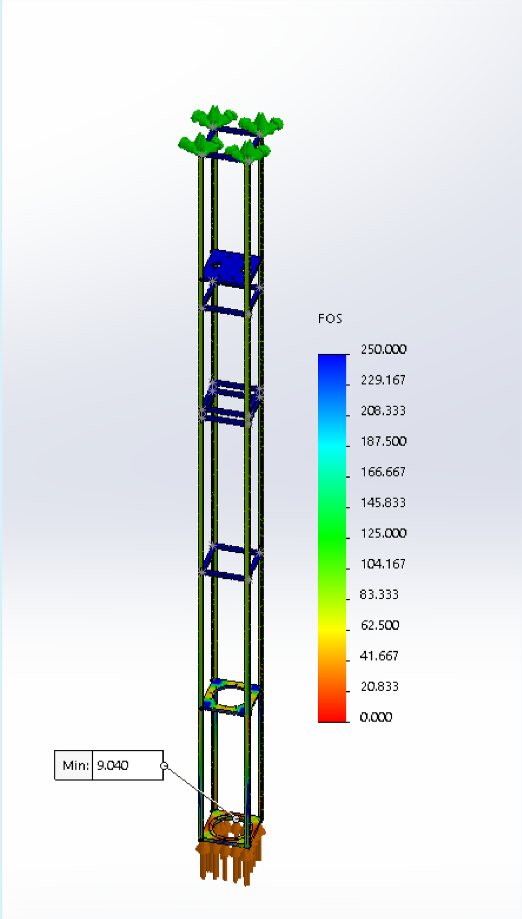
Year Two
Hybrid Engine
Design
Manufacture
Cold / Hot fire test



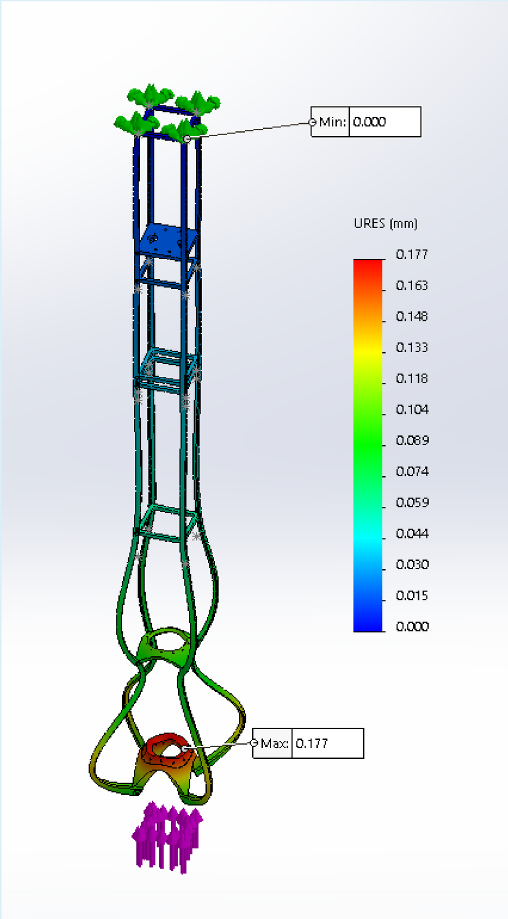
Year Three
Hybrid Rocket
Engine Optimization
Rocket Integration



Frame Design

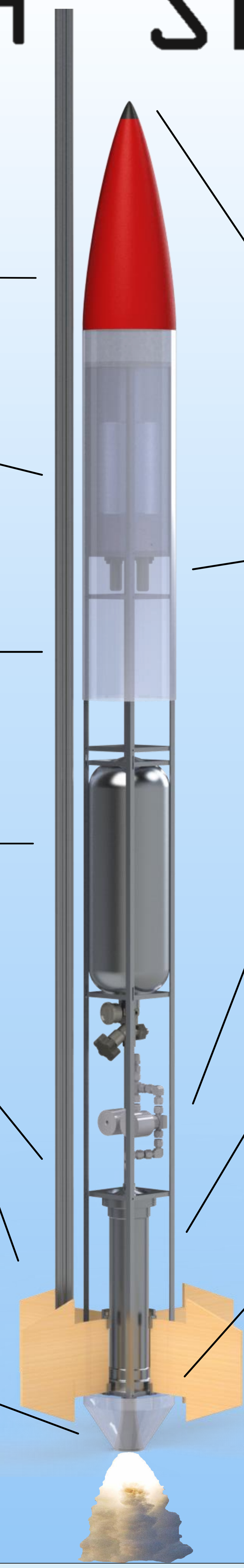


Factor of Safety: 200lbf applied to combustion chamber region of structure with fixed top.



Displacement: 200lbf applied to combustion chamber region of structure with fixed top.

The structural frame will act as the "house" for all components, to incorporate, propulsion, avionics, and recovery. The design of our rocket frame is centered around cost, manufacturability, weight, strength, and availability. A minimum FOS of 9.04 and maximum displacement of 0.177 mm was seen for an applied force of 200 lbf.



Nose Cone
The nose cone was 3D printed to an ogival curve responsible for directing the flow of air outside of the rocket.

Recovery Bay
Responsible for the recovery of the rocket via dual stage deployment. Raptor CO2 cartridges are used as stored internal energy devices.

Payload Bay
An enclosed volume where the payload is contained. This payload can be a measurement device or dead-weight.

Oxidizer Tank
A highly pressurized vessel that contains liquid nitrous oxide, acting as our oxidizer within the combustion chamber

Injection Plate
Responsible for providing desired oxidizer flow into the combustion chamber with the assistance of the impinging plate

Fins
Fins provide stability during flight, allowing the rocket to maintain its orientation in flight. Critical to the relationship between CP and CG.

Tapered Base
The tapered base helps to reduce the aerodynamic base drag on the aft portion of the rocket.

Nose Cone Tip
Aluminum was machined to the tip of an ogival curve with a surface finish of 32 Ra. Vital to minimizing drag at the most critical point on the rocket.

Electronics Bay
An enclosed volume where the electronics of the rocket are stored. A combination Raspberry pi's, Arduino's and an Altus Metrum Telemega are used.

Flow Regulator
A solenoid valve that controls flow of the oxidizer into the injection plate. Flow regulation can also be used to vent the rocket fuel incase of an emergency.

Combustion Chamber
An enclosed volume where the solid reducer and liquid oxidizer react to produce a superheated, highly pressurized chamber of gas

Nozzle
Stainless steel nozzle was machined at Seneca Machining. This geometry is responsible for directing the flow of hot gases outside of the combustion chamber into the environment providing thrust.

Current and Future Work

- Re-design of the rocket body around a reduced diameter Oxidizer tank.
- Optimum design of "V2" combustion chamber and nozzle.
- Integrate thrust vectoring system onto the propulsion system
- Further development into rocket payload, onboard or deployable instrumentation for Spaceport America Cup Competition.
- Continuation of UNH SEDS within the CEPS community.

Acknowledgments

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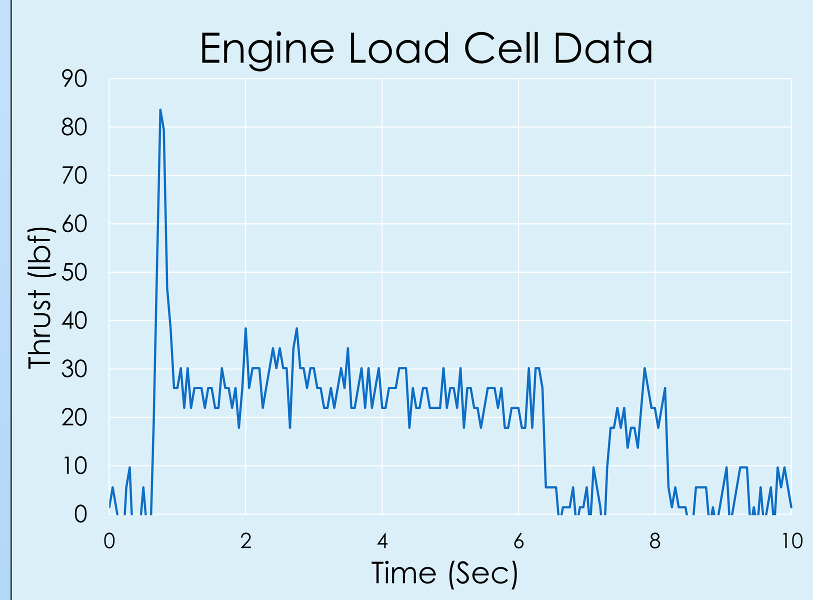
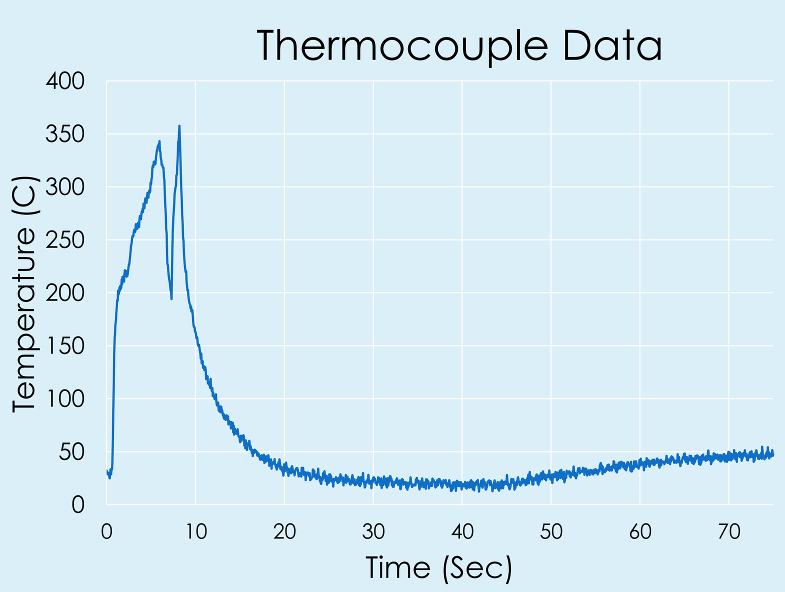
Propulsion

- On August 20th, 2019 UNH SEDS conducted its first of three hot fires for 2019-2020.
- An unscheduled disassembly of the graphite nozzle led to inadequate data for analysis.
- "V1", utilized hydroxyl-terminated polybutadiene (HTPB) and liquid nitrous oxide.
- Stainless steel was used in all further nozzle designs.
- The initial use of graphite was due to its ablative properties.

March 6th, 2020 hot fire test

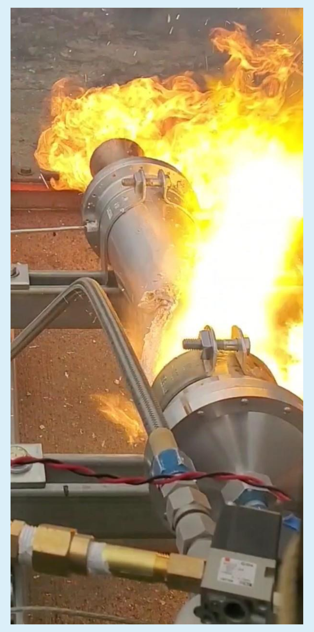
- On March 6th, 2020 UNH SEDS conducted its second hot fire.
- "V2", utilized Paraffin wax and liquid nitrous oxide.
- Maximum thrust of 25 lbf was recorded.
- Specific impulse is a measure of how effectively a rocket uses propellant as fuel. We achieved an I_{sp}=177.12 sec
- Our engine lacked the temperature and pressure required for stable combustion.





Moment of chamber breach

March 20th, 2020 hot fire test



Aluminum and Paraffin fire

- On March 12th, 2020 UNH SEDS conducted its third hot fire.
- "V2", utilized Paraffin wax with 0.05% by weight Ferrocene Catalyst and liquid nitrous oxide.
- Changes made since March 6th hot fire:
  - A reduction in nozzle throat diameter was made to increase chamber pressure.
  - An improved ignition system was used to increase chamber temperature prior to nitrous flow.
- Maximum thrust of 45 lbf and an I_{sp}=318.522 sec was recorded.
- Inconsistences in fuel grain led to a breach of the combustion chamber.