Overview of the SABER Mission and Launch Vehicle Design

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Mission Overview

The Suborbital Atmospheric Balloon Elevated Rocket (SABER) mission is a university student developed space launch vehicle. The vehicle uses a high altitude launch to maximize commercial solid fuel rocket motor range capabilities. Our system uses a single stage rocket powered by an O-8000 solid fuel motor launched off a zero-pressure balloon and gondola system. The mission objective is to take 2-5 kg payloads to altitudes of 70-110 km. SABER will utilize standard amateur rocket architecture combined with ballooning to lower development time and reduce costs.

Vehicle Performance Simulations

High altitude simulations run in a 6DOF Simulink simulation.

<table>
<thead>
<tr>
<th>Ignition Altitude</th>
<th>Rocket Mass</th>
<th>Max Velocity</th>
<th>Max Accel.</th>
<th>Max Q</th>
<th>Apogee</th>
<th>Ignition to Apogee</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 km</td>
<td>44 kg</td>
<td>1160 m/s</td>
<td>305 m/s²</td>
<td>26 kN/m²</td>
<td>92 km</td>
<td>125 s</td>
</tr>
<tr>
<td>30 km</td>
<td>44 kg</td>
<td>1165 m/s</td>
<td>310 m/s²</td>
<td>14 kN/m²</td>
<td>100 km</td>
<td>125 s</td>
</tr>
<tr>
<td>35 km</td>
<td>44 kg</td>
<td>1168 m/s</td>
<td>312 m/s²</td>
<td>7.5 kN/m²</td>
<td>107 km</td>
<td>125 s</td>
</tr>
</tbody>
</table>

Balloon Ascension Analysis

Vehicle Recovery Analysis

Conclusions

SABER’s mission concept has the capabilities to put space within the reach of student engineering teams. The platform combines ballooning and rocketry to create a space launch vehicle that bypasses development of propulsion and cuts costs using commercial motors and amateur systems. The SABER mission plan is to fly in 2019 with the start of hardware prototyping this semester.

Acknowledgements

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Concept of Operations

Full Vehicle Overview

Gondola Overview

Booster Overview

Balloon/Gondola
- Zero-Pressure Balloon
- Custom Manufactured
- Polyethylene Plastic
- 4682 m³ Volume (fully expanded)
- 11.4 kg He
- Controls Booster Ignition
- Separate Recovery System

Booster
- 12 ft. tall
- Carbon Fiber Airframe
- O-8000 Solid Fuel Motor
- CO₂ Recovery Ejection System

The gondola will secure the rocket booster during ascent and, upon ground station command it will ignite the motor.

The booster is a single stage solid fuel rocket with three main sections. Airframe material is carbon fiber with fiberglass nose cone.