Team H.E.L.I.O.S.

Helium Exhaust Liberating Inflation Optimization System

A. JAMES CLARK SCHOOL OF ENGINEERING

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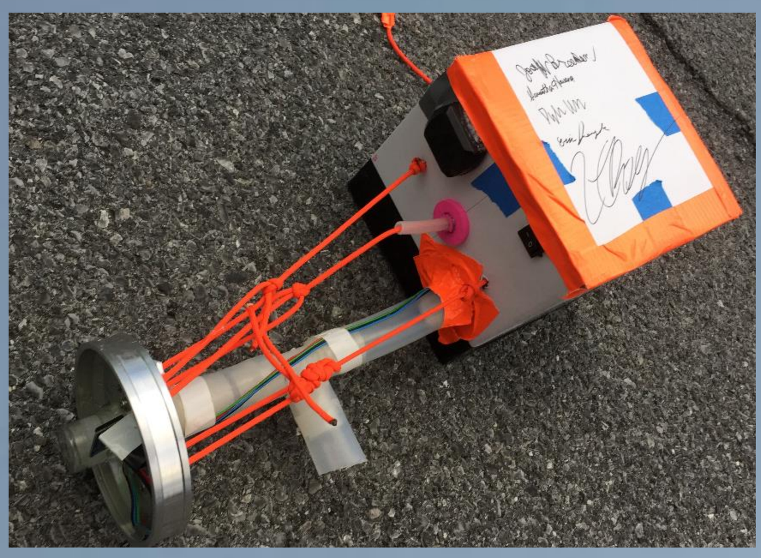
Alongside: Grayson Miller, William Gilbert, Steven Lentine, Camden Miller, Professor Mary Bowden

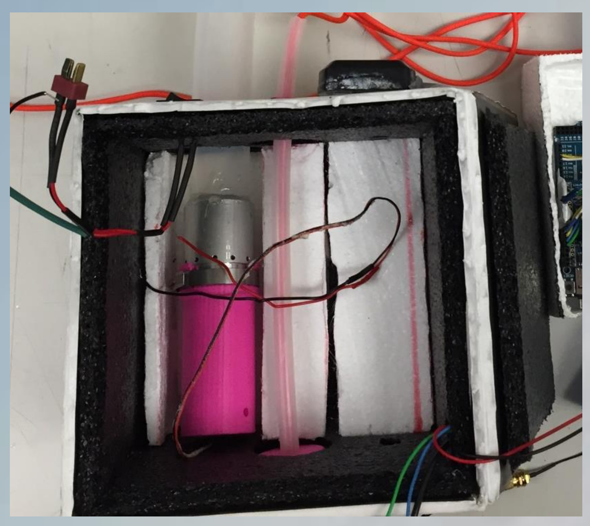
Goal

To release helium from a weather balloon to reduce the rate of ascent and increase the burst height of the balloon



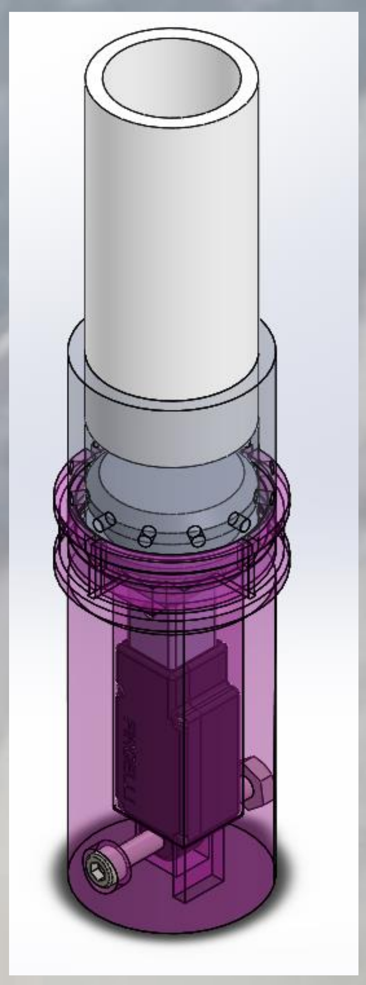
Abstract

The payload's primary system was a valve designed to open at 60,000 ft, and then close after a minute of releasing helium. The mission was successful, as the data indicated that the ascent rate decreased by 4.9% after operation of the valve. HELIOS also collected readings for temperature inside the payload, and pressure and temperature inside and outside of the balloon. All of this data was compared against GPS position values. The success of HELIOS was also the first step to delaying the burst height further to set record-breaking heights in the future.



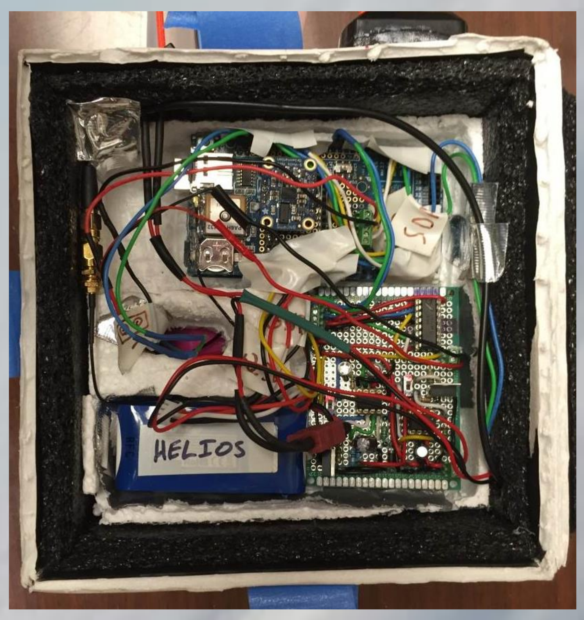
Methodology

HELIOS was designed, constructed, and tested over the course of 9 weeks in preparation for launch on November 14, 2015. The payload housing was constructed of a 7.0'' insulated cube. The box housed all electronics and the custom-made valve controlled by an H-bridge and programmed via Arduino to open for one minute at 60,000 ft. HELIOS also consisted of a custom plug within the balloon neck connected via tubing to the box, and containing one of the pressure sensors. It was secured by a Ninjaflex 3D printed sleeve and a hose clamp.



Sensors

- GPS+Logger Shield
- MS5607 Pressure/Temperature (Inside and Outside)
- BNO055 Inertial Measurement Unit



The pieces above made by Steven Lentine and Camden Miller

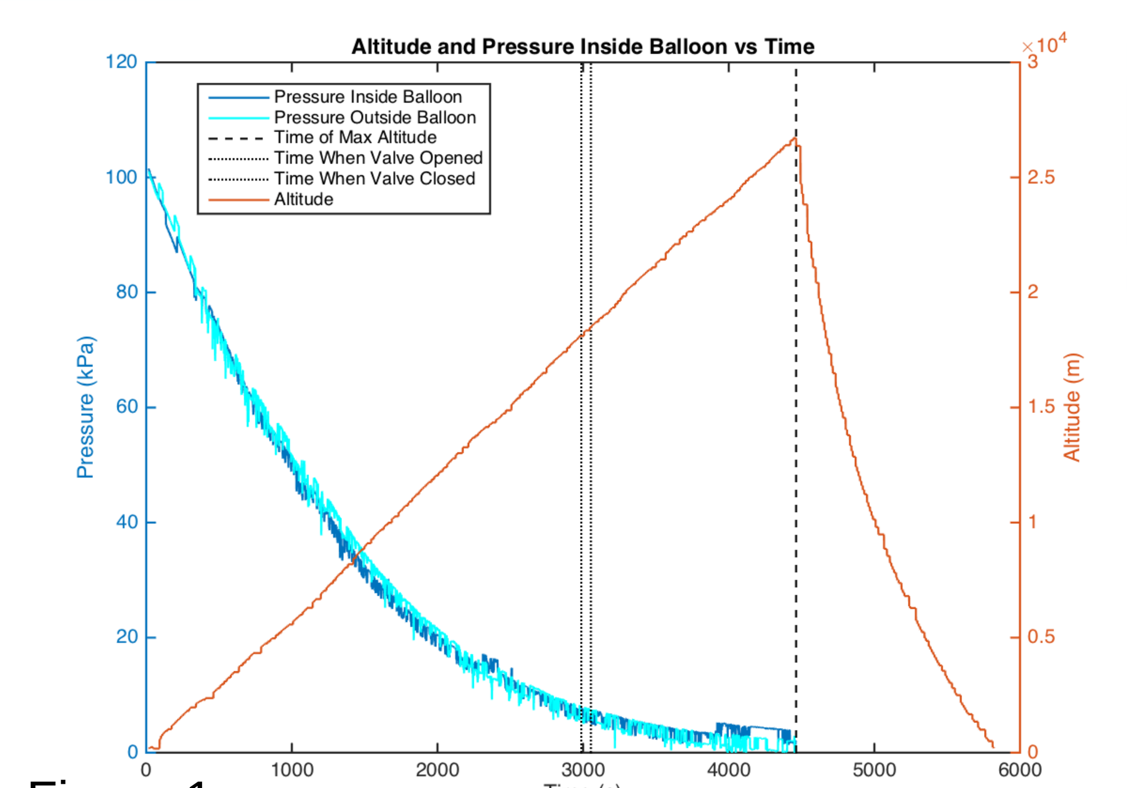


Figure 1

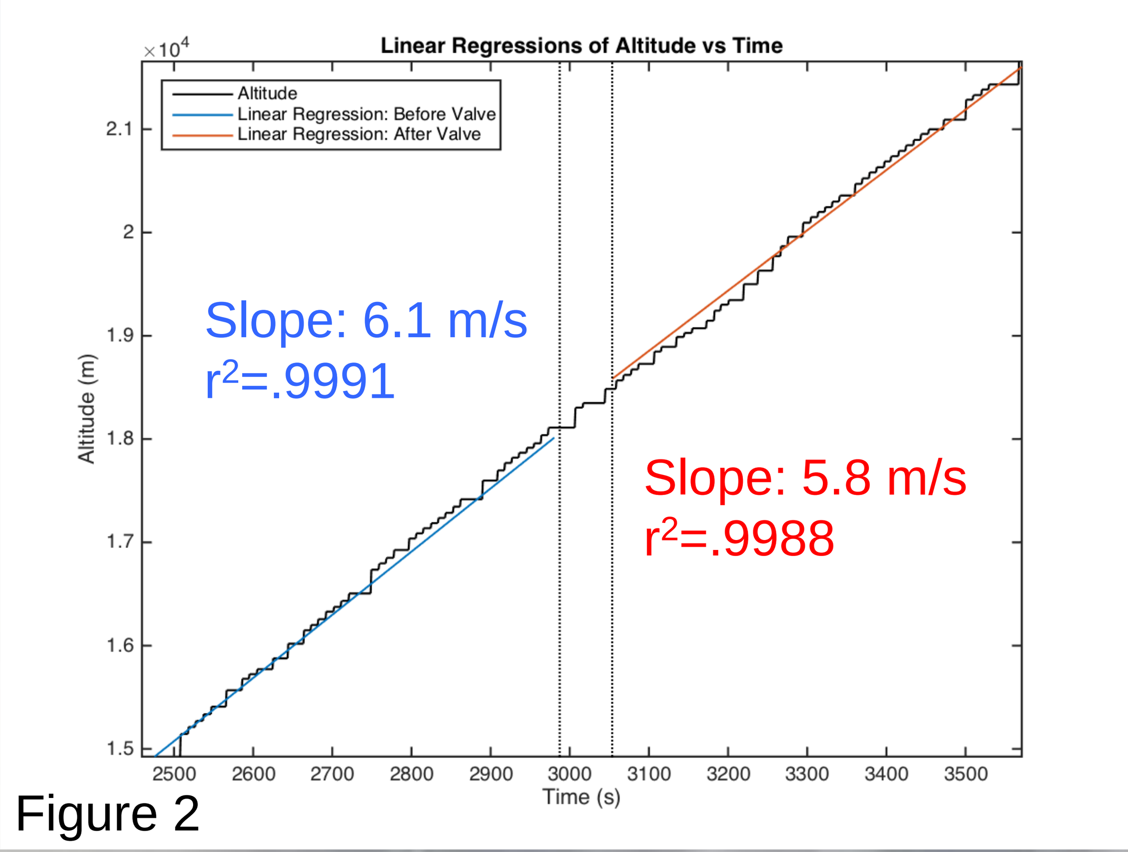


Figure 2

Altitude varies linearly with time, while pressure varies exponentially with altitude and time. Temperature is more sporadic.

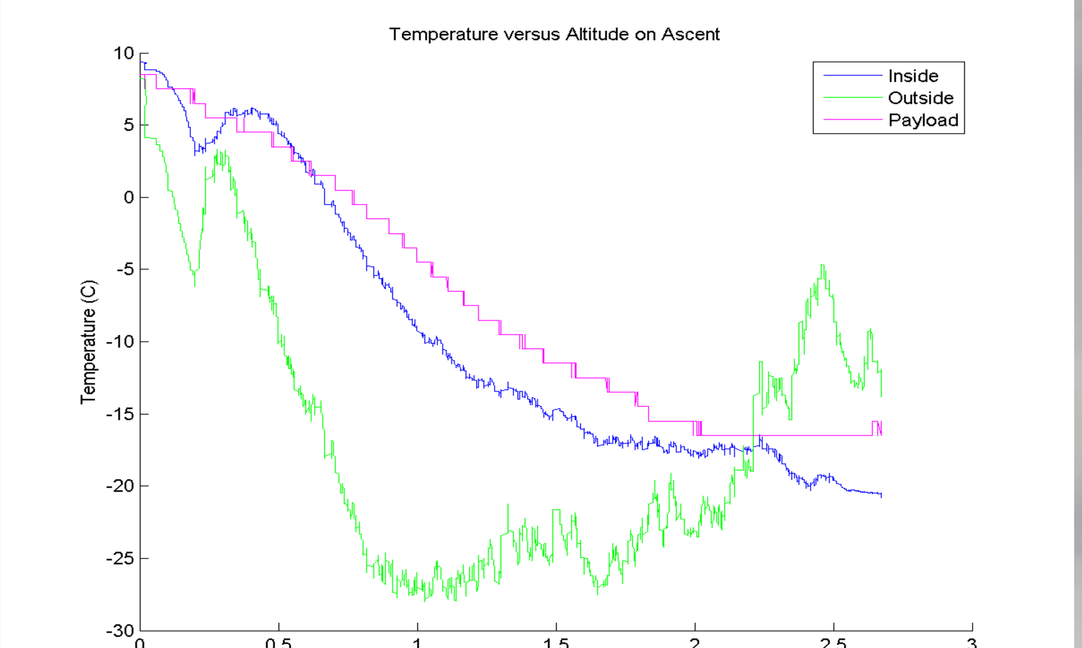


Figure 3

Conclusion

During the flight, HELIOS opened its valve, released an unknown quantity of helium gas, and decreased the rate of ascent from 6.1 m/s to 5.8 m/s (4.9%) (Figure 2). The payload was conservative with how long the valve was open and releasing helium for safety, so the change in internal pressure is negligible (Figure 1). However, the vertical speed change is clear. HELIOS collected the first data from UMD for pressure inside the balloon and found it very similar to the ambient pressure (Figure 1). The temperature was noticeably more consistent inside the balloon than outside or even within the payload (Figure 3). The valve assembly functioned correctly, as confirmed by the noticeable difference in speed and lack of leaks, so this is a viable system for future attempts to delay the burst height of the balloon and hopefully set height records.

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Background image taken by Bach's Box Payload