The University of North Dakota
Grand Forks

School of Engineering and Mines
2011 Engineering Senior Design

Precision Integrated GEOgraphical Navigation

Near Space Recovery Technology Team

Team Members:
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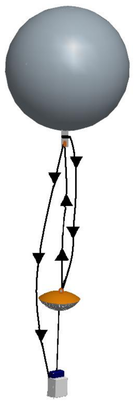
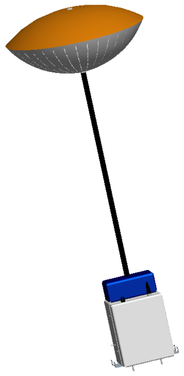
Mission Objective:
To design a recovery system to accompany scientific payloads on high altitude balloons. System must be capable of guiding payloads to a user designated “safe” landing zone in order to successfully recover payloads intact, and prevent damage to people and property.

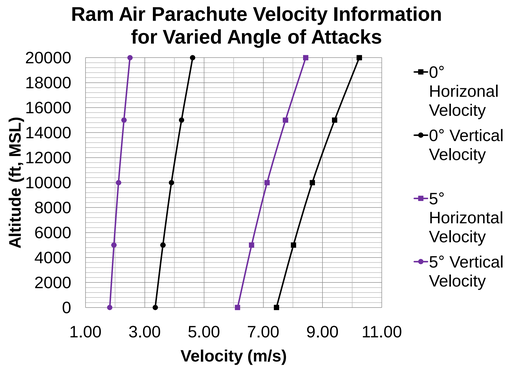
Balloon and Parachute Flight Profile

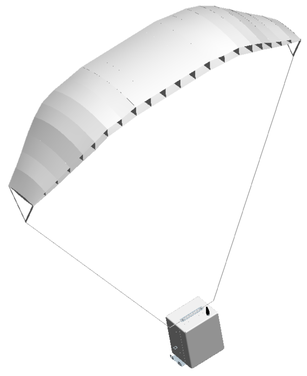


Ascent Phase
A helium filled latex balloon lifts the system to approximately 100,000 feet msl at a rate of approximately 1000 ft/min.

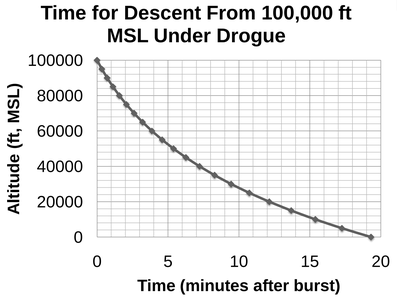


Drogue Descent
Initial descent of the system is accomplished using a drogue parachute for stabilization.



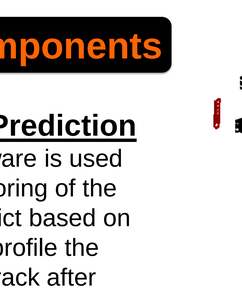


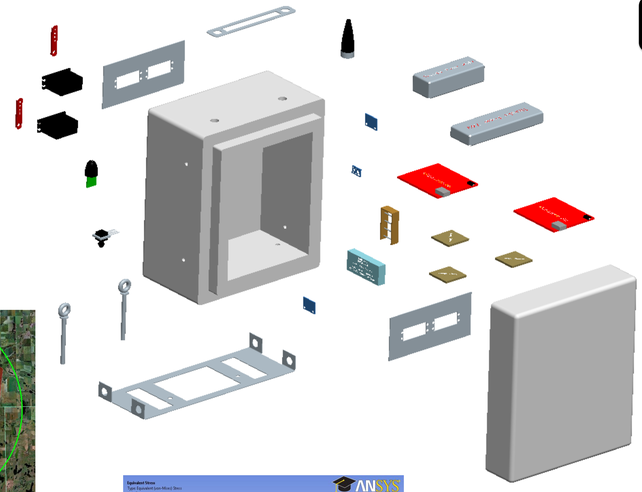
Steerable Flight
Steerable flight is accomplished using a ram-air style parachute capable of course and descent rate alterations.

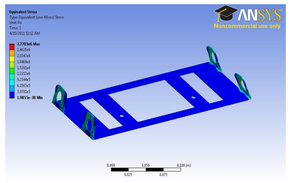


System Components

Tracking and Prediction
BalloonTrack software is used for real-time monitoring of the flight and can predict based on a generated wind profile the expected system track after burst or cut-away.





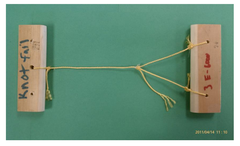


Electronics
- GPS Based Guidance
  - GS407 High Altitude GPS
- Li-Po Batteries
  - Thunder Power 7.4V 5000 mAh
- Servos – Steering Control
  - Hitec 322-HD 180° Rotation
- Magnetometer – Heading Information
  - HMC5843 Triple Axis Magnetometer
- Radio Transceiver
  - Radiometrix Multichannel 500 mW
- Microprocessor
  - ArdupilotMega Autopilot
- Temperature and Pressure Sensors
  - BMP085 High Accuracy Sensor (+/- 0.03 hPa)
  - Honeywell S&C Pressure Sensor Full Range Sensor

Testing and Analysis

Cut-Away System
Nichrome wire is heated to cut 50 pound test braided Daiwa line (300° F M.P.). Testing examined the optimal combination of voltage, current, heating time, and wire thickness.

Rigging and Deployment
Parachute lines are rigged with braided nylon line with 120 N tensile strength. Full analysis and testing of the deployment mechanisms and sequence was completed. Testing showed reinforced lines and a more flexible and less temperature sensitive glue was needed.



Thermal Analysis
Thermal analysis and testing of the bus were conducted to obtain a temperature profile throughout the flight. Significant overheating may occur without radiation shielding.

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