BalloonSat Flight Report

Tracker Test Flight

Space Hardware Club

Flight 10

Nov. 21, 2009

Club Members:

Eric Becnel
Jennifer Hunt
Tamara Cottam
Philip Sauvey
Caleb Lindsey
Blake Parker
Seiya Shimizu
Charles Boyles
Introduction:

The University of Alabama in Huntsville’s Space Hardware Club (SHC) released a high altitude weather balloon in the North Campus Residents Hall parking lot on November 21, 2009. The flight used a 500gram balloon and leftover helium from the Nov. 6th and 7th flights. The intent was to fly a very short flight to verify proper operation of the SHC transmitters. With this, a backup transmitter with cut-down capabilities was flown. A solar panel experiment was flown comparing different types of solar cells along with a camera pointing down photographing the ground during flights with hopes of getting a shot of the campus. The flight landed in the only tree in the Madison Square mall parking lot.

Launch:

The launch was performed from the North Campus Residents hall parking lot. The short flight was predicted to land west-southwest of the launch location. By launching from NCRH the predicted landing spot shifted north, missing I-565 by a comfortable distance.
Flight:

The trackers for this flight were actively tracked by the SHC Ground Station in the Engineering Building. Live tracking and active altitude propagation was completed by the ground station and was used to do an automated controlled cut-down. This was completed at approximately 1 mile high. The expected flight path can be seen in green as the actual flight path is seen in blue.

The flight went great. It was short, with a cut-down altitude of one mile high. This allowed the team member to visually see the controlled cut-down from the communications lab.

Figure 2 Balloon Path with Path Propagation Prediction
Payload Descriptions:

The Trackers

The Flight had three trackers. Two of the trackers were the malfunctioning SHC trackers. The problem in previous flights was thought to be related to operating near the ATV transmitter. The third tracker incorporated a controlled cut-down to release the balloon when commanded.

Solar Cells

See attached PDF file “Flight_10_Solar_Panel_Experimental_Test_0001”

Ground Station Description:

The ground station software consisted of the following primary components: the Balloon Tracker, Balloon Propagator, Automatic Cut-down Controller, a MySQL database, and some PHP scripts to generate Google earth KML files.

The Balloon Tracker software parses APRS style packets coming in from multiple serial ports and logs their contents to the MySQL database. The Balloon Tracker also uses the location information encoded in the packets to determine the balloon’s azimuth and elevation with respect to the club’s computer controlled antenna array. This azimuth and elevation is then sent to the array’s rotator controller to maintain optimal link quality.

The balloon propagator uses sounding predictions and data from NOAA as well as information about ascent rate, descent rate and burst altitude to predict the path the balloon will take. The initial parameters of the propagation can be updated during flight by querying the MySQL database to provide a more precise estimate of the location of the recovery site. The balloon propagator has been used after a previous flight with good results. This flight was the first time this propagator was used before a flight. The results were reasonable considering the variability of low level winds and the short duration of the flight, but we are considering using new low level wind prediction sources to improve pre-flight predictions. The propagator may also build its own sounding data during ascent to aid in predicting low level winds at the end of the flight thus creating more accurate in-flight predictions of the recovery site.

The Automatic Cut-down Controller periodically queried the MySQL database and calculated the current ascent rate and combined this with the current altitude to determine when the balloon would reach the predefined cut-down altitude. When the balloon reached the cut-down altitude the Automatic Cut-down Controller keyed up the radio and transmitted the DTMF code sequence required to activate the cut-down sequence on the balloon.
To enable the Automatic Cut-down Controller to key up and transmit over the air the club implemented an interface between the ground support computer and the radio. The circuit diagram for this is seen in Figure 3.

![Computer to Radio Interface Circuit Schematic](image)

**Figure 3 Computer to Radio Interface Circuit Schematic**

The PHP scripts consist of a script which generates a KML file which will cause Google earth to reload the other script which is the mission script. The mission script loads mission parameters from the MySQL database and generates ground tracks for recovery crew vehicles as well as three dimensional tracks for balloons. It is planned for the mission script to support balloon propagations as well once the balloon propagator design is more mature. These PHP scripts are hosted on a club web server allowing both local users as well as members of the community to monitor mission resources live during flights. Figure 4 shows some of the displays used during the flight.

![Dual Projector Ground Support Display in Communications Lab](image)

**Figure 4 Dual Projector Ground Support Display in Communications Lab**
Recovery:

The recovery of the balloon took the team of students only a few minutes. The landing point was only a few miles from campus and the exact position was known. It was located in the east parking lot of Madison Square Mall which can be seen in Figure 5.

![Recovery Site as Seen by Balloon on Descent](image1.jpg)

Figure 5 Recovery Site as Seen by Balloon on Descent

Special Thanks to:

- Lance Warden for ground station programming
- Jason Winningham for the backup tracker and fill rig
- NSSTC for helping with launch
- All those who supported SHC in this effort