The Idaho Space Grant program has initiated a high altitude scientific ballooning program. To date there have been 3 flights of over 90,000 feet. A long term goal of the program is to develop the capability to photograph the moon from altitude. There are a number of technologies that need to be developed before such an image can be attempted. The first step is to develop the capability to determine the attitude (tip/tilt angles relative to the vertical) and orientation (azimuth) of the balloon gondola/payload at any instant of time.

Some thoughts/possibilities –

- use three-axis accelerometers to determine the angle from the vertical. Is there another way to determine tip/tilt angles? If the horizon could be viewed, then that could be used as a reference but the horizon is difficult to distinguish at these altitudes, the horizon is curved, and it is possible the balloon could fly at night. Also, the attitude should be determined in real-time and image processing to autonomously detect and determine the orientation angle of the horizon would be difficult. It is presumed that accelerometers would be located at the center of gravity of the gondola.

- Use a compass to determine the azimuthal orientation of the gondola to determine magnetic north, but would require correction for the latitude/longitude to provide an accurate measurement of orientation relative to true north.

- Another possibility would be to use small gyros, but I think that this may be getting technically quite involved.

- Sun sensor (which would require accurate knowledge of date, time, and location) or star sensors, but real time optical recognition of star patterns would again be quite difficult.

The package should be low power and low mass (on the order of several hundred grams). The sampling rate should be no less than one Hz (more than 1 measurement per second).

Mass: 500 grams  
Power: unknown  
Sampling rate: > 1 Hz  
Pointing accuracy: < 0.1 degree

Additional considerations include operation at extremely low pressures and temperatures. At 100,000 feet, the balloon is well into the stratosphere. At these altitudes, the external pressures are on the order of 5-10 mbar (about 0.5 – 1% of the pressure on the surface) and temperatures can get as low as 210 – 220 Kelvins (about -60 degrees C = -75 degrees F).

The next balloon launch is scheduled for May 1, so the instrument could be flown before the end of the semester.

Note – there is the opportunity to write a proposal to obtain funding for this project. The Idaho NASA Space Grant program has an Undergraduate Student Design Project Grant Program that will fund up to $2,500 for a project. See


Although the deadline for proposing has passed, late proposals may still be accepted. One requirement is interaction with NASA or industry. There are several people at JPL and at University of Arizona Lunar and Planetary Lab who I think will agree to participate.