Lighter-Than-Air Science *University Students Fly Balloons*

Remember the colorful helium-filled balloons that decorated special celebrations? Balloons are for fun, but some are employed in serious pursuits, too. For the HABET (High Altitude Balloon Experiments in Technology) projects at Iowa State University, Ames, Iowa, students use helium-filled biodegradable latex balloons similar to those used by the United States National Weather Service to carry scientific and engineering payloads into the upper atmosphere. Data is transmitted and received from balloons via an RF link throughout the entire flight.

The HABET flight team in action during a balloon flight. The team is taking note of the change of the spacecraft's predicted landing site.
l to r: David Shoemaker, Colt Wallace (Flight Director), and Katie Blumer

One constant among the many variables being tested is Andrew Corporation's HELIAX® LDF5 7/8-inch foam dielectric cable. RF signals sent or received for any balloon experiment travel through HELIAX cable. HABET Manager Colt Wallace: "We use HELIAX cable to run between our antenna on the roof to our receiving station in the lab – about 150 feet. HELIAX cable has very low loss, so we have little signal degradation. That is why we chose it."

For balloon flights less than 90 miles from the base station, signal loss is small, but "Once they get 200 to 300 miles away, signals are weaker and loss is more important. For the student projects in the lab, we use a yagi antenna to track very small satellites that are 800 kilometers in orbit, and HELIAX cable transmits the data. There is almost no signal loss between the antenna and our receiver."

Students participate in many and varied projects on the HABET team.

StratoLink

Transmitting data back to earth from balloon craft is typically done through amateur radio frequencies. StratoLink will transmit data through the ORBCOMM network to the Spacecraft Systems and Operations Lab (SSOL) on campus. Using this network, StratoLink will bring high altitude ballooning to educational groups in high schools or universities without licensed amateur radio operators.

Yaw Control

Wind gusts and atmospheric turbulence can spin or swing the payload. Controlling the heading angle of the payload as it ascends through the atmosphere (at about 1000 ft/min) will point it in a constant direction and keep it there. If the payload can be held at constant heading, telescopes and cameras can be sent up by balloon to transmit images back to earth.

Recovery Guidance System

As a balloon ascends to an altitude between 70,000 and 100,000 ft, it bursts, descending through the atmosphere on a hemispherical parachute. The parachute slows the payload until it reaches ground. Controlling a parachute's decent path is impossible, so HABET is experimenting with a steerable parafoil to bring the payload into a safe landing area. Under test is an automatic control mechanism in the payload that is programmed with safe landing locations before the balloon is launched. As it descends through about 30,000 ft, the parafoil inflates, and the GPS receiver, along with the automatic control mechanism, steers the payload to a designated landing site.

Rockoon

This project experiments with sending a balloon 60,000 to 100,000 ft into the atmosphere with a platform for launching rockets. Rockets launched at high altitudes don't experience atmospheric drag and use less fuel, allowing them to carry heavier payloads than if launched from earth.

Stanford/NASA

Stanford University students built a satellite communications system and NASA Ames Research Center scientists built a payload system (with an onboard controlled environment for microscopic worms). These two systems were tested on balloon launches in August 2003. The communications system worked, but NASA had to redesign the controlled environment when the microscopic worms didn't survive the flight.

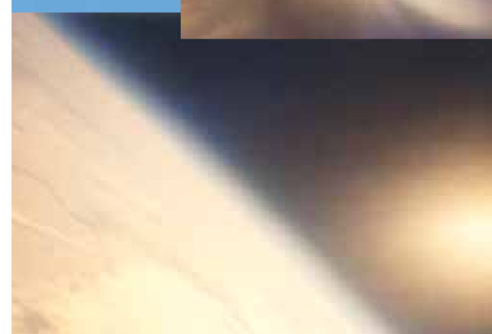
Altitude Record

The flight team is aiming for a record flight altitude of 130,000 ft. The helium-filled balloons HABET typically uses burst at about 85,000 ft. By using a large balloon, a lower helium fill-volume, and a lighter payload, the team hopes to send balloons above 120,000 ft. Greater altitudes allow the HABET team to fly payloads where the atmospheric pressure simulates that of Mars.

Mars Probe Antenna

University of Iowa students built a 40-m long antenna to accompany the Mars probe. The school didn't have an anechoic chamber large enough to test the antenna, so they asked if HABET could fly the antenna to a specified altitude, hold there for 20 minutes, and return it safely to earth. The SSOL students designed an altitude hold system for the antenna. It was lifted to 15,000 ft and held there while tests were successfully completed. An antenna of the same design was on the space flight that recently landed on Mars.

With each project, accurate data is essential. Says Wallace, "Once the balloon is launched, we rely on the antennas and cable to deliver data from the spacecraft. This data also helps us predict landing sites. We depend on the HELIAX cable to help us achieve this accuracy."



Photos of the sun (above-right) and the earth (above) taken by HABET spacecraft at about 86,000 feet.