High Altitude Glider Project

Balloon photograph taken from 25km. Image credit: Paul Verhage
Motivation

• Space Systems Development Lab launching weather balloons for low cost flights to the edge of space
• Rocket Mavericks launching high powered sounding rockets
• Extra payload space available on both systems
Our Proposal

• Design an unmanned glider as a payload
  – Supplement radiosonde balloon launches by allowing more control over payload landing location
  – Flight testing in the thin upper atmosphere, similar to what can be found on Mars
  – Possibility of Rocket Mavericks competition entry
Purpose

• For students to gain experience in a multidisciplinary design project
• Collaboration between Aero/Astro labs and other departments/groups
Design Goals

• Targeted release altitude of 100,000 ft
  – First dropped from a helium balloon
  – Later deployed from high power sounding rocket
• Return to launch site autonomously
• Carry useful payloads
  – Video camera(s) to capture flight and deployment
  – Digital still camera for higher resolution photos
  – Optical Spectrometer
  – Cuvettes with Astrobiology experiments
  – Others yet to be defined?
Design Challenges

• Packaging - the UAV must fit in a 12 in diameter by 36 in long cylinder for rocket launch
• Low temperature and pressure environment – effects on sensors and other electronics
• Telemetry – Long range communications required (>100 miles from launch/landing sites possible), also must be small and lightweight
• Speed – need to be able to fly through jet stream
• Duration – Desired at altitude for science missions
Who’s involved?

• Currently ~ 20 students and faculty advisors from the following groups:
  – Aircraft Aerodynamics and Design Group (ADG)
  – Space Systems Development Laboratory (SSDL)
  – NASA AMES Astrobiology group

• Still looking for more interested student participants
  – Amateur Radio Club members
  – EE and CS students with interest in long range communications or PCB design
  – Undergrads

• Other Groups
  – Rocket Mavericks – provide rocket launch platform
Aircraft Aerodynamics and Design Group

- Leading the project
- Will design and construct glider, integrate the payloads and telemetry
- Experience with building small research UAV’s
- Small Autopilot w/ GPS, inertial measurement unit, etc..
- ~10 students involved
• Providing the balloon platform for most of the launches
• Expertise with telemetry and payload integration
• A number of students working closely with the project

BioLaunch B07a (March 11, 2007)
NASA Astrobiology Group

- Supply Science payloads – optical spectrometer, other experiments in small cuvettes to be exposed
- Help with integration of payloads into the UAV
Rocket Mavericks

• High powered rocketry group
• Launch sounding rockets out of black rock desert in Nevada

Photograph courtesy of Steve Jurvetson

To100k.org Test Flight #1 - Courtesy of To100K.Org
Schedule

• May 11\textsuperscript{th}, 2007 – Balloon launch – test of autopilot at low temp/pressure, 1\textsuperscript{st} telemetry test
• June 2\textsuperscript{nd}, 2007 – Balloon launch – further testing of autopilot system and telemetry
• Summer – 2 balloon launches to test complete system
• October 18-21\textsuperscript{st} – Mavericks launch in Black Rock
Current Airplane Configuration

• ~3’ wing span, 3’ length
• Pivoting wing
• Payload bay ~ 4” x 6” x 18”
• Max. systems weight = 4 lb (target 2 lb)
• Max. flying weight = 6 lb (target 3.5 lb)
Onboard Electronics Architecture
Radio Requirements

- Two way telemetry @ 9600 baud rate
- Range > 100 NM
- 4 hour nominal mission time
- Minimize weight and power consumption
- Maximum weight = 8 oz
- Maximum energy available = 6 W-hr
- UART communication desirable
Radio Considerations

• 0.2 W limit at 2.4 GHz (?)
• Ground Station – portability, affordability
• Off the shelf solution preferable
• Currently use MaxStream 2.4GHz XBee Pro radio with 6 m dish on ground
• More powerful modules available
Our Questions

• Can off-the-shelf radios meet specs?
• If not can we use a HAM radio?
• If so, what do we need to consider?
• If HAM possible, can you help us?
  – Use existing system
  – Build a new one
  – Technical and/or financial support
Questions?

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