Outline

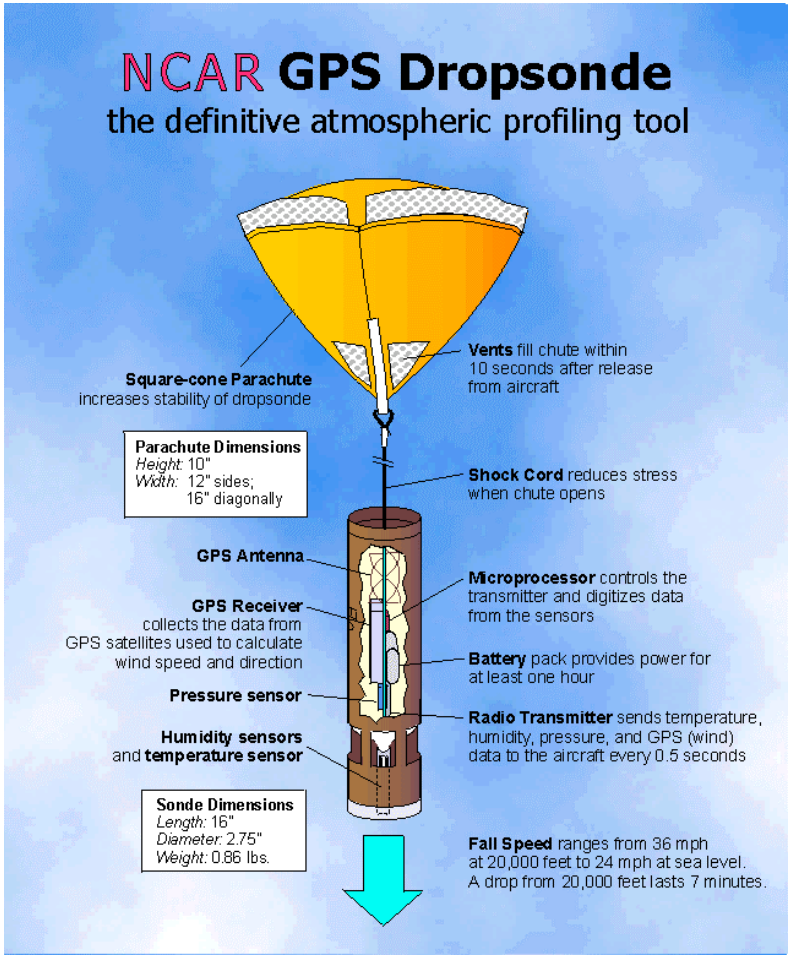
- Jude Allred, Ahmad Bilal Hasan, Saroch Panichsakul, William Pisano, Peter Gray, Jyh Huang, Richard Han, Dale Lawrence, Kamran Mohseni. **SensorFlock: an airborne wireless sensor network of micro-air vehicles**. Sensys, Nov 2007
  - Micro-air vehicle - semi-autonomous flight control with loiter circles for hovering
    - http://www.mae.ufl.edu/mav/Ourmavs01.html
  - Wireless transmission characteristics for Air-to-Air and Air-to-Ground communications

Application scenarios

- Chemical dispersion sampling
  - Toxins, pollutant etc.
- Atmospheric weather sensing
  - MAVs with temperature, pressure, humidity …
- 3-D sensing possible if the MAV can fly to the different depths

Existing Approaches

- Balloons and dropsondes
  - Passive
  - cannot chase event
- Large unmanned air vehicle (2-3 meters)
  - Dangerous for air traffic and ground personnel
- Small bird sized
  - Safe: 500 grams, 20 m/s
    - Propeller in back, foam
  - Cheap: $600
  - Plentiful



Avionics

- 8-bit microcontroller
  - Xbee Pro Zigbee 2.4 GHz radio
    - Packet based rather than bit based in Mica-2
  - Backup with RC link
  - GPS, single roll rate Gyro, absolute pressure sensor
- Fail-safe operation
  - Flown within visual range (0.5 km vs 1.5 km for the wireless link)
  - When out of RC link range, kill motor and soft land
- Launcher
  - Plane-A-Pult automatic launcher

Control sub-system

- Trajectory adjustment: 10 Hz
- Roll-rate adjustment: 100 Hz
- Network routing: 40 Hz
  - 10 ms per quanta
  - 56 kbps
- Data packets: 50 bytes
  - Source ID
  - GPS location
  - GPS time
  - Hop count
  - Seqence number
  - Sender ID
  - Sender RSSI (Received Signal Strength Indicator)

Experiments

- Flight test with 5 planes
  - Circular loitering mode
- Air-to-air received signal strength
  - Path loss co-efficient: A2A: 1.9, A2G: 2.1, G2G: 3.5
  - Urban cellular: 2.-3.5
- Antenna orientation:
  - Perpendicular to the aircraft
- Symmetry:
  - A2A links are symmetric
- Characterization of packet loss
  - Incomplete, higher with distance for A2A - possibly because of buffer overflow on the routers
- Airbourne multihop - not done because of line-of-sight requirements for flights

Discussion

- Relevance of hardware chosen
- Relevance of application scenario
- Relevance of research challenges addressed
  - Scalability?
  - Aggregation mechanisms?
  -