Airborne Avionics Research Group

Development of a Low-Cost UAV for Civilian Airspace Integration Trials

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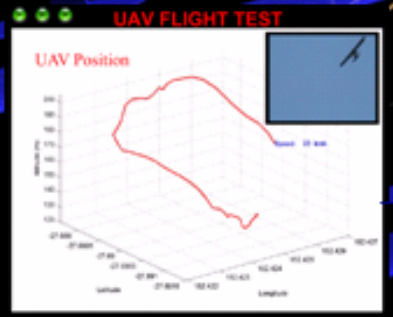
Introduction, Goals and Background:

- QUT has been developing cost-effective avionics since 1991
- The project has grown from an undergraduate project to a specialist research and development program for UAVs
- Current platform based on 1/3 scale model of a Piper Cub
- 2002 saw successful laboratory integration, but EMI prevented autonomous flight
- 2003 performed EMI mitigation measures and moved to a PC/104-based avionics architecture
- The goals for 2004 were:
  - Remove the EMI victim (RC Receiver) from the UAV On-Board Architecture
  - Integrate the Microair T2000 UAV transponder
  - Develop an airworthiness framework for the UAV
  - Perform a UAV flight in Controlled Airspace



Development of the Avionics Architecture:

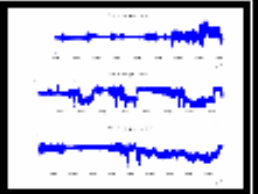
- Used to facilitate Autonomous Flight
- Air and Ground systems linked by ISM Spread Spectrum Modem
- Core Flight Management and Control Computer (FMCC)
  - PC-104 Platform running QNX RTOS kernel
  - Performs navigation and control algorithms
  - Interfaces to High Level Sensors (GPS, DMU)
  - Interfaces to embedded platforms for low-level data
- On-Board Microair T2000 UAV Mode C Transponder
- Ground Station Systems responsible for:
  - Telemetry and Command Program on Laptop
  - Interfacing the hobby-grade RC receiver to transmit control surface deflections via the ISM Band Modem
  - Manage control uplink and telemetry downlink packets

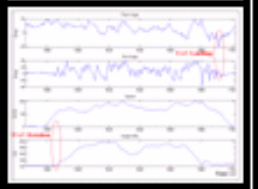
Airworthiness Framework:

- An airworthiness system is essential for safe operation and ongoing airspace integration trials
- QUT worked closely with CASA, Airservices Australia, airfield owners and QUT's insurance company to develop the framework
- Framework includes:
  - Technical Maintenance System (TMS)
  - Operational Maintenance System (OMS)
  - Engineering Management System (EMS)
  - Activities are carried out under Airworthiness Instructions (AI)
- Careful balance struck between efficiency and control
  - Flexibility in the system allows for changes in the field
- Airworthiness procedures tested and refined through flight testing
  - Photo at left shows maintenance procedures at the airfield
- Area approval granted from CASA for UAV operations
  - Excerpt of Area Approval shown at the top-left of frame

Results:

- A number of successful flight tests at the Graincleaner Airfield
- Successful Validation of Airworthiness System Concepts Applied to UAV Design and Operation
- Successful Integration of Mode C Transponder
  - Flight validation to commence early 2005





- COTS Hardware Lessons Learned
  - IMU sensitive to engine vibration - Semi-Rigid mountings investigated to mitigate vibration effects
  - Half-Duplex Data Link - Trade-offs in situational awareness and controllability for RPV flight
- Benefit of using COTS components
  - Rapid development time for hardware
  - Use of QNX has dramatically increased scope of project
  - RTOS reliability improved aircraft safety through isolation of software errors
  - Investigation for using QNX RTOS for the ground station underway

www.bee.qut.edu.au/projects/quav

Sponsors:

QUT Queensland University of Technology

FLYING FIGHTERS

Microair Avionics

QNX SOFTWARE SYSTEMS

TEXTRON Fastening Systems

CRC Cooperative Research Centre for Satellite Systems (CRCSS)