The Ground Control Room as an Enabling Technology in the Unmanned Aerial System

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Presented at the American Society for Photogrammetry and Remote Sensing Annual Meeting, Tampa, FL, May 9, 2007
NASA UAS Legacy

Helios

Hyper-X

X-40

UCAV

X-37 (concept)

Commanche

Altair

Altus

APV-3

NASA UAS Legacy
Global Science Needs

- UAS Strategic component of Global Observing System
Shared Airspace
Autonomous and Manned Vehicles

• Contrast to Military Needs
  – No Enemy
  – Non-cooperating A/C
  – Numerous Agencies involved
    • FAA NAS – COA process
    • ICAO International

• Strong Emphasis on ELOS
  – Sense and Avoid (SaA) non-cooperating A/C high priority

• Social Responsibility
  – Predictable decisions mitigating mission compromise situations
Unique Telemetry Needs

• **C2 must expand to support SaA sensor suites**
  – Near Term very heavy reliance on visual clues
  – Eventually image recognition technology can be incorporated in the A/C

• **Science data very different from C2**
  – Sensor WEBs
  – Disruption Tolerant
  – Bursty and Asymmetrical
  – Security requirements different
System of Systems

Flight Center

Science Center

Simulation Center
Pilot in a Bubble

What Is

What Should Be
More than a pretty picture

- Use panoramic cameras to show features a pilot would see but unknown to the DTD
  - Cameras can be spectrally tuned for better clarity than available to a pilot
  - Camera resolution can be modulated
  - Enhances pilot ability to sense non-cooperating aircraft
Satellite Data Fusion

• Add satellite data to the camera images
  – Terrain
  – Land Cover
  – Infrastructure
  – Debris Field
• Simulation Center Fuses the GIS data to improve pilot’s perception
  – Active contributor to the actual mission
• Provides the ability to simulate UAS flight
  – Training
  – Mission compromise simulation
Live Databases

• Graphic Representation
  – Data from ADS-B and Center RADAR (cooperative A/C)
  – On Board RADAR (non-cooperative A/C)

• Provides the ability to represent non-cooperating aircraft in simulation
  – Pilot training for SaA
Two [computer] Brains are better than One

- **Air [Flight Executive]**
  - Above Autopilot in Authority
  - Advises PIC in the event of a compromise situation
  - Able to make socially responsible decisions in the event of lost C2

- **Ground [Simulation Center]**
  - Provides Enhanced Situational Awareness
    - Fuses live camera images with
      - GIS data
      - Live data feeds
  - Provides Image Redundancy
  - Provides Simulation Capability
    - Training
    - V and V
Today, Tomorrow, and Beyond

• Today
  – heavy reliance on visual clues
  – Flight Executive Computer managing Flight Termination

• Tomorrow
  – Visuals enhanced with image recognition
  – On board RADAR
  – Flight Executive involved in compromise mitigation

• Beyond
  – Collision Avoidance built into the A/C flight Control System
  – Flight Executive handles mission compromises
    • Least Risk algorithms
A Beginning