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

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NASA UAS Legacy

- Helios
- Hyper-X
- X-40
- UCAV
- X-37 (concept)
- Commanche
- Altair
- Altus
- APV-3
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