High Fidelity Training for UAS Aircrew

From the Wright Flyer to the “Blue Box”

From Mastiff to PMATS

CERI UAV Human Factors Workshop
21 May 2007
Outline

- Corporate Introduction
- UAS Training Context
- Predator Mission Aircrew Training System (PMATS)
  - Background
  - Program Specifics
- UAS Community Signposts
We Know Training From The Ground Up
# Industry Leader ... Fixed and RW Training Solutions

## PRODUCTS

| Distributed Mission Operations (DMO) | A-4 | F-15 | AH-1S |
| Collective Training Systems - AVCATT | A-5 | F-16 | AH-1W |
| Tactical Operational Flight Trainer | A-6 | FA-18 | AH-64 |
| Operational Flight Trainers | A-7 | EA-18G | CH-46 |
| Weapon System Trainers | AV-8 | F-22 | CH-47 |
| Weapon Tactics Trainers | B-2 | F-111 | CH-53 |
| Part Task Trainers | B-52 | F-117 | UH-1H |
| Deployable Training Devices | C-130 | KC-10 | UH-1N |
| Aircrew Systems Trainers | C-141 | KC-135 | UH-60 |
| Computer-Based Training | E-3 | MQ-1 | SH-60 |
| Maintenance Trainers | E-6 | P-3 | OH-58 |
| Front End Analysis | EA-18G | T-37 |
| Instruction | F-4 | T-38 |
| Training Management | F-5 | T-45 |
| CLS / CTSS | F-14 |

## AIRCRAFT

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| F-14 |

## SPECIALITY

- Systems Integration
- Instructional Systems
- Performance Enhancement
- Brief/Debrief/AAR
- PC Architectures
- Avionics Modeling
- Interoperability
- Aero Modeling
- Image Generation
- Visual Displays
- HMD
- Sensors
- Legacy Simulator Upgrades
- Distributed Microprocessors
Brief History of DoD UAS Training

- **80s: Israeli Mastiff & Pioneer enter DoD inventory**
  - Creation of dedicated schoolhouse at Ft. Huachuca
  - Classroom theory + live flights

- **90s: The MUSE Generation**
  - Initially designed solely to train Hunter crews
    - 6-DOF aircraft model + Visual Scene Generator + training scripts
    - Plug MUSE into GCS and “fly” it around
  - Additional platforms & sensors added:
    - Pioneer, Outrider, Predator, U-2, etc.
  - From operator training to staff level training
    - Original intent under utilized
      - Primarily due to operational burden on “flight-worthy” systems
  - Crew training syllabus remained heavily dependent on live flights

- **21st Century: Embedded Training**
  - Difficulty with fault insertion into “flight-worthy” system
  - UAV training pipelines remain live flight dependent
  - Student throughput perennially backlogged
PMATS Overview

- Predator Mission Aircrew Training System (PMATS)
  - Requirements
    - High-fidelity, fully immersive, Predator simulation for both pilots and sensor operators
    - Maintain concurrency with fielded system
  - Front End: (Nearly) exact replica of flight-worthy system
    - OEM supplied
  - Back End:
    - 6-DOF flight model (OEM provided)
    - Virtual Environment
      - Terrain, sensor imaging, synthetic targets / forces
    - Instructional System Support
      - Instructor Operator Station (IOS)
      - Fault insertion; recording/playback; briefing / debriefing
    - Networked server backbone; distributed training (i.e., DMO)
PMATS Overview

Program Specifics
- Awarded: Jun3, 2005
- Deliver 7 systems to Creech AFB
  - System Includes:
    - Student workstation (Predator GCS)
    - Instructor Operator Station (IOS)
    - Brief / debrief workstation
- Retain a “testbed” system at Link

Current Status
- Initial Delivery: Commenced Dec 2006
  - 8 PMATS
  - 3 Brief / De-brief
- April 2007: USAF Exercised Option
  - 8 more PMATS
  - 2 more Brief / De-brief
Core Enabling Technologies

- Instructional Systems
  - IOS, Brief/Debrief, Malfunctions, Role Players
- Interoperability
  - Local and long haul networks
- Environments
  - Physics based, Natural, Battlefield, Targets, Crowds
- COTS PC Architecture
  - Host Computer, Image Generator, Instructional Systems
- Modeling
  - Aero, Sensors, Weapons, Communications

Enables Realism to the Operators
Leverages Existing DoD Investment
UAS-Unique Simulation Technology

- **UAS Datalink Modeling**
  - For accurate training of both LOS & SATCOM procedures
    - Handoffs between forward and read GCS
    - Link loss emergency procedures training

- **Environmental effects on aircraft and sensors**
  - Icing, winds, clouds, haze, smoke, thermal crossover

- **Extendable training system matches fielded platform**
  - Sensors: EO / IR, SAR, Nose camera
  - Weapons
  - Communications: ARC-210 voice comms
  - Configuration: RQ-1B, MQ-1B, MQ-9, etc.

- **Emergency Procedures Training**
  - Instructor console configured to inject UAS-centric faults
Environment Realism

3D Clouds

Uniform Cloud Layer
- Clear
- Raining
- Snowing

Variable Visibility

Lightning

Thermals/Microbursts

Airfield Guidance Systems

Surface is:
- Dry
- Wet
- Snow
- Slush
- Ice

Sea Level Temperature & Barometric Pressure

Upper Winds

Ridge Winds

gust

turbulence

Lower Winds

3D Clouds

SAF

Tactical Smoke

Smoking Vehicles

Vehicular Dust

Variable Visibility

Fog

Fog

Dust

Dust

Dust

Dust
UAS Training Systems Concept

High Fidelity GCS

Sensors

IOS

Brief / Debrief

GCS

Synthetic Environment

High Fidelity CGF
Physics Based Entities

Dissimilar Devices
DMO/DMT

Database Generation System

Additional Suites

Brief / Debrief
PMATS Training Advantages

- From Taxi to Shutdown
  - Visuals precisely replicate Creech airfield and Nellis ranges
  - Potential to eliminate (some number) of live syllabus flights

- Emergency procedures training
  - Overcomes reluctance to insert complex faults into flight-worthy system
  - Some UAV emergencies cannot be simulated during a live flight
    - Examples: Engine Cut; Datalink Loss; Severe Weather (icing)

- Reconfigurable on the fly
  - Ability to replicate wide variety of fielded configurations (when available)
    - RQ-1A, RQ-1B, MQ-1, MQ-9…
  - Customized crew training (concurrency)

- Tactics Development
  - “Try before you fly”
  - Reduces live flight demos

Same advantages as seen in manned aircraft training systems
Positive UAS Community Signposts

- From the Wright Flyer to the Blue Box
  - Simple airplanes; small quantities; few pilots
  - Hard to justify the case for fully immersive simulators

- From Mastiff to PMATS
  - Relatively small worldwide investment in UAS (vs. manned aviation)
  - Hard to justify value of PMATS-like concept during those early years
  - UAS community “mass” in 2006 changes the equation
    - Complexity, cost, number of affected personnel

- PMATS Contract Signposts
  - Formal recognition of the value of immersive training
  - Contract awarded to a recognized training company
  - Acknowledgment that embedded training has limitations
  - Potential Return on Investment
    - Reduced live flight syllabus
    - Increased student throughput
    - Enhanced training experience; more qualified graduates
Conclusion

“Aviation Discipline / Culture
One Standard for Manned / Unmanned”

- PM UAVS Pathfinder 06 presentation.

- “Moving the Army’s UAS program from MI oversight into the manned aviation world allows us to bring the same technical and safety rigor to these systems as we employ on all our other aircraft.”
  - Paraphrased from COL Hazelwood’s (PM UAVS) presentation at AAAA Symposium, Feb 2007

- We agree.
  - Especially regarding simulation and training.

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