Challenges and Opportunities for Testing of Autonomous Systems

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Agenda

- 412 TW/Edwards Overview
- T&E at 412 TW
- Ranges & Capabilities
- Current Autonomy Projects
- Future Autonomy Projects
- Autonomy Test Challenges
Our Mission and Our Vision

Conduct Developmental Test and Evaluation of air, space, & cyber systems to provide timely, objective, and accurate information to decision makers.

Tester of Choice...Today and Tomorrow
412 Test Wing Mission

- 412 Test Wing (part of Air Force Test Center)
  - Plans, conducts, analyzes and reports on all flight and ground testing of aircraft, weapons systems, software and components as well as modeling and simulation for the US Air Force
  - Core components: flying operations, maintenance and test engineering
  - Test and evaluation mission areas
    - Airframe, propulsion, avionics (APA) in Test Engineering Group
    - Electronic warfare (EW) in the Electronic Warfare Group
BIG Mission... BIG Base!

Washington, D.C.

MOJAVE

HERNDON

DULLES INTL. AIRPORT

ROSAMOND

FALLS CHURCH

FAIRFAX

ROSAMOND DRY LAKEBED

ANDREWS AFB

LANCASTER

PALMDALE

GREENBEL PARK

0 5 10 MILES
Test Range Network
Range Capabilities

- Operate and Sustain Real-Time Systems
  - Mission Control Rooms
  - Data Acquisition and Transport Systems
  - Telemetry (TM) Systems
  - Encryption/Decryption Systems
  - Data Decom Systems
  - Air to Ground Communication Systems
  - Mobile Systems

- Sustain Range Instrumentation
  - PIRA targets and vehicles
  - TSPI Pods and Sensors

- Develop and Enhance Range Systems
  - Based on defined requirements perform software and hardware developments
Instrumentation Capabilities

• Operate and Sustain Instrumentation Systems
  - Perform pre and post flight checks and provide troubleshooting of instrumentation systems
  - Repair and replace data recorders, data acquisition systems, and sensors
  - Design instrumentation systems and components

• Development Engineering Requirements
  - Develop data validation tools
  - Support the development of Range Commander’s Council standards
Test Engineering Capabilities

- **Test Discipline Support**
  - Provide planning, conduct, analysis and evaluation support in the APA test engineering discipline
  - Provide data technician support and analysis in the areas of deficiency reporting for reliability and maintainability (R&M) testing
  - Provide Weapons munitions accounting and planning for weapons integration test test activities

- **Reporting Support**
  - Provide technical editing support to ensure that the reports are readable, comply with appropriate policies, and meet timeliness requirements

- **Data production**
  - Develop, operate, and sustain data analysis and production capabilities for the CTFs
Electronic Warfare Test Capabilities

• Benefield Anechoic Facility (BAF)
  □ Plan, configure, and operate the BAF chamber systems and test environment
  □ Operate and sustain the key BAF sub-systems to include simulators, stimulators, radar absorbing material (RAM), and other test equipment

• Integrated Facility for Avionics Systems Test (IFAST)
  □ Plan, configure and operate the hardware and software systems for a variety of hardware in the loop test facilities

• Modeling and Simulation (M&S)
  □ Develop, operate and sustain hardware and software systems for manned cockpit simulators
  □ Operate and maintain the computing resources needed for M&S capabilities
Current Autonomy Projects

• Currently no developmental testing Programs of Record

• Majority of work happening at lower TRL levels
  – AFRL
  – DARPA
  – Academia
  – sUAS

• Numerous projects ongoing that begin to touch at autonomous principles and systems
Projects “Touching” Autonomy

- AGCAS/ACAS/ICAS
- Sensor Data Fusion
- Hypersonic projects
- NASA-Armstrong Alliance
  - Autonomy Architecture Efforts
  - Collision Avoidance
  - sUAS test ranges
- Test Pilot School
  - Loyal Wingman
  - Vista F-16
  - Test Management Projects for AFRL & others
Future/Anticipated Projects

• Currently no Programs of Record for Autonomous Systems
• Anticipate initial projects will be upgraded capabilities to existing subsystems within existing aircraft
• sUAS will likely be entrypoint for future programs of record for initial fully autonomous aircraft
What are We Doing to Prepare

- TRMC UAST & OSD ATEVV Working Groups
- TRMC/GTRI Autonomy Range Study
- AFRL Autonomy Projects
- Johns Hopkins University Applied Research Lab
  - TACE
  - Autonomy Development
- 412 TENG UAST Working Group
- NASA-Armstrong Alliance
- Ground Based Sense and Avoid System
- sUAS Test areas within Edwards Complex
- Efforts to get involved in upcoming programs
  - We want to help and learn now!
Concerns for Testing Autonomy

- What Does Autonomy Look Like?
- How do we test it Safely and Effectively?
- Airspace Deconfliction and Safety
- Range Resources Required
- Personnel Skills and Abilities Required
- How Much is Enough Testing
- How do we analyze autonomous systems
- How do we design systems for test
- AUTONOMY WILL BE DIFFERENT
  - We can’t wait until it shows up to figure out testing
Testing of Autonomy Thoughts

- Run Time Assurance
  - NASA EVAA designs
- Licensure
- Safe & Effective Ranges
  - TACE & Live Virtual Construct
  - Common Architectures
  - Design for Test
- Paradigm Shift in how Testers think
  - Lack of Repeatability
  - Can never be done – What is enough?
- Continuum of Test
- Types of testers required
QUESTIONS?