Human-Automation Interface Research at 711HPW

March 2015
Tom Hughes, Ph.D.
INFOSCITEX
711HPW/RHCI
Air Force Research Laboratory

Integrity ★ Service ★ Excellence

Key Challenges That Increasing System Autonomy May Help Address

Decentralization, Uncertainly, Complexity…Military Power **in the 21st Century will be defined by our ability to** ***adapt – adaptation is the underlying foundation of autonomous technology***

- **Manpower efficiencies**
- **Rapid response**
- **24/7 presence**
- **Harsh environments**
- **New mission requirements**
- **…….. Across Operational Domains**

711HPW/RHCI

USAF Experts in Human-Automation Interaction

Balance of basic & applied research experience

- **Strong in-house research expertise**
- **Extensive research collaborations & partnerships**
- **AF Customers: ASD R&E, AFMCLC/WI, AF/A2Q**

International Leadership: NATO, TTCP, DEAs

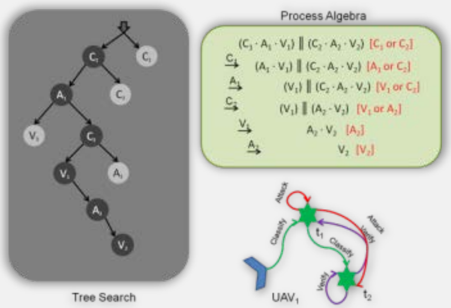
2 Focused Research Program Portfolios:

1. **Human Interaction with Adaptive Automation**
2. **Supervisory Control Integration & Demonstration**

MISSION: Researching the fundamental underpinnings of human-automation interaction and designing the human-machine interface to enhance the operator's continuous situation awareness and decision making in ways to ensure flexible, fault tolerant mission operations.

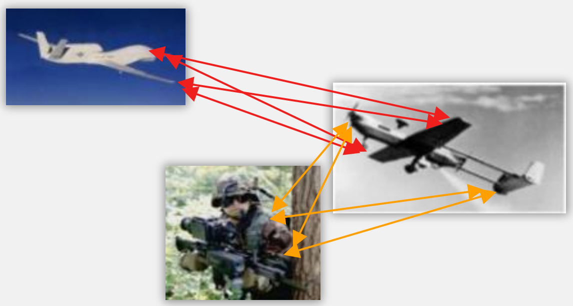
1) Human Interaction with Adaptive Automation

How can human-automation problem solving be improved for dynamic mission planning?

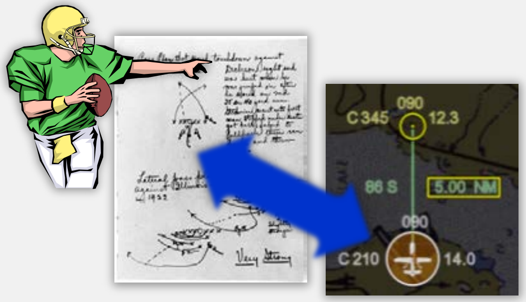


Should autonomy level be adaptable or adaptive? Does personality influence automation usage?

What support will operators need for decentralized decision-making and limited communications?

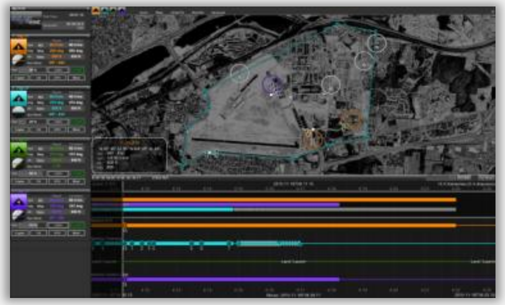


What control architecture is best to seamlessly transition between autonomy levels?



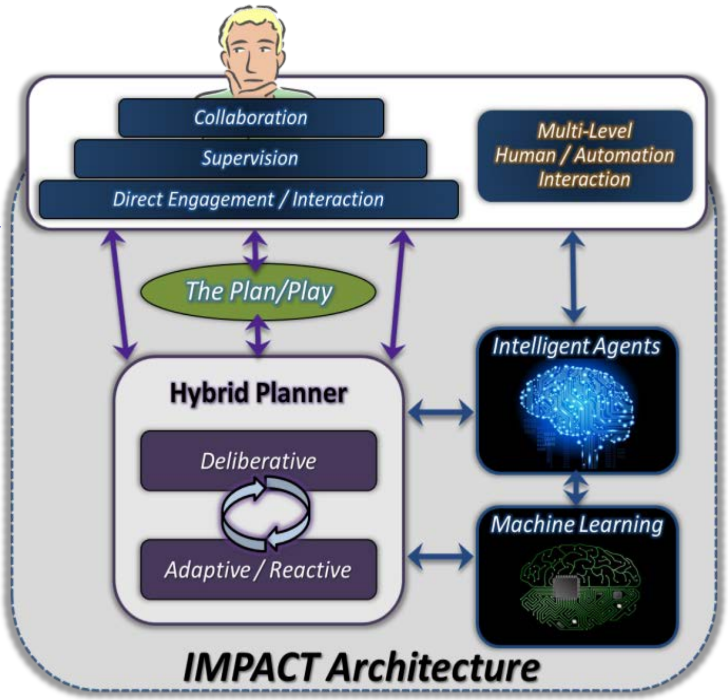
Flexible, Adjustable H-A Interaction Methods & Feedback Tools

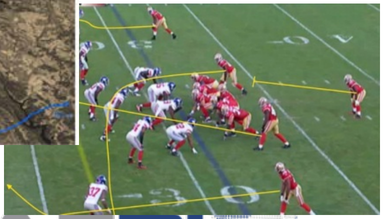
What methods can be used to interact with automation for multi-vehicle supervisory control?



ARPI: Realizing Autonomy via Intelligent Adaptive Hybrid Control

- **Tri-Service Research Team**
- **Task: Supervise collaborative heterogeneous UV teams for base security**
- **Objective: Maximize H-A Team Agility**
- **Multiple methods to be explored:**
  - ***Improved cooperative control algorithms***
  - ***Intuitive Human-autonomy dialog***
  - ***Agent technology***
  - ***Machine learning***
- **Central theme: Playbook**
- **Virtual Lab: *AFRL, SPAWAR, NRL, ARL***





ARPI: Autonomy for Air Combat Missions

- Develop Autonomy Technologies for air combat in a future highly contested or A2AD environment
- Mixed team of manned and unmanned aircraft
- Develop a "Tactical Battle Manager" to plan and coordinate actions of multiple aircraft
- Discover new tactics through machine learning

2) Supervisory Control Integration & Demonstration

How does mission type & interface tech impact multi-UAS control?

How to enable a synergistic family of flexible, distributed control stations?

SOC Supervisor

Multi Transit Operations Pilot

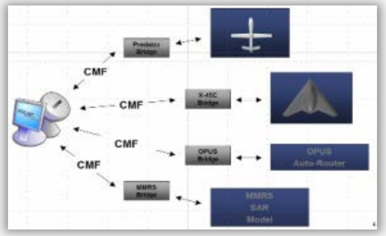
Single Aircraft Pilot

VIGILANT Spirit Control Station

What interface concepts & automation tools truly enable new UAS capability?

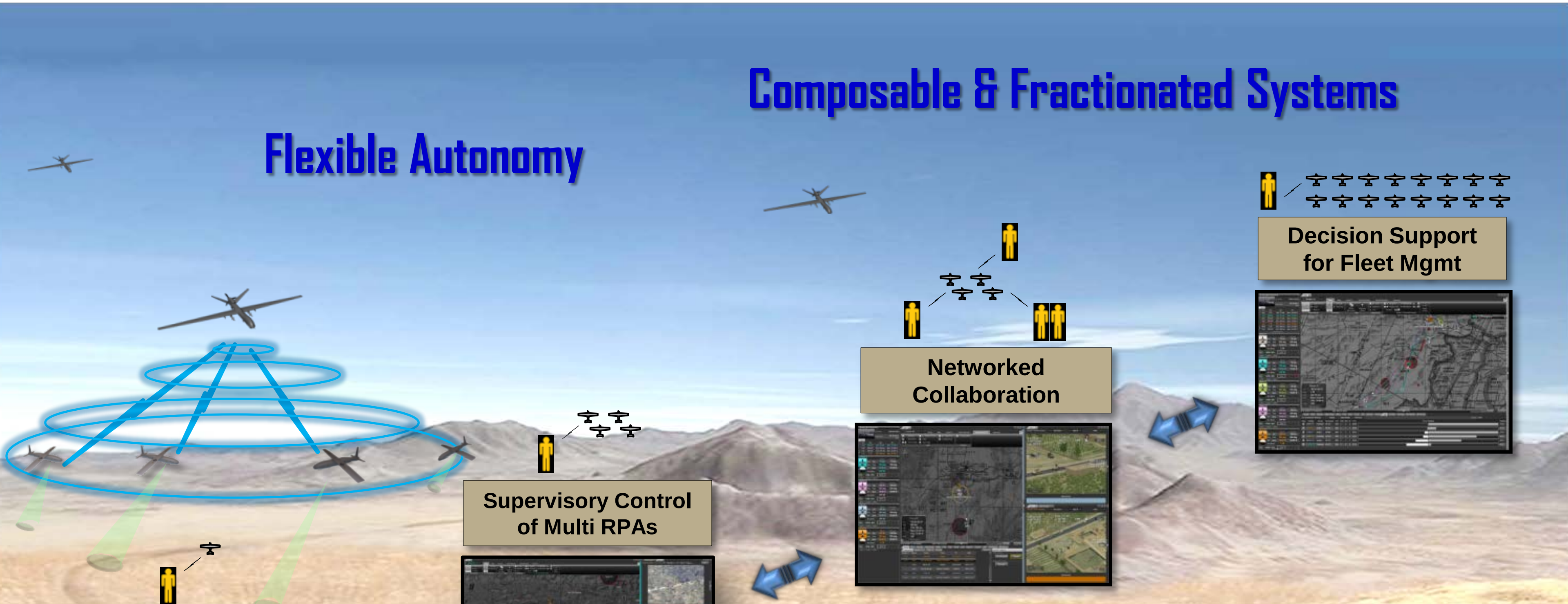
Reconfigurable, Networked Operator Control Station Tech to Minimize Crew Size, Enable Multi-UAS Ops

How to design standard, flexible control station architectures for interoperability?



Multi-Role Control Station

M – N Spectrum of Control Capability



- Net-centric & Scalable: 1 to *M* operators - 1 to *N* heterogeneous RPAs & payloads
- Reconfigurable: benign to dynamic missions
- Flexible automation aids to reduce crew workload and increase mission effectiveness
- Fused info displays to speed decision making
- Govt-owned common control station app.

Future Vision

Calibrated trust

Continual engagement

Automation transparency

Flexible autonomy

Intuitive control

Shared intent

Flexible & Fault Tolerant Multi-autonomous System Control

Questions?