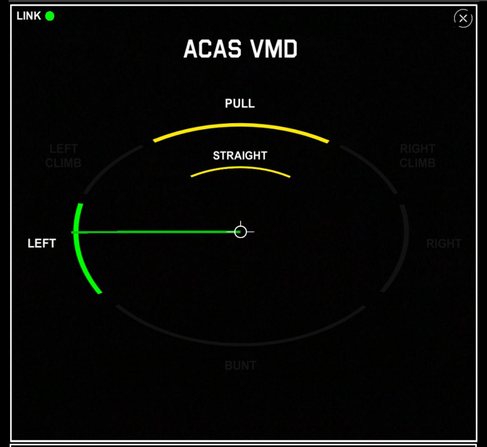
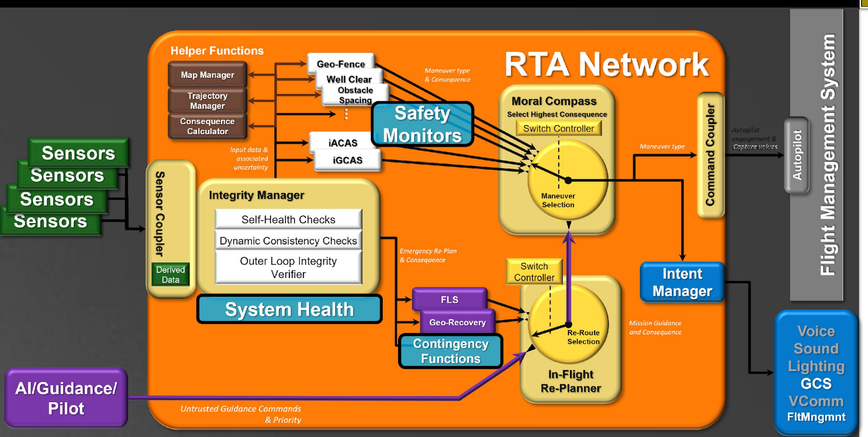
AUTONOMY RESEARCH CENTER FOR **STEAHM**

NASA JPL

Design and Evaluation of Expandable Variable-Autonomy Architecture's (EVAA) Intent Manager Interface for Improved Human-Autonomy Teaming



ACAS Intruder Evaluator



Research Objective

- Design, develop and implement a multi-modal system that employs situational and intentional (explainable autonomy) awareness tools for an advanced autonomous aerial system called EVAA – a hierarchal autonomous system framework that depends on deterministic systems with higher authority to protect against catastrophic piloting faults, in collaboration with NASA Armstrong Flight Research Center (AFRC).
- Improve EVAA's Human-Autonomy Teaming (HAT) capabilities by enhancing Human-Computer Interaction (HCI) and communication, refining the Intent Manager's graphical user interface(s), and implementing a broader human interface design.
- Calibrate trust between the human operator and autonomy to ensure efficient Human Systems Integration (HSI).
- Establish a basis for an adaptive mechanism that dynamically adjusts actions and task delegation to adapt and accommodate the human operator.
- Evaluate EVAA's Intent Manager system post-improvement and make recommendations to NASA for Human Readiness Level (HRL) rating and future autonomous system development.

Research Methods

- Establish EVAA flight simulation testbed to provide a flexible framework that enables autonomy algorithm research and software development.
- Design, prototype, and develop a multi-modal user interface system in the form of a ground control station that consists of the following standalone situational awareness and flight-test displays:
  - Air Collision Avoidance System (ACAS) Viable Maneuver Display (VMD).
  - Ground Collision Avoidance System (GCAS) VMD.
  - ACAS Intruder Evaluator.
  - EVAA Aware – Real-time simulated operational display.
- Research HCI best practices, adopt a human-centric design, and practice human factors engineering to address potential trust barriers and explainability challenges .
- Conduct simulated human-in-the-loop (HITL) studies to evaluate the combined system performance and verify the effectiveness of situational awareness tools and graphical user interfaces.
- Perform usability testing to evaluate display qualities and refine interface design through an iterative qualitative and quantitative mixed-methods approach using the following design metrics:
  - Modified Cooper-Harper Scale.
  - Display Specific Modified Cooper-Harper Scale.
  - Bedford Workload Scale.
  - System Usability Scale (Likert).
  - Standardized User Experience Percentile Rank Questionnaire (SURP-Q).

Research Team

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