Trustworthy Autonomy

Autonomy

1. Self-directing freedom and especially moral independence. - *Websters*

2. Independence from the organism as a whole in the capacity of a part for growth, reactivity, or responsiveness. – *Medical Reference*
The Challenge

• Verification & Certification of a Complex System
• A Possible Solution – Run-Time Assurance (RTA)
Avoid Collisions
Do Not Impede the Pilot
Flight 18 event 6, 45 kts, 100' buffer

sUAV
Safety Systems

- Sense Own-State & Atmospherics
  - Sufficient to support trajectory estimation

- Sense Collision Threat
  - Terrain
  - Aircraft
  - Weather
  - Missiles

- Predict Escape Trajectories
  - Evasion Types
  - Maneuvering Capability
  - Evasion Trajectory Estimations
  - Associated Uncertainties

- Predict Future Threat State
  - Scan/Track Pertinent Threat
  - Simplify Threat Profile
  - Associated Uncertainties

- Determine Need to Evade & Threat Lethality
  - Minimum Approach
  - Integrity Check
  - Time to Evade
  - Command Evasion

- Evade
  - Integrity Check
  - Execute Evasion

- Pilot Controls
  - Mode Selection
  - Interface

- Notify
  - Alert
  - Record
  - Recall

- Common Interface

- Autopilot Coupler
How we will achieve this

1. Modular Software Architecture
   • Top down architecture hierarchy with clearly specified interfaces

2. Functionally Partitioned Modules
   • Each module limited to a single safety function
   • Software isolation of Vehicle performance modeling

3. Computational Agility
   • Rapid assessment of vehicle situational hazards with quick and decisive mitigation of those hazards
Developmental Test & Evaluation

Common Vehicles
- Elissa

Common Hardware
- EVAA Processor

Test Ranges
- Indoor Range
- Low-Altitude sUAS Test Ranges
- Rural-Desert Range
- Rural-Urban Range
- High-Altitude Wilderness Range
- Instrumented Obstacles