Trustworthy Autonomy

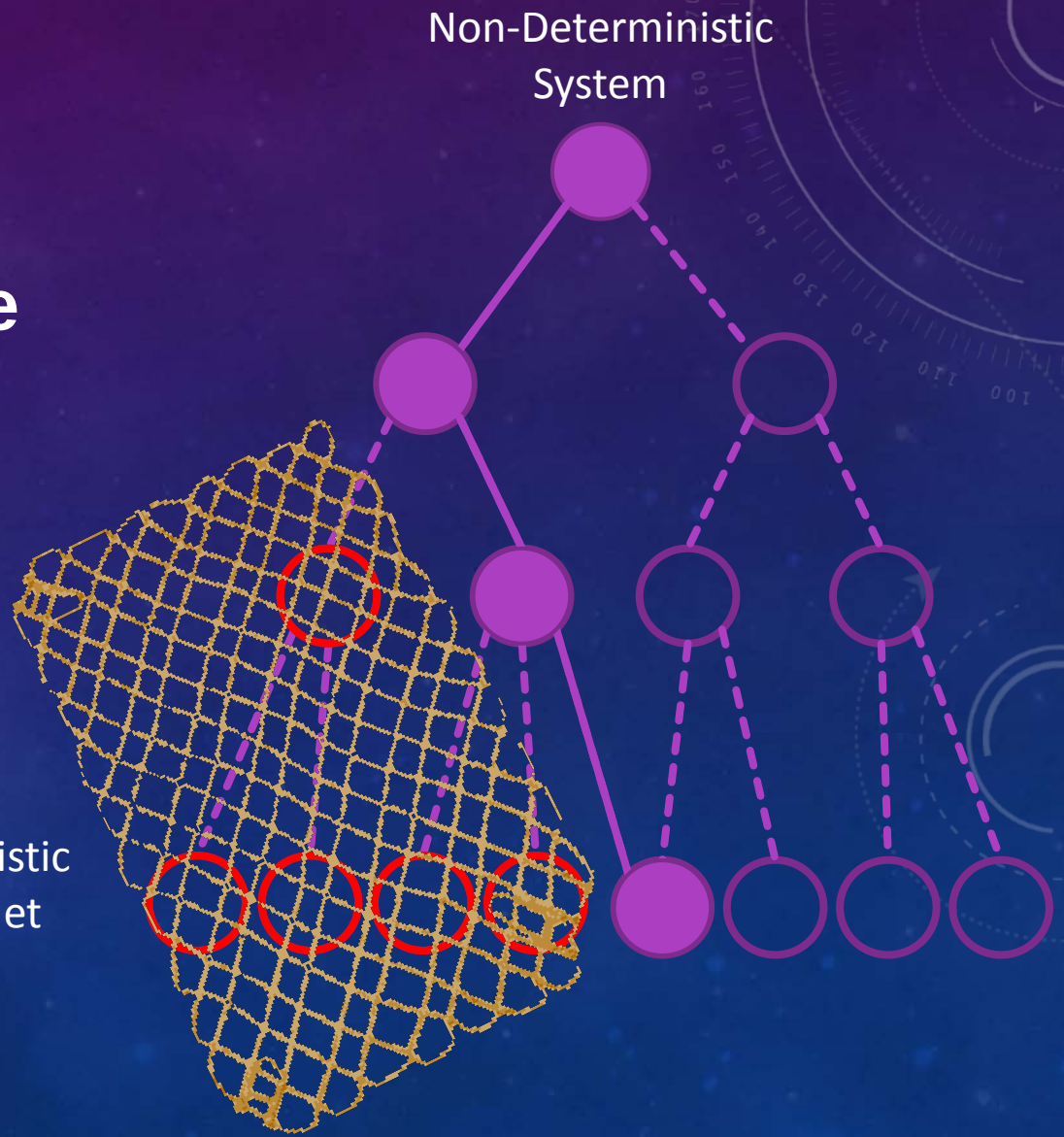
Autonomy

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*

Mark Skoog
Principle Investigator Automatic Systems
Armstrong Flight Research Center

The Challenge

- **Verification & Certification of a Complex System**
- **A Possible Solution – Run-Time Assurance (RTA)**



Research Timeline

1980 2000 2010 2016

Automated Maneuvering Attack System (AMAS)

Automation Research

AFTI/F-16
Advanced Fighter Technology Integration

AFTI & ACAT/F-16
Automated Collision Avoidance Technology

Automated Collision Avoidance

Air

Ground

Integrated

Dedicated Safety Work

Quad-Rotor

Ground Collision Avoidance

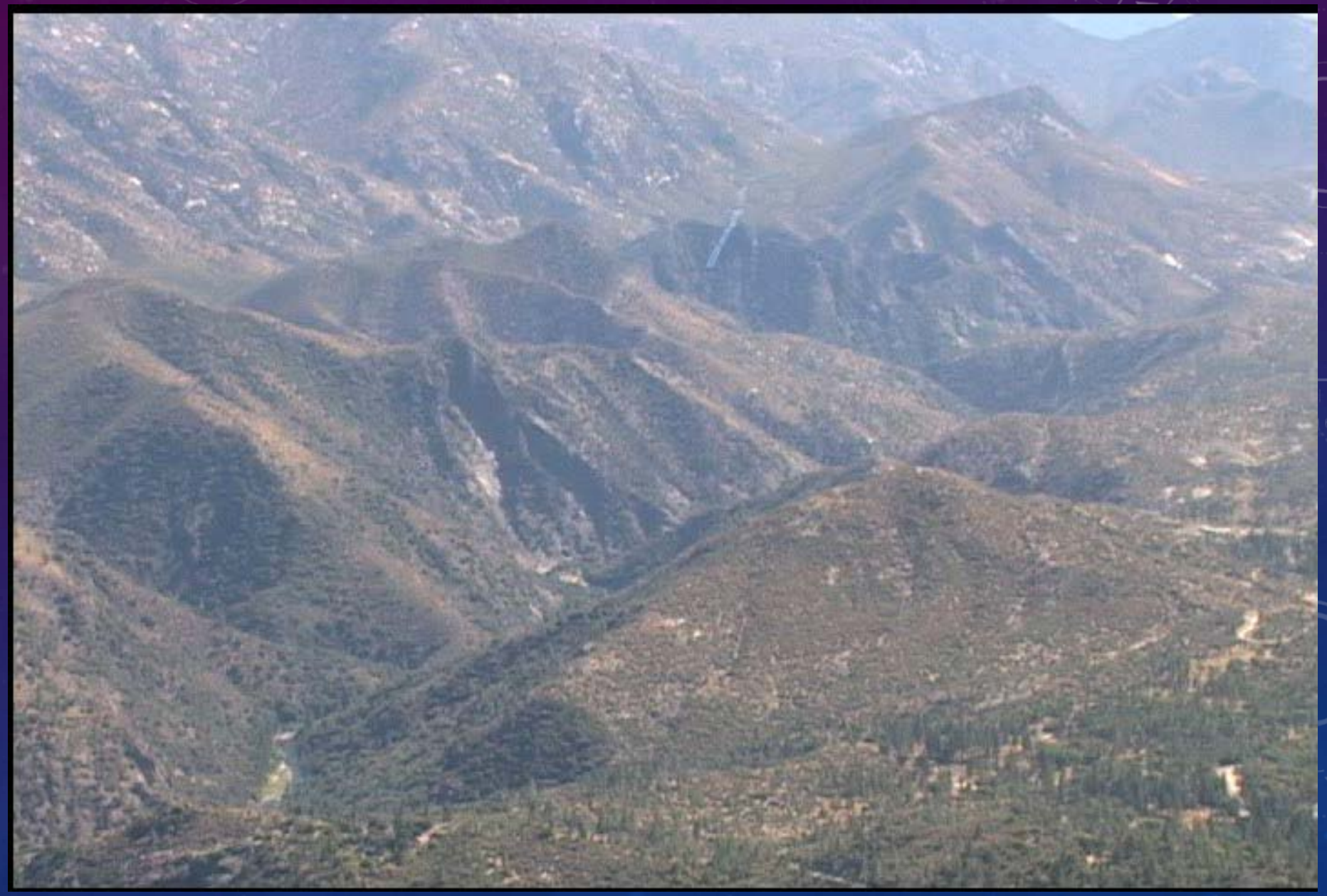
GA

Small UAS

Platform Diversity

SUAV/iGCAS/SR22
Improved Collision Avoidance System

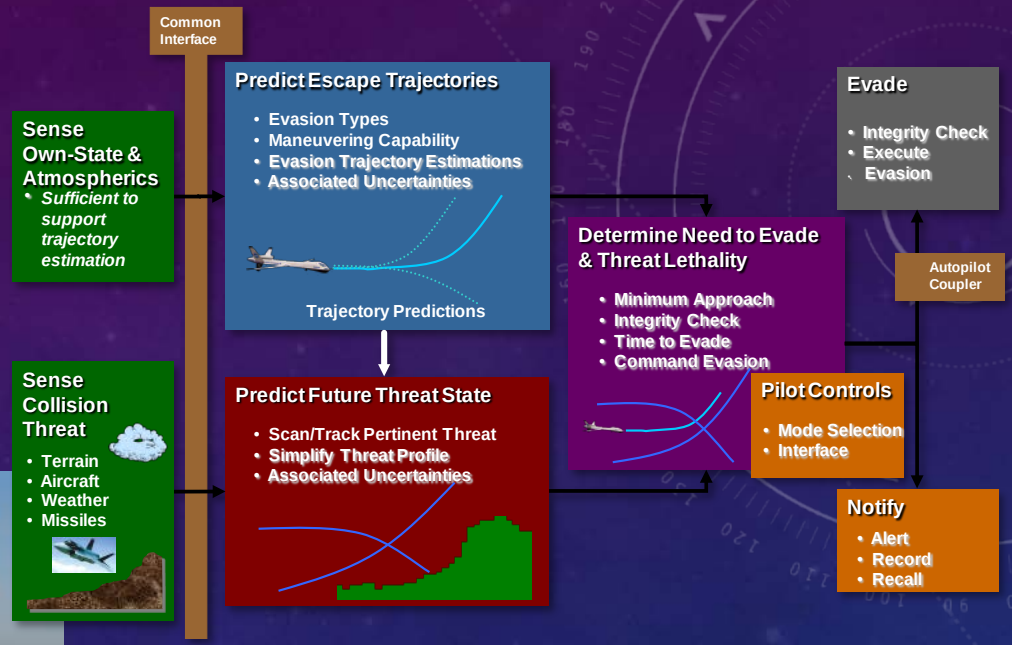
Avoid Collisions

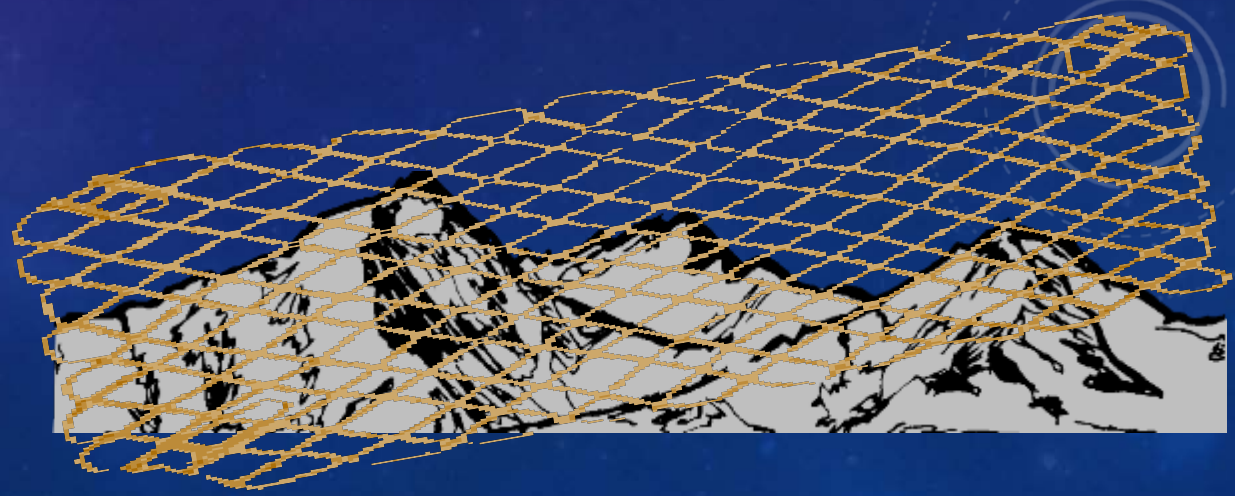


Do Not Impede the Pilot

sUAV

Safety Systems

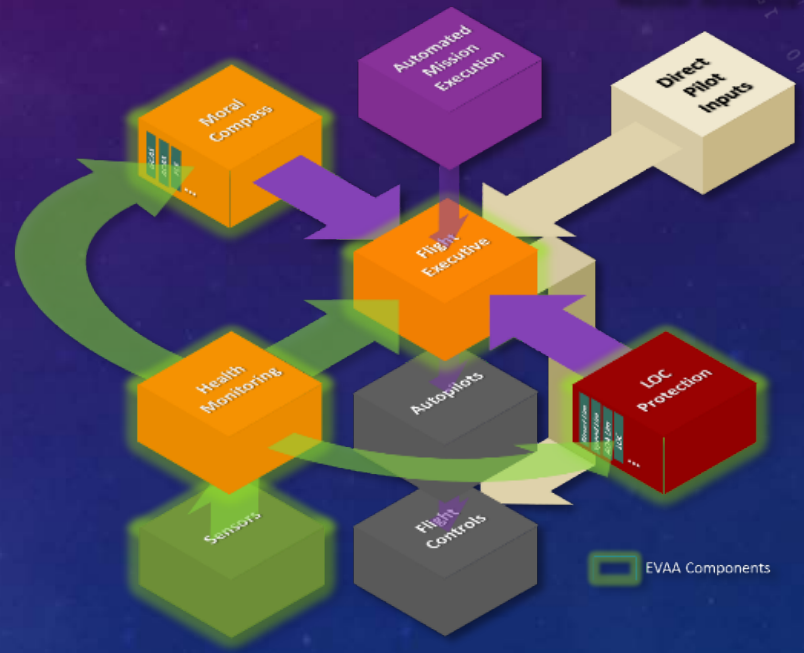




How we will achieve this

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

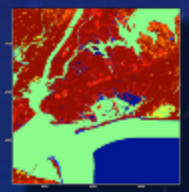
Expandable Variable-Autonomy Architecture
EVAA




Weather Avoidance


Aircraft Avoidance


Geo-Fence



Forced Landing System


Terrain Avoidance

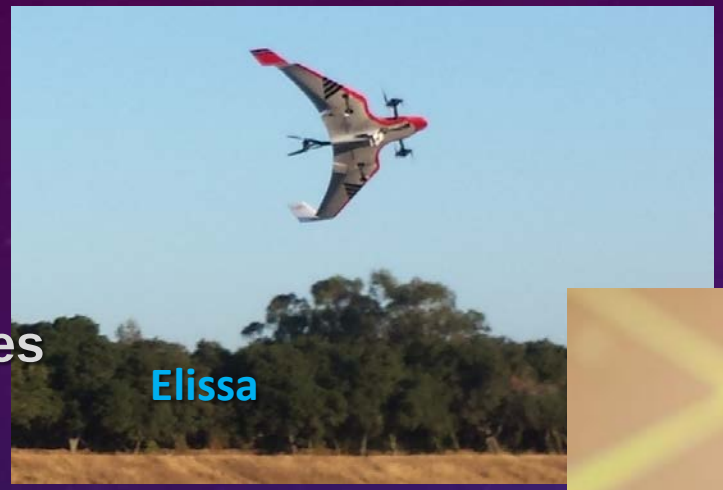


Obstacle Avoidance


Health & Integrity Monitoring

Developmental Test & Evaluation

Common Vehicles

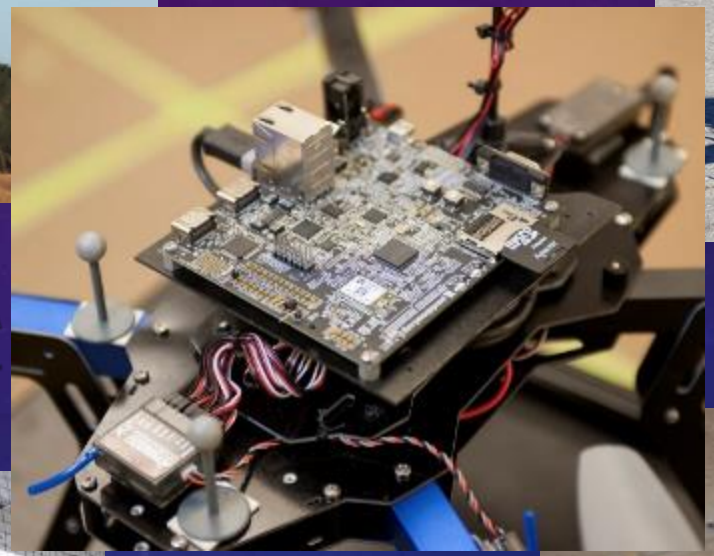


Elissa

QR4

Common Hardware

EVAA Processor

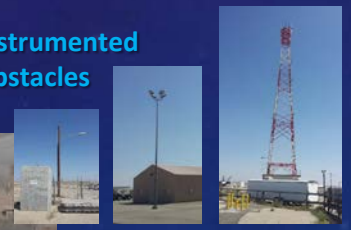


Test Ranges

Indoor Range

Rural-Urban Range

Instrumented Obstacles



Low-Altitude sUAS Test Ranges

Rural-Desert Range

High-Altitude Wilderness Range


NASA
Langley Research Center
NASA
Questions