Flight Controls Q&A

Presentation to: NASA ODM
By: Wes Ryan, Manager ACE-114
Date: March, 2016
Objective

- Flight Path Control - Key Enabler for ODM
- Summarize FAA Efforts & Next Steps
Long Term Goals

- Create Regulatory Environment for Safer, More Innovative Aircraft
- Work With Industry, NASA, & Others to Plan for Future
- Consider Role of Flight Path Control
- Technology More Affordable Every Year
FAA R&D Efforts & Planning

• The Part 23 Rewrite, FAA R&D, Standards Work, & UAS Certification Efforts All Fit Together - Prototyping New Ideas

• Creating a Long Term Vision for GA - Start With Low Risk, Work up to Higher Risk

• Our R&D Building Blocks
  • AOA for Stall Prevention
  • Dual Axis “Smart” Autopilots
  • Non-Deterministic & Adaptive Systems
Identify Building Blocks

- Started with Sensors – AHRS, AOA, etc.
  - Better Sensors, Design Tools, Actuators, Displays, etc.
- Evolving from Passive/Sensing, to Active Systems, to Adaptive Systems
- Augmented Flight Control - FBW
Why AOA Sensors?

- Non-required system
- Provides Direct Indication of Stall
- Pilots Trained on Speed, but Dynamic Stall is Common – Better Information
- Low Risk Solution to Root Cause of Accidents in GA
“Smart Autopilot” Work

- Provide Envelope Protection
  - Garmin’s GFC-700, Avidyne DFC-90
- How Can we Simplify Certification?
  - Real Time Integrity Monitoring?
  - Independent Monitor with Reversion?
  - “Black Box” with Executive Monitor on Behavior of System?
- Working with Adaptive Aerospace on Solutions
Retrofit - TruTrak ECO

• Tru Trak Designing Separate Surface Autopilot – Easier Interface for Existing Aircraft
Should We Consider NHTSA?

- Level 0 – Warning systems alone
- Level 1 – multiple automatic control functions (steering, braking, throttle) that operate independently
- Level 2 – Combined function automation, but driver still responsible for monitoring the road. The driver is expected to be available to assume control on short notice.
- Level 3 – Driver is not expected to be constantly monitoring. However, the driver is available to assume control with sufficiently comfortable transition time
- Level 4 – Full self-driving cars where the vehicle performs all critical driving functions.
What Design Best Practices?

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
How We Will Achieve The Vision?

• A Software Framework
  • Expandable Variable-Autonomy Architecture (**EVAA**)
  • A Federated Architecture
    • Safety Systems
      • 1
      • 2
      • 3...
    • Flight Executive
  • Software Structure & Techniques

• Classical & Non-Classical Verification Methods

• Demonstration of the Technology
  • Flight Demonstrations
  • Social Interaction
Integrated Controls

• Seek Whole Aircraft System
  • Avionics, Propulsion, Flight Path Management, Configuration Management
  • Controls Thrust, Aero, Configuration, System
  • Follows Intended Point to Point Flight Path
• Rely on Safety Net & Mitigations
  • Safe Degraded Modes – Self Protection
  • Auto-recovery – Panic Button
  • Whole Aircraft Parachute
• Considering an ASTM Group to Create Standards
Impact on Skill?

• Contrasting Technology
  • Legacy Instruments – Federated
  • Modern Device – Intuitive Interface
• Expected Skill – Pilot Flies Through System
  • Controls “fly” but direct flight path control by DFCS, not the pilot (“On” the Loop)
• Clear System Status and Pilot Expectation
• Pilot Pulls the “Rip Cord” – Parachute Recovery for Catastrophic Failure of System
Discussion......