NASA SBIR 2018 Phase I Solicitation

A3.03 Future Aviation Systems Safety

Lead Center: ARC

Participating Center(s): LaRC

Technology Area: TA15 Aeronautics

Public benefits derived from continued growth in the transport of passengers and cargo are dependent on the improvement of the intrinsic safety attributes of the Nationâ€™s and the worldâ€™s current and future air transportation system.Â Recent developments to address increasing demand are leading to greater system complexity, including airspace systems with tightly coupled air and ground functions as well as widely distributed and integrated aircraft systems.Â Current methods of ensuring that designs meet desired safety levels will likely not scale to these levels of complexity (Aeronautics R&D Plan, p. 30). The Airspace Operations and Safety Program (AOSP) is addressing this challenge with a major area of focus on real-time system-wide safety assurance (RSSA). A proactive approach to managing system safety requires:Â

- The ability to monitor the system continuously and to extract and fuse information from diverse data sources to identify emergent anomalous behaviors after new technologies, procedures, and training are introduced.
- The ability to reliably predict probabilities of the occurrence of hazardous events and of their safety risks.Â Â

Understanding and predicting system-wide safety concerns of the airspace system and the vehicles as envisioned by NextGen is paramount. Such a system would include the emergent effects of increased use of automation and autonomy to enhance system capabilities, efficiency and performance beyond current, human-based systems, through health monitoring of system-wide functions that are integrated across distributed ground, air, and space systems. Emerging highly autonomous operations such as those envisioned for UAS and on-demand air mobility (ODM) will play a major role in future airspace systems. In particular, operating beyond the operatorâ€™s visual line-of-sight (BVLOS) and near or over populated areas are topics of concern. Safety-critical risks include:Â

- Flight outside of approved airspace.
- Unsafe proximity to people/property.
- Critical system failure (including loss of C2 link, loss or degraded GPS, loss of power, and engine failure).
- Loss-of-control (i.e., outside the envelope or flight control system failure).Â

Tools are being sought for use in creating prototypes of RSSA capabilities.Â The ultimate vision for RSSA is the delivery of a progression of capabilities that accelerate the detection, prognosis and resolution of system-wide threats.Â

Proposals under this subtopic are sought, but not limited to, these areas (with an emphasis on safety applications):Â

- Develop data collection architecture, data exchange model and data collection mechanism (for example via UTM TCL-4).
- Develop and demonstrate data mining tools and techniques to detect and identify anomalies and precursors to safety threats system-wide.
- Develop and demonstrate tools and techniques to assess and predict safety margins system-wide to assure airspace safety.Â
- Develop and demonstrate prognostic decision support tools and techniques capable of supporting real-time safety assurance.
- Develop and demonstrate V&V tools and techniques for assuring the safety of air traffic applications during certification and throughout their lifecycles, and, techniques for supporting the real-time monitoring of safety requirements during operation.
- Develop and demonstrate products to address technologies, simulation capabilities and procedures for reducing flight risk in areas of attitude and energy aircraft state awareness.
- Develop and demonstrate decision support tools and automation that will reduce safety risks on the airport surface for normal operations and during severe weather events.
- Develop and demonstrate alerting strategies/protocols/techniques that consider operational context, as well as operator state, traits, and intent.
- Develop methodologies and tools for integrated prevention, mitigation, and recovery plans with information uncertainty and system dynamics in a UAS and in a TBO environment.
- Develop and demonstrate strategies for optimal human-machine coordination for real-time hazard mitigation.
- Develop and demonstrate methods and technologies enabling transition from a dedicated pilot-in-command or operator for each aircraft (as required per current regulations) to single operators safely and efficiently managing multiple unmanned and ODM aircraft in civil operations.
- Develop measurement methods and metrics for human-machine team performance and mitigation resolution.
- Develop system-level performance models and metrics that include interdependencies and relationships among human and machine system elements.