



NASA SBIR 2016 Phase I Solicitation

A2.02 Unmanned Aircraft Systems Technology

Lead Center: AFRC

Participating Center(s): GRC, LaRC

Unmanned Aircraft Systems (UAS) offer advantages over manned aircraft for applications which are dangerous to humans, long in duration, require great precision, and require quick reaction. Examples of such applications include remote sensing, disaster response, delivery of goods, agricultural support, and many other known and yet to be discovered. In addition, the future of UAS promises great economic and operational advantages by requiring less human participation, less human training, an ability to take-off and land at any location, and the ability to react to dynamic situations.

NASA is involved in research that would greatly benefit from breakthroughs in UAS capabilities. Flight research of basic aerodynamics and advanced aero-vehicle concept would be revolutionized with an ability of UAS teams to cooperate and interact while making real time decisions based upon sensor data with little human oversight. Commercial industry would likewise be revolutionized with such abilities.

There are multiple technological barriers that are restricting greater use and application of UAS in NASA research and in civil aviation. These barriers include, but are not limited to, the lack of methods, architectures, and tools which enable:

- The verification, validation, and certification of complex and/or nondeterministic systems.
- Humans to operate multiple UAS with minimal oversight.
- Multi-vehicle cooperation and interoperability.
- High level machine perception, cognition, and decision making.
- Inexpensive secure and reliable communications.

This solicitation is intended to break through these and other barriers with innovative and high-risk research.

The Integrated Aviation Systems Program's work on UAS Technology for the FY 2016 NASA SBIR solicitation is focused on breaking through barriers to enable greater use of UAS in NASA research and in civil aviation use. The following five research areas are the primary focus of this solicitation, but other closely related areas will also be considered for reward. The primary research areas are:

- *Verification, Validation, and Certification* - New inexpensive methods of verification, validation, and certification need to be developed which enable application of complex systems to be certified for use in the national airspace system. Proposed research could include novel hardware and software architectures that enable or circumvent traditional verification and validation requirements.
- *Operation of multiple UAS with minimal human oversight* - Novel methods, software, and hardware that enable the operation of multiple UAS by a single human with minimal oversight need to be developed which

ensure robust and safe operations. Proposed research could include novel hardware and software architectures which provide guarantees of safe UAS operations.

- *Multi-vehicle cooperation and interoperability* - Technologies that enable UAS to interact in teams, including legacy vehicles, need to be developed. This includes technologies that enable UAS to negotiate with others to find optimal routes, optimal task allocations, and optimal use of resources. Proposed research could include hardware and software architectures which enable UAS to operate in large cooperative and interactive teams
- *Sensing, perception, cognition, and decision making* - Technologies need to be developed that provide the ability of UAS to detect and extract internal and external information of the vehicle, transform the raw data into abstract information which can be understood by machines or humans, and recognize patterns and make decisions based on the data and patterns.
- *Inexpensive, reliable, and secure communications* - Inexpensive methods which ensure reliable and secure communications for increasingly interconnected and complex networks need to be developed that are immune from sophisticated cyber-physical attacks.

Phase I deliverables should include, but are not limited to:

- A final report clearly stating the technology challenge addressed, the state of the technology before the work was begun, the state of technology after the work was completed, the innovations that were made during the work period, the remaining barriers in the technology challenge, a plan to overcome the remaining barriers, and a plan to infuse the technology developments into UAS application.
- A technology demonstration in a simulation environment which clearly shows the benefits of the technology developed.
- A written plan to continue the technology development and/or to infuse the technology into the UAS market. This may be part of the final report.

Phase II deliverables should include, but are not limited to:

- A final report clearly stating the technology challenge addressed, the state of the technology before the work was begun, the state of technology after the work was completed, the innovations that were made during the work period, the remaining barriers in the technology challenge, a plan to overcome the remaining barriers, and a plan to infuse the technology developments into UAS application.
- A technology demonstration in a relevant flight environment which clearly shows the benefits of the technology developed.
- Evidence of infusing the technology into the UAS market or a clear written plan for near term infusion of the technology into the UAS market. This may be part of the final report.