Air Force to spend $950 million on Autonomous technologies Research to enable its Anti-access and area denial (A2/AD) missions

The Air Force is looking to increase the use of autonomous technology and has released a Broad Agency Announcement for industry participation, according to a July 7 agency notice. The objective of Science and Technology for Autonomous Teammates (STAT) program is to develop and demonstrate autonomy technologies that will enable various AF mission sets. The STAT program will push for research to strengthen three capabilities: Multi-domain Command and Control (MDC2); Intelligence, Surveillance, Reconnaissance (ISR) Processing, Exploitation, and Dissemination (PED); and Manned-Unmanned Teaming (MUM-T) in combat situations.

Autonomy is a capability (or a set of capabilities) that enables a particular action of a system to be automatic or, within programmed boundaries, “self-governing.” Autonomous systems provide a considerable opportunity to enhance future Air Force operations by potentially reducing unnecessary manning costs, increasing the range of operations, enhancing capabilities, providing new approaches to air power, reducing the time required for critical operations, and providing increased levels of operational reliability, persistence and resilience. This is the view of Air Force Office of the Chief Scientist that has come with report “Autonomous Horizons Volume I: Human Autonomy Teaming”.

The Science and Technology for Autonomous Teammates (STAT) program is seeking to improve Air Force operations through machine learning that uses human-machine teaming, autonomous decision-making processes, and information analytics research, according to the BAA overview.

DOD has been seeking to advance initiatives that focus on machine learning and artificial intelligence since the "Third Offset" strategy was unveiled in September 2014. The continued efforts are intended to promote technologies and concepts that support the U.S. military's technological advantage.

The total estimated value is $950 million for the total period of performance, which is based on the following annual estimates: $118 million in FY 2018, $152 million in FY 2019, $159 million in FY 2020, $153 million in FY 2021, $149 million in FY 2022, and $219 million in FY 2023.

The program seeks technologies that:

1) Enable airman-machine teaming for executing Air Force missions.

2) Reduce workload or manning without compromising mission effectiveness or decision timelines.

3) Enable autonomous systems to understand commander's intent and mission requirements and adapt to changing circumstances in a manner consistent with commander's intent.

4) Allow autonomous and unmanned systems to safely and efficiently integrate into Air Force operations.

Chosen technologies will be open, reusable, adaptable, platform agnostic, secure, credible, affordable, enduring, and able to be integrated into autonomous systems. STAT's objective is to demonstrate modular, transferable, open-system architectures, and deliver autonomous technologies to multidomain applications. The software algorithms must understand mission requirements, respond to human directions, and respond to unexpected threats and changing circumstances.

The technology demonstrations that result from this BAA will substantially improve the Air Force's capability to conduct missions in a variety of environments while minimizing the risks to Airmen. The overall impact of integration of autonomous systems into the mission space will enable the Air Force to operate inside of the enemy's decision loop.

Program Structure

This research will be part of Experimentation Campaigns in: 1 -Multi-domain Command and Control; 2- Intelligence, Surveillance, Recognizance (ISR) Processing Exploitation and Dissemination (PED); and 3- Manned-Unmanned combat Teaming to demonstrate autonomy capabilities to develop and demonstrate autonomy technologies that will improve Air Force operations through human-machine teaming and autonomous decision-making.

This effort features EIGHT important research areas of interest, listed below, which include needs for both technology maturation and integration:

1. **Mission Planning and Debrief.**

STAT research must enable platforms to receive information generated during the mission planning process, and provide relevant information during the debrief process, without causing extension of the mission cycle timelines or requiring increased manpower. This area develops the capability for STAT-enabled systems to take in information about the mission plan (including mission contracts, contingencies, targets, frequencies, etc.) that will be necessary to react appropriately and autonomously to events and commands during mission execution. This area is critical for MDC2, ISR PED as well as manned-unmanned teaming.

2. **Flight Operations**

Autonomous platforms must be able to safely aviate and navigate in ‘military airspace’ with other aircraft, manned and unmanned, while monitoring their own state of health and performing the appropriate actions to ensure safe flight. The platforms must perform basic flight operations to include automated flight modes, flight safety, survivability, and energy resource management. Autonomous vehicle functions enable the execution of mission taskings that span over all mission phases and kill chain elements. These elements are intended to execute the desired vehicle response commanded from other subsystems such as dynamic mission planning. Air and ground collision avoidance capabilities are required, adaptable to varying aircraft capabilities in maneuverability, sensors, and datalinks. Flight Operations is responsible for ensuring continued, safe operation in the presence of flight-critical failures and degradations. It is also responsible for ensuring continued, safe execution of mission tasking in the presence of mission-critical guidance, navigation, and control system failures and degradations.

3. **Communications & Datalinks.**

The communications and data links are responsible for processing, passing and coordinating messages both onboard and between external communication nodes. Technologies are required for dynamic networking capabilities within the full spectrum of communications control and intelligent management of the dissemination of information (the how, when, and how much to communicate in a given environment agnostic of any singular communications medium). This area supports MDC2, ISR PED, and manned-unmanned teaming.

4. **Human Interfaces.**

Human interfaces and decision aids enable the human to team with autonomous systems, leveraging the advantages of both human and machine intelligence. Human interfaces with autonomy platforms must be intuitive and simple for a human to use. This means that direct supervision of all decisions cannot be required. The interfaces provide human awareness and understanding of autonomous system decisions with minimal display clutter, through tailorable human-machine interfaces, effectively alerting the operator when human action is required. This area is critical for MDC2, ISR PED as well as manned-unmanned teaming.

4. **Multi-Domain Mission Operations.**

Multi-Domain Mission Operations is focused on mission execution and operation of mission systems. Major components include:

- Situation understanding through robust sensor exploitation, data analysis, and information sharing
- Dynamic mission planning for contingencies
- Multi-domain command and control

Robust sensor exploitation is essential for the deep understanding of the environment required for autonomous, closed-loop decision-making in a complex mission environment, with applications to autonomous vehicles command and control, and the processing, exploitation, dissemination (PED) process.

The situation understanding capability must provide detection, geolocation, identification and tracking of target and threats using a variety of sensing sources, traditional single and multi-INT fusion, distributed and cooperative techniques, and must operate over a large breadth of operating conditions. Dynamic mission planning determines how to achieve commanded mission effects, and includes task assignment and scheduling across multiple manned and unmanned systems, route planning, and re-planning for any mission contingencies. Dynamic mission planning and re-planning can occur at vehicle, team, or battlespace levels, and must occur as part of the overall command and control structure. Multi-domain command and control is essential for achieving coordinated effects through the use of heterogeneous assets in air, space, and cyber domains.

6. **Executive Functions.**

The Executive Functions purpose is to provide high-level reasoning capabilities and a goal-prioritization service based on Commander’s Intent. The Executive Function research should support an agent-based model for Observe, Orient, Decide, and Act (OODA-loop). Information about the operational environment will need a common state representation that allows for rational decision-making based on mission plans and current mission status. Decisions made by the machine will include determining what information must be shared with human operators, when new self-tasking should occur based on opportunity or necessity, planning new possible Courses of Action that achieve Commander’s Intent, and responding to a dynamic battlespace that requires adaptive behavior, such as real-time schedule changes and route planning. This area is critical for MDC2, ISR PED as well as manned-unmanned teaming.

6. **System Integration.**

The technology components and capabilities developed must be capable of being integrated and demonstrated in USAF mission applications. Components should be as platform-agnostic as possible, and be adaptable to different capabilities, sensors, datalinks, etc. with minimal modification. Systems engineering activities are needed to determine functional, physical, and interface architectures, including allocation of tasks between humans and system autonomy. This activity includes Open System Architecture and Open Technology Development to ensure common interfaces and standards where appropriate. The architectures shall determine how the autonomy functions will be allocated and instantiated, how components will interact, the processing power required, and the information storage/access issues that arise from having distributed autonomous decision-making across multiple platforms and agents.

6. **Test and Evaluation, Verification and Validation techniques.**

This area is critical for all autonomy research in MDC2, ISR PED and manned-unmanned teaming. The autonomous behaviors developed as part of this effort will require verification and validation, in addition to robust test and evaluation. These test events will stress the response of complex autonomous systems to both planned and unplanned events, and will require cutting edge non-traditional verification and validation techniques. Formal methods specification, simulation-based research & development, and analysis are included in these techniques. Modeling & simulation (M&S) activities will demonstrate technology readiness, air worthiness certification, and/or cyber-security authorization in coordination with existing in-house government M&S activities and support multiple, iterative field or flight test evaluation efforts.

Security: It is expected that during the development and demonstration of technologies supporting the AFRL STAT portfolio that information will be used or generated up to the level of Collateral SECRET. Heightened security awareness and threat-based countermeasures are particularly essential during the research and development phase when our technology is most vulnerable to espionage, sabotage, or exploitation. The contractor shall train personnel in, and follow appropriate operations security (OPSEC) measures during the performance of these research activities.

Safety: The contractor shall consider system safety requirements when developing these identified technologies/technical objectives (Ref: Military Standard (Mil-Std 882E Department of Defense Standard Practice System Safety)). The system safety process is to identify and document any system safety hazards introduced during all phases (e.g., planning, design, fabrication and testing) and recommend adequate risk mitigations to either eliminate the identified safety risk or minimize them to acceptable risk level. The design goal shall be to eliminate all hazards. Any residual hazards and subsequent design risk shall be summarized and provide enough detail to support an informed program management decision with regard to the design's overall safety risk. The contractor shall conduct an evaluation or assessment of these technologies and recommend appropriate system safety task(s) to be conducted in the appropriate research areas of interest

References and Resources also include:

https://about.bgov.com/blog/air-force-spend-950-million-autonomous-tech-rd/

http://intelligencecommunitynews.com/afrl-posts-new-baa-for-stat-program/

https://www.grants.gov/web/grants/view-opportunity.html?oppId=295281