

Industry Day:

University Affiliated Research Center (UARC): Tactical Autonomy

Agenda

Time	Activity
10:45 - 11:00 am	Sign-in
11:00 - 11:15 am	Introductions and Rules of Engagement
11:15 - 12:15 pm	Discuss requirement and BAA
12:15 - 12:30 pm	Break
12:30 - 1:30 pm	Questions and Answers



Chief Scientist of
The Air Force



Industry Day University Affiliated Research Center (UARC): Tactical Autonomy

20 July 2022

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Overview

- Industry Day Purpose
- Agenda
- Background
- Requirements
 - Technical
 - Consortium
 - STEM
- Proposal Preparation
- Broad Agency Announcement (BAA)
- Awards
- Questions



Industry Day Purpose

Purpose:

Outline the Broad Agency Announcement (BAA), requirements, and selection process

- “BAA Preflight briefing”
- This discussion is market research, the BAA will contain final requirements and selection process. The BAA takes precedence over anything discussed.
- Questions are welcomed, we’ll answer!
 - Q&As will be officially documented and distributed to registered attendees

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Background

For decades, Congress has recognized the need to develop a diverse national science, technology, engineering, and mathematics (STEM) workforce. While federal agencies provide significant opportunities for underrepresented racial and ethnic minorities in these fields, the national STEM workforce remains less racially and ethnically diverse than the U.S. general population. As the largest federal R&D funding agency and the largest employer of federal STEM professionals, the U.S. Department of Defense (DoD) plays an essential role in the U.S. science and technology ecosystem and can greatly expand opportunities to diversify the STEM workforce. To this end, the DoD operates under a department-wide STEM strategic plan, with the following :

Inspire community engagement in DoD STEM education programs and activities to provide meaningful STEM learning opportunities for students and educators.

Attract the Nations' and DoD's current and future STEM workforce through multiple pathways to educational and career opportunities.

Increase participation of underserved and underrepresented groups in STEM education and workforce development programs, activities, and outreach.

Advance the efficiency and effectiveness of STEM education and workforce development programs, activities, and outreach through evaluation and assessment

Background – Why Tactical Autonomy

Despite the autonomy advances in the last decade, several factors continue to impede the deployment and adoption of autonomous systems:

1. **Trust in Mission Autonomy:** Machine learning techniques widely used today are inherently unpredictable and lack the necessary mathematical framework to provide guarantees on correctness, while DoD applications that depend on safe and correct operation for mission success require predictable behavior and strong assurance. Additionally, if we assume autonomous systems are capable of moral agency, then the goal of machine ethics is to enable machines to reason ethically.
2. **Collaboration between Platforms:** Achieving higher levels of autonomy in uncertain, unstructured, and dynamic environments, increasingly involves data-driven machine learning techniques with many open systems science and systems engineering challenges.
3. **Human-Machine Teaming:** In the absence of an adequately high-level of autonomy that can be relied upon, substantial operator involvement is required, which not only severely limits operational gains, but creates significant new challenges in the areas of human-machine interactions and mixed initiative control.

Background

- 2019 Secretary of the Air Force interviewed/selected Ms. Rooney to establish Diversity, Equity, Inclusion, and Accessibility (DEIA) office as direct report
- Met with Dr. Coleman, Chief Scientist of the Air Force, at senior leader meeting
- Initiated planning, coordinating w/in Department of the Air Force (DAF) and Department of Defense (DoD)
- Section 220 of the FY22 National Defense Authorization Act (NDAA) directed DoD to develop a plan to assess the capacity of Historically Black Colleges and Universities and Serving Institutions (HBCUs/MIs) and establish program(s) to award contracts, grants, or other agreements in order to develop the capability of these institutions to more effectively compete for Federal R&D funding.



Background

Identified program advocates (DAF and DoD)

SecAF approved plan on 25 Mar 2022

Developed team and began parallel efforts to build program and receive approval from USD(R&E)

Alignment:

- Program Sponsor – (AF/ST) Chief Scientist of the Air Force
- Contracting Activity – (AFRL) Air Force Research Laboratory
- Management Activity – (SAF/CDM) Air Force Concepts, Development, and Management Office

Advisors:

- Under Secretary of Defense for Research and Engineering (USD(R&E))
- Under Secretary of Defense for Acquisition and Sustainability (USD(A&S))
- Under Secretary of Defense for Personnel and Readiness (USD(P&R))

Program Description

Establish an Historically Black Colleges and Universities (HBCU) led University Affiliated Research Center (UARC) consortium to execute research focused in Tactical Autonomy (TA) that will aid in the transition of research into practical applications.



Objective

The program objective is to:

- Foster creative autonomy research in science and engineering; technologies to enable DAF / DoD mission sets; minimal supervision from humans; operations in complex and unpredictable environments; with applications in Air, Space, Cyberspace, Ground, and Sea.
- Enhance early career development of outstanding STEM professionals to ultimately increase and diversify the pool of STEM talent to fulfill the Department's missions; and
- Increase opportunities for HBCUs and students to engage with the Air Force, Space Force and DoD missions and related challenges in science and engineering.

Requirements

TECHNICAL

- Provide basic and applied research to advance the field of tactical autonomy and transition research into practical application in the below focus areas, while utilizing 10 initiatives, as referenced in the *DoD Better Buying Power 3.0: Achieving Dominant Capabilities Through Technical Excellence and Innovation*:
- Focus Areas:
 - Trust in Mission Autonomy
 - Collaboration between Platforms
 - Human-Machine Teaming

CONSORTIUM

- Create and lead a consortium of HBCUs to achieve the stated objectives to include increasing Carnegie Research Foundation Classification(s) from R2 (high research) to R1 (very-high research) for at least one of the consortium schools. As well as, develop an ecosystem in autonomy related disciplines, between academia, the DAF/DoD, small businesses, and the local/regional community.
- Establish a domestic, state of the art research facility(s) dedicated to tactical autonomy research,
- Assemble, foster, and support a world-leading team of autonomy faculty and researchers,
- Increase the quality and quantity of job candidates in this area of military need, and
- Support an ecosystem of business and government partnerships to transition autonomous technologies to the warfighter

STEM EDUCATION

- Develop STEM education research, development and related activities to support K-12 and postsecondary education programs and activities, including workforce training and career and technical education programs and activities, undergraduate, graduate, and postdoctoral education, and informal education programs and activities related to autonomy.

Requirements: Technical

Definition:

- Tactical Autonomy is defined as autonomous systems acting with **delegated and bounded authority** of humans in support of tactical, short-term actions associated with a longer-term strategic vision.

Requirements: Technical

Trust in Mission Autonomy

- Systems will behave as expected when exposure to the operators or “users” results in behavior expectations (a mental model of what the system will do) and users are willing to be vulnerable to the actions taken by the autonomous solution.
 - A major contributor to trust is proficiency of the solution. Estimating proficiency requires Test, Evaluation, Validation & Verification (TEV/V) which can be challenging in complex systems and particularly difficult in autonomy.
 - New approaches to TEV/V are required that envision more than a single authorization, but periodic validation / certification.
- A myriad of hardware/software (HW/SW) assessment technologies and technical approaches are sought to support fielding of Tactical Autonomy.
 - As an example, Artificial Intelligence (AI) or Machine Learning (ML) models may be needed to collect mission data to aid in establishing trust as models improve over time.
- After deployment of the models, consideration should be given to:
 - Gathering observations and incorporating updates to the AI models to enable Tactical Autonomy.
 - Regression testing of prior tests and the identification of issues from ‘re-training’ users to account for new errors introduced by autonomy updates.
- Focus on tactical/real-time trust estimates to establish a ‘pocket of trust’ based on details of the current planned or ongoing use, versus aggregate measures of performance.

Requirements: Technical

Collaboration between Platforms

- Study interaction between various autonomous agents to determine feasibility. To achieve mosaic warfare requires disaggregation / distribution across manned and unmanned platforms. The composition of legacy solutions with new systems/platforms can create an adaptive kill web but should not be overly costly to develop.
- Three main technical challenges have to be addressed to achieve this goal:
 - Interoperability – should not lock down standards that limit technical innovation.
 - Composability – allow solution to combine together to accomplish tasks that could not have been accomplished independently.
 - Adaptability – broad, flexible solutions; functionality change.

Requirements Technical

Human-Machine Teaming

- Hybrid teaming where individuals have different roles. Roles need to be flexible – subordinate, peer, and supervising/tasking.
- Identify levels of acceptance, failure, etc., for approval. Describe and develop assessments to define levels of success.
- Requirements over time to achieve optimal performance.
- Research must answer the following questions
 - What is the system doing?
 - Why is it performing in this manner, and,
 - What happens if it's exposed to a different set of variables?
- Systems can use a representation with similar aspects of human cognition to facilitate the formation by the human teammates of a mental model of what the Tactical Autonomy is doing. Alternatively, in some instances joint training, co-creation between the human operators and the Tactical Autonomy developers.
- Research and development of systems must be inter-predictable. If systems must represent explainability, they are likely to suffer a loss in performance.
- Research and development of systems must focus on the dynamic between explainability and performance to avoid sacrifices in performance. It must be additive to the human-machine teaming relationship to spur development in Tactical Autonomy and be identified as an asset in real-time operations.
- Areas of particular interest are tactical autonomous systems that:
 - Enhance multi-domain situational awareness
 - Reduce Cognitive Workload
 - Enable Force Protection
 - Support Cyber Defense
 - Augment Logistics
 - Automate maneuver and mobility

Requirements: Consortium

The recipient shall lead the Consortium to ensure fundamental elements are focused on planning and executing programs in alignment with tactical priorities and goals. It is critical that the Consortium be constructed and managed to foster an open, collaborative environment in which each member of the Consortium is equal and receptive to leveraging knowledge and resources, as well as, sharing and adapting best practices to achieve the Government's priorities and objectives.

Requirements: Consortium

- The recipient shall create a Consortium Coordination Plan (CCP) agreement between the lead institution and consortium members clearly outlining the responsibilities of the consortium lead and those of the supporting HBCUs, or non-HBCU institutions of higher education (IHE) providing pro-bono or in-kind R&E support. Plans should identify additional faculty requirements in the research area of interest. Research staff, Contract Staff, and other personnel required to support the research and manage the program.

Lead the Consortium

- The recipient shall serve as the lead institution and shall plan Consortium Management Committee (CMC) Meetings, submit consolidated Consortium-wide deliverables, conduct program evaluations and overall outreach and communications efforts. The Recipient will also be responsible for the distribution of funding to all members of the Consortium. At a minimum the CCP shall include:
 - Prospective HBCUs
 - Definitions
 - Lead Institution Agreement
 - Responsibilities of Individual Members
 - Data Management
 - Confidentiality
 - Intellectual Property
 - Termination
 - Governing Law and Dispute Resolution
 - General Provisions

Structure and Operation of the Consortium

- Summarize the organization of your consortium, its governance structure, and how it will be managed. You should include details on the funding plan for the lead institution and what functions it will provide to the consortium members. Also include details on how member institutions will request-receive-execute funding, how their performance will be evaluated and how underperforming members can improve their performance or be removed from the consortium.
- Prepare the next generation. Provide a focus on education and training research, both in research on education and training, and in the actual education and training of researchers, graduate students, and practitioners.

STEM

- The recipient shall utilize the consortium to achieve the STEM objectives (see next slide). The CCP shall address (macro level) the plan to achieve this.

Requirements: STEM Education

Develop STEM education research, development and related activities to support K-12 and postsecondary education programs and activities, including workforce training and career and technical education programs and activities, undergraduate, graduate, and postdoctoral education, and informal education programs and activities that:

Support the development of a diverse workforce pipeline for science and technology with respect to autonomous systems;

Increase awareness of potential ethical, social, safety, and security risks of autonomous systems;

Promote curriculum development for teaching topics related to autonomy, including in the field of autonomy ethics;

Support efforts to achieve equitable access to K-12 autonomy education in diverse geographic areas and for populations historically underrepresented in science, engineering, and autonomy fields; and

Promote the widespread understanding of autonomy principles and methods to create an educated workforce and general public able to use products enabled by autonomous systems and adapt to future societal and economic changes caused by autonomous systems.

Proposal Preparation

Proposals must:

Demonstrate and articulate a **clear, unique and innovative** approach to achieve the Technical Requirements. New and creative solutions and/or advances in knowledge, understanding, technology, and the state-of-the art.

Demonstrate a **clear, complete, creative and achievable approach** for developing and leading a consortium of HBCUs to achieve the stated objectives to include increasing Carnegie Research Foundation Classification(s) from R2 (high research) to R1 (very-high research) for at least one of the consortium schools.

Depict a management structure that **supports the development of an ecosystem in autonomy** related disciplines, between academia, the DAF/DoD, small businesses, and the local/regional community with the express goals of:

- Establishing autonomy related infrastructure,
- Establishing autonomy related business partnerships, and;
- Establishing a long-term relationship with DAF/DoD for the essential engineering, research, and development capability in tactical autonomy.

Proposal Preparation

Proposals must (continued):

Identify STEM education research, development, and related activities to support K-12 and postsecondary education programs and activities, including workforce training and career and technical education programs and activities, undergraduate, graduate, and postdoctoral education, and informal education programs and activities that:

- Support the development of a diverse workforce pipeline for science and technology with respect to autonomous systems;
- Increase awareness of potential ethical, social, safety, and security risks of autonomous systems;
- Promote curriculum development for teaching topics related to autonomy, including in the field of autonomy ethics;
- Support efforts to achieve equitable access to K-12 autonomy education in diverse geographic areas and for populations historically underrepresented in science, engineering, and autonomy fields; and

Promote the widespread understanding of autonomy principles and methods to create an educated workforce and general public able to use products enabled by autonomous systems and adapt to future societal and economic changes caused by autonomous systems.

Broad Agency Announcement (BAA)

BAA: FA9550-22-S-0001

Will be posted to <https://www.grants.gov/>

Anticipated Release: Aug 2022

Anticipated Proposal Due Date: Oct 2022

Anticipated Grant/Contract Award: 8 Dec 2022

Anticipated Performance Start: 1 Feb 2023

Questions can be sent to: afrl.hbcu.msi@us.af.mil

Broad Agency Announcement (BAA)

Anticipated award:

- 1 Grant (and possibly 1 Contract) to 1 University
- Consortium managed by the 1 awarded University

Estimated Value:

- \$60,000,000 (\$12m per year)

5 year grant/contract

- Anticipated Period of Performance:
 - 1 Feb 2023 – 31 Jan 2028
- UARC re-certification occurs every 5 years to determine continuation

Grant/Contract Type:

- Cost Reimbursable/TBD

Broad Agency Announcement (BAA)

Eligibility:

- Historical Black Colleges and Universities and
- Carnegie Foundation Classification of R2 or higher
- Responsible based on Risk Assessment
 - Must be qualified and responsible based on 32 CFR 22.415 and FAR 9.1
 - At a minimum, we'll check FAPIIS and SAM

Fund Types:

- Predominantly 6.2 Applied Research
- May utilize 6.1 Basic Research

Selection Process:

- Merit Based Selection, Competitive Procedures (32 CFR 22.315)
- Cost Analysis

Broad Agency Announcement (BAA)

Principal evaluation and selection criteria:

- The technical merits of the proposed research and development. New and creative solutions and/or advances in knowledge, understanding, technology, and the state of the art; and,
- Potential relationship of the proposed research and development to Department of Defense missions. These efforts should be demonstrated through a Consortium Plan that is clear, complete, creative, and achievable to accomplish the objectives and demonstrate a structure to support an ecosystem in autonomy related disciplines, between academia, the DAF/DoD, small businesses, and the local/regional community with the express interest to increase opportunities for faculty, staff, and students to recognize the Air Force, Space Force, and Department of Defense mission and related challenges in science and engineering.

Principal evaluation and selection criteria meet the minimum specified in [32 CFR 22.315\(c\)](#).

Principal selection criteria are of equal importance to each other.

The combined principal selection criteria are more important than the additional evaluation and selection criteria.

Broad Agency Announcement (BAA)

Additional evaluation and selection criteria:

- The likelihood of the proposed effort to develop new research capabilities and broaden the research base in support of U.S. national defense;
- Adequacy of current or planned facilities and equipment to accomplish research;

Principal evaluation and selection criteria meet the minimum specified in [32 CFR 22.315\(c\)](#).

Principal selection criteria are of equal importance to each other.

The combined principal selection criteria are more important than the additional evaluation and selection criteria.

Awards: Grant

Purpose

A legal instrument that, consistent with 31 U.S.C. § 6304 and 2 CFR 200, is used to enter into a relationship:

- The principal purpose of which is to transfer a thing of value to the recipient to carry out a public purpose of support or stimulation authorized by a law of the United States, rather than to acquire property or services for the Federal Government's direct benefit or use.
- In which substantial involvement is not expected between the Federal Government and the recipient when carrying out the activity contemplated by the grant.
- No fee or profit is allowed.

Terms and Conditions:

DoD Research and Development General Terms and Conditions, Sept 2021

- Title 2, Code of Federal Regulations (CFR) Part 200
- <https://www.nre.navy.mil/work-with-us/manage-your-award/manage-grant-award/grants-terms-conditions>

Awards: Contract

Purpose:

Mutually binding legal relationship obligating the seller to furnish the supplies or services and the buyer to pay for them.

- This includes, but not limited to an Indefinite Delivery/Indefinite Quantity (IDIQ), which is a legal instrument that, consistent with FAR Subpart 16.5, provides a method to order from existing agency indefinite-delivery contracts

Terms and Conditions:

Federal Acquisition Regulation (FAR)

- <https://www.acquisition.gov/browse/index/far>

Points of Contact

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<https://www.afrl.af.mil/tactical-autonomy-UARC/>

Questions

All Q&As will be documented for the record & future distribution

Verbal answers will be provided to the best of our knowledge

After the conference, the UARC Manager/Contracting Office will validate answers and revise, if needed

Official Q&As will be distributed to all registered parties via email in approximately 1 week

