

DAF Scientific Advisory Board
FY 2022 Study

Collaborative Combat Aircraft for Next Generation Air Dominance

Terms of Reference

Background

The Department of the Air Force (DAF) is defining the Next Generation Air Dominance (NGAD) Family of Systems (FoS), which will incorporate uncrewed aircraft operating alongside the DAF's fifth or sixth generation crewed fighter. Multiple uncrewed aircraft will take commands from a fighter pilot in the crewed platform, operating semi-autonomously in a Collaborative Combat Aircraft (CCA) approach. The uncrewed aircraft will be a combat aircraft employing a distributed, mission-tailorable mix of sensors, weapons and other mission equipment. They will be significantly less expensive than the crewed platform so that they might potentially be used as attritable assets. To realize the CCA concept with acceptable pilot workload, the uncrewed aircraft will need to be semi-autonomous, taking high level direction from the pilot and then autonomously implementing this direction. Recent advances in artificial intelligence (AI) and machine learning are believed to enable this approach. Research programs at the Air Force Research Laboratory, the Defense Advanced Research Projects Agency, and elsewhere have demonstrated some of the needed capabilities. There are also commercial systems, notably self-driving cars, demonstrating some of these technologies. The DAF will benefit from a study that examines potential CCA concepts of operations (CONOPs) and concepts of employment (CONEMPs) for NGAD, determines technology requirements associated with these CONEMPs and evaluates enabling technologies to understand what capabilities could be credibly achieved in the near-term future and in the longer term.

Charter

The study will:

- Review relevant DAF Operational Imperative study products and related government and industry efforts on AI and autonomy to determine potential CCA CONOPs and CONEMPs for NGAD, determine potential uncrewed platforms that could comprise an NGAD FoS, and identify associated mission systems, including sensors, weapons, electronic warfare, navigation, and communications systems.
- Determine technology requirements associated with potential CCA CONEMPs, focusing primarily on autonomy-related technologies, including requirements for establishing and maintaining own force and hostile track data coherency across platforms, for assigning weapons to targets, and for conducting engagements. Determine and assess alternative allocations of these functions between the pilot and AI.
- Assess technology availability and risks for satisfying these technology requirements, including consideration of innovative approaches.
- Propose science and technology investments needed in the near-term and in the longer term future to develop and deploy an NGAD FoS.
- Develop testing standards and processes to acceptably validate CCA operational performance.

Study Products

Briefing to SAF/OS and AF/CC in October 2022. Publish report in December 2022. (Assumes May 2022 Study start)

DAF Scientific Advisory Board

FY 2022 Study

Responsible Artificial Intelligence (RAI) for Supporting Combat Engagements

Terms of Reference

Background

There is a widespread expectation that Artificial Intelligence (AI) and machine learning technologies will revolutionize warfare. For example, the National Security Commission on Artificial Intelligence has stated that “Our armed forces’ competitive military-technical advantage could be lost within the next decade if they do not accelerate the adoption of AI across their missions.” AI technology development and transition are key. However, there is intense concern, societal and in the Department of Defense, about ethical issues associated with replacing human judgement with AI. In commercial industry, this concern has been reflected by the development of RAI principles and tool sets. While AI is broadly applicable across the Department of the Air Force (DAF), the use of AI during combat engagements, including in particular the use of semiautonomous combat air vehicles, is an area of particular concern. The DAF must ensure its systems and personnel comply with laws and with American values. The DAF will benefit from a study that defines realistic use cases and issues for air combat engagements, and develops approaches, including adaptation of best commercial practices, to ensure air combat systems adhere to RAI principles.

Charter

The study will:

- Using inputs from Operational Imperative and related analyses, identify potential use cases for AI in combat engagements, focusing on air-air and air-ground engagements during operations against peer- and near-peer adversaries. Survey DoD and Service policy and efforts regarding AI and autonomy, including RAI, in weapon systems.
- Survey RAI principles, such as those promulgated by the Organization for Economic Co-operation and Development, and determine how commercial companies have built their own policies based on these principles.
- Identify applicable principles including the Uniform Code of Military Justice, the Law of War, and the extensive literature on military ethics.
- Survey RAI tools used by commercial organizations, including tools to ensure the reliable operation of systems incorporating AI.
- Determine the applicability of commercial principles, practices, and tools to air combat engagement use cases.
- Develop an RAI strategy, including principles, practices, and tools, that could be implemented to make AI-enabled air combat systems safer for DAF personnel and civilian noncombatants, while not slowing or otherwise burdening combat operations.
- Propose science and technology investments needed in the near-term and in the future to develop RAI principles, processes, and tools for the DAF.
- Develop recommended testing standards and processes to validate combat engagement related AI acceptability.

Study Products

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