NASA STTR 2020 Phase I Solicitation

T15.04 Integration of Airframe with Distributed Electric Propulsion (DEP) System

Lead Center: AFRC
Participating Center(s): ARC, GRC
Technology Area: TA15 Aeronautics

Scope Title
Develop Highly-Integrated Air Vehicle Technologies Using both Distributed Electric Propulsion (DEP) System and Airframe

Scope Description
NASA/Aeronautics Research Mission Directorate (ARMD) laid out Strategic Implementation Plan for aeronautical research aimed at the next 25 years and beyond. The documentation includes a set of Strategic Thrusts that are research areas which NASA will invest and guide. It encompasses a broad range of technologies to meet future needs of the aviation community, the nation, and the world for safe, efficient, flexible, and environmentally sustainable air transportation. Furthermore, the convergence of various technologies will also enable highly integrated electric air vehicles to be operated in domestic or international air space. In response to Strategic Thrust #1 (Safe, Efficient Growth in Global Operations), #3 (Ultra-Efficient Commercial Vehicles) and #4 (Transition to Low-Carbon Propulsion), a new subtopic titled “Integration of Airframe with Distributed Electric Propulsion (DEP) System” is proposed in all areas related to the subject.

References
ARMD/Advanced Air Transport Technology (AATT) Project: https://www.nasa.gov/aeroresearch/programs/aavp/aatt
ARMD/Revolutionary Vertical Lift Technology (RVLT) Project: https://www.nasa.gov/aeroresearch/programs/aavp/rvlt
ARMD/Convergent Aeronautics Solutions (CAS) Project: https://www.nasa.gov/aeroresearch/programs/tacp/cas
ARMD/Transformational Tools and Technologies (TTT) Project: https://www.nasa.gov/aeroresearch/programs/tacp/ttt
ARMD/University Innovation (UI) Project: https://www.nasa.gov/aeroresearch/programs/tacp/ui
ARMD Strategic Implementation Plan: https://www.nasa.gov/aeroresearch/strategy
ARMD Urban Air Mobility Grand Challenge: https://www.nasa.gov/uamgc
Expected TRL or TRL range at completion of the project: 2 to 6

Desired Deliverables of Phase II

Prototype, Analysis, Software, Hardware, Research

Desired Deliverables Description

Integration of Distributed Electric Propulsion (DEP) system into an aircraft involves multidisciplinary design, analysis, and optimization (MDAO) of several disciplines in aircraft technologies. These disciplines include aerodynamics, propulsion, structures, acoustics, and/or control in traditional aeronautics related subjects. The use of light-weight high-power electric components (e.g. motors, controllers, etc.) in propulsion system are enabling new electric propulsion aircraft for fixed wing and Vertical Take-Off and Landing (VTOL) applications. Addressing ARMD’s Strategic Thrust#1 (Safe, Efficient Growth in Global Operations), #3 (Ultra-Efficient Commercial Vehicles) and #4 (Transition to Low-Carbon Propulsion), innovative approaches in designing and analyzing highly integrated DEP aircraft are needed to reduce the energy use, noise, emissions, and safety concerns. In support of these three Strategic Thrusts, the following integration research areas for DEP aircraft are to be considered under this solicitation.

1. Configure and analyze DEP-enabled highly-integrated multidisciplinary aircraft features or vehicle configuration.
2. Develop MDAO tools and methods to assess DEP-enabled highly-integrated multidisciplinary aircraft features or vehicle configuration.
3. Develop tools and methods to assess safety issues associated with DEP-enabled highly-integrated multidisciplinary aircraft features or vehicle configuration.

Expected outcome (TRL 2-3) of Phase I awards, but not limited to:

- Highly integrated multidisciplinary aircraft features with DEP system for fixed wing or VTOL application.
- Highly integrated DEP-enabled fixed wing or VTOL aircraft definition and system level assessment.
- Initial development of analytical/computational/experimental/simulation tools and methods in assessing highly integrated multidisciplinary aircraft features or vehicle configuration with DEP system.

Expected outcome (TRL 4-6) of Phase II awards, but not limited to:

- Detailed feasibility study and demonstration of the subscale hardware of highly integrated multidisciplinary aircraft features or vehicle configuration with DEP system.
- Refinement of tools and methods in assessing highly integrated multidisciplinary aircraft features or vehicle configuration with DEP system.
- Experimental (e.g., wind tunnel) results or simulation capability that assess the validity of the highly integrated multidisciplinary aircraft features or vehicle configuration with DEP system.

State of the Art and Critical Gaps

Design and analysis (analytical, experimental, computational, and/or system analysis) addressing highly-integrated DEP aircraft technology are critically needed.

Traditional/conventional aircraft design and development have been approached from individual discipline topics such as aerodynamics, propulsion, structure, etc. In order to improve the performance of an aircraft, multidisciplinary solutions including MDAO approach are encouraged.

Relevance / Science Traceability

The proposed subtopic supports ARMD’s Strategic Thrust#1 (Safe, Efficient Growth in Global Operations), #3 (Ultra-Efficient Commercial Vehicles), #4 (Transition to Low-Carbon Propulsion), and ARMD Strategic Implementation Plan 2017. Specifically, the following ARMD programs and projects are highly relevant.
NASA/ARMD/Advanced Air Vehicles Program (AAVP):

- Advanced Air Transport Technology (AATT) project
- Revolutionary Vertical Lift Technology (RVLT) project

NASA/ARMD/Transformative Aeronautics Concepts Program (TACP):

- Convergent Aeronautics Solutions (CAS) project
- Transformational Tools and Technologies (TTT) project
- University Innovation (UI) project