



NASA STTR 2019 Phase I Solicitation

T15.01 Distributed Electric Propulsion (DEP) Vehicles toward Urban Air Mobility (UAM) and Regional Airliners

Lead Center: AFRC

Participating Center(s): ARC, GRC, LaRC

Technology Area: TA15 Aeronautics

Distributed Electric Propulsion (DEP) aircraft employ multiple electric propulsors to achieve unprecedented performances in air vehicles. The propulsors could be ducted/un-ducted fans, propellers, cross-flow fans, etc. Some of the benefits identified using this propulsion system are reductions in fuel burn/energy usage, noise, emissions, and/or field length. A focus on full vehicle performance; stability and control prediction; and safe, efficient operation is considered a high priority. Addressing NASA's Aeronautics Research Mission Directorate (ARMD's) Strategic Thrust #3 (Ultra-Efficient Commercial Vehicles) and #4 (Transition to Low-Carbon Propulsion), innovative approaches in designing and analyzing DEP-enabled Urban Air Mobility (UAM) aircraft are investigated and encouraged. In support of these two Strategic Thrusts, the following DEP aircraft research areas are to be considered under this subtopic:

- *Explore DEP-enabled UAM aircraft concepts and designs* - passenger-carrying UAM vehicles will be required to operate safely and efficiently within an urban airspace setting. The study shall include vehicle system level assessment including feasibility, design, benefits, predicted performance, concept of operations and/or failure assessments.
- *Develop tools and methods to assess DEP-enabled UAM aircraft and its operation* - assessing a feasibility of UAM vehicle concept and operation requires reliable analytical, computational, experimental, and/or simulation tools and methods for safe and efficient operation. The study shall include computational, experimental, and/or simulation tools and methods in addressing safe and efficient operation of DEP-enabled UAM vehicles. The approach to validation of tools and methods should be discussed.
- *Develop low-noise DEP-enabled UAM aircraft* - community noise associated with UAM aircraft operating in an urban setting is very challenging and needs to be addressed from the system and component perspectives. The study shall address the noise problems of the UAM aircraft through vehicle design, noise reduction technologies and vehicle operations strategy. Effectiveness of proposed noise reduction approaches should be validated through reliable noise assessment tools and methods.
- *Develop ride quality and gust load alleviation technologies for safe operation of UAM aircraft* - dynamic gust encounters and wake vortices from neighboring aircraft can pose a very challenging problem for UAM operation. The ride quality of small UAM can suffer during gust or wake encounters. Structural loads on these aircraft could experience large excursions that could cause safety concerns. The study shall address relevant vehicle flight dynamics in the presence of gust and wake encounters and associated flight control technologies that could improve ride quality and gust load alleviation for UAM aircraft.

The expected outcome (Technology Readiness Level range: 2 to 3) of Phase I awards include but are not limited

to:

- DEP-enabled UAM aircraft concept definition and system level assessment
- Initial development of analytical/computational/experimental/simulation tools and methods in assessing DEP enabled UAM aircraft and its operation; definition of approach to validate tools and methods

The expected outcome (Technology Readiness Level range: 4 to 6) of Phase II awards include but are not limited to:

- Detailed feasibility study and demonstration of the subscale hardware
- Refinement of tools and methods in assessing DEP-enabled UAM aircraft and its operation; validation of tools and methods developed in Phase I
- Experimental (e.g., wind tunnel, flight demo) results that assess the validity of the DEP aircraft concept

This research area is of particular interest to the following NASA programs:

- ARMD/Advanced Air Vehicles Program (AAVP)
- ARMD/Transformative Aeronautics Concepts Program (TACP)

References:

- NASA Aeronautics Strategic Implementation Plan, 2017 Update: <https://www.nasa.gov/sites/default/files/atoms/files/sip-2017-03-23-17-high.pdf>
- NASA ARMD; Advanced Air Transport Technology (AATT) Project: <https://www.nasa.gov/aeroresearch/programs/aavp/aatt>
- NASA ARMD; Revolutionary Vertical Lift Technology (RVLT) Project: <https://www.nasa.gov/aeroresearch/programs/aavp>
- NASA ARMD; Convergent Aeronautics Solutions (CAS) Project: <https://www.nasa.gov/aeroresearch/programs/tacp/cas>
- NASA ARMD article on Urban Air Mobility (UAM): <https://www.nasa.gov/aero/nasa-embraces-urban-air-mobility>