A1.09 Inflight Icing Hazard Mitigation Technology

Lead Center: GRC

Technology Area: TA15 Aeronautics

Scope Title
Sensing and Mitigation of Icing Conditions

Scope Description
All-weather sensing and mitigation is a future challenge for electric vehicles, both electric vertical take-off and landing (eVTOL) operating in the urban air mobility (UAM) mission and unmanned aerial systems (UAS) in current and future mission profiles. The primary focus is on icing but other weather hazards including wind, reduced visibility, lightning and degradation of Global Positioning System (GPS) may also be addressed. Characterize the conditions which create ice accretions on a UAS and/or eVTOL (either a class or a specific aircraft) across the anticipated operational envelope, and analyze the ice shapes using simulation tools and ground test methods. Map performance degradation to atmospheric conditions obtained from flight test and/or atmospheric simulations. In-situ characterization of icing conditions using existing or new instruments or techniques must address the weight and power constraints expected for a class or specific vehicle. Ground-based remote sensing of icing conditions must be suitable for various vertiport sites, based on commercial instruments and/or data services.

References

Expected TRL or TRL range at completion of the project: 3 to 5.

Desired Deliverables of Phase II
Prototype, Analysis

**Desired Deliverables Description**

Deliverables may include some or all of the following: design or prototype of a multi-sensor suite for weather hazard identification, characterization of expected icing conditions along with associated performance degradation, and/or novel algorithms for identification of weather hazards.

**State of the Art and Critical Gaps**

All-weather operations are important for vertical lift air vehicles, which have missions that require operating in weather at altitude. Formation of ice over lifting surfaces can affect aerodynamic performance.

Detection and avoidance of icing is a key technology for acceptance and certification, for both manned and unmanned vehicles. Unplanned icing incidents have already occurred involving unmanned aerial systems undertaking current missions. Icing detection requires a broad database of icing encounters for validation. This requires a significant campaign of testing in icing wind tunnels and in flight.

Atmospheric characterization is another key part of detection and avoidance. A vehicle must not only detect that it is in icing but also quantify the severity of the icing and any decision that must be made in a timely manner. Remote sensing methods, whether from a terminal area sensor or from a forward-looking sensor on the vehicle, are not currently capable of meeting these requirements. Current aviation weather research mostly involves either ground-level or cruise altitudes, since this is where current commercial aviation operation takes place. However, Unmanned Aerial Vehicles (UAVs) and eVTOLs may operate at low altitudes (within a few hundred feet altitude), where complex meteorological events can occur that are not well represented in prior weather research.

**Relevance / Science Traceability**

All-weather sensing and mitigation is a particular challenge for electric vehicles, both eVTOL operating in the UAM mission and UAVs operating in current and future mission profiles. Mitigation through detection and avoidance is especially critical for systems which already have stringent power and weight requirements.