CAMIEM: Compact Additively Manufactured Innovative Electric Motor

- **Idea/Concept:**
  - Utilize additive manufacturing (AM) methods to achieve new motor designs with significantly higher power densities and/or efficiency. Compare performance against a baseline motor.
- **Transition opportunities/status:**
  - TTT: R&D to identify and establish AM process & material qualification tools for flight hardware.
  - CAS AQUIFER: Leveraging lessons learned and expertise gained to support AQUIFER.
  - National Renewable Energy Laboratory (NREL): Development of additively manufactured stator fabrication technologies in support of an internal NREL funded project.
  - DARPA TRADES Project: Defining a challenge problem on the design and modeling of AM electric motors.
- **Status:**
  - Three baseline motors were fabricated and tested. The motor power output is 8.3 kW at 7500 rpm with 94% efficiency and a power density of 4.0 kW/kg.
  - System studies were conducted for Urban Air Mobility (UAM) Aircraft to include Uber eCRM-002 and NASA 15-Passenger Tiltwing Turboelectric Concept.
  - Additive manufacturing methods have enabled the design and fabrication of new components to include:
    - selective laser sintering for metallic structural parts for the housing (with reduced mass)
    - rotors (with complex airfoil/fan structure for improved stator cooling)
    - a stator cooling ring (dense fin pattern for cooling)
    - direct printed silver coil iron core stator (with higher temperature capability, torque, and stator fill)
    - direct wire embedding of a stator (for automated fabrication for reduced labor, time, and cost).
  - New motor configurations with AM components were assembled and tested. A fully integrated motor configuration is projected to increase power by 2x, power density by 1.75, and torque density by 2x.

High Power Density Electric Motors

Baseline CAMIEM Motor

CAMIEM V2 Motor

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