Hybrid Wave-Rotor Electric Aero-Propulsion (HyWREAP)

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Purpose

The goal of this project is investigate the proposed hybrid wave-rotor electric aero-propulsion (HyWREAP). The tasks are to perform flow and combustion analysis of the pressure-gain, wave-rotor combustor (WRC) turbine concept, and determine the highest-impact subsonic and supersonic flight application of HyWREAP. We will focus on integration of electric drive and synergistic WRC capabilities, develop a technology development roadmap and propose a path to test and verify the concept in feasible stages, working with our industry partner.

Background

Brayton-cycle continuous-flow combustors allow free expansion, wasting exergy. Though ubiquitous in Nature, oscillatory and pulsatile flows are rarely exploited by engineers. Constant-volume combustion (CVC) offers high specific impulse and power over a wide Mach range with limited or no mechanical compression. The proposed HyWREAP system will enable air transport to reach unprecedented fuel savings and emissions cuts by optimally combining two energy sources. Electrical energy can be almost all converted to propulsive power, compared to heat engine conversion of fuel energy, but fuel burn lightens the airplane. Electric fan drive will also enable much more efficient taxiing in congested airports. The low-rpm WRC turbine and electric motors will drive fan propulsors, with optimally greater WRC role for higher flight speeds and longer-range flights. For some applications, an electric- drive HP compressor will boost pressure. We target 90% fuel cuts for subsonic regional jets over 2010 technology, based on combining benefits from WRC integrated with electric drive in HyWREAP. In addition, we will explore HyWREAP concepts for supersonic and domestic subsonic commercial & business aviation.