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Jetoptera Tests High-Speed VTOL Concept In Wind Tunnel

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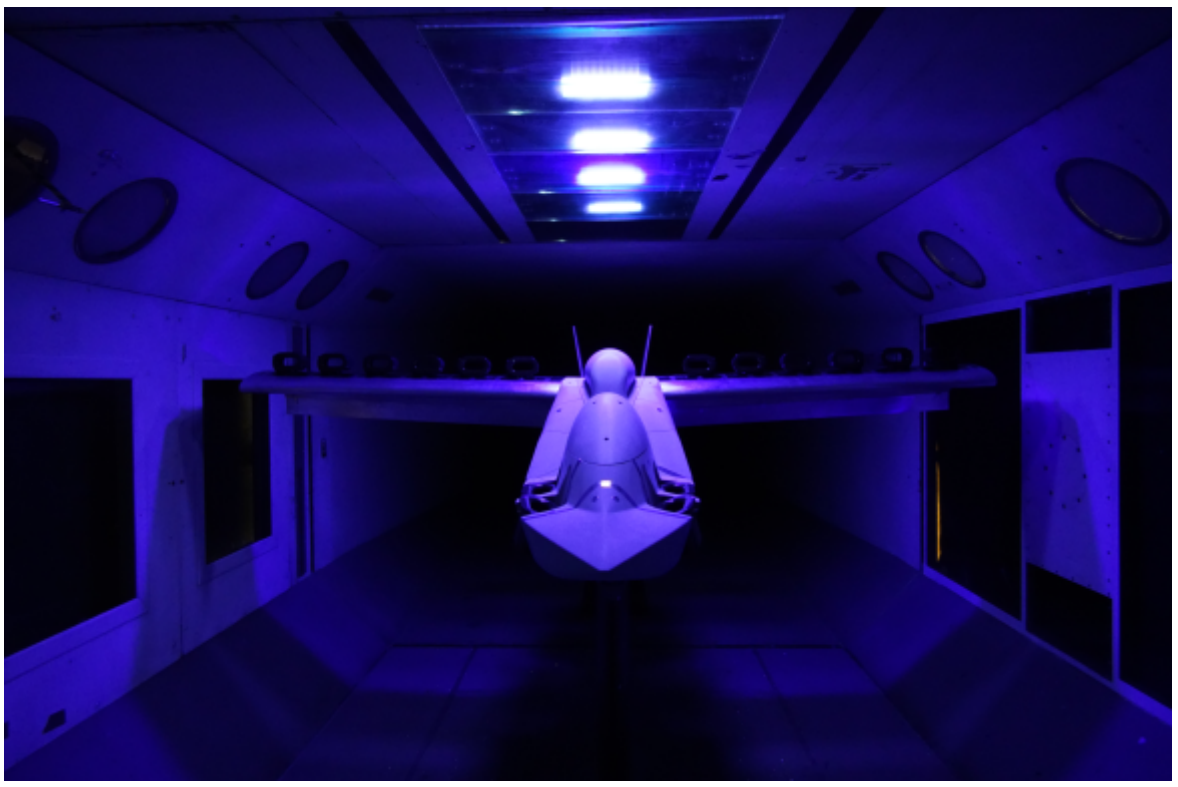

Wind tunnel model has fluidic thrusters over the wing for lift augmentation and embedded in the fuselage for vertical thrust.

Credit: Jetoptera

U.S. startup Jetoptera has completed wind tunnel testing to validate the ability of its adaptive Fluidic Propulsion System (FPS) to enable aircraft designs that combine vertical-takeoff-and-landing capability with high speed.

The tests in the University of Washington's Kirsten Wind Tunnel involved a 30%-scale, 10-ft.-span model of a 5,000-lb. gross weight vertical takeoff and landing (VTOL) aircraft capable of speeds up to Mach 0.8. The concept was designed in collaboration with Northrop Grumman's Scaled Composites and Pratt & Whitney's Gatorworks.

Data from the tests will be used to help build a 6-deg.-of-freedom aerodynamic model to enable Jetoptera to explore the flight envelope and performance of multiple different high speed vertical takeoff and landing (HSVTOL) concepts up to 40,000 lb. gross weight. The startup is working on the larger designs under the HSVTOL Challenge run by the U.S. Air Force's AFWerx innovation arm and sponsored by Special Operations Command.

Jetoptera's FPS channels air from turbocompressors to annular nozzles where the pressurized exhaust entrains and accelerates large amounts of ambient air to augment thrust. The "3-in-1" adaptive FPS used on the wing tunnel model has VTOL, transition and high-speed flight configurations.

The concept aircraft has 12 FPS thrusters arrayed along of the top of the wing providing upper surface blowing (USB) to increase lift coefficient at low airspeed. The design has four more thrusters in the forward fuselage and four in the aft fuselage, mounted vertically to provide thrust for VTOL. This combination allows the aircraft to perform vertical or short takeoffs and landings, says Andrei Evulet, Jetoptera CEO and chief technology officer.

Air for the FPS thrusters is provided by a single turbocompressor based on a two-stage fan driven by an existing 2,500-shp-class Pratt & Whitney turboshaft. For takeoff, air is fed to all three sets of thrusters. For transition for wing-borne flight, the fuselage-mounted thrusters are stowed and air is fed to the thrusters blowing over the wing and flaps. For cruise, the wing thrusters are stowed and all the air goes to a single nozzle suitable for speeds up to M0.95, Evulet says.

In Jetoptera's original FPS concept, air was provided by a gas generator. The move to a turbocompressor means the air is cooler and the conduits and thrusters in the concept aircraft can be 3D printed using plastics.

The wind tunnel test was conducted under Jetoptera's fifth small business contract from the U.S. Air Force. Under a previous contract, the startup evaluated the efficiency of upper-surface blowing of the wing and high-lift flaps using FPS. The system produced lift coefficients 8, Evulet says, 30-50% more lift than NASA's LEAPTech project, which used an array of leading-edge propellers to blow the wing.

The wind tunnel test used a metered compressed air supply that will enable Jetoptera to calculate thrust and lift. Data indicate the configuration's hover efficiency sits between that of a helicopter and a tiltrotor, Evulet says, while the aircraft can fly at twice the speed of a tiltrotor.

The biggest challenge still to be overcome, he says, is stowing the USB thrusters inside the wing to reduce drag in cruise flight. Because of the lower temperatures produced by the turbocompressor, Jetoptera has even looked at using elastomeric thrusters that inflate when fed pressurized air, then deflate for stowage.

In addition to the HSVTOL studies for the Air Force, Jetoptera is working with Freedom Flight Works under a U.S. Army small business contract to apply FPS to a powered parafoil for the Joint Precision Airdrop Delivery System program. The startup is also looking at wing-in-ground-effect aircraft as well as a general aviation applications, including a concept for a 10,000-12,000-lb. business-jet-class aircraft with short-takeoff capability.

Founded in 2015, Edmonds, Washington-based Jetoptera has raised about $10 million to date, Evulet says. Some of that has been raised through crowdfunding and the startup is exploring launching another similar campaign, he says.

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