

STARTS AFTER PAGE 34

InsideMRO™

\$14.95 SEPTEMBER 4-17, 2017

AVIATION WEEK

& SPACE TECHNOLOGY

Curtain Call for Cassini

**Taiwan's Fighter
Development Plans**

**RICH MEDIA
EXCLUSIVE**



Cockpits of the Future

Agile Electronic Warfare

Air Berlin Fire Sale

AVIATION WEEK
NETWORK

Staying Power

Hybrid gasoline-electric propulsion gives new multicopter drones more endurance

Graham Warwick **Washington**

Battery capacity severely limits the performance of multirotor small unmanned aircraft systems (UAS), which dominate the commercial drone market because of their ease of deployment and use. A new generation of drones is now becoming available, with hybrid gasoline-electric propulsion providing significantly increased payload and endurance.



ADVANCED AIRCRAFT CO.

Virginia-based startup Advanced Aircraft Co. (AAC) plans to begin deliveries of its Hercules long-endurance multirotor small UAS in December. A hybrid electric propulsion system gives the vertical-takeoff-and-landing (VTOL) drone a 2-hr. endurance carrying a 4-lb. payload. Maximum payload is 7 lb. and maximum endurance with two 100-oz. fuel tanks is 3.5 hr.

At 36 lb. gross weight, the Hercules can operate under the FAA's Part 107 small-UAS rule, but it has 4-6 times the endurance of battery-powered multirotor VTOL drones carrying the same payload. This is due to hybrid propulsion and a configuration that combines six rotors with aerodynamic fairings that are free to rotate between vertical and horizontal to reduce drag while generating some lift.

Top Flight Technologies, a startup based in Malden, Massachusetts, has launched its Airborg H8 10K, an eight-rotor gasoline-electric VTOL that can fly for 3 hr. with an 8.8-lb. payload and for 1 hr. with up to 22 lb. The vehicle is heavier than the 55-lb. gross-weight limit on small UAS under Part 107 and will require certification. Top Flight has launched the Airborg Engagement Program to help customers develop applications for the UAS and

assist with regulatory compliance.

New York-based ULC Robotics has flight-tested a VTOL small UAS developed for aerial inspection of utilities. The 10-ft.-span flying wing has a payload capacity of 10 lb. and a flight time of 1.5 hr. with battery power, but the company plans to integrate hybrid gasoline-electric propulsion to boost this to 5 hr.

HERCULES AAC's 36-lb. Hercules has a maximum endurance of 3.5 hr. on a 1.5-kW hybrid gasoline-electric propulsion system.

Unlike the other two VTOL UAS, ULC's design transitions to wing-borne flight for a more efficient cruise. For vertical flight, the vehicle has eight rotors mounted in coaxial pairs on the ends of two booms under the wing. These shut down in forward flight, when a pusher propeller provides thrust.

AAC was founded in 2015 by former



TOP FLIGHT TECHNOLOGIES

NASA Langley Research Center engineer Bill Fredericks, who says the Hercules will reduce the cost per acre for aerial mapping and surveying by 45% compared with conventional multirotor small UAS, because its longer flight time increases productivity.

The UAS has a 1.5-kW serial hybrid propulsion system that consists of a two-stroke gasoline engine, modified with electronic fuel injection for digital control, driving a compact generator developed by LaunchPoint Technologies. A backup battery provides 2 min.

of flight time to enable a safe landing if the engine fails.

The \$60,000 base model of Hercules has a maximum endurance of 3.5 hr. or a maximum payload of 9 lb. With a second fuel tank installed, the UAS can fly about 3 hr. carrying a 2-lb. payload, says Fredericks. This compares with about 30 min. for a conventional multirotor.

Top Flight was founded in 2014 by Massachusetts Institute of Technology (MIT) researcher Long Phan. An off-the-shelf drone fitted with a prototype hybrid propulsion system set the current endurance record for small UAS of almost 2.5 hr.—a record Fredericks hopes to beat in September.

The Airborg H8 10K has a 10-kW propulsion system comprising a gasoline engine driving a compact Halbach array generator—the same technology used in the Hercules—to power the rotors and keep the backup lithium-polymer batteries charged. The UAS has a 5-gal. fuel tank. A “digital gearbox” controls the speed and torque of the rotors for flight control.

While its initial UAS is aimed at applications including infrastructure inspection in remote areas, Top Flight is developing a 100-kW hybrid-propulsion UAS capable of carrying 100 kg (220 lb.) for up to 3 hr., according to MIT. This could be used to haul freight and as a precursor to an autonomous air taxi. The company is also working on more powerful and efficient turbine-based hy-

AIRBORG Weighing more than 110 lb., Top Flight's Airborg has a 10-kW propulsion system and 3-hr. endurance with 9-lb. payload.

brid propulsion systems.

AAC's longer-term goal is to develop the Greased Lightning, a hybrid diesel-

electric distributed propulsion VTOL UAS designed by Fredericks while he was at NASA Langley. The 50%-scale, 62-lb. GL-10 prototype was flown in 2015 and had 10 props—eight on the tilting wing and two on the tilting tail.

The full-size 275-lb. Greased Lightning was designed to fly for 24 hr. at speeds up to 350 kt. The design combines long endurance and fast flight with hover capability, and AAC plans to position the aircraft for military Class 2 UAS, commercial linear infrastructure inspection, and package-delivery markets. ☛