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Urban Aero’s AirMule Flies Free
By Angelo Collins

After more than a decade of research, design and simulation, Tactical Robotics Limited announced the first untethered flight of their “AirMule” VTOL unmanned aerial vehicle (UAV) concept. The maiden flight occurred on Dec. 30 at Megiddo Airfield in northern Israel.

Rafi Yoeli is the CEO of Tactical Robotics Limited, and has played a key leadership role with its parent company, Urban Aeronautics Limited. Although currently only using private funds, Urban Aeronautics has previously received support from the Israeli Ministry of Defense. In the mid-2000s, Urban also received some funding for a feasibility study from the Office of Naval Research, together with Bell Helicopter and Penn State University, of their original manned X-Hawk. During this time, Urban also received strong interest from the US Marine Corps and the US Army UAV center in Fort Rucker, Alabama. The company has committed over a decade of work towards their Fancraft technology, which is supported by over 40 patents.

AirMule Untethered
As the AirMule had demonstrated completely autonomous flight in 2013, the leap to untethered flight, Yoeli explained, was red tape more so than any technical development. The aircraft itself did not require any changes or upgrades other than the installation of a Flight Termination System (FTS) connected to the fuel shutoff valve. After integrating the FTS and receiving approval from the Civil Aviation Administration of Israel (CAAI), the Israeli Federal Communications Commission (IFCC) and Megiddo Airport authorities, Tactical Robotics was able to convince the CAAI that the AirMule was safe enough to authorize untethered flight in a relatively densely populated region of the country. “Regulations are at least as strict as in Europe and the US so it was challenging,” Yoeli noted, “especially since Israel is very small and, as you can imagine, a lot of UAVs flying around.”

The demonstrations being conducted at Megiddo airfield will prove out the AirMule’s cargo delivery capability using test loads over an approved distance. A ground control station based on a ruggedized laptop will be used during testing as a primary control interface to the AirMule. In the future, the company will utilize satellite communication in order to navigate Beyond Line of Sight.

The AirMule’s Flight Control System (FCS) is completely fly-by-wire and utilizes an Inertial Navigation System (INS) with differential GPS, as well as two laser altimeters and one radar altimeter for real time state estimation and localization.

The AirMule made its first untethered flight on Dec. 30 at Megiddo Airfield in northern Israel. Urban Aeronautics has been flying this version of their Fancraft since 2010. (Urban Aeronautics photos)

The AirMule will use GPS waypoint navigation, but there are plans to demonstrate operations in GPS-denied environments during later phases of development. Tactical Robotics also plans to incorporate onboard active sensors for their enhanced variants, such as a gimbaled electro-optical/infrared (EO/IR) camera and possibly Light Detection and Ranging (LIDAR) sensor.

Cormorant
Anticipating successful demonstrations, Tactical Robotics plans to develop the AirMule for the Israeli Defense Force — and possibly the US military, falling into Category 1 of the international Missile Technology Control Regime (MTCR). A smaller export variant, dubbed the “Cormorant,” has received Category 2 certification.

Interestingly, a “cormorant” is a swimming bird with a relatively short wingspan, flying with greater effort than any other bird of flight. The avian cormorant’s flight is a metaphor for that of the AirMule, symbolizing the technical challenges the company has faced in achieving stable and controllable flight with a compact ducted fan design. But these challenges come with great payoffs: a cormorant has great agility under water, while the AirMule/Cormorant will be able to
fly in obstructed areas, such as narrow city streets, in which even helicopters cannot operate.

The 5.9 ft (1.8 m) diameter fans are shrouded, reducing the dangers of the blades coming in contact with people or other objects. Pitch and heave control is accomplished with duplex electro-hydraulic actuators controlling forward and aft rotor collective. Four cascading vanes control roll, yaw and side force through the use of electro-hydraulic actuators. Dual ducted fans in the rear provide high-speed forward thrust. The current AirMule demonstrator uses a 730 shp (544 kW) Turbomeca Arriel 1D1, while production aircraft are planned to use the 985 shp (735 kW) Arriel 2N.

The maximum take-off weight is 3,700 lb (1.7 t) and maximum speed is 100 kt (180 km/hr). The AirMule design mission is to take 500 kg (1,100 lb) of useful cargo 50 km (27 nm) and return. The Cormorant specifications are all essentially the same as above, but it will be limited to taking a 440 kg (970 lb) payload to a range of 300 km (162 nm).

Flying into the Future

Rafi Yoeli, the original designer of the AirMule, said that “Looking back at a decade of internal rotor VTOL aircraft development at Urban Aeronautics Ltd, it gives me great satisfaction to see that we are able to transform a dream into a safe and reliable aircraft that is designed to meet manned helicopters safety criteria and absolutely stands up to existing airworthiness standards. With close to 200 flights on the AirMule prototype we are confident that this capability can be fielded in just a few years to provide breakthrough capabilities to any military force or civil agency that needs to robotically deliver systems, supplies and other provisions in and out of otherwise inaccessible environments.”

For civil and manned applications, Yoeli introduced Metro Skyways, which is also a subsidiary of Urban Aeronautics and Sister Company to tactical robotics. Metro Skyways is working to develop a more compact car-sized manned variant of their AirMule aircraft. Yoeli explained that “Metro Skyways is at an early stage of exploring business opportunities that will develop Urban’s ‘Fancraft’ technologies into a family of safe, FAA-certifiable personal and commercial, manned VTOL aircraft for the civil market.”

About the Author

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42nd European Rotorcraft Forum (ERF)
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International Powered Lift Conference (IPLC)
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Sept. 29-30
Hartford, Connecticut, USA
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Helicopter Military Operations Technology (HELMOT)
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Williamsburg, Virginia, USA

Rotorcraft Virtual Engineering Conference
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University of Liverpool
Liverpool, UK
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Nov. 18-19
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