

## ANALYSIS: Small unmanned aircraft launched to shake-up civil market

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Hanging from a basement ceiling in a farmhouse workshop, prior to a weight and balance check, is a small unmanned aircraft its creators hope will shake-up the market and make civilian unmanned aviation affordable enough to compete with manned aircraft.

The AeroVel Flexrotor, an odd but intriguing mix of fixed- and rotary-wing technology, offers long-endurance unmanned operations at an affordable price. It can fly for almost 40h, yet has a wingspan of only 3m (10ft) and a length of less than 2m, gaining 8h of endurance from every 1kg of fuel.

Flexrotor was designed with perfection in mind, but the team behind it are always adapting and making necessary compromises to achieve their goal of reducing the operating costs of robotic aircraft to a minimum – and creating the impetus to get rules changed and unmanned aviation firmly established outside the confines of military airspace and budgets.

The technology – all encompassed within a sub-20kg airframe – is an impressive feat, and owes its pedigree to some of the design team responsible for Insitu's 1998 unmanned Aerosonde crossing of the North Atlantic. After the Aerosonde came the SeaScan, which was subsequently modified for military roles and renamed the ScanEagle. This has become the pre-eminent airframe in the small unmanned aircraft category, recovering with GPS guidance to a vertical wire and thus free to operate away from prepared surfaces and suited to ship-borne operation. The system's performance and utility led to the purchase of Insitu by Boeing in a multimillion dollar deal in 2008. Tad McGeer, co-owner of Insitu, had already left in 2005 to found a new company called AeroVel.

Nearly a decade later, the start-up has recorded its first sale. AeroVel business development director Andy Nickerson says the company's launch customer, Oregon-based Precision Inc, plans to fly the Flexrotor on environmental conservation and anti-IUU (illegal, unreported, and unregulated) fishing missions in locations Central America and anti-poaching missions in other countries. Precision Integrated is also preparing to fly US domestic missions including search and rescue assistance, wildlife surveys, wild land firefighting monitoring and environmental and scientific research in the Arctic.

AeroVel's plans have also been helped by the recent US government ruling that Flexrotor can be exported free of the restrictions of the International Traffic in Arms Regulations (ITAR), which in recent years have been applied to unmanned aircraft regardless of application. The result is that the aircraft falls under a much simpler licensing regime administered by the Department of Commerce, helping AeroVel to gain access to the valuable overseas commercial market.

Flexrotor, with echoes of the experimental 1950s “tail-sitters”, was created after McGeer and a colleague saw a battery-powered RC model aircraft tail-hanging and an idea began to take shape.

McGeer’s vision for the Flexrotor is to create an aircraft capable of being operated with minimal infrastructure demands. While the ScanEagle made operation from a ship possible, it came at a price, and the need still remained on most military ships to move the Skyhook recovery device and the catapult launcher to clear the flightdeck for helicopter operations. This can be time-consuming when deck space and time are at a premium, and the equipment has proven too bulky for small vessels.

Flexrotor needs none of this additional infrastructure, and was designed to operate in remote areas from small vessels such as tuna fishing boats.

The Flexrotor’s performance is based around the need for a disc large enough to create vertical lift for take-off and landing, with the aid of variable-pitch propellers and wing-tip thrusters, but avoiding too heavy a disc loading.

The aircraft is powered by a 3W, single-cylinder 28cc engine, which McGeer says is not ideal, but “useable” for the moment until Aerovel finishes designing its own powerplant.

The aircraft has an extraordinary flight profile during launch. It moves from a vertical take-off and climb to a pitch-over, a dive to gain speed and then a zoom back up to height – a profile McGeer describes as having a “roller coaster thrill”. It looks dramatic to say the least, but the Flexrotor settles beautifully into level flight and returns unprecedented range and endurance for an aircraft of its size.

In addition to private investors, the project has also been backed by the US Defense Advance Research Projects Agency and the Office of Naval Research, in collaboration with the University of Washington and Hood Technology Corporation.

Flexrotor is aimed at markets such as meteorological research flights, remote sensing for mineral exploration and supporting tuna boats. A theme of each of those missions is operating in remote, sparsely populated or unpopulated areas.

Endurance is also a big selling factor in the economic argument. It increases the number of flight hours weighed against maintenance hours. Flexrotor is planned to remain in the local area of the control station for long periods, or can be sent off autonomously on long range flights. McGeer considers that the utility of such platforms in geomagnetic survey, meteorology research, data relay, and local imaging surveillance are well-proven.

Wide-area search is also an emerging area of interest for aircraft of this type, a task which McGeer considers is hard by any method, manned or unmanned. “Automation is necessary to avoid boredom. People can't stare at the empty ocean for long, with naked eyes or video, before they zone-out and miss things”. Sentient, he notes, among others, has demonstrated software that shows some promise for automatic flagging of “non-ocean” in video, as opposed to the use of radar, which while more readily available and less affected by meteorological conditions requires a more expensive aircraft.

When asked about the use of satellite links for the relay of commands and the downlink of telemetry and sensor data, McGeer explains that the current Flexrotor is too small to accommodate the necessary technology for that task. Flown with only an electro-optical sensor so far, any future mid-wave or infrared system would also require cooling and every additional kilogram of sensor weight will reduce endurance by 8h and place additional electrical demands on the aircraft.

Aerovel plans to fly the Flexrotor on environmental conservation and anti-IUU (illegal, unreported, and unregulated) fishing missions in locations Central America and anti-poaching missions in other countries. Precision Integrated is also preparing to fly US domestic missions including search and rescue assistance, wildlife surveys, wild land firefighting monitoring and environmental and scientific research in the Arctic.