Grass cutting edge

It is rare that something totally original that could completely change our perception of normal flight invades the aerospace industry. That time has come: the FanWing has landed

Dikla Peebles

Dubbed 'one of the few truly new aircraft since the Wright Brothers' by The New York Times, the oddly configured FanWing, which employs an arrangement of wing rotors to obtain lift and propulsion, made its first public demonstration at the annual ParcAberporth Unmanned Systems event this year. The debut flights that week exhibited both fast take-off and stable cruise performance, attracting attention that has since spread worldwide. It seems that the innovative aircraft technology may provide not only unmanned surveillance applications, but also potential solutions to aviation noise, land-use and fuel concerns.

Winner of a Saatchi & Saatchi prize for innovation, and peer nominated for other prizes, Pat Peebles, the self-educated inventor who conceived and then single-handedly developed the FanWing, originally had a vision of creating lift and thrust by transferring the work of the propeller to the wing. After years of experiments he finally set horizontal fans into the leading edge. It's not the first attempt to use cross-flow fans for flight, as Professor J. M. R. Graham from London's Imperial College commented to Newsweek: "Many people have tried. The fact remains that it works."

How does it work? Air is sucked in by the fan, accelerates, and is ejected behind the fan, producing lift and thrust. The large

FAN TIME

It has taken more than a decade for the FanWing concept to take off

1995/6: Earliest tests used a swinging-arm rig with the basic wing design as a 'paddle wheel' in the wing slot. Before giving up on the design, a cross-flow fan rotor was inserted.
1997: A wind tunnel was loaned by the University of Rome using a model then loaned to Imperial College London, where it was tested as a basis for two M.Eng theses.
2001: Construction of a specialist wind tunnel.
2002: The wind-tunnel model was designed with a variable wing shape, achieving improved efficiency from 20G/W to 30G/W of lift.
2005: The vectored-thrust model used a primitive balance and a manual tethering system to measure vertical thrust with horizontal flight tests to test hover and stability.
2008: The latest VT model has an on-board data logger to measure speed, altitude, climb rate, rotor rpm, engine temperature and control surface deflection.
2008+: Plans are to construct a larger wind-tunnel model (40cm diameter rotor x 2m span) with moveable wing surfaces and different rotors for rotor optimization, in conjunction with CFD analysis. (CFD on such an unusual technology has not produced reliable results so far.)

triangular section in the wing provides structural strength, and because pressure on each blade is low, the rotor cage can be lightweight. The result is unusual lift combined with the ability to carry heavy loads. The largest prototype model flew on repeated tests with almost instant take-off and a 20kg take-off weight.

Peebles predicts several practical advantages. As well as established short take-off capability and stability, a cruise speed much lower than conventional aircraft will provide maneuverability and fuel economy, not to mention low noise, for short-haul flights. A vertical take-off development is ongoing with a new patent pending, but the company sees the short take-off version already useful in applications beyond the surveillance platform in manned or unmanned local freight, seaplanes, firefighting, crop dusting and emergency aid.

Peebles had proved his concept with a series of scaled model prototypes that took off fast and flew efficiently. His UK-based company had obtained rigorously researched patents and there seemed to be clear potential applications and advantages. But it seemed that that wasn't enough. As Ken Rosen, Sikorsky designer of the Black Hawk, told Peebles when they met in the USA: "Nobody will listen until you have the science." Peebles says, "We found ourselves in a catch-22 situation. We needed the tests and documentation to prove we were sufficiently credible to gain the financing to provide the tests and documentation. What I hadn't realized was that without 'concept of proof', most professionals would dismiss the actual flying models sight unseen. The response was, basically, 'it's useless, it's not new and it won't work'."

Concept of proof

"It's something I guess I should have expected," Peebles continues. "But the most authoritative people cast out often quite random judgments, and there was no platform for discussion or, for that matter, rebuttal." He describes an internationally renowned aerospace academic who was asked at UK's 2008 Farnborough Air Show to offer an expert opinion on the FanWing. "His reaction was to toss a piece of cardboard in the air and as it spun downward he commented, 'I don't mean to be dismissive, but the principle is so simple anyone could have done it.'" Peebles is frustrated, but resigned: "It was a teacher's trick – but just that, a trick, and basically meaningless. One has to ask how a piece of cardboard takes off almost instantly, flies and then lands. The problem is, these people have their following and they do us harm."

The situation follows a classic innovation trajectory. Luminary writer and scientist Sir Arthur C. Clarke early on offered Peebles a warning, a compliment and a reassurance. He emailed: 'The Wright Brothers had a local reporter writing about their first successful flight, though nobody believed the report and the whole achievement was ignored for several years.' Mark Twain said, 'The man with a new idea is a crank – until the idea succeeds.' Peebles says, "Of course it was great to have that sense of background support. We also had top-level journalists who certainly bothered to find out what was actually going on here.

"One understands that I was a wacky inventor with a flying grass-cutter," he adds. "A professional in the aerospace business would have to be pretty brave to be associated with that."

The turning point

A growing number of people were, it seems, fairly brave. New support and open acknowledgement of the technology included Saatchi & Saatchi, some major aerospace professionals and business consultants, and private investors from several countries. Professor Graham, an aerospace academic who had shown supportive interest from the start, supervised three Imperial College dissertations, one of which was award-winning. Fundraising was, Peebles says, always "hair-raising", but steady investment came from what Peebles describes as exceptionally supportive shareholders. "It was slow, but people gradually stopped saying, 'If it's so good, why is it taking so long?' and were saying, 'It's run the innovation gauntlet and is still up and flying. Maybe there's something to it.'"

The turning point for Peebles came in June 2008, when the first test flights of his prototype urban surveillance UAV platform were made at ParcAberporth. Instant feedback came from the pilot. Mark Easey, whose usual role is as a principal UAV test pilot for a major aerospace organization, had stepped in to fly the FanWing at the last moment. Peebles recounts, "Mark was totally new to the technology, and therefore an important objective judge for us. After his initial shock – the model is very odd, and there was also extra drag from the grass take-off – he was openly excited by the fast take-off and how simple and stable it was to maneuver. He said there was no doubt that it would be able to fly up and down streets and around corners. In fact, what we'd been claiming all along." The film of Easey's flight and an interview with Peebles first appeared at the Farnborough Air Show and then, having been blogged by *Flight* magazine's technical editor Rob Coppinger, hit online discussion groups worldwide. Peebles says, "Our own early films suffered from shaky amateur photography and incomplete test flights. Now at last people could stop listening to the experts and watch the real thing."

Commercial response has been strong so far. The company is now working closely with top-level aerospace business management, who seem confident that the FanWing technology can eventually meet demands for efficient low-fuel and low-land-use freight and commuter aircraft, as well as immediate unmanned security applications. Peebles says, "It'll be good to see where we can take this with the right people and the right tests. It's not only a commercial project, but something quite exciting in its own right. It's a new way to fly, and that can't be all bad." ∎

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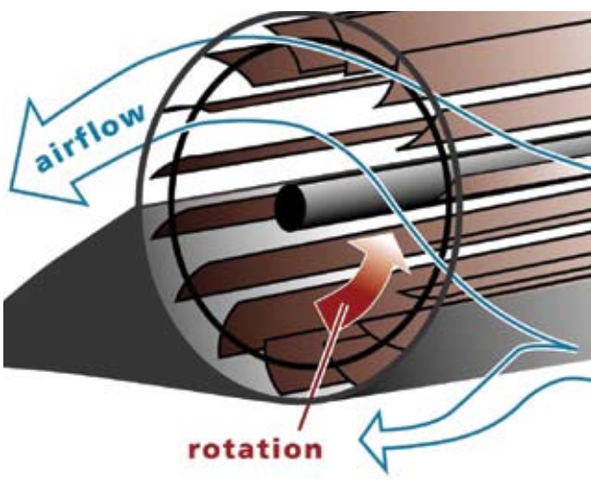
Below: FanWing principle of flight. Pilot Mark Easey before his first FanWing flight, ParcAberporth, West Wales Airport