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DESIGN EMMA KELLY PERTH

For StopRotor, change is in transition

Industry heavyweights have struggled, but an Australian husband and wife team think they have cracked the hybrid secret

Combining vertical take-off and landing (VTOL) capability with high-speed cruise has been an attractive but elusive goal since the early days of flight.

Designs have fallen on one or more of the key metrics of fuel efficiency, lift capacity, controllability, simplicity and reliability. However, an Australian husband and wife team believe they have cracked these barriers with a new take on an old idea.

And, say Deanne and Rowan Watkins, of StopRotor Technology, their Hybrid RotorWing could be a contender for the VTOL X-Plane challenge recently set out by the USA's Defense Advanced Research Projects Agency (DARPA), which is calling for new ideas in the search for a machine that can hover with greater efficiency than current rotorcraft and maintain airspeed above 300kt (555km/h).

Stoptrotor designs go back at least to the 1970s, and evolved into a 1980s Sikorsky-NASA project called X-wing, based on a modified S-72. The idea was to rise vertically by spinning a top-

mounted, four-bladed wing, which also contributed to lift in forward flight when stopped.

The Watkins believe their concept – which they describe as similar in appearance to the Boeing X-50 Canard Rotor/Wing VTOL, which made test flights as late as 2006 – makes this idea practical by introducing an as-yet untried technique for transition between vertical and forward flight.

FORWARD FLIGHT

Most previous attempts to create a stoptrotor aircraft have tried to transition between rotary and fixed-wing modes during forward flight, but in forward flight the airflow is along the longitudinal axis of the fuselage and parallel to the rotor disc. In that situation the vertical lift rotor blades are subject to asymmetric airflow; like an ordinary helicopter at high speed, instability results from the great difference in lift between advancing and retreating blades. And, says Deanne, this instability inhibits the slowing, and then locking, of the rotor to provide lift as a normal wing in forward cruise,



Sikorsky-NASA's X-wing was an early attempt at a stoptrotor

which is the key characteristic of any stoptrotor concept.

Alternatively, she says, tail- or nose-sitter configurations have been tried. These configurations align the airflow with the rotor's rotation axis, which resolves lift asymmetry, but the vertical fuselage orientation is unstable during take-off and landing, and limits payload placement and cabin function.

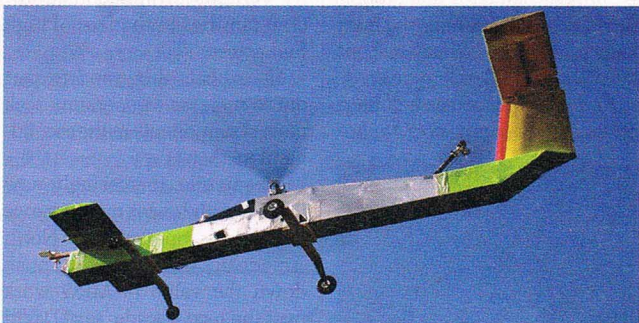
Stoptrotor's solution is to borrow a trick from aerobatics and raise the nose of the aircraft to nearly 90°; such a high angle of attack in forward flight, which can be achieved by aerodynamic controls, vectored thrust or a variable centre of gravity, aligns the airflow with the rotor's rotational axis.

Altitude is lost during transition, but the rotor can be started or stopped easily. The Watkins say they have achieved nearly 90° angles of attack with their flying prototype in fixed-wing mode.

Proof-of-concept prototype testing using computer simulation and flying models is being undertaken. In 2012, the Watkins submitted two patent applications for the concept. StopRotor has been working on the concept, developed by airline pilot Rowan, for the past four years and is now seeking an OEM partner to help it take the idea forward.

The Watkins concede they have gone public with the concept earlier than originally planned because of the release of the DARPA VTOL X-Plane specification. "We don't have the capability to submit a proposal but we have an idea," says Deanne. "We believe our concept works. All others have tried to transition in forward flight when you don't have a stable airframe." ■

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StopRotor Technologies has trialled its system on a scale model

For DARPA, 'elegant' X-Plane challenge shuns easy answers

In setting out its VTOL X-Plane challenge, the US Defense Advanced Research Projects Agency (DARPA) notes that fixed-wing aircraft are two or three times faster than in the 1960s, but "attempts to in-

crease efficient VTOL aircraft speed have stalled".

Says programme manager Ashish Bagai: "We have not made this easy. Strapping rockets on to the back of a helicopter is not the type of approach we're looking

for. Rather than tweaking past designs, we are looking for true cross-pollinations of designs and technologies from the fixed-wing and rotary-wing worlds. The elegant confluence of these engineering design paradigms is

where this programme should find some interesting results."

Not easy, indeed. As DARPA says, increasing helicopter speed has been "one of the greatest challenges of the past half century for aerodynamics engineers".