

Impossible challenge?

Mike Hirschberg, executive director of AHS International, asks if sustained human-powered helicopter flight will ever become a reality, as his organisation continues to challenge engineers through the AHS Sikorsky prize.

AHS International is the vertical flight technical society, and our mission is to provide global leadership for scientific, technical, educational and legislative initiatives that advance the 'state of the art' of vertical flight.

In February 1980, after the Gossamer Condor and Gossamer Albatross human-powered aeroplanes won the British Kremer prizes, the American Helicopter Society (as we were then known) issued its own challenge – to build an aircraft that could hover for 60 seconds over a 10x10m spot and reach a momentary altitude of 10ft, using only human muscle power.

AHS initially set an award of \$10,000 (later raised to \$25,000) for the Igor I Sikorsky Human Powered Helicopter (HPH) Competition – the AHS Sikorsky prize.

Dozens of HPHs have been built and tested over the past 33 years with varying degrees of success. The initial achievement of getting an aircraft 8in off the ground for 6.8s in 1989 at California State Polytechnic University (Cal Poly) was followed by a flight of 19.4 seconds, reaching a 2.3ft height, at Nihon University in Japan in 1994.

Incentive boost

Many more HPH aircraft were designed in the ensuing years, but none flew. By the late 2000s, the competition seemed moribund, and the \$25,000 prize had shrunk in value over the years.

In 2009, Sikorsky pledged \$250,000 to the winner of the competition. With a tenfold increase in the prize money, renewed interest and publicity led to a new generation of HPH contenders.

The University of Maryland was first to demonstrate what three decades of advancements in composite structures, computer-aided design and analysis of rotor aerodynamics, structures and aeroelasticity could bring to bear on the problem.

The school's quad-rotor Gamera hovered for 4.9 seconds in May 2011. The current Gamera II – with four 14.5m diameter rotors and weighing

only 37kg – has come tantalisingly close to the three major requirements of the AHS Sikorsky Prize – in separate flights in summer 2012, the Maryland team flew for 65s and to a height of 8.8ft, and it made a 55s controlled flight in February 2013.

Other contenders

Meanwhile, two other HPH contenders were taking shape. NTS Works in the US, led by a former member of the 1980s Cal Poly team, built a reaction drive single rotor HPH, dubbed 'Upturn', weighing 43kg with a 25.9m diameter rotor.

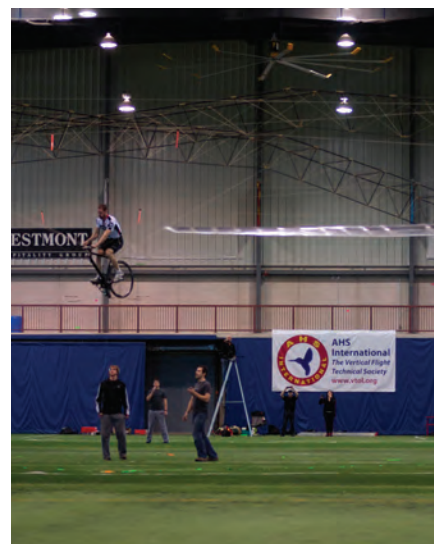
Initial testing resulted in an unofficial tethered ten-second flight, rising about 1.9ft, in June 2012. NTS Works later donated the aircraft to Cal Poly, where the students continue its development as the Upturn II.

AeroVelo in Canada built its Atlas HPH in 2012. With 20.4m rotors and an overall length of 58m, the giant quad-rotor is larger than any production helicopter ever built and weighs only 53kg. First flight was in August 2012, and since then Atlas has demonstrated controlled flights up to 47s, and reached 9.5ft in March 2013 (illustrated).

Over the decades, several studies have concluded that the AHS Sikorsky Prize is unwinnable. These analyses have shown that even with the most optimistic assumptions, a human cannot output sufficient power to satisfy all three requirements in the same flight.

The recent flights, however, seem to indicate that it is possible, though the practical difficulty of having a flight where everything goes perfectly has been repeatedly demonstrated. The challenge of optimising lift, weight, structural strength and rigidity, as well as human power output is like balancing on the head of a pin.

The aircraft have to be tested indoors since they are too fragile to withstand even a small gust of wind, and only an exceptional cyclist with a high power-to-weight ratio even has a chance



of succeeding. The 'pilots' have to be in peak physical form, and everything has to be perfect.

So, when is a practical human-powered helicopter going to come to market – one that we can use to zoom around the neighbourhood, take to the grocers or ride to work? Probably not in this century, if ever. Certainly not with the level of technology that we can envision today.

However, similar to the Gossamer Condor human-powered fixed-wing, the AHS HPH Competition is not about creating a practical machine. It's an engineering challenge to the vertical flight technical community. Teams comprised primarily – or entirely – of students have demonstrated impressive creativity and innovation.

The projects are galvanising experiences that complement theoretical understanding with practical application. This multi-disciplinary project harnesses technical skills and understanding, leadership, motivation, business acumen, sleep deprivation and teamwork to overcome what many have said for a third of a century is an impossible challenge. This summer may finally prove that the impossible is possible. **RH**

See the latest information on the AHS HPH competition, including the rules and the latest videos and news articles at: www.vtol.org/hph

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