

BY GARY GRESS

Homebuilt VTOL

Vertical takeoff and landing (VTOL) aircraft have always fascinated me, so I decided to try to build a tilt-prop model. This version is the latest in a line of about seven or eight generations of designs, each generally lighter and simpler than the one that preceded it. But none of the previous versions was able to hover for more than a few seconds, mainly because of a lack of stability in pitch.

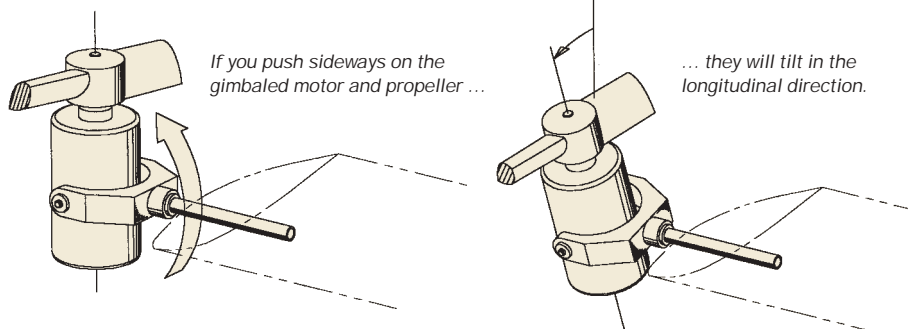


I finally overcame these problems and achieved a successful hover with my latest model, which uses just two airplane propellers to provide lift and ensure stability and control. I managed to eliminate helicopter-type cyclic pitch controls as well as any other devices that react with the air. This aircraft achieves pitch and yaw control in hover by tilting its propellers, and roll is controlled by varying the speed of the two motors. Driven by piezo gyros through external mixers, two sub-microservos and two electronic speed controls round out the model's equipment.

The concept for this model was inspired by the Bell XV-15 and Bell/Boeing V-22 Osprey tilt-rotor aircraft, but I believed I could take advantage of a model's relatively small size and make it simpler. So instead of helicopter-type rotors, I decided to use conventional airplane propellers, but it took a lot of experimenting to make the plane stable and controllable in pitch.



A close-up view of the micro-size radio gear that controls my aircraft.



SPECIFICATIONS

MODEL: gimbaled, tilt-prop VTOL

DESIGNER: Gary Gress

SPAN: 19.6 in. (between propeller shafts)

AIRFRAME: 1/8 and 3/16-inch-diameter carbon-fiber tube

FLYING WEIGHT: 16 oz.

RADIO USED: Hitec Feather 4-channel receiver w/two JR NES-241 sub-microservos

MOTORS USED: two SimProp Power Speed 300 6Vs w/two modified Horst 280 6:1 gearboxes and two Jeti JES110 11A or Great Planes Electrify C-10 speed controls

PROPS: Roswell Flyer, 11.5-in.-diameter

MIXERS: one WattAge fixed elevon mixer and one V-tail adjustable elevon mixer

GYROS: three Heli-Max micro piezos with covers removed

BATTERY: 8-cell, 600mAh Ni-Cd

I eventually found that by mounting the motors on gimbals (thereby allowing them to swivel sideways and tilt forward and backward around the wing tube), I could achieve unqualified pitch control of the plane via 90-degree precession. (Precession is a unique feature of gyroscopes. Remember trying to turn the axle of a spinning bicycle wheel?)

By applying a lateral or sideways moment to the gimbaled motor/gearbox, and consequently to the propeller, the assembly tilts in the desired longitudinal direction, 90 degrees from the direction of the applied moment. The reactions of the propeller assemblies on the airframe cancel each other, and pitch control is unaffected.

With this method, however, there wasn't enough stability in pitch, so I augmented it by adding a piezo gyro to the control circuit. That's all I needed to achieve stability; I finally had absolute control of the propellers.

Though the battery pack allows 2½ minutes of flight time, typical hovers last only about 30 to 45 seconds. Because low temperatures affect the gyro and battery performance, all but one of the flights has taken place in the 9x9 confines of my living room. Though the plane is stable and tends to remain over one spot, it is difficult to maintain a constant altitude of 3 to 4 feet in such a small space.

This is the extent of the testing done to date. I am now working on a new model with wings, a proper fuselage and other changes that will enable transition and cruise. Since tilt and differential thrust control are already available in hover mode, I plan to use them for control in cruise, as well. This will, I hope, eliminate the need for control surfaces and their associated servos.

Anyone who has questions about this project is welcome to email me at ggress@attcanada.ca. †