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HOW IT WORKS; Gyroscopes That Don't Spin Make It Easy to Hover

 By **PETER WAYNER**

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WHEN learning to fly a helicopter, either a full-size one or a radio-controlled model, one of the greatest challenges is keeping the craft hovering in one spot. But model fliers, at least, now have some assistance: digital circuitry that can help them develop the right touch in just a few hours.

The secret is the piezo gyroscope, a small motion-sensing device originally developed to help take the shake out of home videos. The Segway personal scooter may be the most famous secondary application of the technology, but given that few of the scooters have been produced yet, the gyroscopes have seen far greater use in model helicopters and other aircraft.

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Unlike spinning gyroscopes (like the kind often sold as a toy), piezo gyroscopes do not rotate. Instead, they vibrate, detecting motion along the axis perpendicular to the axis of rotation. Wayne Hillenbrand, the event director of the Maryland Helicopter Association, says piezo gyros are so inexpensive now that they are used with all modern model helicopters to keep the machine pointed in the right direction.







"Every time the machine changes main blade pitch, or power, the tail rotor tends to move," Mr. Hillenbrand said. A gyroscope can detect the movement and send a signal to a processor that adjusts the speed of the tail rotor to compensate. This eliminates any need for rudder control input, he said.

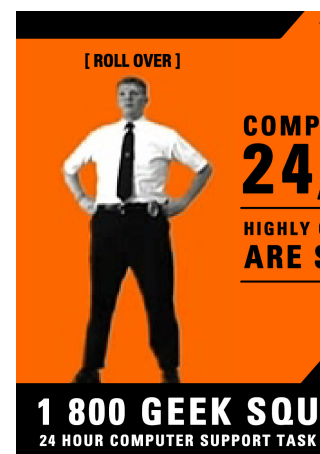
A new, more ambitious four-rotor copter, called the Draganflyer III, uses three gyroscopes, one for each axis. A computer polls the gyroscopes and uses the responses to detect any listing or tilting before adjusting the power to one or more rotors to fix the problem. If a Draganflyer starts moving to the right, the computer cuts the power to the left rotor. If it starts twisting, the processor revs two rotors to keep it twisting in the other direction.

Such digital assistance makes it possible for many people to learn quickly to fly a model helicopter -- something that used to take months of training. In the world of radio-controlled flying machines, the helicopters require most intense devotion because their controls are so hard to master and the machines are expensive to fix when they crash.

Zenon Dragan, the inventor behind the machine, said his device, which weighs slightly more than a pound and is 28 inches wide, was built from carbon-fiber composites, making it close to indestructible.

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[ROLL OVER]

COMPUTER
24
HOURS
HIGHLY TRAINED
TECHNICIANS
ARE STANDING BY

1 800 GEEK SQUAD
24 HOUR COMPUTER SUPPORT TASK FORCE

"You tip over a regular helicopter, you're going to need two weeks and \$600 to fix it," said Mr. Dragan, of Saskatoon, Saskatchewan.

"I can guarantee you that everyone will learn how to fly it," he said, speaking of his invention. But then he caught himself. "We've had frustrated people who think that because of the gyros it flies itself," he added. That is not the case. "Without the gyros it will just flip over. The gyros are like a time machine. They make everything go in slow motion."

The pilot is still responsible for guiding the machine away from furniture, plants, trees and other people. The programmers who wrote the control software for the Draganflyer needed to balance the stability of the machine with the responsiveness. Too much help from the computer produces a very placid device that tends to stay in one place. Too little help and it requires a master to manipulate it.

"It's a Catch-22 situation," Mr. Dragan said. "The more stable the helicopter, the less maneuverable it is. There's a trade-off, and this model is still kind of challenging. Our next modification is to add a super-easy mode. We're definitely going to toss a few more gyros on it and it will hover itself."

Gyroscopic assistance makes it possible for model helicopter pilots to pull off stunts that could not be done before. "Without the current generation of gyros, most people could not fly backwards or sideways maneuvers," Mr. Hillenbrand said. "Now, many people can do sideways loops, backwards loops, all at 60 miles per hour."

Some are not even satisfied with that. Rogelio Lozano, a roboticist at the National Center for Scientific Research in France, said he reprogrammed his Draganflyer to take off, hover about 15 inches off the ground and land without any human interaction.

He uses the built-in gyroscopes, but to compensate for any drift, he added an extra sensor that measures orientation relative to an antenna.

The Draganflyer lists for \$749, a price that makes it an expensive toy. So Mr. Dragan is also pitching the device to real estate agents and police department SWAT teams that might need aerial pictures. A tiny video camera can be mounted on the device for \$200. The company also makes a larger, much more expensive model that is sold to the military for surveillance use.

These prices should continue to drop, Mr. Dragan said. "Just a few years ago, those piezo gyros were thousands of dollars apiece. So as component prices drop, the price of these machines comes down to the point where eventually they'll be under \$99."

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