LET GEORGE DO IT?

Used Correctly, Autopilots Offer Second-Pilot Safety Benefits

STORY BY DAVE HIGDON

A well-equipped traveling airplane usually has a "George" available — an autopilot ready, willing and quite able to serve up its helping hands to the human aviator pushing its buttons.

Perhaps by dint of aircraft design progress or simple evolution of thinking, among pilots who believe they can fly as well or better — without the costs or maintenance of a helper — the autopilot often commands no more respect than a chauffeur.

For some, the upfront cost of even a simple roll-axis-only autopilot or wing leveler is hard to justify, let alone the five-figure tab of something working in two axes. But the more seasoned viewpoint recognizes the benefits of the autopilot — advantages demonstrated during the first public showing of an aircraft flown by a George.

That demonstration in 1914 instantly appealed to manufacturers, generals, admirals and airline entrepreneurs, all of whom seemed to recognize its safety aspects. In the years since, tens of thousands of pilots can attest to the value of their George — most of them offering a "There I was…" story, with the autopilot coming through at a critical juncture.

This story began 96 years ago with a young American engineer named Lawrence Sperry.

Continued on following page

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LET GEORGE DO IT?
Continued from page 41

From Father to Son, From Sea to Sky

Lawrence Sperry was not yet 22 years old when he brought to its feet a crowd of thousands of French, American and British witnesses to the Concours de la Securité en Aéroplane — the Airplane Safety Competition — being flown above the Seine River outside of Paris.

Sperry made three passes above the river in a Curtiss C-2 biplane equipped with his new four-gyro, gyro-stabilized, flight-control device — each without human control input. He first flew by with his upper torso disengaged from the C-2's roll controller and his hands held high above his head. On the second pass, Sperry's French mechanic, Emil Cachin, walked about 7 feet out on one wing, then some more — again with Sperry showing he wasn't flying. On the final fly-by, the youthful Sperry and Cachin stood on opposite wings far from the cabin, eliminating any doubt. As they might say today, the crowd went wild.

The new mechanical gyroscopic control system was…well, in control. Sperry further cemented the view of his device's abilities by demonstrating the system's ability to manage hands-off take-offs and landings.

Scarcely a decade after the Wright Brothers' tentative first flights, a revolution in aviation already was under way — not one of speed, distance or altitude, but one of control. Pilots still feel and appreciate the ripples of that revolution.

Today, autopilots provide such sophistication and integration they practically can control the flight from brake release for take-off to stopping on the runway after landing, managing everything but the landing gear and flaps in the process.

While not an all-cases, every-time solution to in-flight situations, autopilots offer safety advantages disproportionate to any disadvantages.

Autopilots 101: A Brain and its Helping Hands

The basics of autopilots remain largely the same. Spinning gyroscopes sense movement about an axis or axes, then transmit this information to a brain, which relays a correction command to a helping hand — in the case of an aircraft, a lightweight, controlled-motion motor known as a servomechanism, or servo.

The servo moves the control surface as commanded by the brain until new input shows the aircraft back to its desired state and the input command ends. This feedback loop makes the system work, regardless of type or number of axes controlled.

Initially, they all were spinning-mass, metal gyroscopic devices with built-in sensors to detect motion, both direction and extent. Today, solid-state sensors increasingly provide the position information in much the same way as providing video commands to a cockpit flight display.

Whether by pneumatic power, analog electric signal or digital computer code, the brain's instructions cause the servo to respond to the changes detected by the gyro sensors. Today, pneumatic examples still exist; analog-electric dominates, and all-digital control-by-computer-code systems are becoming common.

Need Determines the Right Type

Variety. Not only is it the spice of life, but it also is a component in aircraft autopilots and flight-control systems.

Avoiding a discussion of the competing design philosophies of autopilots — rate-based versus attitude-based — aircraft owners should understand the variety of control offered by various levels of automatic flight-control systems:

• Wing leveler. This basic single-axis system, called the "wing leveler," is a common low-cost work-saver popular among owners of homebuilt and entry-level factory aircraft.

Wing levelers typically employ an add-on anti-servo or trim-tab to the back of one aileron; a simple processor in the panel takes its reference for level from the attitude of the airplane when engaged. From there, the processor does nothing more than sense changes about the longitudinal axis and signals the servo to move the tab to counter the roll.

That's it; it keeps the wings level — hence its moniker, "wing leveler." Aim in the direction you want to go; it drifts with the wind and does not provide any help holding altitude.

• Full single axis. Essentially, the fundamental single-axis autopilot is a wing-leveler system with more sophistication in how it handles roll control. Popular single-axis systems can be slaved to the directional gyro (DG); so, as the autopilot holds the wings level it also steers the specific heading set on the DG.

Popular single-axis systems also can be linked to VOR and GPS navigation radios to track either a VOR signal or the GPS-determined route, including seamless heading changes in some systems. Additionally, the single-axis system working with the nav receiver generally can track a localizer (LOC) signal, whether as a stand-alone or as part of an instrument landing system (ILS).

Remember, the single-axis George works only in the roll axis. Altitude control is all up to the human.

• Basic two axis. Take all the single-axis features and add altitude hold, and you have the most common form of two-axis autopilot. Two-axis systems vary in sophistication level, adding depth to the help available from the more sophisticated systems.

The simplest two-axis systems generally use an absolute-pressure sensor to provide altitude reference. When it senses a change, it signals the brain, which commands the elevator servo to counter the detected pressure change. A change in altimeter setting generally will require a reset of altitude hold.

• Three axis. Many people believe three-axis autopilots add full control of the rudder to complement the roll-and-pitch control of a two-axis system. In reality, this third axis generally serves only to counteract uncommanded yaw, a characteristic of some high-performance aircraft.

This axis generally is called a yaw damper, and this dampening action is its only job. Most three-axis autopilot systems allow for the yaw damper to be turned on or off depending on need and phase of flight.

• Altitude control. Some of the more sophisticated two- and three-axis autopilots give George a role in managing altitude with climb and descent control, altitude capture and altitude hold. The most sophisticated of these give the human pilot control over whether the autopilot uses climb rate or airspeed as its climb reference.

Putting George to Work as the Co-Pilot

The safety implications of a well-designed, properly functioning autopilot only seem vague or abstract to the unfamiliar, vanishing the moment you realize you really could use one at that instant.

Cruising along "inside the eggshell," as instrument pilots describe it, is a demanding flight environment on a good day. Hand-flying in this environment is taxing, even more so in rough air. Bouncing around, trying to write down a new

Continued on following page

LET GEORGE DO IT?

Continued from page 43

clearance, looking up new navigation points, finding different waypoints and frequencies — all while trying to keep the airplane straight, level and headed in the correct direction — quickly becomes more than taxing.

Unless you can write down new instructions or look up new materials and manage to watch your gyros, you're apt to find the airplane deviating in heading and altitude — and very quickly in anything but smooth air.

Releasing the yoke allows the hand-flown airplane to drift, and it will begin an almost imperceptible roll in one direction of another. From this shallow, subtle roll, the aircraft could begin to descend, almost imperceptibly. Soon, you're in a descending, accelerating spiral and trying to sort out the tumbling instruments.

Contrast this killer scenario with the same situation, adding a George to lend a mechanical hand. First of all, the simplest wing leveler offers help in this environment, even if it can't prevent the plane from drifting off course. Make the box a full-function, two-axis autopilot, however, and nothing gets out of spec — let alone out of control.

The human simply sets George to track a VOR course or sets it to track a GPS-generated course. Or you simply select the ATC-dictated heading on the DG and "Engage."

On Approach: George Flies You from Soup to Sunshine

The hearty single- and two-axis systems also work for flying an instrument approach by allowing the pilot to choose between inputs as needed.

For example, a pilot can start by using the DG to keep the airplane on the course per ATC instructions. When commanded to turn inbound to intercept a LOC or ILS, the pilot can use stepped turns commanded by the DG or the autopilot's roll-control knob, smoothly reorienting the airplane to the new heading. As the CDI needle begins to center to the LOC signal, the pilot commands the autopilot to track the signal; now, it steers the airplane to center up the CDI.

For the two-axis unit, the system's altitude-hold capabilities hold the airplane within 50 feet of the altitude ATC assigned — right up to the point the glideslope needle or other descent indicator comes into play. With the autopilot steering the LOC on-center, the pilot needs only to manage glideslope and make sure the wheels and flaps are set; then, watch for the runway to appear ahead.

Simple Help is the Best

Even outside stressful IMC flights and other challenges, a good autopilot con-

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AUTOPILOT RESOURCES

AVIDYNE:
www.avidyne.com

BENDIX/KING BY HONEYWELL:
www.bendixking.com

CENTURY FLIGHT SYSTEMS:
www.centuryflight.com

COBHAM S-TEC:
www.s-tec.com

TRIO AVIONICS (light-sport and experimental aircraft)**:**
www.trioavionics.com

TRUTRAK FLIGHT SYSTEMS (light-sport and experimental aircraft)**:**
www.trutrakflightsystems.com

tributes to flight safety. Take, for example, a lengthy cross-country flight of two, four, even five hours. While you monitor all the flight parameters the autopilot manages — and all the ones it doesn't — you can relax, let George handle corrections, make trim changes needed to hold your altitude, and maybe fly all the heading changes on non-direct flights.

If the autopilot can track a GPS-generated course directly, you get to enjoy the benefits of something more akin to a flight management system than a simple autopilot with a heading input. And when it's time to resume hand command to descend, maneuver the pattern and cap the leg with the kind of smooth landing a refreshed, relaxed pilot should make — with none of the exhaustion-related issues you might encounter after hours of constant small corrections during the flight.

When You Can't Fly

One last safety element of a good autopilot: pilot incapacitation. Even on a smooth day, an aircraft needs steady attention to hold course and altitude.

Now, imagine yourself stricken with food poisoning, a sudden illness or worse — with friends or family on board. In this nightmare scenario, George can help a non-pilot on board while getting advice on how and where to land. An autopilot will keep the airplane sailing along, as commanded by your settings, until the fuel runs out, the engine stops and the plane comes down.

Most of us have heard of instances in which a pilot became incapacitated by carbon monoxide poisoning, then awoke later with a major headache and a ringing in his ears, but who was alive, thanks to the autopilot. The autopilot held the wings level and at a constant attitude as the plane glided to a wings-level touchdown after the engine stopped.

We credit George with a "good landing" — one in which everyone walks away.

If you have never shared with your customers the safety benefits of installing a good autopilot, think about that moment in flight when you most wished for a helping hand. Or imagine a loved one trying to stay alive while coping with a pilot debilitated and unable to fly.

This mechanical pilot can be there to help in many a tight spot, whether it's just to give you a break on a long cross-country flight, fly while you scout for an alternative destination, or, my personal favorite, when ATC needs you to "Stand by to copy an amended clearance" — and you're in the clouds, looking at the inside of a tumbling eggshell, fearful of taking your hands off the controls for even a few seconds to write.

Prices for autopilots range from about $7,500 upward for a good single-axis, and about $12,000 plus for a two-axis — money that will seems well worth the investment the first time it helps a customer through a tough spot.

Whether keeping you on the straight-and-level or providing a helping hand on a gusty ILS approach, few safety devices in airplanes can do more to help a struggling aviator than a good autopilot. ❑