Harbinger of things to come

New Avidyne autopilot—enhancing flight safety

BY DAVE HIRSCHMAN

The nose of the Cirrus SR22 points high into the summer sky while the little remaining airspeed bleeds off at an alarming rate.

Steve Jacobson, Avidyne's vice president for product management, manually rolls the airplane 60 degrees to the left while holding the nose-high attitude. A synthetic voice chimes in with a warning: "Caution! Underspeed!"

The airplane is on the ragged edge of a stall when Jacobson presses the "straight and level" button on the DFC90 autopilot. The autopilot immediately kicks in bringing the nose down to the horizon, leveling the bank angle, and the airplane accelerates placidly in level flight.

The S&L button is one of the key safety features of Avidyne's retrofit DFC90 autopilot—a new piece of digital equipment meant for the roughly 5,000 glass-panel airplanes (mostly Cirrus SR22s, Columbias, and Pipers) built with Avidyne Entegra primary and multifunction displays and S-Tec autopilots. The $13,885 (installed) DFC90 upgrade also provides "envelope protection," an innovative safety feature that guards against autopilot-induced stalls and overspeeds, and handles the airplane with remarkable precision—even in windy, gusty, crosswind conditions.

The DFC90 is identical in size and similar in appearance to the S-Tec autopilots it's designed to replace and uses the same servos. More than 300 DFC90s were sold before Avidyne began customer deliveries in July. The key difference from the S-Tec is that the DFC90 gets its information from the same ADAHRS that informs the PFD, not the turn coordinator. As a result, the DFC90 collects far more data and guides the airplane, both vertically and horizontally, with tremendous precision.

Jacobson, a former U.S. Air Force test pilot, has flown Avidyne's Experimental-category SR22 G-3 through long series of maneuvers with the new, attitude-based DFC90 autopilot and says the performance of the S&L button is always the same. The airplane smoothly rights itself with a minimum of altitude loss and airframe stress: between 0.5 and 2.3 Gs.

"We try to minimize G-loading on the airframe without sacrificing recovery performance," Jacobson said. "I've engaged it in a wide variety of different scenarios, and its performance has been completely consistent."

Jacobson joined Avidyne 10 years ago as a systems engineer and has played a major role in developing the DFC90 (and its close cousin, the DFC100 for the Avidyne Release 9 integrated avionics suite). He and his colleagues say their attitude-based autopilots offer myriad improvements over their rate-based predecessors, and the new autopilots will serve as the foundation for future advancements and safety features. Avidyne and its competitors are exploring a range of "passive" systems that operate continuously, even when the autopilots aren't engaged. (Garmin recently announced its "ESP" system which nudges the flight controls back toward level flight when pilots exceed certain pitch, bank, and airspeed limits.)

"These autopilots have got many years of upgrade capacity built into them," Jacobson said. "Many of the improvements we'll make in the future will be done through quick software upgrades."

Flying the DFC90

The placement, appearance, and push buttons on the DFC90 are strikingly similar to the S-Tec Fifty-Five X for a reason. All the pilots who buy the new autopilot already will have some level of familiarity with the S-Tec, so many of the button-pushing procedures and combinations are the same. (One new button, however, is labeled "IAS," and it allows pilots to select a constant indicated airspeed for climbs or descents.)

The autopilot goes through its internal diagnostics a few seconds after engine start without any input from the pilot. A red autopilot disconnect switch is mounted on the top of the SR22's sidestick control, and the autopilot also can be disabled by adjusting the trim (a hat switch), pushing the "AP" button on the unit itself, or overpowering it with brisk control inputs.

Jacobson had programmed the autopilot to maintain 120 KIAS up to an altitude of 4,500 feet, and once we

were climbing with the flaps retracted, he engaged the autopilot and it quickly settled on the target airspeed. The airplane maintained a 1,200-fpm rate of climb until about 50 feet below the selected altitude, and then leveled off crisply and precisely.

Adjusting the barometric pressure, an oft-repeated task during cross-country flights, is a one-button affair with the DFC90. The pilot simply makes the adjustment on the PFD, and the airplane maintains its previously selected altitude.

With the airplane level in cruise flight, Jacobson programmed the autopilot for a rapid, 1,600-fpm climb while reducing the power to near idle. The airplane obediently pitched up to start the climb, and then sensed that all was not well.

"Speed protection active," the synthetic voice said, accompanied by a textual warning on the PFD. As the airspeed diminished, the autopilot reduced the pitch attitude and refused to allow a stall. With the power all the way back at idle, the airplane held 82 KIAS (1.2 times V_S) with the wings level in a slight descent.

We returned the airplane to cruise configuration and then used the vertical speed mode on the autopilot to command a rapid descent. As the airplane approached V_{NE}, the "overspeed" text and aural warnings returned, and the autopilot smoothly pulled out of the dive.

"Envelope protection" may sound like something that belongs in a post office, but it's the beginning of an extremely promising area of new safety features that can enhance pilot situational awareness and help us from inadvertently flying into dangerous conditions—whether autopilots are actively flying or not.

We clicked the autopilot off and hand-flew the airplane into a series of unusual attitudes. This time, the warnings used different phrases: "Caution! Underspeed!" and "Caution! Overspeed!" The S&L button quickly righted the aircraft in all cases.

During a simulated engine failure, Jacobson programmed the autopilot to maintain 88 KIAS (the SR22's best glide speed), and a single push of the IAS button kept the airplane at exactly that speed while he found the nearest airport and redirected the airplane toward it.

Returning to our starting point, we gave the autopilot the unenviable task of intercepting an ILS two miles outside the final approach fix at a 70-degree angle. The DFC90 performed the difficult feat smoothly, and without over- or undershooting—despite an 11-knot quartering tailwind. (The autopilot allows a maximum bank angle of 22 degrees in intercepts and holds.) It tracked the localizer and glideslope precisely despite sharp gusts and turbulence from the final approach fix to the runway.

Conclusions

The DFC90 is a highly capable autopilot that increases smoothness, precision, and ease of use, whether the autopilot is flying or providing flight director bars for pilots to follow manually. These qualities are nice to have, but not essential.

An S&L button capable of righting the airplane from upsets, however, and full-time envelope protection designed to avoid upsets before they happen, are dramatic advancements for general aviation. In this sense, the DFC90 could be the harbinger of an entirely new category of flight safety enhancements in development at Avidyne and elsewhere.

During research and development for the DFC90, Jacobson studied every Cirrus mishap that's ever taken place and determined that the situational awareness and unusual attitude recovery tools built into the DFC90 could have mitigated or eliminated about one-third of them. The DFC 90 is an exciting product in its own right, and it's sure to provide the technology foundation for many more advancements to come.

For more information, visit the website (www.Avidyne.com). AOPA

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