Auto-Recovery Systems Are Part Of Bizav Pilots' Future

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James Albright

I've always looked forward to the Static Display at each NBAA-BACE as a way of not only seeing what aircraft manufacturers have to offer, but also what they envision for the future. Aircraft auto-recovery systems fall into both categories. They have been around for decades, and they are finding their way into the next generation of business jets.

G-LOC

I first heard about auto-recovery systems with a version installed in the General Dynamics F-16 Fighting Falcon, a single-engine, single-seat multirole fighter. The aircraft was conceived in the 1970s to capitalize on an increased thrust-to-weight ratio, providing greater maneuverability with minimum energy loss. The result was a fighter that could "out-G" the pilot, able to sustain a 9G turn. Several F-16 pilots have been lost over the years due to a G-induced loss of consciousness (G-LOC).

The F-16 Fighting Falcon can be equipped with an automated ground collision avoidance system. Credit: U.S. Air Force

To combat this problem, the U.S. Air Force developed an automated ground collision avoidance system (Auto GCAS) that takes control of the aircraft if the pilot fails to respond to an imminent ground collision. It is designed to roll wings level and initiate a +5G pull to prevent ground impact. Since its introduction, Auto GCAS has saved the lives of many F-16 pilots.

The F-16 is a fly-by-wire (FBW) aircraft, providing the Auto GCAS interface with the flight controls.

Spatial Disorientation

Fighter pilots have more than just G-LOC to fear in an air combat or training environment. Theirs can be a disorienting world where the loss of a visible horizon and disturbances of visual, vestibular and proprioceptive senses can literally fool them into thinking up is down and down is up. Maneuvering in a fast-changing air-to-air combat situation can leave pilots disoriented.

The idea of an auto-recovery system has been expanded to deal with a pilot's spatial disorientation, most notably in the Dassault Rafale fighter, to provide an automatic

The Dassault Rafale's auto-recovery system can have the aircraft recovering from a pilot's spatial disorientation. Credit: Aksveer/Wikimedia

recovery from nose-high and -low situations back to establish a 5-deg. climb at 350 kt. with the push of a button. The Rafale is also FBW.

Of course, you don't need to be in a fighter aircraft or an air combat situation to become spatially disoriented. Pilots have succumbed to this phenomenon for a variety of reasons. A sloping cloud deck, for example, can fool a pilot's senses into thinking the wings are level when aligned with the clouds. Or a sudden acceleration can play tricks with the pilot's inner ear to think the aircraft is pitched nose up, just as a sudden deceleration can make the aircraft seem nose down.

In 2019, an Atlas Air Boeing 767 was on approach to Houston-George Bush Intercontinental Airport (IAH) when one of the pilots bumped one of the takeoff/go around (TO/GA) switches, causing the engines to throttle up to TO/GA thrust. The crew was in instrument conditions and the acceleration made the pilot flying believe they were pitched up excessively and stalling, so he pushed the nose of the aircraft down and didn't reverse his inputs until they popped out of the weather. But it was too late, and the aircraft impacted doing over 400 kt.

The list of causes is very long; the lesson is that any pilot can become spatially disoriented. The cure, of course, is better training. But technology can provide a good "just in case" solution.

Wake Turbulence

In early 2017, the pilots of a Bombardier Challenger 604 temporarily lost control of their twin-engine business jet after hitting the wake of an Airbus A380, which was flying in the opposite direction 1,000 ft. above and slightly to the right. The Challenger rolled several times and lost 8,700 ft. of altitude before recovering. The aircraft was damaged beyond repair.

As our skies become crowded while fitting more aircraft into optimal routes, chances for these kinds of wake turbulence upsets increase. I've also seen a few instances of aircraft systems malfunctions inducing an unusual attitude that required exceptional pilot skills to recover. In a few cases the pilot's first reaction was too hasty and resulted in greater aircraft damage or loss. Having a one-button solution that simply returns the aircraft to wings-level,

unaccelerated flight can provide valuable time to assess a situation before acting (provided the pilot has the presence of mind to hit that one button).

Dassault will further develop the auto-recovery concept with its recently launched Falcon 10X. The new aircraft will protect pilots who become disoriented or find themselves in an unusual attitude (induced by wake turbulence or other causes). In such a situation, pilots simply press a button, and the aircraft will automatically recover to straight-and-level flight at a safe attitude and speed. The 10X is an FBW aircraft.

Fly-by-wire technology isn't required, however. The Airbus H160 medium twin-engine helicopter uses what is known as a "fly-through" autopilot. The automatic flight control system (AFCS) is always "on." When in "hands on" mode, the pilot controls the aircraft conventionally. In "hands off" mode, the pilot releases the controls, and the helicopter maintains the same flight path and airspeed. If the pilot becomes disoriented or surprised by a loss of visibility, a quick double-tap of a button returns the helicopter to a stable, controlled position, allowing the pilot to regain situational awareness.

Autoland

Taking the idea to its logical conclusion, the Garmin Safe Return Autoland system will analyze terrain, download data-link weather, select an airport for landing, communicate with ATC, shoot an instrument approach, and land the aircraft. The system is currently certified and installed in production Cirrus Vision Jets. The Vision Jet is a single-pilot aircraft and Safe Return can be activated by passengers with the press of a button.

On the Cirrus Vision Jet, Garmin's Safe Return Autoland system can select an airport, communicate with ATC, and land the aircraft. Credit: Cirrus

The Vision Jet is not a fly-by-wire aircraft, but it does have an autopilot and autothrottles, as well as very-robust communications systems. The Safe Return Autoland system is a revolutionary solution to the problem of relying on a single pilot for the safety of the aircraft and its passengers.

I think the auto-recovery systems that return aircraft to straight-and-level flight are a great start, but there is room for improvement. Those systems that include an autoland feature should become the new standard in auto-recovery systems. I will be looking for both types at the NBAA-BACE Static Display at Henderson Airport, starting on Tuesday, Oct. 12, 2021.