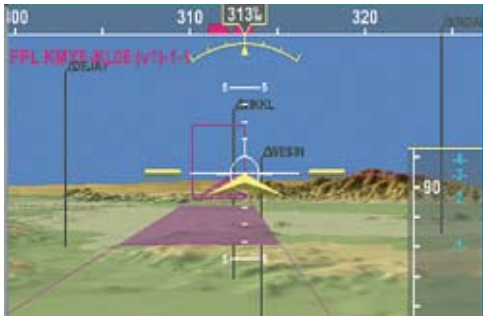
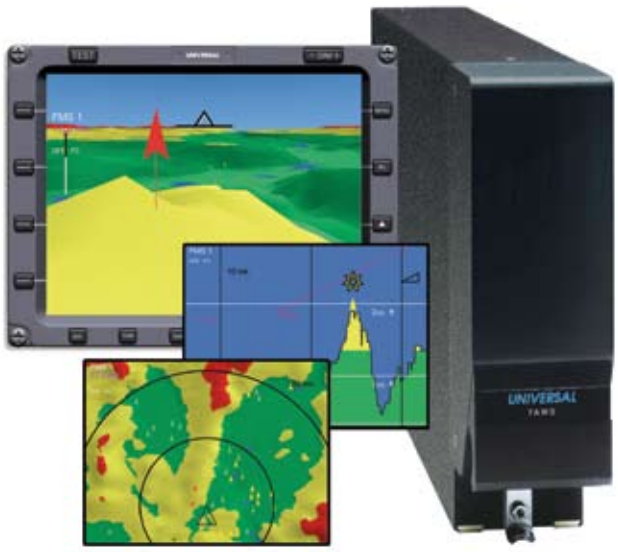


Avoiding CFIT

Helping Customers with Color-Coded Maps, Active Alerting

STORY BY DAVE HIGDON



If more pilots understood the relative risks and the relatively low cost of protection of some kind, they might come around — especially given that these technologies have all but eliminated CFIT accidents in aircraft so equipped.

The stark spotlight of a singular tragedy can open our eyes like no other.

For example, my pilot friends are asking far more questions about traffic-alert solutions in the wake of the Hudson River mid-air collision this past summer.

Interestingly, few of them talked technology solutions for controlled flight into terrain (CFIT) accidents after one of our mutual flying friends flew into an Arkansas mountain while trying to escape the VFR into IFR trap several years ago. Ditto for some of my friends in the experimental community when a well-known manager for a prominent kit maker flew into a mountain flying with comfortable altitude under a solid overcast.

The rapid, smooth rise in the mountain slope defies easy detection by the naked eye in even clear weather. In poor condition, the chances fall.

Pilots, despite evidence of its benefits, seem slow to embrace protection from themselves and the inadvertent flight into the ground. Many seem to feel they'll never so succumb. Others fail to see the potential danger because they always fly under positive control when conditions make CFIT more likely: night, VFR or IFR.

If more pilots understood the relative risks and the relatively low cost of protection of some kind, they might come around — especially given that these technologies have all but eliminated CFIT accidents in aircraft so equipped.

Maybe that's the message needed: If you get the protection, it'll make sure you never need to worry.

If Pilots Understood

According to a report from the AOPA Air Safety Foundation, between 1993 and 2006, more than 380 fatal accidents occurred at night, in VFR conditions, because the pilot flew the airplane right into the terrain.

Instances are far fewer for pilots in instrument meteorological conditions flying under IFR clearances. But they do happen.

Conversely, the mandate of ground-proximity warning systems on commercial and turbine aircraft have resulted in a near total elimination of CFIT accidents for those aircraft.

No such mandate exists for most private aircraft, an area which the ASF report reveals needs help.

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The ways in which pilots can and do suffer unplanned, unexpected encounters with terrain and obstacles vary as widely as the variety of combinations. And far too often, they are fatal, particularly when the encounter occurs at night, in poor weather or both.

Information about terrain elevation and obstacle heights abounds in aviation reference materials — from the VFR navigation charts and the instrument en route charts to the approach plates used to land and depart during instrument meteorological conditions.

Fligth instructors, the AOPA ASF and training institution offer a plethora of classes, tips and strategies for avoiding things that can go "bump" in the sky. And pilots who understand the risk potential seem more open to using technology to protect them from CFIT.

An Ages-Old Problem

We used to hear about CFIT and its outcomes far too often. It's easy to forget that in today's post-TAWS world.

Older aviators, however, likely remember those decades when pilots flying into the ground during controlled flight caused fits of frustration for aviation-safety advocates pursuing solutions.

For years, the solutions focused on discovering a combination of training and situational awareness to combat the phenomenon. These prevailing technologies for avoiding inadvertent flight into the ground failed to cover many of the scenarios in which pilots fell victim.

The earliest ground-proximity warning systems arrived in the form of radar altimeters — and they helped, some, particularly for pilots approaching runway ends invisible through the weather.

Knowing before breaking out that the ground beneath you waits as far away as the altimeter says it should provides great comfort — and an extra method for seeing how high you are, which is an especially useful piece of information on a non-precision approach.

However, for outside situations and knowing the distance to the ground straight down, radar altimeters offered less than optimal help. And the system didn't allow for some of the more creative approaches pilots sometimes fly, ones with excessive descent velocity, excessive approach speed, excessive closure rate and such.

Despite the number of charted information sources available to pilots and all of the strategizing, the problem persisted.

Engineers at Bendix, working in the early part of the 1970s, came up with a box that combined a radar altimeter with an electronic system that could voice alert for certain situations detected by the radar sensor. Programmed to trigger at set altitudes when the gear was up, these earliest TAWS offerings were relatively simple, but effective within the limits of their capabilities.

Still, CFIT continued to occur.

Enter the enhanced ground-proximity warning system (EGPWS) — a TAWS solution with considerably more sophistication.

Among the many unanticipated benefits of the dual revolutions in microprocessor technology and accurate satellite positioning, EGPWS represents today's ultimate tool in the fight to end CFIT.

EGPWS provides the pilot with a degree of versatility and utility that enhances the pilot's ability to manage close-quarters maneuvering and still safely know and avoid the ground — below or above — and obstacles, such as towers and buildings. The predictive nature of EGPWS also makes it useful for avoiding obstacles.

But EGPWS isn't inexpensive, and it requires other sophisticated gear — more money — to function at its best.

Thankfully, beyond the gold-standard EGPWS exist other tools to help the attentive pilot avoid things that can go "bump" in-flight.

The more owners and pilots know and understand the tools available, the more they seem to embrace the options that best fit their needs and budgets.

The Simplest Solution: Color-Keyed MFD and GPS Displays

The FAA produces every VFR chart with a printed grid system, and inside each grid, it prints a number coinciding with the minimum altitude required to assure clearance over the highest point within that particular square.

Simple, right? What could be easier? For the en route segment of any trip, nothing.

The problem is, we must start and end flights at ground level in any given grid. We also must spend time — sometimes, a lot of time — climbing to the clearance altitude after takeoff or to land, descending below the safe-clearance altitude to get to the runway.

These environments are where most problems occur.

One early, simple and helpful tool is the portable color GPS. It's been about a decade since Honeywell, for one, started shipping its Skymap IIIC portable GPS navigators with basemap software, which codes terrain according to its height above sea level.

In mean sea-level terms, the color-coding works like this on the Skymap IIIC: Terrain gets a pale-green color from sea level up to 500 feet; above 500 to 1,000 feet, the green goes a shade darker; 1,000 to 2,000 feet, the color goes more yellowish, with yellow the color from 2,000 to 3,000 feet. From 3,000 to 5,000, the color goes red, then darker red above 5,000 to 9,000 feet; after that, the color goes white.

The pilot needs to understand the color key and think in terms of what the screen shows in relationship to the aircraft altitude.

With the Skymap display showing the location and GPS altitude at all times, plus the sensitive altimeter, the pilot has two sources to see, at a glance, whether the current altitude will run afoul approaching terrain, as well as the terrain elevation adjacent to where he lands. If the color-coding shows the terrain elevation incompatible with the current altitude, the pilot makes

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a new decision and modifies his altitude.

It's a simple, straightforward tool that doesn't talk or beep or otherwise annunciate — which means it works only as well as the operator's familiarity and attention level.

The changing-terrain-color GPS and MFD display maps of other systems takes the same idea and kicks it up a notch.

The latest integrated modular systems from Avidyne and Garmin International — the Release 9 Entegra and the G1000, respectively, as well as similar products in their line-ups, employ color-coding in a more proactive way by having the depiction of underlying terrain change colors according to the aircraft's relative height above the terrain. A number of other products from L-3 Avionics Systems and Honeywell also employ active color-coding.

These systems generally don't annunciate aural warnings, but their active nature of terrain-coding make them useful, budget-minded tools an attentive pilot should notice during the normal panel scan.

For example, on a cross-country flight at 5,000 msl, the approach of mountainous terrain in West Virginia, will change from green to yellow when within 2,000 feet of the aircraft's altitude, then to another color when between 2,000 and 1,000 feet, then to red, in most instances, when terrain gets within 1,000 feet — with different color saturations and combinations for terrain above the aircraft. With some of these systems, obstacles also can be shown similarly.

On these integrated displays, particularly those with synthetic vision on the PFD, possible CFIT threats get color-coded in yellow and red, depending on the imminence of the threat.

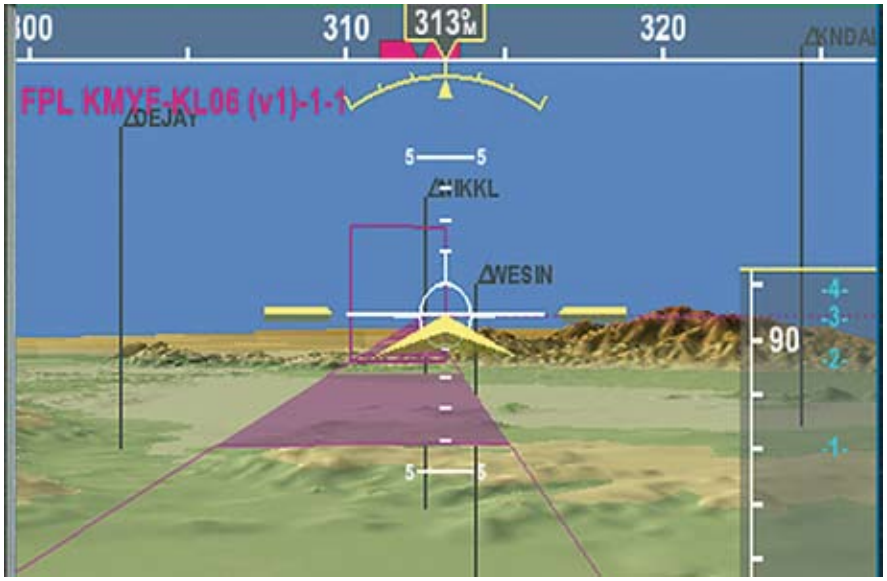
The latest in these passively functioning ground-proximity warning approaches show up in the horizontal-profile depiction of a flight plan available on a variety of new products. Honeywell's AV8OR compact MFD and AV8OR ACE electronic flight bag/GPS both employ this function, as do the Primus Apex Edge and its relative, the KSN 770. L-3's SmartDeck integrated flight display offers similar functions as well.

On virtually any of today's MFDs, integrated cockpit systems and moving-map GPS systems, technology can be added that acts to ensure pilots act appropriately.

Active Terrain, Obstacle Protection

Enhanced ground-proximity warning systems come in several forms from several avionics manufacturers, and not a pilot in my acquaintance who flies with one can say enough good about the tool.

EGPWS and GPWS are where GPS positioning, high-resolution baseline terrain maps and high-speed computer-processing power combine to provide the maximum in protection. Typically no bigger than a paperback book, these systems are designed to work with displays and audio-control systems for maximum effectiveness.



The AV8OR Horizon 3D is a portable electronic flight bag with synthetic vision that provides optimal situational awareness. Wireless communication between the mobile computer platform display and the GPS-enabled inertial navigation unit make the AV8OR Horizon 3D a reliable standalone navigation system.

L-3's LandMark 8100 with WAAS/GPS

They are as difficult to ignore as they are easy to use; although, like all technological solutions, realizing their maximum potential depends in part on the pilot fully understanding the various modes and limitations.

Honeywell's EGPWS

Honeywell's EGPWS products basically work this way: The internal GPS and its systems know aircraft position to within 100 feet; the aircraft's speed to a knot or so; and flight direction to within a degree. This is the first half of the system.

The second half of the system consists of digital memory containing the high-detail terrain map and obstacle database.

Uniting the two halves offers a powerful computer algorithm that looks downward, ahead and about three degrees on either side of the flight vector, including when turning. Should the aircraft get to 1,000 feet of terrain while flying en route, the EGPWS provides a visual alert on the display screen and an aural alert through the audio system.

Because the computer also looks ahead, the system is programmed to sound out alerts about any obstacle within 500 feet below or closer. This alert gives the pilot a 2-minute warning, then a 1-minute warning and so on, becoming more urgent the closer the aircraft and obstacle become. This EGPWS system is smart enough to calculate the warning time regardless of speed or turn rate.

Honeywell's system also knows the location of all the runway ends at all the airports in its vast database; so, it can change the warning cycles for aircraft descending and within five miles of an airport.

Honeywell's EGPWS systems operate continuously, independently of other avionics or even the avionics power switch, regardless on what display they play. Its extensive lineup of EGPWS for FAR 23 and FAR 25 aircraft also includes models for helicopters as well as turbine and piston aircraft. These systems can work aurally for aircraft lacking an MFD or other graphic-map display.

L-3's Landmark TAWS

Always working at the cutting edge, L-3 Avionics Systems answered the FAA mandate for TAWS systems in turbine aircraft with two options it dubbed LandMark.

L-3 recently updated its LandMark 8100 model with an integral WAAS/GPS sensor to make it a wholly stand-alone tool for terrain avoidance and warning functions with an increased degree of position accuracy.

Both the LandMark 8000 and LandMark 8100 meet the stringent requirements for Class B TAWS systems, including all aural warnings, landing-configuration operability, higher display resolution and longer warning times.

Boasting a range of up to 320 miles and functional at speeds to 900 knots, as well as enhanced elevation display for MFD, EFIS or radar displays, the LandMark systems work with or without a display on which to show terrain.

The 8000 is designed to integrate with existing on-board air-data and GPS equipment to fulfill its position and speed awareness.

L-3 integrated the needed sensors, WAAS/GPS included, into the 8100, making it a fully autonomous TAWS solution — with or without a screen display depicting the terrain.

Universal's TAWS: Now in 3-D

Universal Avionics offers both Class A and Class B TAWS solutions, and both offer a version of

Universal's TAWS

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...What good is spending thousands of dollars on the installation of a sophisticated safety device if the pilot lacks knowledge sufficient to hear, believe and act on what the system provides?

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the profile view previously mentioned, but as a full-screen display in full color-keyed glory instead of a small horizontal segment at the bottom of the screen with terrain, obstacles and airspace boundaries shown as icons and outlines.

Universal's TAWS works with its own and others' FMS equipment to show how terrain plays out against an arrival or departure procedure — showing the horizontal profile of an impending conflict dozens of miles ahead of the threat encounter and giving the flight crew ample time to make a new decision.

Even more interesting and potentially useful is its 3-D view, which defines waypoints with a tall stick and terrain beyond and around the stick, colored according to the aircraft's altitude. Terrain more than 1,000 feet below gets green; between 1,000 feet below the aircraft and its altitude, the terrain gets yellow; anything higher goes red, showing its conflict potential.

The Next Step is Here

Pilots being pilots, we hold the demonstrated ability to find ways to foul up things beyond our ability to fix them — particularly when we fail to realize the situation for whatever reason.

Garmin's SafeTaxi system and Honeywell's SmartRunway and SmartLanding systems took a step toward reducing problems of runway incursions, taxiway confusion and other safety threats on the ground.

Honeywell also recently announced TSO approval of upgrades to its Mark V and Mark VII EGPWS products.

These technological advances help a pilot stay more aware and spur them to act when circumstances look bleak.

The Pilot Interface Problem

As with all safety-enhancing technologies, none of these solutions for CFIT or its cousin, the landing-error accident, work without a reactive pilot interface.

Many of us have seen videos or read articles about pilots who, so fixed on other tasks, flew right through aural warnings of stowed landing gear or too-slow flight, and they paid the price for failing to heed the warnings engineers and technicians created to save them from such outcomes.

While there's no disputing evidence that TAWS, EGPWS and color-reactive visual warning systems have helped reduce CFIT — largely eliminating such accidents in EGPWS- and TAWS-equipped aircraft — it bears remembering: Any safety system functions only as well as the pilot behind the yoke.

It's important for pilots to become trained and competent in all the modes these technologies offer and the different ways in which they function. After all, what good is spending thousands of dollars on the installation of a sophisticated safety device if the pilot lacks knowledge sufficient to hear, believe and act on what the system provides? ❑

If you have comments or questions about this article, send e-mails to avionicsnews@aea.net.