



Cockpit Avionics

The earliest versions of the Internet and e-mail trace their existence back to the 1950s, when Rand researchers first started thinking about ways to connect computers through a common network. You might be surprised to learn that early ideas for cockpit synthetic-vision systems (SVS) also originated in the 1950s, as part of a joint Army-Navy research project.

The goal at the time was to transform the familiar blue-over-brown artificial horizon ball into something pilots could use in poor visibility or at night for navigation. But just like the Internet, a whole host of technological advancements needed to emerge before the seemingly utopian promise of SVS could be molded into a certifiable cockpit technology.

Researchers started thinking seriously about SVS with the advent of the modern EFIS. In the

mid 1990s NASA made noteworthy progress with research related to the Aviation Safety Program. By that time, color active-matrix LCDs were allowing compelling computer-generated visuals to be drawn on primary flight displays; microprocessors and graphics adapters were paving the way for the creation of detailed views of the outside world; and global terrain and obstacle databases coupled with GPS and other nav sensors were emerging to ensure that the images presented on the displays accurately depicted the real world. Fast-forward a decade and aviation is on the cusp of a cockpit revolution, experts say.

“Flying with synthetic vision 10 years from now is going to be like flying with an HSI today,” predicts Randy Robertson, vice president of engineering for Honeywell. “It’s going to be commonplace in general aviation

The promise of synthetic vision: turning ideas into (virtual) reality

by Stephen Pope

and second nature for tomorrow’s pilots.”

With the FAA’s recent release of Advisory Circular 23-26, “Synthetic Vision and Pathway Depictions on the Primary Flight Display,” all the pieces are in place to bring SVS to civil aircraft, observers say. Chelton Flight Systems and Universal Avionics so far are the first manufacturers to offer SVS, but they won’t be the only ones.

Other players are about to join the fray with ever more capable and compelling concepts. This October’s NBAA Convention is likely to feature several important SVS-related announcements from

avionics makers and OEMs, who at last appear ready to pull back the curtains from their secretive programs. Once that happens, other OEMs that have been on the fence about SVS are expected to follow suit in the mad rush to offer buyers the latest technology.

For the time being, though, avionics makers aren’t saying much. Honeywell and Rockwell Collins have demonstrated some interesting SVS concepts, but each company is remaining tight-lipped about precisely when and where its ideas will show up first. Honeywell’s Primus Epic integrated cockpit was developed from the very beginning to grow

and adapt as technology changed. The company’s Apex avionics system, designed for Part 23 airplanes (and selected for the Grob SPn light business jet), will also likely benefit from SVS treatment.

Likewise, Rockwell Collins has said it is only a matter of time before SVS is added to Pro Line 21’s baseline architecture, which like Primus Epic was designed to grow and expand through software upgrades.

SVS Market Heating Up

Universal Avionics obtained FAA certification for its Vision 1 SVS in the King Air 350 earlier this year and was scheduled to

Making Old Panels New Again

Synthetic-vision technology won’t be confined to the flight decks of new airplanes. Thanks to the scalable architecture of the latest flat-panel retrofit cockpit designs, avionics manufacturers will one day be able to offer upgrades for SVS and other advanced technologies using the basic hardware they are selling today.

An area where that trend is coming to fruition right now is the addition of cockpit file servers for display of checklists, electronic charts and graphical weather. In the future, the same company that sold you your aftermarket cockpit and upgrade to e-charts will also provide add-on hardware and software to instantly transform that bland blue-over-brown ADI into a virtual world replete with mountains, lakes, runways, other airplanes and heaven knows what else.

It’s all part of the business plan. Avionics makers know buyers aren’t likely to replace the LCD-based cockpit they just bought, but they’re hoping operators will be willing to join the SVS upgrade parade in the future. Here is a brief look at some of the retrofit cockpit options that have made headlines of late.

[Pro Line 21 IDS Coming to the Avanti]

Owners of Piaggio Avanti turboprops got some good news last month in the form of an announcement by Rockwell Collins that it will offer buyers the chance to upgrade to Pro Line 21 avionics, the same baseline cockpit that is sold in new Avanti IIs rolling out of the factory.

For the older Avanti’s front office, Collins is providing the Pro Line 21 IDS integrated display system and AHS-3000 attitude heading reference system. The retrofit will bring three 8- by 10-inch LCD flight displays to the Avanti flight deck, integrated with existing sensors, radios, flight-management systems and autopilot. The result is “cutting-edge technology for pilots” without the

high cost of a complete avionics overhaul, said David Wu, director of marketing for Rockwell Collins. Jet Works in Denton, Texas, will perform the installations after certification is completed in September.

Rockwell Collins was named the avionics supplier in the Avanti II around the time competitor Honeywell announced plans to offer a retrofit cockpit for the original Avanti based on the Primus Epic avionics system. With Pro Line 21 IDS, Collins is now able to compete for the aftermarket business, which could lead to a nice windfall considering that nearly 100 Avantis with older Pro Line II avionics are flying today.

Collins has been marketing its Pro Line



This artist's concept shows what Pro Line 21 avionics will look like in the Piaggio Avanti.

complete flight-testing the system in a Challenger 601-3A late last month. The latter STC approval will be a big one, as it will make Universal the first manufacturer to certify SVS in a Part 25 airplane. Chelton Flight Systems was the first ever to certify the technology when it gained FAA approval for the FlightLogic EFIS through a blanket STC related to the Alaska Capstone technology demonstration program.

Coincidence or not, the FAA Advisory Circular dealing with SVS seems to have been written with Universal's concept in mind. The document talks about using terrain shading, depicting bodies of water using dark shades of blue and displaying other information in language that closely mirrors even early versions of Vision 1.

Universal originally sought approval for a concept that presented a 3-D view of its terrain awareness and warning system (TAWS) on the multifunction display. The FAA balked and Universal was forced to accept a compromise in which terrain

could be shown on the MFD in three dimensions in shades of red, yellow and green, but the picture couldn't show the airplane banking. The result was a view of the world that is useful to pilots but strangely unrealistic.

Universal went back to the drawing board and re-emerged with the full SVS version of Vision 1 (see photo on page 24), a product company president and CEO Ted Naimer—who routinely flies the company Challenger into mountain airports in Europe—said he's been dreaming about for a long time.

Now that Universal has obtained its first approval for Vision 1, the company is accelerating research into other advanced-vision technologies. Naimer and CMC Electronics president and CEO Jean-Pierre Mortreux signed a multiyear distributor agreement at the EBACE show in Geneva last month that clears a path for Universal to market CMC's M-Series infrared enhanced-vision system. The executives said the alliance is only the beginning of a

Synthetic vision is fast evolving from the wire-mesh stick presentation of Chelton's FlightLogic EFIS (below left), into virtual worlds replete with shaded hills and mountains, bodies of water and even a subtle haze in the distance, as shown in this concept from Honeywell.



much closer relationship for the companies, which are jointly exploring a broad range of areas where marketing and engineering partnerships could aid both.

But that doesn't mean a merger is in the cards, Naimer emphasized. Instead, the companies decided to form the alliance to leverage the largely complementary technologies each sells to business aircraft operators and OEMs. Naimer and Mortreux have even started discussions about developing a combined enhanced- and synthetic-vision system that would mate CMC's infrared camera with Universal's Vision 1 SVS. (The M-Series EVS initially will be used with Universal's UCD electronic flight bag computer and later will be shown on the nav display in its EFI-890R retrofit cockpit. List price for the camera system is \$66,000.)

An early pioneer in the field of advanced-vision research is Rockwell Collins, which has been testing and demonstrating technologies that redraw digitized

maps of the earth's topography and combine them with infrared EVS. Test pilots from NASA and Gulfstream flew a GV last year equipped with the experimental Rockwell Collins SVS and a combination of other sister technologies, including head-up displays, a new type of multi-scan weather radar, a voice-recognition system and cockpit displays including 3-D computer-generated views of the terrain, obstacles, runways and flight path.

During the trials pilots shot a series of instrument approaches to NASA's Wallops Flight Facility in Virginia using only SVS for visual guidance. With the windshield intentionally blocked by a screen, Gulfstream and NASA pilots flew approaches to minimums using the computer-generated graphical information displayed on an LCD monitor and on the HUD without any trouble, researchers said. (In the past, Gulfstream executives have stated emphatically that SVS will be included in their top models, probably an indication that rivals

Bombardier and Dassault aren't far behind in discussions with avionics makers on similar cockpit offerings.) NASA and Rockwell Collins have tested similar SVS/EVS concepts in NASA's Boeing 727 using infrared sensors from manufacturer Max-Viz of Portland, Ore.

NASA Pioneers Advanced-vision Research

NASA has long been testing SVS concepts, taking the research project a step further recently by using millimeter-wave radar to supplement infrared EVS. Although the image produced by millimeter-wave radar isn't nearly as well defined as infrared, it has the advantage of being able to see through clouds. Fusion of infrared sensors tuned to various wavelengths and millimeter-wave radar acting as a third, active sensor could provide a more complete view of the world ahead of the aircraft, NASA researchers believe.

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21 IDS upgrade to owners of a variety of in-service business jets. The company recently gained approval to install the system in airplanes with AP-105 and APS-65 autopilots, a key to bringing the avionics to older King Airs, Falcon 20s and 50s and the Avanti. Pro Line 21 IDS also interfaces with APS-85, APS-80 and SPZ-500 autopilots.

The version of Pro Line 21 installed in new airplanes is similar to the IDS upgrade, but it is integrated slightly more deeply into the aircraft systems. A main ingredient of Pro Line 21 in the newest business jets and turboprops that carry the system is the integrated flight information system. This computer file server resides in the avionics bay and is capable of hosting a wide range of software.

Primus Epic CDS/R for the CL601

In addition to the cockpit upgrade for the Piaggio Avanti announced last year, Honeywell recently teamed with Ruag Aerospace Services in Oberpfaffenhofen, Germany, to bring its Primus Epic Control Display System/Retrofit (CDS/R) system to six Bombardier Challenger 601-1As operated by the German Ministry of Defence.

Primus Epic CDS/R is a derivative of Honeywell's Primus 1000/2000 and Primus Epic integrated avionics systems. It offers two, three or four 8- by 10-inch active matrix LCD flat-panel screens and is available for retrofit installation in a variety of business jets.

Ruag Aerospace is performing the installations at its Ruag Aerospace Services sub-

siary in Wessling, Germany. The company is taking the lead in the design, installation and certification of the four-screen Primus Epic CDS/R installation, just as Canadian research firm Marinvent did for the Avanti program. Following certification, Ruag plans to make the modification available to other Challenger 601-1A operators and modification centers.

In addition to the display system retrofit, Ruag is installing Honeywell Primus 880 weather radars and EGPWS with the optional Runway Awareness and Alerting System software add-on. The existing Honeywell autopilot and non-Honeywell radios and FMS are being retained as part of the installation.



Ruag Aerospace is installing this Primus Epic CDS/R avionics system in six Challenger 601-1A twinjets for the German Ministry of Defence.

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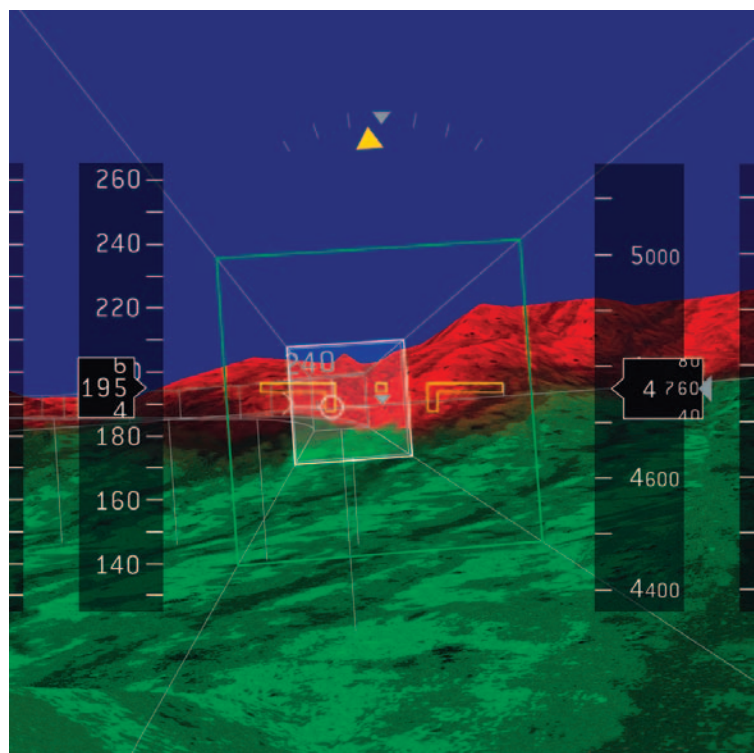
BAE Systems and NASA demonstrated such a system last year in a NASA Boeing 757 at the Wallops Test Center. During one of the flights by a pair of uninitiated Air Force pilots, a truck was parked on the end of the runway while a screen placed in front of the windshield blocked the view ahead.

The Air Force pilots complained about the view created by the millimeter-wave radar on the HUD (describing it as reminiscent of snow on a TV screen), but both agreed it was similar to making a landing on a dark night and that they could easily see the truck. When all three sensors were combined into a single EVS image, the pilots said the picture was far better. Ideal was the combination of EVS views laid atop an SVS presentation of the terrain

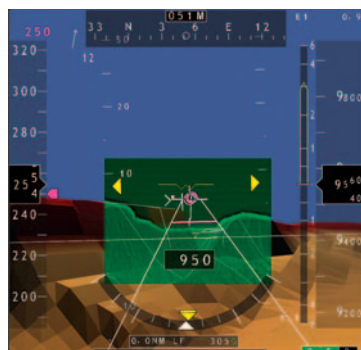
on the PFD, a technique that blended the virtual and real views with illusory depth and texture.

Honeywell researchers, meanwhile, have been demonstrating an SVS using terrain and obstacle data taken from the company's enhanced ground proximity warning system (EGPWS). It's a similar video-game-like presentation, but Honeywell claims its concept is more advanced than its competitors' and that it has undergone significant human-factors vetting at the company's laboratory in Minneapolis.

The Honeywell concept overlays symbology borrowed from its HUD designs on a compelling 3-D view of hills, mountains, obstacles and runways in colors reminiscent of a VFR sectional chart. Fly too close to terrain or an obstacle and the portion of the display the com-



Rockwell Collins and NASA have been testing various SVS designs using highway-in-the-sky guidance cues and infrared EVS to aid situational awareness. Top right, IS&S of Exton, Pa., is currently refining the database for its developmental SVS.



puters deem the biggest danger could turn red as the EGPWS triggers an aural warning, Honeywell researchers say.

Honeywell's Robertson said the company's strategic plan is to have a certified SVS for Primus Epic and the Apex system within five years, which will become common to all platforms. "In the future, terrain on a PFD is going to be a standard ADI presentation," he said. "A lot of people are working on different concepts and we certainly have ours. The open architecture

of our products was designed from the very beginning to allow for this kind of growth."

Innovative Solutions & Support, a company best known for its RVSM equipment and more recently retrofit cockpits, has also launched a research project related to SVS. The company plans to bring the technology to its line of aftermarket cockpits for business airplanes once it has finished developing the system. IS&S founder and CEO Geoffrey Hedrick said the graphics portion of the product is finished and that designers have now turned their attention to refining the database, which will also include a class-A TAWS the company is developing.

"The display graphics are well along in development," Hedrick said. "We are now in the database process, optimizing the compression algorithms for the graphical portion. Our interest is primarily in improving the view in the approach phase. We're focusing on a very high-resolution database on

approach because you don't really need that precise a view when you're flying along at 35,000 feet."

IS&S's synthetic-vision database and graphical engine will be hosted on a file server that also contains Jeppesen electronic charts and the TAWS. Hedrick said the FAA has yet to see the company's SVS firsthand, but he added that officials have reviewed the concept as well as an electronic flight bag the company is designing. As is the trend lately, this class-3 device will be integrated with the displays, eliminating the need for a separate handheld computer. The EFB would show a plan view of terrain that pilots would use in conjunction with the SVS view for situational awareness.

Garmin and Avidyne have remained quiet about development work related to SVS, but with the first very light jets from Eclipse and Cessna nearing their anticipated certification dates

Continued on page 24 ►

EFI-890R Buyers Awaiting Vision 1 Upgrades

A number of business aircraft have received EFI-890R cockpit components and are now awaiting the STC approvals for hardware and software upgrades that will integrate Universal Avionics' Vision 1 SVS on the PFDs.

Most recently, Universal and Kansas City Aviation Center teamed to develop a three-screen LCD upgrade for the Pilatus PC-12. Designed as a replacement for the turboprop single's Bendix/King EFIS 40 cockpit, the Universal EFI-890R avionics system includes a pair of PFDs and an MFD, each measuring 8.9 inches diagonally. Priced at about \$300,000, the package will include provisions for Vision 1, electronic charts, datalink weather, TAWS, color video and other features. Flight testing is expected to conclude by the end of this month.

Other Vision 1 programs currently in the works include the following: IFR Avionics of Van Nuys, Calif., has been awarded a contract to complete and certify a four-display EFI-890R suite in a Gulfstream III; Duncan Aviation of Battle Creek, Mich., has completed an STC for a three-display EFI-890R installation in a King Air B300; Stevens Aviation, an authorized Universal Avionics dealer, was also selected to perform the retrofit work on the King Air B300, at its installation facility in Nashville; Duncan Aviation last April gained an STC for the system in the Challenger 600, an approval that followed the STC in the 601-3A in 2004; and Premier Air Center gained an STC for the flight deck upgrade in a Falcon 20, which included four EFI-890R displays.



This Challenger 601-3A owned by Universal Avionics is undergoing final flight testing for the Vision 1 SVS portion of the airplane's EFI-890R cockpit.



► Continued from page 22

experts are predicting cockpit-related announcements won't be long in coming.

Chelton Flight Systems, meanwhile, has targeted the business turboprop and helicopter markets with its FlightLogic SVS and has obtained approval to install the system in the Citation 501, the first business jet to fly with a certified SVS.

The FAA's Take

Even the scientists who worked on the Army-Navy instrumentation research project 50 years ago realized that the perspective-type instruments they had in mind would require a sophisticated electronic display. It wasn't until many years later—in 1994, when NASA, the FAA and private industry began extensive exploration of ideas related to SVS—that people started taking the technology seriously.

Part of the forward-thinking

Universal Avionics' Vision 1 SVS is poised to become the first certified in a Part 25 business jet following anticipated approval in the Challenger 601-3A. Right, NASA thinks the basic SVS presentation can be improved with special guidance cues.

Agate (Advanced General Aviation Technology Experiment) program, the research sought to reduce the fatal GA accident rate by using artificial views of the world coupled with highway-in-the-sky (Hits) guidance tunnels to make flying at night or in poor visibility just as safe as a day-VFR trip aloft.

NASA has been working on synthetic vision for a lot longer (in the 1980s it studied ideas for SVS proposed for a supersonic civil transport), but like e-mail and the World Wide Web it has taken a while for the technology to mature to the point that the concept could make the leap from simple curiosity to everyday use. While SVS isn't quite commonplace in the cockpits of business

airplanes yet, the FAA's increasing recognition of the safety benefits of the technology could mean that a synthetic cockpit view will soon be as ubiquitous as e-mail.

That's not to say FAA officials don't have concerns about SVS. Chief among their worries is that SVS as a background image on a PFD could detract from the readability of other symbology on the display or provide misleading terrain and orientation cues. With the release of AC 23-26 the FAA addresses each of the concerns in a straightforward, logical way that makes it clear to the reader that the agency has thought about the issue a lot.

From all the positive and constructive comments about SVS contained in the document it's clear that the FAA also understands what an important potential safety innovation SVS really is and has grown eager to see it implemented in general aviation.

In its advisory circular the FAA states its chief complaints early. The argument has long been that SVS would be so compelling that pilots might try to use it in ways that would put them and their passengers in dangerous predicaments, such as scud-running through a mountain valley. The FAA noted that current systems might not always offer the depth/distance cueing necessary for safe terrain avoidance. Further raising the risk would be a "compressed" display providing misleading altitude and range estimations coupled with errors from GPS, terrain databases and/or baro altimeters. In other words, a pilot flying at low altitude in low visibility with an SVS that is not properly calibrated is an accident waiting to happen, the FAA said.

The AC points out the potential dangers not merely because they

are seen as limitations of SVS technology, but also to provide manufacturers with guidelines for designing systems that meet minimum safety criteria. For example, the AC states that if terrain is displayed on the same screen as the primary attitude indicator, pilots should be able to distinguish between terrain above and below the airplane. Put another way, terrain above the aircraft should appear above the zero-pitch line and terrain below should be below the line; if the display shows the aircraft as clearing the terrain, it must actually do so.

The zero-pitch line should be highly contrasted against most possible backgrounds, the document goes on to say. This isn't a problem with a traditional electronic ADI, but because SVS terrain will incorporate various shading and textures the zero-pitch line could be hard to see.

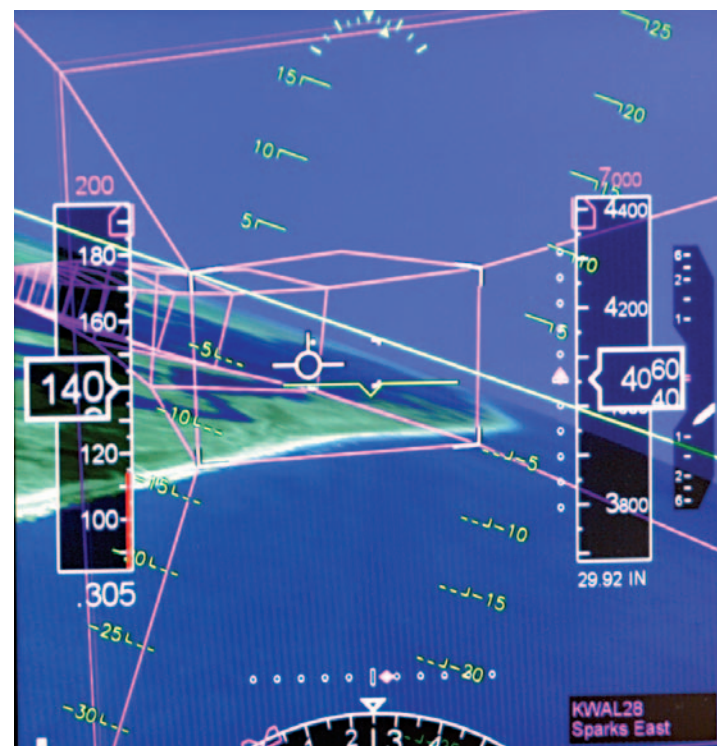
Also, because sloping terrain might appear to the pilot as the

horizon line, the FAA wants makers to employ a solid, bold zero-pitch line extending across the entire display. Other symbology on the PFD, including the pitch ladder, obstacles and traffic, should always be viewable without washing out against the terrain background.

Realism the Goal

Noting that the view on the display has a limited left-to-right field of view, the FAA recommends SVS be developed with a second, plan-view display. Normally this would be the nav display showing TAWS views, but it also could be a thumbnail map view on the PFD. The top-down TAWS presentation would show elevation in sectional-chart colors or the red, yellow and green the TAWS uses.

Likewise, the FAA wants avionics manufacturers to use coloring and shading techniques on the PFD that help the pilot understand what he is seeing. Shaded



Innovative Solutions & Support Targets Bizav

Innovative Solutions & Support has launched upgrade programs for the Pilatus PC-12, a number of Cessna Citation models, Lear-



jet 35/36 and King Air, each of which calls for pulling out nearly all of the existing avionics in the panel, installing the new IS&S-designed panel and hooking up the wiring. The company claims the entire process, including training, manual revisions and returning the aircraft to service, will take less than four days. Price for the complete cockpit package, including installation, is targeted at less than \$250,000.

IS&S is in the process of obtaining its first STC in the PC-12.

Shown here in the Pilatus PC-12, IS&S is developing a low-cost glass cockpit retrofit for business airplanes.

The full package can be integrated with RVSM hardware and includes four of the company's 6- by 8-inch flat-panel primary flight and navigation displays as replacements for the airplane's original EFIS gear. Next in line for the upgrades are Citations and Learjets, for which the company has already received orders. IS&S is also planning upgrade certification programs for the Learjet 20 series, the Hawker 700 and a number of other models, although the timing will depend on orders received. Each of the programs is planned around IS&S's 8-, 10- and 15-inch displays. Authorized installers of the equipment are Epps Aviation in Atlanta and Western Aircraft in Boise, Idaho.

The majority of the avionics—such as FMS, radios, weather radar and so on—is retained during the upgrade, although adding new air-data computers and AHRS would likely be part of the package for older airplanes. During the installation, avionics shops would replace existing symbol generators with data concentrator units and slide in the color displays (up to four total), consisting of PFDs and navigation displays on the left and right. Other equipment included in the retrofit comprises two main control panels and two aux panels and new standby instruments produced by IS&S. The new control panels go exactly where the old panels went, and they even use the same wiring.

brown terrain can be used effectively, the FAA said, especially when color bands depict the height of terrain relative to the aircraft.

In addition to sectional-chart-like colors, the FAA also recommends that SVS employ features and information that reproduce a clear, daytime picture that correlates directly to approach charts, including terrain, obstacles and runway orientation. Such depictions are not mandatory, but they

are desirable and, if used, should be evaluated by the manufacturer for accuracy, with particular emphasis on the database and its update cycle, the FAA noted. Additionally, all certified SVS concepts should incorporate a TSO'd TAWS or terrain warning system similar to TAWS including a "minimums" callout.

The FAA noted that bodies of water, including oceans, major rivers and lakes, should be dis-

played, writing that different shades and texture of blue can be used to differentiate between the sky and water. As noted earlier, Universal Avionics was the first to seek certification for use of water on the PFD. The result looked so good that it is not unreasonable to assume that Vision 1 helped convince the FAA that pilots won't mistake a blue ocean for the sky and accidentally try to fly upside-down.

Addressing the issue of terrain database integrity, the FAA noted that 30-arc-second resolution (providing "round offs" of terrain peaks and valleys) should be considered the minimum, and that higher resolution is desirable. (NASA found that pilots prefer to fly with databases portraying terrain in the highly realistic one- to three-arc-second range).

Interestingly, this is but another instance where the FAA wants the

view on the display to be as realistic as possible. The better the terrain resolution, the more hazardous the terrain looks to the pilot and the more likely he will be to steer clear. In fact, despite the earlier stated concerns about SVS displays potentially being too compelling, the agency appears to have made a 180 by pressing for systems that are true to the real world.

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[FlightLogic for the Citation 501]

Chelton Flight Systems has gained a blanket STC for its FlightLogic EFIS covering hundreds of small Part 23 airplanes, in addition to obtaining an additional STC for the Citation 501 and offering the system in a variety of helicopters. Next in line for the upgrade is the Citation 550.

The approvals include installation of Chelton's 6.25-inch-diagonal color LCD PFD and navigation display, WAAS-certified GPS receiver and TAWS in a package that sells for less than \$100,000 uninstalled. So far the cockpit has proved most popular with operators of turboprops and helicopters, but Chelton has a plan to tackle the business jet market.

Bell has selected the FlightLogic system as standard in the new 417 light single and plans to use larger 6- by 8-inch displays that Chelton introduced recently. The flat-panel screens will be the future baseline for cockpits targeted at larger Part 23 business jets, possibly to include older Learjets, Falcons and other Citation models.

Chelton hasn't said which models will come first, but the larger displays should be enticing for bizjet operators looking for a less costly option than the retrofit systems from Honeywell and Rockwell Collins, which cost several hundred thousands of dollars to buy and install.

—S.P.



The first SVS certified for civil airplanes, Chelton's FlightLogic EFIS has found a niche in business aviation, recently with a STC for installation in the Cessna Citation 501.

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The FAA developed its SVS Advisory Circular on the lessons learned through trials with NASA and industry partners. One of the big questions researchers grappled with was how the system should react during an upset.

Some within the agency said the SVS should automatically revert to a traditional ADI, but

in its latest guidance the FAA said the SVS view should be retained during unusual attitude recovery, but that some indication of the sky and ground should always be visible on the PFD regardless of attitude.

The FAA writes that the terrain database should be developed and maintained in a manner similar to TAWS and FMS data-

bases, adding that the view on the screen should show a smooth depiction of motion. The loss of terrain update (for example, a frozen screen) is unacceptable.

SVS/EVS Blending Next?

The combination of SVS and EVS to create next-generation advanced vision systems will depend heavily on future EVS tech-

nology. There are two primary types of EVS sensor, cooled and uncooled. Cryogenically cooled sensors provide a higher-resolution image than microbolometer-type uncooled sensors but they also carry much higher prices. As an example, whereas the CMC infrared sensor selected by Universal Avionics for the EFI-890R cockpit carries a list price of less

than \$70,000, top-of-the-line cryogenically cooled systems run in the range of \$500,000.

Kollsman has introduced a next-generation cryogenically cooled EVS as a follow-on to the All Weather Window product certified in 2001 and flying today aboard more than 300 Gulfstreams. (The highest-time aircraft in the fleet has flown more than 5,000 hours with EVS, Kollsman noted.)

The EVS II product will be a standard feature in the larger Gulfstreams and has been selected by FedEx for its fleet of widebodies. This new-generation sensor is claimed to offer the highest sensitivity available, measured in NETD (noise equivalent temperature delta) of less than five millikelvins. By contrast, Kollsman's original EVS is tuned to what had been an industry-best 16 millikelvins NETD. The new detector has a far sharper picture than the original, said Roy Gentry, Kollsman executive director for commercial aviation systems marketing.

Also announced is a lower-cost microbolometer EVS from Kollsman called Gavis (General Aviation Vision System), with an NETD of about 50 millikelvins. Grob has selected Gavis for the SPn utility jet, both companies announced at EBACE last month. Designed around an aerodynamic teardrop-shaped fairing, the Gavis camera system weighs less than four pounds and can be installed in a variety of locations, including the top or bottom of the nose, the top of the fuselage or atop the tail.

In the Grob jet Gavis will be fitted in a special fairing on top of the nose. The camera has a 30-degree field of view, providing a realistic view ahead of the airplane. Price for Gavis is targeted at \$92,500.

At last November's NBAA Convention Kollsman announced that it had formally launched an SVS program, and Gentry said the company is currently seeking a partner whereby Kollsman would develop the synthetic-vision software portion of the product and then perhaps license it to an avionics manufacturer. Gentry added that it could be only a matter of time before synthetic displays mix with enhanced infrared views to create a future advanced-vision system.

"There are some interesting discussions going on within the FAA right now about how far you can go with just synthetic vision before you need to put the E in SVS," he said. When the time comes, he promised, Kollsman will be ready with a product. □