Synthetic vision with infrared becomes helicopter’s SmartView

by R. Randall Padfield

Airframe synthetic-vision systems (SVS), when combined with GPS, gyros, accelerometers and terrain and obstacle databases, provide pilots with a colorful, animated depiction of the world outside the cockpit, matching what they would see looking through the windshield on a clear day. But to really see what is outside in dark or low-visibility conditions, you need an infrared (IR) camera. When you add forward-looking IR to SVS, you get a heat-referenced, real-world view along with a 3-D, database-derived and geo-referenced virtual view. Together they are called enhanced or combined SVS.

In early April, Honeywell offered AIN an opportunity to experience the company’s in-development combined synthetic-vision system (CVS) for helicopters during a demonstration flight. Here is what we learned.

Honeywell delivers synthetic vision for business aircraft under the brand name SmartView. The system uses the terrain database of the company’s enhanced ground proximity warning system (EGPWS) merged with head-up display (HUD) symbology and presents the SVS graphics on an aircraft’s primary flight displays (PFD). SmartView is Part 25 certified for Gulfstreams with PlaneView avionics and Dassault Falcons with EASy II flight decks, and Part 23 certified for Pilatus PC-12 NG turboprops with Apex cockpits. PlaneView, EASy and Apex are all based on Honeywell Primus Epic avionics. Each of these also has an integrated map display.

The situational-awareness advantages of enhanced, synthetic vision for airplanes are obvious, especially for operations on or near the ground, such as taxi, takeoff, approach and landing. How much more valuable, then, would enhanced vision be for aircraft, namely helicopters, that spend much more of their time closer to the ground?

Honeywell’s Advanced Technology Group has the same thought. “Helicopters fly close to the ground, often in obstacle-rich and low-visibility environments and, frankly, they are more likely to hit things than airplanes, and they do,” Trish Ververs, an engineer fellow with Honeywell’s Advanced Technology Group, told AIN. “We think an enhanced synthetic-vision system would be particularly helpful in improving the situational awareness of helicopter pilots in target-rich environments, such as those in metropolitan areas, which are frequently also in congested airspace.”

So it is no surprise that Honeywell has been developing synthetic vision for helicopters for quite some time—since 2006, in fact—and is quite far along in development of the system. The same team has worked on both the airplane and helicopter systems. “We're in the middle of flight-test, and one of the tests we do is human-factors evaluations,” said Ververs, who specializes in crew interface and platform systems. “Sometimes we do these evaluations in a laboratory. Sometimes we’re talking to the users. Right now with this advanced-technology program, we need to develop scenarios where we can test the system. We want to see how pilots react and adapt to the system.”

This objective is what brought the Honeywell team to Morristown Airport in New Jersey in early April. AIN was one of the lucky outside groups invited for a demonstration flight in Honeywell’s AgustaWestland AW139. What we did not know is that we would also be one of Honeywell’s SVS test subjects.

Research Flights in Target-rich Environment

Morris Township is home to Honeywell’s corporate headquarters, and its company aircraft, including N139H (an AgustaWestland AW139 helicopter), are based at Morristown Airport. The Advanced Technology Group received permission to turn the executive twin into a test aircraft for a week. The New York City area provided a particularly target-rich environment for evaluating and demonstrating SmartView for helicopters.

Three members of the research team came from other Honeywell locales, so they could make good use of their time and kept the helicopter flying as much as possible.

Marc Lajeunesse, whose title is lead pilot (rotary wing), conducted the demonstration flights. His primary job is flying Honeywell’s CEO and other top executives in both the AW139 and the company’s business jets. He has more than 13 years’ experience with head-up display technology, flying the Dassault Falcon 900 EASy and 2000, Gulfstream G450/550 and recently the G650. (He’s also rated in the Bombardier Challenger 300, BAe Jetstream 41, Sikorsky S-76 and Bell 222.) Lajeunesse has done all the flight-testing and demonstrations with the Honeywell SVS for helicopters. Well acquainted with the NYC area, Lajeunesse mapped out a route that would show other pilots and passengers how the system works in its display of obstacles at various altitudes and distances and the warnings it provides the pilots.

“What you’ll see today is not a product; it’s research, although we are at the point right before we transition from research to an actual product,” Ververs said before our 30-minute flight in N139H. From a research standpoint, the SVS project will reach “Technology Readiness Level 6” by year-end, she said. Then the project will transfer to engineering for transformation into a product that can be installed and used.

“One aspect is make it into the product and some may not,” Ververs continued. “Our job is to make sure the things we develop are useful to the pilot.” The engineering unit will decide what the end product will be, “depending on what our customers want and the features we have.” She anticipates that Honeywell will have a final product within the next two to three years. Because SVS would be offered as part of a larger Primus Epic upgrade, it would not be priced individually, she said.

Honeywell’s AW139 has four large vertical, full-color Honeywell Primus Epic primary flight displays (PFDs), two each in front of both pilot positions, and a fifth display—a horizontally mounted Sagem moving-map display—in the middle of the panel. The helicopter also has a Max-Viz forward-looking infrared (Flir) system. Honeywell’s SVS also works with Flir from other companies, including CMC and Kollsman.

Showing the Value of Synthetic Vision Plus Infrared

A key objective of the flight demonstration, Lajeunesse said, “is to show the additional value provided to the pilot by combining SVS with infrared, primarily in low-visibility and night conditions, but also in good visibility.”

To help guest pilots experience this, Honeywell provided a switch by which they could quickly change their left PFD from SVS (synthetic-vision system only) to CVS (combined-vision system, meaning SVS plus infrared) and back again. The guest pilot’s right display could show
Tricking Out N139H with Synthetic Vision

For the demonstration/research flights in Honeywell’s AW139, the research team from the company’s Advanced Technology Group removed the middle seat of the front three aft-facing executive seats in the cabin and replaced it with an electronics box that operated the SVS and a map display for helicopters, which Honeywell is also developing. N139H already had Max-Vi forward-looking infrared, so that was not difficult to couple into the system.

A large flat-screen monitor, mounted vertically on top of the electronics box, allowed John Suddreth, Honeywell developer (research and development), and other passengers in the cabin to view the SVS and map displays as repeated images of what was available to the pilot. Suddreth also had a keyboard, which he used to boot up and adjust the SVS system, as needed. (Trish Ververs and Gang He, another staff scientist on the Honeywell Advanced Technology team, did not accompany AIN on the demonstration flight, but provided information during the preflight briefing and after the flight.)

For research purposes, numerous parameters were recorded during the flight, including audio and video, so that the entire flight could be “re-fly” afterwards on a computer, showing not only instrument indications, but pilot reactions and responses.

“So, I’m a guinea pig, too?” I asked Ververs before we took off.

“Yes, of course,” she replied. “That’s the whole point.”

There are also limits to the processing speed of the obstacle database in extremely data-rich environments, requiring a tradeoff between detail and the primary goal of obstacle avoidance. Does it really matter if a tall building is shown as a box on the SVS instead of showing a detailed replica of the building, as one might see in a simulator’s depiction of the same building? Probably not. And this is where an IR view of the building combined with SVS can provide enough real-world detail to make the building easier to identify in all visibility conditions, and could be absolutely critical in some situations, such as when an air-med helicopter pilot is looking for an accident site or hospital helipad at night or in marginal daytime visibility.

Summing up the advantages of combined vision with infrared, Ververs said it provides real-time information for objects not in the terrain or obstacle database, provides detail not available in synthetic vision and it increases the confidence of pilots by confirming the SVS picture.

Flying with SmartView

Lajeunesse’s planned route took us south from Morristown Airport to Raritan Bay, northward up the Hudson River to New York City (heading directly toward the east stanchion of the Verrazano Bridge), past Governors Island to lower Manhattan at the confluence of the Hudson and East Rivers, along the west bank of Manhattan toward the George Washington Bridge, making a 180-degree turn to the south, back down the Hudson, a right turn across Hoboken and finally picking up Route 280 heading northwest to return to Morristown.

The sky was blue and visibility unlimited (until it became hazy when we turned northward toward NYC), making it easy to match up terrain and obstacles. While the good visibility inhibited the CVS from showing off its stuff in low visibility, it did allow us to make closer approaches.

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Charles Atlock, AIM’s editor-in-chief, interviews Trish Ververs, an engineer fellow with Honeywell’s Advanced Technology Group, for AIMtv. John Manfredo, AIM creative director, films the interview, which took place at Honeywell’s facility on Morristown Airport, New Jersey.

Sikorsky Aircraft is offering an optional automated rig approach function for the S-92. The FAA-approved system was developed with S-92 and S-76 operator PHI. Available as a retrofit to existing S-92s, the rig approach function is “a fully coupled and automated approach capability with a higher safety margin than currently is available with any other offshore approach procedure,” according to Sikorsky. The system has been in development since 2007, and most flight-testing was conducted in 2011. “The rig approach system is one of the most intuitive and innovative systems I have ever flown,” said PHI chief pilot Paul Perkins.

Avidyne STCs Autopilot for Bonanza

The FAA issued a supplemental type certificate to Avidyne covering installation of the company’s DFC90 autopilot in 25 Beechcraft Bonanza models. The STC requires interfacing with the Aspen Avionics EVD1000 Evolution Pro PFD. The DFC90 autopilot is a plug-and-play replacement of the S-Tec 55X autopilot and uses the 55X’s servos. The DFC90 can also replace S-Tec 30/50/60-2/65-series autopilots in the 25 Bonanza models covered by this STC.

Sporty’s Offers iPad EFB Approval

Business jet operators needing FAA approval to use Apple’s iPad running the ForeFlight mobile app can now sign up for Sporty’s Easy Approval system. For $79, the Sporty’s team will help jet operators governed by Part 91F, 91K or 135 gain FAA approval to use ForeFlight on an iPad as an electronic flight bag (EFB). Included in the price are documentation, training, iPad testing and operational guidance. The training includes Sporty’s “Flying with ForeFlight” video. —Matt Thurber