SYNTHETIC VISION...REAL OPPORTUNITY

Twelve months ago one of the smaller avionics players came to NBAA with a plan for a cockpit combining enhanced and synthetic vision. Now, says *Brendan Gallagher*, some of the big names are also eyeing the market.

The view from the cockpit with IPFD and the real runway. Right: The display shows runway and obstacles.

If not old-hat, infrared-based enhanced vision systems (EVS) for business aviation are no longer the exotica they were. Canada's CMC Electronics has EVS positions with Bombardier, Boeing, Dassault and Pilatus, while Kollsman Commercial Aviation Systems has been selected by Gulfstream. Cutting through weather and the darkness of night, high-definition IR sensors now allow growing numbers of business aircraft to land in conditions that until recently would have forced a diversion.

The drive for ever better situational awareness continues however, and now the name of the game for many suppliers is to integrate the real-time, but narrow-field IR imagery with a wider virtual view derived from a powerful terrain database. This was the concept that Kollsman brought to NBAA 2005, dubbing it the vision-based cockpit.

This package brings together some certificated hardware – an EVS with associated IR imager, a compact head-up display – with a synthetic vision capability that is still in development.

Terrain

Based on high-resolution terrain databases from Jeppesen, the synthetic vision system (SVS) element still has an estimated 18 months to go to certification.

Kollsman emphasizes the light weight and comparatively low cost of vision-based cockpit and is aiming to carve out a niche for itself in the very-light-jet market and even the upper reaches of general aviation.

Honeywell, by contrast, has gone straight for the top end, winning an SVS position on Gulfstream's large-cabin types (see sidebar story) but has announced no plans to integrate IPFD with an infrared or other real-time sensor.

This marks it out from prime competitor Rockwell Collins and corporate aviation EVS market leader CMC Electronics, both of which are moving towards a "trust but verify" approach combining synthetic vision with an IR view of the real world.

Of the two, it is the US company that appears closer to bringing a product to market. "We have commitments to our synthetic vision offering and are also talking to a number of potential customers," says flightdeck systems director David Wu. "You may hear about launch of a commercial product with a first customer within the next 12 months."

NASA is contributing to the all-important high-resolution terrain database, supplying data gathered by a number of Space Shuttle missions. "We're compiling our own database, using the best that's out there," Wu says.

Rockwell Collins plans to present the terrain imagery in various ways, using displays from its Portland, Oregon-based head-up guidance business, and on Pro Line 21's head-down primary flight display (PFD) and multi-function display (MFD).

"The high-resolution PFD imagery will set out to represent what you would see if you looked though the windscreen," says Wu. "The MFD will present a plan view, with possibly a cone depicting the field of view available on the PFD."

System development continues, with work remaining to be completed on things like database integrity and graphics.

"We're still deciding on how photo-realistic we want the imagery to be," says Wu. "We've carried out studies with operators and have come up with various different formats to choose from."

One of the issues being addressed is the best way to present synthetic imagery on a head-up display (HUD). "We expect in due course to offer combined IR and synthetic imagery on a HUD," says Wu.

Benefit

"And since the obvious benefit of head-up is that you are looking outside at the real world, you don't want a database-generated image that obscures the view. That has led us to develop a transparent wire-frame format."

Rockwell Collins is committed to integrated EVS/SVS, according to Wu. "Real-time data from a sensor is the obvious complement

Night sight! How Honeywell's IPFD brightened my day

Alan Peaford

We had been flying the Honeywell testbed Citation V for about 10min demonstrating the company's new integrated primary flight display (IPFD) featuring synthetic vision technology.

The display clearly showed the runway at Melbourne airport 15 miles (28km) ahead and a series of obstacles on our route. Suddenly from the right-hand seat Sandy Wyatt switched the display off and a more traditional primary flight display appeared.

"Put it back on. Now!" I demanded. "Let me just swipe your Amex card first," Wyatt joked. But joking aside, there will be few pilots who wouldn't see this as money well spent.

The IPFD is intuitive, with its enhanced situational awareness provided by the synthetic vision technology at the heart of the system. Adopted by Gulfstream as the synthetic vision – primary flight display (SVS-PD) for its G350, G450, G500 and G550 – all equipped with the PlaneView flightdeck based on Honeywell's Primus Epic integrated avionics – the system is set to be certificated by mid-2007 and promises to be a major aid to situational awareness. The synthesized picture of the terrain ahead is derived from the digital database stored in Honeywell's enhanced ground proximity warning system (EGPWS), and does not use any images derived from infrared or other external enhanced-vision sensors.

Renders

The synthetic image is produced by the IPFD processor, which renders the EGPWS data into a three-dimensional perspective view and combines it with aircraft navigation, altitude and air data.

Outside the cockpit window it is dark and the Melbourne airport lights are lost in the blackness of Florida's Atlantic coast, but it is clearly indicated in light blue on the IPFD, having been earlier selected as the arrival airport in the flight management system (FMS).

Another useful aid was a series of range rings overlaid on the terrain, in this case at five mile intervals.

The extended centerline for the arrival runway appears as a distinct cyan line on the display, and can be made to appear either automatically or manually when the radio navaids for the destination are selected.

The Honeywell test aircraft doe not have a full link established between the FMS and IPFD as the company is still developing the functionality, but this will be standard on the production version, says electronic systems displays business and product manager Sergio Cecutta.

As we approach Melbourne, the full runway appears on our screen with the runway markings clearly shown. Honeywell's excellent Runway Awareness and Advisory System (RAAS) is active with the IPFD and confirms we are on the correct runway approach, lit already with distance-remaining markers.

Ultimately, the database will include all of the airport plates, including taxiways and holding points to prevent incursions – it also features groundspeed in mph for taxiing.

"It is a strategic tool allowing the pilot to plan far in advance of events in the flight plan."

Aaron Gannon, human factors engineer, explains just why the system will be an essential aid. "The IPFD synthesizes key information for the pilot and delivers it in an easy way that meets the pilot needs: 'Ambient' in that the pilot makes no special effort to gather data; 'Natural' because the pilot makes no special effort to interpret the data and 'Continuous' as the pilot needs not make any special effort to update the data."

Gannon says that the IPFD complements Honeywell's proprietary Interactive Navigation (INAV), which allows on-screen graphical flight planning.

"It is a strategic tool allowing the pilot to plan far in advance of events in the flight plan."

And it works! There is still a way to go before it is fully operational but without doubt the Honeywell system will change the way pilots view the outside world for ever.

to a synthetic vision display," he says. "Infrared is the leading candidate, but in trials we have also used the weather radar as an additional sensor to further confirm the outside view."

Ottawa-based CMC Electronics has a long history in both sensors and synthetic vision.

Supplier

The leading supplier of infrared sensors to the corporate aviation market, it has also worked in the past with millimeter-wave radar (MMW) and charge-coupled device (CCD) low-light cameras.

At the same time it was tackling the synthetic vision worst case in the form of development work on a helmet-mounted system for use in Canadian Forces search-and-rescue (SAR) helicopters.

"SAR forces typically operate in pretty crappy weather," says human factors engineering manager Dave McKay.

"The government wanted to improve safety and operational effectiveness, and synthetic vision looked like a possible answer."

Aiming to support an ability to operate with a 100ft (30m) ceiling and quarter-mile visibility at any location in Canada, CMC assembled a test system combining a Canadian military terrain database with an IR sensor and a CCD camera.

CMC is now putting its experience into what it calls advanced vision system (AVS), a concept that could come firm up before long as a result of this year's agreement with Universal Avionics on distribution of the Canadian manufacturer's M-Series IR sensor.