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AVIATION TOOLBOX

Sunday, June 1, 2008

Obstacle Avoidance: Can't See...Avoid

Avionics manufacturers are fielding a variety of sensor packages to help helicopter pilots better detect hazards to flight.

It is the difference between a slice of pie and a half an onion.

You can picture the risk of hitting a stationary obstacle with a fixed-wing aircraft as a slice of pie. The airplane is the apex of the slice. The sides of the slice are the lateral limits of the airplane's flight path, or the distance to either side that it can deviate from its heading. Any obstacle that sticks up within those limits is a potential collision threat.

How wide the slice is depends on the aircraft's speed. A fast-moving airplane has a narrow band of potential threats; it will fly past an obstacle off to the side before it can hit it. But a slow-mover will take longer to pass an obstacle, so the slice that represents its collision-threat envelope is wider. The depth of the pie depends on how quickly the airplane can climb or descend.

A helicopter, as we all know, can fly very slow. It can hover at zero airspeed. It can move straight up and down. So its collision-threat envelope doesn't fit in a pie slice. It looks more like an onion cut in two.

"It like half an onion," said Roy Fox, chief of flight safety at [Bell Helicopter](#). "We need to protect the entire hemisphere under the helicopter from obstacles."

That's a daunting problem. Unlike a fixed-wing aircraft, "you can't expect a helicopter to perform to predicted gradients," said Bob Brooks of Sagem Avionics. While a great deal of success has been achieved in reducing fixed-wing accidents involving controlled flight into terrain (CFIT) with terrain awareness and warning systems (TAWS), "all the angular work that went into that is not of any value with helicopters."

Safety experts like Fox, regulators like the [FAA](#)'s Dave Downey, accident investigation officials like Steve Chealander of the U.S. National Transportation Safety Board, helicopter operators, and avionics manufacturers agree that it is a problem that can't fundamentally be solved with black boxes. Avoiding collisions with obstacles, they say, hinges on sound decision-making by pilots.

"Pilots are notorious for saying, 'I can handle it,'" said Chealander, one of five presidentially appointed members of the NTSB, a former U.S. Air Force F-4 and F-16 pilot, and an American Airlines captain and flight safety manager. "But you have to ask yourself why you would want to get into a situation in the first place."

The threat of collisions is as common as it is complex. It afflicts pilots day and night, in visual conditions, in civil and military aircraft and regardless of pilot experience. Accident investigators crashes in which a pilot hit a mountain slope within a 100 ft of the ridgeline. Fox recalls a recent

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Aviall: Give new batteries, wheels FAA-certified rep;

Rapco: Manufact replacement aircr FAA & PAMA stan

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helicopter was approaching an offshore helideck. As the aircraft crossed over the deck's edge, the bump. He got out to find his tail rotor and tail rotor gearbox on the deck. U.S. Air Force Col. Pete safety analyst for the deputy U.S. under secretary of defense for readiness, noted that the Boeing the Bell OH-58D Kiowa Warrior share "a unique accident modality." When one of those aircraft is position with zero-percent illumination, going up and down in a clearing, folks lose situational awareness and catch the tail rotor."

The industry is tackling the threat by taking a slice out of the problem, no pun intended.

CFIT constitutes the biggest slice of the collision-threat pie. It is the leading cause of accidents procedures, and has been for at least seven years. A task force set up by the advisory group RTCA the FAA this year completed drafting technical specifications for TAWS tailored for helicopters. The FAA to issue technical standard orders for such systems. TAWS has been around for years in pioneered by Honeywell and its Enhanced Ground Proximity Warning System. That has contributed reductions in fixed-wing accidents. Adapting such systems to helicopters are likely to produce significant

But TAWS are intended to protect helicopters in cruise flight, and as such are a big first step in a half-onion like shield. Much work remains to address collision threats that helicopters face flying fixed-wing aircraft can go.

Building a Better Collision Shield

Avionics manufacturers are fine-tuning the protection their products offer helicopter crews against terrain and other objects.

Chelton Flight Systems' electronic flight instrumentation system (EFIS) has become a popular primary and multi-function displays, includes such capabilities as real-time depiction of terrain highway-in-the-sky, as well as an air data and attitude heading reference system (ADAHRS), infrared Positioning System/Wide Area Augmentation System (GPS-WAAS), traffic integration and a hel awareness and warning system (HTAWS). Chelton is now offering its 6.0B software upgrade to Automatic Dependent Surveillance Broadcast System (ADS-B) signals.

Chelton also is refining the terrain database for its TAWS by incorporating advanced surface information NASA. The space agency's shuttle Endeavor in 2000 flew an 11-day mission using radar to collect complete high-resolution, digital topographic database of Earth" according to Gordon Pratt, vice president business development for Chelton parent Cobham Avionics & Surveillance. This data will allow 1 terrain resolution of 6 arc seconds, or about 0.1 mi, in most of the world. Currently, terrain outside the States is resolved at 30 arc seconds, or 0.5 mi. "That will permit 25 times greater resolution," length and width of a square measure of terrain each would be five times finer.

Chelton also is offering Jeppesen's obstruction database to all foreign customers. Chelton EFIS ability to load their own obstacles into the TAWS database, an advantage useful when flying around towers and other obstructions lower than the 200 ft minimum required to be reported to the U.S. Communications Commission.

Honeywell's Enhanced Ground Proximity Warning System (EGPWS) Model Mark 22 offers a number beyond those spelled out in the minimum operational performance standards defined by the FAA Committee 212. The FAA is considering adopting those standards. The Mark 22 unit, in addition to approaching terrain as defined by its database, offers modes that warn of an excessive descent after takeoff and a failure to lower landing gear on approach, according to Yasuo Ishihara, the engineer who tailored that company's EGPWS for use on helicopters. Customers can program the system off the radio altimeter. It also can warn of excessive bank angle or pitch-up or an impending terrain

Sagem Avionics has long offered its Terrain and Obstacle Protection System (TOPS), which was Cirrus SR-20 light, fixed-wing general aviation aircraft.

TOPS is part and parcel of Sagem's integrated cockpit display systems (ICDSs), a set of "glass" replace analog display suites. The ICDS displays — Models ICDS-6, ICDS-8 or ICDS-10 — are interchangeable may be installed in portrait or landscape orientations. Sagem Avionics' open architecture design interchangeability throughout the life of the system.

TOPS displays terrain hazards on the multi-function display in two forms: a protection zone that airway on an aeronautical chart and extends 30 nm or so ahead of the aircraft, and a profile view terrain ahead of the aircraft in 2 nm blocks. The protection zone and profile view update dynamically movement of the aircraft.

When terrain or an obstacle extends into the aircraft's flight path, TOPS turns the color of the hazard red to indicate the hazard to the pilot. A key advantage of the system, said Sagem's Jack Shee system shows terrain on the MFD plan view in what he called unambiguous colors.

Some TAWS show terrain hazards in red, the same color weather radar use to depict severe rain

TOPS color scheme permits weather radar to be laid over its terrain display, he said.

Other vendors continue to work on options for warning flight crews of terrain and obstruction hazards.

The Italian company Selex Communications is fielding the Laser Obstacle and Avoidance Monitor on [AgustaWestland](#) AW101s operated as search and rescue (SAR) aircraft by the Danish air force. It also has weighed using the system on its AW101-based bid for the U.S. Air Force's Combat Search and Rescue (CSAR) [AgustaWestland](#). Selex is owned by Finmeccanica.

LOAM is a second-generation, eye-safe laser system. Usable in day and night conditions, the system both warns the crew of possible collision with wires (down to a diameter of 5 mm), pylons and other obstacles and cues the crew with an escape-avoidance maneuver. One version uses a simplified, dedicated display to show flight time to the obstacle and up/down and left/right arrows to indicate the recommended avoidance maneuver.

Selex officials said a laser detector is preferable to a radar one because the laser requires less range to detect its presence. This enables the LOAM system to detect wires at angles of incidence much lower than 90 deg.

An Offboard Solution

U.S. FAA officials in charge of obstacle lighting and marking regulations are weighing a proposal from a Norwegian company's low-powered radar system as an acceptable means of marking powerline hazards.

The Oslo-based OCAS company's Obstacle Collision Avoidance System has been under evaluation in the United States and Canada for several years. It has won enthusiastic support from power companies, in particular Louisville Gas and Electric of Kentucky and the Tennessee Valley Authority. The utilities view the system as a lower-cost option to installing and maintaining aviation beacons on their powerline towers.

OCAS takes a different approach to obstacle avoidance: it proposes a system mounted on the ground. The approach appeals to helicopter operators because it eliminates adding the cost, weight and maintenance requirements of installing detection and warning systems on their aircraft.

The OCAS system installs low-power, L-band radar units, of about 1 watt, on powerline stanchions and towers. When the radar detects aircraft on a collision course with the stanchion or tower, or the area between stanchions, the system activates ground lights to illuminate the obstruction (using existing obstacle lighting). At the same time, the system broadcasts a low-power aural warning on all frequencies.

The OCAS system was developed jointly as a Norwegian national effort by Statnett SF, Norway's power grid operator; the Civil Aviation Administration of Norway; and the Royal Norwegian Air Force. In addition to logging approaching aircraft, OCAS logs by radar tracks, the movement of aircraft near customers' facilities. Data include speed, heading and altitude.

OCAS also has been tested collaboratively in Norway by the Norwegian CAA and the Norwegian Telecommunication Authority.

Heeding the Warnings

Many helicopter operators have been under pressure in recent years to reduce their risk of collision with obstacles and other aircraft. Some, particularly in emergency medical services and law enforcement, have proactively installed terrain awareness and warning systems on their helicopters ahead of any regulatory requirement to do so. As a result, some of those installed systems designed for fixed-wing aircraft may present a potential problem.

Because such systems are designed to protect fixed-wing aircraft in cruise flight, they trigger false warnings in the helicopters in which they are installed.

That is especially true when the helicopter is flying low, when the risk of collision can be highest. "You can mute the TAWS' warnings or simply turn off the system. You end up getting to the point where you have to shut the damn thing off," said a senior pilot in a police helicopter unit.

The problem is that this conditions the pilot to ignore the TAWS' warning and creates the risk of collision with an obstacle even when the system is issuing a genuine warning.

"If you mute it, you're degrading its effectiveness to do what it's designed to do," said Gary Campbell, a pilot operations manager for Canandaigua, N.Y.-based EMS Air Services. Campbell served as an operator representative on a FAA-chartered committee convened by the advisory group RTCA to develop technical standards for TAWS. He also represented the National EMS Pilots Assn on the committee.

Using the Senses

A chief concern of operators seeking collision-avoidance solutions is they do not want to install their pilots to keep their eyes inside the cockpit.

Safe Flight Instrument Corp aims to address that concern. The White Plains, N.Y.-based avionic doesn't rely primarily on displays to alert pilots of impending encounters with powerlines. It rel ears.

The company's Powerline Detection System, which is approved for installation in the complete [Helicopter](#) 206s and [Eurocopter](#)'s AS355, is designed to sense the electromagnetic field emitted by powerlines.

When it detects that, the system generates an unmistakable, Geiger counter-like ticking in the cockpit. The ticking increases in intensity as the aircraft gets nearer to the lines. A red warning light also illuminates the instrument panel.

Putting the Solutions Together

The drive for improved technological protection against collision hazards comes as operators have an appetite for adding new boxes to their aircraft.

Few pilots or aircraft owners have spare real estate on instrument panels for added displays or want the extra weight, maintenance and life-cycle costs of new avionics. Consequently, avionic manufacturers are spending more time and money in developing integrated solutions to instrument and display needs.

These factors already are driving products in the field.

Chelton Flight Systems' electronic flight instrumentation combines multiple capabilities in a single box.

Sagem Avionics in the past year has launched its Integrated Cockpit Display Systems products to meet the same goal.

Further upstream, both AgustaWestland and Bell Helicopters have decided in recent years that, to meet customers' demands for simplified and lower-cost avionics, they would have to control the architecture of the interface of black boxes on their aircraft. Bell's BasiX open architecture for its new Model 422, and Agusta's decision to design the aircraft's brain, the digital acquisition unit, are cases in point.

Much of the momentum toward integrated systems comes from the growing use of enhanced cockpit displays and systems.

Elbit's Kollsman Inc is offering its General Aviation Vision System (GAViS) for helicopter applications. The system, developed to improve situation awareness by extending the pilot's forward vision at night and in adverse weather conditions, can be fed to any video-capable display, according to Ed Popek of Kollsman. GAViS is mounted like an aircraft antenna, the company said, without need for extra equipment such as fairings, lowering total cost of ownership.

GAViS uses one line-replaceable unit drawing 28 v DC. It supplies standard RS170 analog video to the cockpit.

The Kollsman Night Window enhanced vision system consists of an 8-12 micron forward-looking infrared sensor with an integrated IR window and an optional electronics processing/power supply box for added flexibility. It is designed to display an IR image on a head-down display or head-up display.

CMC Electronics is fielding its SureSight M-Series enhanced vision system for helicopters. Last month, CMC Associates installed it on an AgustaWestland AW139 for a corporate customer.

The sensor is designed to help crews fly safely in darkness, smoke, smog and other poor visibility conditions. The M-Series sensor weighs 2.2 lb and measures 2.4X2.5X6 in. It also is in a single line-replaceable unit.

As with many things rotorcraft, the drive for greater and more integrated detection and display capabilities is coming from the military. Mounting losses of aircraft and personnel to brownout crashes in Iraq and Afghanistan are pushing rotorcraft leaders searching for a solution to that major threat.

This has the U.S. Defense Advanced Research Projects Agency undertaking an R&D effort to solve the problem. It has contracted with [Sikorsky Aircraft](#) to integrate and test a new landing system for helicopters that promises safer flying in brownouts.

Known as Sandblaster, it seeks to replace the visual cues lost during brownout by giving helicopter pilots an accurate synthetic depiction of the outside world. The system would integrate various new technologies, including 94 GHz radar, detailed topographical and obstacle data and synthetic-vision displays, to create a synthetic view of the world. It also would integrate advanced flight controls to stabilize the approach profile and reduce pilot workload.

the pilot in landing safely.

Sandblaster would enable the pilot to "see" through the cloud and guide the helicopter to a pre

Sikorsky's team includes Honeywell, which was selected to develop and integrate synthetic-vision technology. Sierra Nevada, which is designing and integrating the 94 GHz radar.

Under the terms of a \$6.9-million, 18-month contract, Honeywell will design and demonstrate a synthetic-vision system for the UH-60 Black Hawk cockpit that enhances situational awareness and reduces the risk of operating aircraft in degraded visual environments.

"Taking-off and landing in arid desert terrain during brownouts can lead to obscured vision, disorientation and accidents," said Vicki Panhuise, Honeywell Defense and Space's vice president of commercial aviation systems. "This technology development program addresses vital warfighter needs to help ensure successful missions."

BAE Systems also proposes to develop a brownout solution for military operators. It has tapped BAE Systems, Inc to provide a synthetic vision display for its proposed system. Mercury's VistaNav synthetic-vision technology would serve as the basis of the system.

Rockwell Collins and Optical Air Data Systems also have teamed to offer a brownout solution called

LandSafe was developed through an exclusive licensing agreement between the two companies. It uses commercial-off-the-shelf fiber optic laser technology to "sense through" particulate matter such as smoke or fog while providing altitude, groundspeed and airspeed information to the flight crew. The system was evaluated by the U.S. Marine Corps for the CH-53E.

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