On the nose: the ClearVision EVS-5000 camera system uses four internal cameras and six sensors to help pilots overcome limited visibility conditions. Image: AerSale

# Heightened awareness

**Technological innovations have raised the bar in commercial and business aviation safety and more developments are to come. Emma Kelly looks at some of the safety system innovations under way.**

**Last** year was the safest year to date for commercial aviation in terms of the global accident rate, number of fatal accidents, total fatalities and the fatality rate, according to figures recently released by the International Civil Aviation Organization.

ICAO's latest Safety Report shows that the fatality rate dropped to 17 people per billion passengers in 2023, down from 50 people per billion in 2022, while the global accident rate decreased to 1.87 accidents per million departures in 2023, down from 2.05 in 2022.

The safety improvement came as traffic climbed post-pandemic to around 4.2 billion passengers globally in 2023, up from 3.2 billion in 2022, and flight departures increased to over 35 million from 31 million the previous year.

2023 saw one fatal accident, which took the lives of 72 people, compared with seven fatal accidents in 2022, resulting in 160 fatalities.

In 2023, turbulence encounters accounted for the most accidents, followed by abnormal runway contact related accidents, with these two categories accounting for half of all accidents, while the single fatal accident was the result of loss of control in-flight.

ICAO highlights five global high-risk categories of occurrence (G-HRCs) – controlled flight into terrain (CFIT), loss of control in-flight (LOC-I), mid-air collision (MAC), runway excursion (RE) and runway incursion (RI).

In 2023, these G-HRCs accounted for all of the fatalities, fatal accidents and nine per cent of total accidents.

## WARNING SYSTEMS

Aviation safety is improving thanks to a multifaceted global effort over decades, which includes technology.

Aircraft systems including terrain awareness warning systems, traffic collision awareness systems and enhanced vision systems (EVS) are just a few of the technological developments over the last few decades that have saved countless lives.

But the safety quest never ends, and numerous technological developments under way are aiming to contribute to the global aviation safety record in the near and medium-term future.

RIs are seen as one of the most persistent threats to aviation safety and there is considerable industry focus on targeting the threat. A number of recent incidents have highlighted the danger.

These include the January 2024 incident at Japan's Haneda Airport when a Japan Airlines Airbus A350 collided with a Coast Guard aircraft on the runway, resulting in the deaths of five crew on the Coast Guard Dash 8 turboprop.

It later emerged that the crew of the Coast Guard aircraft thought they had been given permission to enter the runway when they

> GAPPRI recommends that aircraft manufacturers develop real-time onboard functionality to provide flight crew with awareness of runway operations and alerts in the case of a risk of a runway collision with another aircraft.

had been told to hold short.

A near-collision on the runway at Austin-Bergstrom International Airport, Texas, occurred in February 2023, involving a Southwest Airlines Boeing 737 and FedEx Boeing 767, in dense fog.

The FedEx flight was forced to conduct a missed approach when the first officer saw the Southwest aircraft rolling down the same runway that the FedEx aircraft was on short final approach to – with the two aircraft coming within 150 to 170 feet of each other, according to the US National Transportation Safety Board.

## GLOBAL ACTION PLAN

The Flight Safety Foundation (FSF) warns that the risk of incursions is set to increase as air traffic grows. Releasing its Global Action Plan for the Prevention of Runway Incursions (GAPPRI) at the end of 2023, the FSF called for the need for "robust, co-ordinated safety defences".

FSF President and CEO, Dr Hassan Shahidi, says: "Despite efforts over the years to prevent incursions, they still happen. The risk of runway incursions is a global concern, and the potential consequences of an incursion are severe."

GAPPRI includes 127 recommendations to address the threat of RI, including the development of future technologies that could be deployed in the medium term.

It recommends the deployment of cutting-edge technological systems capable of providing real-time awareness of aircraft and vehicle positions, navigation route assistance, detection of deviations, and timely alerts for potential runway incursions and collisions.

The document says: "Immediate alerts for air traffic controllers, pilots and manoeuvring area vehicle drivers in the event of a potential collision or unauthorised runway entry are vital components."

GAPPRI recommends that aircraft manufacturers develop real-time onboard functionality to provide flight crew with awareness of runway operations and alerts in the case of a risk of a runway collision with another aircraft.

It also recommends the development of onboard functionality to help crew in the manoeuvring area to confirm their location in relation to runways and taxiways, and awareness and alerting to prevent taking off or landing on the wrong runway or taxiway.

## SOUNDING THE ALERT

A number of manufacturers are already on the case in a bid to improve the situation.

In the business and general aviation sector, Garmin has developed Runway Occupancy Awareness (ROA) using Surface Indications and Alert (SURF-IA) technology.

The software solution was certificated in August for the Textron Aviation Cessna Caravan equipped with Garmin's G1000NXi, later followed by certification for the G5000 for the Cessna Citation Excel, XLS, XLS+ and XLS Gen2, with more Garmin-equipped aircraft expected to follow.

ROA is initially available on select Garmin Integrated Flight Decks, including G1000 NXi to G5000 equipped aircraft in the general and business aviation markets.

The technology uses automatic dependent surveillance-broadcast (ADS-B) to alert crew to potential RI caused by nearby aircraft, aircraft on the ground and ground vehicles.

ROA technology analyses aircraft GPS and ADS-B traffic information relevant to the airport's runways and taxiways, providing visual crew-alerting system caution and warning announcements on the pilot's primary flight display and highlighting the runway in yellow or red, depending on the level of threat, on Garmin's Synthetic Vision technology.

It also provides caution and warning

**Software solution: Garmin's Runway Occupancy Awareness system (ROA) uses Surface Indications and Alert (SURF-IA) technology. ROA has been certificated for a number of Garmin-equipped aircraft. Image: Garmin**


**Above and inset, Universal Avionics has developed the Clearvision Enhanced Flight Vision System (EFVS), featuring a wearable display. Images: Universal**

announcements on the SafeTaxi map displayed simultaneously on the multifunction window.

Visual and aural alerts are provided to the crew based on the potential hazard, ranging from no immediate collision hazard to a warning level alert where a collision risk could occur within 15 seconds.

The solution provides warnings for any traffic landing, taking off, stopping or taxiing on the aircraft's intended runway; traffic on approach to the runway or runway that crosses the aircraft's runway; as well as any traffic on the runway at which the aircraft is holding.

"With the rate of RI increasing, there is a real need for increased safety tools in the cockpit," says Phil Straub, Garmin Executive Vice President and Managing Director, Aviation. "Equipping pilots with this technology can reduce the risk of RI and help provide confidence for pilots navigating busy and complex airports."

## POTENTIAL HAZARDS

Developments are also under way for the commercial aircraft market. Honeywell, for example, has been developing its Surface Runway Traffic Awareness System (SURF-A) for more than a decade.

The manufacturer anticipates certification of the solution next year, according to Thea Feyereisen, Senior Fellow, Honeywell Aerospace Technologies.

The solution is designed for all aircraft types, applicable to both retrofit and forward-fit markets. It will initially be integrated with Honeywell's EGPWS MK-VA SmartRunway/ SmartLanding Runway Safety product line, which is designed to increase flight crew situational awareness during taxi, take-off and landing.

Honeywell's SURF-A solution has undergone system performance and human factors flight testing on a variety of aircraft, including a King Air, Dassault Falcon 900 and Embraer 170.

Most recently, it has been testing SURF-A on its Boeing 757 testbed, showcasing the technology around the world.

According to Honeywell, SURF-A acts as a third set of eyes for pilots, using advanced algorithms and real-time positional data to identify and alert pilots to potential hazards during take-off and landing, with aural and visual alerts.

Industry response from pilots has been "very enthusiastic", Feyereisen tells *Inflight*.

"They believe SURF-A is in line with previous safety innovations like EGPWS, TCAS and predictive windshear that are now mandated.

"Honeywell is invested in maturing our aircraft safety systems that help keep aviation one of the safest modes of transportation across the existing and emerging market segments.

"In addition to SURF-A, which is designed to mitigate the risk of RI, we have existing and new products to mitigate RE, wrong surface operations, CFIT and LOC-I."

## VISUAL ADVANTAGE

Ongoing EVS developments are also improving crew situational awareness and

delivering tangible safety benefits.

Universal Avionics has been at the forefront of EVS developments with its ClearVision Enhanced Flight Vision System (EFVS).

The company's CEO, Dror Yahav, says that today more than 3,500 aircraft, including air transport aircraft, business aircraft and helicopters, are flying with Universal's EVS cameras in different versions and configurations.

The ClearVision EFVS, featuring a wearable display, was launched in the commercial aviation market by Channel Islands-based operator Aurigny on its ATR turboprops.

Universal Avionics manufactures EVS cameras for most EFVS, with the latest commercial aircraft programme comprising the full ClearVision EFVS with EVS-5000 multispectral camera and dual SkyLens Head-Wearable displays incorporated in AerSale's AerAware EFVS on the Boeing 737NG.

In the business aviation sector, ClearVision was recently certificated on the King Air B200 with Global Aviation Tech. The EVS-5000 camera is used in several airplane applications, including the Dassault FalconEye system.

Yahav says: "The system is suitable for nearly all aircraft types in which there is available space for the EVS-5000 multi-spectral camera to be installed on the radome of business jets and regional airliners, with the smaller EVS-4000 available for helicopters and light aircraft."

Universal says ClearVision is the industry leader in terms of performance, with the EVS-5000 being the only camera to achieve 50 per cent visual advantage by the FAA, compared with 25 to 33 per cent for others.

"Our EVS-5000 multispectral camera ensures pilots can identify both incandescent and light-emitting diodes runway lights – including edge lights, taxi lights, and approach lighting systems – to land safely in low-visibility conditions," says Yahav.

Universal's EVS combines six sensors, including five that use a combination of different wavelengths across the light spectrum to detect and display terrain features, runways, taxiways and other obstacles that may not be visible to the naked eye, while the sixth sensor is high-resolution infrared to capture thermal images of the environment.

Nor will developments stop there, with a new automatic voice recognition solution, which was a result of the company's recent Grand Challenge employee artificial intelligence contest, set to provide increased situational awareness and prevent RI, according to Yahav.

AerSale achieved FAA certification for its AerAware EFVS for the 737NG, incorporating Universal's ClearVision, at the end of 2023.

Certification of the system on the 737NG marked the first commercial EFVS system to achieve 50 per cent visual advantage and the first large transport aircraft to be certified with a complete dual-pilot EFVS solution featuring a head-wearable display, according to the manufacturer.

AerAware incorporates synthetic vision and EVS, along with primary flight display symbology, to create a user-controlled Combined Vision System that substantially increases situational awareness during all phases of flight, including low visibility conditions.

ICAO Council President Salvatore Sciacchitano acknowledges that reaching the organisation's ambitious safety goal of zero fatalities in commercial operations by 2030 "requires a collective effort". ■

# Turbulent times

Turbulence is also in the spotlight following recent events.

In a paper presented at ICAO's Air Navigation Conference (ANC), in Montreal, Canada, in late August, by Japan and Singapore, and co-sponsored by the Philippines, Thailand, Airports Council International and the International Air Transport Association, the partners note that a variety of methods exist and will continue to be developed to reduce the safety risk of turbulence, from passenger activities to the utilisation of technology.

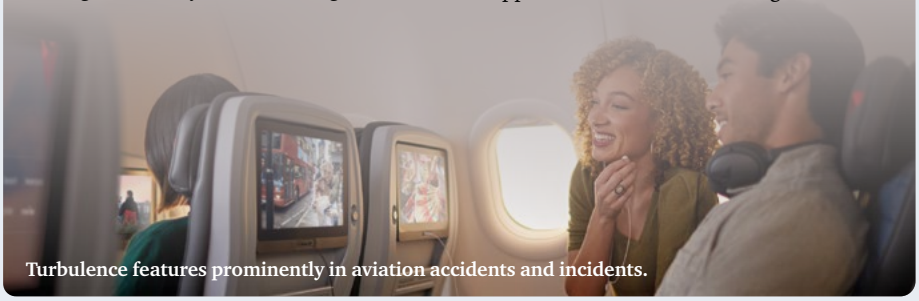
While turbulence does not have a high fatality risk, it does feature prominently in accidents and incidents worldwide, accounting for as much as 40 per cent of all scheduled commercial accidents in 2023.

The paper says evidence suggests there may be more severe weather patterns brought about by climate change which could lead to more turbulence-related incidents.

In addition to calling on stakeholders to share experiences or best practices related to turbulence encounters, improve the availability of air reports and enhance clear-air turbulence forecasting models, Japan and Singapore are calling for equipment and aircraft manufacturers and airlines to develop and adopt technologies.

These technologies include Doppler Light Detection and Ranging (LiDAR), which can warn of turbulence ahead by detecting air currents by emitting laser light and receiving scattering lights reflected from aerosol – fine particles such as water drops and dust – floating in the atmosphere.

The Japan Aerospace Exploration Agency has demonstrated the use of Doppler LiDAR in a series of flight tests.



Turbulence features prominently in aviation accidents and incidents.