TECH NEWS

Safer take-off and landings with state-of-the-art radar and tougher windows

Published 3 weeks ago on April 14, 2022
By Newsroom

On 25 July 2000, a Concorde jet crashed upon take-off in Paris, killing 113 people. The cause of the accident was later identified as a metal strip on the runway that had fallen off another plane. When the jet ran over it, its tyre burst and shredded pieces caused a fuel tank to rupture, resulting in a devastating fire.

Almost a decade later, in January 2009, a US Airways flight struck a flock of geese shortly after take-off in New York City, losing engine power. Fortunately, there were no deaths this time as fast-acting pilot Chesley Sullenberger managed to ditch the plane safely in the Hudson River.

Then, in December 2018, a drone scare at London's Gatwick airport closed the runway for 33 hours, causing long delays that cost airlines many millions of euros.

Three incidents with quite different causes – a foreign object on the runway, birds and a drone – but with a high cost in lives, money or both.

Yet these are just some of the highest-profile air incidents, with smaller-scale ones more common. Foreign object debris (FOD) on runways and bird strikes, for example, cost the airline industry billions of euros annually and create lengthy delays for passengers.

In the 10 years before Covid-19 hit, air passenger numbers were skyrocketing. Despite the setbacks arising from the pandemic, the only way is up as air travel returns and airports get busier.

'If the number of departures increases, then the amount of foreign object debris being spilled will also increase,' said Torsten Leth Elmkjær, CEO and founder of Nordic Radar Solutions in Aarhus, Denmark. 'It is important that you don't have to hold the entire airport on standby because somebody is looking for FOD.'

Three-in-one

Even very small objects can cause significant damage to aircraft moving at high speeds, with screws, bolts and maintenance tools classified as FOD. Added to that is the relatively recent rise in threat from drones.

Elmkjær's company is developing a new radar system to deal with the multiple threats. Its FODDBASA project has aimed at real-time identification of hazardous objects within a 10-kilometre radius of runways.

Airports often rely on vehicle patrols for runway inspections, but these take time and may not spot everything. Unfortunately, Elmkjær said, the use of radar-based options at airports has been limited by their high cost compared to their feature set, including the use of separate systems for FOD and birds. On top of that, there is now a need to take drones into account.

Nordic Radar Solutions has tried to tackle this with its FODDBASA technology by creating an integrated system to address all three issues at once to help improve cost-effectiveness while using fewer radars per airport. 'I think we have rather unique radar technology,' said Elmkjær. 'The three-in-one system is our unique selling point.'

Precision radar

The radars that his company has been developing operate in a higher frequency band of the electromagnetic spectrum than that of some other systems, with the aim of detecting objects smaller than 1 centimetre. Use of this so-called Ka-band spectrum at about 35 gigahertz (GHz), is combined with highly sensitive antennas to detect weak signals from far away.

However, while Elmkjær believes that the initial project was 70% successful, his team found that the radar frequency was not high enough for the required performance levels.

But he is positive it will be possible to achieve the right performance with some adjustment. Nordic Radar Solutions has already developed a system that operates at 92 to 98 GHz, which now needs to go through further testing. 'I have a good feeling that we will soon turn this into a commercial product,' said Elmkjær.

Much of the potential, he believes, comes from Asia and the Middle East, where many airports are planned and legacy systems are not already in place. 'In Asia and the Middle East, they're planning new airports and they will have the newest technology available,' said Elmkjær. 'It's easier to install these kinds of systems when you plan airports.'

Established locations such as Copenhagen Airport have also shown interest.

In addition, Nordic Radar Solutions will offer the systems separately. 'Some are happy to enter just with a FOD-only system, but with the option to purchase the add-ons necessary to have the full three-in-one solution.' Others, such as military airports in Denmark and Belgium, are more interested in systems for drone detection.

In the end, such radar systems have big benefits when considering the alternative of not having them, said Elmkjær. 'These systems are affordable when compared to the amount of damage that can occur if you don't detect that something bad might happen,' he said.

Performance windows

On board aircraft, certain features need to be refined and enhanced for both safety and operational benefits as aviation technology advances. This includes windows capable of handling bird strikes at faster speeds and offering anti-icing and anti-fogging functions.

The Wimper project has focused on the development of windshields and window coatings. They are intended for use in state-of-the-art helicopter-type aircraft developed by Airbus as part of the EU-funded Clean Sky 2 project, which aims to develop cleaner air transport technologies for a greener economy.

The Racer, a demonstrator aircraft reportedly on course to make its maiden flight later this year, is intended to cruise at more than 400 kilometres per hour – compared to an average helicopter's top speed of about 260 kilometres per hour.

The aim is to optimise trade-off between speed, cost-efficiency and performance, while demonstrating the advantage of high speed for missions such as emergency medical and rescue services.

Matthias Tretter, head of R&D at KRD Sicherheitstechnik in Geesthacht, Germany, which makes products under the Kasiglas brand and led the Wimper project, explained that his company has manufactured aircraft windows for some years using impact-resistant polycarbonate materials that work fine on lower-speed helicopters. However, the Racer made it necessary to upgrade the windows for higher-speed situations.

The structure of the windows did not require much modification other than some changes in thickness. The main alterations were to the window coatings, said Tretter. For this, his team used a lightweight glaze, while gluing techniques were harnessed to avoid the use of heavier screws that also create holes in the windows.

'We have shown that we can resist bird strikes with this very thin thickness of polycarbonate,' he said. 'You have this polycarbonate window with the bird-strike resistance and on top you have functional coatings for abrasion resistance.'

Testing was performed with 'jelly' birds made from gelatine, with the windows able to withstand strikes at high speeds, said Tretter.

Ice protection

Not only was that successful, he said, but KRD also managed to add cutting-edge anti-fog and anti-ice capabilities on the inside and outside of the windows, creating a significant advantage for helicopters.

The big advantage of using such coatings is that functions can be added to windows without reducing their transparency. It also offers the potential to reduce the need for heating and air-conditioning systems, giving scope to cut the weight and energy consumption of future flights.

These functions all promise to lead to better, safer and more efficient flight, said Tretter.

'If you don't have ice and you therefore don't need heating for the window, you can fly off faster,' he added.

The research in this article was funded by the EU. If you liked this article, please consider sharing it on social media.