WHITE PAPER

Can Localized Surveillance Drive System-Wide Adoption of Runway Incursion Systems?

Author: Alex Sauriol
Executive Vice President
ATM/Airport Solutions
alex@searidgetech.com

SEARIDGE TECHNOLOGIES

Can Localized Surveillance Drive System-Wide Adoption of Runway Incursion Systems?

Summary

- U.S. National Transportation Safety Board (NTSB) continues to list runway safety in its top 10 most wanted safety improvements. Recommendations include direct-to-cockpit warning of possible collision/incursion.
- Some technology solutions exist including the Runway Incursion Monitoring and Collision Avoidance System (RIMCAS) and Runway Status Light Safety System (RWLS); however these systems generally rely on large-scale, sophisticated, multi-sensor surveillance systems, known as Airport Surface Detection Equipment (ASDE-X) and Advanced-Surface Movement Guidance and Control Systems (A-SMGCS).
- Reliance on ASDE-X and A-SMGCS to monitor surface activity and feed surveillance data to an incursion detection and warning system limits deployment to a subset of equipped airports. Moreover, even airports with existing ASDE-X/A-SMGCS may not have sufficient levels of surveillance reliability to drive a real-time cockpit warning system.
- The last few years has seen the introduction of new Air Traffic Control (ATC) grade surveillance sensors which may be better suited to the task of incursion detection and warning by providing *localized surveillance*.
- Sensors that provide localized surveillance can provide better performance at significantly lower cost to an airport. The scalable nature of the sensors dictates that the same system can across all sizes and types of airports. The scalability and flexibility of the sensors ensures that the system can be applied to any airport and can grow with their needs.

Introduction

The Importance of Runway Safety

The world's deadliest aviation accident occurred on a runway; in March 1977 two passenger jumbo jets collided on a runway at Tenerife, Canary Islands, causing the deaths of 583 passengers and crew. More recently, October 8th, 2001 at Linate Airport in Milan Italy, an SAS flight carrying 110 people collided at takeoff with a small business jet carrying 4 people - all 114 were killed along with an additional 4 people on the ground. The accident investigation concluded that the immediate cause of the accident was the incursion of the business jet on to the active runway.

Air traffic regulators around the world continue to rank runway incursions as one of the most significant risks to aviation safety. Runway incursion detection and alerting systems can have a dramatic impact on preventing incursions; however implementation is currently limited to select airports. This article examines the challenges of deploying these systems and how new localized surveillance technology might be the key to rapid, widespread adoption.

Technology Solutions

There are various technology based systems to assist in detection and prevention of runway incursions; the focus of this article is on ground surveillance based detection systems such as the Runway Status Light Safety System (RWSL) and the Runway Incursion Monitoring and Collision Avoidance System (RIMCAS).

RIMCAS and RWLS systems are comprised of 3 key elements: surface surveillance sub-system, incursion algorithms and alerting. The alerting provides pilot and/or Air Traffic Control (ATC) alerting based on processing by the incursion algorithms and these algorithms process data from the surface surveillance sub-system. Essentially, the detection of runway incursions and subsequent alerting is entirely reliant on the availability of high quality surveillance data; *the surface surveillance is the critical performance driver for an incursion detection system.*

Surface Surveillance

Airport surface surveillance has traditionally been provided by radar based systems. Radar is the backbone of both ASDE-X and A-SMGCS. While radar can be very effective in providing a comprehensive view of an airport surface, it has substantial drawbacks when it comes to the specific task of incursion detection. The first and most important is that the characteristics of the technology make it prone to false target detection. In a warning system, a high number of false warnings mean that in practice - the system is unusable because of the impact each false warning will have on the airport flow. A system with an unacceptable level of false warnings will either be ignored or turned off, and in either case will not help in preventing incursions. Radar for the purposes of incursion detection has other drawbacks including precision detection and a relatively slow update rate; the impact of these drawbacks mean that an aircraft crossing into an active runway might only be detected after the incursion has taken place - leaving little to no time for alerting.

Figure 1 - Localized surveillance - intelligent video camera installed near the ILS

Most ASDE-X and A-SMGCS employ a secondary technology for surveillance which is based on the principle of multilateration. This technology uses a network of ground antennas located around an airfield, to process aircraft and sometimes vehicle transponder signals in order to obtain an accurate position. While this technology provides very precise position information, it is completely reliant on a cooperative transponder in the object being tracked. In cases where an aircraft or vehicle is not equipped, or have switched off the transponder - they will be invisible to the multilateration system. For this reason. ASDE-X and A-SMGCS tend to be based on the fusion of data from both multilateration and radar technologies which leads to the final drawback of this system - *cost*.

ASDE-X and A-SMGCS systems are out of budgetary of reach for many airports - both in terms of initial capital outlay, and in terms of ongoing maintenance these systems require. Therefore to achieve system wide adoption of runway incursion technology *alternative sources of surveillance must to be considered*.

Localized Surveillance

Over the past few years there have been several new surveillance technologies that have started to be deployed at airports. These technologies include millimeter wave radar, intelligent video and laser. Each share a key characteristic, they provide 'localized' surveillance; coverage of a relatively small area, 300-500m from the source (in the case of millimeter wave and intelligent video). These localized sensors are typically much lower cost, easier to deploy and in some cases can make use of existing airport infrastructure.

In terms of a runway incursion system, the benefits of localized surveillance are threefold - reliability, performance and scalability. Reliability is achieved principally through the smaller detection area. Unlike radar which has to provide detection across an entire airport surface, a localized sensor might only need to provide coverage at a single intersection hold point - the advantage here is fewer objects to track and a more concentrated area resulting in few (in some cases no) false detections. Performance is also typically better than radar (for the specific task of incursion detection); in the case of intelligent video based tracking, high camera frame rates allow for rapid calculation of velocity, and very precise location - incursions can be detected in real-time and alerts can be generated milliseconds after an incursion has been detected (for all intents and purposes, *a pilot/driver can be signaled as the incursion is taking place*).

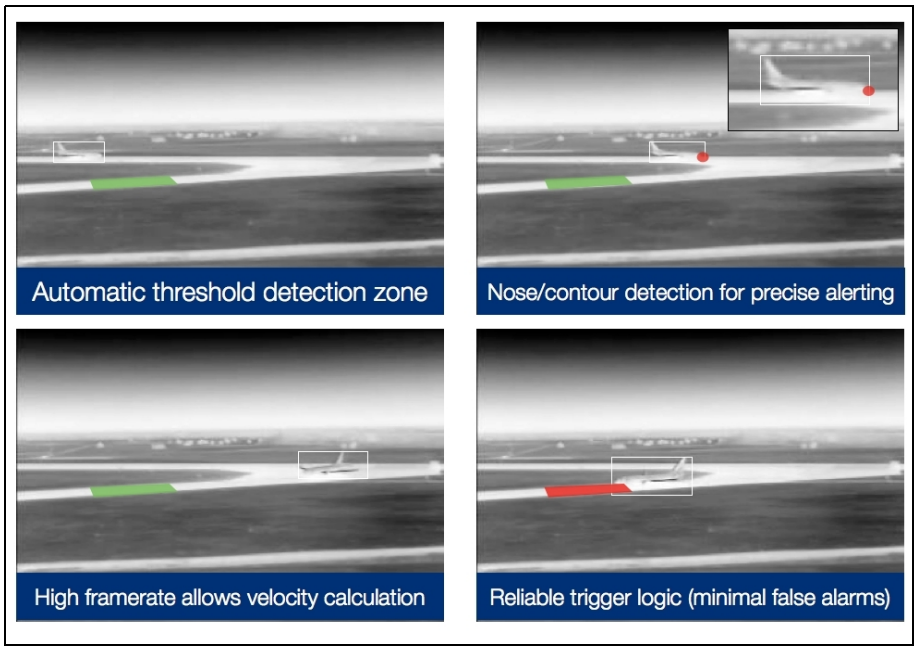

Figure 2 - Target Detection, Velocity Monitoring and Alerting Benefits of Localized Surveillance

Finally, scalability, the key to system-wide adoption. Much like runway lighting, the system components for a small simple airport are identical to that of a large, complex airport; the only difference is the number of sensors required. This allows a small airport to deliver the same level of surveillance performance, and consequently, meet the same stringent system performance requirements under a cost benefit consistent with the airports' operation.

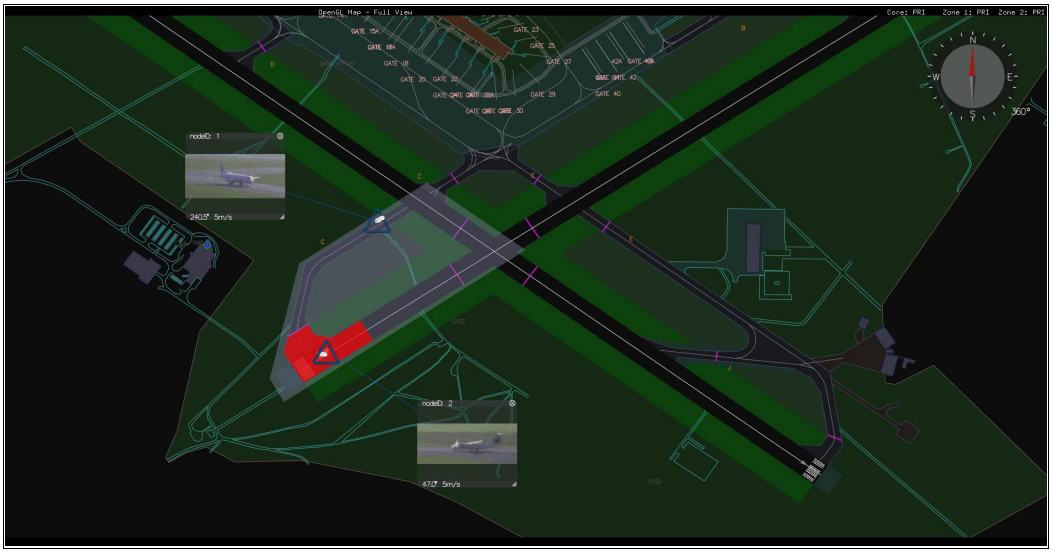

Figure 3- Controller view of a configurable intelligent video based "incursion hot zone"

Conclusion

Runway incursions are an issue that threatens aviation safety and increasing traffic levels will only exacerbate the issue. While significant investment is being made by some of the large agencies into programs like the FAA's RWSL program, it is critical that alternative surveillance technologies be considered. Even in cases where ASDE-X and A-SMGCS are installed, localized surveillance technology can improve the reliability of an incursion detection and prevention system. In cases where no ASDE-X or A-SMGCS is installed, localized surveillance may be the only practical solution.

About Searidge Technologies (www.searidgetech.com)

Searidge Technologies provides intelligent video solutions to Air Navigation Service Providers and airports to help them cost effectively increase safety and efficiency of surface management operations. The company's intelligent video platform IntelliDAR™ is a robust Non-Cooperative Surface Surveillance (NCSS) system and the first operational system of its kind in an air traffic control tower to provide detection, positioning, and tracking of all targets on an airport surface. Searidge is helping its customers with ATC-grade video, gap filling / A-SMGCS augmentation, apron management, and remote tower capabilities.

Working with industry leaders such as DFS, EUROCONTROL, FAA, and NAV Canada, Searidge solutions are installed in sites throughout Europe, Middle East and North America. Founded in 2001, Searidge is a privately held company based in Canada's Capital region.