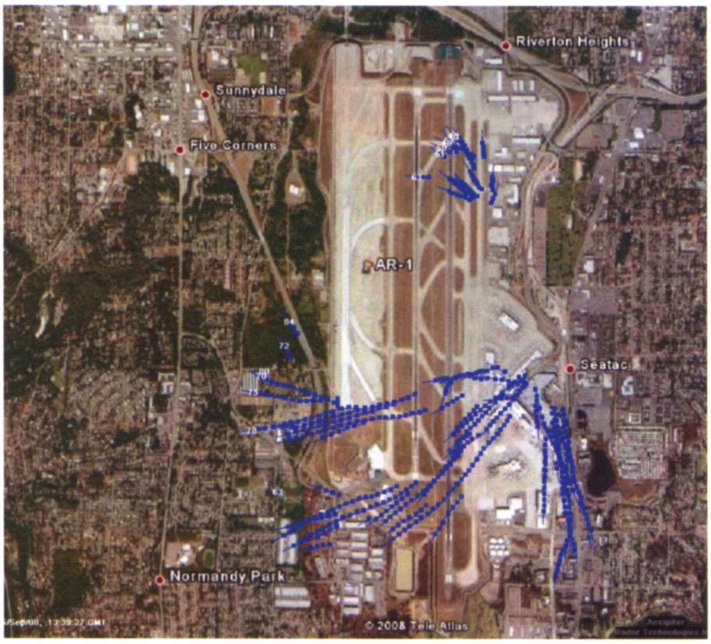
Radars offer bird-strike warning

Engineers are looking to radar technology to warn of possible bird strikes

Despite dire media accounts of the threat of bird strikes following the January 2009 ditching of a US Airways A320 in New York's Hudson River, aircraft have been colliding with birds since the earliest days of powered flight. In fact, the Wright brothers reported close encounters during their test flights more than 100 years ago.

Aviation authorities can, therefore, only attempt to minimise, rather than completely prevent, the risk of aircraft and birds colliding.

Currently, airports employ wildlife control staff who regularly monitor and record bird activity, while ensuring that habitats that attract them, such as standing water and nesting sites, are removed and that other operations like rubbish dumps are kept as far as possible away from the airport. Grass is also left long to discourage nesting and collie dogs, falcons, pyrotechnics and noisemaking devices are used at several airports to scare birds away from runways.



A video frame from the Accipiter bird tracking radar at Seattle Tacoma Airport illustrates an exploding burst of more than 1,000 starlings as they simultaneously left their roosts just outside the airport at dawn. The radar shows them breaking up into separate and unpredictable streams as they crossed the runways at heights between 100-300 ft and at speeds up to 84 km/h.

Accipiter: 1354086

Radar developments

While all these measures help to reduce local bird activity, none could warn of the flock of Canada geese flying just below 3,000 ft a couple of miles away and heading straight towards the departure path of the US Airways jet. This is where recent developments in radar are showing great promise.

Before discussing these developments, however, it is useful to assess just how serious bird strikes are. Here, unfortunately, records have until recently been sketchy, primarily because there are no requirements that aircraft operators report strikes unless there is damage affecting airworthiness. From 24 April, however, the FAA made its bird-strike database available on a public website, withdrawing a proposal to keep certain data confidential.

The FAA list details almost 90,000 incidents since 1990 – around two-thirds since 2000. Pilots reported hitting 2,291 doves between 2000 and 2008. Other airborne victims included gulls (2,186), European starlings (1,427) and American kestrels (1,422).

It is clear, therefore, that bird strikes are an ever present hazard to the airline community and military forces and that worldwide annual costs could easily exceed many tens of millions of dollars for repairs to airframes and engines and for the associated aircraft downtime.

Putting aside the total loss of an aircraft, which is fortunately very rare, jet-engine damage from bird ingestion causes the most expense and can be quite bizarre.

In one case several years ago the centre engine of a DC-10 freighter was partially destroyed during takeoff in the Caribbean and the cost to return it to operation exceeded USD3 million. In this case the damage was caused by a single large fruit bat that struck a critical component when ingested by the engine, with devastating downstream effects. This underlines the fact that aircraft today are much larger and faster and that their increased speed greatly increases impact damage. When struck by an aircraft flying at 300 mph, a small 4 lb (1.8 kg) bird has an impact force of 15 tonnes, while an average-sized Canada goose weighing 16 lb exerts 37 tonnes when struck at the same speed. Currently, jet engines are tested to withstand strikes from 4 lb birds, but this is under review following the New York incident.

So how can radar help? Essentially, birds, bats and even swarms of insects can be seen by radar. Ironically, the engineers who developed the original radar technology in the Second World War tried to get rid of bird returns, because the 'clutter' they created on the radar displays could potentially conceal approaching enemy aircraft. Today, however, engineers in Dutch, US and Canadian organisations are working to enhance the bird data, suppress all other information and refine the performance of earlier equipment designs. The objective is not only to see birds better but also accurately assess their physical mass – where a small flock of geese could equate to a much larger flock of smaller birds – and measure their flight paths and altitudes in order to predict their future movements.

Professor Edwin Herricks of the University of Illinois' Centre of Excellence for Airport Technology (CEAT), one of several FAA-supported Centres of Excellence, each of which has specific objectives and expertise, is investigating how effective radar can be in this role.

While Second World War radar engineers looked at ways of removing bird 'clutter', today the objective is to see birds better and also to assess their physical mass

FAA evaluations

Herricks – an ecological engineer – is running FAA evaluations of bird tracking radar and, separately, automatic foreign object debris (FOD) detection systems for airport runways. Both programmes have a unique similarity. Coincidentally, they are aimed at problems that have each caused at least one major fatal civil aircraft accident – a 1960 Lockheed Electra bird strike at Boston and the FOD-attributed Concorde crash at Paris in 2000 – while continuing to exact a severe, though much less publicised, annual financial toll on civil and military operators.

CEAT is a member of an FAA-funded team launched in 1999 that includes the FAA's Technical Centre in Atlantic City, New Jersey; Accipiter Radar Technologies Inc of Fonthill, Ontario, Canada; and the Wildlife Management Programme at Seattle Tacoma (SeaTac) Airport in Washington State. Accipiter Radar has a system at Seattle and is also deploying systems at Chicago's O'Hare and New York JFK Kennedy Airport under the CEAT project. Bird radar systems have also been fielded – mainly at military air bases – by DeTect Inc of Panama City, Florida, and by GeoMarine Inc of Plano, Texas. *Jane's* understands that Geo Marine intends to provide an evaluation system to CEAT, but DeTect currently does not. "As of today, we have been unable to reach agreement... on a contract to have our MERLIN Aircraft Birdstrike Avoidance Radar System evaluated," says General Manager and Chief Executive Officer Gary Andrews.

"Complete evaluation of radar's current capabilities and its future development potential are the CEAT team's prime objectives," states Professor Emeritus Sidney Gauthreaux of Clemson University in Clemson, South Carolina. Gauthreaux, a leading US radar ornithologist, describes the team's work as "incredibly valuable", but cautions that aviation safety systems require total FAA validation before operational acceptance. A critical question here is how best to use the data with a minimum of false alerts. Accurate interpretation is also vital, since a very large swarm of harmless insects can be mistaken on the radar screen for a large and hazardous flock of small birds. It therefore seems unlikely that air traffic controllers or pilots would be fully qualified, or even have the time, to assess possible threats on a radar screen and then act upon them.

One example of CEAT's work is an Accipiter Radar video of an explosion of more than 1,000 starlings as they simultaneously left their roosts just outside the SeaTac at dawn: a scenario possibly similar to the large starling flock that in 1960 brought down the Lockheed Electra in Boston. The radar clearly shows the flock breaking up into separate streams as they crossed the runways at heights between 100-300 ft and at speeds of up to 84 km/h. Detailed analysis of such flocking manoeuvres might discern basic flocking patterns of different bird species, thereby assisting predictions of their future movements.

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Similar studies are under way at the Dutch TNO research organisation in The Hague. Head Researcher Addy Borst tells *Jane's* that TNO's RobinLite system, due to be installed for testing at Amsterdam Schiphol, is a civil derivative of units supplied to the Royal Netherlands Air Force. Also, Borst has developed a technique – typical of the innovative approaches in bird tracking – to estimate relative bird sizes by counting an individual bird's wing beats from the Doppler frequency shift in the radar returns.

Accipiter Radar has also announced a breakthrough in effectively narrowing the radar's beam to one tenth its present width, providing greatly improved bird altitude accuracy at longer distances: an essential input to warning messages.

While the radars used for bird tracking are derived from low-cost marine units found on private boats and small commercial vessels, their returning signals are intensely processed by sophisticated computer programmes to extract very fine grain data. Newer marine units also replace earlier less efficient magnetrons with solid-state technology

When can we expect bird tracking radars and their alerting systems to become operational? Despite promising progress so far, Herricks cautions that there is still much to be done, particularly in radar interpretation and in developing optimum warning techniques. By way of a parallel, he points out that it took many years after an airline Lockheed L-1011 encountered a severe windshear and crashed, killing all on board, before windshear alerting systems appeared on airline flight decks.

Wes Carleton ■

Additional reporting by Ben Vogel

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