Managing Birdstrike Risk with Information Technologies: A Review of the State-of-the-Art in 2005.

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Abstract
This presentation will discuss three information technologies currently available for management of aircraft birdstrike risk: The United States Air Force (USAF) Avian Hazard Advisory System (AHAS), the USAF United States Bird Avoidance Model (US BAM), and mobile bird detection radar systems. These three technologies have been under development since the mid-1990's and efforts are now underway to exchange data and integrate the technologies.

In 2005 the USAF Bird Aircraft Strike Hazard (BASH) Team assigned responsibility for further development and refinement of the US BAM to the contractor team responsible for the ongoing development and operation of AHAS. The intent is to further integrate the BAM and AHAS. The objective is for the BAM to become a map oriented graphical user interface (GUI) to AHAS, in addition to the historic data it has previously provided. AHAS will also make greater use of BAM data in identifying risk areas on low level routes for pilots. Small Mobile Avian Radar Systems are being used to ground truth and refine the calibration of NEXRAD (WSR-88D) radar data. The intent is to use this data to refine the risk surfaces contained in the BAM and used by AHAS in assessing current risk. This methodology will allow small Mobile Avian Radar Systems deployed on airfields and ranges to refine the "big picture" of bird activity presented by AHAS.

As of 2005, three advanced information technologies are available to support effective management of aircraft birdstrike risk: AHAS, BAM and mobile bird detection radar systems. These are production technologies are operational and currently being integrated to provide a comprehensive information system capable of supporting both military and commercial birdstrike risk management programs.

Introduction
Since 1985 the USAF has recorded over 38,000 bird-aircraft strikes causing more than $500 million dollars worth of equipment damage and resulting in the death of 33 aviators and destruction of 30 aircraft. This paper focuses on the development of advanced sensor technologies to manage this risk.

The Avian Hazard Advisory System
The USAF Avian Hazard Advisory System (AHAS) is the primary birdstrike risk management tool currently in use by USAF. AHAS was first tested in the fall of 1998 in the northeastern US and by 2001 was operational in all of the lower 48 states. The Phase 1 demonstration project used the Next Generation Weather Radar (WSR-88D), or NEXRAD weather radar, to identify potentially hazardous concentrations of birds moving in a region from Cape Fear, North Carolina, north to the Canadian border and

from the coast of the Atlantic Ocean west to the Appalachian Mountains. Data collected from the WSR-88D sites were validated by researchers in the field using mobile radars.

Potentially hazardous soaring bird activity is predicted by using data from the twice daily Model Output Statistics (MOS) weather forecast model and density distributions from the US BAM. A second forecast for potentially hazardous migration of waterfowl is also generated from the MOS weather forecast model. The two bird hazard forecasts are merged and the results for covered military training routes are posted to a dedicated server on the Internet at www.USahas.com.

In 2004 NEXRAD weather radar data were experimentally collected for Alaska, however due to the limited bandwidth of the data feed only hourly images were available. In 2005 NEXRAD weather radar data became available via satellite data link from Alaska, Hawaii and Guam. The bandwidth of this data feed ensures that current data is available every 6-10 minutes, 24 hours a day, seven days a week. This data is now being archived with the intent to expand AHAS operationally to these regions in the near future. Alaska already has a BAM that will speed development in this region but additional development will be required to implement AHAS in Hawaii and Guam.

In 2005, additional improvements to the AHAS web page were tested to provide more information to the end users. The first of these changes are expected to be released for operational use in August 2005.

Bird Avoidance Model

The US BAM was developed using Geographic Information System (GIS) technology for analysis and correlation of bird habitat, migration, and breeding characteristics to produce a birdstrike risk surface. The US BAM currently provides a strike risk surface for the lower 48 states and Alaska.

In 2005 the USAF BASH Team moved further development and refinement of the US BAM to the contractor team currently responsible for the ongoing development and operation of AHAS. The web based GIS server software used for the US BAM is becoming outdated and is increasingly more difficult to support as it is incompatible with contemporary operating systems. Currently, the US BAM is being ported to the latest generation of GIS and server operating system software. This upgrade should be completed in August 2005. The changes include updates to the datasets in the US BAM layers.

Mobile Bird Detection Radar Systems

The USAF pioneered the use of mobile bird detection radar systems for birdstrike risk modeling beginning with a pilot project at the USAF Dare County Bombing Range, North Carolina in 1994. This technology has rapidly improved in the past decade as faster workstation computers coupled with signal processing hardware and software allow bird targets to be tracked and quantified in real time with the result that several commercial providers have emerged and are now offering bird detection radar systems with various levels of capabilities and functionality.

To be operationally useful on an airfield, a bird detection radar system must be able to place a bird in three dimensional space, with high accuracy from the surface to an altitude of no less than 5000 feet (ft) and to a distance of at least 5 nautical miles (nm).

The radar scan pattern and volume of air space required to be covered by a bird detection system on an airfield is determined by;

- The length of the runway for the range of the surface coverage;
- The departure flight profile; and,
- The angle of descent for approach path.

To be operationally useful on a bombing range, a bird detection radar system must be able to measure bird altitude from the surface to 7500 ft or higher depending on the location and out to a distance of 6 nm.

Although the operational requirements of an airfield and bombing range differ, they have common requirements with respect to the necessity of detecting birds within ground clutter. Many commercially available radar systems can detect birds, but the challenge is in matching the radar design to the operational requirements to see birds reliably where the aircraft are operating.

In 2003, Detect upgraded the existing USAF BASH Team mobile bird detection radar systems to the DeTect MERLIN bird detection operating system. This upgrade has allowed the USAF to deploy the radar for operational use on airfields and bombing ranges providing information for direct management of birdstrike risk, as well as for collection of important information to calibrate AHAS and to improve the risk surfaces of the US BAM. The USAF currently has these systems operating as aircraft birdstrike avoidance radars at the Dare County Bombing Range, North Carolina (since 1993) and at Tyndall Air Force Base (AFB), Florida (since 2005).

Mobile bird detection radar systems have also been used to ground truth and refine the calibration of NEXRAD (WSR-88D) radar data throughout 2004-5. A methodology is currently being developed and refined to allow mobile bird detection radar systems deployed on airfields and ranges to refine the “big picture” of bird activity presented by AHAS.

Conclusion

As of 2005, three advanced information technologies are available to support effective management of aircraft birdstrike risk: AHAS, BAM and mobile bird detection radar systems. These are production technologies that are operational and currently being integrated to provide a comprehensive information system capable of supporting both military and commercial birdstrike risk management programs.