MPAR Technology & Potential for Aircraft Birdstrike Risk Management

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Introduction

Bird-Aircraft Strikes (Birdstrikes):

• Awareness has increased since the US Airways 1549 birdstrike-related crash

• Aircrew & passenger safety
  
  – Strikes put the lives of aircraft crew members & their passengers at risk
  
  – Over 219 people have been killed worldwide as a result of wildlife strikes since 1988

• Economic impact:
  
  – Bird and other wildlife strikes to aircraft annually cause well over $1 billion in damage to U.S. civil & military aviation
  
  – Worldwide birdstrikes to commercial aviation cost over $2 billion in damage & delay costs
Operational Birdstrike Avoidance – Challenges

• The atmosphere is full of birds, bats & insects MOST of the time

• We cannot “see & avoid” all of birds
  – Especially in low ‘g’ maneuvering commercial aircraft

• To manage risk, must define what constitutes a hazard to aircraft:
  – Mass
  – Quantity
  – Type
Where Do Birdstrikes Occur?

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<thead>
<tr>
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<th>5000 ft AGL</th>
<th>500 ft AGL</th>
<th>100 ft AGL</th>
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</thead>
<tbody>
<tr>
<td><strong>Military Aviation</strong>*</td>
<td>45-55%</td>
<td>20-25%</td>
<td>20-30%</td>
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<tr>
<td><strong>Commercial Aviation</strong></td>
<td>~10-20%</td>
<td>~30%</td>
<td>50-60%</td>
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*By DeTect, Inc.*
Military Aircraft Birdstrikes

- Over 50% of birdstrikes to military aircraft occur:
  - Away from the airfield
  - Majority during low level training operations (500 – 3000 ft AGL)

- Increased safety risk & associated damage costs
  - Low level, high airspeed operations
  - Lighter, single engine airframes

- USAF reported >5,000 birdstrikes in 2007
  - Included a pilot fatality & loss of 4 aircraft
Commercial Aviation Birdstrikes

• Over 7,500 bird & other wildlife strikes were reported for US civilian aircraft in 2008
  – FAA estimates less than 20% of commercial birdstrikes are actually reported
  – 85% of commercial birdstrikes occur within 6 miles of airport & under 500 ft AGL

• Reduced risk due to heavier airframes & multi-engine aircraft
  – Major economic impact - $1-2 billion annually
  – $75K primarily delay cost for non-damaging birdstrike ($50K for secondary delays)
What is a Bird Hazard to Aircraft?

- 95% of strikes cause no or only minimal damage
- The FAA does not have a standard for civil aviation for **unacceptable strike risk** to aircraft
- We assume that the standard is a bird or flock of birds that is:
  - Large enough to penetrate any structure of the aircraft
  - Damage an engine so it cannot produce useful power
  - Render the aircraft incapable of continued flight
- Standard needs to be set by the authority (FAA, NTSB, etc.) in order for industry to design sensors to accurately identify & alert when these conditions exist
What are we doing today to detect birdstrike risk?

Avian Hazard Advisory System (AHAS)

• USAF system uses NEXRAD (WSR-88D) weather radars to assess bird activity in near real-time with ~6 minute updates
  – Assesses biological density based on radar data & underlying resource datasets
  – Operating & available since 1998 through public web portal (www.usahas.com)

• Tabular & GIS risk formats for all US military routes, ranges, areas & airfields
  – Coverage includes the continental U.S.
  – Extrapolates risk for coverage gaps

• Limitations: low resolution & coverage gaps
AHAS – US Airways 1549 Birdstrike

- Strike occurred outside the classic migratory season
  - Large eruptive southward movement of geese
  - AHAS condition for area at time of strike was MODERATE
- Preceded by a shift in the snowline 24 hrs before the strike
  - AHAS has forecast capabilities for the classic migratory seasons
  - Snow line & freezing water data used to predict eruptive movements of waterfowl & forecast risk
Dedicated On-airport Bird Radar Systems

USAF, Navy, NASA & RAF have used bird radars for airfield support since 2003

• Bird detection & tracking within ~6 miles
  – Current generation systems such as MERLIN & VESPER include automated strike risk alerting
  – Higher resolution, specific data to air traffic control, pilots, airport operators & bird control units (level & location)
  – Documented record for reducing birdstrikes & increasing airspace utilization

• Current systems likely would have detected & warned of the geese flock that brought down US Airways 1549
MPAR Opportunities - Birdstrike Avoidance

- Bird radar technologies at current level have proven ability to manage & reduce bird-aircraft strike risk
- Users are willing to invest more in the technology to increase reliability & performance as ROI is demonstrated
- Improved sensors will increase coverage, data quality & specificity of information provided
- MPAR technology particularly offers potential to significantly increase value of AHAS
  - Especially with dual polarization
Challenge 1: How to estimate target size?

- The challenge is how to estimate target size to determine strike risk to each airframe.

- Dual polarization offers one of the richest datasets for:
  - Separation of birds from insects
  - Measurement of bird sizes
  - Current systems like MERLIN & VESPER can be used to groundtruth evaluation & development of radar systems.
Challenge 2: Predicting birdstrike risk

• The challenge:
  – Birds detected at point A and heading for point B … may well go somewhere else!
  – Birds do not always follow a predictable, linear trajectory

• HOWEVER birds seen upstream on migration can foretell issues downstream in other areas, possibly without radar coverage, or out beyond the bird detection range of the radar
  – We need to continue to pool advisories out of AHAS to manage the ‘big picture’ & not just think in terms of vectoring aircraft

• We likely will never have full coverage in the mountains at low level where the military aircraft train & will need AHAS type assessment of conditions to manage the risk
Challenge 3: Real time bird strike avoidance

- Human factors:
  - Human operator relaying advisories, as is done today, is not ideal
  - ATC is task saturated & action introduces time lag

- **Answer:** birdstrike advisories direct to the cockpit
  - We do it for aircraft for midair collision avoidance
  - Similar approach for birdstrike warning is possible
  - Requires high reliability & low false positives
Summary

MPAR & Birdstrike Avoidance:

• Offers potential to significantly improve AHAS through increased capability & coverage, especially with dual polarization

• Can potentially be used to manage inroute bird strike risk with direct intervention when line of sight view of birds and aircraft is possible

• Can help manage the low level & range airspace by both direct and indirect observations
  – If birds are seen up- and/or down- stream of a low level route we can infer where they are in between (as is currently done with AHAS)
  – Birds migrate up to 12,000 ft in USA and so it provides a tool to better manage the airspace for military and civilian users

• MPAR will not replace systems like MERLIN at the airport
  – These systems however can be used to validate MPAR
Questions?

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