FOD Sensors & Avian Radar Operationalized

Subtitle:
Enhanced surveillance of the greater airfield

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It’s Easier to Predict Where...than How
Regulators, Operators and Others are trying to understand what poses the greatest risk(s) on/near airports.

- Drone?
- Ramp?
- Wildlife?
- FOD?
- Security?
- Runway
  - Incursion?
  - Excursions?
What if FOD, Bird, Drone and Other Detection Technologies were Integrated?

It would make it easier to write a business case...

FOD Radar/Camera for a **2D issue**

Avian Radar for a **3D issue**

FOD Wildlife
(Radar Only)

Exploring

FOD
Including Wildlife Camera & Radar

Avian Bird Detection

2017 ICAO/ACI Wildlife Strike Hazard Reduction Symposium
Operationalizing a Sensor Must be Simple

- **Filter** (better to over filter)
  - Get rid of unwanted “noise”
    - Avian radar algorithms
    - FOD detection algorithms

- **Verify**
  - The hazard
    - “Human-in-the-loop”

- **Respond**
  1. Mitigate the Hazard
     - Pyros, shotgun, horn, etc.
  2. Communicate the Hazard
     - When the hazard cannot be abated
How should AirOps communicate hazards?

- **NOTAM**
  - Long term hazards

- **ATIS**
  - Shorter-term situations

- **SITREPS, BIRDREPS or ...**
  - At SEA we provide specifics over the FAA Tower Frequency when hazards cannot be abated.
  - Flight Crew is Made Aware too.

- **PIREPS**
  - Tends to be effective
  - Typically result in multiple visuals
Lessons Learned

- Sensors can’t detect all birds or hazards
  - It’s OK...people observe/record even less, especially at night.
- Responders want to see the hazard they were sent to.
  - Birds, aka “FOD with a brain”, are on the move
  - Responders get frustrated when they don’t see the hazard.
  - Managers get frustrated when they don’t have skilled observers
Overview - SEA FOD Detection System

“FOD” Detection Sensors on Runway16C/34C
- 101 Edge light sensors by XSIGHT
  - Radar 360°
  - Camera scans runway only 180°
  - Loud speakers, one per sensor, can harass birds
  - Lasers for pinpointing FOD on the surface.
  - NO ONE IS STARRING AT FOD or RADAR MONITORS
FOD Detection System Monitor
Airport Communications Center (ACC)

- **SNR:** 100.71 dB
- **Est. Size:** 24.75 inch²
- **ID:** 88412
- **Role:** XSIGHT
- **Detected:** a minute ago

- **SNR:** 95.40 dB
- **Est. Size:** 22.36 inch²
- **ID:** 88411
- **Role:** XSIGHT
- **Detected:** 3 minutes ago

- **SNR:** 91.24 dB
- **Est. Size:** 7.34 inch²
- **ID:** 88410
- **Role:** XSIGHT
- **Detected:** 4 minutes ago

- **SNR:** 89.17 dB
- **Est. Size:** 1.51 inch²
- **ID:** 88409
- **Role:** XSIGHT
- **Detected:** 7 minutes ago

- **SNR:** 81.27 dB
- **Est. Size:** 2.62 inch²
- **ID:** 88402
- **Role:** Birds
- **Detected:** 10 minutes ago

- **SNR:** 68.06 dB
- **Est. Size:** 2.53 inch²
- **ID:** 88400
- **Role:** XSIGHT
- **Detected:** 10 minutes ago

- **SNR:** 108.11 dB
- **Detected:** 4 minutes ago
- **Updated:**

- **SNR:** 95.47 dB
- **Detected:** 5 minutes ago

- **SNR:** 112.31 dB
- **Detected:** 12 minutes ago

**Off Runway Detections**

**Camera Only 2016/2017**

**Bird Detection**

**Bald Eagle**
ACC Dispatches AOS

Airport Operations Specialist (AOS)
Example: AOS Response
FOD Detection System Operationalized

- AOS Uses iPad app to verify and respond to mitigate hazard.

Vehicle-based
RunwiseMobile
iPad View
iPads used for Remotely Harassing Birds

Objective
- Increased Awareness of Wildlife Hazards

Yellow camera icons indicate units which will emit preselected sounds
### 2016 ACC Hazards Received

<table>
<thead>
<tr>
<th>Hazards detected after excluding the less hazardous objects</th>
<th>Type</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moderate-Large Birds</td>
<td>1,206</td>
<td>99%</td>
</tr>
<tr>
<td></td>
<td>Metal, Tire chunk, Ice</td>
<td>13</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>1,219</td>
<td>100%</td>
</tr>
</tbody>
</table>

2017 ICAO/ACI Wildlife Strike Hazard Reduction Symposium
ACC Comments
“We see bird’s all the time”

• Realization

- A new discussion is needed
  - FOD Detection Systems are important for wildlife managers
    - Half of all strikes occur < 100 ft. AGL
Other Realizations...

- Prey items are a bigger issue than we first thought ($n > 7,200$)
- Bird strikes are removed by scavengers
- Birds resting patterns on runways
This is actionable information!
Birds Not Evenly Distributed

- Yellow = highest bird numbers.

- Ryan Hobbs, MS Thesis Project
  - The Evergreen College, Olympia WA
Forensics

- Assigning a bird strike to an aircraft
What about Avian Radar?

- “Miracle on the Hudson”

- Avian radar is being installed at a few airports
- Rarely are they operationalized.
- Why?

Hazard determination requires filtering out the less hazardous detections along with algorithms that alert responders of bird threats when and where they are found on the airfield.

2017 ICAO/ACI Wildlife Strike Hazard Reduction Symposium
Birds are a 3D issue

January 2009
The FAA, etc. wants real-time hazard alerting here & now.

Flight Crew

Control Tower

Airport Operations
Crow-sized bird and larger

Commissioning and Validation
2005 - 2011

Radar Technology Suppliers
1960’s to date

"Need to Know"
Data Filtering

Too Much Data
Remember
It’s OK if NOT ALL of the hazardous birds are detected. Why?

- Ops personnel still patrol for wildlife hazards
- Filtering produces actionable information!
  - Avoid the “Wild Goose Chase”

**Example:**
1. Where does hazardous bird activity persists?
Persistent Bird Activity Monitoring

“No one is staring at a screen”
Bird Alerts are Audible

Utilizing a Predetermined Threshold of Minimum Bird Activity

- 15% of 15 minutes (2.25 minutes over a running 15 minutes)

Standard Operating Procedure (SOP)

- Threshold is triggered & Goose call alerts
- Region is highlighted
- Avian threat displayed
- OPS personnel are notified by radio
- These responders report their actions
OBJECTIVE – Increased Awareness of Wildlife Hazards

Airport Operations Specialist (AOS)
### Responder Reported Results

<table>
<thead>
<tr>
<th>ARRIVAL TIME (local)</th>
<th>SPECIES</th>
<th>NUMBER</th>
<th>RESULTS</th>
<th>AOS COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1158</td>
<td>Starling</td>
<td>1000</td>
<td>Good</td>
<td>Birds on THR 16C LOC....GRADE A</td>
</tr>
</tbody>
</table>

Push send to deliver this form to Viehoever.p@portseattle.org and Osmek.s@portseattle.org.

**RADAR GRADE:**

- **A** = HAZARDOUS BIRDS SEEN AND MITIGATED (vehicle, siren, pyros, live round, called the ATCT, etc.).
- **B** = HAZARDOUS BIRDS SEEN BUT COULD NOT MITIGATE
- **C** = NO HAZARDOUS BIRDS SEEN
- **D** = NO BIRDS SEEN
- **E** = COULD NOT RESPOND (describe why in the AOS Comment field)
Awareness was increased

Response Time Declined

Same Responder going to Region 16 due to primarily crows

y = -0.4082x + 17.997
R² = 0.2816
April 2017, Dawn, Sea-Tac Airport
At least 6 cormorants struck by B737

- Both engines damaged
- Landing gear damage
- 5 days downtime
- Dents
  - Both cowlings
  - Below windscreen
KSEA Reported Strikes Declining

- Baseline Established: Quarterly Distribution of Strike Kits to Airlines Begun
- Avian Radar Operationalized
- FOD Sensors Operationalized