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DeTect™ INTELLIGENT RADAR

# Discriminating birds from noise in bird radar data from an offshore wind farm

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## Introduction

- MERLIN dual solid-state radar system installed offshore on the North Sea to study the impact of offshore wind farms on birds.
- Vertical Scanning Radar: registers flight altitudes and flux of birds (number of birds/km/hour), while the Horizontal Surveillance Radar registers flight paths and flight directions of birds in the wind farm and its vicinity.
- Not only birds are detected by radar, but also undesired radar echoes such as weather, waves and radar interference. Rain and waves result in large amounts of noise in the database.
- These undesired radar echoes are referred to as **noise** or **clutter**.

**Goals of this study:**

1) To develop an analytical procedure to effectively filter clutter (i.e. data mining);
2) to determine the real-time flux of birds in the wind farm area at different altitudes and to calculate a real-time collision risk.

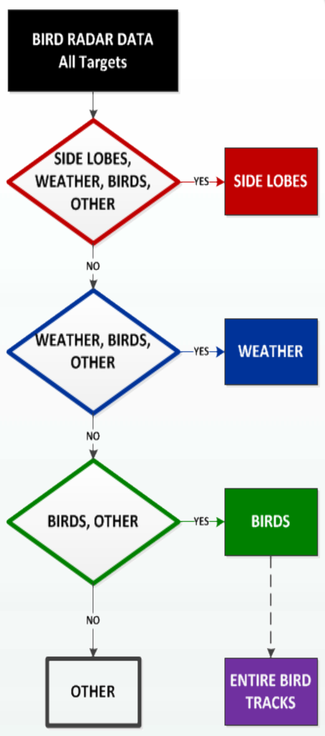
*MERLIN bird radar on the offshore platform in the C-Power wind farm*

## Methodology

- Step 1 - Reference Data:

MERLIN Editor is used to select different types of targets (e.g. weather, side lobes, birds) and stores them in separate reference databases.

| REFERENCE DATA | |
|---|---|
| **SIDELOBES** | |
| 64065 | YES |
| 67720 | NO |
| **WEATHER** | |
| 160026 | YES |
| 68841 | NO |
| **BIRDS** | |
| 67720 | YES |
| 78779 | NO |




- Step 2 - Model Building:

SQL Data Mining models analyze the reference databases and identifies discriminating variables between bird types and other target types.

- Step 3 – Model Testing:

SQL Data Mining models are tested on archived bird radar data and the results are analyzed to determine success. Two types of tests were performed:

- **In Sample Tests** are performed on the reference data , therefore it is the first test of the data mining model to confirm model accuracy and effectiveness.
- **Out of Sample Tests** are performed on archived data to confirm the data mining models accuracy and effectiveness on real-world data.

## Conclusions

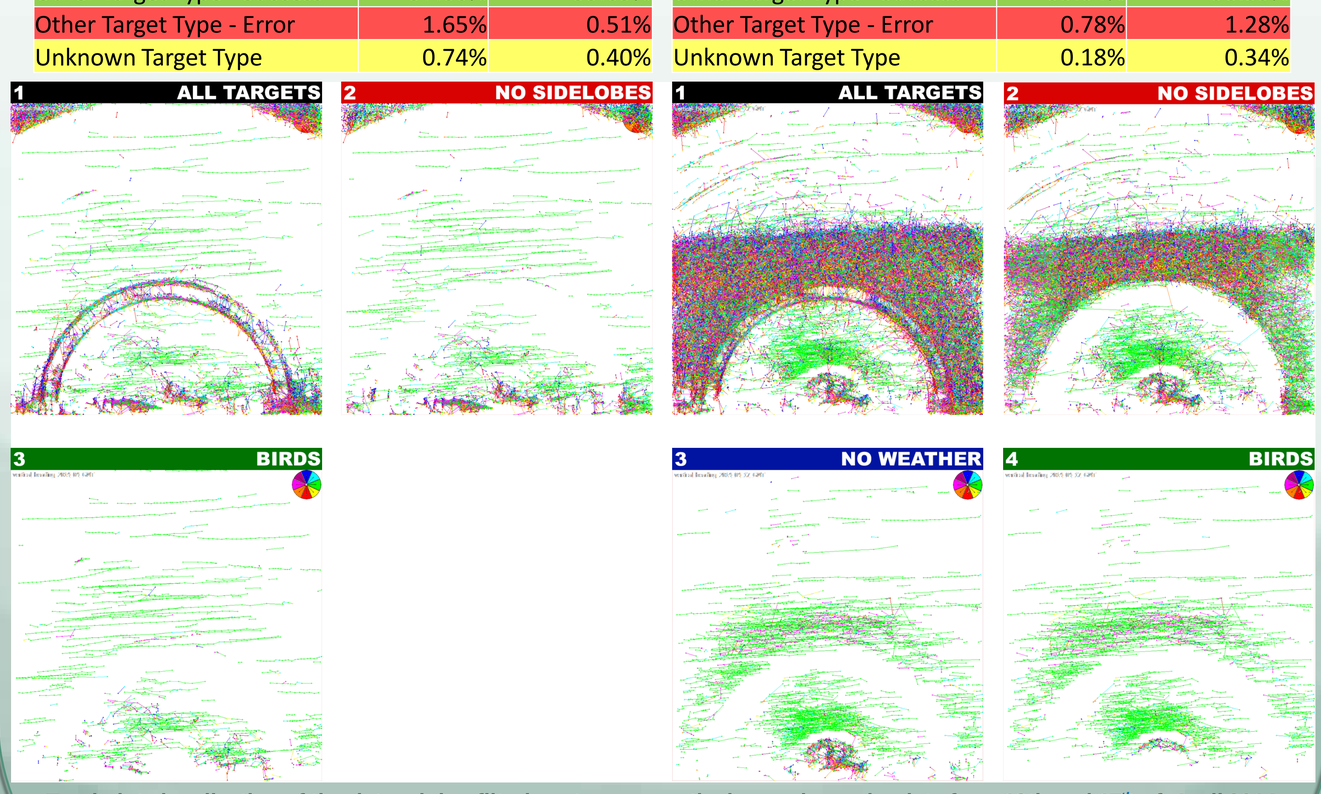
- The model effectively filters clutter from the vertical bird radar data, without losing significant numbers of bird targets.
- Quality control of the model so far results in **a success rate of 89.8 to 98.6% for the bird targets** and 97.6 to 99.0% for all other targets.

- **What is next?**
  - The model algorithm will be applied in real time processing of bird radar data before storing them in the database.
  - The filtered data will result in an improved registration of the bird flux in the wind farm and therefore an improved assessment of the collision risk for birds, based on the bird flux at rotor swept height.

## Results

| April 13th, 2014 | Targets | Track IDs |
|---|---|---|
| **BIOLOGIST CLASSIFICATION** | | |
| ALL | 53631 | 28622 |
| ALL Track IDs > 1 Row | 36454 | 11445 |
| Bird Target Type | 1791 | 247 |
| Other Target Type | 34663 | 11198 |
| **OUT OF SAMPLE TEST** | | |
| Bird Target Type - MODEL | 2441 | 301 |
| Bird Target Type - BIOLOGIST | 1791 | 247 |
| **DATA MINING ERRORS** | | |
| Bird Target Type - MODEL difference from BIOLOGIST | 573 | 57 |
| Bird Target Type - BIOLOGIST difference from MODEL | 182 | 48 |
| Unknown Target Type - MODEL | 258 | 45 |
| **OUT OF SAMPLE SUCCESS** | | |
| Bird Target Type - Success | 89.84% | 80.57% |
| Bird Target Type - Error | 10.16% | 19.43% |
| Other Target Type - Success | 97.60% | 99.09% |
| Other Target Type - Error | 1.65% | 0.51% |
| Unknown Target Type | 0.74% | 0.40% |

| April 17th, 2014 | Targets | Track IDs |
|---|---|---|
| **BIOLOGIST CLASSIFICATION** | | |
| ALL | 193996 | 69196 |
| ALL Track IDs > 1 Row | 162547 | 37747 |
| Bird Target Type | 9427 | 836 |
| Other Target Type | 153120 | 36911 |
| **OUT OF SAMPLE TEST** | | |
| Bird Target Type - MODEL | 10766 | 1395 |
| Bird Target Type - BIOLOGIST | 9427 | 836 |
| **DATA MINING ERRORS** | | |
| Bird Target Type - MODEL difference from BIOLOGIST | 1200 | 472 |
| Bird Target Type - BIOLOGIST difference from MODEL | 133 | 37 |
| Unknown Target Type - MODEL | 272 | 124 |
| **OUT OF SAMPLE SUCCESS** | | |
| Bird Target Type - Success | 98.59% | 95.57% |
| Bird Target Type - Error | 1.41% | 4.43% |
| Other Target Type - Success | 99.04% | 98.39% |
| Other Target Type - Error | 0.78% | 1.28% |
| Unknown Target Type | 0.18% | 0.34% |




*Trackplot visualization of the data mining filtering steps on vertical scanning radar data from 13th and 17th of April 2014*