Detecting and tracking marine mammals around tidal turbines: development of a dual multibeam sonar system

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Energetic habitats: important for tidal turbines and seals
Tools to measure underwater behaviour

Passive acoustic tracking

Animal borne tags/telemetry

Active acoustic tracking
Tracking marine mammals with sonar: the process

- Sonar data
- Detect moving targets
- Track moving targets
- Classify marine mammals
  - Sonar development
  - Track marine mammals around turbine
Sonar data

Tritech Gemini: 720 kHz multibeam

No measured responses to signals by seals

Existing target tracking module

Detection probability (seals) >0.95 up to 30m
Detect and track targets
Detect and track targets – 3D
Detect and track targets – 3D
Detect and track targets – 3D

Mean absolute error: 2.16 m (95% CIs = 2.01 – 2.32)

Classify marine mammals
Classify marine mammals

Mobile targets in tidally energetic environments

- 95 targets.hr\(^{-1}\)
  - 6.6 seals.hr\(^{-1}\)
  - 88.8 non-seals.hr\(^{-1}\)
- Each day = ~2,100 non-seal targets;
- Need an effective means of data reduction.

kernel Support Vector Machines

The objective is to train a classification model based on labelled data. The trained model is then used for classifying novel data.
Kernel support vector machines

Used for a wide range of pattern recognition applications in biology

- Quantifying movement behaviour of cheetahs from GPS tags;
- Constructing social networks based on co-occurrences of jackdaws;
- Counting individual wildebeest within aerial survey photo;
- Classify seals in sonar data?
Kernel support vector machines
Kernel support vector machines

- All seals correctly classified;
- Majority of non-seals correctly classified;
- ~8% of non-seals classified as seals.

From: ~89 false positive detections/hour
To: ~8 false positive detections/hour

Seal tracking with sonar:

Summary

Sonar data

Detect moving targets

Track moving targets

Classify marine mammals

Track marine mammals around turbine

- Sonar is suitable for detecting wild seals in tidally energetic habitat;
- Development of 3D tracking appeared promising;
- Errors in depth estimation ~2m;
- kSVM appear to be good classification approach for seals in sonar data;
- All seals correctly classified;
- ~8% false positive rate.

Photo: Atlantis Resources Ltd
Next steps: redeployment around operating turbine...