ACOUSTIC DETECTION OF A CONFLICT SPECIES

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Background

- Human-wildlife conflicts are increasing
- Cost-effective methods for reducing damage or conflict levels are important in wildlife management
- A wide range of devices to detect and deter animals
- Scaring of conflict-species is part of wildlife management

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Limitations to available scaring devices

- Most simple are static (scarecrows)
- Often randomly activated (propane cannons)
- Animal activated devices are non-specific
- The effectiveness is often highly variable

→ High risk of habituation

→ No cost-effective concept circumventing habituation

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A new concept

Species-specific acoustic detection of an animal causing conflict

Study animal:

Barnacle goose – easy to study, vocal, causing conflict with agriculture

Method:

Speech recognition -> using acoustics to detect and classify behaviour

Why acoustics?

Cheap, reliable, highly sensitive, long-range

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A new concept

The acoustics associated with three behaviours needed:

Landing – to activate scaring stimulus

Feeding/flushed – to determine whether scaring was successful

Linkage between acoustics and behaviour was obtained in the field

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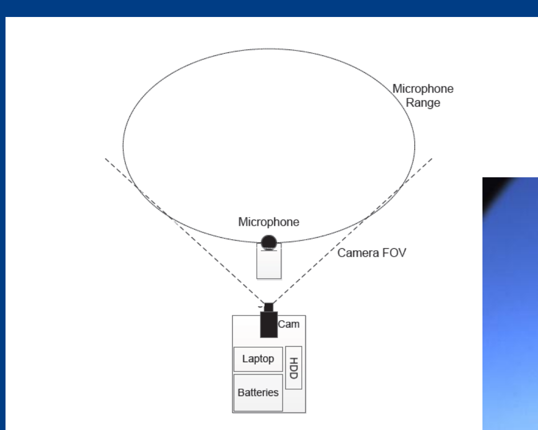
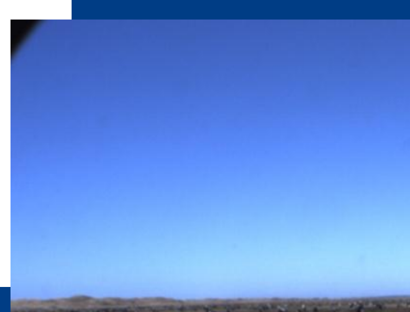
Setup at Vest Stadil Fjord, April 2011



Syncronised audio and video recordings



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Data processing

Syncronised audio and video recordings were manually categorised into the three behaviours:

- landing
- feeding
- flushed

→ data for pattern recognition algorithm

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Time for engineers and their Support Vector Machines

$$a = log_{10}\left(\frac{f_{max}}{A} + k\right) \tag{10}$$

The calculation of GFCC is illustrated in figure 2, where the incoming signal has a duration of 46 ms (2048 samples), as cepstral coefficients are derived from short-time analysis. The log-energy of each critical band is represented by spectral vectors, and a cosine transform converts the spectral vectors into cepstral vectors, according to the formula

$$c_n = \sum_{k=0}^{K-1} S_k cos\left(n\left(k - \frac{1}{2}\right)\frac{\pi}{K}\right) \quad n = 0, \ldots, K-1 \tag{11}$$

Here c_n is the nth cepstral coefficients and S_k is the spectral log-energy of the kth band. In this research 20 critical band filters where used, which gives a feature vector of dimension 21, as the 0th order cepstral coefficient is included (see Brookes (1997-2011)). The filters were *hamming* shaped, however both *hanning* and *triangle* shaped filters are often used in MFCC

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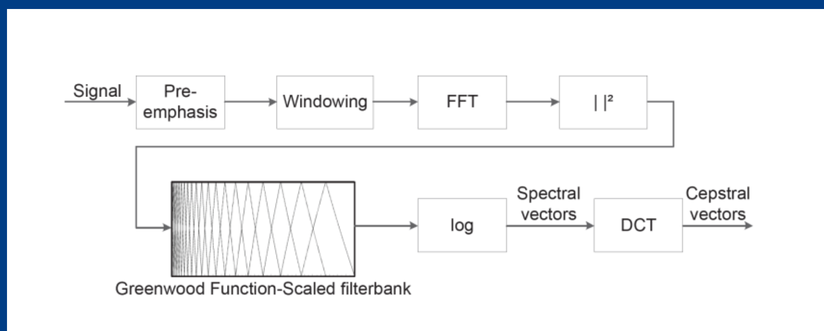
Signal processing



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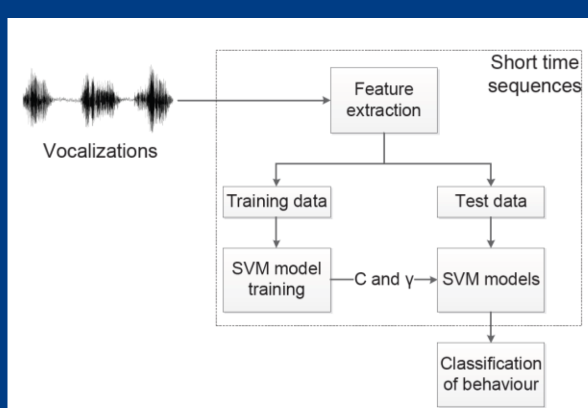
Flow of behaviour classification



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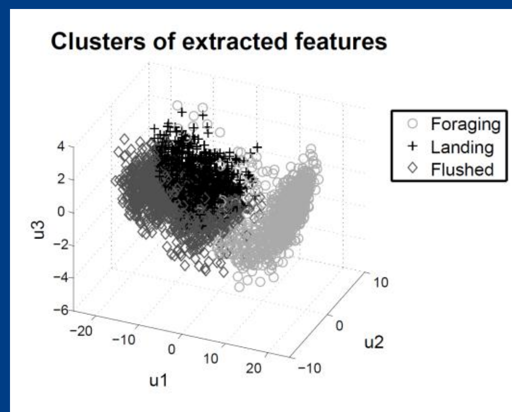
Results

PCA: Discriminates between extracted features of different behaviours



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Results

SVM models are able to classify test data with high accuracy

Behaviour	Accuracy[a]
Flushing	0.95/0.93
Landing	0.91/0.90
Foraging	0.92/0.91

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Conclusions

Acoustic measurements, feature extraction and statistical modeling may be used to

- detect geese
- classify their behaviour with high accuracy

We obtained information sufficiently accurate to respond appropriately to the presence or absence of geese

→ Pilot project involving scaring in spring 2012

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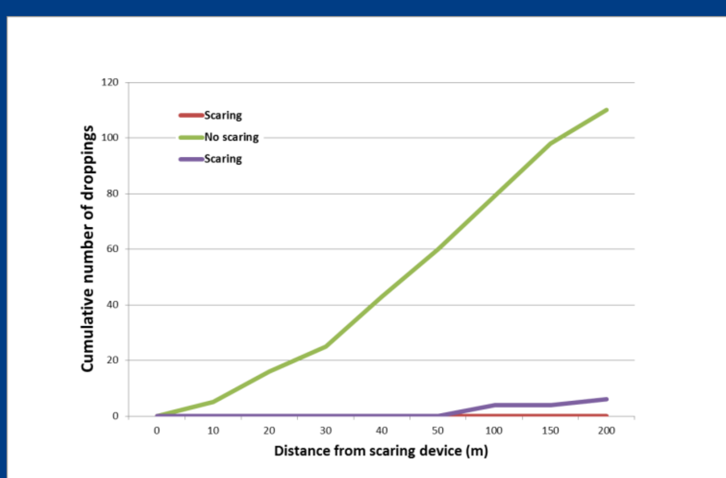
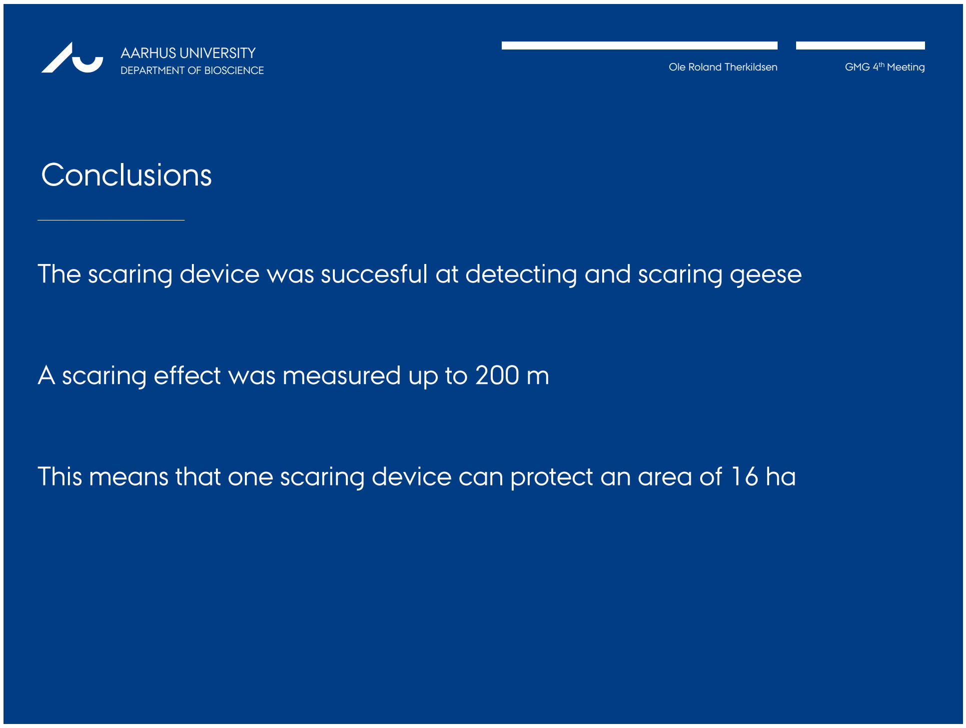
Pilot project – preliminary analysis

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Conclusions
The scaring device was succesful at detecting and scaring geese
A scaring effect was measured up to 200 m
This means that one scaring device can protect an area of 16 ha