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Automatic analysis of the underwater soundscape characteristic to the Australian Northwest Shelf

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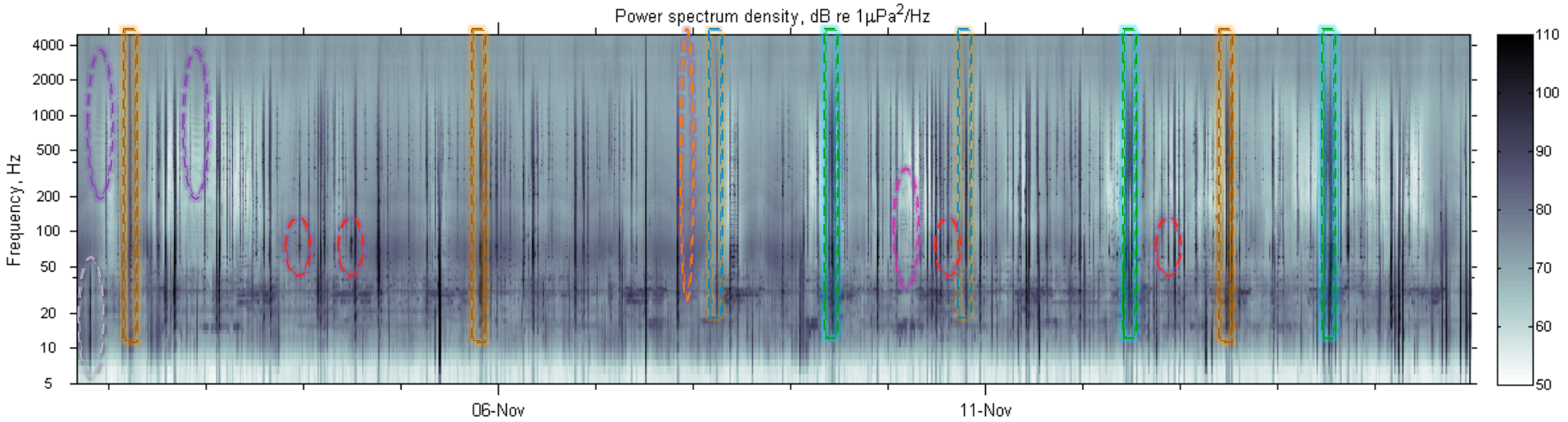
Outline

- Current PAM trends & how this work differs
- Significance
- Challenges
- Expectations
- Solution Plan
- Current state of affairs

Motivation … (?)

PAM – Targeted Solutions



Marine Mammals

Snapping shrimp

Fish (type 1) chorus

Fish (type 2) chorus

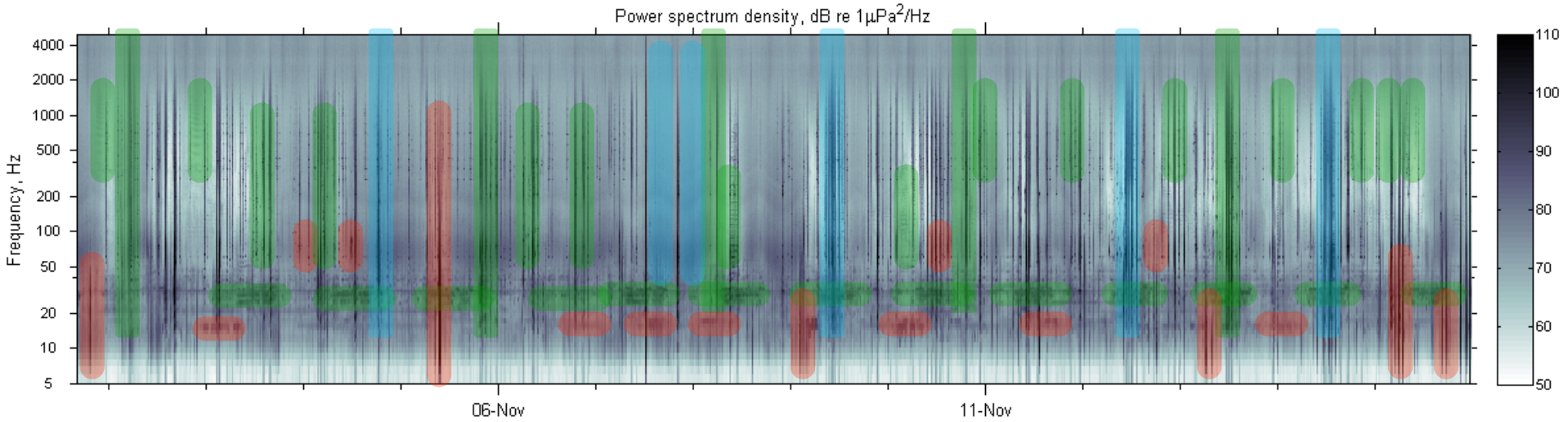
Mooring

Vessel noise

Rain

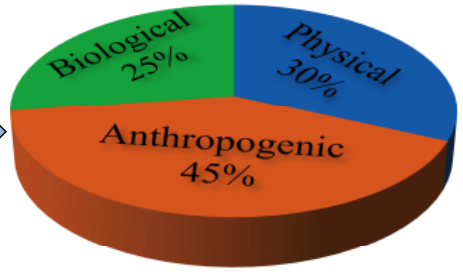
Wind

Our Goal – Bigger Picture



AUTOMATIC CHARACTERISATION TOOL

Contributions separated by source type

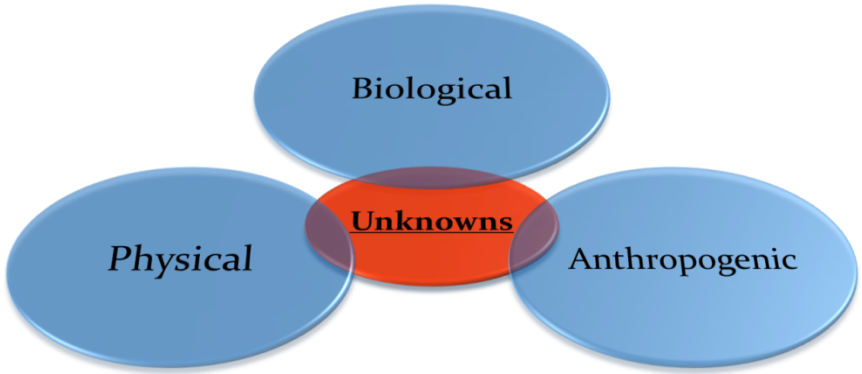


Significance

- Unified approach to acoustic monitoring
- Environmental impact assessments
  - Before and after conditions
  - Risk of masking
- Observe ecosystem dynamics
- Archival data – historical perspective
- Cues to effects of climate change

Challenges

- Huge Repertoire
  - sounds of interest (how would you define noise?)
  - detection/classification/recognition methods
- Variations
  - source behaviour
  - channel effects
- Unknown sounds &
  sounds previously not encountered



Desired Characteristics

- Robustness
  - varying interference levels
  - vocalization variations
- Flexibility
  - varying data collection methods
- Adaptability
  - recording sites
- Throughput
  - near real-time speeds

Solution - Where to start?

Spectrogram Correlation

Matched Filters

Spectral Analysis

Hidden Markov Models

Teager-Kaiser Energy Operator

Neural Networks

Wavelet Transforms

Dynamic Time Warping

Rule-based Classifiers

Discriminant Function Analysis

Entropy Analysis

Cepstral Features

Group Delay Function

Hilbert-Huang Transform

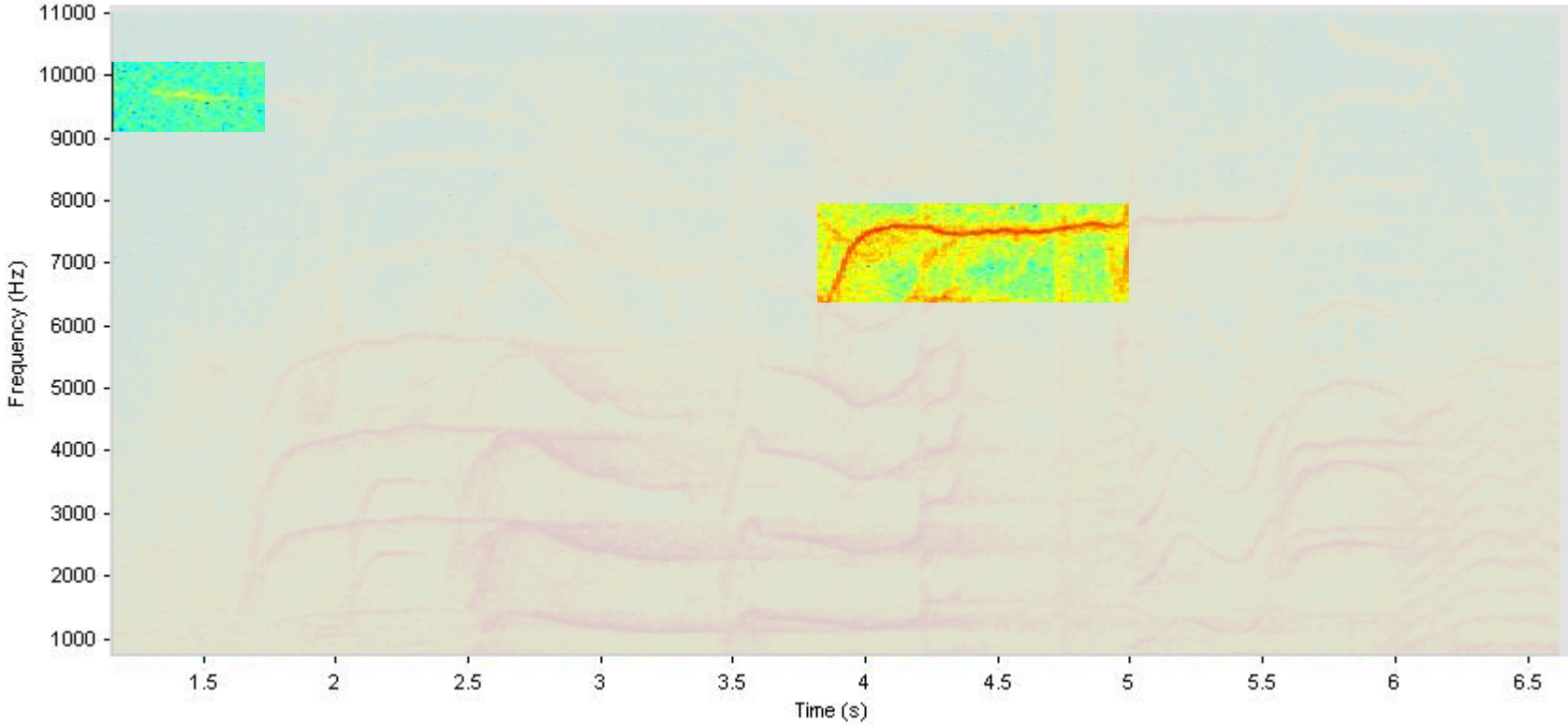
Gaussian Mixture Models

Classification & Regression Trees

Spectrogram Edge Detection

Alternate view of the problem

Context - big & small

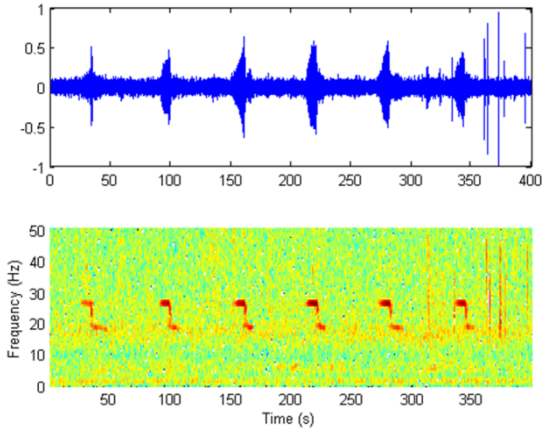


Detect, then classify …

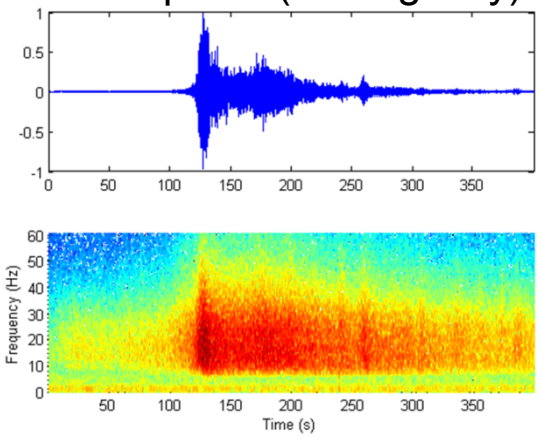
First phase - Detection

- Tonal Narrowband signals
- Continuous Broadband signals
- Very-short duration signals

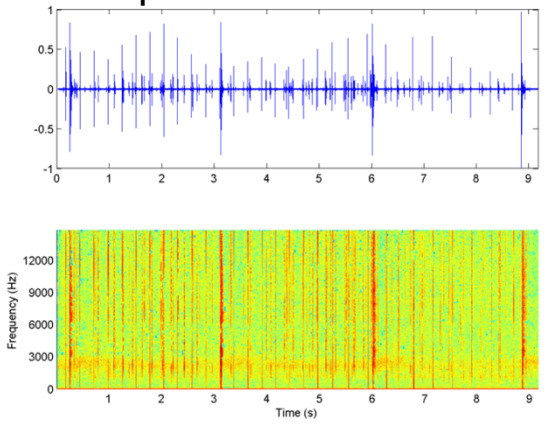
Antarctic Blue Whale



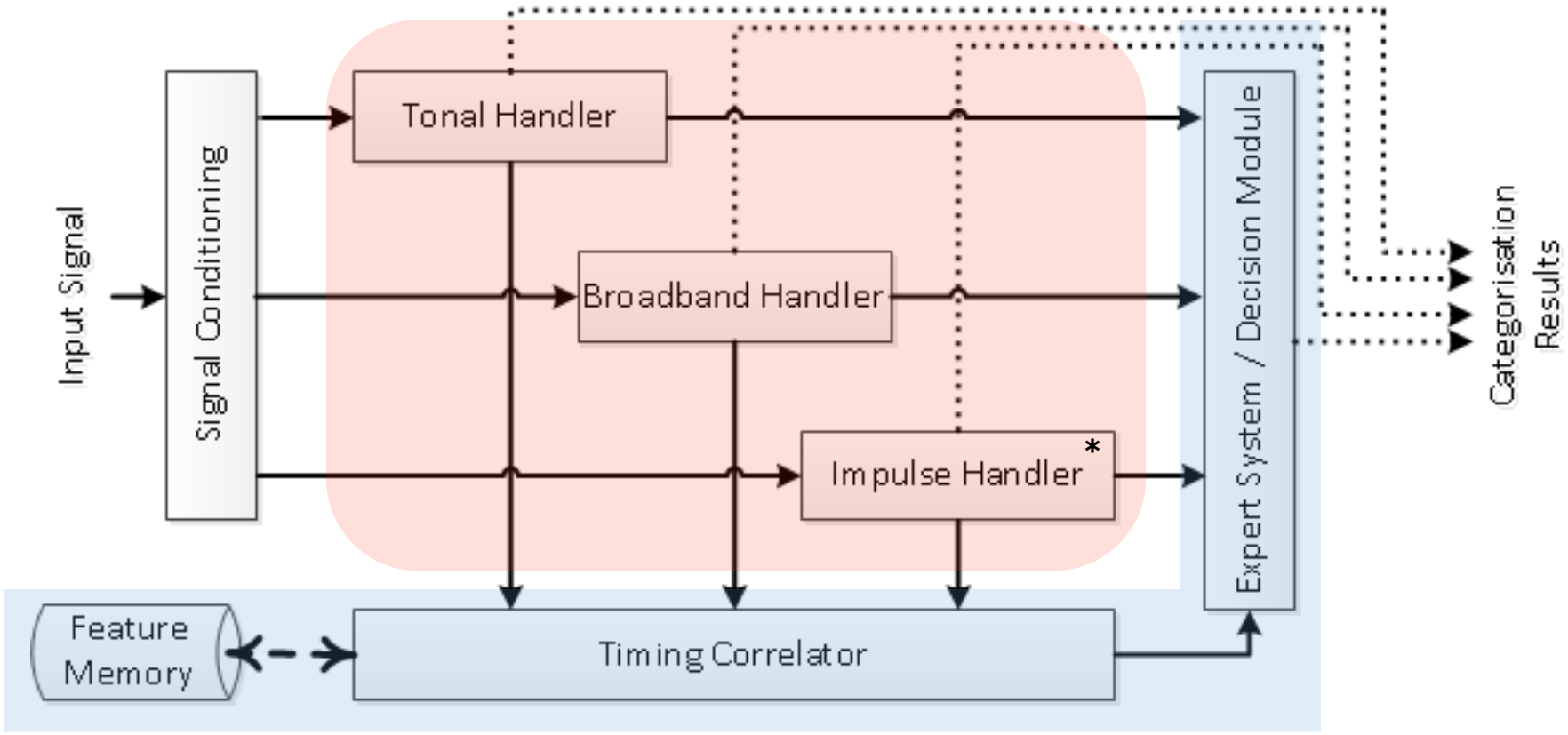
Earthquake (Boxing Day)



Sperm Whale Clicks



System Architecture



* Madhusudhana *et al*., J. Acoust. Soc. Am. **137** (2015)

Thank you

- Questions?