Real-time monitoring of noise and acoustic events: listening, identifying and understanding

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**LIDO live data flow**

<table>
<thead>
<tr>
<th>Country/Location</th>
<th>Platform</th>
<th>Data stream</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRANCE</td>
<td>ANTARES</td>
<td>36 x 250 kHz</td>
</tr>
<tr>
<td>NEPTUNE CANADA</td>
<td>Folger Passage</td>
<td>1 x 96 kHz</td>
</tr>
<tr>
<td>NEPTUNE CANADA</td>
<td>Barkley Canyon</td>
<td>1 x 96 kHz</td>
</tr>
<tr>
<td>NEPTUNE CANADA</td>
<td>Barkley Slope</td>
<td>1 x 96 kHz</td>
</tr>
<tr>
<td>SPAIN (MED SEA)</td>
<td>OBSEA</td>
<td>1 x 96 kHz</td>
</tr>
<tr>
<td>JAPAN (JAMSTEC)</td>
<td>Hatsushima</td>
<td>1 x 100 Hz</td>
</tr>
<tr>
<td>JAPAN (JAMSTEC)</td>
<td>Kushiro</td>
<td>3 x 100 Hz</td>
</tr>
<tr>
<td>ITALY (ESONET)</td>
<td>NEMO TSS/TSN</td>
<td>2x4 x 96 kHz</td>
</tr>
<tr>
<td>SPAIN (ATLANTIC)</td>
<td>BIMEP</td>
<td>1 x 96 kHz</td>
</tr>
<tr>
<td>CTBTO ?</td>
<td>11 HA</td>
<td>11 x 200 Hz</td>
</tr>
</tbody>
</table>
Real-time monitoring of noise and acoustic events: listening, identifying, and understanding audio data stream.

Segment 1:
- Measure noise
- Discard segment with no acoustic event
- Assign acoustic events to broad categories
- FM-tonal sounds
- Impulses...

Segment 2:
- Classifier 1
- Classifier 2
- ...
- Sperm whales
- Beaked whales
- Pilot whales
- Dolphin
- Explosions
- Ships
- Sonar
- Tracking
- Density
- Estimation
- Bearing, Position
- Trajectory, ...

Segment 3:
- Real-Time Mitigation
- Long term assessment and Control of the effects of noise sources on marine organisms
- Public outreach

Universitat Politècnica de Catalunya
Laboratori d'Aplicacions Bioacústiques
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DETECTION & CLASSIFICATION

Fin whales, 29th April 2010, 02am, off Kushiro, JAPAN, JAMSTEC observatory
(Feed Forward Neural Network)

Real-time monitoring of noise and acoustic events in cetacean acoustic niches

LOCALIZATION

Sperm whale tracking, 09th August 2005, 09pm, East-Sicily, NEMO observatory
(Hybrid spatial spectral estimation: space-time methods and TDOA-based methods)

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INTERACTION WITH NOISE

Sperm Whales at ANTARES (Ligurian Sea), July 2010

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**GLOBAL NOISE MEASUREMENTS**

(10 segment average)
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GLOBAL CETACEAN DISTRIBUTION
(50 segment average)
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Detection of short tonal sounds in the band 0.2–16 kHz.

Acoustic data from Neptune, 3–24 March 2010, 10 min recorded every 3.5 hours.
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http://listentothedeep.com
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<table>
<thead>
<tr>
<th>Deep-sea or shallow water cabled observatories</th>
<th>Towed arrays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio-linked, expandable or moored stand-alone buoys</td>
<td>Underwater vehicles, e.g. gliders</td>
</tr>
<tr>
<td>Underwater neutrino telescopes</td>
<td>Past and Existing recordings</td>
</tr>
</tbody>
</table>
Monitoring existing noise sources

http://www.sonsdemar.eu
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The system is designed to be modular and dynamic (allows the choice of detectors/classifiers) depending on the objectives and geographical areas.

The system successfully allows:
- the real-time detection and classification of acoustic events
- the real-time and long-term monitoring of noise
- immediate mitigation actions
- the online display of the audio stream and the statistical analysis

The modular system can be implemented on:
- cabled observatories,
- autonomous radio-linked buoys, moored antennas
- autonomous vehicles (e.g. gliders),
- towed arrays
- existing data sets,
- etc.
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The system can be applied (industry):
- during offshore operations, seismic surveys (expandable buoys),
  windmills/wave energy (autonomous buoys during construction,
  cabled observatory during operation), shipping lines, coastal
  operations (e.g. harbour construction), etc.

The system can be applied (science):
- in existing and future acoustic observatories
- during CFE and tagging to understand the acoustic ecology of
  the individual,
- existing recordings

The system will be implemented (Fall) with:
- an alert procedure that will allow to automatically target acoustic
  events of interest and receive it live (e.g. mitigation or research)
- automatic display of AIS data and correlation with noise
  measurements to determine the acoustic signature of ships cruising
  over the observatories
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The data from the existing observatories are available to the scientific community

The system can be operated by a non-expert

The analysis is performed automatically and doesn’t require post-processing

The system is immediately available to be applied to any Acoustics Observatory