MSc. Thesis Proposal

Title: **Acoustic detection of marine species and underwater noise sources with Machine Learning**

Supervisors

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Introduction

Motivation

Underwater noise represents a significant threat to marine life, as much as other pollution such as oil spills or plastic debris. Indeed, marine mammals communicate and orient themselves with sounds. Noise from ships or offshore operations can interfere with their communication and it was proven by many studies that they lead to changes in behavior for many species. It is therefore crucial to better monitor anthropogenic induced noise and marine mammals' activities around them.

Existing work

An algorithm was already developed that can assess the presence of ships and dolphins from a hydrophone recording. The algorithm includes several steps of data pre-processing to transform the sound recording into a specific spectrogram, which is then analyzed through a CNN. A sensitivity study on several parameters was conducted to achieve a better performance and it was highlighted that a reliable and representative dataset is at least as important as optimized hyperparameters.
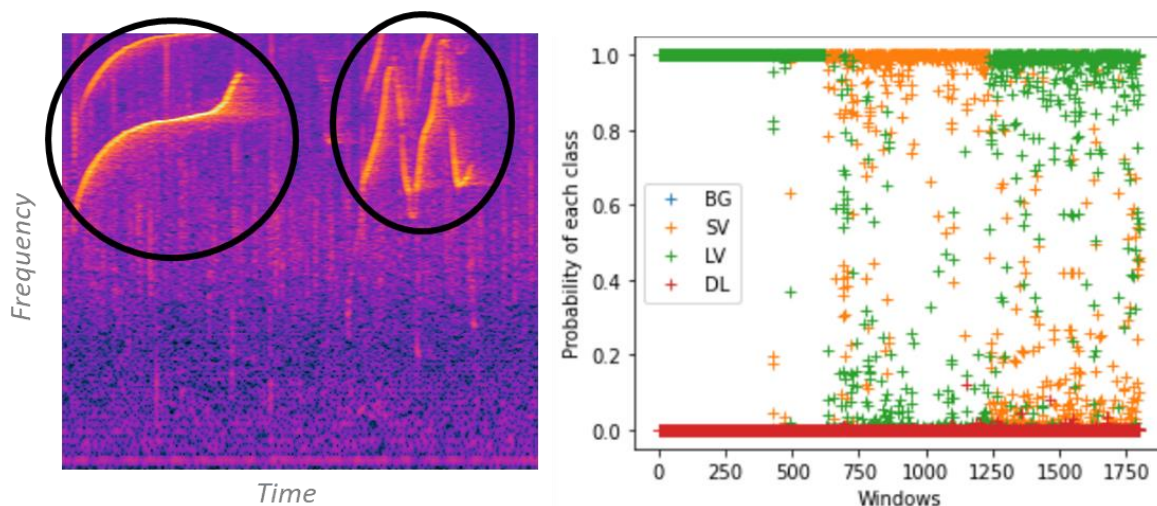

Figure 1: Analysis of a hydrophone recording

Objectives

The objectives of this thesis are:
- Compare the current algorithm against more complex algorithms from the literature and choose the most performant and accurate.
- Further develop the chosen algorithm so that it can:
  - Detect the type of noise (clicks or whistles) generated by the dolphin,

- o Identify more types of ships,
- o Identify overlapping sounds,
- o Identify whales.

To reach the objectives, data from the RepMUS exercises (RepMus21 presentation) will be used. During this exercise, 3 hydrophones were deployed at locations where dolphins are spotted daily, and the AIS of all ships participating were recorded. The data will be made available to the student.

The expected tasks are:
- Gain domain expertise to understand the manual process of sound detection and its challenges.
- Literature review to facilitate those challenges through machine learning.
- Comparison of multiple architecture on the same dataset.
- Addition of new features, as previously stated.

Requisites
Applicants must have:
- General knowledge on Artificial Intelligence
- Affinity with data processing
- Coding experience with python or similar

Good to have:
- Linux experience
- LateX experience
- Git experience

Added value to have:
- Knowledge on sound data processing

Location
blueOASIS (www.blueoasis.pt) Edificio D.Pedro, Quinta da Fonte, R. Malhões, 2770-071 Lisboa or Ericeira Business Factory, R. Prudêncio Franco da Trinitade 4, 2655-344 Ericeira.
The student **must be present at the office at least 4 days per week**. This is mandatory to pursue a thesis with blueOASIS.

Companies Involved
blueOASIS is a young team with more than 65 years of combined knowledge and experience on Aerospace, Mechanical, Naval and Maritime engineering. The multicultural and multidisciplinary team is committed to make our oceans safer and greener, using state of the art numerical and data science tools. BlueOASIS focuses on renewable energies, ocean cleaning, decarbonization, sustainable offshore structures and green ships optimization.

Bibliography
Dommergues, B., Cruz, E., Vaz, G., "Optimization of underwater acoustic detection of marine mammals and ships using CNN", Proceedings of Meetings on Acoustics, ICUA 2022.