MSc. Thesis Proposal

Title: Visual assessment of wave height in surf zones from imagery using Machine Learning

Supervisors

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Introduction

Motivation

Waves are characterized by their period and wave height. But when an ocean wave comes close to the shore, the bathymetry influences its shape: the lower the water depth, the steepest the wave, up to a point where the wave breaks and completely changes shapes. Precise wave measurement in near shore, out of the surf zone, are relatively easy to make using specific moored buoys. However, this is not the case in the surf zone, where the tides change daily the water depth and where the waves breaking energy can damage the expensive equipment. Measuring devices can therefore only be deployed for a few hours at the most. An accurate knowledge on the wave characteristic is non the less crucial for the safety of the sea users, but also for general coastal management. AI can facilitate this assessment by allowing a low-cost global coastal monitoring.

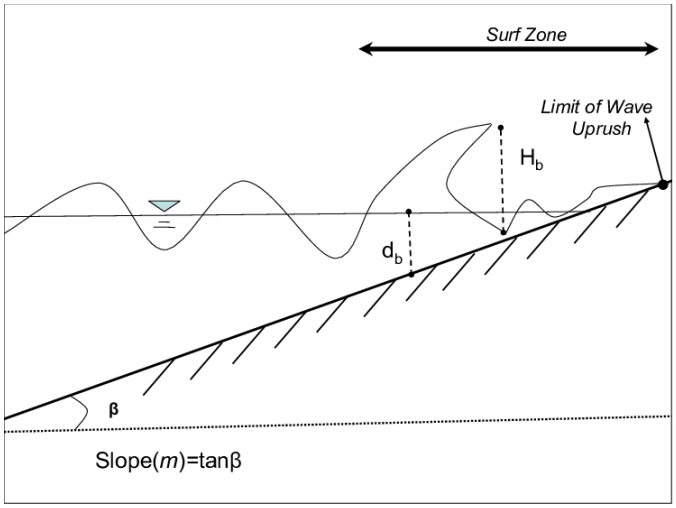

Figure 1: Analysis of a hydrophone recording

Existing work

This problem is similar to the automated detection of the horizon line, but with additional complexity. Various algorithms have been used in that regard, mostly using edge detection techniques such as the Hough transform. Similar approach can be used to detect the top and bottom lines of the breaking wave, giving a number of pixels corresponding to the wave height, that then must be converted into a height.

Objectives

The objective of this thesis is to train, evaluate and optimize an AI algorithm capable of assessing the wave height of incoming waves from camera images, including after the breaking point within the surf zone. The student can first focus on non-breaking waves, then extend his/her work to breaking waves. The tasks are as follows:

- Literature review: understand how coastal waves are measured and what are the limitations of local sensors. Determine the added value of using AI and which architectures are the most suited for the study.
- Dataset: gather camera images at location where accurate wave measurements or wave model results are accessible. Web scraping using selenium can be helpful for that step. Access to IH's data will be provided.
- Labelling: label the dataset using the on-site measurement or model results.
- Image pre-processing to facilitate feature extraction
- Training and validation
- Algorithm optimization. A Bayesian method can be followed.

The student should provide a working algorithm with its final characteristics and metrics, a pre-processing method, and recommendation for future work.

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 ocean waves.

Location

blueOASIS (www.blueoasis.pt) Edificio D.Pedro, Quinta da Fonte, R. Malhões, 2770-071 Lisboa The student is invited to join the team in the office when the supervisor is present (at least three days per week).

Companies Involved

blueOASIS is a young team with more than 45 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.