MSc Thesis

Title: **Automatization of Image Processing for Marine Renewable Energy**

Requirements: Numerical Methods, Linux, Python, DataScience (AI/ML/DL)

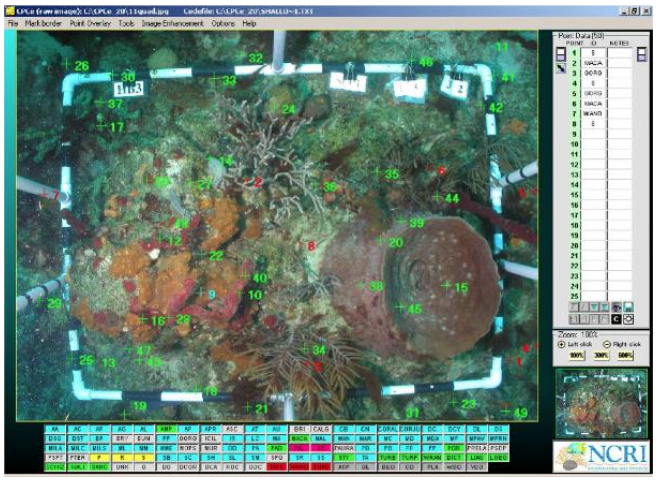
Duration: 6-9 months

Location: IST and/or WavEC-Offshore Renewables (www.wavec.org) (Lisbon, Portugal)

Supervisors: **Prof. João Sousa (IST), Dr. Pedro Vinagre (WavEC), Dr. Guilherme Vaz (WavEC), Eng. António Maximiano (WavEC)**

Description

Marine biofouling is a threat to industries working in the marine environment. In the **Marine Renewable Energy** (MRE) sector, for example, biofouling adds weight to structures/equipment/components (e.g., moorings, energy converters) and increases their surface diameter (added thickness and roughness) resulting in loss in performance. Also, biofouling can induce and/or promote corrosion. Furthermore, the colonization of structures at sea will have an artificial reef effect promoting local biodiversity, but which can also promote the propagation of non-native species (NNS) across geographies.



Developers and operators need to perform monitoring and maintenance activities frequently (largely site- and device-specific), to avoid impairment of their assets, and to mitigate impacts caused by NNS. Biofouling monitoring is often performed using divers or a remote operated vehicle (ROV). Photos/videos are taken to the structures/equipment/components of interest, capturing biofouling from different angles and using a measure of scale. Then, software (e.g., CPCe) can be used to analyse the photos to quantify the biofouling through parameters such as composition and number of species and presence of NNS, coverage, biomass and density.

However, despite its usefulness (e.g., it allows quantifying biofouling without sampling biofouling at sea and analysing it in the laboratory), the analysis of photos is time-demanding and identifying and quantifying species requires a person to do all of the steps in the process.

This thesis aims to develop automatization of the photo analysis process by using state-of-the-art AI algorithms. This should enable the user to perform the task much faster (or almost no user intervention), and to analyse a much larger volume of data. The newly developed process/algorithm should also be able to: - quantify the coverage area; - recognize species/groups of species and NNS; - quantify biomass and density. This algorithm should be able to perform these tasks on offline images at first, but on the mid-long term, a faster procedure should be envisaged to perform the same analysis while operating a ROV/UAV.

This work will be useful to many industries, such as Marine Renewable Energies systems like Floating Offshore Wind Platforms, Current/Tidal Turbines, Wave Energy systems, but also for several Ocean Structures (aquaculture cages, buoys) and all sorts of Shipping Vessels.

Bibliography

1. Kohler K.E., Gill S.M., 2006. Coral Point Count with Excel extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. Computers & Geosciences, Volume 32, Issue 9, p. 1259-1269. https://doi.org/10.1016/j.cageo.2005.11.009.
2. Bannister J., Sievers M., Bush F., Bloecher N., 2019. Biofouling in marine aquaculture: A review of recent research and developments. Biofouling: The Journal of Bioadhesion and Biofilm Research 35 (6), p. 631-648. https://doi.org/10.1080/08927014.2019.1640214.
3. Titah-Benbouzid H., Benbouzid M., 2017. Biofouling issue on marine renewable energy converters: a state of the art review on impacts and prevention. International Journal on Energy Conversion 5 (3), p. 67-78. https://doi.org/10.15866/irecon.v5i3.12749.
4. Galil B.S., McKenzie C., Bailey S., Campbell M., Davidson I., Drake L., Hewitt C., Occhipinti-Ambrogi A., Piola R. 2019. ICES viewpoint background document: Evaluating and mitigating introduction of marine non-native species via vessel bio-fouling. ICES Ad Hoc Report 2019, 17 pp. http://doi.org/10.17895/ices.pub.4680.