MSc Thesis

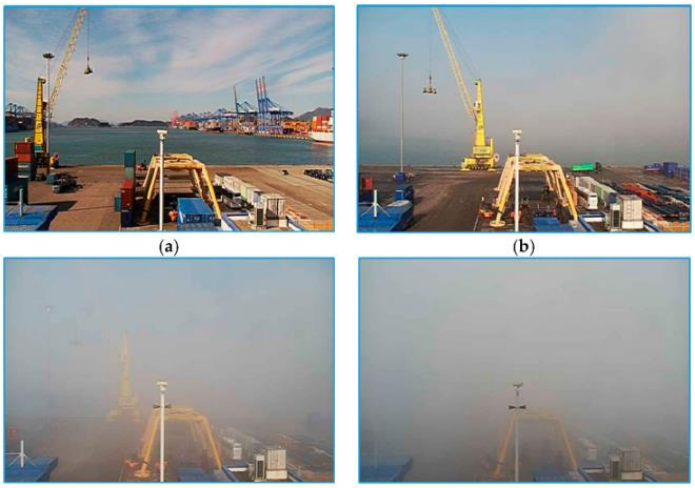
Title: **Characterization of fog and visibility range through image processing**
Requirements: Numerical Methods, Python, DataScience (AI/ML/DL)
Duration: 6-9 months
Location: IST and/or WavEC-Offshore Renewables (www.wavec.org) (Lisbon, Portugal)
Supervisors: Prof. João Sousa (IST), Dr. Guilherme Vaz (WavEC), Eng. Gonçalo Fonseca (WavEC)

Objective

Development of an image processing methodology and tool based on a Deep Learning algorithm to estimate the visibility range and characterize fog dispersion utilizing camera imagery.

Description

Fog is an atmospheric effect that impacts the risk of activities and operations in several infrastructures where visibility is key to identify existing obstacles. Offshore operations and logistics rely on the ability to identify, and forecast, changes in visibility in real time allowing a safer planning and execution of operations. Currently, visibility-meters are available and can be deployed for fog identification and characterization, however these sensors do not characterize the non-homogeneous dispersion of fog and are expensive to acquire and maintain. Using off-the-shelf cameras to tackle this problem requires the development of methodologies involving image processing technics and machine learning strategies.



This thesis will focus on the development and implementation of algorithms that shall provide an estimation of visibility range and characterization of the spatial dispersion of fog or haze through the utilization of camera imagery. Visibility range estimations shall consider spatial nonlinearities and when based in camera images it is required that supporting methodology accommodates the potential influence light variances arising from day-night periods and eventually seasonality.

This opportunity will allow interaction with a parallel project, that includes the deployment of an infrastructure comprehending atmospheric remote sensing, camera imagery and visibility metering. Such interaction will be key in the development of work to be performed in this thesis, such as feeding in machine and/or deep learning algorithms, testing and validation. This work will be useful to several maritime operations and transportation that rely in specific visibility requirements and it is also envisioned that it may further impact on other industries such as aviation.

Key Tasks

- Identify the various existing methods for analysing images, offline and online, and identify advantages and disadvantages (see [1] for similar work);
- Perform tests using different images from different places, visibilities ranges, spatial nonlinearities to identify which are the most suitable methods for each scenario;
- Validate the methods and measure how they are influenced by light variances, such as day-night/ seasons.

Teamwork and Results

The candidate will work closely with different teams within WavEC. It is also in the interest of WavEC to use the results of this master's thesis in future projects that require data processing. Upon good performance of the candidate the work may be presented in a conference and / or in a Journal.

Bibliography

1. Palvanov A., Cho Y. I., 2019 VisNet: Deep Convulational Neural Networks for Forecasting Atmospheric Visibility. Sensors (Basel). 2019 Mar 18;19(6). pii: E1343. doi: https://10.3390/s19061343.
2. CSutter, T., Nater, F., Sigg, C., 2014 Camera Based visibility estimation.
3. Wauben W., Roth M., 2016 Exploration of fog detection and visibility estimation from camera images.