

MSc. Thesis Proposal

Title: Detection of anomalies in vessel manoeuvring and traffic behaviour using AIS data and machine learning

Supervisor

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Introduction

Motivation

World trade is heavily dependent upon sea-borne trade, as over 90% of the traded goods carried in ships¹. In addition, there is also a tendency of growth in maritime traffic as well as a rise in the size of ships. However, the waterways infrastructure is almost static, i.e. the structures at ports and terminals are the limitation to the growth in size of ships due to high investment cost and geographical limitations. As a consequence, the margin for errors in maritime logistics becomes very small, both due to the potential economic as well as human and environmental impacts. An example of the gigantic worldwide consequence of human error in maritime transport is the Ever-Given ship that grounded in the Suez Canal in 2021. Engineers have been trying to improve maritime transport safety by performing statistical analysis on historical collision data to identify the causes of maritime collisions. However, this approach is hampered by the limited number of incidents that can be collected in each area over a given period of time. The Automatic Identification System (AIS) produces a large amount of maritime traffic data available by collecting trajectory data through land and satellite-based stations. This existent database offers the opportunity to discover insights into maritime traffic behaviour, route estimation and anomalous behaviour detection. The tool that will be developed can be applied to Vessel Traffic Management Information systems, Portable Pilot Units, Ship Management Control Systems, among others.

Existing work

Several studies attempted to analyse manoeuvring anomalies, but few are using tools such as machine learning to accelerate the manoeuvring identification process[1]–[5]. EMSA recently made a bid focussing on developing tools for this purpose, specifically to identify anomalies in manoeuvres and traffic. The research here proposed aims to promote increased safety in ports and terminals and prevent accidents and their consequences. [6], [7]

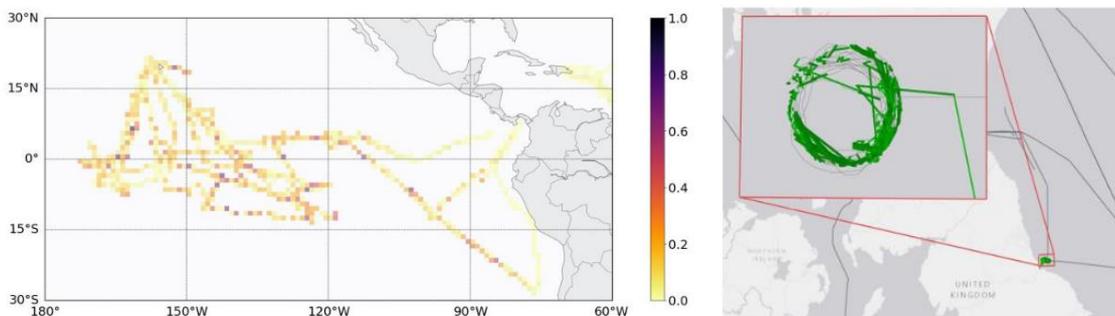


Figure 1 – Examples of ship trajectories anomalies

Objectives

To analyse AIS data series and develop tool to identify manoeuvring patterns and behaviour in a specific port or terminal:

- Study of the State-of-the-art tools for the identification patterns of manoeuvrability, ship and pilot behaviour, as well as of anomalies.
- Verify and catalogue data coming from the AIS, checking the integrity of the database, removing inconsistent data and outliers if necessary.
- Statistical analysis of the processed data, identifying correlations, generating indexes, time analysis, and other data pertinent to the analysis.
- Identify manoeuvring patterns, considering:
 - Machine learning (ML) methods as a tool.
- Test the tool against new data coming from AIS, trying to find anomalies, and verifying the accuracy of the tool developed.

Requisites

Applicants must have:

- General knowledge on shipping.
- General knowledge on statistics and machine learning method.
- Coding experience with python or similar.

Good to have:

- Latex experience.
- Git experience.

Added value to have:

- Linux experience.



Location

The student must be present at the office at least 4 days per week. This is mandatory to pursue a thesis with blueOASIS.

blueOASIS (www.blueoasis.pt) offices at Oeiras or Ericeira.

Edifício D.Pedro, Quinta da Fonte, R. Malhões, 2770-071 Lisboa

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Companies Involved

blueOASIS is a young team with more than 60 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.

References:

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