**Title:** Predictive Modelling and Simulation of Marine Debris Dispersion in Maltese Territorial Waters

**Abstract:**

The accumulation of surface marine debris in the territorial waters of Malta presents a severe ecological and environmental challenge, adversely impacting marine life and human activities. This project focuses on the application of a practical system integrating a physics-based Lagrangian dispersion model with an AI-enhanced predictive model. Utilizing historical wind and surface ocean current data, the system employs the Lagrangian model to simulate and visualize past movements of marine debris. Concurrently, an AI model using a CNN-LSTM architecture is developed and trained on the same dataset. This model predicts critical environmental parameters for future scenarios, which are then fed into the Lagrangian model to project future debris dispersion. Hosted on a web platform, this approach offers a significant advancement in marine debris management by facilitating real-time data visualization and predictive analytics. This project not only demonstrates a method for enhancing marine conservation efforts through accurate predictions of marine debris movement but also underlines its vital role in planning and executing effective cleanup operations, thus contributing to a more comprehensive understanding of marine pollution dynamics.

1. **Introduction**
   1. **Problem Definition/Motivation**

Marine debris around Malta’s territorial waters presents a significant environmental challenge. Consisting largely of plastics and other non-biodegradable materials, this debris poses a direct threat to marine ecosystems, endangering aquatic life and disrupting the natural balance. The presence of marine debris also compromises the ecological value of coastal areas, adversely impacting recreational activities. This project seeks to address these challenges by developing an integrated system that aims to track and predict the movement of marine debris. The goal is to provide actionable insights that can guide effective cleanup operations and inform strategies for long-term marine conservation in Maltese waters.

* 1. **Aims and Objectives**

The aim of this project is to develop an integrated, AI-enhanced system for simulating and predicting the movement of marine debris in the territorial waters of Malta, thereby supporting marine conservation efforts.

To achieve this aim, the following objectives have been identified:

1. Data Integration: To preprocess and integrate the datasets, which include wind and sea surface current data to be used for both models.
2. Lagrangian Model Development: To utilize the Ocean Parcels library for simulating the movement of marine debris, employing historical data to ensure accurate simulations.
3. AI Model Development: To create a CNN-LSTM model capable of predicting future wind and sea surface currents weather data.
4. Web-based Visualisations: To develop a web-based platform that facilitates the visualization of both past data and predicted future simulations, providing essential tools for marine conservation and debris management.
5. **Literature Review**
6. Proposed Solution/ Methodology
7. Testing and Evaluation
8. Conclusion

References