Preliminary Problem Statement: Efficiency of Swarm Robotics in Maritime Shipping

Introduction

Maritime shipping is responsible for more than 70% of all imported and exported goods in the EU. Increasing demand has led to an increase in the size of container ships. These ships are more efficient but also more challenging to maneuver, leading to accidents, including a container ship getting stuck in the Suez Canal, causing global shipping delays and other disasters resulting in deaths. A solution could be to apply swarm and modular robotics to maritime shipping, where small ships, each capable of carrying a limited number of containers, can operate individually or collaborate in a larger swarm when necessary. This would enhance the maneuverability of the system, enabling more flexible navigation in tight spaces. However, this approach may also increase the overall surface area of the swarm, which reduces efficiency due to greater drag.

Problem statement

This thesis will investigate how different configurations of a swarm of boats affect sailing efficiency compared to a single large containership.

Methods

We will use a combination of simulated experiments and real-world experiments to compare the efficiencies of different configurations.

For the simulation, we will use a well-known simulation library, like Webots[1], though other similar platforms may also be considered. In the simulation, we will create several models of different sizes and shapes to measure the sailing efficiency of the boats in the given configuration and other parameters that have an impact on the sailing efficiency of the swarm.

The real-world experiments will be done using a simple minimum viable product (MVP) model of a boat that we have designed and built. These experiments will be used to validate our results from our simulated experiments. This is to clarify the reality gap between the simulation and the real world.

Intended outcome

We will deliver an analysis based on the simulation results, which are based on the boat's shape and the configuration we added to the simulation. This will be followed by an analysis of the swarm's efficiency both in the real world and in the simulation. We will discuss which real-world parameters had an impact on the experiments that could not be measured in the simulation. Finally, we will discuss our results and give an overview of the efficiency when using a swarm of maritime robots compared to a single large containership.

[1] https://cyberbotics.com/