Master Project

Autonomous seabed mapping using online learning and optimal experimental design

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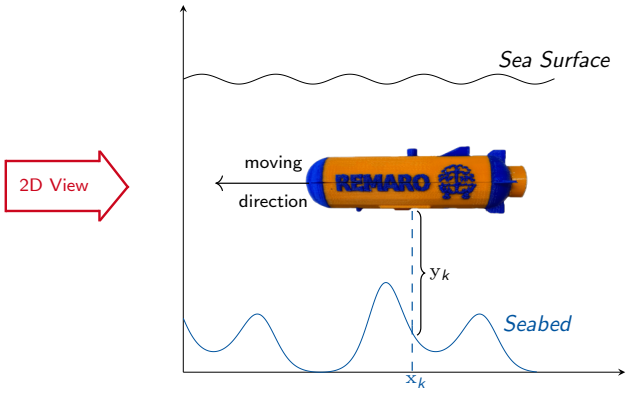
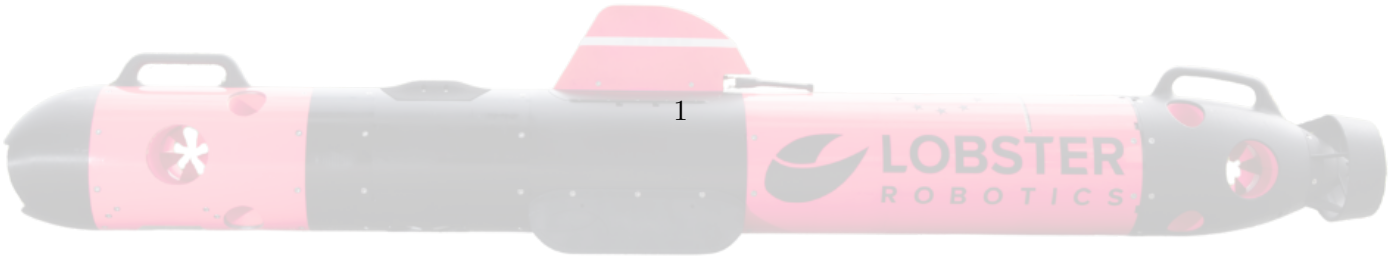
Mapping the seabed is a time-consuming and resource-intensive task, traditionally requiring human-operated survey vessels and extensive post-processing. Modern underwater drones, or Autonomous Underwater Vehicles (AUVs), collect visual data using onboard cameras. These recordings are later stitched together using image registration techniques to form a coherent map of the seabed.



This process can be significantly improved by building an accurate model of the seabed during the mission. Such a model helps guide the fusion of images and reduces the reliance on costly post-processing. However, constructing this model in real time is challenging due to the nonlinear and uncertain nature of the estimation problem.

This project focuses on developing an online learning algorithm that estimates the seabed structure as data is collected. To maximize the quality of the resulting model, the method will also incorporate adaptive experimental design, allowing the AUV to decide where to explore next in an optimal fashion.



Project tasks

This master's thesis project is aimed at developing a parameter estimation method applicable to a specific class of nonlinear systems. Concretely, we wish to:

1. Design an estimation algorithm that takes into account the underlying latent, stochastic, state process of the AUV. The algorithm should must be suitable for large datasets.
2. Design a scalable algorithm for adaptive experimental design and online learning.
3. Validate the algorithm using data collected from a physical robot.

This master's thesis is carried out in collaboration with Lobster Robotics. The designed algorithm will be validated on real-life data collected during a Lobster Robotics mission.