

**Boston University**

**Electrical & Computer Engineering**

**EC463 Senior Design Project**

**Customer Installation**

**C-Slam: Adopting the SLAM Algorithm for Underwater Robotics**



Submitted to

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by

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**1. Details of Customer Installation**

On April 25, 2024, our customer installation took place online via Microsoft team, as our project is entirely software-based. All team members—Robert, Xinglin, Zhaowen, Lydia, and Lucía—participated in the session. Additionally, our customer, Mike Gratton, was present. Mike has access to the program through our Git repository, allowing him to run it smoothly.

Our github repository: *https://github.com/peterguzw0927/Senior\_Design*

**2. Requirements**

Original:

* Simultaneous localization and mapping (SLAM) techniques correlate multiple sightings of landmarks in data to correct the estimated position of the vehicle.
* The corrected localization is used to warp recorded data for better alignment with its true location.
* SLAM is generalizable and can handle various kinds of sonar datasets.
* Deliverables include prototype SLAM software and a final report outlining the selected SLAM algorithm.
* The final report includes an analysis supporting the algorithm's performance, particularly on real data.

Skipped:

* Enabled real-time navigation for continuous position and orientation updates.
* Integrated relocalization for swift and precise position recalibration.

Final:

* Explored diverse types of sonar datasets.
* Successfully processed the sonar dataset, generating images and Inertial Navigation System (INS) data.
* Precisely identified correct landmarks from the torpedo dump sonar dataset, employing filtering and edge detection techniques.
* Calculated geographical coordinates of each landmark relative to the vehicle position.
* Performed pose graph optimization using landmark coordinates to refine the vehicle trajectory.
* Reviewed and discussed the final corrected trajectory of the vehicle with the client.

**3. Assessment of product installation testing**

In our final assessment, we found the SLAM algorithm to work really well. We looked at different sonar data types and managed to process them to create images and INS data. We used image processing techniques to classify the landmarks in the sonar images accurately. Then, we are able to compute the exact location of each landmark compared to the vehicle. This helped us to perform loop closure on the vehicle’s trajectory to navigate accurately. Overall, we were pleased with how the algorithm performed in real-world situations.

**4. Follow up plans**

If time permits, we plan to extensively test our SLAM algorithm in diverse real-world scenarios and compare its performance with established solutions like Blue-ROV SLAM. Through comprehensive evaluations, we aim to identify strengths and weaknesses, informing further optimization efforts to improve the system's reliability and effectiveness.

**Customer Acceptance Email**

*Gratton email*