# USE OF AUV'S FOR DETECTION AND MAPPING OF LOST EQUIPMENT AND MARINE LITTER

MIR MARINE & MARITIME INTELLIGENT ROBOTICS

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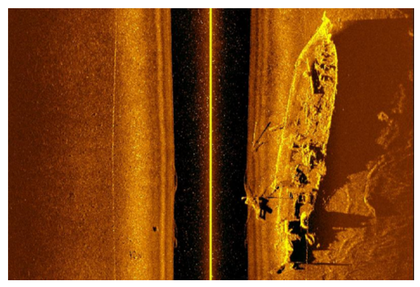
Co-funded by the Erasmus+ Programme of the European Union

## CONTEXT AND MOTIVATION

- The accumulation of marine litter and lost fisheries equipment is a growing concern for both environmental preservation and navigation.
- Marine debris damages marine ecosystems and poses a threat to biodiversity.
- Approximately 2% of all fishing gear used ends up lost in the ocean.
- To put into perspective, the amount of longline fishing gear littering the ocean each year can circle the Earth more than 18 times.
- Autonomous Underwater Vehicles (AUVs) are essential for detecting and mapping marine litter and lost equipment.
- Side scan sonar (SSS) is excellent for wide-area coverage and precise detection of objects on the seabed.

HUGIN Endurance is an advanced autonomous underwater vehicle (AUV) developed by Kongsberg Maritime.



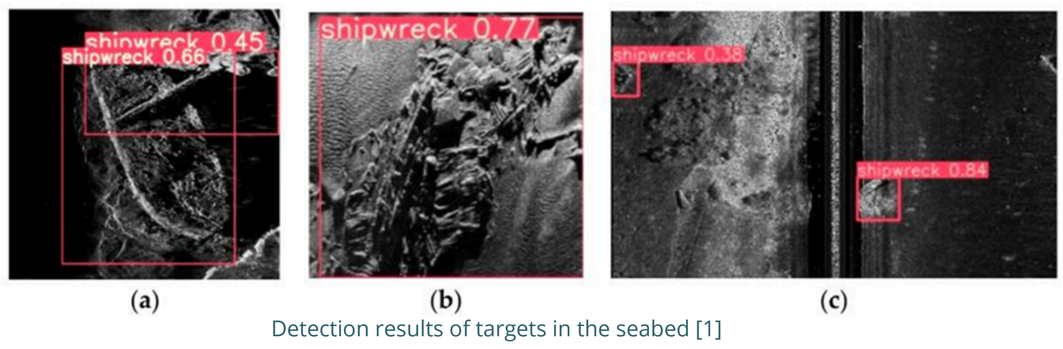
## STATE OF THE ART

Recent advancements in object detection algorithms have significantly improved the performance of Automatic Target Recognition (ATR) systems.

- **Transformer Modules with YOLOv5:** These modules have shown promising results in real-time underwater object detection.[1]
- **Enhanced YOLOv7 Approach:** This approach effectively detects small objects in noisy and low-resolution underwater images. [2]
- **AUV Real-Time Detection:** This method enables real-time object detection, allowing for efficient and accurate target recognition during missions.[3]

Recent advancements in SLAM algorithms have significantly improved underwater mapping capabilities.

- **Dense Subframe-based SLAM with Side-scan Sonar**: This framework improves the accuracy of AUV pose trajectory and reconstructs quasi-dense bathymetry of the seafloor.[4]
- **Fully-Automatic Side-Scan Sonar SLAM Framework:** This method generates detailed maps of the seafloor by integrating optimized image processing, robust data association, and graph-based SLAM optimization techniques.[5]




Detection results of targets in the seabed [1]

## CONTRIBUTIONS

This research aims to develop a system that accurately detects and maps marine debris on the seabed by utilizing advanced object detection algorithms, ensuring precise AUV localization through SLAM, and integrating these methods into an effective underwater detection and mapping solution.

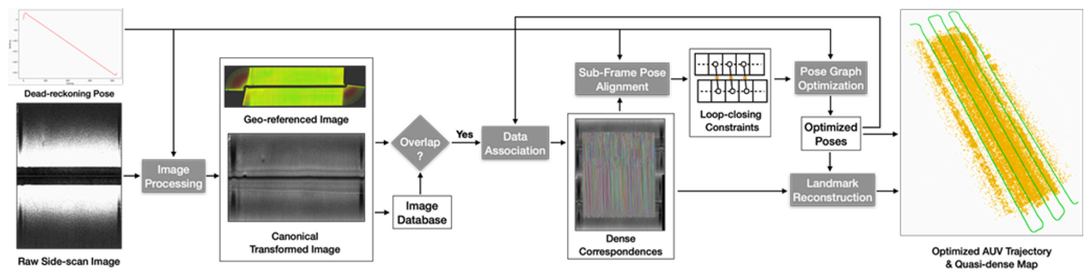
Thesis overiew:

**Phase 1:**

- Implementing methods for detecting marine litter based on [1][2][3], and evaluating these methods to determine the most effective approach.
- Implementing SLAM techniques discussed in [4][5], and evaluate the methods for accuracy and efficiency.
- Integrating the chosen detection method with the selected SLAM techniques and evaluating the performance of the system.

**Phase 2:**

- Testing the algorithm using synthetic data and evaluating its performance.
- Testing the algorithm using real data and evaluating its performance.




Overview of the subframe-based side-scan sonar SLAM framework [4]

## REFERENCES

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3. Tang, Y., Wang, L., Jin, S., Zhao, J., Huang, C., & Yu, Y. (2023). AUV-based side-scan sonar real-time method for underwater-target detection. Journal of Marine Science and Engineering, 11(4), 690.
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