

Master's, Bachelor's and Project Theses in the Field of: **Ship Detection in Optical and SAR Satellite Images**

Topic Description

Maritime monitoring increasingly uses optical satellite images and Synthetic Aperture Radar (SAR) data. Optical images show ship shape, colour and context, but are affected by clouds, haze, shadows and changing illumination. SAR uses active radar and can be acquired independently of daylight and largely independently of cloud cover. For AI models, however, SAR images remain challenging: grainy patterns, geometric distortions and bright reflections from coasts, waves or ports can create false alarms.

This topic investigates data-driven and deep-learning methods for detecting or classifying ships in optical, SAR or fused satellite data. Relevant challenges include small targets, arbitrary orientation, near-shore false alarms, inconsistent labels and partial occlusions caused by clouds, sea state or infrastructure. Beyond accuracy, the focus is on understanding when models fail under realistic conditions.



Possible Thesis Directions

Possible theses may analyse, improve and compare existing machine-learning models on public or project-related datasets. Directions include benchmarking, robust detection under image disturbances, classification under domain shifts between optical and SAR data, or studies of offshore, inshore and harbour scenes.

Depending on the degree level and prior knowledge, the focus may be robustness measurement and improvement, explainable AI, uncertainty quantification, SAR-optical fusion, oriented bounding boxes or lightweight models. The thesis should provide methodological insight and practical guidance for robust maritime monitoring.

- 1) **Model analysis and benchmarking:** compare classification or detection models under optical and SAR-specific disturbances.
- 2) **Robust and trustworthy AI:** investigate augmentation, domain adaptation, explainable AI, uncertainty estimation or SAR-optical fusion.

Requirements

- Interest in computer vision, remote sensing and maritime applications
- Beneficial: Python/PyTorch, object detection, image datasets and robust evaluation

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Start

by arrangement