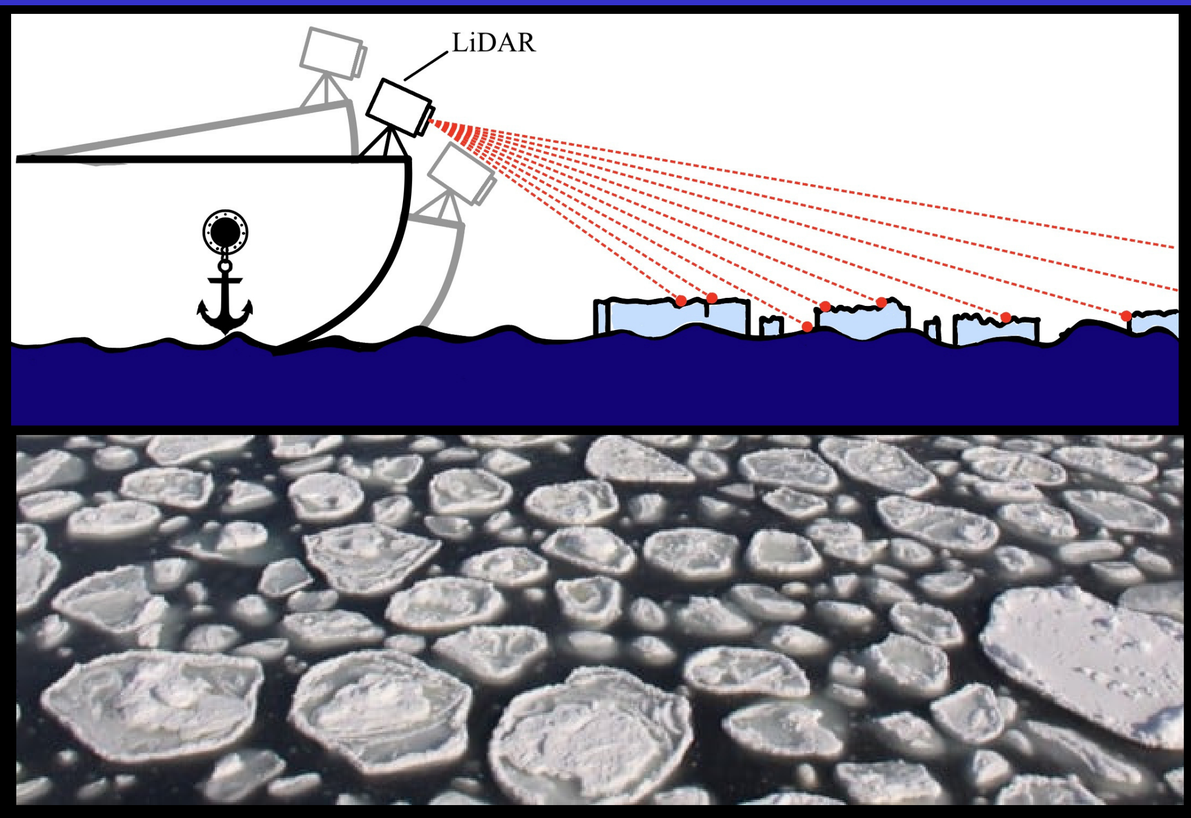
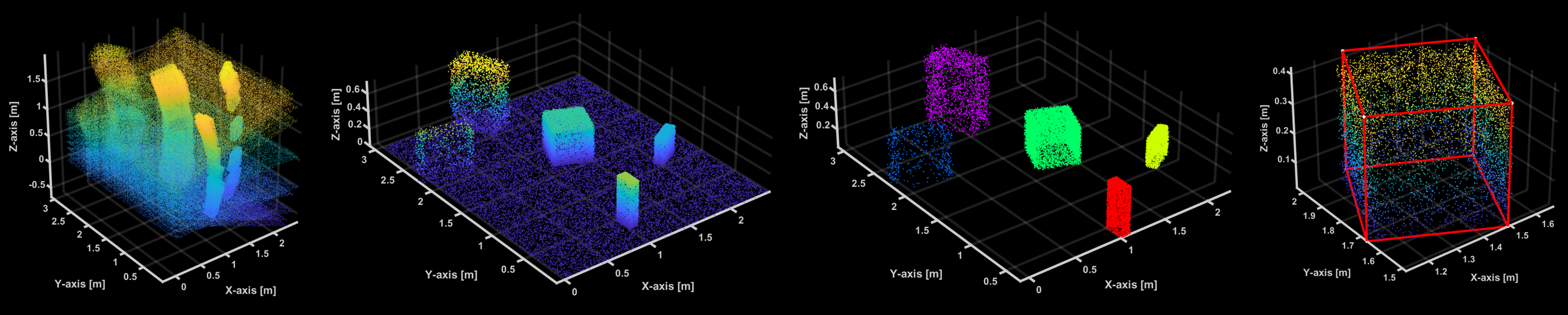
Ice floe size and shape characterisation from LiDAR scans

Background and Objectives

The Antarctic Marginal Ice Zone's sea ice is pivotal for numerous ecosystems and global temperature regulation. Understanding the formation and behaviour of ice floes in this region is essential for its future protection. Employing a ship-mounted LiDAR sensor can be used to track this behaviour, albeit with challenges like ship movement during data acquisition. This project aims to develop the first iteration of a processing pipeline to counter this motion, enabling the extraction of ice floe size and shape parameters.



How does the pipeline work?



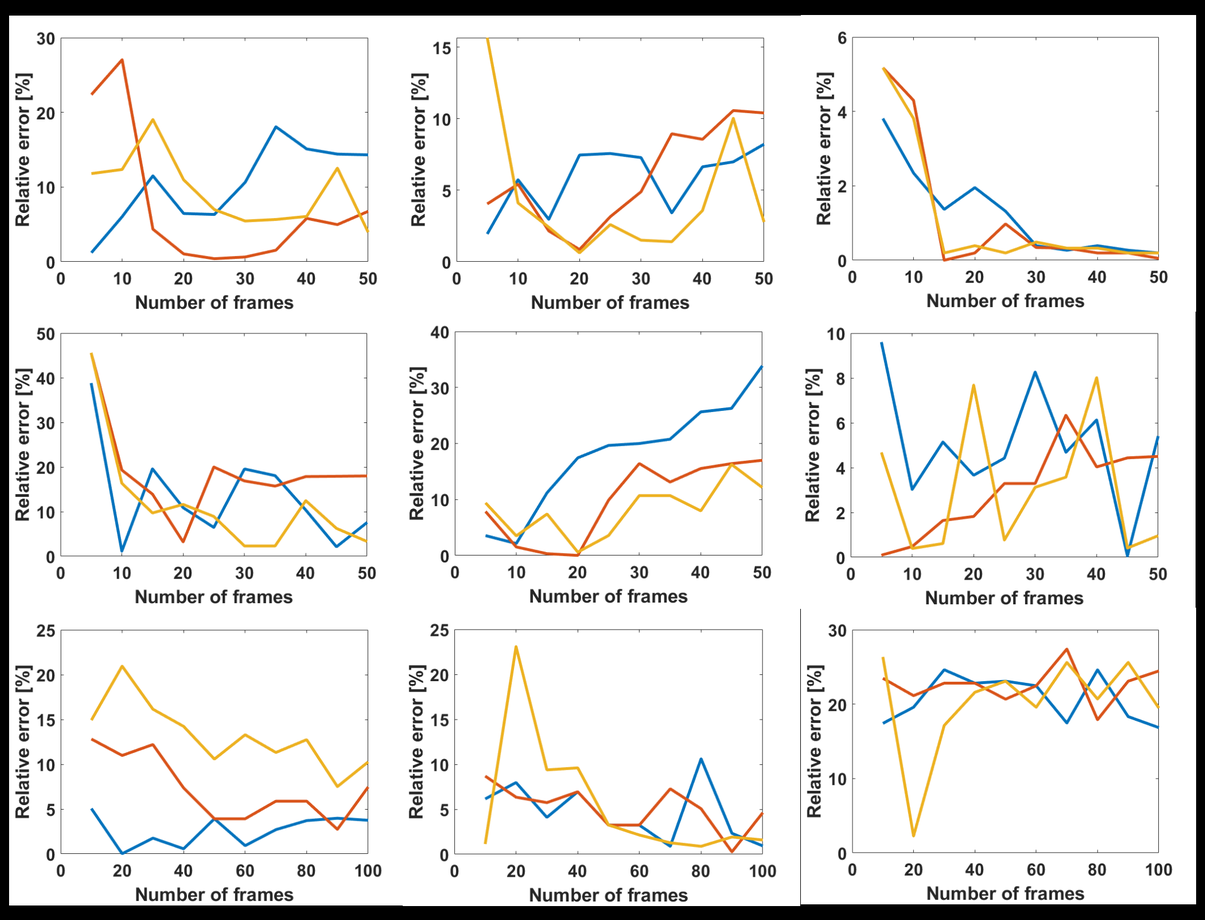
Compensate for the motion by using an ICP algorithm with an initial transformation from an IMU to register point cloud frames

→ Remove the ground plane using RANSAC and separate the objects using Euclidean clustering

→ Select an object, apply a filter, estimate a rectangular model and extract its dimensions

Results

Static, dynamic and range experiments tested the accuracy of estimates using mild, medium, or aggressive filters and varying concatenated frame counts.



Conclusions

In experiments on stationary and moving targets, a medium filter processing around 20 point cloud frames minimized relative error, though its effectiveness dropped at greater distances. Performance improved with more frames, addressing point cloud sparsity at these extended ranges. The mild filter outperformed others in relative error at greater distances, where angular error also caused ground plane points to evade the RANSAC algorithm, a problem exacerbated by imperfect point cloud registration. The project successfully initiated a processing pipeline for Antarctic sea ice characterization, providing a basis for future work.

GitHub Repo

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