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https://github.com/SamiraLashkari/BeamImager

Automatic detection of seaweed and mussels in the water column using Python scripts

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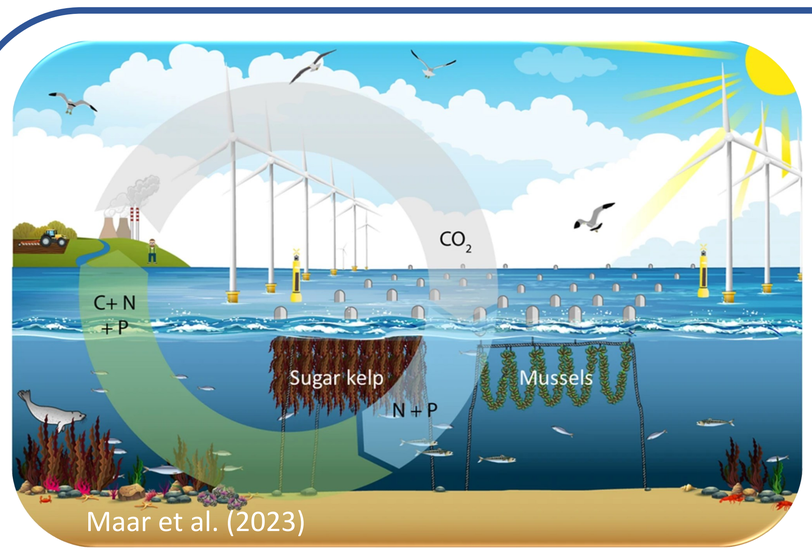
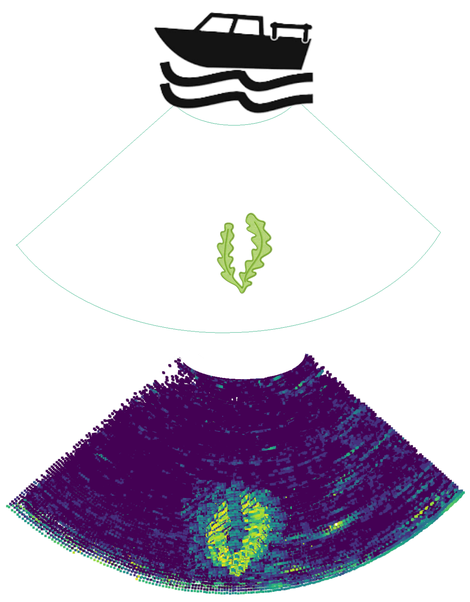
Introduction

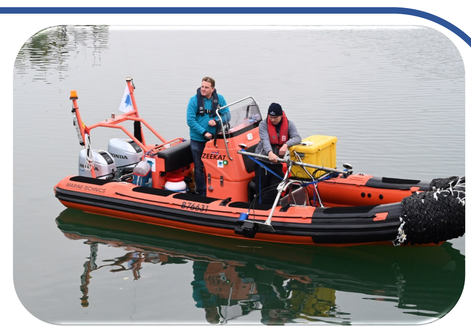


Integrating of aquaculture installations within windmill farms, maximizing the utility of marine space.



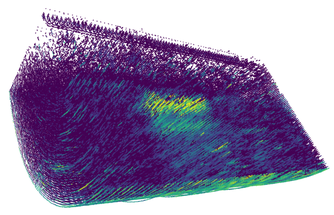
Using multibeam water column data has shown great potential for monitoring fish, marine mammals, geological features and oceanographic phenomena, e.g. Schimel et al. (2020) and Colbo et al. (2014).

In our study, multibeam water column data were collected with a portable Norbit WBMS multibeam system, installed over-the-side on a RHIB. Water column data were collected at 15 Hz, the maximum ping rate allowed by the system, while sailing at 2-3 knots. Both Qinsy (QPS) and NavAQ (BeamWorx) have been used as acquisition software.

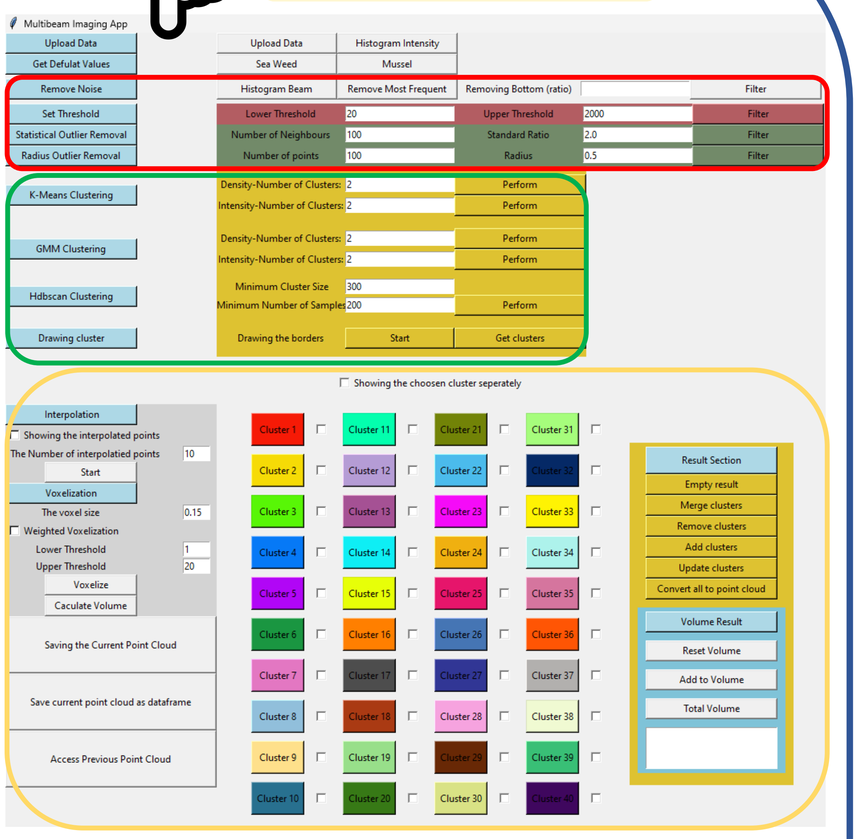


Methods

Raw Data → Processing: • AutoClean • Qimera → • X, Y, Z and intensity • Ping number • Beam data → Conversion: Open3d library in Python → 3D Point Cloud

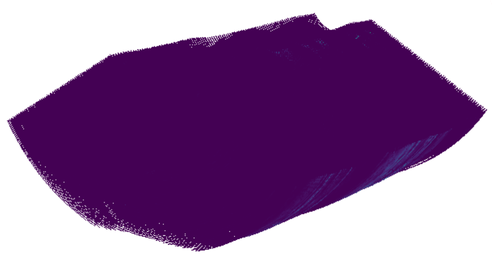


Ask me for a demo!

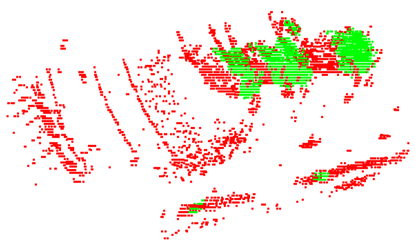


Graphical User Interface: Data can be loaded, and users can configure parameters for each step (filtering, clustering & volume calculation) to initiate the process. Once optimal parameters are determined through testing, they can be set as defaults for seaweed and mussel analysis.

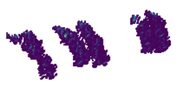
Entire point cloud



Outlier removal
Red: remove
Green: retain



Result



Filtering

Noise Removal:
- Removing the highest bins of beam histogram (background noise).
- Data close to seafloor (contain more noise) are removed (percentage).

Thresholding: Filtering the point cloud based on intensity values. Low-intensity scatters (water itself) were eliminated, and aquaculture instal-lations retained.

Outlier removal: statistical removal of outliers and radius outlier detection. Points with few neighboring points are deleted

Clustering

K-means clustering: Grouping points into a predefined number of clusters based on their proximity to centers or intensity.

AND OR

Gaussian Mixture Model clustering: Assigning points to clusters by modeling data as probability-mixture distributions. Number of clusters is predefined.

AND OR

Hdbscan clustering: Automatically identifying clusters based on the varying shapes and densities present in a dataset.

Volume Calculation

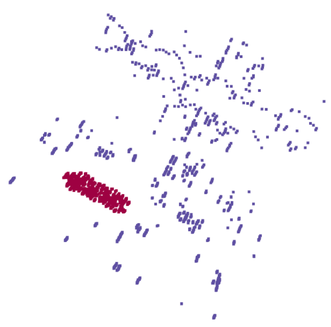
Generating results: Individual clusters can be removed, merged or retained

Interpolation: Increasing the density of points within clusters

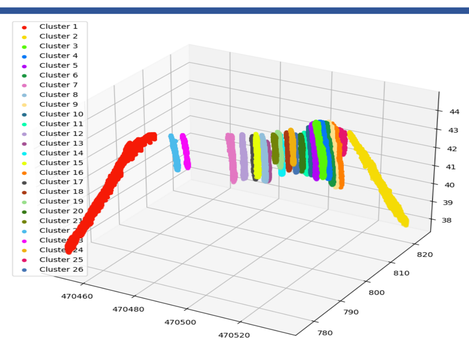
Voxelization: Clusters volumes are calculated using weighted voxelization. Each voxel his weight is based on its point density.

Results

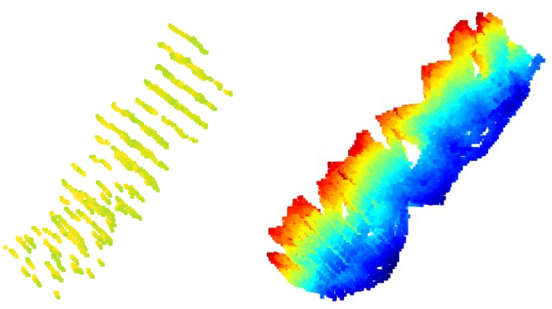
- Removed
- Retained (seaweed)



Filtering: The point clouds were filtered according to the intensity, followed by the removal of outliers using statistical methods.



Clustering: The detection and segmentation of dropper lines of mussels as separate clusters. This segmentation enables the calculation of the volume for each dropper line individually.



Volume Calculation: One cluster of seaweed is visualized before (left) and after (right) interpolation. The denser point cloud allows calculating more precise volumes.

References:

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- Schimel, A.C.G.; Brown, C.J.; Ierodiaconou, D. Automated Filtering of Multibeam Water-Column Data to Detect Relative Abundance of Giant Kelp (*Macrocystis pyrifera*). *Remote Sens.* **2020**, *12*, 1371. https://doi.org/10.3390/rs12091371
- Colbo, K.; Ross, T.; Brown, C.J.; Weber, T. A review of oceanographic applications of water column data from multibeam echosounders. Estuar. Coast. Shelf Sci. **2014**, 145, 41–56.

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