Open-Set Semantic Mapping and Localization

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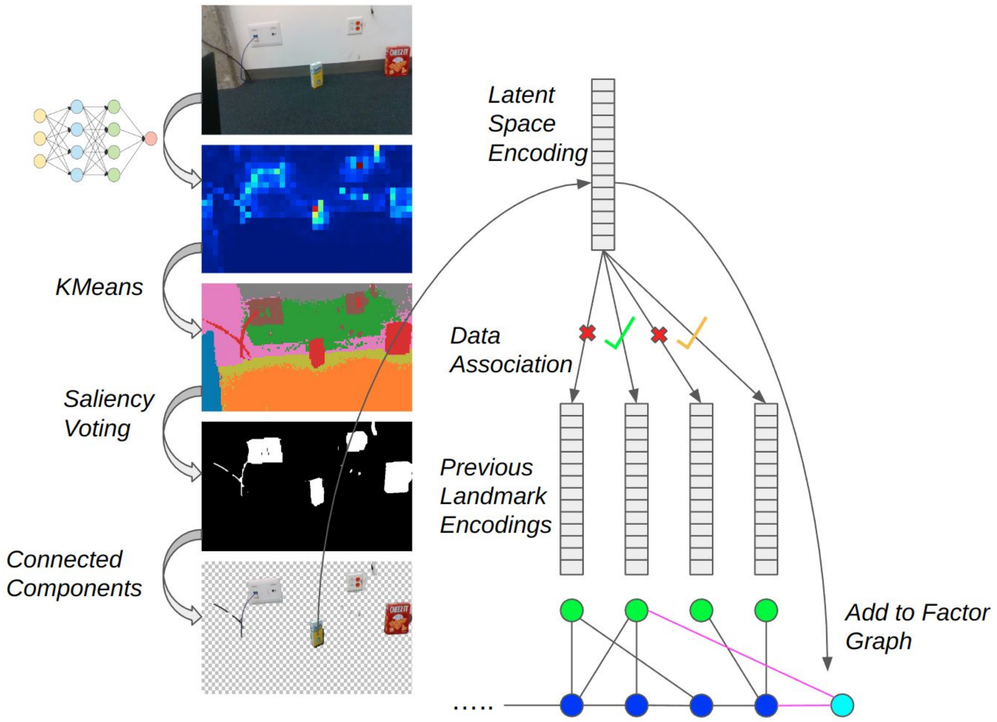
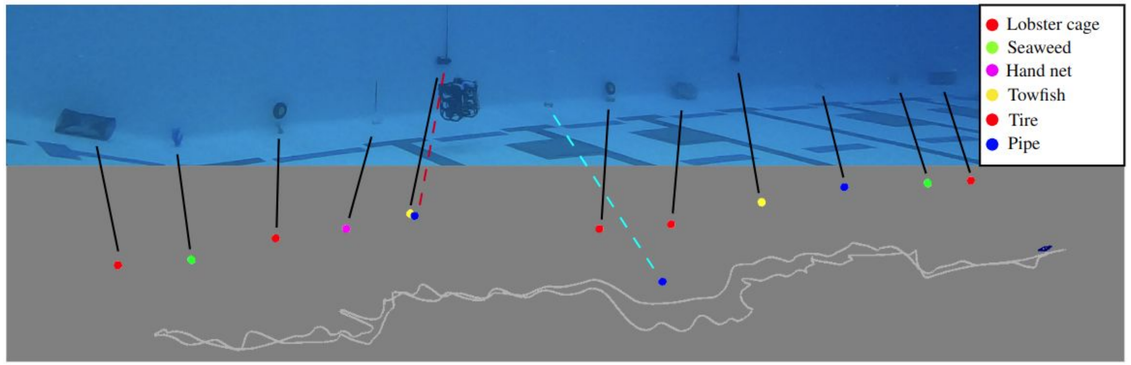
Motivation

- Existing semantic mapping systems are either closed-set (can only detect objects seen in training data) or dense (reasoning at the pixel/feature level rather than object level)
- The goal of this work is to create a method to leverage visual foundation models to build object-level maps while simultaneously enabling robotic systems to robustly localize themselves with such maps

Method



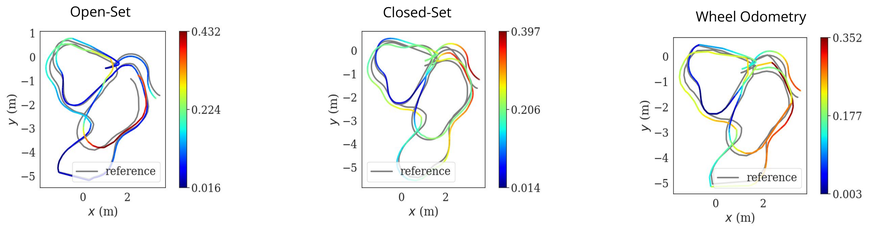
Results



The proposed method has enabled object-level mapping in underwater scenarios, where there is a dearth of labeled training data, and where dense methods fail due to on-board memory requirements. Localization accuracy improves compared to feature-tracking methods, as feature-tracking methods are not robust to underwater lighting effects.

Dataset	Ours (ML)	Ours (EM)	Ours (MM)	Closed Set	Geometric Only (ML)	Wheel odometry only
Pioneer SLAM	**0.139**	0.184	0.197	0.180	0.180	0.202
Pioneer SLAM 2	**0.231**	0.342	0.341	0.602	0.472	0.341

Average pose error in meters. The method is evaluated on a public dataset (TUM), demonstrating that our method is able to mitigate odometric drift more effectively than closed-set and geometric methods.



Please visit the project pages below for the full papers, videos, data, and code!

LOSS-SLAM: Lightweight Open-Set Semantic Localization and Mapping

Opti-Acoustic Semantic SLAM with Unknown Objects in Underwater Environments