Collaborative Research: NRI: INT: Cooperative Underwater Structure Inspection and Mapping

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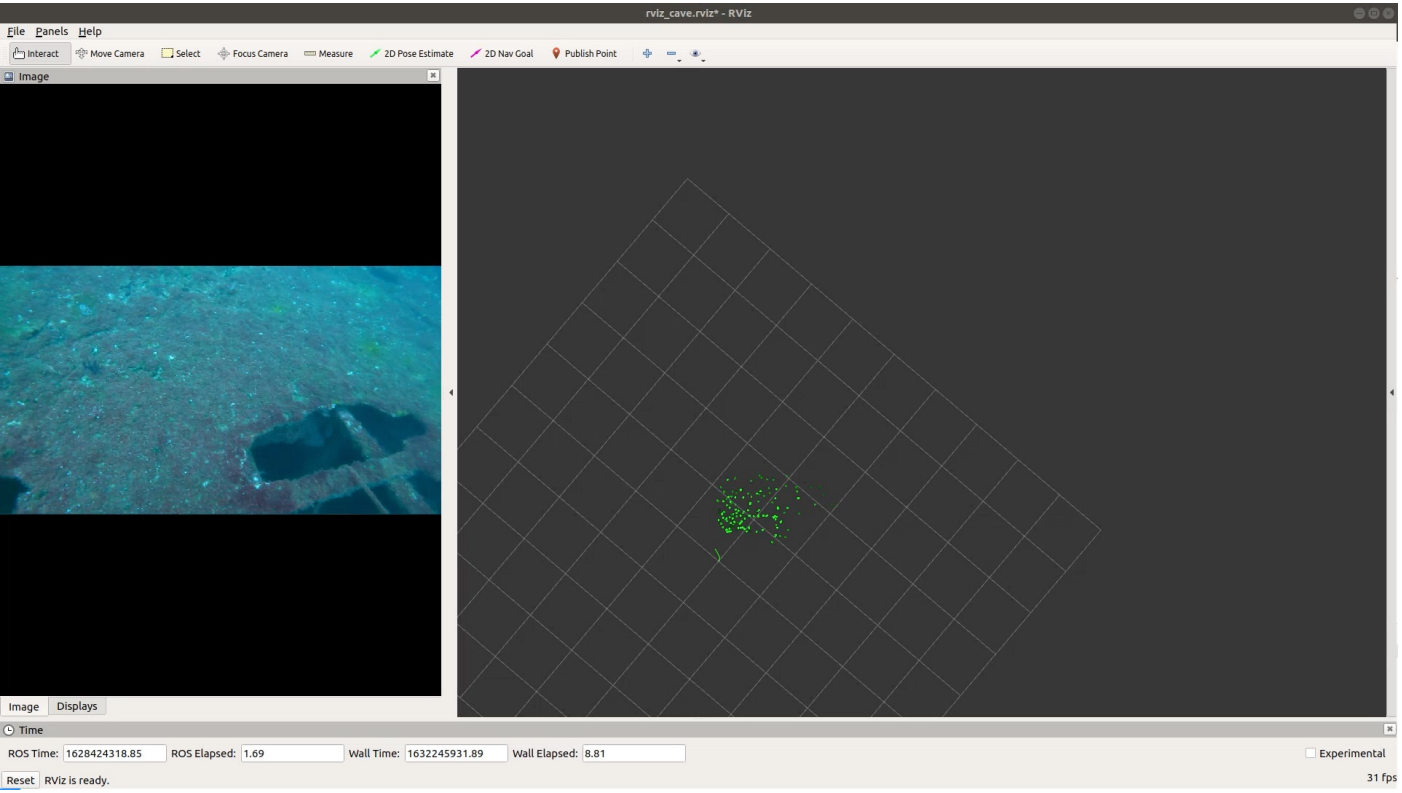


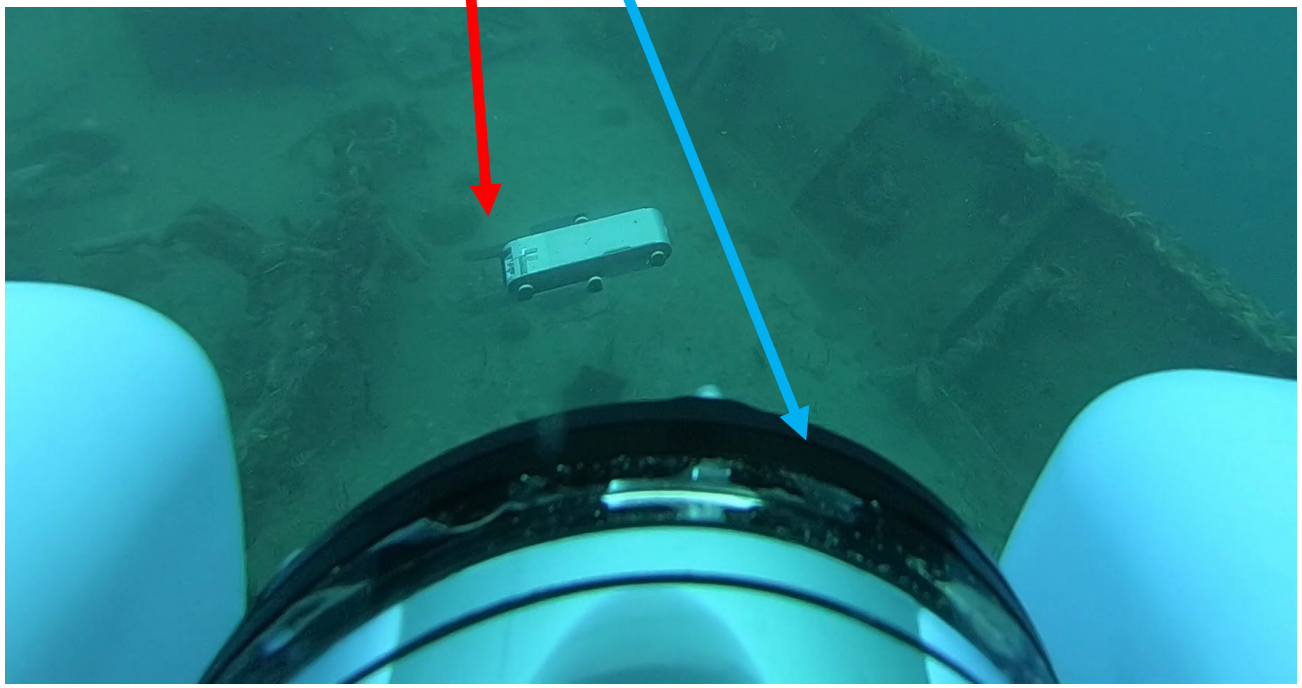
B. Joshi, et al. High Definition, Inexpensive, Underwater Mapping. ICRA, 2022

NSF awards 2024741, 2024541, and 2024653

Overview

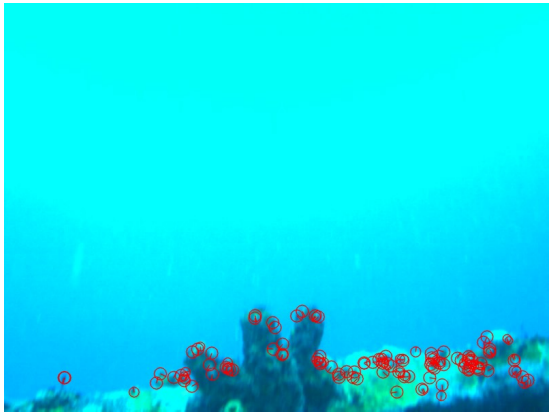
Team of robots explore an underwater structure

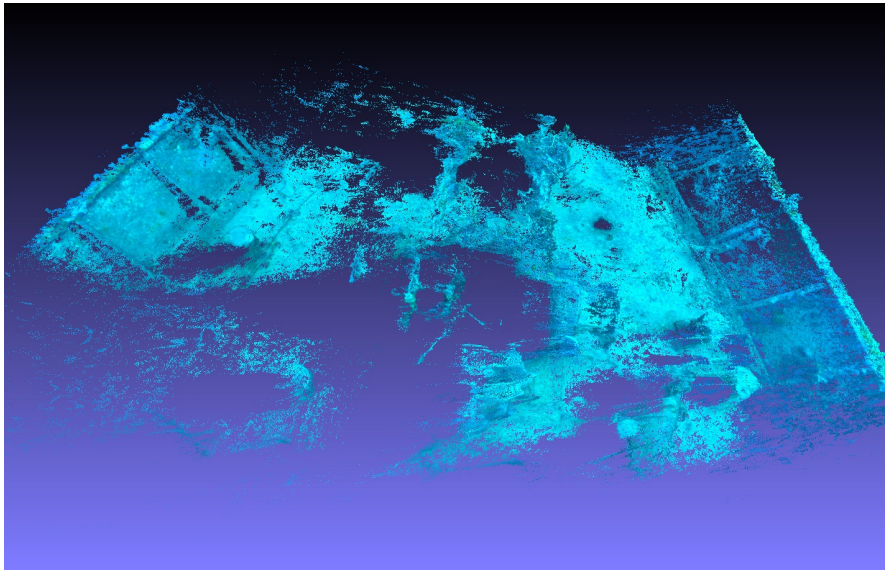
- Robots operate near the wreck (*Proximal Observers*) -- Detailed mapping
- Robots operate from a distance (*Distal Observers*) -- Overview of the situation

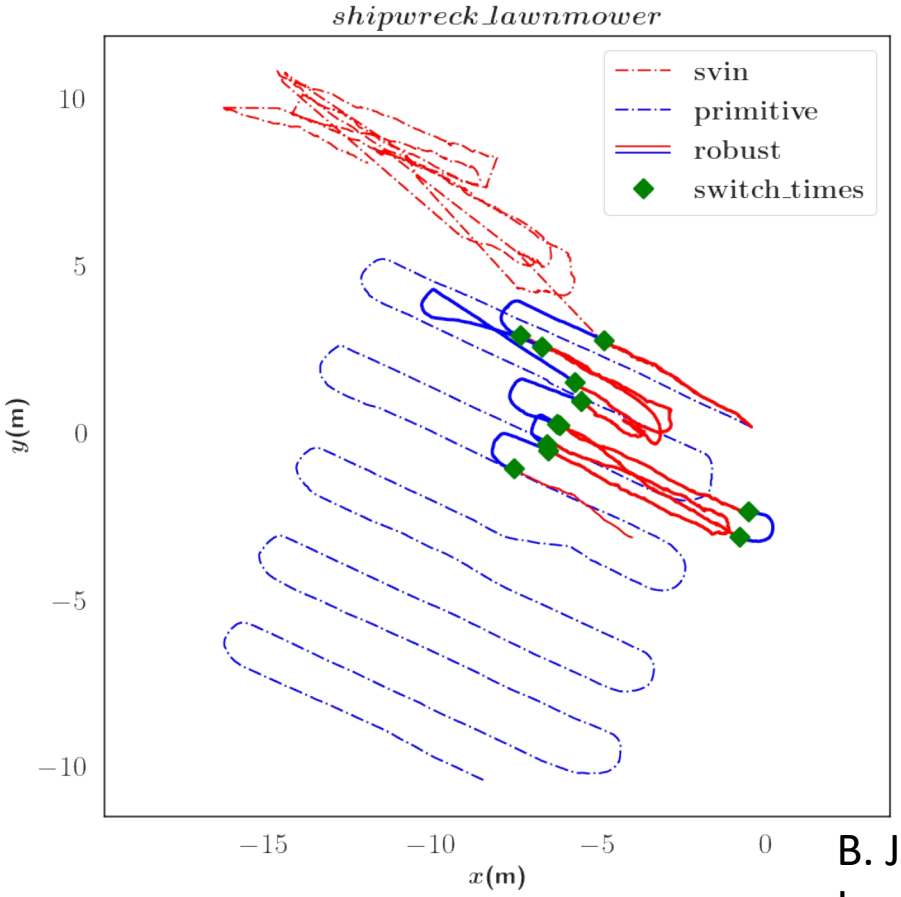


Robust State Estimation for AUVs

Robust to VIO failures by switching to a model based odometry





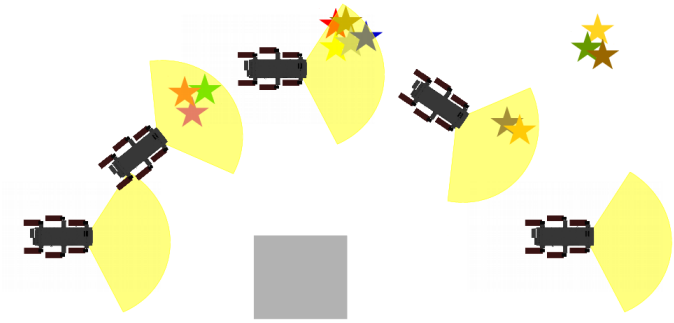


B. Joshi, et al. Robust Switching Model-based/Visual Inertial Odometry for an Autonomous Underwater Vehicle. RAL/IROS 2022 (under review).

Perception-aware navigation

AquaVis – Path optimization framework

- observing visual objectives
- safely avoiding obstacles



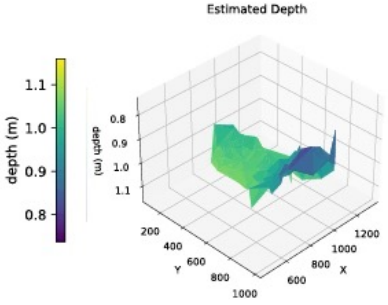
M. Xanthidis et al. “AquaVis: A Perception-Aware Autonomous Navigation Framework for Underwater Vehicles”. IROS 2021

Inexpensive 3D reconstruction

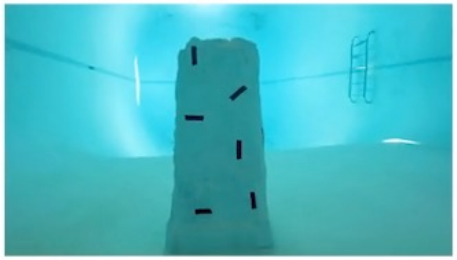
Non-stationary photometric stereo:

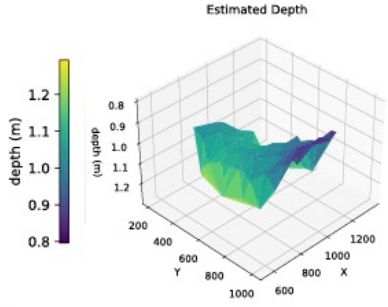
- Estimate object' surface normal by observing changes in surface points' reflected light intensities
- Camera's position tracking and pixel matching

(a-1)
1st loop



(a-2)
2nd loop





(H: 0.94 m x L: 0.51 m x W: 0.49 m)

M. Roznere and A. Quattrini Li. Photometric Stereo for Non-Stationary Underwater Robots. IROS 2022 (under review).

Future work

- Exploration strategies for the Proximal Observer
- Distal Observer moves to see the proximal observer and the wreck
- Limited acoustic communications

Aqua2 AUV with USBL