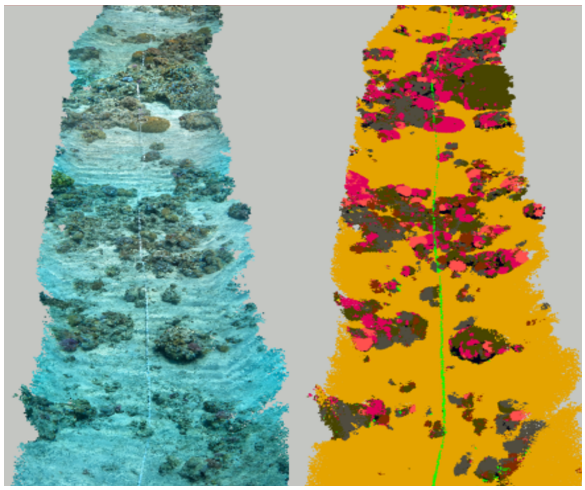
3D Computer Vision for Underwater Videos of Reefs

At ECEO, we are developing a new method for monitoring coral reefs from underwater videos [2]. Videos from coral reef sites collected as part of the Transnational Red Sea Center's expeditions in Israel, Jordan, and Djibouti. The videos are analyzed using frame-wise semantic segmentation, and simultaneous localization and mapping (SLAM) is used to create 3D point clouds from reef sites visited, where each point has both its RGB color and its semantic class (e.g. Rock, Sand, Live Coral, Dead Coral, etc.) attached. The ease with which such videos can be collected promises to increase the scalability of coral reef monitoring methods by an order of magnitude.



In this project, the aim of the student is to test the absolute newest deep-learning-based 3D mapping approaches on our large dataset of underwater videos. In particular, the student would test the feasability of approaches like Ace0 [1], FlowMap [3], and Dust3r [4] to large-scale underwater mapping. There are particular challenges to underwater mapping, namely the diffractive geometry leading to challenging intrinsics calibration, and the color of the scene changing as a function of the distance.

This project is aimed at students that are proficient in Python and have some background in machine learning. Experience with deep learning and PyTorch, as well as with 3D vision is beneficial.

Contact

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References

[1] Eric Brachmann, Jamie Wynn, Shuai Chen, Tommaso Cavallari, Áron Monszpart, Daniyar Turmukhambetov, and Victor Adrian Prisacariu. Scene coordinate reconstruction: Posing of image collections via incremental learning of a relocalizer. *arXiv preprint arXiv:2404.14351*, 2024.

[2] Jonathan Sauder, Guilhem Banc-Prandi, Anders Meibom, and Devis Tuia. Scalable semantic 3d mapping of coral reefs with deep learning. *Methods in Ecology and Evolution*, 2024.

[3] Cameron Smith, David Charatan, Ayush Tewari, and Vincent Sitzmann. Flowmap: High-quality camera poses, intrinsics, and depth via gradient descent. In *arXiv*, 2024.

[4] Shuzhe Wang, Vincent Leroy, Yohann Cabon, Boris Chidlovskii, and Jerome Revaud. Dust3r: Geometric 3d vision made easy. *arXiv preprint arXiv:2312.14132*, 2023.

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