

Challenges in Underwater Photogrammetry-based Coral Image Instance Segmentation

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Coral reefs, crucial ecosystems facing degradation due to global warming, have become a focal point of scientific interest. While underwater image-based semantic segmentation has been the primary focus for coral reef classification in underwater photogrammetry imagery, instance segmentation offers additional valuable information, such as the number and size of different coral colonies, which semantic segmentation cannot provide. However, underwater photogrammetry-based coral image instance segmentation presents significant challenges due to poor image quality, occlusions, morphological variability, limited training data, lack of ground truth, class imbalance, and the lack of standardization in data acquisition. Specifically, Underwater images suffer from low visibility, color distortion, and backscatter, making accurate segmentation difficult. Occlusions and overlapping of corals further complicate the task. The scarcity of annotated data and the diverse morphologies of coral reefs hinder the training of robust segmentation algorithms. Class imbalance, with fewer coral instances compared to the background, biases segmentation models. Additionally, the absence of standardized protocols for image capture introduces variations in datasets.

Addressing these challenges requires the development of robust algorithms capable of handling underwater image characteristics, larger and more diverse annotated datasets, and collaboration among researchers, domain experts, and photographers to standardize data collection and share best practices. In this paper, we propose a novel multi-modality instance segmentation method based on underwater seabed imagery, which will assist oceanographers in revealing the truth of coral growth beneath the ocean. By overcoming the challenges and advancing instance segmentation techniques, we can enhance our understanding of coral reef dynamics and aid in their conservation efforts.

Keywords: Underwater photogrammetry; coral images; Instance segmentation; Coral reefs