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Automated Segmentation and Classification of Coral using Fluid Lensing from Unmanned Airborne Platforms

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Abstract Text:

In recent years, there has been a growing interest among biologists in monitoring the short and long term health of the world's coral reefs. The environmental impact of climate change poses a growing threat to these biologically diverse and fragile ecosystems, prompting scientists to use remote sensing platforms and computer vision algorithms to analyze shallow marine systems. In this study, we present a novel method for performing coral segmentation and classification from aerial data collected from small unmanned aerial vehicles (sUAV). Our method uses Fluid Lensing algorithms to remove and exploit strong optical distortions created along the air-fluid boundary to produce cm-scale resolution imagery of the ocean floor at depths up to 5 meters. A 3D model of the reef is reconstructed using structure from motion (SFM) algorithms, and the associated depth information is combined with multidimensional maximum a posteriori (MAP) estimation to separate organic from inorganic material and classify coral morphologies in the Fluid-Lensed transects. In this study, MAP estimation is performed using a set of manually classified 100 x 100 pixel training images to determine the most probable coral classification within an interrogated region of interest. Aerial footage of a coral reef was captured off the coast of American Samoa and used to test our proposed method. 90 x 20 meter transects of the Samoan coastline undergo automated classification and are manually segmented by a marine biologist for comparison, leading to success rates as high as 85%. This method has broad applications for coastal remote sensing, and will provide marine biologists access to large swaths of high resolution, segmented coral imagery.

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