Morphological Image Recognition of Deep Water Reef Corals

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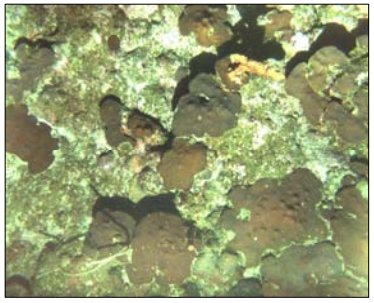


Original color image

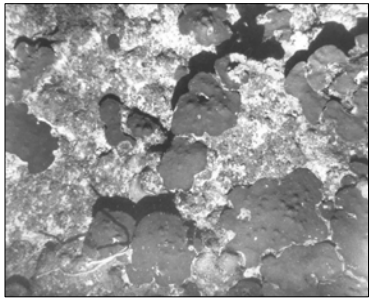
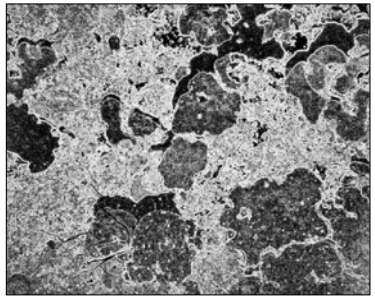


Image Converted to grayscale



Morphological Gradient (MG) intensity "texture" patterns

Introduction

Deep water coral reefs (30-100m) could shelter commercial fish stocks and provide coral larvae for recovering shallow reefs. Deep corals appear healthier than shallow corals, but depth has restricted their study. Current quantitative study methods involve scattering random points across images and visually identifying substrates.

Montastrea annularis complex is a major reef building coral representing as much as 75% of the coral cover in some areas. Its dominance and smooth texture make it an ideal candidate for image processing. The goal of this research was to develop an algorithm to segment out colonies of the *M. annularis* complex and calculate percent coverage values

Methods

Images taken by the SeaBED Autonomous Underwater Vehicle (AUV) off the Hind Bank, U.S. Virgin Islands, were analyzed with the existing random point method and the algorithm. A description of the algorithm's recognition process is shown to the left and below.

Results

Algorithm accuracy was measured using the mean of the first 15 ASF iterations, and improved exponentially with actual percent cover (Figure 1). Percent cover values generated by the algorithm (Figure 2) are competitive with those obtained using the random point method.

Discussion

Degraded coral is compensated for by misidentified substrate in the percent cover calculations. This compensation explains why error remains high while percent cover remains comparable to the random point method.

This algorithm is basic and has room for more specialized recognition strategies. Future work will involve identification of multiple species with an ultimate goal of calculating diversity and species richness.

Acknowledgments

This research was made possible by the Guest Student Program at Woods Hole Oceanographic Institution (WHOI) and the continued collaboration between WHOI and the University of Puerto Rico

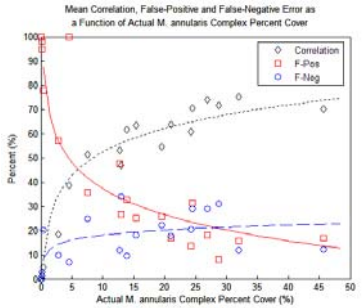


Figure 1. Mean correlation, false-positive and false-negative error

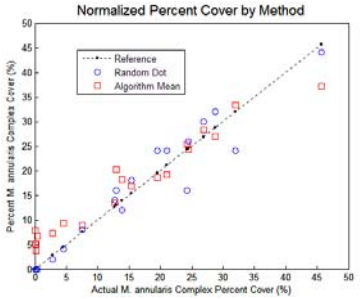
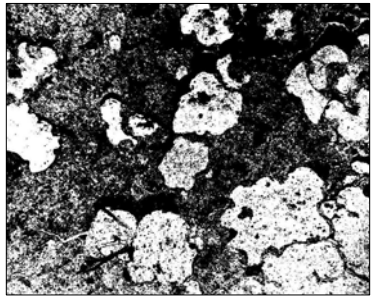
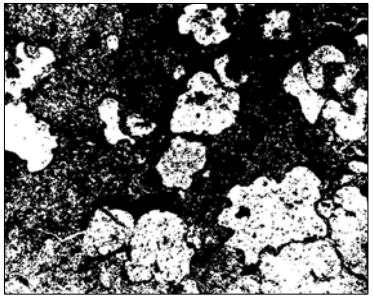
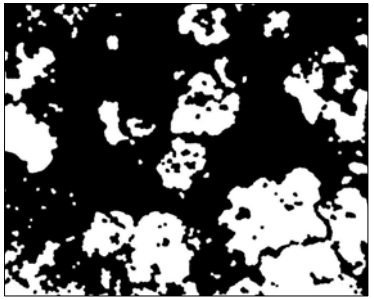


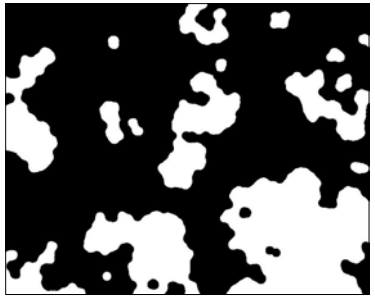
Figure 2. Algorithm mean and random point method normalized against actual percent cover



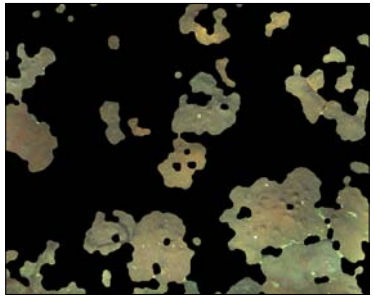
MG threshold with subtracted light and dark regions







An open-close Alternating Sequence Filter (ASF) removes salt-and-pepper noise. Each successive iteration removes particles of a larger diameter. One, five, and fifteen iterations are shown.



Original image superimposed over recognized areas