Semantic Segmentation of Underwater Sonar Imagery based on Deep Learning

Maryam Rahnemoonfar
Texas A&M University-Corpus Christi

Extensive degradation of seagrass beds is taking place in coastal areas around the globe because of natural and human induced disturbances. These negative impacts affect approximately 65% of the original seagrass communities, mainly in Europe, North America, and Australia. Mapping of seagrass degradation due to natural and human disturbances such as potholes and propeller scars is essential to estimating overall abundance, disturbance regimes, and the overall health of related marine systems.

It is difficult to detect seagrass disturbances under water with optical sensors because light is attenuated as it passes through the water column and reflects back from the benthos causing errors in calculations. Underwater acoustic techniques have allowed many advances in the field of remote sensing and these techniques can be used to produce a high-definition, 2-D sonar image of seagrass ecosystems. In this study we use sonar sensors for pattern identification in seagrass.

Recent years have witnessed enormous advancement in the pattern recognition research based on deep learning. Majority of deep learning methods are developed for RGB imagery. However, for many applications such as detecting objects underwater other types of sensors such as sonar or radar are required. Here we developed a new deep learning framework based on Dilated Convolution and Inception Densenet to perform semantic segmentation for automatic extraction of potholes in underwater sonar imagery. Side scan sonar images usually contain speckle noise and uneven illumination across the image. Moreover, disturbance presents complex patterns where most segmentation techniques will fail. We tested our proposed approach on a collection of underwater sonar images taken from Laguna Madre in Texas. Experimental results in comparison with the ground-truth and state-of-the-art semantic segmentation methods show the efficiency and improved accuracy of our proposed method.