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Abstract

The labeling of Environmental Microorganisms (EM) which help decomposing pollutants, plays a fundamental role for establishing sustainable ecosystem. We propose an environmental microorganism classification engine that can automatically analyze microscopic images using *Conditional Random Fields* (CRF) and *Deep Convolutional Neural Networks* (DCNN). First, to effectively represent scarce training images, a DCNN pre-trained for image classification using a large amount of data is re-purposed to our feature extractor that distils pixel-level features in microscopic images. In addition, pixel-level classification results by such features can be refined using global features that describe the whole image *in toto*. Finally, our CRF model localizes and classifies EMs by considering the spatial relations among DCNN-based features, and their relations to global features. The experimental results have shown 94.2% of overall segmentation accuracy and up to 91.4% mean average precision of the results.

Keywords: Environmental Microorganism; Conditional Random Fields; Global Feature Extraction; Image Classification; Image Segmentation

1. Introduction

Recent decades, due to industrialization, we can observe a growing number of pollutants like waste water entering the human environment. This increases

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