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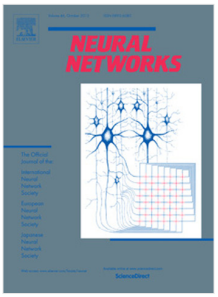

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Land Cover Classification from Multi-temporal, Multi-spectral Remotely Sensed Imagery using Patch-Based Recurrent Neural Networks

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Abstract

Environmental sustainability research is dependent on accurate land cover information. Even with the increased number of satellite systems and sensors acquiring data with improved spectral, spatial, radiometric and temporal characteristics and the new data distribution policy, most existing land cover datasets are derived from a pixel-based, single-date multi-spectral remotely sensed image with an unacceptable accuracy. One major bottleneck for accuracy improvement is how to develop an accurate and effective image classification protocol. By incorporating and utilizing multi-spectral, multi-temporal and spatial information in remote sensing images and considering the inherit spatial and sequential interdependence among neighboring pixels, we propose a new patch-based recurrent neural network (PB-RNN) system tailored for classifying multi-temporal remote sensing data. The system is designed by incorporating distinctive characteristics of multi-temporal remote sensing data. In particular, it uses multi-temporal-spectral-spatial samples and deals with pixels contaminated by clouds/shadow present in multi-temporal data series. Using a Florida Everglades ecosystem study site covering an area of 771 square kilometers, the proposed PB-RNN system has achieved a significant improvement in the classification accuracy over a pixel-based recurrent neural network (RNN) system, a pixel-based single-image neural network (NN) system, a pixel-based multi-image NN system, a patch-based single-image NN system, and a patch-based multi-image NN system. For example, the proposed system achieves 97.21% classification accuracy while the pixel-based single-image NN system achieves 64.74%. By utilizing methods like the proposed PB-RNN one, we believe that much more accurate land cover datasets can be produced over large areas.

Keywords: Patch-based RNNs, LSTMs, Deep learning, Multi-temporal remote sensing imagery, Spatial Context, Land cover classification

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