A Novel Convolutional Neural Network Random Forest Hybrid Model to Aid in the Identification of Tree Species Using Multispectral and LiDAR Data

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Remote sensing technologies have revolutionized the ability to detect and classify tree species. This is vital for sustainable management and conservation, and especially early detection and prevention of invasive species. It is a cost-effective alternative to traditional manual data collection. In this study, multispectral and LiDAR data were used to classify 8 tree species in two local areas using machine learning. To do this, a convolutional neural network (CNN) and random forest (RF) hybrid model was proposed. The motivation of this model is to extract lower level features with the CNN and use the superior classification abilities of the RF to generate predictions. Past papers using a version of this model simply used values from the last layer of the CNN (after the softmax function), which could potentially reduce the classification strength of the RF. Classification was done using aerial RGB imagery with a 1 meter spatial resolution. The model's performance was evaluated against five other models, and analysis showed that the proposed method was able to classify trees with an accuracy of 97%, outperforming the other algorithms. Overall, this study not only provides an effective way to classify trees, but in general a novel application of random forests to aggregate features extracted using convolutional kernels. In future, LiDAR-derived metrics may be used as a more robust way to gather structural information, and, in general, CNN-RF may be applied to many other problems where aggregation of independent features may aid in classification, or possibly regression (meteorology, medical imaging, etc.).

Awards Won:

National Geographic Society: Excellence in Geography and Geospatial Science Award

NC State College of Engineering: Scholarship to attend NC State Engineering Summer Camp