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Conference Abstract

Deep Learning for Forest Species Identification Based on Macroscopic Images

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Abstract

The fast and accurate identification of forest species is critical to support their sustainable management, to combat illegal logging, and ultimately to conserve them. Traditionally, the anatomical identification of forest species is a manual process that requires a human expert with a high level of knowledge to observe and differentiate certain anatomical structures present in a wood sample (Wiedenhoeft (2011)).

In recent years, deep learning techniques have drastically improved the state of the art in many areas such as speech recognition, visual object recognition, and image and music information retrieval, among others (LeCun et al. (2015)). In the context of the automatic identification of plants, these techniques have recently been applied with great success (Carranza-Rojas et al. (2017)) and even mobile apps such as Pl@ntNet have been developed to identify a species from images captured on-the-fly (Joly et al. (2014)). In contrast to conventional machine learning techniques, deep learning techniques extract and learn by themselves the relevant features from large datasets.

One of the main limitations for the application of deep learning techniques to forest species identification is the lack of comprehensive datasets for the training and testing of convolutional neural network (CNN) models. For this work, we used a dataset developed at the Federal University of Parana (UFPR) in Curitiba, Brazil, that comprises 2939 images in JPG format without compression and a resolution of 3.264 x 2.448 pixels. It includes 41

different forest species of the Brazilian flora that were cataloged by the Laboratory of Wood Anatomy at UFPR (Paula Filho et al. (2014)). Due to the lack of comprehensive datasets world wide, this has become a benchmark dataset in previous research (Paula Filho et al. (2014), Hafemann et al. (2014)).

In this work, we propose and demonstrate the power of deep CNNs to identify forest species based on macroscopic images. We use a pre-trained model which is built from the resnet50 model and uses weights pre-trained on ImageNet. We apply fine-tuning by first truncating the top layer (softmax layer) of the pre-trained network and replacing it with a new softmax layer. Then we train again the model with the dataset of macroscopic images of species of the Brazilian flora used in (Hafemann et al. (2014), Paula Filho et al. (2014)).

Using the proposed model we achieve a top-1 98% accuracy which is better than the 95.77% reported in (Hafemann et al. (2014))using the same data set. In addition, our result is slightly better than the reported in (Paula Filho et al. (2014)) of 97.77% which was obtained by combining several conventional techniques of computer vision.

Keywords

Deep learning, Convolutional Neural Networks, Automated Species Identification

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