Application of Transfer Learning for Root Segmentation in Assessment of Plant Health

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Abstract

Minirhizotron imagery can be used to assess plant root health, and the amount of data for analysis motivates automation of root detection through use of neural networks. Building upon previous work, we show that we can use transfer learning from our PRMI dataset to assess root health across twelve classes of a new dataset to answer questions regarding how root health is affected by access of a tree by large herbivores, site infestation by Pheidole megacephala, and location of the tree. This dataset was collected from three paired sites at the Ol Pejeta Conservancy in Laikipia, Kenya, and consists of 20,000 images collected between September 2021 and May 2022. Each paired site represents four locations based on all four possible combinations of site infestation by Pheidole megacephala for at least 20 years and existence of herbivore-exclusion fence to keep large herbivores out. 1,332 images across all twelve classes of site and treatment combination were labeled with respective ground truths for model training. Our work uses the UNet architecture using pretrained weights on the network encoder and decoder which were obtained in 2019 in work which achieved over 99% accuracy on a dataset of peanut and switchgrass imagery. In our work, we found that training the model with our new dataset resulted in consistent performance across all classes of our new dataset, with over 99% accuracy for each class.

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