

Fall 2024 ML 7641 Group 19 - HyperLeaf2024

Proposal

Gantt Chart

Midterm Checkpoint

Final Report

Midterm Checkpoint

CS7641: Final Report

Team-19

December 4, 2024

1 Literature Review

Numerous methods utilize hyperspectral imaging (HSI) data for agricultural applications, and these are well documented. Review papers like [1] detail techniques for predicting plant characteristics like nutrient composition, phenotyping, and fertilizer content using HSI datasets. While most state-of-the-art methods employ traditional Partial Least Squares for predicting plant properties, recent approaches like those in [2] have used 2D Neural Networks, exponentially improving performance by incorporating spatial information.

2 Motivation and Problem

The problem we have chosen to address is that of identifying the properties of wheat plants through regression by using a hyperspectral imaging data set. Biodiversity and the need for sustainable agriculture are growing, so different varieties and characteristics of wheat must be accurately identified to improve crop management and resilience.

3 Dataset Description

We are using the HyperLeaf2024 dataset(link), which contains 2,410 hyperspectral cubes of wheat leaves from a 2023 winter wheat imaging trial. Each cube has an Imaging resolution of 512x512 and a spectral range of 400nm to 1000nm divided over 200 bands. Each cube is of size 512x512x204 and captures roughly 10 leaves at a time. For spectral calibration, the cubes contain a white calibration panel which can be used to standardize the reflectances.

4 Dataset Processing

Image/Cube:

- The cube is processed through a U-Net-based segmentation model to identify leaves, background pixels and the calibration panel.
- The leaves are then separated using connected components and each component/leaf is resized to 48x512x204.
- Each leaf pixel is clipped to the range $[0,1]$ and saved as a 16-bit TIFF file.

Labels:

- Grain weight yield was measured by the combine harvester
- The amount of fertilizer was calculated in real time during harvesting.
- Sub-species of Wheat was noted down from the field it was harvested. There are 4 categories.

Name	Proposal Contributions
Cole Miller	3d CNN, Github Pages
Jebby Arulson	2d CNN, Presentation
Ovais Quershi	PLS, Presentation
Sunil Kumar	Distillation, Report
Prathiba Narayan	Autoencoder, Report