Hyperspectral based prediction of nutrient content in maize leaves

Hyperspectral imaging is a promising method to predict crop traits in a high-throughput manner and unlock quantitative genetic studies. A single hyperspectral image can be used to predict several unrelated traits at once using spectral data from 350nm - 2500nm. Researchers have successfully modelled different physiological traits in maize such as vegetative Nitrogen content but the effect of different development stages, genotypes, and treatments on modelling power remains unclear. Here, I explore the ability to model leaf macro- and micro- nutrient content and leaf water content from hyperspectral transmittance data collected with a LeafSpec imaging device. I will compare three different machine learning algorithms; Partial Least Squares Regression, Random Forest and a Convolutional Neural Net to model nutrient content collected from twenty hybrids throughout the 2020 field season in fertilized and not fertilized blocks. Genotypes and development stages excluded from model training are used to externally validate models. Sulfur, Nitrogen, Calcium, Copper, and Iron leaf concentrations were the most amenable nutrients to prediction with coefficient of determination scores from 0.78 - 0.73, respectively. Models trained on samples from a collection of time points were able to accurately predict new time points and genotypes. The findings demonstrate the ability to predict nutrient content in field grown maize over a variety of developmental stages, genotypes, and treatments from a handheld hyperspectral imaging device.