## OKLAHOMAVIEW 2019 - 2020 ACTIVITIES

OklahomaView's HIA was "A comparison of pixel-based and object-based image analysis (OBIA) with machine learning algorithms in mapping peanut seedlings using UAV imagery." Early detection of in-field peanut germination is important to promote higher yields by allowing farmers to replant in the event of peanut germination gaps. Advancements in remote sensing, such as unmanned aerial vehicle (UAV) and machine learning provide the potential of detecting peanut seedlings accurately at the field scale. Identification of plant seedlings can be achieved through both pixel-based and object-based image analysis. However, it is not clear that which method is superior. This study used images collected by a UAV flight, taken by the USDA - Agricultural Research Service (USDA-ARS) Grazinglands Research Laboratory (GRL) in El Reno, Oklahoma in July 12, 2019 with a MicaSense Red Edge sensor with 5 bands (Blue, Green, Red, Red Edge and Near Infra-Red), to detect peanut plants with both pixel-and object-based image analysis.

PIXEL BASED PEANUT CLASSIFICATION USING NEURAL NETWORK

Neural networks were used to recognize patterns and to make predictions. The neural network that was built utilizes the pixel values of all the bands of the image and predicts the binary peanut class (peanut or non-peanut). The neural network for the classification model was built using Keras on TensorFlow. The loss function used was "categorical sparse crossentropy" and the optimizer used was "RMSprop" in this model. The model produced an **accuracy of 80.7%** with 12 hidden layers and 25 epochs.
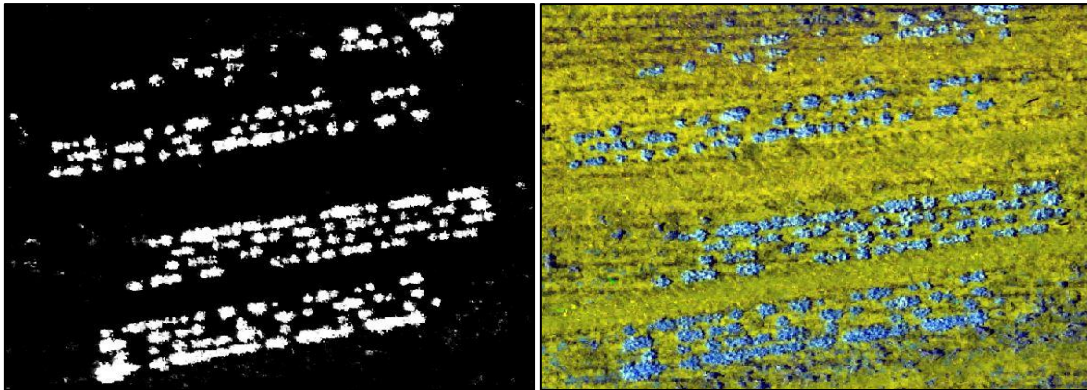
Identified peanut seedlings (white color) for a zoomed in area from pixel based classification and the color composite image (EVI, Green, and RedEdge as RGB) for the same area same.

OBJECT BASED PEANUT DETECTION USING DEEP LEARNING

Object detection was used to identify and localize an object from an image. It can be accomplished by labelling the data using bounding boxes around the target object. Various band combinations had been tested (see table below) to find the combination that has the best performance. A total of 1827 bounding boxes or annotations were manually drawn across the peanut field. All of the samples were divided into 70% and 30% for training and validating, respectively. The algorithm used to build object detection model is a Single Shot MultiBox Detector (SSD) in ArcGIS Pro. The confidence threshold was set to 0.4 and we can conclude that the band combination of **Red, RedEdge, and Near Infra-Red outperforms all the other band combinations**, with an **accuracy of 79.02%**. Pixel based classification had a better accuracy than object based peanut detection. However, further segmentation of pixel based results is needed to count the number of peanut seedlings to determine germination rate.

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BENEFITS TO OKLAHOMA

Advancements in technologies such as remote sensing, especially the unmanned aerial vehicle (UAV), and machine learning algorithms that provide accurate classification and prediction models, greatly benefits the field of agriculture.

- Save time for breeders in determining germination rate of peanuts, which was previously achieved by physically counting the seedlings throughout the peanut fields.
- The data obtained and used to train the model and therefore knowledge obtained can be easily transferred to other peanut fields for accurate detection of peanuts.
- The basic tools used for the project, ArcGIS Pro and python, can be transferred to identify other crops.
- A graduate student, Bhagya Hosur from the Department of Computer Science at Oklahoma State University, get trained in the project.
- The project was collaboration between USDA-ARS GRL and OSU, which strengthens the connection of the OKlahomaView Consortium members.

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