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Point Cloud vs. Pixels
Who sees the grapes better?

Apichaya Thaeerat | Ariel Ooms | Asante Akwasi

Introduction

Michigan's diverse grape production plays a vital role in the state's economy, contributing to both the wine and juice industries. Cabernet Franc (Cabfranc) is a popular variety used in winemaking, while Concord grapes are primarily cultivated for juice production. Understanding the productivity of these grape varieties is essential for optimizing yield, resource allocation, and overall vineyard health.

To accurately assess grape cluster count is crucial for effective vineyard management, this project focuses on comparing the efficiency and reliability of grape cluster counting in two distinct grape species using handheld LiDAR and UAV Natural color and multispectral imagery. Drones are increasingly utilized in vineyard monitoring due to their capability to cover large areas efficiently, providing high-resolution multispectral data that helps in assessing plant health and vigor. On the other hand, LiDAR technology is advantageous due to its ability to create highly detailed 3D point clouds, allowing for precise spatial measurements of grape clusters.

By comparing cluster counts across both fields and technologies, we aim to identify the strengths and weaknesses of each approach and establish which one provides the most accurate and reliable cluster assessments under the specific conditions of Michigan vineyards.

Research Question

How does the count of grape clusters compare between handheld LiDAR point clouds and UAV multispectral imagery?

Objective

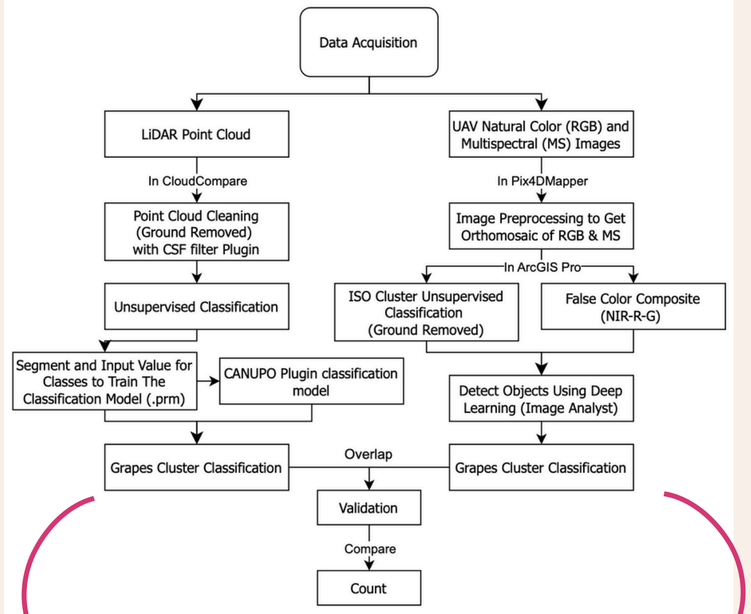
To evaluate and compare the accuracy of grape cluster counting between handheld LiDAR point clouds and UAV multispectral imagery.

To investigate which method provides more reliable results for grape cluster counting and suggest optimized workflows for vineyard monitoring.

Abstract

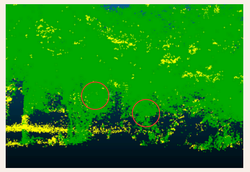
Michigan's grape industry, encompassing wine and juice production, relies on precise vineyard management to optimize yield and maintain health. Grape clusters in mid-growth stages present challenges for both approaches, particularly in distinguishing clusters from surrounding vegetation. This study evaluates the accuracy and reliability of grape cluster counting methods, comparing handheld LiDAR technology and UAV Natural Color (NC) and Multispectral (MS) imagery. The handheld LiDAR generates detailed 3D point clouds, enabling precise spatial measurements, while UAVs provide high-resolution NC and MS data for broader coverage and plant health analysis. By comparing these technologies, this research highlights the strengths and limitations of each, offering insights into optimized workflows for effective vineyard monitoring. Results revealed grape clusters could be detected from the Deep Learning Object Detection from NC and MS orthomosaic and from LiDAR point clouds that are not directly correlated and comparable. The grapes we observed are in the mid-growth stage which is challenging to identify both on LiDAR Point cloud and orthomosaic images in order to train the model for classification. We recommend gathering data at later growth stages when grapes are more visually distinct to enhance model training and classification accuracy.

Methodology



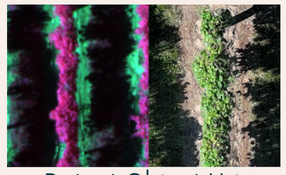
LiDR Point Cloud

Grapes Cluster

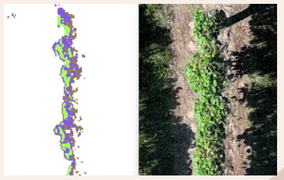


The classification cannot detect the grapes.

Orthomosaic of Multispectral imagery



Detect Object Using Deep Learning



Results

Grape clusters in orthomosaic from NC and MS could be detected from the Deep Learning Object Detection, however, the clusters are not correlated with the actual grapes in the field. Some grape clusters were detected from LiDAR, but does not correspond to the manual counts in Cloud Compare.Results from the two methods are not directly correlated/ comparable.

Conclusion

The grapes we observed are in the mid-growth stage which is challenging to identify both on LiDAR Point cloud and orthomosaic images in order to train the model for classification. Suggestion provided to get the data again in the stage with full growth when grapes change color to red-purple which is easier to distinguish from the vine. Therefore, the training data is better hence, better classification.

Acknowledgement

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