A parallelized method for mapping floral resources for bees using drone imagery

Introduction

Motivation: The western honey bee, Apis mellifera, has seen historic declines over the last century. Honey bee populations have emerged as one of the most important and yet still one of the least understood factors in this decline. Knowledge of the distribution of the species of flowering plants in a landscape is crucial for understanding the effect, but recording the location and species of the available plants can be difficult. We developed an automated method to identify flowering plant species in a landscape, so that we can better understand which plants contribute to colony survival.

Methods

The traditional strategy used for identifying plants from drone imagery follows three key steps:
1. Stitch together individual drone images into an orthomosaic
2. Use a segmentation tool to segment plants from the orthomosaic
3. Classify each plant by its species using machine learning

Our experiment strategy is designed to improve upon the traditional strategy by:
- Improving segmentation performance by better capturing the variety of plant species in the training set
- Improving object detection performance by running steps in parallel

Results

We tested both strategies on a dataset of 12 images spanning 1.5 acres of the Santa Monica Mountains in California. Using the traditional strategy, 150 plants were identified, while the experimental strategy identified 100 plants total. The traditional strategy only classified 27 plants correctly, while the experimental strategy classified 87 plants correctly. The experiment strategy improved the accuracy of the classification by about 80%.

Conclusions and Future Work

By rescinding the segmentation and classification steps in parallel, we were able to reduce the running time and memory usage of the pipeline for creating images of the flowering plants in a landscape. These improvements in accuracy, memory usage, and runtime will be crucial if we are to use the pipeline on larger landscapes, especially those large enough to encompass the 10 km range that flower bees may fly from. Future work may consider training the pipeline to work with a larger variety of flowering plants and at different seasons.

Acknowledgements and Funding

I would like to thank Matt Crane for collecting drone imagery, the funders of this project, and the lab members for their technical support. Professors Aamir R. Mccarren, Marina Donatello, and Mohamed Benmira for their helpful feedback on the project proposal and poster. Funding for this project was provided by the Santa Monica Mountains National Recreation Area.