Tracking Bee Movements with Machine Learning

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Inspiration

Honey bees have the ability to detect the Earth's magnetic field and use it for orientation and navigation[2]. Nowadays, Radio Frequency (RF) is omnipresent. Previous work, showed a strong evidence of north-seeking ability disruption in European robins upon exposure to RF. Bees are easy to work with and require no IRB approval.

Overview

We seek to examine honeybee sensitivity to modern RF transmissions, which although their impact on the static field is small, with the explosion of wireless transmissions are much more pervasive than in the past. Before testing the bees with RF transmissions, however, we are testing them with electromagnetic frequencies as they are easier to work with and will give us an indication of whether or not the bees are affected with any frequencies.

For this project, we want to see if the EMF's alter the bees' motion. Over the course of several months, we have taken video of the bees in a controlled environment and used different software to try and analyze the bees' motion vectors under the influence of a coil emitting EMF's.


Heat Maps

- Determine areas where honey bees concentrate their movements and plots in a pretty graph.
- Utilizes background subtraction algorithms to isolate dynamic pixels in a video feed.
- If the heatmaps show movement concentrated around the coil while the coil is on and random movement when the coil is off, then there may exist correlation between field and movement.
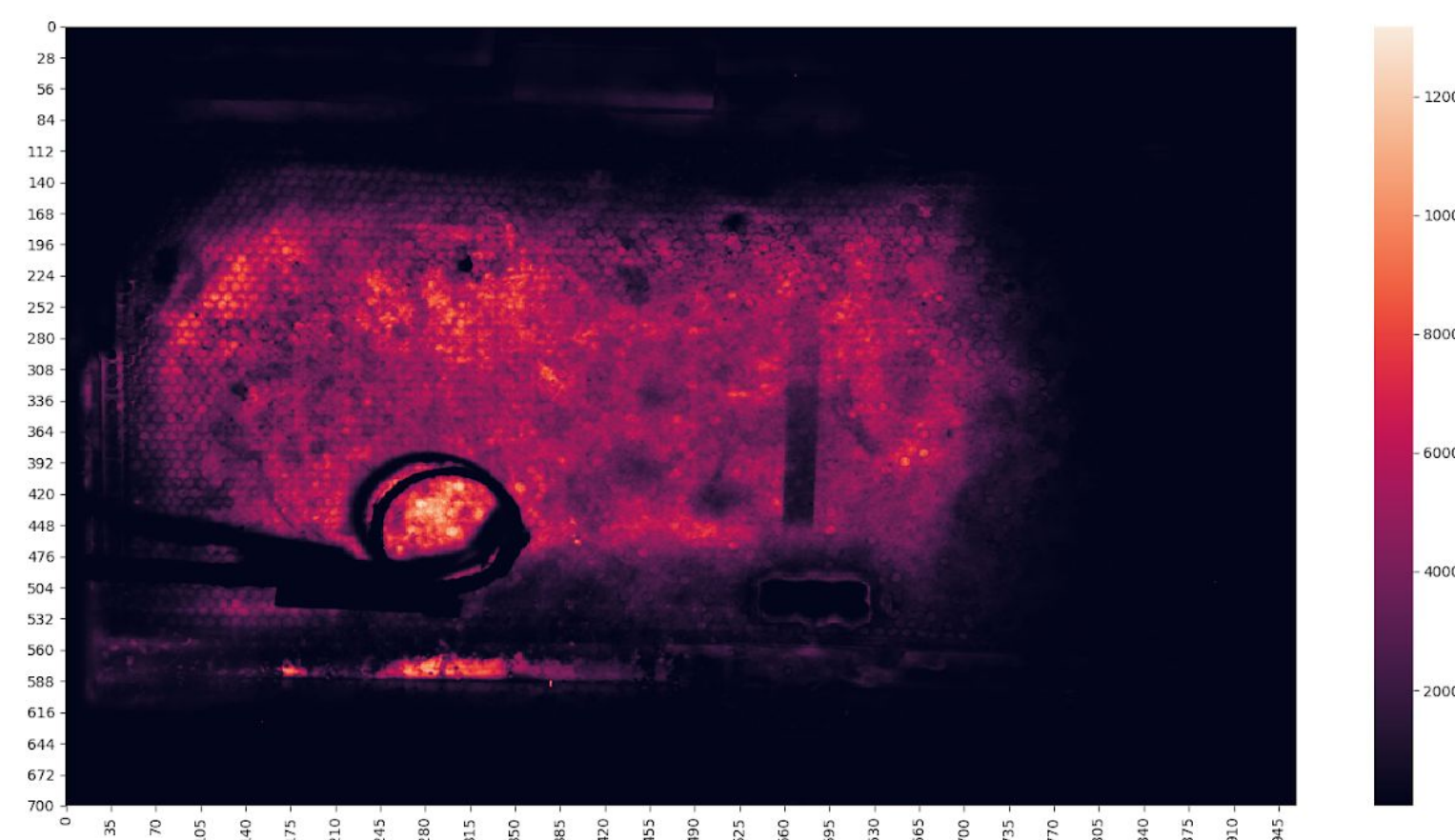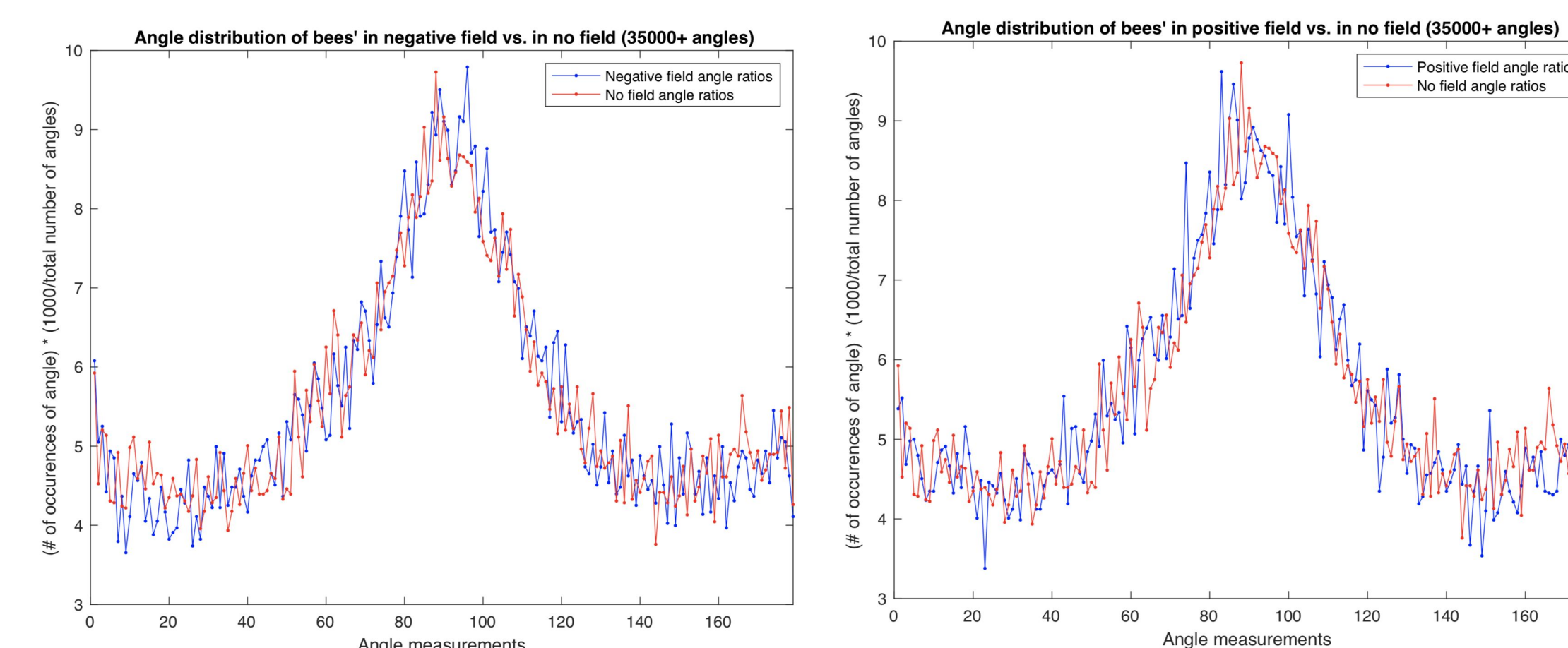

Computer Vision

- Determines the bees' orientations using a Python library (Open CV)
- A background subtraction algorithm is performed on the bee video, determining what is moving frame by frame
- Ellipses are drawn around what the background subtraction picks up as bees (large blocks of white pixels, i.e. the moving parts of the video, which are the bees).
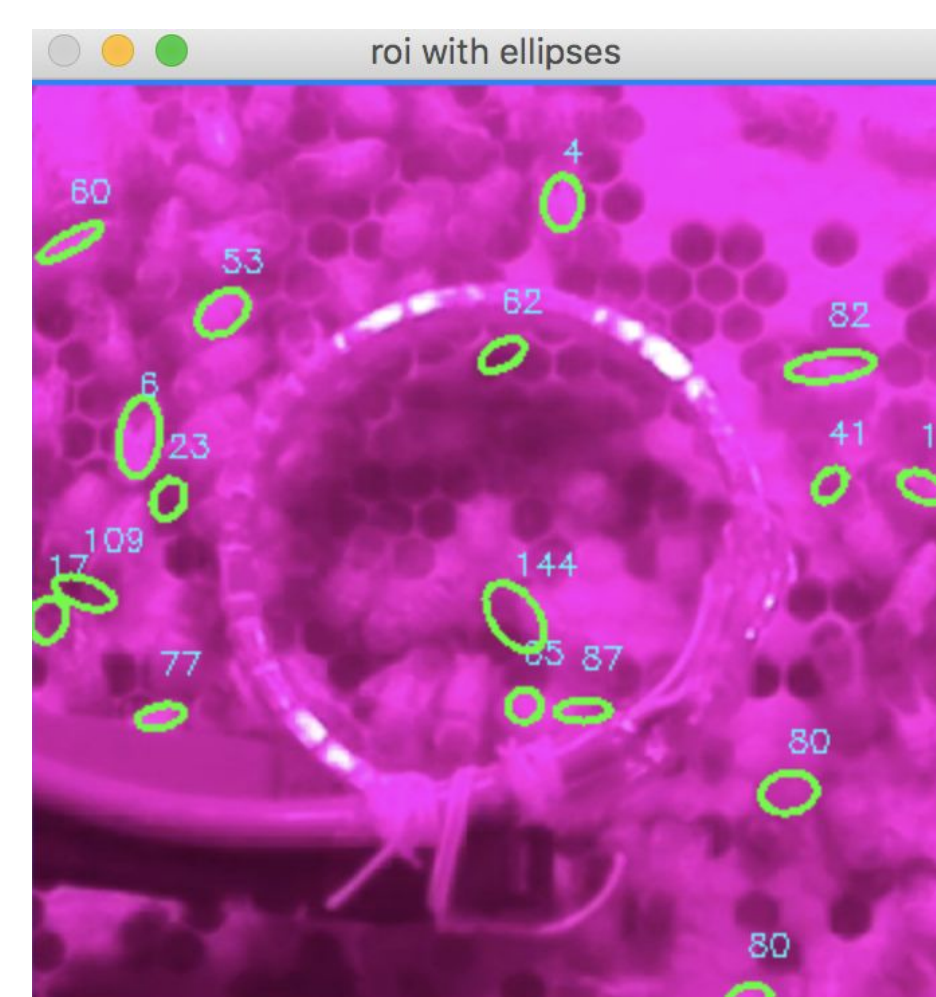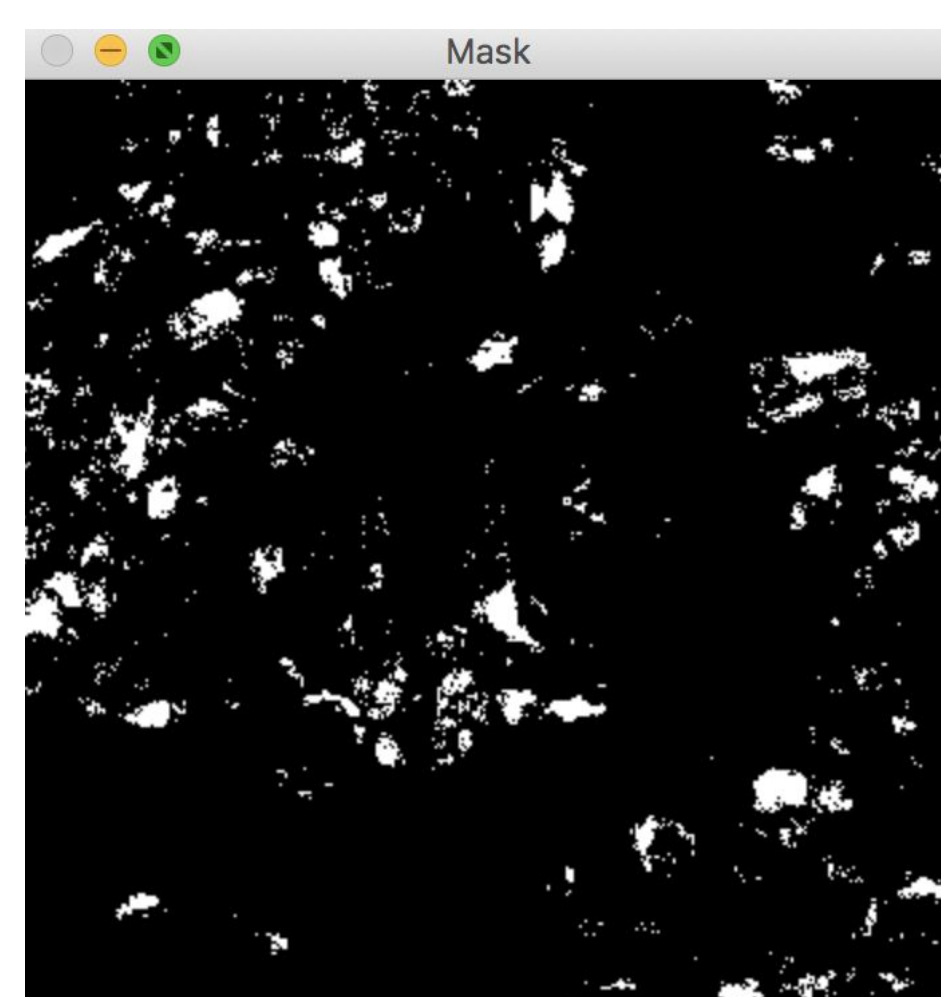

- Collected data from all 3 states of the coil (negative field, positive field, no field) and compared the bees' orientations between them to see if there is a difference.

Simulation

- Use Pygame Python library to create a beehive movement simulation
- Can be used to run experimentation of computer vision algorithms in a controlled environment
- Avoids issues that come up when analyzing real hives, such as poor lighting or resolution
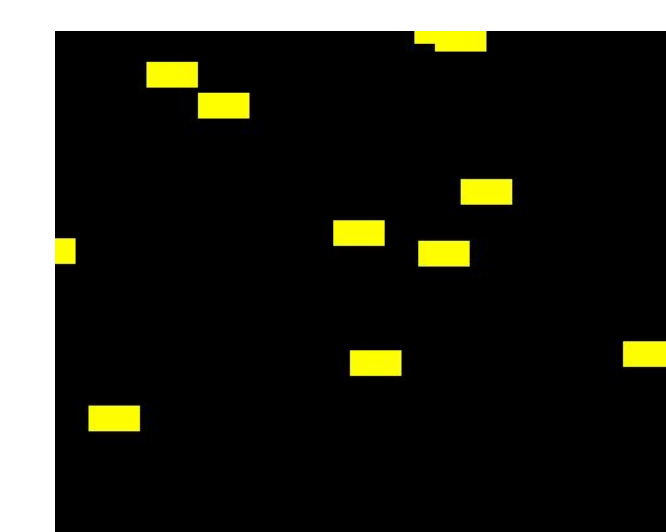
Future Work

- Improve accuracy of computer vision algorithm to include ellipses around static bees and around undetected moving bees
- Expand the simulation program to include multiple bees with the bee image and to incorporate tasks that bees perform
- Train a neural network to detect bees in our hive
- Continue to improve pygame simulation for realism

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