Bee Behavior Tracking

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Introduction

Bees are extremely important to the agriculture industry because they are the main form of pollination and are considered the farmer's best friend. To try to understand and analyze their behavior would be a great help in determining how and potentially why they choose what flowers or plants to pollinate.

Background

There has been former research in tracking bees such as:

- Robust Bee Tracking with Adaptive Appearance Template and Geometry-Constrainted Resampling ;Protik Maitra, Stan Schneider and Min C. Shin; University of North Carolina at Charlotte

This research deals with tracking of many bees in a hive. My research differs in that I am tracking a single bee in flight and also classifying its behavior.

Research

- Three bee behaviors to classify
  - Flying
  - Approaching
  - Landing
- Data
  - Bee flying around in a video with simulated flowers performing various behaviors
- Method
  - Bee detection
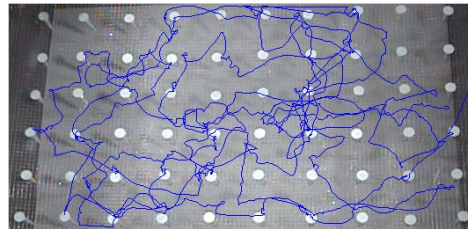 - Use background subtraction to detect bee trajectory in a video

Figure 1: Bee Trajectory
This figure shows the detected bee path.

  - Convert bee trajectory to speed and distance data
  - Model bee behavior through Hidden Markov Model using speed and distance
  - Use Viterbi Algorithm to determine bee behavior
  - Use backtracking to detect approaching.

Impact

- Result from Hidden Markov Model with backtracking to find approaching
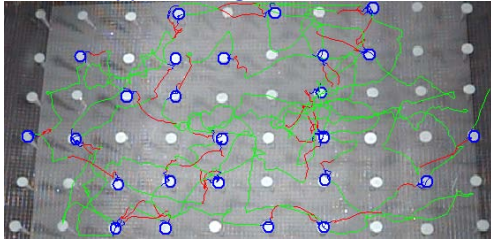

Figure 2: Bee Behavior Recognition Results

In the above figure, green is flying, red is approaching, and the blue circle denotes a landing.

- The example results above show promise in that this technique could be utilized by bee researchers to track and classify bee behaviors.
- Some challenges faced:
  - Video debris such as reflections of the researcher's arm causing bee detection and behavior recognition to lose focus.

Conclusions

- Bee detection was stable as long as video was stable
- Implementing Hidden Markov Model and backtracking to classify flying and landing was 90% correct at identifying landings.
- Approaching was vague and as such expert knowledge was required to determine criteria for approach.

Future Work

There are still bee behaviors that I would like to classify, such as rejections in which a bee approaches a flower but does not land on it. Also, I would like to deal with video debris, objects in the video that change or move that are not the bee.