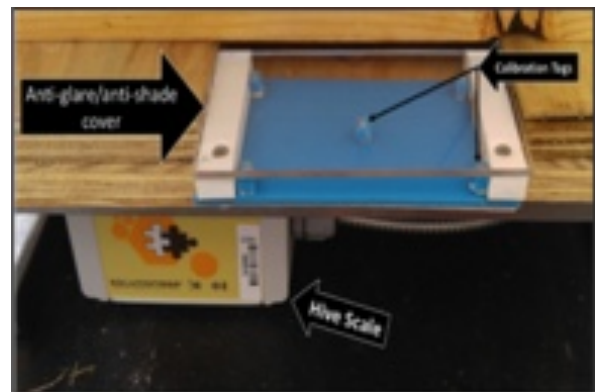
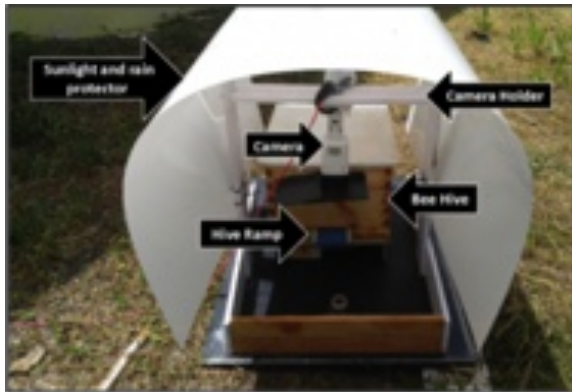


BigDBee: Large-scale multi-parameter analysis of honeybee behavior in their natural habitat

<https://bigdbee.hpcf.upr.edu/>

Overview:

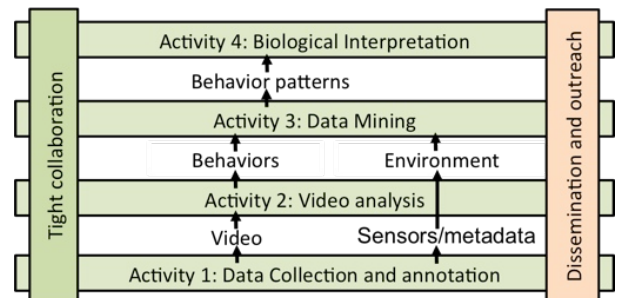
Honey Bees exhibit highly complex behavior and are vital for our agriculture. Due to the rich social organization of bees, the overall performance and health of a bee colony depends both on a successful division of labor among the bees and on adequate reaction to the environment, which involves complex behavioral patterns and biological mechanisms. Much remains to be discovered on these matters as research is currently limited by our ability to effectively collect and analyze individual's behavior at large scale. The technology developed in this project will use video capture at the entrance of the colony and sensors to enable us to **study the individual behavior of thousands of bees over extended periods of time.**



Large-scale recording of bee activities 24/7 using cameras and sensors

Approach:

The BigDBee project embraces a **multi-disciplinary Big-Data approach** for the ecological study of bee behavior. The contributed technology is expected to enable the design of new multi-parametric and large-scale data collection and analysis that allows broader data mining and analysis of patterns. These advances are expected to help us uncover mechanisms of the circadian rhythms of the bee in their natural habitat that is based on the variations in behavior of individuals.



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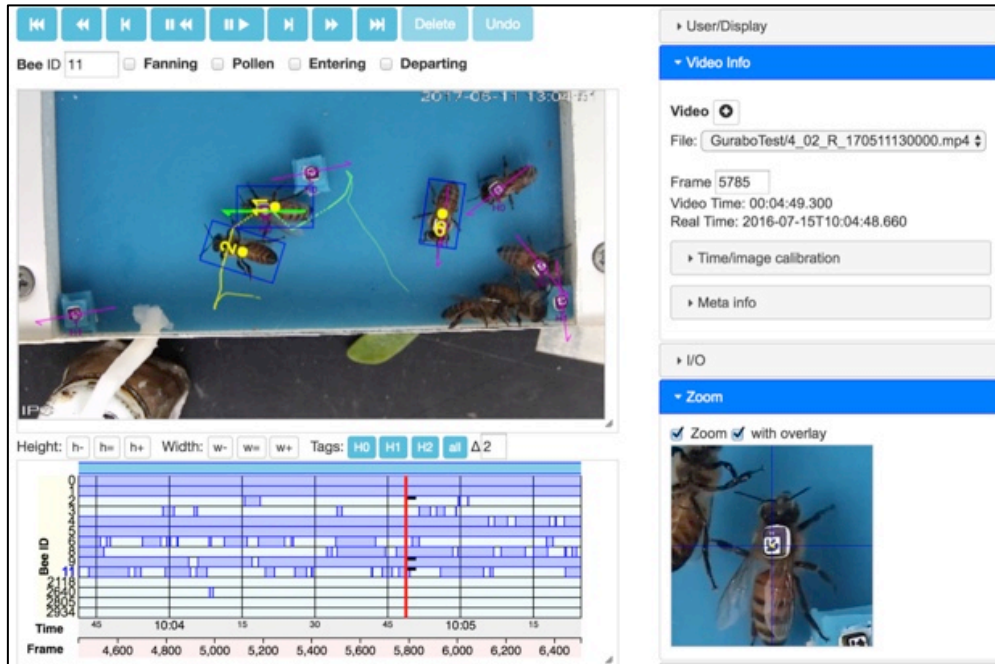
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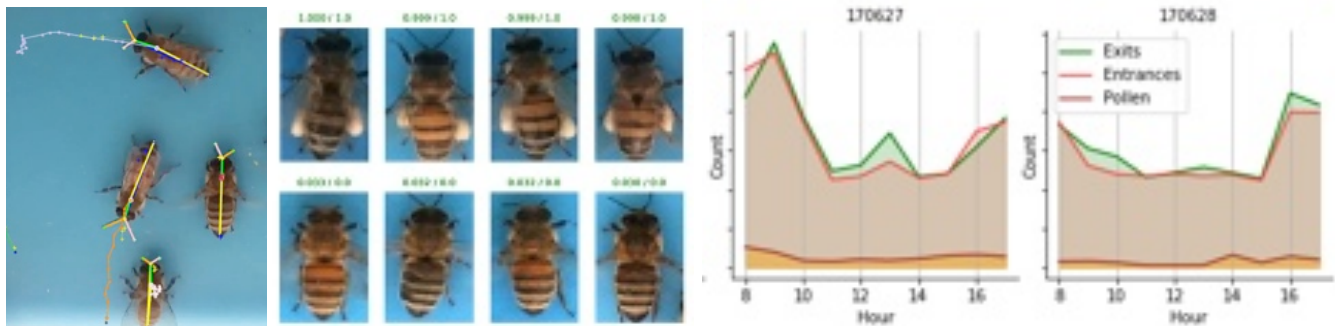


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Highlights:



Automatic detection of tagged bees and crowd-sourcing of the annotation of behavior using Flask+JS WebApp hosted at the UPR High-Performance Computing facility accessing several months of videos (1.2TB of data).



(left) Automatic detection, pose estimation and tracking of unmarked bees; (middle) recognition of pollen bearing bees; (right) Long-term monitoring of foraging behavior including pollen payload detection.

Selected publications:

- Rodríguez, Ivan F. and Megret, Remi and Acuna, Edgar and Agosto-Rivera, Jose L. and Giray, Tugrul. (2018). “**Recognition of Pollen-Bearing Bees from Video Using Convolutional Neural Network**”. IEEE Winter Conference on Applications of Computer Vision (WACV)
- Rodríguez, I. F., K. Branson, E. Acuña, J. L. Agosto-Rivera, T. Giray, R. Mégret, “**Honeybee Detection and Pose Estimation using Convolutional Neural Networks**”, Congrès Reconnaissance des Formes, Image, Apprentissage et Perception (RFIAP), Paris, France, 25-28 June 2018*
- Rodríguez, Ivan F., Rémi Mégret, Roian Egnor, Kristin Branson, José L. Agosto, Tugrul Giray, Edgar Acuña. “**Multiple Insect and Animal Tracking in Video using Part Affinity Fields**”, Workshop Visual observation and analysis of Vertebrate And Insect Behavior (VAIB) at International Conference on Pattern Recognition (ICPR), Beijing, China, 20-24 August 2018
- Esteves Rivera, Christian J., Emmanuel Nieves, Remi Megret, Ivan F. Rodriguez (2018). “**Web App development for multi user annotation interface**”. Puerto Rico Interdisciplinary Scientific Meeting (PRISM). Gurabo, Puerto Rico.
- Chan, Jeffrey, Ivan F. Rodriguez, Rémi Mégret, José L. Agosto-Rivera, Tugrul Giray, “**Learning good features to discriminate untagged bees in video using non-supervised learning**”, SIDIM 2019, Humacao, March 1-2 2019.
- Latorre, Edward, Kelvin López, Ivan F. Rodríguez, Matías Rosner Ortiz, Rémi Mégret, Tugrul Giray, José L. Agosto, “**Recognition of Fanning Bees from Video using Convolutional Neural Networks**”, SIDIM 2019, Humacao, March 1-2 2019.**
- Acuna, Edgar, Velcy Palomino, Jose Agosto, Rémi Mégret, Tugrul Giray, Alberto Prado, Cédric Alaux and Yves Le Conte, “**Clustering Honeybees by its Daily Activity**”, International Conference on Pattern Recognition Applications and Methods (ICPRAM), Prague, Czech Republic, Feb 19-21 2019.***

*Collaboration with Howard Hughes Medical Institute, Janelia Research campus

**Collaboration with Computer Science department, University of Puerto Rico, Arecibo campus.

***Collaboration with Institut National de la Recherche Agronomique, Avignon, France