

Automatic honeybee colony sociometry

(Sociométrie automatique des colonies d'abeilles)

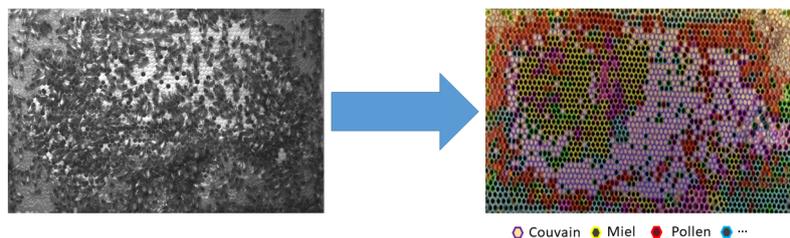
Context:

A combination of environmental stresses including chemical pollution, invasive predatory or parasitic species, or climate change is producing, on a global scale, an undeniable decline in bee colonies. This damage to the main pollinating species is not only a precursor of important losses in agricultural production but also a testimony to the degradation of the Earth's ecosystem. Therefore, the study of bee health must be considered from a holistic perspective and mobilize the concerted efforts of distinct communities of knowledge and expertise.

The "SuperBeeLive" project that we are conducting is based on the real-time monitoring of a bee colony, from its birth to its death, in order to monitor in detail its homeostasis and its health status. For this monitoring we have designed a hive whose instrumentation allows the collection of several types of digital and video data streams in parallel, in a systematic, automatic and non-invasive way. This instrumented hive is currently populated, and video data are permanently recorded.

One of our aims is to determine the sequence of events that destabilize the social organization of the colony following an episode of insecticide poisoning. The destabilization description implies first to go through the definition all the best parameters to define the steady state conditions of the honeybee colony homeostasis. From the videos of each frame, multiples classes of data could be extracted going from individual bee behaviors to the nature of each cell. Most of the work of the project consist to extract and analysis large sets of data. This internship is dedicated to the production of sociometric data.

Among these data, the description of the cell contents is key to understand the health status of the colony because it allows to evaluate the nutritive reserves and the brood, two determining elements of the dynamics of a colony. Another important sociometric data to describe the colony dynamics will be allow to study the demography of the colony. Daily measurement at nightfall will permit to follow the evolution of the global population, but also the populations of the different bee castes. Indirectly, it will allow to follow the number of "bees outside the colony", mainly foragers, by regular measurements during the day.



The main objective

Main tasks:

The master project consists in conceiving a method of daily analysis of the cells in an automatic way to annotate their contents (empty cell, brood with larva, capped brood, pollen reserve, uncapped honey reserve, capped honey reserve), to describe the distribution of the contents and their location on the frame. The difficulty lies in the fact that bees are present almost permanently on each cell. The method to be developed in the form of an analysis software consists of 3 steps: 1/ to reproduce automatically the frame without bees from a series of photos taken regularly during one day 2/ to annotate automatically the contents of each cell 3/ to produce a precise analysis and a method of visualization of the data.

The other part of the work will be to deploy a neural network able to annotate each bee. Morphologically the individuals of each caste - queen, drone and worker - are clearly distinguishable and thus can be counted with a machine learning approach. The global counting will be performed at regular intervals during day and night. The data obtained will be then classified to follow the global population of the colony, the populations of each castes and the approximated population of foragers.

Application: Applications for this position (CV, Motivation Letter, last grade report, References) will be received EXCLUSIVELY in a single PDF document accessible for download via email sent to Mattieu ROUSSET (matthieu.rousset@inserm.fr) and Pascal Poncelet (Pascal.Poncelet@lirmm.fr)

Qualifications:

- **Python, Scikit learn, Keras, Umap/T-sne, matplotlib, jupyter**
- **Supervised and unsupervised classification, image classification, deep learning**
- **HTML/CSS – a web server must be deployed.**

Supervision:

- UMR 5506 LIRMM Equipe ADVANSE : Pascal PONCELET
- IBMM : Matthieu ROUSSET

Location : LIRMM / Rucher Scientifique de l'IBMM localisé sur le campus de la Délégation Régionale du CNRS

Gratification : 6 months