Chapter 2
Microscopic Image Processing for the Analysis of Nosema Disease

Soumaya Dghim
Universidad de Las Palmas de Gran Canaria, Spain

Melvin Ramírez Bogantes
Costa Rica Institute of Technology, Costa Rica

Carlos M. Travieso-Gonzalez
Universidad de Las Palmas de Gran Canaria, Spain

Rafael A. Calderon
National University of Costa Rica, Costa Rica

Mohamed Salah Gouider
Université de Tunis, Tunisia

Juan Pablo Prendas-Rojas
Costa Rica Institute of Technology, Costa Rica

Geovanni Figueroa-Mata
Costa Rica Institute of Technology, Costa Rica

ABSTRACT

In this chapter, the authors tried to develop a tool to automatize and facilitate the detection of Nosema disease. This work develops new technologies in order to solve one of the bottlenecks found on the analysis bee population. The images contain various objects; moreover, this work will be structured on three main steps. The first step is focused on the detection and study of the objects of interest, which are Nosema cells. The second step is to study others' objects in the images: extract characteristics. The last step is to compare the other objects with Nosema. The authors can recognize their object of interest, determining where the edges of an object are,

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counting similar objects. Finally, the authors have images that contain only their objects of interest. The selection of an appropriate set of features is a fundamental challenge in pattern recognition problems, so the method makes use of segmentation techniques and computer vision. The authors believe that the attainment of this work will facilitate the diary work in many laboratories and provide measures that are more precise for biologists.

INTRODUCTION

Nowadays, microscopic image analysis has become increasingly important for the recognition and classification of diseases. Several tools are available to process and analyze images in the medical and biological fields, but their relevance cannot adapt with certain problems.

Diagnosis is one of the most commonly used methods in the verification of contagious diseases in food producing animals such as bees, and has always been the most important. This method makes it possible to test and analyze the key characteristics and then define the disease by providing the necessary information on its type and classification. In the late 1990s, Nosemosis, a parasitic disease, affected European and Asian bee populations. Nosema Apis (N. Apis) was the most likely cause of Nosema. Biologists have devoted many of their studies that treat the disease and describe its molecular and genetic characteristics.

Honeybees are very important for the honey they produce and for their vital role as agricultural pollinators. Biologists considered that the human diet can be directly related to bee pollination, also they estimated the economic value of pollination to several billion dollars ("Colony Collapse", 2009; "Bee Mortality", 2008), and furthermore, they considered the honeybee health a great impact on economy and biodiversity worldwide.

Honeybees (*Apismellifera*) are social insects, which form colonies composed of three classes of individuals: the queen, thousands of workers and, when there is greater nectar flow, several hundred drones. The colony population can vary between 30,000 to 60,000 individuals, depending on the time of year, with each individual performing a specific function (Espina et al, 1984). The queen is the only fertile female of the hive, her main function being egg laying. The workers are in charge of feeding the young, building honeycombs, protecting and defending the hive, and collecting food, among other functions. The drones participate mainly in the fertilization of the queen and in maintaining the internal temperature of the hive (Crane, 1990).

The breeding and management of honeybees is known as "Beekeeping", an activity practiced almost anywhere in the world with a great ecological and socioeconomic

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