Remote sensing of flying insects by dark-field detection with telescopes and opto-electronics: The Lund University Mobile Biosphere Observatory

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Abstract

We present a method for automatically detecting flying insects and remotely acquire several of their parameters with the use of remote sensing and stand-off methods. We employ telescopes with a spectrometer, a high-speed camera and Si and InGaAs quadrant photodetectors, we demonstrate the measurement of the reflection spectrum, wingbeat frequency, size and movement direction of flying insects in a narrow volume. We employ a telescope battery towards a black cavity in order to minimize optical background. When insects fly through the field of view of the telescope, the sunlight scattered from the insect contains information that can be used to recognize and identify the insect and to obtain its behavioural characteristics. Such an equipment gives us the possibility to facilitate the better understanding of insect behaviour, and to evaluate different insect traps, for example. The Lund University Mobile Biosphere Observatory (LUMBO) was recently built and its first campaign was conducted in the summer of 2013, when one of the objectives was to study the selectivity of a liquid filled polarization tabanid trap developed in the Environmental Optics Laboratory of the Eotvos University. Here we present an overview of the telescope-based novel stand-off methods and some aspects of data evaluation of remotely optically sensed insects.
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Introduction

We present a method for automatically detecting flying insects and tandemly acquiring video of their parameters with the use of remote sensing. The method is based on the utilization of a miniature camera connected to a high-speed numerical camera and a high-speed photography system. The automated detection system is able to recognize flying insect species and to determine the parameters of the flying insects, including their body size, wing length, and flight velocity. The system is based on the use of a high-speed camera and a high-speed video camera. The high-speed camera is able to capture images of the flying insects at a rate of 10,000 frames per second.

Methods

Experimental setup

We employ LUMEB's telescope system to observe a sky area of interest to detect the presence of flying insects. The system is based on the use of a high-speed camera and a high-speed video camera. The high-speed camera is able to capture images of the flying insects at a rate of 10,000 frames per second.

Preliminary evaluations

Birds and insects are often observed using remote sensing techniques. The use of remote sensing techniques is particularly useful in the study of birds and insects. The use of remote sensing techniques allows for the observation of birds and insects in their natural habitats without disturbing them. The use of remote sensing techniques also allows for the observation of birds and insects in remote locations.

Future plans

Our goal is to combine the data from these remote sensing techniques with the data from the high-speed camera to create a comprehensive database of flying insect species. The database will be used to study the behavior of flying insects, including their flight patterns, and to understand the role of flying insects in the ecosystem.

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