Section Sciences et Ingénierie de l'environnement
Design Project 2014 (semestre de printemps)

Proposition n° 30

Locality-Accuracy Tradeoff in Agricultural Pest Prediction

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Descriptif du projet

Pest attacks are responsible for a significant decrease in crop productivity, in severe cases causing billions of dollars in harvest losses worldwide. The Swiss agriculture industry relies heavily on predictions in order to precisely mitigate such attacks. In particular, such predictions are carried out at the country level using an operational modeling tool called SOPRA (http://www.sopra.info/), developed by Agroscope, a network of federal research stations for agriculture. These models use environmental data from MeteoSwiss stations sparsely deployed throughout the country.

The codling moth is an example of pest particularly relevant for agriculture applications. We are interested in exploring how SOPRA predictions for the codling moth's eclosion can be enhanced by microclimate monitoring. In particular, we are interested to leverage information

gathered from traditional environmental sensors (e.g., anemometry, temperature, and humidity) already deployable in high spatial density, in order to achieve spatially finer predictions. Sensorscope Sarl, an EPFL-based startup that employs wireless sensor networks for environmental monitoring applications, could provide such stations and is therefore interested in understanding the potential impact of its technology on the pest attack predictions. Finally, we intend to validate these predictions using ground truth data gathered by dedicated traps for the codling moth developed by a leading company in the area of biological control measures for plant protection (Andermatt Biocontrol AG), possibly extended with wireless monitoring capabilities developed again by Sensorscope Sarl in collaboration with two laboratories at EPFL (DISAL and LCAV).

Objectif

MeteoSwiss stations are located quite far from some agricultural sites, and thus may experience different weather patterns than dormant pests. This project studies the use of inexpensive, passive temperature sensors deployed in close proximity to apple orchards in order to predict the lifecycle of the codling moth with higher accuracy. We are interested in understanding the tradeoff between sensor accuracy and locality, particularly with respect to its impact on the accuracy of pest development models. Students will have to review the models' underlying theory, understand and improve a simple Matlab model developed in a former design project (F. Baerenbold and I. Kiefer, Technical Report DISAL-SP52, 2013), and conduct the deployment of two or more small weather stations (one of them endowed with an actively ventilated temperature sensor) on an agricultural site together with moth traps (traditional or enhanced with wireless monitoring capabilities). Data should be collected throughout the pest's spring lifecycle. Ultimately, the students should be able to determine whether or not local, possibly passive sensors offer a significant advantage over those of MeteoSwiss in predicting the eclosion of the codling moth.

Descriptif tâches

The project tasks can be summarized as follows:

- understand relevant literature regarding codling moth lifecycle modeling
- understand and improve the former Matlab model developed for codling moth lifecycle
- perform temperature measurements at agricultural site (passive sensor, ventilated sensor) and compare them with MeteoSwiss data
- compare eclosion predictions using the Matlab model fed with either MeteoSwiss temperature data, local measurements, or a combination of the two data sets
- if possible, in collaboration with Agroscope, explore prediction differences generated by SOPRA with and without local temperature measurements
- develop an understanding of the locality-accuracy tradeoff

Divers

Work breakdown: 50% theory, 25% programming, 25% field work.
Prerequisites: Matlab
Keywords: agricultural monitoring, pest distribution, wireless sensor networks
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