Session 4

Acoustic insect detection for horticulture

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Digitalization holds the key to make plant protection and especially pest management more efficient and effective. To create a digital system, capable of assisting growers by advising on when and how to fight pests, the system must be able to assess the state of the pest population within the greenhouses. Therefore, there is a need to create digital pest detection sensors.

Many different methods, such as trap systems combined with optical or optoacoustic sensors for evaluation, have been proposed in the field of insect detection. However, none has yet fully solved the problem of digitally assessing the populations of pests in a greenhouse. While optical solutions offer many benefits, acoustic devices may end up being cheaper and less prone to problems like occlusion or varying light conditions. Microphones have successfully been used to detect pest infestations in grain storage as well as in different kinds of wooden plants.

One goal of this project is to investigate the feasibility of an acoustic insect detection system for use in pest management in greenhouses. Therefore, hardware has to be found that is sensitive enough to collect very low-level acoustic insect signals in a greenhouse environment and an algorithm has to be designed that is capable of recognizing different pests within these recordings. The first challenge can be solved by using highly sensitive measurement microphones, giving the system an acoustic perception far beyond human hearing. The second is a classic pattern recognition problem. Related problems, such as recognizing bird songs, have been very successfully solved by deep learning algorithms in the past years. To train such algorithms, big training data sets are necessary. For a highly specialized task, such as acoustic insect classification, adequate data sets are not yet available.

Consequently, as a first step, a data set has to be created. Using an anechoic box and a low noise microphone, a data set of high-quality recordings of the pests under investigation can be collected. By using this recording setup, the common problem of annotating the different sounds can be overcome, if only a single pest species is placed within the recording chamber and environmental noises are eliminated. Furthermore, a low-cost microphone array, consisting of six small microphones, shall simultaneously record a second data set.

Based on the data sets, a deep learning model will be trained to assess the general possibility of distinguishing relevant greenhouse pests by their sound and compare the low- and high-cost hardware performance. Plans for the final project stage include the setup of different microphones in a greenhouse, to compare their performance under real-world conditions. Finally, the developed sensor system will be validated against other solutions, such as digital camera equipped traps.