Project No.	Project Title	
2021 -01-012	Robotic platform for ecological monitoring of insects' population	
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Abstract

Global food demand must be met by doubling agricultural production by 2050. The existence of harmful insects lowers agriculture production. The common practice to date is to spray all agricultural fields. This harms the plants, the crops, and has environmental and health impact. This project aims to develop a robotic platform for adaptive and automatic sampling and monitoring of insects' populations on trees and bushes, to provide localized and timely detection.

An autonomous mobile robot is an intelligent agent, capable of planning the path through the field in known and unknown environments. It identifies the environment and advanced through the field to reach the targets to monitor insects. Depending on the situation, the environment can either be defined in advance or not. In this research, I present a new approach to determine an optimal sampling path through the field, in order to minimize the number of insects in the field, at the end of the robot(s) working day. Moreover, an operational research model was built, with an objective function that minimizes the loss of the grower, by calculating the robot working hours per day according to the specific inputs of every grower.

Seven models were developed to determine the optimal sampling path of the robot-three strategies (Neighbor, Snake, Random), and for each strategy, three methods (sample every plant, sample every N plants, online random sampling). The models were examined over several scenarios and compared with six performance measures. Results revealed that for regular fields (2000 dunam), with only one working robot, it is not necessary to visit a large quantity of plants every day, but the sampling must be done thoroughly(i.e., each plant should be sampled), and plants should not be skipped or at least as little as possible. In other cases, when the fields are larger (4000-8000 dunams), we will probably prefer to use the neighbor strategy and sample every vine, which performs thorough work, and at the same time controls a larger amount of plants on each working day.

Keywords: path planning, operations research, adaptive sampling, automatic sampling