STABILIZATION OF A STERILE INSECT TECHNIQUE MODEL BY FEEDBACK LAWS

KALA AGBO BIDI

Sorbonne Université & INRIA, Paris, France

The Sterile Insect Technique (SIT) is one of the most ecological methods for controlling insect pests that are responsible for worldwide crop destruction and disease transmission. This technique consists in releasing sterile males into the insect pest population. This approach aims to reduce fertility and, consequently, the target insect population after a few generations. Classical SIT has been modeled and studied theoretically in a large number of papers to derive results to study the success of these strategies using discrete, continuous, or hybrid modeling approaches (recent papers [2, 5, 6]). Despite this extensive research, little has been done concerning the stabilization of the target population near extinction after the decay caused by the massive initial SIT intervention. In this work, we study the global stabilization of a pest population at extinction equilibrium by the SIT method and construct explicit feedback laws that stabilize the model. However, the practical implementation of these feedback controls is limited by the need for continuous and often difficult measurements. Finding a feedback control that ensures the global stability of the system with only more accessible measurements is a complicated mathematical problem. To overcome this, our approach focuses on the one hand, in building an observer for the SIT model to estimate the different states and on the other hand using deep reinforcement learning (RL) to suggest and construct feedback laws that only depend on these measurements (namely the adult mosquito population, which can be measured using pheromone traps).

This is a joint work with Jean-Michel Coron, Luis Almeida, Amaury Hayat and Nathan Lichtlé [1, 3, 4].

References

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