Inferring population dynamics of house-hunting ants

Christina Pantopoli

The behaviour of ant-species *Temnothorax albipennis* has been extensively studied by the Bristol Ant Lab, which led to the discovery of many mathematical models that examine and analyse the process of an ant colony emigration from one nest site to another. Some of these models describe this occurrence by a set of differential equations which detail the development of the different categories of the ants in a colony. However, they fail to take into account how complex is the process of an emigration and do not consider the difficulties of keeping track of the individual interactions between the ants.

Aims and Objectives

Previous work [1] has showed that there are restrictions in the equation discovery systems (Nutonian Eureqa and LANGRANGE), that were used to develop ODE (Ordinary Differential Equations) from position data since the systems can only accurately create individual equations. The aim of this project is to develop a new system that discovers ODEs as a set, it will consider the relationships between ODEs when creating them.

Stage 1: To generate an algorithm that would work as an equation discovery system that takes into consideration the dependency between different equations.

Stage 2: Integration of the algorithm and user interface design, to simulate a working model in a software by using C (a programming language) to find set of ODEs that are connected with each other.

Stage 4: To link the existing ODE models, Pratt and Planque models and agent-based models Pratt-Sumpter,AH-HA and SPACE models by the use of the new model, to create more accurate equations that represent the individual behaviours of the ants.

Deliverables

The development of an equation discovery model that can find coupled ODEs and through experiments figure out the error margin of the new system and if it could improve. Implement a software that will take different data and use the equation discovery model to create ODEs that depend on each other. Run the position data of the ants' emigrations through the software and conduct a statistical analysis of the results compared to the existing ODEs of the ants' emigration.

Added value

It will help compare agent-based computational models with population-based ODE models which will deliver more clear results for the population dynamics of ants during the process of ant emigration Also this project could help with the accuracy of a tracking software for the ants that is used as we could compare the data that is shown in the tracking software with the data that the ODEs will provide and use a statistical analysis to see their margin of error so as to improve the tracking software to take into account more variables or improve the system that discovers the equations.

[1] James Collerton. "Learning Population Dynamics in Ant Colony Emigrations" Department of Computer Science, University of Bristol, 2015