Background

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 seek to describe this occurrence by a set of differential equations which detail the development of the different categories of the ants in a colony. Although, these models generate the general behaviours of the ants, they fail to take into account how complex is the process of an emigration. There are other models that consider the difficulties of keeping track of the individual interactions between the ants, still their results cannot be handled efficiently and effortlessly.

Aims and Objectives

Previous work [1] has showed that there are restrictions in the equation discovery system (Nutonian Eureqa) that was used to develop ODE (Ordinary Differential Equations) from position data since the system can only accurately create individual equations and not system. The aim of this project is to develop a new system to discover equations more adequately so as to consider the relationships between a set of equations.

Week 17-19: To explore the various equation discovery models and understand how they work.

Week 20-23: Research and implement different techniques to figure out how a new system should perform to solve the complications of the existing systems.

Week 24-28: To generate the logic of a model that would work as an equation discovery system.

SV 1-3: To simulate a working model that uses a genetic algorithm or any other search method to find a set of ODEs.

SV 4-6: 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.

Deliverables

The Nutonian Eureqa and LANGRANGE will be used as examples of equation discovery systems and the work that was completed from previous thesis will be applied and try to form a system that does not have any restrictions for constructing ODEs. Through experimentation, the result will be the development if an equation discovery model that can find coupled ODE and implement this in functioning software.

Added value

This project's result will benefit in learning equations from biological data in a productive way that will offer biologists the opportunity to study their areas of fields more extensively. It will also 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.

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