

Project agreement, Alexandre Vanini: Research project, an ant war simulator.

Study on ant-bio-based robotic, behaviors and algorithms. **Supervisor** Payam Zahadat.

Bio-inspired robotic (or more commonly “Biomimetic”) is the art of studying the nature to replicate its behaviors into robotic to solve complex human problems. There are numerous examples such as the very famous “Japanese Bullet train” (Shinkansen) which gets its nose design from the Kingfisher bird’s beak (who’s aerodynamic), reducing the train’s energy consumption by 15%, making it 10% faster and quieter. Other examples are the use of insect-inspired algorithms for coordination within groups of robots, on land, air, or even underwater.

This project aims on studying the abstract mechanisms employed by ants during attack between colonies of the same species. Ants are one of the various social species that can be studied to create bioinspired algorithms and models of collective behaviors. They are very interesting because as a single unit, an ant is a very simple being, but as a swarm they show a lot of exciting collective behaviours and their underlying mechanisms can be studied and used for everyday problems.

This research project is meant to be a preliminary study that will hopefully develop into a master thesis.

The focus of this research project will be to do a literature survey and gather multitude of knowledge available on particular ants’ behaviors and approaches to their modelling and simulation. More specifically, I am interested in how individual ants in colonies of the same species coordinate and collaborate within their group while conducting a war. The mechanisms of interest span from breeding workers, food and supply gathering, protection, attack and defense plan to communication and pathfinder mechanisms. By collecting enough information, the idea is to create a complete study that will allow to continue the work in a future project, e.g., master thesis. The plan is to turn this study into an agent-based model of specific mechanisms simulating ant colonies in war. Moreover, once the master thesis work starts, we can make an informed decision if some of the studied mechanisms can be brought to a group of small physical robots as a proof of concept, so to have a real life simulation of “ants doing war”.

Even though biomimetic on ants is a very studied topic with numerous papers, videos and books about the subject, there is no proper implementation of an ant war simulator. The closest implementations of it are simulations of pathfinders (here is an example found on Github: <http://bwiklund.github.io/ant-simulator/>). It is very likely that this project will be a reflection of all the studies, such as “Combat between large derived societies: A subterranean army ant established as a predator of mature leaf-cutting ant colonies” written by Scott Powell or “The Remarkable Self-Organization of Ants”, written by Emily Singer.

As this research project is meant to be continued into a master thesis, it will mostly be about studying what has already been done and how. But also study and read on ants behaviors during attacks to sort out new mechanisms or study already existing ones. The idea is to process a lot of existing document (papers, videos and code implementation) to be able to be very specific on how such a simulator could be built (technology stack, framework and languages), but also what would be the key point to take into consideration (algorithms, behaviors, ant species, etc..).

The project should result into a literature study paper on available algorithms that model ants as individual agents working together to show particular collective behaviors in colony level, relevant methods and implementation tools for simulating such systems, and a draft plan of future work for implementation of an ant simulator and analysis of the resulting behaviors, e.g., in the master thesis.. It will also define the limitations and uses of such a simulator, the interesting behaviors to implement or create and study mechanisms that can be used elsewhere.