MATLAB FS11 – Research Plan
Desert Ant Behavior

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General Introduction

The study of the desert ant behavior adopted for finding food is of particular interest as it shows how ants' approach is incredibly elaborated and efficient despite the enormous environment - with respect to their size - in which they operate.
In the past century biologists have tried to explain this phenomenon with theories that have been disproved only around the late 80's. The study of desert ant behavior can thus be considered a fairly new subject.

Fundamental Questions

The goal of the project is to understand and illustrate the techniques used by desert ants to navigate in a vast and hostile environment. In particular, we would like to be able to answer to the following questions:

- Which mechanisms do ants adopt to navigate into the desert in order to find a food source and return to the nest? Is there a technique that performs significantly better than the others?
    - We would like to describe and compare the three main methods, namely path integration, skylight compass orientation and landmark orientation. Are they independent of each other? If not, how are they combined in order to obtain an optimal result?
- In which environment does a method work better than the other options?
- Do ants communicate their position and compass information to help each other?
- How can ants remember exactly a path that is thousands of times their body length?

Expected Results

The goal of the research is to show that the desert ant's behavior to find a food source can be described with well-defined and advanced mathematical and/or

physical models. It is also expected to get a basic understanding of how ants retrieve and process information coming from the surrounding environment (e.g. how do they calibrate their "internal" compass). Moreover, we would like to perform simulations of the three methods in a number of different environments and rank their performances.

References

Local and global vectors in desert ant navigation, M. Collet, T. S. Collet, S. Bisch & R. Wehner;
Desert ant navigation: how miniature brain solve complex tasks, R. Wehner;
Path integration in desert ants, Cataglyphis fortis, M. Müller & R. Wehner

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Research Methods

It is not known yet which model(s) will be used to describe desert ants' behavior because most of them have not been covered in the lecture. The Cellular Automata model, however, could be used to capture the movements of an ant (which should be based on the already visited neighbor cells). This section is most likely subject to change as the research progresses.
