A micro robotic platform to study cooperation and resilience in ant colonies
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Introduction

The main goals of this project are to develop an ant-sized magnetic agent that is capable of interacting with living ants and a durable technique to mark and track the ants. The motivations are to understand:
1. How infections spread within a colony through local interactions.
2. How the physical touch through antennae can influence the colony behavior and work cycles.

Production of the magnetic agents

For the first set of experiments where we want to study spread of infections, we glued a pathogen-carrying ant on a rectangular magnet (Fig. 1).

For the second set of experiments, we constructed a prototype (Fig. 2) with a magnet embedded inside an elastomer (PDMS) body and decorated the head with artificial polymer antennae.

Improvement of trajectory emulation

The position of the agent is controlled through a MATLAB code developed by our supervisor.

We modified this program to generate patterns that closely mimic the trajectories of real ants by including the rotational manipulator. The trajectories of real ants were previously recorded using tags glued on individual ants (Fig. 3).

Optimization of experimental platform

The agents are driven by two permanent magnets attached to three manipulators (two planar and one rotational) to mimic the movement and behavior of the ants.

A gear system (Fig. 4) was added to the rotating manipulator to multiply its speed by 3.6 and emulate the movement of the antennae. In order to achieve a smooth movement, the arena was coated with Teflon tape.

Identification system for marking individual ants

Previously biologists had to manually paint each individual ant to classify them during the aging experiments. This process was time consuming and the paint wasn’t durable.

To address this issue, we successfully designed and 3D-printed polymer rings (Figs. 5&6) with a binary code (64 combinations) assigned by weekly age. These rings provide a permanent solution for lifetime tracking (~1 year) and they can be easily applied with simple tweezers.