Decentralized Control of Communicating Agents

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Objectives

- Design distributed algorithms for the coordination of multiple robots.
- Determine bare minimum requirements for sensing, communication bandwidth, and computation power that will enable the micro robots to act in a coordinated manner.
- Improve the fidelity of the models by incorporating features and capabilities of the robots, such as noise and turning constraints.

Simulation Environment

- Focus on modular programming
  - Models of each aspect of the robots can be easily modified/swapped
- Realistic sensing capabilities
  - Robots only know distances not directions
- Realistic movement capabilities

We used the model of a bristle bot to determine the movement of the “robots” in our simulations

Completed Algorithms

- Follow the Leader
- Circular Formation
- Leader Rendezvous
- Equidistant Circle
- Leaderless Rendezvous

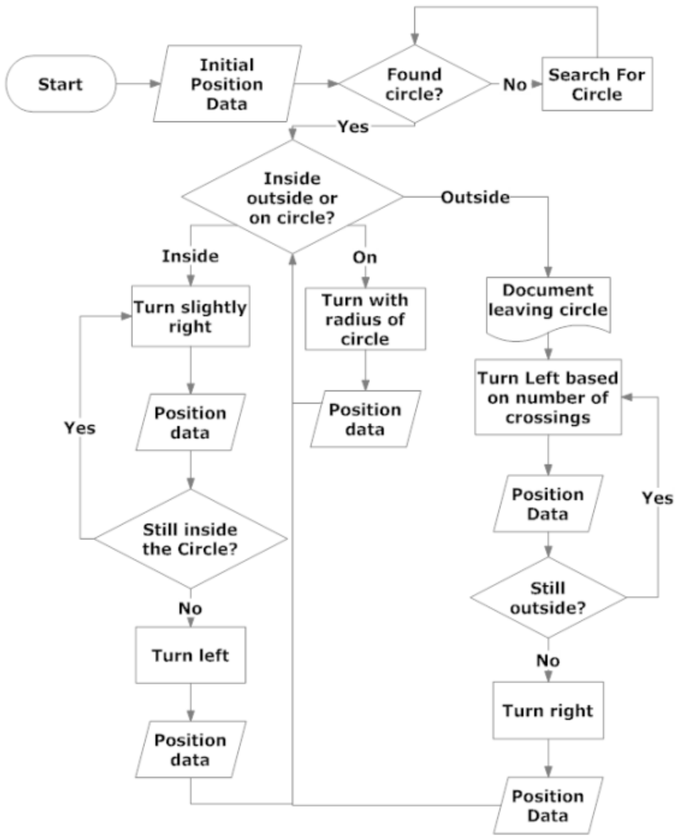
Future Work

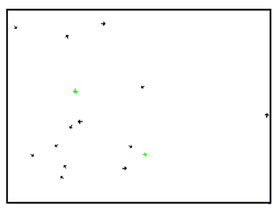
- Implementation in Bristle Bots
- Additional tuning for noise and collisions

Equidistant Circle

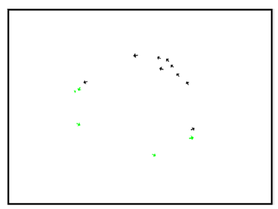
Algorithm Goal
Robots travel counterclockwise

Control Summary
Turn right while inside the circle and left while outside the circle

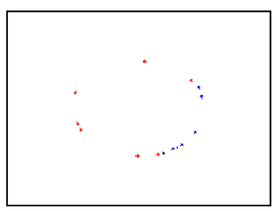




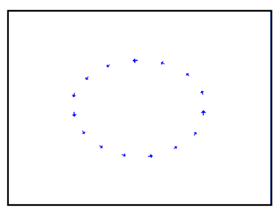
Initial randomized placement



Finding the circle to travel along



Communicating to neighbors on circle

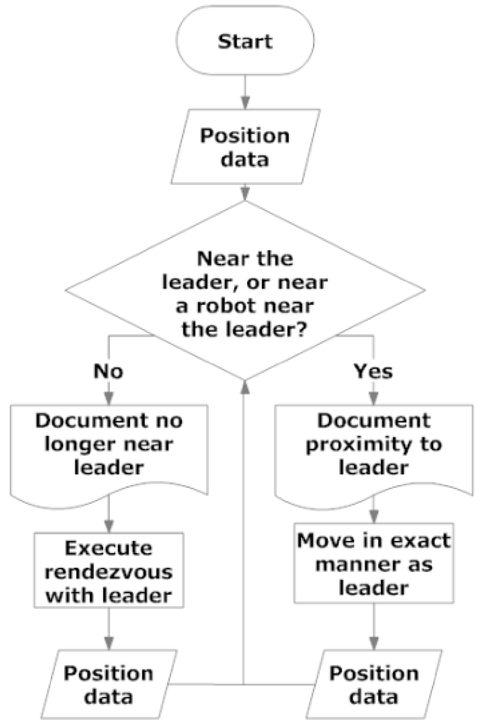


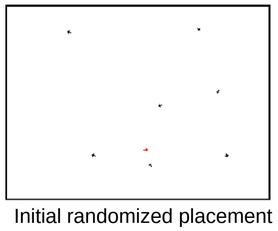
Equidistant spacing while traveling in circle

Follow the Leader

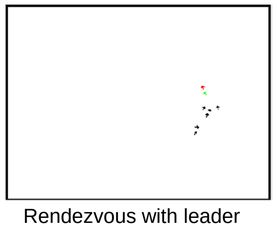
Algorithm Goal
Robots will follow a leader who is on a predetermined path

Control Summary
Robots move with the leader when close and rendezvous otherwise

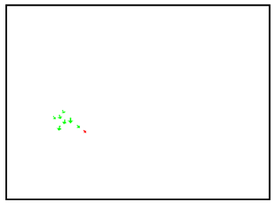




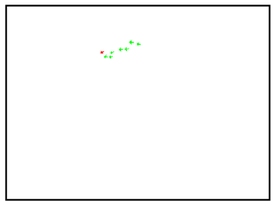
Initial randomized placement



Rendezvous with leader



Following leader

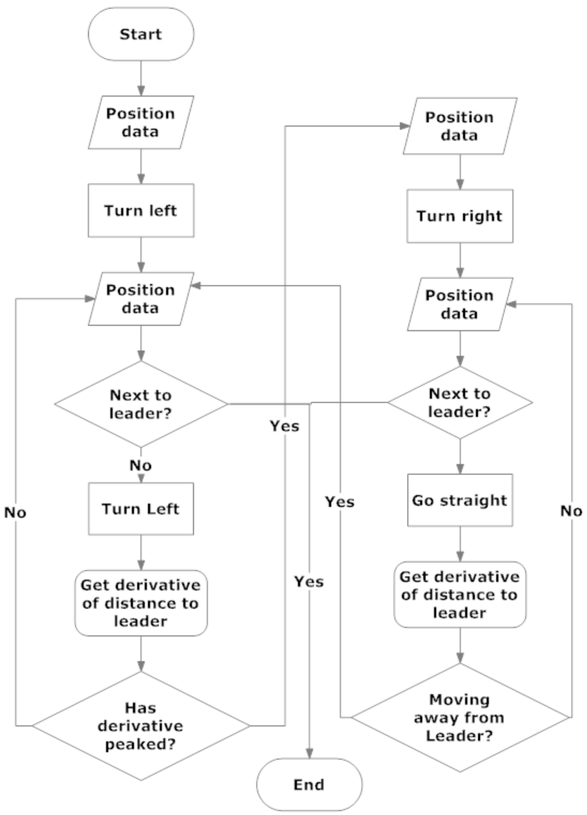


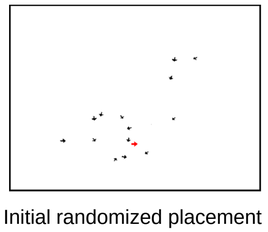
Continue following leader along predetermined path

Leader Rendezvous

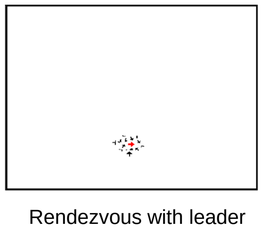
Algorithm Goal:
Assemble all the robots around a stationary leader

Control Summary:
Each robot turns until derivative of its distance to leader is minimized





Initial randomized placement



Rendezvous with leader

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