Assignment 3: Swarm Robustness

CS 491/591: Programming Swarm Robots
Assigned October 10th, 2017
Due: October 30th, 6:00pm Mountain Time
Version: 1.1
Last modified: October 28, 2017

1 Change Log

- Changed the maximum number of pages in the report to 5.

2 Description

This project is based in Bjerknes and Winfield's 2013 paper entitled "On fault tolerance and scalability of swarm robotic systems". The major claim in this paper is that the emergent swarm behaviour they describe does not become more robust as the number of agents increases.

You will work with your assigned partners to extend the ARGoS epuck simulation we have been building in class. This new simulation will implement the directed flocking algorithm described by Bjerkes and Winfield. In the paper they had 10 physical epucks and extrapolated to large swarms using a mathematical model. Your team will simulate large swarms in order to support or question Bjerkes and Winfield's conclusions.

Format your 5 page paper as described in the syllabus. Use the peer review rubric to guide your writing and figure creation.

2.1 Introduction and Related Work

Give the background of your question and formulate a hypothesis about whether Bjerkes and Winfield's prediction will be supported by experiments using the ARGoS simulator. Your hypothesis does not need to proven correct in your paper - being proven incorrect is just as valuable, but the hypothesis has to be clear and testable. This hypothesis forms the backbone of your paper.

2.2 Methods

1. Implement the algorithm described in the paper for flocking and following a light.
2. Implement the three failure types described in the paper in your simulation.
3. Create argos experiment files with 10, 30, 50, 70, 100, and 120 robots for each of the three failure cases.

4. In your experiments explore the relationship between time to complete the task and the number of robots.

5. When running your experiments repeat each trial 100 times ($6 \times 3 \times 100 = 1800$ trials total for the paper). You will need to turn off the graphics in ARGoS and find a way to run ARGoS many times automatically to get your data.

2.3 Results

1. Show the time taken for the swarm to reach the beacon as a function of swarm size using a notched box-plot.

2. Repeat the analysis for each type of error.

3. Is the time taken related to the swarm size linearly? If not what is the relationship.

2.4 Discussion

Was your hypothesis correct? If not why not, if so, why so? Are your conclusions the same as Bjerknes and Winfield? If not what explains the difference. If your results are the same describe how they were able to predict your results without running large swarms.

References

Place references to the sources of information you used in this assignment. Make sure you reference all code you used to implement your swarm, scientific papers, and books. You may cite websites. You will be graded on the quality and reliability of your sources. Stackexchange is much less reliable than a published book for example.

Author contributions

Include a contributions statement before the introduction section. The contributions may fall into three categories: analysis, code, and writing. For example your author contribution statement might look like this:

\section*{Author contributions}
J. C. wrote the code that generated Figs. 1, 3, and 5. V. W. wrote the code that generated Fig. 4. Both authors wrote the code that generated Figs. 6 and 7. J.C. wrote sections 1 though subsection 2.3, and section 3.6 of the paper. V. W. wrote subsection 2.4 through 3.5. The authors wrote sections 4 and 5 together. J. C. performed stability analysis for the map and V.W. identified the fixed points for the flow.

3 Notes

Format your paper as described in the project section of the web syllabus. Use the ACM paper template provided. Organise the paper into the following sections:

1. Abstract
2. Introduction
3. Related Work
4. Methods
5. Results
6. Conclusions
7. References

The paper may not exceed 5 single spaced pages including references.