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Using Supercomputers to Control Multiple Robots

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Abstract

Supercomputers have been a key enabler to many technological advancements. The pipeline to develop capable supercomputer users is years long. Getting started with a supercomputer can be difficult. As a part of the XSEDE EMPOWER Learner program, this research focuses supercomputer user development. SWOSU students do not have working code for many of the training modules available for learning supercomputing. This research details the development of these codes based on materials provided by the National Science Foundation, Shodor Foundation, and National Center for Supercomputing Applications. The result of this research is a better understanding of supercomputing training and more tools available to SWOSU students.

Project Plan

The progress plan is to first simulate an autonomous TurtleBot in Gazebo using ROS (robot operating system). After it can be proven and tested that a single simulated robot can move around a track in simulations then we will move up to two simulated robots. Once two robots can be simulated and sent upon their goals then we will add more simulated robots. The plan is to keep adding robots to the simulation until we feel we have reached an amount we can constitute as a swarm. Once we can simulate and control multiple robots in the simulation environment the plan is to pass the control over to the supercomputer and slowly increase the number of machines it controls and simulates starting at one.

End Goals of This Project

Up until now, we have been working mostly in the Simulation environments and on computers. But to test the extent of the supercomputer's ability to handle making multiple varying decisions for multiple machines is to build and run a physical robot swarm. The goal is to have the supercomputer play two on two matches of soccer against itself. The physical robots we plan to use are modified remote-controlled cars. The plan is to give them raspberry pi "brains" to send data back to a raspberry pi cluster and to take commands from the cluster and move the robot accordingly.

Autonomous Swarm Robotics

Group or swarm robotics is not a new concept. The Swarminoid project is a great example of a group of robots working together to perform a task. In this project there were three robot types (footbot, eyebot, and handbot) that all worked together to perform a task. Each type served a role in achieving the same goal. While this setup worked well, the focus of this research is how can a supercomputing environment make these decisions and control the group. According to the article Swarm robotics: A review from the swarm engineering perspective in their abstract they define swarm robotics. "Swarm robotics is an approach to collective robotics that takes inspiration from the self-organized behaviors of social animals. Through simple rules and local interactions, swarm robotics aims at designing robust, scalable and flexible collective behaviors for the coordination of large numbers of robots". This is a great descriptor for the robotics portion of our research.

Research Goals

- Use supercomputing and machine learning to autonomously control a swarm of robots.
- Focus on how we can use the supercomputer to handle the decision-making process for a swarm of robots.
- Teach others to do what we've done.

Referenced works

. Brambilla, M., Ferrante, E., Birattari, M., & Dorigo, M. (2013). Swarm robotics: a review from the swarm engineering perspective. *Swarm Intelligence*, *7*(1), 1–41. doi: 10.1007/s11721-012-0075-2

. Ducatelle, F., Di Caro, G. A., Pinciroli, C., & Gambardella, L. M. (2011). Self-organized cooperation between robotic swarms. *Swarm Intelligence*, *5*(2), 73–96. doi: 10.1007/s11721-011-0053-0