

Research Plan

Osayame Gaius-Obaseki

HRBB 407

Mentor: Dr. Nancy Amato

Supervisor: Aditya Mahadevan

Department: Computer Science and Engineering

Program: DREU

Research Title

Adapting Roadmapping Based Group Behavior Techniques for Use in Real World Environments.

Description

This research aims to adapt techniques for simulating group behavior in multi-agent systems that use implementing roadmapping techniques to make them more realistic.

Purpose

I chose this area of research of research because it is vital to understanding multi-agent robotic systems. Understanding and simulating group behavior will allow behaviors to be studied as artifacts of a group, rather than that of an individual agent. Motion planning techniques applied to group behavior allow for the creation and simulation of collision-free paths for robots that have been designated a particular task. The implementation of these techniques in actual robots will improve the simulations.

Project Goals and Implications

This project will lead to a better comprehension of how multi-agent systems translate, and how the translation can be realistically simulated when using motion-planning techniques. The results could be scaled to model larger systems with many agents. The ability to simulate the behavior of these agents before experimentation will reduce development time and possible errors. Furthermore, this research would allow for better modeling of agents in the real-world. A real-world application of this would be the simulation of flocking patterns in birds during disasters or changes in seasons.

Personal Goals

This research will develop my skills as a researcher in the field of robotics. This summer and my following two years as an undergraduate are vital in my preparation for higher levels of academia. I hope the relationships I develop this summer will aid me in continuing my research after I graduate from my current institution.

Approach

My research approach will involve: familiarizing myself with previous research done in my field that will be helping in solving this problems; experimenting with the code-base and simulations already available at the Parasol Lab; writing new roadmap based simulations and reconfiguring existing code. I will write code for recognizing markers in the environment. These markers are necessary to localize the robot in the environment. I will test this code both in simulation and with the iRobot Creates in a real environment.

Methods

I will primarily be programming the agents using the C++ language in a Linux-based operating system. The simulation of agents will be done on a UNIX system.

Work Schedule

I will be physically present in the Parasol Lab from 9am to 5pm daily, unless I am attending REU organized events.

Deliverables and Dates

June 8th – Initial website emailed

June 9th – Research Plan

June 6th – Midterm Evaluation

July 14th – Research abstract

July 21st – Final Website & Final Evaluation

July 22nd – Final Research paper

July 22nd – Final Research poster

Mentor's Project Goals

Localization is one of the key components of practical robotics. Although it is hard in a completely unknown environment, it is easier in an environment whose features are known a priori. One scheme for localization in a known environment is to use visual markers that denote specific coordinate positions or features such as rooms. The goal for this summer is to implement one visual localization scheme and demonstrate that it works with a group of iRobot Create. The end-result of this project will be to show a pursuit-evasion scenario working in simulation as well as in a completely distributed manner on multiple robots in a real environment, using the aforementioned localization scheme.

Mentor's Student Mentee Goals

Project Specific Goals: This project has three parts. The first part is to implement marker-based localization within our simulation. Visual markers will be scattered in a virtual 3D environment. Agents in simulation will detect markers to localize themselves. The second part is to design 3D models of some real environments (e.g. our lab, or the 4th floor). The third part is to implement detection of actual markers using cameras (i.e. an actual vision sensor). The Student mentee will work in collaboration with other student mentees on the first two parts. The student mentor (Aditya Mahadevan) will handle the third part since it requires prior knowledge of image processing and camera

geometry. Once these parts are completed, the mentees will be responsible for verifying the correctness of the localization scheme in simulation and testing its robustness in a real-world pursuit-evasion scenario. Analysis of the results should be included in the final report.

General Goals and Expectations: During the course of the summer research, the student mentee will be required to read relevant papers assigned by the mentor (especially in the first two weeks). Papers deal with motion planning, multi-robot systems and computer vision techniques. These papers will be discussed at regular intervals. The student will also be required to submit weekly reports to the faculty mentor detailing their progress and describing any difficulties. In addition, they will interact with the student mentor daily and work on sub-goals.