Saurabh Mishra
Parasol Lab, HRBB 407
Faculty Mentor : Dr. Nancy Amato
Graduate Student Mentor : Daniel Tomkins
Department : CSCE
REU 2013
1 Project Title

Caravanning with Multiple Robots

2 Description

Caravanning is an application for distributed group coordination of movement amongst heterogeneous agents in an environment\[1, 2\]. This means that different agents (robots) can communicate with each other to find a valid path through a given space. Each robot might know a certain portion of the environment and by communicating with other robots, each robot will be able to find a path from the start to the goal.

3 Purpose

Caravanning has uses in the military, including construction and search and rescue missions\[1\]. One agent may not have the complete information about an environment, hence different agents must communicate with each other to find a valid path from the start to the goal configuration\[1\]. It might be costly to send all the information from one robot to the other. As the number of robots grows it will be expensive to send all the information from one robot to another. We provide a method where, instead of sending the information about the environment, a robot that has the information could become the leader and guide all the other robots through the space. The algorithm can swap the leader when required and the robot with the new information will then become the leader.

4 Project goals and implications

My goal this summer is to incorporate more physical robots in the caravanning system. Currently the method works well with two robots in the physical environment. One of the main problems is that when a long chain of robots tries to move around a corner, the robot towards the end tends to collide with the wall or lose sight of the leader. Also as the chain grows, it becomes harder to select a leader, as more information will need to be passed to every robot\[3\]. After the leader is elected, we will have to ensure that it reaches the leader position correctly. My primary goal is to understand the working of the current system and then come up with new methods to incorporate more robots. I plan to get this system working with at-least four to five physical robots. I will also ensure that the robots follow the leader and do not collide with any obstacles in the path.

After this, the next step is to improve the leader election process. In this process, all the robots communicate with each other and try to find which robot knows the environment best. The robot with the best information is elected as the new leader and the other robots follow it. As the number of robots grow, it becomes expensive to send the information to every robot. I will work towards making a new algorithm that is more efficient than the current one. After the new leader is elected, I will make sure that the new leader reaches the leader position correctly. There might be cases where the path is narrow and it will be difficult to plan in those areas. My mentor has suggested that I use a backwards RRT from the current leader to the new leader and guide the new leader to the leader position.

5 Personal Goals

My personal goals is to learn more about motion planning so that I can continue researching in this field. I also want to get a better understanding of programming in C++. I would like to gain more knowledge in the field of robotics. I want to take the robotics class in the future and this would help me do better in that class.
6  Approach

• I will first understand the current working of the system and then develop a new algorithm to improve the system.

• I will start by reading more about the current method and how it works. Once I understand the current method, I will find why it does not work with more physical robots.

• I will come up with an algorithm using which the robots can follow the exact path as the leader. This way, if the leader finds a correct path from the start to the goal, the robots following it will also do the same.

• My second goal will be to improve the leader swapping. This is the part where a new leader, who knows has the information for the environment, is elected [1].

    I might not be able to get all this done in the given time but I should at-least get more robots to caravan. If I accomplish enough I will be able to contribute something towards a publication by the end of this summer.

7  Method and Materials

• C++ - We program the robots using C++ programming language.

• Linux Environment - The computers we use to program the robots work on the Linux operating system.

• Vizmo - It is a 3D visualization/authoring tool for files provided/generated by OBPRM motion planning library. It allows you to display workspace environments, roadmap, path, and start/goal positions.

• iRobot Creates - These are the physical robots that we use in our system.

8  Work Schedule

I am expected to be physically present in the Parasol lab from 10am-6pm, except when attending the REU events or lunch. I am also allowed to come to the lab any other time and work on the project.

9  Deliverables and Dates

1. Weekly report - Due every Saturday before mid-night
2. Research Plan - Due June 13 at Brown Bag
3. Initial Website - Due June 21
4. Ethics Training - Due June 21
5. Progress Report and 5 Week evaluation - Due July 11
6. Abstract Due - Due August 5
7. Research Paper and final Website - Due August 7
8. Final Evaluation - Due August 9
10 Mentor’s Project goals

I would like Saurabh to scale up the system to have more robots. I want him to understand how the caravanning process works and think about better ways of solving the problem. He should try to come up with efficient ways of incorporating more robots. After this, he can try to improve the communication between the robots.

11 Student Mentee goals

I expect Saurabh to become familiar with the problem of motion planning and come up with better techniques to solve the problem. He should understand how to approach a problem and work in a team to get the best results. He should make daily progress and understand that research is a part of education and not just a job. I also want him to learn our group research infrastructure so that he can continue to work with the Parasol Lab after the summer and contribute towards a publication.
References

