TEXAS A & M UNIVERSITY
REU Program
RESEARCH PLAN

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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REU

1. Research Topic

Motion Planning in Multi-Agent Systems

2. Description

Motion planning is used to solve the problem of finding a valid path to move a robot from one point to another in a environment. The problem of moving robots from one place to another gets harder when there is more than one robot involved and each one of them has to find a valid path which does not interfere with the paths of other robots. This can be done in a centralized or decentralized manner and agents are restricted by behaviors[1].

The importance of applying motion planning for multi-agent systems comes from the need of performing coordinated movement for completing a task. For example, it can be used for space probes that cooperate with other space probes for taking photos of the surface of the moon. Another example could be moving some agents at the same time in a 3D simulator without colliding between them or with the statical objects in the environment.

3. Purpose

I have worked before with algorithms related to robot movement in an environment with obstacles so I can contribute with new ideas and of course with a new point of view. By taking part in the Group Behaviors project, I can extend my knowledge about the motion planning techniques used today to solve different problems related to motion planning in robotics and other fields. Also I can have new ideas to apply to different projects in which I am involved.

I want to use this topic for my Computer Engineering & Telematics Engineering Bachelor Degree Thesis and continue with the research after it.

4. Project Goals and Implications

The multi-agent system research will contribute to the work that has been developed in the laboratory, adding the difficulty of using more than one robot and giving valid trajectories for each one of them. These trajectories must not interfere with other agent paths and this is what makes the problem harder than the motion planning for one agent.

5. Approach and Student Goals

Personal Goals

By the end of the research summer program, I expect to acquire more experience with motion planning and robotics. I also expect to improve my research abilities which include: Learning more from reading papers, improving my writing skills and being more analytic with the information obtained while researching. I want to write a Thesis related to this topic and publications.

Approach

I'm going to work directly with the motion model of the multi-agent system and the global and local planners. We can define the motion model as the module that controls the inputs of the system and the

agent's states.

My basic activities include reading different papers related to multi-agent systems, and understanding the related work that has been done before. Then I have to implement an abstraction of the motion model and determine its role in local and global planners.

Method & Materials

The textbooks proposed by my Faculty Mentor and my PhD Student Supervisor include "Principles of Robot Motion: Theory, Algorithms and Implementations"by Howie Choset, Kevin M. Lynch, Seth Hutchinson, Sebastian Thrun, et al.

The programming language used is C++. We can consult and use the functionality in PMPL (Parasol motion planning library) and the multi-agent system framework which my research will contribute to.

PMPL is a library which contains all the basic functions for motion planning. The multi-agent system framework will contain all the functionality developed for simulating behaviors and interactions of agents in multi agent systems.

Work Schedule

Students are expected to spend a minimum of 40 hours in the lab each week working on their research. These should include at least the hours of 10am to 6pm on Monday through Friday, which are the hours that all Parasol lab members are expected to be in the lab to facilitate meetings.

Deliverables and Dates

I have to deliver to my Faculty Mentor, Dr. Amato, and my Graduate Student Mentor, Jory Denny, a weekly report which includes all my activities including Seminars and meetings. Also I have to participate in the weekly Motion Planning meeting and other meetings for discussing different projects.

The deliverables for the REU program are specified in the next list. Some of them coincide with the ones asked by my Mentor. Also included are the deliverables related to the multi agent proposal.

- **June 13.** Research Plan
- **June 21.** Initial Personal Website (REU).
- **June 21.** Ethics Training (REU).
- **July 8.** Implementation for holonomic agents. Motion model.
- **July 11.** 5 Week REU Evaluation.
- **July 11.** Progress Report (REU)
- **July 19.** Implementation for Non-holonomic agents. Motion model.
- **July 22.** Integrate the code with the rest of the team.
- **August 5.** Abstract (REU)
- **August 7.** Research Paper (REU)
- **August 7.** Final Website (REU)

- **August 8.** REU (UGR) Poster Session
- **August 9.** USRG Poster Session
- **August 9.** Final Evaluation (REU)

6. Faculty Mentor Expectations

Project goals

The goals of the project can be summarized as:

- Improve a motion planning method for a multi agent system.
- The undergraduate student can get valuable experience and gain potential to pursue serious independent research with advanced students.

Student Mentee Goals

By the end of the Summer it is required to have the individual part of the project implemented and ready to join it to the rest of the team work. The individual work must be tested, probed and documented. A poster, which includes the abstract and a resume of the research and the results, must be presented .

I expect her to get familiar with the research infrastructure of our group so she can continue to collaborate with us when she returns to her home institution with her advisor Prof. Marco Morales.

Referencias

[1] H. Choset, K. M. Lynch, S. Hutchinson, G. A. Kantor, W. Burgard, L. E. Kavraki, and S. Thrun. *Principles of Robot Motion: Theory, Algorithms, and Implementations.* MIT Press, Cambridge, MA, June 2005.