Research Title:
Region Identification in Unsupervised Adaptive Strategy Framework

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Description:
The problem statement of Motion Planning is to figure out a path from the start location to the end location in a given configuration space. To accomplish this task several planners have been researched upon. Different planners take different parameters and constraints into account to optimize the motion planning process. Several adaptive strategies have been proposed by researchers where the planner adjusts the algorithms based on the environmentally determined factors. The paper "An Unsupervised Adaptive strategy(UAS) for constructing Probabilistic Road Maps" demonstrates a planner demonstrating a combination of different learning adaptive strategies to make the Motion planner more practical and efficient. The UAS require less user intervention, model the topology of the problem in a reasonable and efficient manner, can adapt the sampler depending on characteristics of the problem, and can easily accept new samplers as they become available.

Unsupervised Adaptive Strategy(UAS) for constructing Probabilistic Roadmaps primarily talks about integration of two existing Motion Planning Algorithms viz. Feature Sensitive Motion Planning and Hybrid PRM. Firstly, this UAS planner implements the feature-sensitive framework to accomplish division of a simplistic environment into optimal homogeneous regions or clusters based on subdivision strategies guided by the K-means clustering algorithm. It then uses the Hybrid PRM algorithm to further sample and connect the nodes in each cluster using different sampling algorithms based on topology. This approach outperforms the Hybrid PRM and Feature sensitive Motion Planner by implementing both topological and sampler adaptation with minimum user intervention.

After a few discussions with my group, with this research paper in mind, a few major research areas interest me further. First, I would like to study the effect of increasing the complexity of the environment parameters and constraints. This way I will test the UAS algorithm for robustness with increased complexity. Next, I would also like to try experimenting with the clustering techniques(currently k-means) by changing them to study and compare the resulting clusters for factors like better modeling of homogeneity and their effect on the efficiency of the Planner. With testing multiple clustering methods we can conclude if there is a more efficient clustering algorithm that could be used for the UAS thereby making it more competent. Lastly, I also would like to test the effect of varying the number or type of parameters used to define the configurations. This might also affect the outcome of the partitioning algorithm by making it generate more relevant results and can be an issue worth looking into.

Purpose
Region Identification is an important factor for optimising Motion Planning. The research aims at using and developing better Region Identification techniques to improve the Unsupervised Adaptive Planners.

Project Goals and Implications:
At the end of the project we should be able to conclude if the region identification in UAS has improved as it is critical to the performance of the planner.

Personal Goals
Through this I want to get an opportunity to work on the challenges the problem Motion Planning entails and figure out how these challenges can be resolved. I also want to gain insight into the application process for the graduate school and the different programs that were offered. I also expect the project to provide me with an environment where I can socially network with students from several universities who are interested in my field of research.

Approach:

- Identify the different clustering techniques and environmental parameters after discussions with my mentor and research of my own
- Implement theses new methods.
- Test the modified planners for more complicated test environments and in the process document the observations and conclusions.

Method and Materials:

We will implementing our algorithms using C++ along with the existing Motion Planning Framework at the Parasol Motion Planning Lab to accomplish our targets.

Work Schedule

40 Hours per Week.

Deliverables and Dates:

Week 1-2: Background reading on different aspects of motion planning, Website [June 11th at 12:00 p.m.], Research Plan [June 11th at 12:00 p.m.]
Week 3-4: Implement and evaluate different clustering techniques
Week 5-6: Implement and evaluate new partitioning features
Week 7-8: Implement and evaluate complex environments, Research Abstract [July 23rd at 12:00 a.m.]
Week 9-10: Research Poster [August 3rd at 8:00 a.m.], Final Research Paper/Website [August 5th at 12:00 a.m.]

Gig 'em Aggs!