Robotics and Embedded Systems

KI.FABRIK

Master/Bachelor Thesis – Semester Project

Path Planning Algorithms via Open Motion Planning Library (OMPL)

Background

Open Motion Planning Library (**OMPL**) [1] assist mobile robots, manipulators, and humanoid robots plan optimal path non-collided dynamic/static obstacles with in the configuration space (C-space). One of the challenges in OMPL is to develop appropriate algorithms which involves multiple factors and engineering restrictions. Optimal path planning is the problem of finding a valid sequence of states between a start and goal that optimizes an objective [2]. Therefore, the integrated benchmarking system is used for examining algorithms. Recently, Adaptively Informed Trees (**AIT***) and Effort Informed Trees (**EIT***) [2] has been proposed to allow sample-based algorithms to perform heuristic function in solving goal-based tasks with reverse research method, such as applying the Lifelong Planning A* (**LPA***) [4] that calculates accurate cost heuristics. Batch Informed Trees (**BIT***) [3] takes advantage of Informed graph-based searches and unifying Anytime sampling-based planners with alternately approximate and search the problem domain. However, those mentioned algorithms cannot well perform the tasks If desired goal is other side of a corridor from the initial states. As known as the Narrow passage problems.

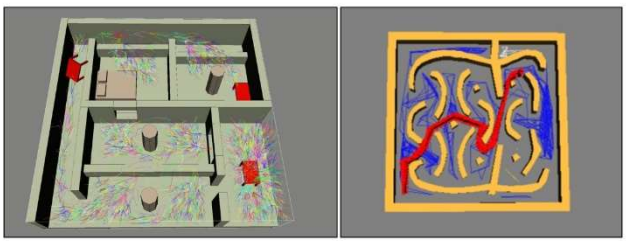
Your Tasks

In this thesis, your task will be learning state-of-the-art knowledge of robot motion planning and OMPL. Further step will be developing more advanced algorithms compared BIT*/AIT*. To be specific:

1. You will first learn basic knowledge of robot motion planning.
2. You will reproduce the results from OMPL and other related research topics. By doing this, you will have a deep understanding of sample-based tree-like algorithms and the state-of-the-art research results.
3. You will benchmark different algorithms properties using OMPL database.

Requirement

- High self-motivation;
- Approx. six-month working time;
- Experiences or knowledge from related courses;
- C++ programming experiences.



a) Piano Mover's Problem b) Fast Marching Trees

Figure 1 Overview of the benchmark environments.

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[1] Sucan, Ioan A., Mark Moll, and Lydia E. Kavraki. "The open motion planning library." IEEE Robotics & Automation Magazine 19, no. 4 (2012): 72-82.

[2] Strub, Marlin P., and Jonathan D. Gammell. "Adaptively Informed Trees (AIT*) and Effort Informed Trees (EIT*): Asymmetric bidirectional sampling-based path planning." The International Journal of Robotics Research 41, no. 4 (2022): 390-417.

[3] Gammell, Jonathan D., Timothy D. Barfoot, and Siddhartha S. Srinivasa. "Batch Informed Trees (BIT*): Informed asymptotically optimal anytime search." The International Journal of Robotics Research 39, no. 5 (2020): 543-567.

[4] Koenig, Sven, Maxim Likhachev, and David Furcy. "Lifelong planning A∗." Artificial Intelligence 155, no. 1-2 (2004): 93-146.