Elastic Roadmaps In The Context Of Dynamic Narrow Passages

MSc. Project Proposal at the Autonomous Multi-Robots Lab, Cognitive Robotics, TU Delft

Brief description:

As the usage of mobile manipulators is shifting from confined environments towards more dynamic ones, motion planning algorithms must allow replanning during execution. Sampling based methods are widely used for mobile manipulation as they are able to deal with a large number of degrees of freedom. In contrast to single query methods (RRT, etc.) which compute a path from scratch for each planning request, roadmaps keep information on connectivity to decrease the computational cost for a specific request. Yet, most approaches are restricted to static environments and require full knowledge about obstacles [1]. Therefore, elastic roadmaps are proposed that allow online updating while keeping the computational burden low [2].
Within the framework of elastic roadmaps, algorithms for fast updating are developed and novel methods for connectivity checking are explored.
A common problem for sampling based methods consists of narrow passages as they are unlikely to get detected during the sampling process. Such passages also appear in dynamic environments and must be detected during the updating process of an elastic roadmap. In this context, using local planners for connectivity checking should be explored as these show improved behavior when dealing with dynamic environments compared to conventional connectivity checking. After developing a theoretical description of an algorithm, it should be implemented in the Robot Operating System (ROS) via the motion planning platform EXOTica [3]. In the final stage, experiences on a real robot system should be conducted to asses the efficiency of the method.

Desired qualities:

- Motivated and independent
- Good problem solving skills
- Interest and preferably experience in graph theory
- Experience in C++/python programming
- Preferably Experience ROS

Start Date: September 2020

For further questions or to apply, please contact M.Spahn <m.spahn@tudelft.nl>. When applying, please provide a short motivation, up to date CV, a transcript of your current degree program and intended start date.

Group information: http://www.autonomousrobots.nl/

References:

[1] W. Khaksar, M. Z. Uddin, and J. Torresen. Multiquery Motion Planning in Uncertain Spaces: Incremental Adaptive Randomized Roadmaps, 2020
[2] Y. Yang and O. Brock. Elastic roadmaps-motion generation for autonomous mobile manipulation, 2010
[3] V. Ivan, Y. Yang, W. Merkt, M. P. Camilleri, and S. Vijayakumar. EXOTica: An Extensible Optimization Toolset for Prototyping and Benchmarking Motion Planning and Control, 2019