IROS 2011 Tutorial:

Motion Planning for Real Robots

Sunday, September 25, 2011

URL: http://kavrakilab.org/OMPLtutorial

1. Abstract

This full-day tutorial will teach both novice and experienced participants how to setup, configure and use motion planning on a real robot. Novice users can expect to learn how to set up, configure and execute the perceptual, kinematic, planning and execution components required for motion planning on an advanced multiple degree of freedom robot. Expert users will be able to explore the motion planners in more details, focusing on how they can be reconfigured for particular tasks. The tutorial will be based on a set of tools within the OMPL (Open Motion Planning Library) and ROS (Robot Operating System) software. The participants will have access to simulated environments and real robots (the Willow Garage PR2 robots) for a hands-on experience in using motion planning with real robots. The tutorial will conclude with an examination of case studies based on suggestions from the participants and organizers, highlighting how the motion planners can be configured for particular robots or motion planning scenarios.

All tutorial material will be made available online after the tutorial at http://kavrakilab.org/OMPLtutorial.

2. Organizers

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3. Schedule

08:30–09:00	Overview and Introduction
09:00–09:30	Background on concepts in sampling-based motion planning
09:30–10:15	The Open Motion Planning Library (OMPL)
10:15–10:45	*Coffee break*
10:45–11:15	Introduction to ROS and connection to OMPL
11:15–12:00	Overview of the simulation environment
12:00–12:10	Live demo on PR2
12:10–13:30	*Lunch*
13:30–15:00	Hands-on programming of PR2 by participants, part I
15:00–15:30	*Coffee break*
15:30–16:00	Hands-on programming of PR2 by participants, part II
16:00–16:30	Discussion with participants and wrap-up

4. Motivation and objectives

Motion planning is easy to understand, yet state-of-the-art algorithms to solve motion planning problems in a general fashion can be hard to implement. Furthermore, integrating motion planning algorithms in a bigger software system targeted at specific robots is also challenging. The OMPL library implements many sampling-based algorithms and makes it easy to integrate with larger software systems and tailor to specific systems. ROS provides a very rich software infrastructure with perception, kinematics and execution components that can be integrated with planning to create a complete motion planning and execution pipeline. The tutorial aims to provide a high-level description of the motion planning algorithms in OMPL coupled with implementation level details on configuring motion planners on real robots. The tutorial will provide plenty of opportunity for participants to get hands-on experience with solving motion planning problems in real-world environments, both in simulation and on the robot using real sensor data.

After the tutorial participants should be able to:

- define motion planning queries and solve them with a planning algorithm,
- visualize the results,
- use the environment models that accessible through ROS interfaces for motion planning, and
- solve and execute motion planning queries for the PR2 hardware platform.

The skills obtained in this tutorial are easily transferrable to the rapidly growing list of other robots on which ROS can run (see http://www.ros.org/wiki/Robots).

5. Primary/secondary audience

We are primarily targeting participants who would like to learn to implement motion planners on real robots using realtime sensing. Some familiarity with ROS is desired but not essential. This will be a hands-on tutorial, so programming experience in C++/Python is desired. A secondary audience is researchers in motion planning who would like to build on the tools and components available in OMPL and ROS to create more advanced motion planners. This tutorial will also be of interest to educators wanting to use a stable, well-featured software tool for teaching motion planning.