EECS Graduate Seminar Series @ UC Merced

Presents

Safe Motion Planning under Uncertainty for Mobile Manipulators in Unknown Environments

Dr. Vinay Pilania

Mercedes-Benz Research & Development North America, Sunnyvale

Friday, Nov. 22, 2019. 11:45am-1:00pm; Location: CLSSRM 263

ABSTRACT:

For a mobile manipulator to operate and perform useful tasks in human-centered environments, it is important to work toward the realization of robust motion planners that incorporate uncertainty inherent in robot's control and sensing and provide safe motion plans for reliable robot operation. Designing such planners pose a significant challenge because of computational complexity associated with mobile manipulator planning and planning under uncertainty. Current planning approaches for mobile manipulation are often conservative in nature and the uncertainty is largely ignored. In this talk, I will describe our recent work on sampling-based efficient and robust mobile manipulator planners that use smart strategies to deal with computational complexity and incorporate uncertainty to generate safer plans. The first part of the talk addresses the design of an efficient planner for deterministic case, where robot state is fully known. I will introduce a Hierarchical and Adaptive Mobile Manipulator Planner (HAMP) that plans both for the base and the arm in a judicious manner – allowing the manipulator to change its configuration autonomously when needed if the current arm configuration is in collision with the environment as the mobile manipulator moves along the planned path. We show that HAMP is probabilistically complete. The second part of the talk deals with the computational complexity involved in planning under uncertainty. For that, I will briefly mention our localization aware sampling and connection strategies (LAS, LAC) that help to reduce the planning time significantly with little compromise on the quality of path.

Finally, I will discuss the incorporation of our planners within an integrated and fully autonomous system that carries out mobile pick-and-place tasks in unknown static environments. We demonstrate our system both in simulation and real experiments on SFU mobile manipulator.

BIOGRAPHY:

Vinay Pilania is a Staff Engineer – Motion Planning Algorithms at Mercedes-Benz Research & Development North America, Sunnyvale. Prior to that he was a postdoc fellow at the University of Michigan. He received the B.Tech. (Honours) and M.Tech. degrees from the Indian Institute of Technology (IIT) Kharagpur, Kharagpur, India, in 2009, and the Ph.D. degree in engineering science from the Simon Fraser University, Burnaby, BC, Canada, in 2015.

From 2009 to 2015, he held a research assistant position with Robotic Algorithms & Motion Planning Lab at Simon Fraser University. He has received Best B.Tech. and M.Tech. Thesis awards for designing a prototype of rescue robot for underground mine post disaster applications. He is also the recipient of Institute Silver Medal for best academic performance at IIT Kharagpur. His main research interests include motion planning under uncertainty and control, autonomous mobile manipulation, decision making under uncertainty, and manipulation of deformable objects.

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