MPC-Based Trajectory Planning with Prioritized Constraints

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

Context

Robots operating in the real world must be both *safe* and *efficient.* For example, a mobile robot may seek to reach its goal efficiently while avoiding collisions with humans and other objects in the scene. Model predictive control (MPC) provides a flexible planning paradigm for such settings by formulating the planning problem as constrained optimization. However, in scenarios with many constraints and/or prediction errors — e.g., collision avoidance in a crowded space — the optimization problem may become *infeasible*, i.e., it may not have a solution. This infeasibility leaves the robot without an actionable plan.

Objective

The objective of this project is to design and implement an MPC framework that avoids infeasibility by relaxing constraints *when necessary*. By additionally encoding a priority of constraints, this framework will ensure that less critical constraints (e.g. acceleration limits for comfort) are relaxed before more critical ones are violated (e.g. collision avoidance). The developed software module will be benchmarked in extensive hardware experiments on a mobile robot to demonstrate reliability in a realistic, dynamic environment.

Desired qualities:

- Motivated and independent with a strong engineering mindset: you will have to debug complex problems with many moving parts
- Experience in C++ programming, ideally knowledge of the Robot Operating System (ROS)
- Experience/interest in motion planning, constrained optimization, and MPC

For further questions or to apply, please contact Mr. Lasse Peters <l.peters@tudelft.nl> and Prof. Dr. J. Alonso-Mora <j.alonsomora@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/