Guiding Multi-Robot Local Motion Planning Using Machine Learning

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

Brief description: Motion planning and safe navigation for teams of robots like micro aerial vehicles (MAVs) is crucial for their deployment in real world applications such as aerial inspection, drone delivery and multi-view cinematography. Recent motion planning algorithms can efficiently generate global collision-free trajectories for a large number of robots in complex static environments [1]. These approaches are generally centralized and can provide completeness guarantees. However, the heavy computation burden of those approaches hinders their running in real-time. In contrast, distributed and decentralized motion planning methods [2] can be very efficient and can deal with dynamic changing environments. But they often lead robots to local minima or deadlocks. A promising solution to the problem is to combine the advantages of the global and local motion planning approaches [3].

The objective of this thesis is to develop a globally guided local motion planning method for multi-robot systems in cluttered environments. The main idea is to use an offline global planner to learn a motion guidance providing to a local planner, such as model predictive control (MPC), to improve its performance. Potential main works of the project include (i) collecting demonstration trajectories and extracting effective data using an offline global planner, (ii) leaning a trajectory guidance using deep learning and (iii) incorporating the learned global guidance with a local motion planner.

You will test your approach in experiments with multiple quadrotors (Crazyflie 2.1, Parrot Bebop 2) at the DCSC Lab and the Cyberzoo at TUD.

Desired qualities:

- Motivated and independent
- Good problem solving skills
- Experience/interest in motion planning, constrained optimization and machine learning
- Experience in Python/C++ programming and Robot Operating System (ROS)

For further questions or to apply, please contact Mr. H. Zhu <h.zhu@tudelft.nl> and Ass. 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/

References:

[1] W. Hönig, J. A. Preiss, T. S. Kumar, et.al., "Trajectory planning for quadrotor swarms," *IEEE Transactions on Robotics*, vol 34, no. 2, pp. 856-869, 2018.

[2] H. Zhu, and J. Alonso-Mora, "Chance-constrained collision avoidance for mavs in dynamic environments," *IEEE Robotics and Automation Letters*, vol. 4, no. 2, pp. 776–783, 2019.

[3] B. Riviere, W. Hönig, Y. Yue, et. Al., "GLAS: Global-to-local safe autonomy synthesis for multi-robot motion planning with end-to-end learning," *IEEE Robotics and Automation Letters*, 2020.