Improving Collision Avoidance Performance Online

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

Brief description: The number of autonomous robotic systems in human environments is overgrowing. Hence, safe and socially intuitive navigation is critical when moving among other robots and humans. Learning-based methods, such as Reinforcement Learning, have demonstrated amazing capabilities learning collision avoidance policies in complex and dynamic environments with a high number of agents [1]. Yet, such policies are learned offline based on simulated data and may fail when applied in real scenarios due to the Real-to-Sim gap. In contrast, online learning has been used to learn a time-varying dynamics model improving the navigation performance of an autonomous racing vehicle [2]. However, applying directly online learning algorithms to learn a collision-avoidance policy in dynamic environments is dangerous because a policy trained in this way may suffer from unexpected behaviors [3]. To this end, this project aims to develop a safe online learning algorithm that can improve the collision avoidance performance of a pre-trained policy in a real scenario.

You will test your approach in experiments with a mobile robot (Jackal) and on-board sensing and computing (RealSense D435i, NVIDIA Xavier) at the CoR Lab and the Cyberzoo at TUD.

Desired qualities:

- Motivated and independent
- Good problem solving skills
- Experience/interest in optimization algorithms, reinforcement learning and/or autonomous navigation
- Experience in C++ programming, Python and Robot Operating System (ROS)

For further questions or to apply, please contact B. Brito <bruno.debrito@tudelft.nl> or 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.alonsomora.com/

References:

[1] Everett, Michael, Yu Fan Chen, and Jonathan P. How. "Collision Avoidance in Pedestrian-Rich Environments with Deep Reinforcement Learning." arXiv preprint arXiv:1910.11689 (2019).

[2] Wagener, Nolan, et al. "An Online Learning Approach to Model Predictive Control." arXiv preprint arXiv:1902.08967 (2019).

[3] Zhang, Jiakai, and Kyunghyun Cho. "Query-efficient imitation learning for end-to-end autonomous driving." arXiv preprint arXiv:1605.06450 (2016).