

Benchmark of Multi-agent Reinforcement Learning for cooperative driving

Background

Since cooperative driving plays an important role in promoting a harmonious traffic environment, the cooperative driving policies are becoming more popular than self-interested policies. Recent years have witnessed significant advances in Multi-agent reinforcement learning (MARL), which has registered tremendous success in solving collaborative and competitive decision-making problems. MARL has achieved good results in online games, but it is still rarely used in the autonomous driving field. A benchmark of cooperative driving using MARL should be established.

Description

Multi-agent interaction is a fundamental aspect of autonomous driving in the real world[3]. Since we already have the CommonRoad RL platform¹ for single agent[2], its easy for us to develop a multi-agent edition based on that.

The thesis includes the following steps: First, the performance of different MARL algorithms with different RL libraries [1] [4] should be compared on the CommonRoad highway scenarios, which becomes the first basic benchmark of CommonRoad MARL. If RL libraries are not used, the algorithms to be embedded into the same framework for convinence. Next, the more complexed cooperative goals should be designed and converted to CommonRoad planning problem format. Since ample scenarios are contained in CommonRoad, the cooperative tasks should be found out from them. And the same as before, the performance of different algorithms should be compared on CommonRoad Scenarios.



Graphic taken from ²

¹<https://commonroad.in.tum.de/>

²<https://www.car-2-car.org/about-c-its/>



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Research project:

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Type:

BA/MA

Research area:

Multi-agent Reinforcement Learning

Programming language:

Python

Required skills:

Advanced programming skill, able to work independently, familiar with basic deep learning knowledge

Language:

English

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Tasks

- Literature review of works related to MARL algorithms and cooperative driving
- Familiarizing with the current MARL framework, the CommonRoad platform, and the existing RL libraries(e.g.RLlib).
- Evaluation of the performance of different RL algorithms with different RL libraries like RLlib[1] on CommonRoad scenarios
- Defining and implementation of other complex cooperative driving tasks using MARL algorithms, including ramp and crossroads
- Documentation of codes and other related materials

References

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- [2] Xiao Wang, Hanna Krasowski, and Matthias Althoff. Commonroad-rl: A configurable reinforcement learning environment for motion planning of autonomous vehicles. In *IEEE International Conference on Intelligent Transportation Systems (ITSC)*, 2021.
- [3] Ming Zhou, Jun Luo, Julian Villeda, Yaodong Yang, David Rusu, Jiayu Miao, Weinan Zhang, Montgomery Alban, Iman Fadakar, Zheng Chen, et al. Smarts: Scalable multi-agent reinforcement learning training school for autonomous driving. *arXiv preprint arXiv:2010.09776*, 2020.
- [4] Ming Zhou, Ziyu Wan, Hanjing Wang, Muning Wen, Runzhe Wu, Ying Wen, Yaodong Yang, Weinan Zhang, and Jun Wang. Malib: A parallel framework for population-based multi-agent reinforcement learning, 2021.



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