TECHNISCHE UNIVERSITÄT MÜNCHEN
NEUROWISSENSCHAFTLICHE SYSTEMTHEORIE
PROF. DR. JÖRG CONRADT

PRACTICAL COURSE

Implementation of different driver AIs for behavior learning in The Open Racing Car Simulator (TORCS)

Problem description:

Knowledge about the current environment and its future development is essential for an autonomous agent in general and self-driving vehicles in particular to safely navigate [2]. Human drivers make predictions about the behavior of other traffic participants permanently and seamlessly, which gives us the ability to quickly react to changing behavior. To enable artificial systems to react appropriately to behavioral changes at runtime using any learning algorithm, considerable amounts training data of different drivers or driver models are needed. Working with an open source race simulator gives two key advantages: First, it is comparably easy to generate large amounts of training data due to the controlled and known (ground truth) simulation environment. Second, the environments and simulation itself can be adapted to our needs.
The goal of this practical project is to implement (at least two) different Artificial Intelligence (AI)-drivers in The Open Racing Car Simulator (TORCS) [5]. Those drivers should later serve as training data input for learning algorithms regarding behavior prediction like e.g. [3]. Therefore, the behavior of the different drivers in similar situations should significantly vary to ensure richness and diversity in the training data. Furthermore, the implemented AI-drivers should not "outrace" the ego-vehicle but rather stay at least in perceivable distance. These criteria should serve as initial metrics for evaluation of the AI-drivers. Finally, the students are expected to link their implementation with an existing interface [1] to TORCS in the framework of the Robot Operating System (ROS) [4].

Tasks:

This practical project is designed for 2 or more students (or two teams) with interest in autonomous driving and AI as well as strong experience in C++ coding and at least basic knowledge about ROS.

- Familiarization with the principles and software needed for this project (e.g. TORCS and ROS)
- Review existing AI-driver implementations for TORCS
- Implementation of at least two different AI-drivers
- Experimental evaluation and comparison of the implemented drivers

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Bibliography:

[1] `https://github.com/fmirus/torcs_ros`.
[2] M. Aeberhard, S. Rauch, M. Bahram, G. Tanzmeister, J. Thomas, Y. Pilat, F. Homm, W. Huber, and N. Kaempchen. Experience, Results and Lessons Learned from Automated Driving on Germany's Highways. *IEEE Intelligent Transportation Systems Magazine*, 7(1):42–57, Spring 2015.
[3] R. Graf, H. Deusch, F. Seeliger, M. Fritzsche, and K. Dietmayer. A Learning Concept for Behavior Prediction at Intersections. In *2014 IEEE Intelligent Vehicles Symposium Proceedings*, pages 939–945, June 2014.
[4] M. Quigley, K. Conley, B. P. Gerkey, J. Faust, T. Foote, J. Leibs, R. Wheeler, and A. Y. Ng. ROS: an open-source Robot Operating System. In *ICRA Workshop on Open Source Software*, 2009.
[5] B. Wymann, E. Espié, C. Guionneau, C. Dimitrakakis, R. Coulom, and A. Sumner. TORCS, The Open Racing Car Simulator. `http://www.torcs.org`, 2014.