TECHNISCHE UNIVERSITÄT MÜNCHEN
NEUROWISSENSCHAFTLICHE SYSTEMTHEORIE
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P R A C T I C A L C O U R S E

Learning to drive based on multiple sensor cues in The Open Racing Car Simulator (TORCS)

Problem description:

In recent years, several simulated car racing competitions like the Simulated Car Racing Championship (SCRC) [3] arose from a substantial amount of research in computational intelligence applied to simulated car racing.
The goal of this practical project is to implement an artificial driver, that learns to drive in the simulated environment of The Open Racing Car Simulator (TORCS) [5] based on multiple sensory cues. Additional to the sensors described in [3], the current ego-view image of the driver is available as visual sensor cue. The students are expected to investigate and use different learning algorithms during this practical. The first step is to train a Deep Neural Network (DNN) to learn visual cues like angle and misplacement of the car with respect to the track from the synthetic camera image. Furthermore, the students should experiment with different learning approaches (e.g. supervised learning, reinforcement learning) for Spiking Neural Networks (SNNs) in Neural Engineering Objects (Nengo) [2] to learn driving commands from a combination of the learned visual cues and other sensor sources available (e.g. range finders). 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 machine learning as well as strong experience in Python coding and at least some knowledge about ROS.

- Familiarization with the principles and software needed for this project (e.g. ROS, DNNs, Nengo)
- Training of a DNN to obtain low-dimensional, relevant cues for driving from visual information
- Training of SNNs in Nengo from range finders and visual information to generate driving commands
- Integration of the chosen implementation in the current ROS-framework for TORCS [1]
- Experimental evaluation

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Bibliography:

[1] `https://github.com/fmirus/torcs_ros`.
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[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.