



## Research Activity (HiWi, Master/Bachelor Thesis)

### Development of a self-learning Braitenberg Vehicle

Machine learning is a very current topic. However, handling of neuronal networks is currently experiencing a trend towards the use of high-level entry abstracting implementation details away. Although this accelerates the development process and the deployment to products, it reduces the detailed understanding of the basic operation of artificial neural networks.

The research at the IDS targets optimization on these lower entry levels.

In this work, a neuronal network is designed that controls a Braitenberg vehicle.

The demonstrator is a Terasic car equipped with two motors and light sensors. It has an integrated FPGA from Altera mounted. The aim of the vehicle is to finish a predefined route, which is marked by a color-tagged lane, as quickly as possible.

The training of the neuronal network is intended to happen by rewards based on the duration of the lap times and accuracy of following the trace. Since this can take a long time with many attempts, a suitable simulator has to be developed as a first step. This should take basic physical properties of the vehicle such as acceleration and inertia into account and additionally support visualization in the form of two-dimensional graphics.

To evaluate sensor data and drive the motors, a hardware is to be synthesized on the FPGA, performing calculations of the pre-trained neuronal network.

A thesis or student work within this topic may include the complete implementation or even sub-tasks of it. For more information please contact Kevin Kauth.

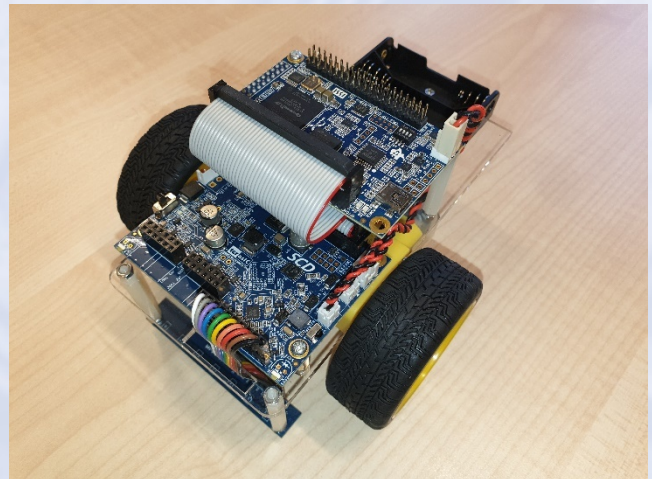


Fig. 1. Braitenberg Vehicle „A-Cute Car“ from Terasic

#### Tasks

- Development of a physical vehicle model
- Implementation of a 2D simulator for manual control of the Braitenberg vehicle
- Design and training of a basic neural network to follow a marked lane.
- Development of an FPGA-based hardware for the calculation of neuronal networks

#### Requirements

- Interest in the basic operation of an artificial neuronal network
- Experience in object-oriented programming
- Previous knowledge in hardware development

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