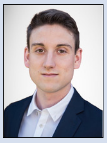


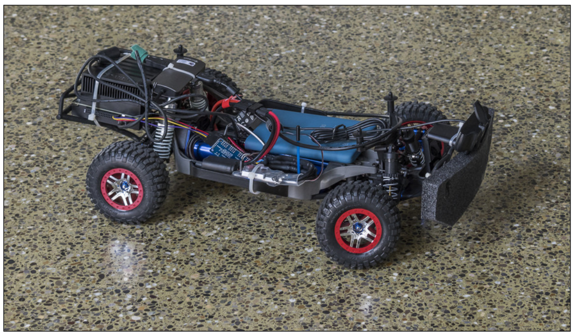
Sascha Jecklin

Student	Sascha Jecklin
Examiner	Prof. Dr. Guido Schuster
Subject Area	Sensor, Actuator and Communication Systems

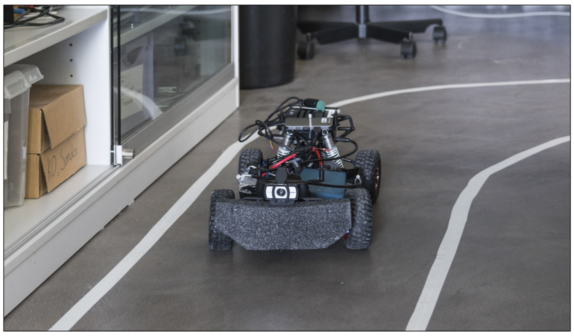
Building a self-driving car platform

Transferring machine learning models from simulation to a real world application

Used Jetson AGX Xavier from NVIDIA
https://developer.nvidia.com/embedded-computing



Fully assembled car based on a Traxxas Slash 4x4 1:10
Own presentment



The built car driving autonomously within a lane using a neural network.
Own presentment

Introduction: Machine learning is used in an increasing number of applications. Companies are building a variety of robots and tools that once should help and support people. There is still much to learn until for example, self-driving cars can drive fully autonomously. In places like Silicon Valley, however, self-driving cars are already hitting the road. These cars are not only expensive prototypes but also require many hours of training data to learn. The aim of this work is to enable a developer to build his own small car for a more modest budget. With this vehicle, the experience gained in a simulation can then be transferred to a real application.

Approach: In the first step, the idea of transferring experience from simulation to a real application is explained. The requirements for a car for this project are defined. Different simulation environments and programmable vehicle platforms are evaluated. The second part deals with the construction of the car and the installation of suitable software. Limitations regarding hardware and software are pointed out. Finally, trained machine learning models are used to make the car self-driving. Among other things, a model completely trained in simulation is used.

Result: The resulting vehicle is fully programmable and has enough processing power to perform today’s most demanding neural network inference. Its interface allows the user to add sensors such as inertial measurement units, lidars or stereo cameras. On the software side, the use of a Robot Operating System was planned. This did not work because the Xavier is quite new and was not able to run ROS correctly at that time. Instead, the Donkey® Car software was used. The car is able to drive autonomously on two different tracks inside the HSR with minimal training data. In addition, the car is able to drive in a lane with a neural network trained exclusively in simulation.