Project CS 686 – Proposal

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Autonomous driving, in the past labeled as utopian and being a component of many films, seems to become more and more realistic. Not only the big car companies like Tesla, GM or Daimler do a lot of research in this area but also companies new to the industry like Google and Uber launched their own projects to develop a self-driving car and both make enormous progress reaching this goal. For instance, the Google Car drove more than 1.5 million km on roads in the autonomous mode. But even if the Autopilot of Tesla creates the impression that vehicles can drive autonomously, there is always a safety driver sitting in the car and supervises the reaction of the car. Making the safety driver redundant is the next step that needs to be done. But it is a very difficult goal to ensure that the vehicle will always act optimal and safe in every situation.

The system architecture of a self-driving car is very complex and in general several processes are executed simultaneously to obtain a steering wheel angle and brake or accelerator commands. In one of the first steps sensors perceive the environment and information are fused to achieve a higher accuracy. Additionally, several techniques are applied to localize the vehicle in its surrounding. Once the perception is done, it is important to generate a desired trajectory, which keeps the vehicle on the driving lane and avoids obstacles. Afterwards, the deviation of the current position from the desired position is used as an input for the controller, which calculates the steering wheel angle as an output. This project will point out the difference of new approaches which use AI techniques to obtain a steering wheel angle to the common approaches which consist of path planning and trajectory tracking. Methods, based on AI, use neural networks to gain the steering wheel angle from pictures of a front camera. This is called end-to-end learning and videos that show the environment while a human is driving the vehicle are used to train the network. The main goal of this project is to introduce different approaches for path planning, trajectory tracking and end-to-end learning, compare the two-step method with the end-to-end method and discuss both advantages and disadvantages of each approach.

The following papers will be used to analyze this problem:

Bojarski	End to End Learning for Self-Driving Cars
Bojarski	Explaining How a Deep Neural Network Trained with End-to-End Learning Steers a Car
Ziegler	Trajectory Planning for BERTHA a Local, Continuous Method
Alia	Local Trajectory Planning and Tracking of Autonomous Vehicles, Using Clothoid Tentacles Method
Tagne	Immersion and Invariance Control for Reference Trajectory Tracking of Autonomous Vehicles
Chen	DeepDriving: Learning Affordance for Direct Perception in Autonomous Driving
Paden	A Survey of Motion Planning and Control Techniques for Self-driving Urban Vehicles