CS 680 Project

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Topic: Literature reivew on trajectory planning and tracking in comparison to end-to-end learning

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# Introduction

This project is part of the course CS 686 Introduction to Artificial Intelligence by Kate Larson at the University of Waterloo. A for us interesting application domain should be chosen for this project and within this domain a problem is supposed to be identified. The goal of the project is to analyze which artificial intelligence techniques or other approaches are used to tackle this problem. This project will deal with autonomous driving and different approaches to obtain the steering angle of a self-driving car.

## Application Domain

The application domain of this work is autonomous driving. Autonomous driving has been part of many movies like Batman (1966 to 1968) or Knight Rider (1982 to 1986) and seemed to be a utopian idea of driving. But within the last 10 to 15 years a lot of research was done on this topic and great progress was made. Self-driving cars become more and more realistic and it seems to be only a matter of time when the first fully autonomous vehicle is licensed.

Two previously milestones were the PROMETHEUS project in 1980 and the DARPA Grand Challenge in 2004. Due to the enormous research on this topic within the first mentioned project a vehicle was able to drive 95 % of the 1,600-km long drive autonomously. Later in 2004, the goal of the challenge was to drive a 150-mile off-road track as fast as possible without any human interaction with the car. This was the inception for many further events like the Hyundai Autonomous Challenge in 2010 or the drive of Daimler with an autonomous vehicle on the historic Berta-Benz route. Especially the Google self-driving car and Tesla’s autopilot gain a lot of attention. [1, p. 34, 1]

The increasing research and progress in this area are mostly connected to the different advantages of self-driving cars. Firstly, driverless cars could increase safety and reduce the number of deadly crashes caused by human faults. Moreover, it is an option to enable mobility for disabled or older persons. Less traffic jams are predicted as well as an increasing road capacity and less fuel consumption. Furthermore, it could be changing our relation to vehicles. Instead of owning a car by yourself you could share a ride or a vehicle whenever you need one. However, there also critical and yet unanswered questions about licensing, security, insurance regulations and many more. [2, pp. 167-168]

## Problem in this Domain

In a typical self-driving car, the different processes are ordered hierarchically. At first, different sensors like LIDAR, cameras and GPS units are used to locate the vehicle itself, to perceive its environment and measure important values of the vehicle. In combination with prior information about the road network, e.g. due to a digital map, it is necessary to plan a route through this network. In the behavior layer several decisions are made. These decisions will lead the car to the destination and ensures that the vehicle satisfies the traffic rules. Afterwards, motion planning determines the desired trajectory of the vehicle. In the last layer the self-driving car uses a controller to calculate a steering angle in order to keep the vehicle on the desired trajectory or to minimize the deviation of the desired route. [1, p. 35]

Some of the latest research suggest a different architecture and approach for the trajectory planning and tracking. Instead of separating these two steps, end-to-end learning is used by NVIDEA [3]. This system, known as PilotNet, is based on a neural-network and can output the steering angle only by the pictures of the front camera of the vehicle. In order to reach this goal, the network was trained with road images that are linked to a steering angle generated by a human driver. The remainder of this structured as follows: Firstly, different approaches for trajectory planning and tracking are introduced. Secondly, methods using end-to-end learning to determine the steering angle will be presented and ….

Formelzeichen und Abkürzungen (Beispiel)

|  |  |  |
| --- | --- | --- |
| x | m | x-Koordinate im kartesischen Koordinatensystem |

# Literaturverzeichnis

**Im aktuellen Dokument sind keine Quellen vorhanden.**

# Abbildungsverzeichnis

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[3] Mariusz Bojarski, Davide Del Testa, Daniel Dworakowski, Bernhard Firner, Beat Flepp, Prasoon Goyal, *End to end learning for self-driving cars.* [Online] Available: https://arxiv.org/pdf/1604.07316.pdf. Accessed on: Nov. 08 2017.