Autonomous driving for vehicles

Ing. Martin Krybus | Supervisor doc. Ing. Jan Platoš, Ph.D.

VŠB TECHNICKÁ UNIVERZITA OSTRAVA | FAKULTA ELEKTROTECHNIKY A INFORMATIKY

Motivation

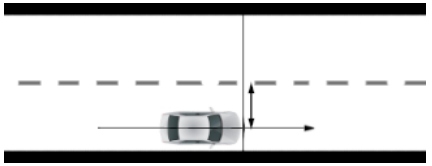
Due to the modernization of the world, greater demands on comfort, reduction of the ecological footprint and minimization of accidents, autonomous driving has become an increasingly large area of research in recent years, and **artificial intelligence** in the form of neural networks has great potential to solve this problem effectively.

Simulator

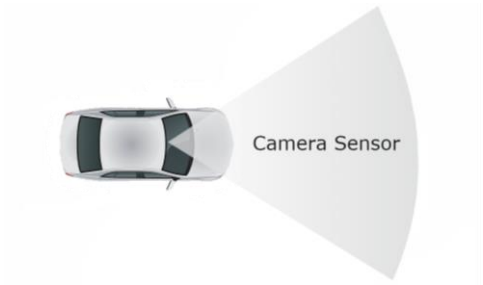
The simulator can simulate driving of various complexities, share information about the situation around the vehicle in real time and drive this vehicle using a **reinforcement learning algorithm**. In my work I use the **Q-Learning algorithm** in combination with a neural network to solve the problem of autonomous vehicle control using his own experience gained through trial and error.

Testing environment

The test environment consists of a closed **procedurally generated track** in an open landscape. The color-based collision detection system works in the environment and displays basic information about the vehicle to the user.



Camera sensor



The vehicle has a **camera sensor** that detects the immediate surroundings of the vehicle and the driver's view. The sensor can capture information about the traffic situation, whether it is approaching a bend, or whether, for example, the road is narrowing.

Choice of optimal behavior

The behavior of the vehicle is described by the reward function. The reward function implicitly determines the goal of optimization and its correct choice is an important part of training. The function maps the decision pair and the state to a real number. In this work, two types of vehicle behavior are designed and demonstrated in the form of a video recording.

Conclusion

Reinforcement learning algorithms can solve complex problems such as finding and recognizing patterns in an image and locomotion of robots. Tasks that may be difficult to solve with classical management methods can now be solved without the need for a full understanding of all aspects of the problem. In this work it is shown that current reinforcement learning algorithms are able to learn to drive in a simulated environment.

Vehicle model

A vehicle with user-definable physical properties allows an external algorithm to control **direction**, **acceleration** and **braking** only based on images from the camera sensor. The technology used in the work uses trained deep convolutional neural networks and allows the algorithm to make the right decisions depending on the environment.

Convolutional neural network

The **convolutional neural network** assigns importance to different aspects / objects to the input image and is able to distinguish them from each other. While in primitive classification methods filters are created manually, convolutional neural networks with sufficient training have the ability to learn these filters and properties.