Abstract

Being an active research field, autonomous vehicles still have a tendency for drastic improvements in terms of safety and efficiency. An autonomous vehicle reduces human errors from driving since it is controlled by an algorithm. One such algorithm of autonomous driving deals with the selection of maneuvers while encoding the outside environmental information which comes from different types of sensors. These maneuvers allow a vehicle to plan a collision-free path, observing all the strong kinematic constraints, especially in confined parking spaces.

Currently, the state-of-the-art maneuver based path planning algorithms can guide a semi-autonomous car to its desired parking spot but it does at the expense of high computational cost, often providing non-deterministic results. This is because city parking scenarios tend to be highly dynamic. In this master thesis, the development of an algorithm for the selection of achievable maneuvers in a perpendicular parking scenario is considered. The main challenge is to allow a car to deal with a dynamic environment in a timely manner under the limited computational resources. A supervised machine learning technique along with a shallow neural network has been used to achieve this task. To do so we have generated a training dataset through modeling and simulating the perpendicular parking situation in MATLAB. This simulation includes an appropriate environmental model, vehicle-dynamics model, collision detection algorithm and maneuver sets. Maneuvers are formulated according to their kinematic constraints such as the car's maximum steering angle which should not be violated.

Once training data is prepared, it is used to train the shallow neural network while varying its hyperparameters to achieve optimal results. The neural network is used for multi-label classification which provides all possible maneuver sets given the environmental information as input. It can be seen that the learned model chooses feasible maneuvers rapidly. This way it eliminates the need for a computation-intensive search. The efficiency of this approach is confirmed by MATLAB simulations.

Keywords: Machine Learning, Maneuver Set, Perpendicular Parking, Neural Network.