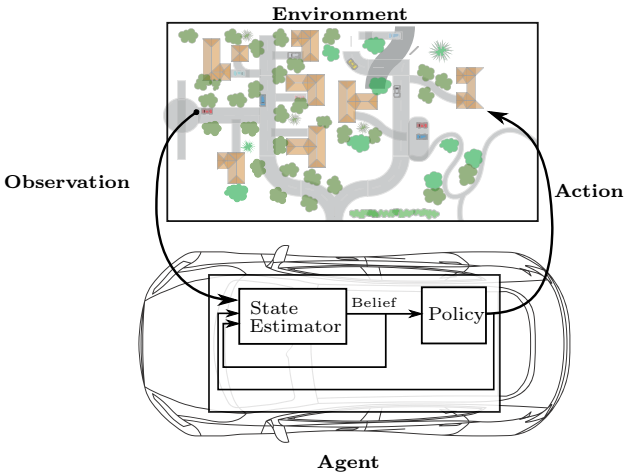
Deep Reinforcement Learning based Probabilistic Motion Planning for Autonomous Driving

In our research group for autonomous systems and sensors at fortiss we investigate new algorithms in the field of path and trajectory planning for autonomous vehicles in cooperation with the department of piloted driving at AUDI AG.



Background

In urban scenarios an autonomous vehicles must be capable of integrating the uncertainty of pedestrians' intentions, sensor noise as well as possible inaccuracies in trajectory tracking and control into a low-risk and collision-free trajectory. Existing probabilistic motion planning algorithms for autonomous vehicles do not allow for a combination of arbitrary uncertainty models, such as a learned model of pedestrians' intentions with nonlinear measurement or actuation predictions, as this would in principle require to define the underlying POMDP model in a high dimensional and continuous state space. Solving such a model becomes computationally intractable or is not even feasible.

Recent advances in Deep Reinforcement Learning enables us to deal with high-dimensional MDP and POMDP problems using function approximation. The exact model definition needs not to be known in advance as it can be deduced by the reinforcement learning agent during environmental interaction. This brings advantages regarding applications in complex planning scenarios.

Description

Within the scope of this thesis, existing approaches in the field of Deep Reinforcement Learning with a focus on POMDP problems shall be used to train an agent in a simulation environment to successfully plan a low-risk and collision-free trajectory in a simple urban scenario. We want to optimize network architectures and cost functions, and see how well the agent can adopt its policy to different probabilistic models, e.g. sensor noise or uncertainty in pedestrian's intentions.

Tasks

- Literature Research
- Creation of a basic simulation environment in ROS and Gazebo capable of dealing with environmental uncertainty
- Design of a Deep Neural Network (input, output, hidden layers, recurrence), e.g. in Tensorflow
- Training and evaluation of different network architectures based on applicability and accuracy

If you have any questions, feel free to contact me.

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Type:
MA

Research area:
Autonomous Driving

Programming language:
Python, C++

Required skills:
Deep Learning, Reinforcement Learning, Probability Theory, ROS

Language:
english

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