This dissertation presents novel algorithms for vehicle path planning in scenarios where the environment changes. In these dynamic scenarios the path of the vehicle needs to adapt to changes in the real world. In these scenarios, higher performance paths can be achieved if we are able to predict the future state of the world, by learning the way it evolves from historical data. We are relying on recent advances in the field of deep learning and reinforcement learning to learn appropriate world models and path planning behaviors.

There are many different practical applications that map to this model. In this dissertation we propose algorithms for two applications that are very different in domain but share important formal similarities: the scheduling of taxi services in a large city and tracking wild animals with an unmanned aerial vehicle.

The first application models a centralized taxi dispatch center in a big city. It is a multivariate optimization problem for taxi time scheduling and path planning. The first goal here is to balance the taxi service demand and supply ratio in the city. The second goal is to minimize passenger waiting time and taxi idle driving distance. We design different learning models that capture taxi demand and destination distribution patterns from historical taxi data. The predictions are evaluated with real-world taxi trip records. The predicted taxi demand and destination is used to build a taxi dispatch model. The taxi assignment and re-balance is optimized by solving a Mixed Integer Programming (MIP) problem.

The second application concerns animal monitoring using an unmanned aerial vehicle (UAV) to search and track wild animals in a large geographic area. We propose two different path planning approaches for the UAV. The first one is based on the UAV controller solving Markov decision process (MDP). The second algorithms relies on the past recorded animal appearances. We designed a learning model that captures animal appearance patterns and predicts the distribution of future animal appearances. We compare the proposed path planning approaches with traditional methods and evaluated them in terms of collected value of information (VoI), message delay and percentage of events collected.

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The public is welcome to attend.