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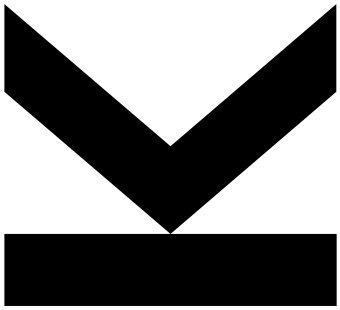
MASTER THESIS:

LANE CHANGE PREDICTION



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I. Research Idea

Various innovative and disruptive solutions in the field of intelligent transportation systems (ITS), such as autonomous driving and mobility analytics, involve making predictions based on data. For the decision-making processes of autonomous vehicles (AVs) the most crucial challenge is to predict the future movement of road participants. Here the sub-task of predicting lane changes is the most important task to enable safe and risk-free autonomous driving. Generating such predictions is highly non-trivial given the typical sensitivity of the system to small perturbations such as distinguishing between lane keeping and lane changing.

Diverse approaches exist to perform this task. At the intersection of machine learning and statistics, gaussian processes (GPs) and neural networks (NN) can be used as a promising method to predict these mobility patterns.

GPs can handle problems that possess high dimensionality, small samples and nonlinearity, thus gaining increasing attention in the area of driver behavior modelling. Trained on a finite set of input-output training data they provide mean as well as a reliable estimate of their own uncertainty that can further be included in the decision-making process of AVs.

II. Scientific relevance of the research idea compared to related published work

The creation of a fully autonomous vehicle (SAE J3016 Level 5) highly depends on making the optimal decisions in every scenario. For this even the slightest bit of uncertainty in the prediction steps needs to be incorporated in the decision-making process. There are a number of NN used in the literature to predict lane change intention, the downside of these regular NN algorithms, compared to GP based approaches, is that they do not create a uncertainty estimate with the point-prediction. Thus this information can not be used in the decision-making process.

III. Goal of the thesis

- Study existing literature related to lane change intention prediction
- Design and development of a (deep)-GP/NN lane change intention prediction algorithm into the existing framework
- Validation of the developed algorithm
- Comparison of the developed algorithm against State of the Art algorithms
- Write a publication paper with the proposed work developed during this thesis

IV. Own research questions and hypotheses

- Which states can be predicted with the developed model? What is the accuracy of the approach?
- Which features of the other road participants can be used as input for the algorithm? Which are more relevant?

V. Short presentation of the planned method

The planned method can be a (deep) gaussian process. It will however depend on the considered scenario, input data, and the student's initiative. The student will be highly encouraged to develop a novel method.

VI. Thesis structure design

The thesis will have a typical IMRAD (Introduction, Methods, Results and Discussion) structure.

VII. Draft of time plan

The presented thesis is planned for a six-month period. An initial time plan:

- 1st month: Study related literature and identify opportunities to apply lane change prediction for transportation problems.
- 2nd-4th month: Apply lane change prediction to transportation datasets, present and refine results according to discussions with the supervisor. Identify a problem of interest and develop a novel method based on (deep) gaussian processes.
- 5th-6th month: Write master thesis and possibly contribute to an original research paper.