KI DELTA LEARNING
Scalable AI for Automated Driving

Trajectory and Behavior Prediction

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WP 3.4

Networks

Use-Case in Delta Learning

Motion prediction of traffic participants is a key task for safe autonomous driving as it influences the own behavior. Recent publications for trajectory prediction propose taking social interactions between vehicles into account implicitly.
Regarding state-of-the-art approaches, one question remains mostly unanswered: Can the influence of the vehicles on each other be quantified explicitly (cf. Figure 1)?

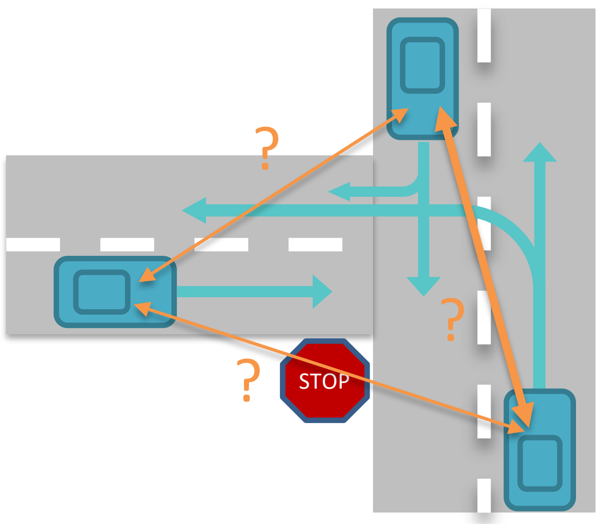

Figure 1: Traffic scene abstraction, with orange edges showing interaction candidates. Here, the line thickness encodes the interaction score.

Technical Problem

State-of-the-art approaches for vehicle motion prediction are machine learning-based and lack interpretability.
Self-attention is one mechanism giving insight into the interactions. Originating from the field of natural language processing, the mechanism learns pairwise weights between the encodings from an input data sequence. When applying self-attention to encoded vehicle motion data, it is often assumed that the mechanism is able to learn interactions. The computed weights directly provide a score that expresses pairwise interactions between vehicles. However, this assumption has not been confirmed quantitatively yet.

Technical Solution

In order to analyze this problem further, we develop a novel end-to-end trajectory prediction model based on Graph Neural Networks (GNNs) and self-attention. An architectural overview is given in Figure 2. In contrast to many state-of-the-art approaches, the model focuses on social interactions and requires no map information. A prediction example is shown in Figure 3.

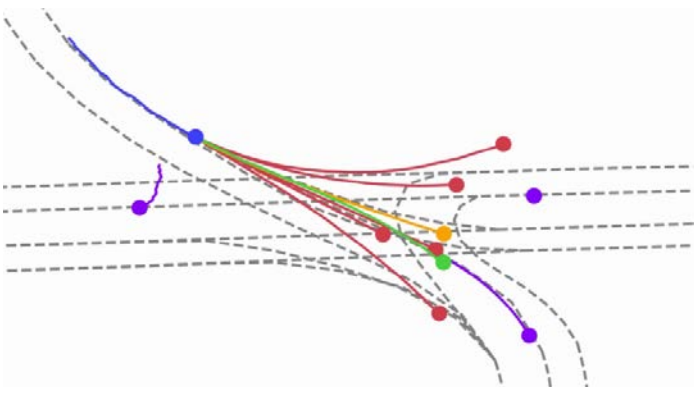

Figure 3: Prediction example: The past trajectory of the predicted vehicle is colored in blue, the ground-truth future trajectory in green. Predictions are colored in orange and red. The past trajectories of vehicles interacting with the predicted vehicle are colored in purple.

Evaluation

Evaluation is done using the Argoverse Motion Forecasting Dataset. The model achieves state-of-the-art performance for map-free prediction. First experiments with the CARLA simulator show reasonable result, see Figure 4. The trained model runs effortlessly in real-time on our test system (i9-7920X and GeForce RTX2080 Ti).

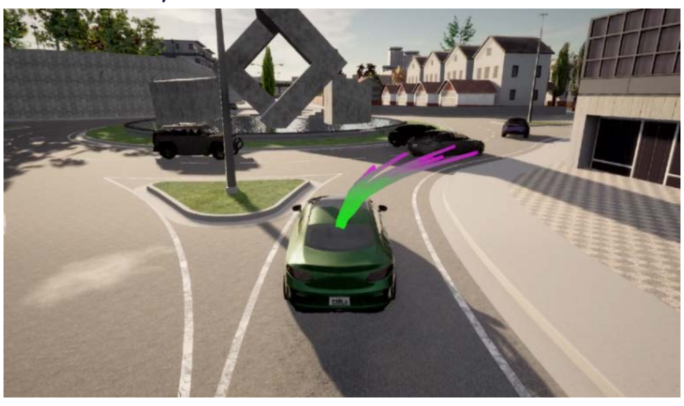

Figure 4: Trajectory prediction model applied for an agent in the open-source CARLA simulator. The most likely trajectories for the future horizon are drawn.

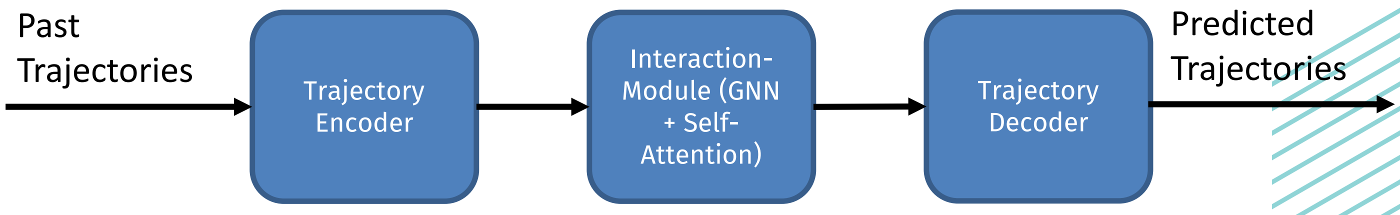

Figure 2: Architectural overview of the trajectory prediction model

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Partners

External partners

KI Delta Learning is a project of the KI Familie. It was initiated and developed by the VDA Leitinitiative autonomous and connected driving and is funded by the Federal Ministry for Economic Affairs and Energy.

Supported by: Federal Ministry for Economic Affairs and Energy
on the basis of a decision by the German Bundestag

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