KI WISSEN
Automotive AI Powered by Knowledge

2.4 An Efficient and Robust Multi-Modal Trajectory Predictor Baseline for Autonomous Driving

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Trajectory Prediction and Motion Planning

Motivation

Safe and comfortable driving requires to predict future actions of other traffic participants. Prediction algorithms should combine accuracy and speed with robustness against changes in sensor setup and map representation.

Technical Problem

State-of-the-art (SotA) models exhibit a trend to larger model size and expressiveness, requiring ever increasing amounts of training effort and raising questions about their robustness in out-of-distribution testing.

Technical Solution

We introduce a model that leverages simple polynomial representations proposed and validated in [1, 2] for traffic participant trajectories and road geometry. This also facilitates the inclusion of prior knowledge about sensor noise levels for regularization.

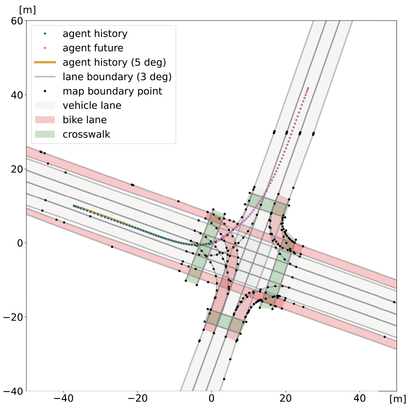

Figure 1: One scenario in Argoverse 2 motion dataset. Agent history trajectory and road geometry information are represented with polynomials. (© Continental AG)

Instead of predicting sequences of future locations over the entire prediction horizon, our model only predicts a minimal number of future kinematics states of objects, i.e., positions, velocities and accelerations, leading to a substantial reduction in the model's output dimension. Fusing predicted and tracked states, the future movement of objects can be expressed again with polynomials. This also ensures continuity between predicted trajectory and current object kinematics.

Results vs. SotA models

- Rank 24 in Argoverse 2 leaderboard with
  - only 9% decrease in prediction accuracy
  - only 40.8% of the input data size
  - only 4.5% of the model size
  - only 4.7% of the model inference time
- Significantly improved robustness over SotA models in out-of-distribution test.

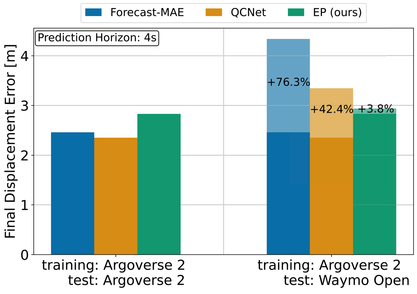

Figure 3: Final displacement error in out-of-distribution test cases. All models are trained on Argoverse 2 motion dataset. (© Continental AG)

References

[1] Y. Yao et al., An Empirical Analysis of Object Trajectory Representation Models. In proc. of ITSC, 2023, arXiv:2211.01696
[2] J. Reichardt, Trajectories as Markov-States for Long Term Traffic Scene Prediction. In 14th UniDAS FAS-Workshop, Berkheim, 2022
[3] Y. Yao et al., Everything Polynomial: An Efficient and Robust Multi-Modal Trajectory Predictor for Autonomous Driving, in preparation

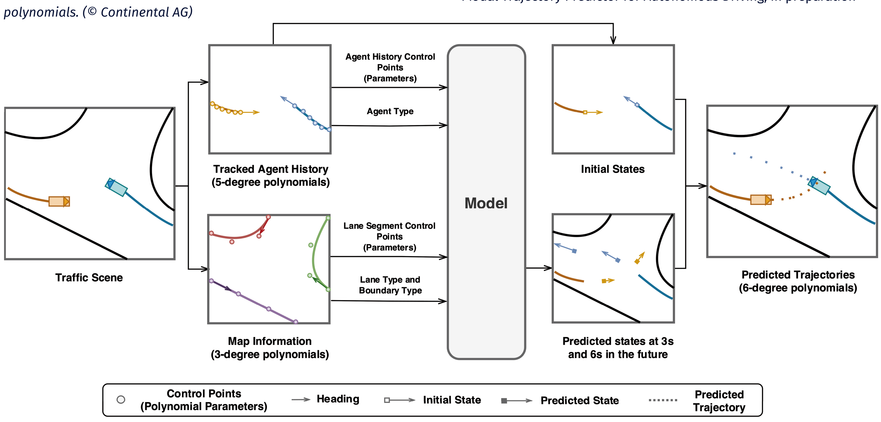

Figure 2: Our proposed model architecture. Agent histories and road geometry are both represented via polynomials. The current object kinematics and future kinematic states predicted by the model are fused into one continuous polynomial trajectory prediction. (© Continental AG)

Partners

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