

IDP or Guided Research Project | Master's Thesis

Improving Temporal Consistency for Learning-Based Vehicle Motion Prediction for Autonomous Racing



The TUM Autonomous Motorsport team is at the forefront of developing advanced software for autonomous racing vehicles, participating in and winning cutting-edge racing series such as the Indy Autonomous Challenge (IAC) and the Abu Dhabi Autonomous Racing League (A2RL). Pushing the limits of autonomy, performing precise overtaking maneuvers at speeds exceeding 270 km/h - where milliseconds count - requires highly efficient software.

Although motion prediction networks run continuously on an autonomous vehicle, each inference and training step is typically treated as an independent problem. The predicted trajectory can therefore jump or exhibit entirely different motion patterns between consecutive cycles despite an almost unchanged scene, propagating instability into downstream modules. In close-proximity racing, consistency over time matters as much as pointwise accuracy.

This research project investigates network designs and training strategies that make motion prediction temporally consistent, evaluating consistency metrics, the trade-off against pointwise accuracy, and the effect on downstream planning.

Work packages:

- Literature research on temporal consistency and multi-modal prediction stability
- Implementation of mechanisms to improve temporal consistency between frames in motion prediction for autonomous racing
- Evaluation of the accuracy–consistency trade-off in closed-loop simulation
- Analysis of the results and identification of directions for future research

Requirements:

- Enthusiasm about deep learning and autonomous driving
- Good programming skills in Python/C++
- Excellent Grades in ML- / DL-related courses
- Ability to collaborate in a team and engage in interdisciplinary research

If you are interested in this project, send me (marcel.weinmann@tum.de) your CV and grade report (Application Deadline 14.09.2026).