Professorship of Autonomous Vehicle Systems
TUM School of Engineering and Design
Technische Universität München

TUM

Master's Thesis

Interaction-aware Motion Planning in Autonomous Racing using Game Theory

Trajectory planning in autonomous racing is a crucial challenge: it must not only generate an optimal driving line but also enable strategic maneuvers such as overtaking and evasive actions. In multi-vehicle racing scenarios, it is essential to go beyond merely reacting to opponents and instead proactively shape one's own behavior to gain a competitive advantage.

However, many current planning methods act reactively and conservatively, as they fail to account for how an autonomous vehicle's actions influence the responses of other competitors. A promising approach to capturing this interaction is game-theoretic motion planning. Game theory has already been successfully applied in various autonomous driving contexts and could unlock new potential in racing scenarios as well.

The goal of this thesis is to analyze existing game-theoretic methods for interactive trajectory planning. This includes conducting a comprehensive literature review to identify promising approaches. Subsequently, these methods will be implemented and evaluated in competitive racing scenarios to assess their strengths and weaknesses in direct comparison.

The following tasks are included in this Master's thesis:

- Literature review and state-of-the-art analysis
- Identification of suitable algorithms and implementation of the algorithms in Python or C++
- Evaluation of the various algorithms in competitive racing scenarios

The report should document the individual steps in a clear and structured manner. The candidate agrees to independently conduct the Master's thesis and disclose all scientific resources used.

The submitted work will remain as examination material in the possession of the institute.

Prof. Dr.Ing. J. Betz   Alexander Langmann, M. Sc.

                                         Dr.Ing. Mattia Piccinini

                                         Abgabe: _____