Adaptive Robust Game-Theoretic Decision Making Strategy for Autonomous Vehicles

Varadaraya Ganesh Shenoy

February 28, 2021

1 Abstract

In a traffic environment, autonomous vehicles are a part of the scenario which involves other players such as human driven vehicles, pedestrians. To tackle this situation effectively, level-k framework which is adaptive and robust can be applied by the agents to group them according to their depth of strategic thought to decide the corresponding action. Robust techniques that deal with mismatches between vehicle dynamics and its predictions as well as incorrect labelling of agents, can make autonomous vehicles less conservative.

In this project, a robust decision-making algorithm is designed for autonomous vehicles to handle model errors in the prediction model while achieving less conservative actions using the confidence of the driver behavior. This strategy is then tested to examine the efficiency of lane-changing maneuver.

2 Methodology

In a mixed-traffic scenario, for optimal motion planning, vehicle-vehicle or vehicle-pedestrian interaction has to be taken into account. This paves way for a framework based on game theory [1–4] that can decide strategically to deal with the interactions in a mixed traffic scenario with multiple agents.

The proposed algorithm combines robust feedback min-max with level-k game theory to predict the uncertainties between model predictions and true agent behavior. This takes place while the control actions are being determined.

This project will be implemented on Python for lane-changing maneuver under three strategies: Normal, Adaptive and Robust. Furthermore, the collision and lane change rates under these three strategies will be examined.

References

[1] Fanlin Meng, Jinya su, Cunjia Liu, and Wen-Hua Chen. Dynamic decision making in lane change: Game theory with receding horizon. 2016.

[2] G. S. Sankar and K. Han. Adaptive robust game-theoretic decision making strategy for autonomous vehicles in highway. *IEEE Transactions on Vehicular Technology*, 69(12):14484–14493, 2020.

[3] Meng Wang, Serge Hoogendoorn, Winnie Daamen, B. Arem, and Riender Happee. Game theoretic approach for predictive lane-changing and car-following control. *Transportation Research Part C Emerging Technologies*, 58:73–92, 2015.

[4] Je Yoo and Reza Langari. Stackelberg game based model of highway driving. 2012.