NGI EXPLORERS

CHALLENGE #45
CMU-AD-02

Behavioral Planning for Autonomous Driving

Lab Website: labs.ri.cmu.edu/argo-ai-center/

Meet the expectations of this US Node through the technology challenge described below

APPLY NOW

GOALS

Behavioral Planning for Autonomous Driving. We are developing algorithms for urban and highway driving that enable more anthropomorphic autonomous behaviors than previously possible, and we are seeking to combine these with safety guarantees for a result that combines human-like fluidity with the higher safety potential of rapid-response computing and actuation. We are also investigating shared human-vehicle autonomy strategies. Two recent projects that explore these areas have included the following: FG-GMM based Social Behavior Estimation for Autonomous Driving Vehicle in Ramp Merging Control: Social behavior is important for autonomous driving vehicles, especially for scenarios like ramp merging which require significant social interaction between autonomous driving vehicles and human-driven cars. Previous intern projects have worked towards enhancing the lab's previous Probabilistic Graphical Model (PGM) work merging control model for the social behavior of autonomous driving vehicles. To better estimate the social behavior for autonomous driving cars, a Factor Graph (FG) is used to describe the dependency among observations and estimates of other cars' intentions. Real trajectories are used to approximate the model instead of human-designed parameters. Forgetting factors and a Gaussian Mixture Model (GMM) are also applied in the intention estimation process for stabilization, interpolation, and smoothness. The advantage of the factor graph is that the relationship between its nodes can be described by self-defined functions, instead of probabilistic relationships as in PGM, giving more flexibility. Functional Trajectory Forecasting and Consistency Guarantees for Self-Driving Cars in Social Settings: Self-driving cars will be required to navigate urban scenarios such as intersections, ramp merges, and lane changes. These are all highly social environments that require accurate estimates of the intentions of other cars. Increasingly, this problem is being tackled by learning a behavior model from data. A previous intern worked with the lab to develop a new learning-based method which is based on non-parametric regression in Reproducing Kernel Hilbert Space. The method provided three important contributions: The use of a prediction function class which can account for the interactions between all relevant vehicles, both autonomous and human-driven; A novel prediction function where the output is a smooth trajectory over time, rather than a series of discrete points; A bound on how our estimated trajectory will vary as a function of the time at which it is calculated

DETAILS

The main objectives for this challenge are: To improve the safety and performance of autonomous driving behaviors in challenging scenarios; To develop more sophisticated models of human driving behavior to enable realistic simulation testing and real-world deployment of autonomous driving behaviors.

SKILLS REQUIRED

Vehicle dynamics and control; Autonomous driving behavior planning techniques (machine learning-based or other); Experience with CARLA or other relevant autonomous driving simulator.

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