PhD Proposition RENAULT / INRIA Grenoble

Autonomous driving: Application of dynamic probabilistic occupancy grids for the contextualized planning of emergency trajectory with minimum criticality.

Context

Whether the driver is real or virtual (autonomous vehicle), the robotic management of emergencies is a problematic with multiple stakes. Among the various questions posed by the elaboration and execution of these emergency maneuvers, we can consider:

- Is the driver reasonably able to handle the situation alone?
- If a robotic action is envisaged, are the risk levels and their associated seriousness acceptable to the stakeholders (drivers, passengers, other actors of the scene, constructor, legislator...)?

In this context, the international organization EuroNCAP provides homologation scenarios requiring high performance driver assistance systems, while being adapted to the technical limitations of current perception systems and actuators. To date, active safety protocols have been evaluating AEB (Autonomous Emergency Braking) and Lane Keeping Assist (LKA) separately. This maneuver restriction is adapted to a frontal perception of the obstacles / lines resulting from a radar / camera data fusion. By projecting in the near future, a more robust 360° perception of the scene (objects and infrastructure) opens the door to more complex, more dynamic and more secure maneuvers thanks to the simultaneous control of 2 or 3 actuators (steering, accelerator, brake) (AES: Automatic Emergency Steering).

Objective

The thesis, proposed in the framework of CIFRE PhD project in partnership between RENAULT and CHROMA Team (INRIA-Grenoble), aims to develop these onboard optimization algorithms for emergency trajectory using steering and braking (normal or differential) systems. In response to the two questions mentioned above, optimal trajectories minimizing the criticality of the risks will be calculated by optimizing a complex cost function under constraints (environment, vehicle dynamics and actuator saturation).

The provided input data are: a dynamic probabilistic occupancy grid of the space and infrastructure data, the vehicle constraints (actuator saturation, handling limitations…).

The expected outputs are: a steering wheel angle and a braking torque references. To do this, two optimization problems must be solved under constraints:

- Path planning: a tactical level trajectory (typically 3sec horizon) will be calculated for later use by the longitudinal and lateral controllers.

- Path following: steering angle and braking torque references will be optimized to achieve the trajectory from the previous step.

The integration of path planning and following problems in a single optimization problem is possible to obtain the best solutions.

Candidate profile

Candidate should have good background in statistics, mathematics, control theory, optimization and programming (Python, C/C++, Matlab/Simulink). Experience with vehicle dynamics modeling and control is a plus. Good English level is required as well.

Conditions

Contract: 3-years CDD CIFRE

Salary: 2500 euros per month gross

Locations: Technocentre RENAULT Guyancourt and INRIA Grenoble

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