ÉCOLE POLYTECHNIQUE
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Collaborative Sensing and Decision Making For Intelligent Vehicle Maneuvers

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New generations of intelligent vehicles are becoming more and more developed. These kind of vehicles have very powerful resources inside, such as efficient computers, sensors and actuators. These cars can be extended on many ways such that they can reduce a lot the injuries caused by the road accidents.

One of the most dangerous maneuver on the road is the overtaking. This project deals with the implementation of collaborative sensing and decision making in this specific scenario.

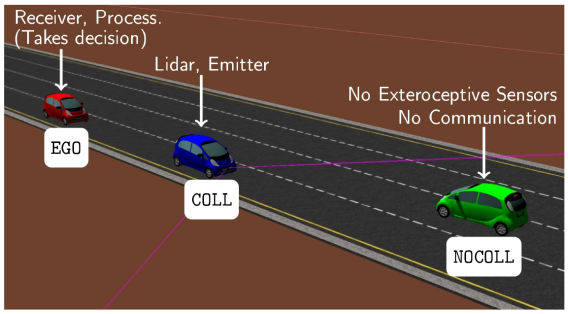

Figure 1: Vehicles used for the project

Three kind of cars have been used. The first one are the non-collaborative vehicles (green one on the figure 1). These vehicles do not have any exteroceptive sensors or communication devices. They are considered as the on-coming traffic. The second type of vehicle is the collaborative vehicle (blue on on the figure 1). They have Lidars, to sense the environment. A Lidar Tracking program has been used during this project. This program has been developed by Luca Brusantin (see DISAL-SP59). This type of vehicle also has an emitter to send information. This vehicle is the one that will be overtaken by the third type of vehicle which is the EGO vehicle (red on the figure 1). It has a receiver in order to receive the information from the collaborative vehicle. It can also process the information and takes the decision to overtake the collaborative vehicle or not.

At the beginning of the project, two path-following controllers have been implemented. It is an efficient way to control the vehicles on the track with predefined trajectories.

Then, a lane detection algorithm has been implemented using the information received from the Lidars. This algorithm tries to place the vehicles seen by the Lidars on the right lane. This algorithm has shown very good results when the sensors are perfect. If some standard deviation are added, this algorithm is less good.

Finally, a decision making algorithm has been implemented. This algorithm is used with a Finite State Machine in order to have a realistic behavior for the EGO vehicle. It is also using the notion of risks such that:

- If the risk is low (no on-coming traffic on the overtaking lane), the EGO vehicle will try to overtake.
- If the risk becomes too high, the EGO vehicle will abort the overtaking in order to avoid an accident.

This algorithm has also shown some very good results when the sensors are perfect. If some standard deviations are added to the sensors, this algorithm is less good but it still has a good performance.