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# Dynamic Platooning for Intelligent Vehicles

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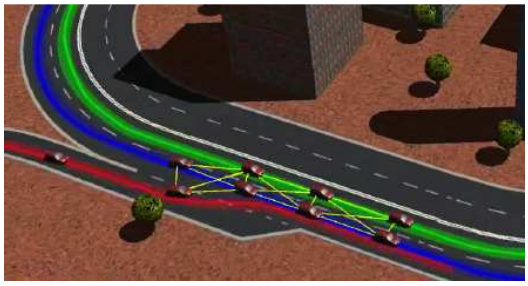
This project starts by re-implementing the work of Gowal et al. on leaderless graph-based platooning and brings the following two improvements:

First, the vehicles are able to join or leave the platoon without jeopardizing the stability of the formation. This is necessary to enjoy the benefits of platooning. Vehicles have individual origins and destination, so traveling in a formation is only a part of their trips.

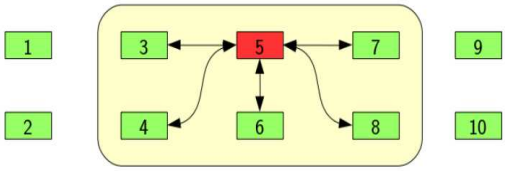
Second, for use in a realistic scenario, we want a formation that can follow any road, straight or curved. Many previous works have assumed that the x-axis of the car's coordinate system is always aligned with the road direction. Therefore, they either needed a straight road or the a-priori knowledge of the path so they could use curvilinear coordinates. To overcome these requirements, we added a lane keeping behavior (through a computer vision line-following algorithm) on top of the graph-based platooning. Those modifications were implemented and tested using the Webots robotics simulator.

To make the formation dynamic, we need to generate the matrices for graph-based platooning dynamically. We also implemented a communication protocol between the cars to handle request.

Moreover in order to improve the flexibility and the reliability of our implementation, the cars only interact with their immediate neighbors, leaving us a chain of interconnected cells. The problem is completely distributed and no vehicle has a global knowledge of the formation. So vehicles need to be able to make assumptions about the shape of the formation to perform actions. We identified three local rules that cars obey, and that lead to a determined global shape. Platooning is enabled for formation on one and two lanes.



*Cars joining a platoon*




*Local neighborhood of a car.*

A scenario is designed on a highway, where cars can platoon, connected to a single lane road through one entrance and one exit. When a car arrives on the highway, it joins or creates a platoon. Then the platoon drives on the curved highway, following the line-markers, while accepting new cars and reshaping to keep the formation correct.

At any time a car can exit the platoon. The procedure depends on the lane. For the right one the car leave, while if it is on the left it first join the right lane.

We demonstrated that it is possible to modify the composition of a platoon during its run while keeping it stable and we are able to run a scenario where cars create, join and leave a platoon on a curved highway.