Toward a Robust and Safe Cooperative Highway Navigation of Multi-Vehicle Systems

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Overall research context

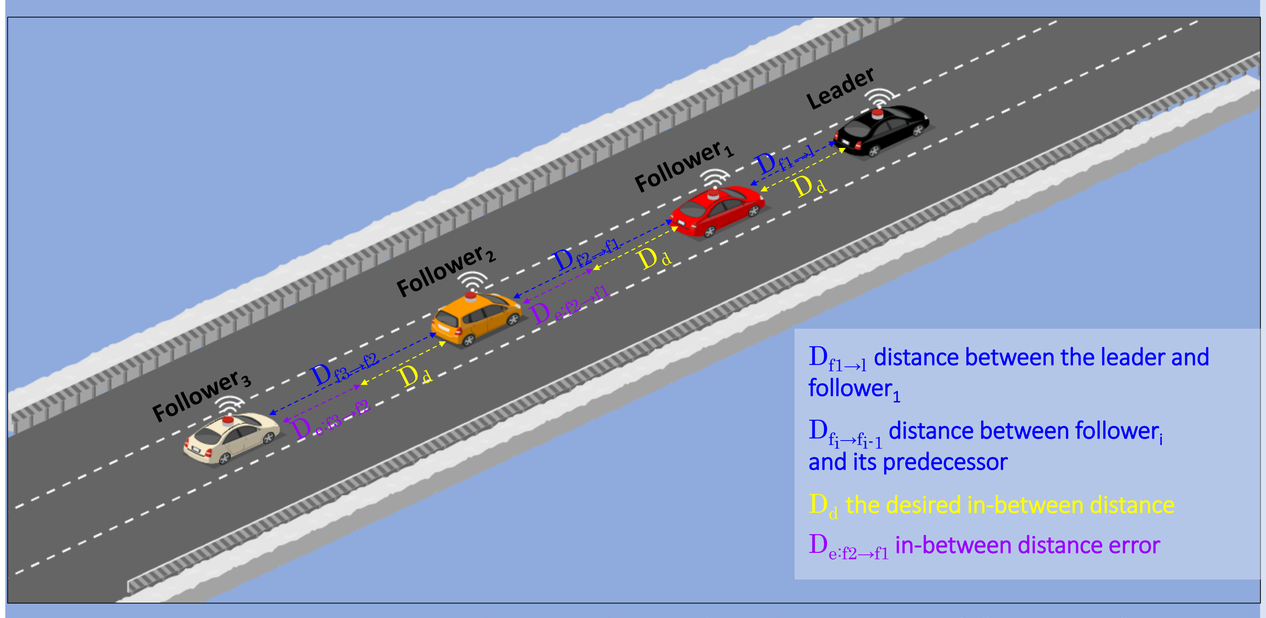
Multi-Vehicles Systems (MVS) advantages address many areas: safety with accident reduction; health while improving passengers comfort; transportation time since it reduces road congestion; ecology with fuel efficiency among other advantages.

In this Ph.D thesis we take advantage from the recent development on **Autonomous Vehicles (AVs)** and **Vehicle-to-everything communication (V2X)** to solve complex navigation scenarios on highway environment.

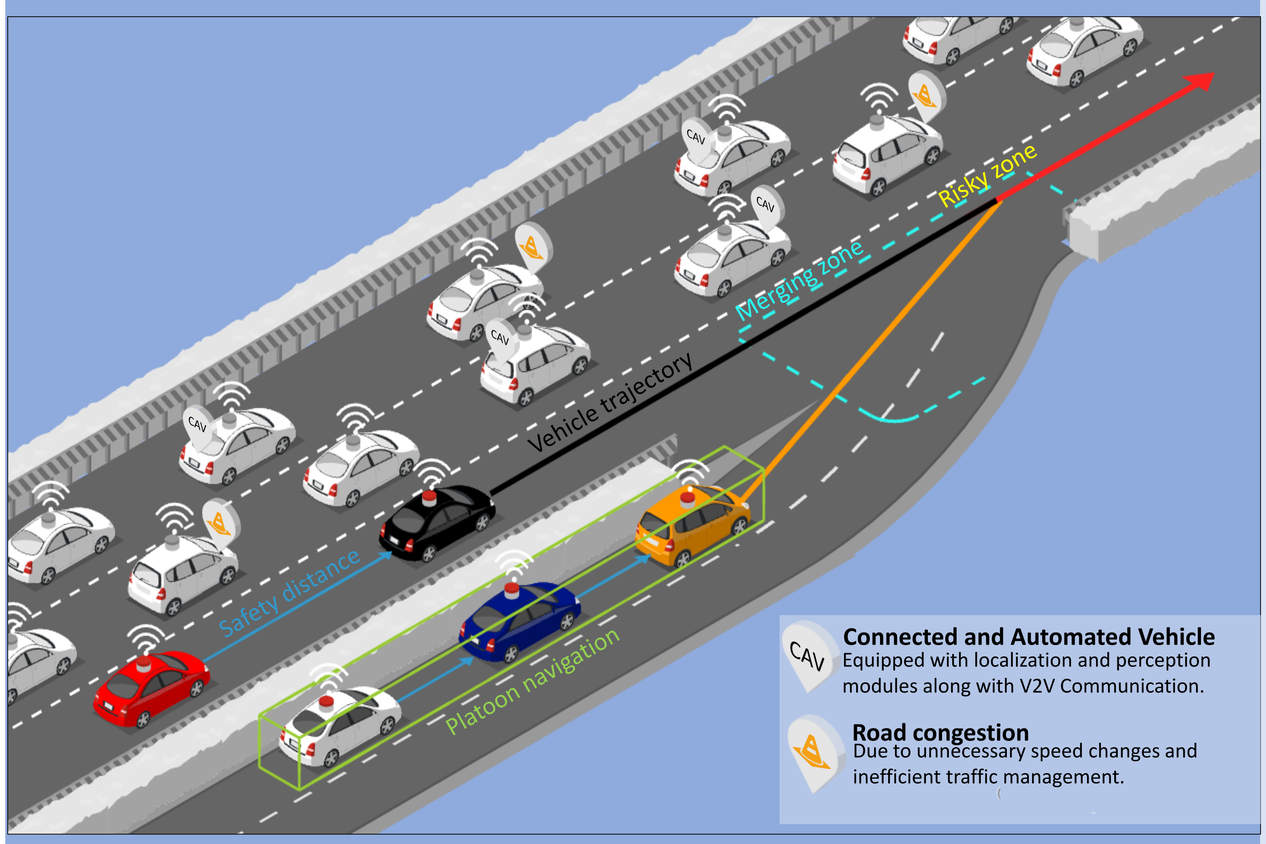
Cooperative highway navigation

Current Objectives

- Reduce on-road accident by avoiding conflicting trajectories between CAVs and rear-end collisions.
- Increase highway capacity and solve merging bottlenecks.
- Avoid non-necessary acceleration changes improving thus the energy efficiency.

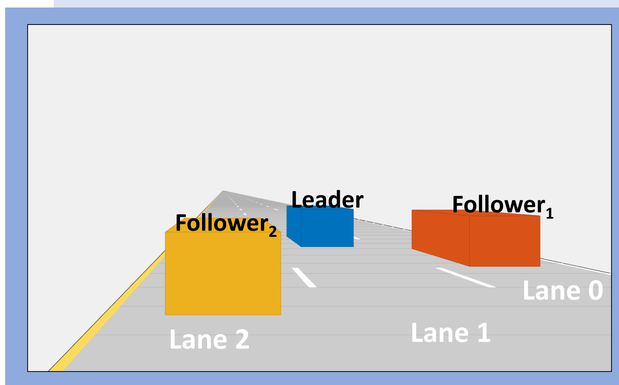


Eco-Cooperative Cruise Adaptive Control (eC-ACC)

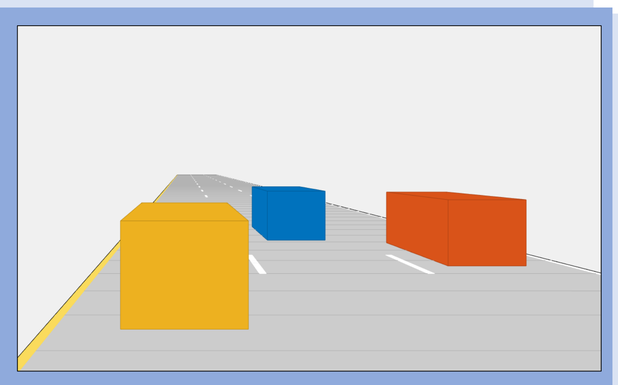


On-ramp merging on highway

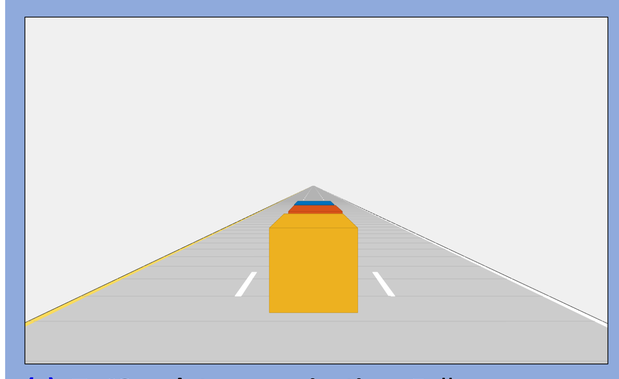
MVS formation configuration and reconfiguration



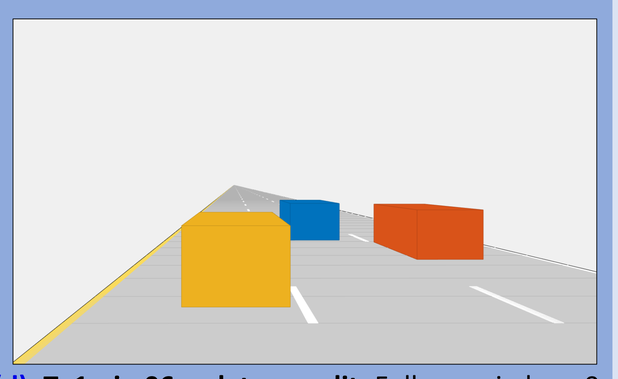
(a): T=0s, initial configuration: Follower$_1$ in lane 0, leader in lane 1 and Follower$_2$ in lane 2



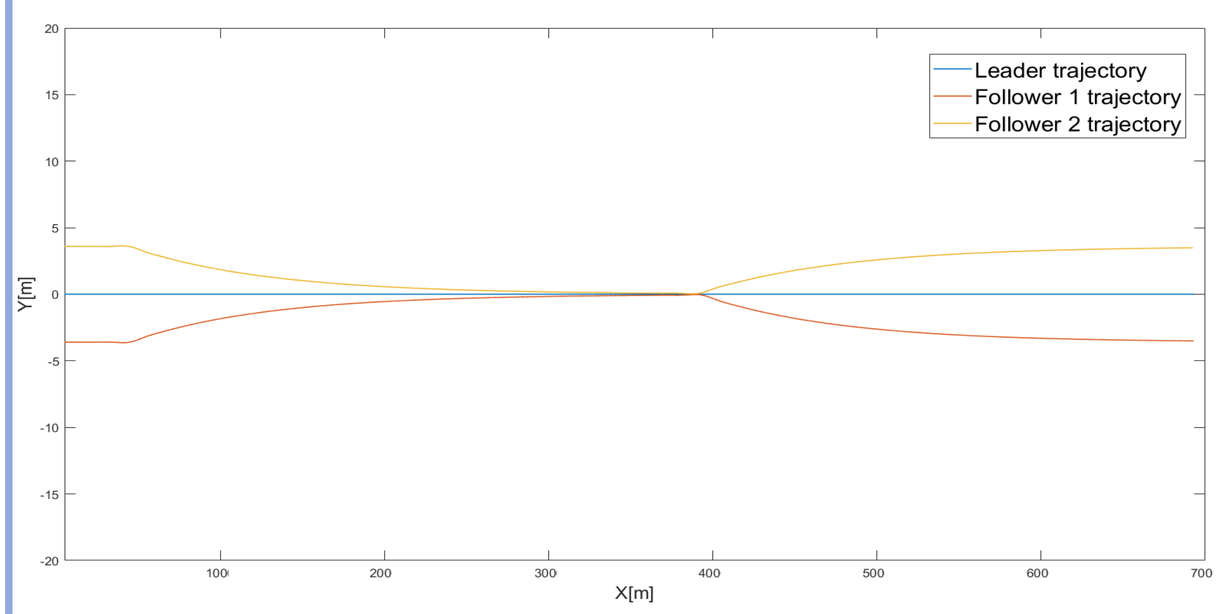
(b): T=15s, platoon creation: Follower$_1$ to lane 1, leader in lane 1 and Follower$_2$ to lane 1



(c): T=43s, platoon navigation: Follower$_1$, leader and Follower$_2$ in lane 1



(d): T=1min 06s, platoon split: Follower$_1$ in lane 0, leader in lane 1 and Follower$_2$ in lane 2



Vehicles' trajectories

Perspectives

- Tackle on-ramp merging on highway scenario.
- Include vehicle's dynamics on the proposed solution.

J. Vilca, L. Adouane and Y. Mezouar, "Stable and Flexible Multi-Vehicle Navigation Based on Dynamic Inter-Target Distance Matrix," in IEEE Transactions on Intelligent Transportation Systems, vol. 20, no. 4, pp. 1416-1431, April 2019, doi: 10.1109/TITS.2018.2853668.

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