

Safe and Smooth On-ramp Merging on Highway Strategy for Cooperative Automated Vehicles

Lyes Saidi¹, Lounis Adouane² and Reine Talj³

Laboratoire Heudiasyc, UMR CNRS 7253, Université de Technologie de Compiègne, France

Overall research context

Cooperative Automated Vehicles (CAVs) 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.

Among the objectives of the Ph.D thesis, addressing the **on-ramp merging on highway** complexity. In fact, the CAVs permit with the help of a **flexible formation modeling and control** and a **safe motion synchronization** to envision a **cooperative merging strategy**.

Scenario study: cooperative on-ramp merging

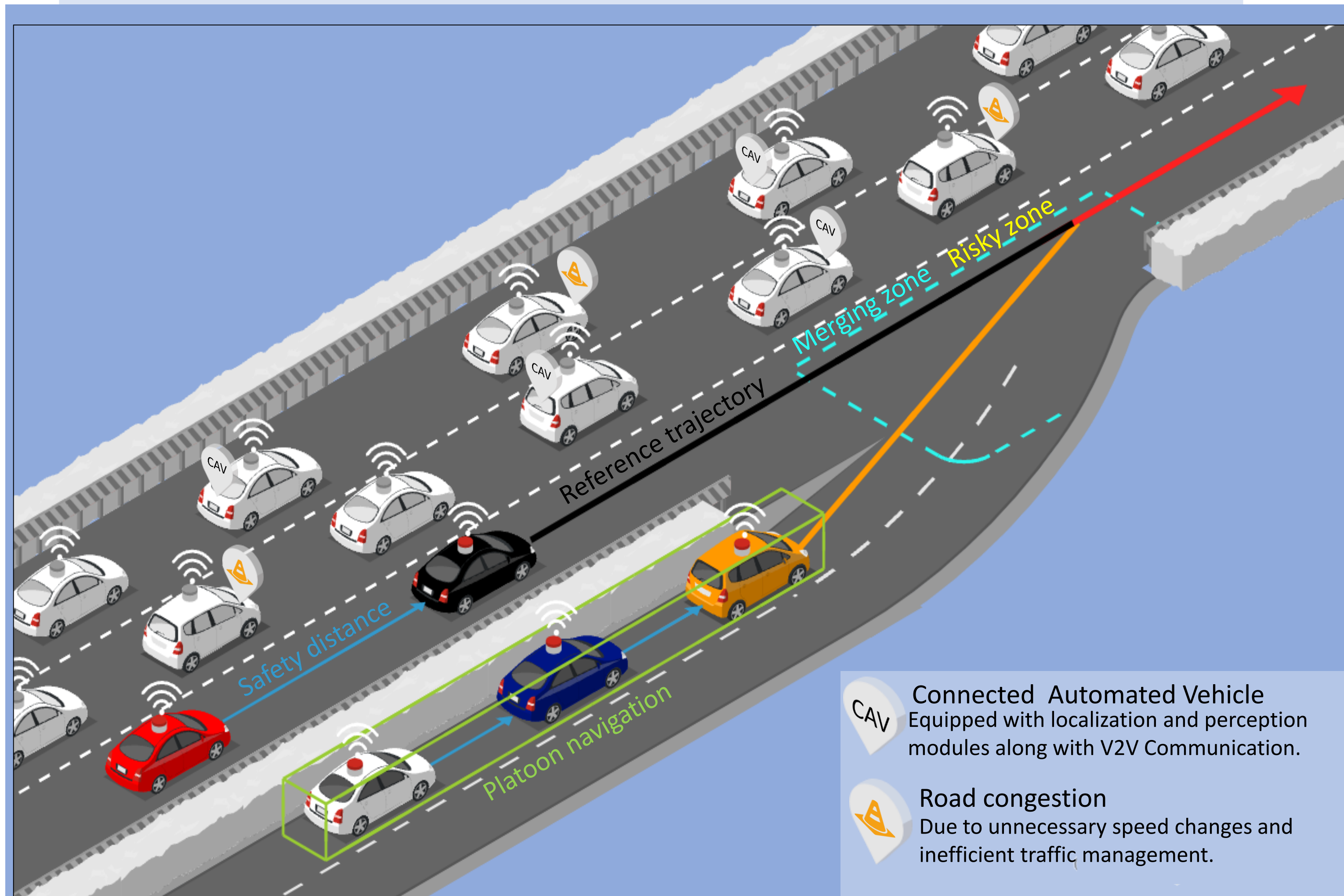


Figure 1: On-ramp merging on highway

Cooperative merging strategy

- Decision making level: decide on a safe and efficient passing sequence of the CAVs through the merging zone (cf. Figure 1).
- Global planning level: decide on the global path of the CAVs w.r.t. their initial position and their destination, the road geometry, etc.
- Local planning level: decide on the local trajectory of the CAVs w.r.t. their passing sequence and their reference global path.

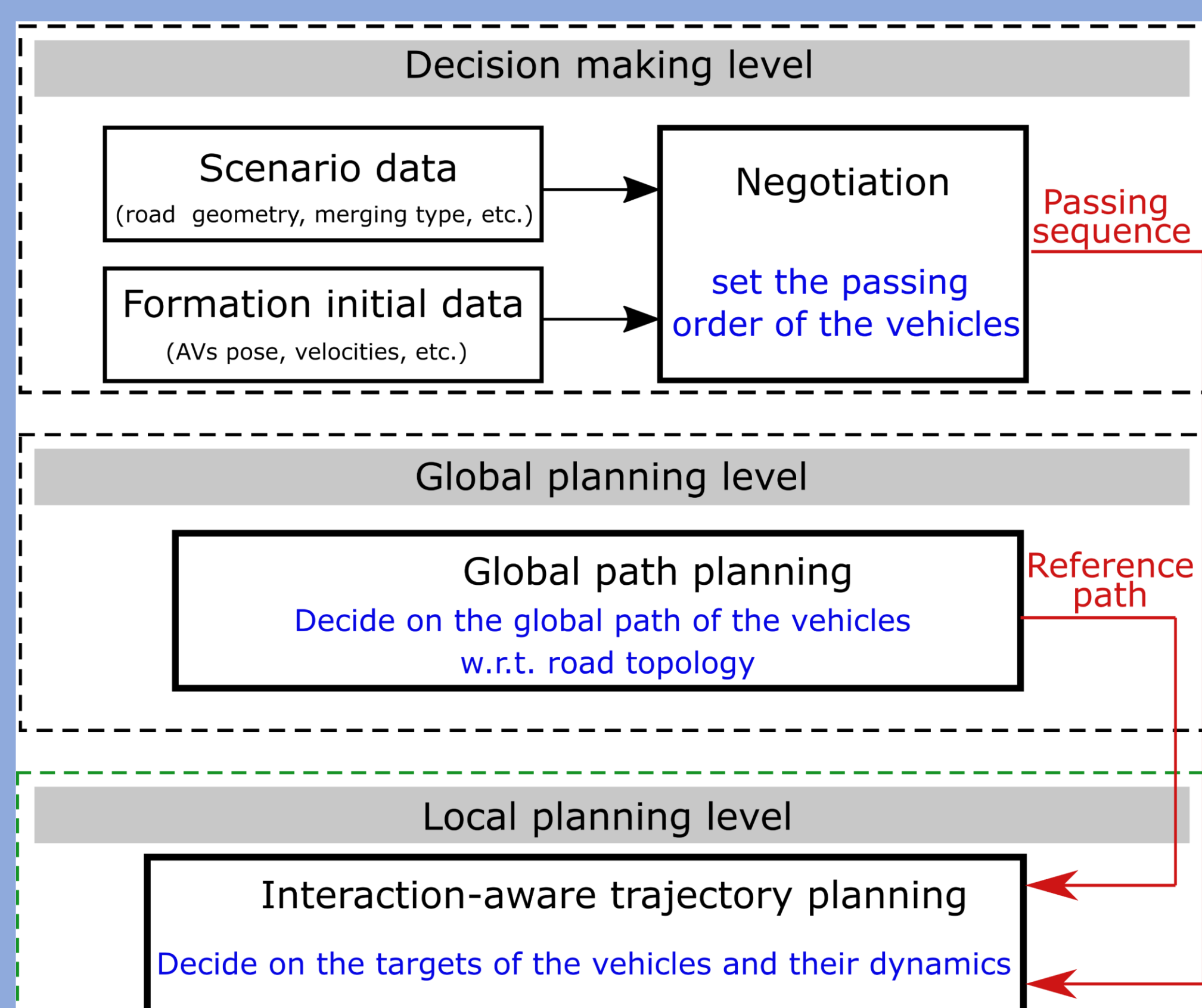
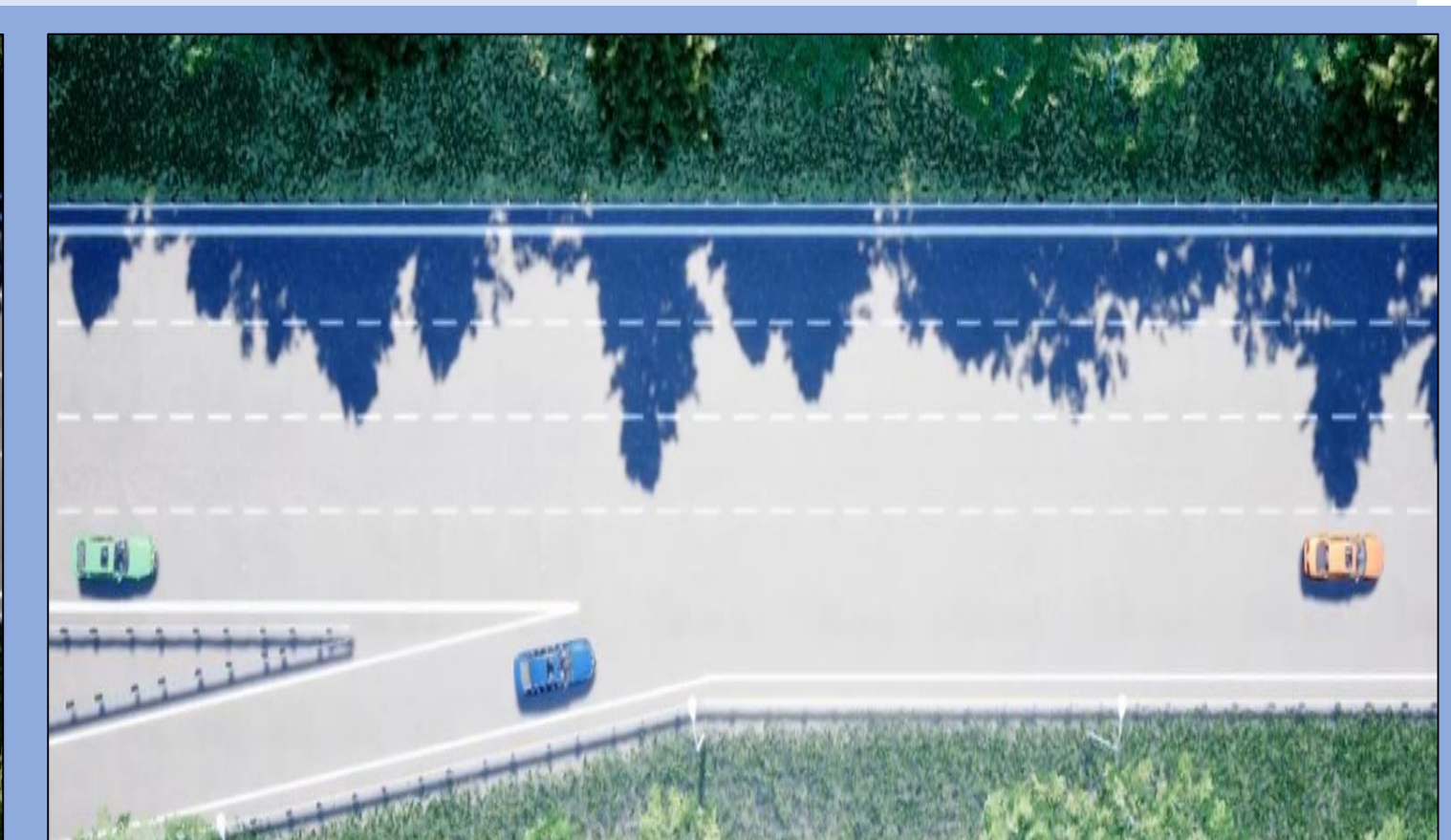


Figure 2: The overall architecture of the cooperative merging strategy

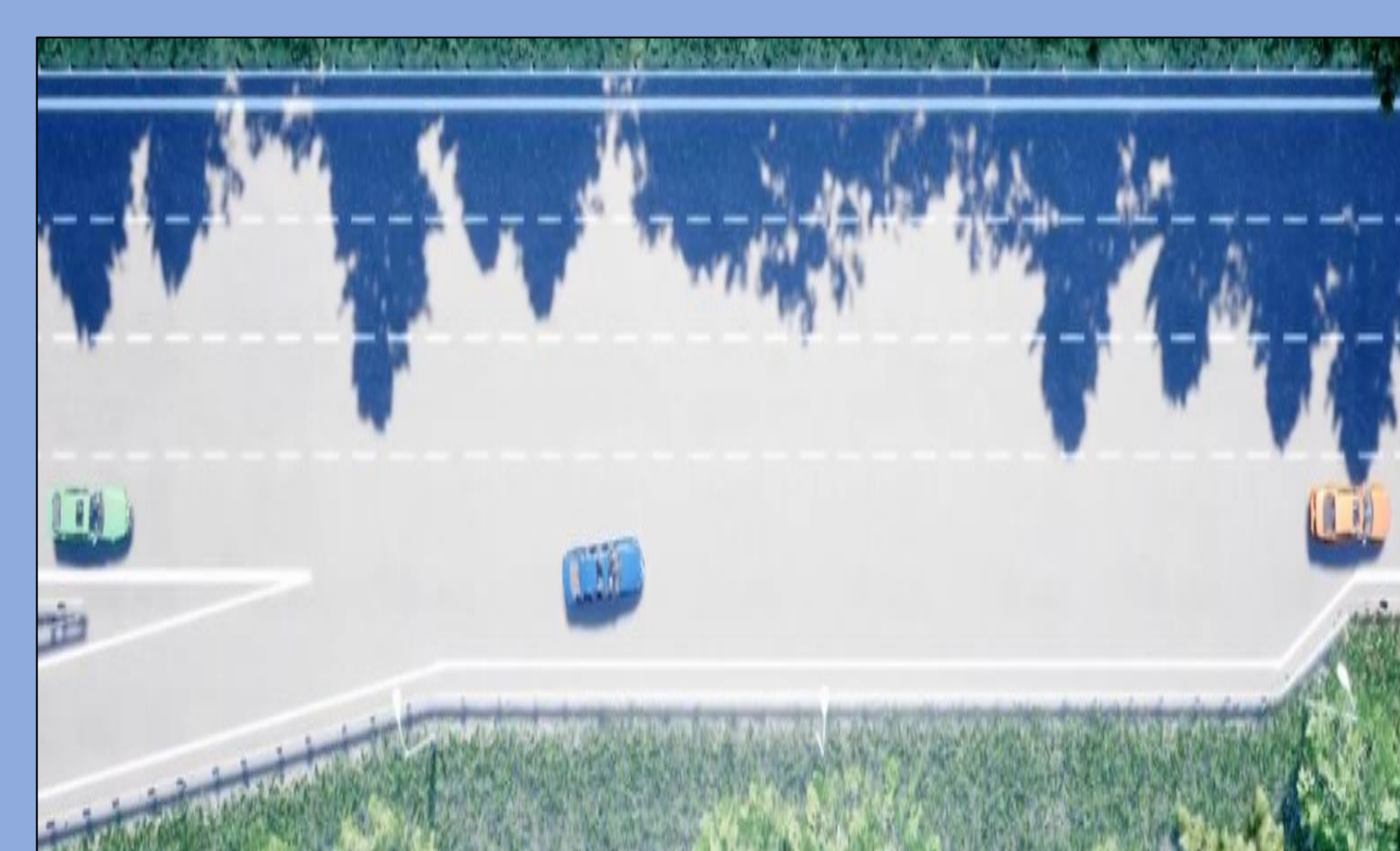
Cooperative on-ramp merging for CAVs



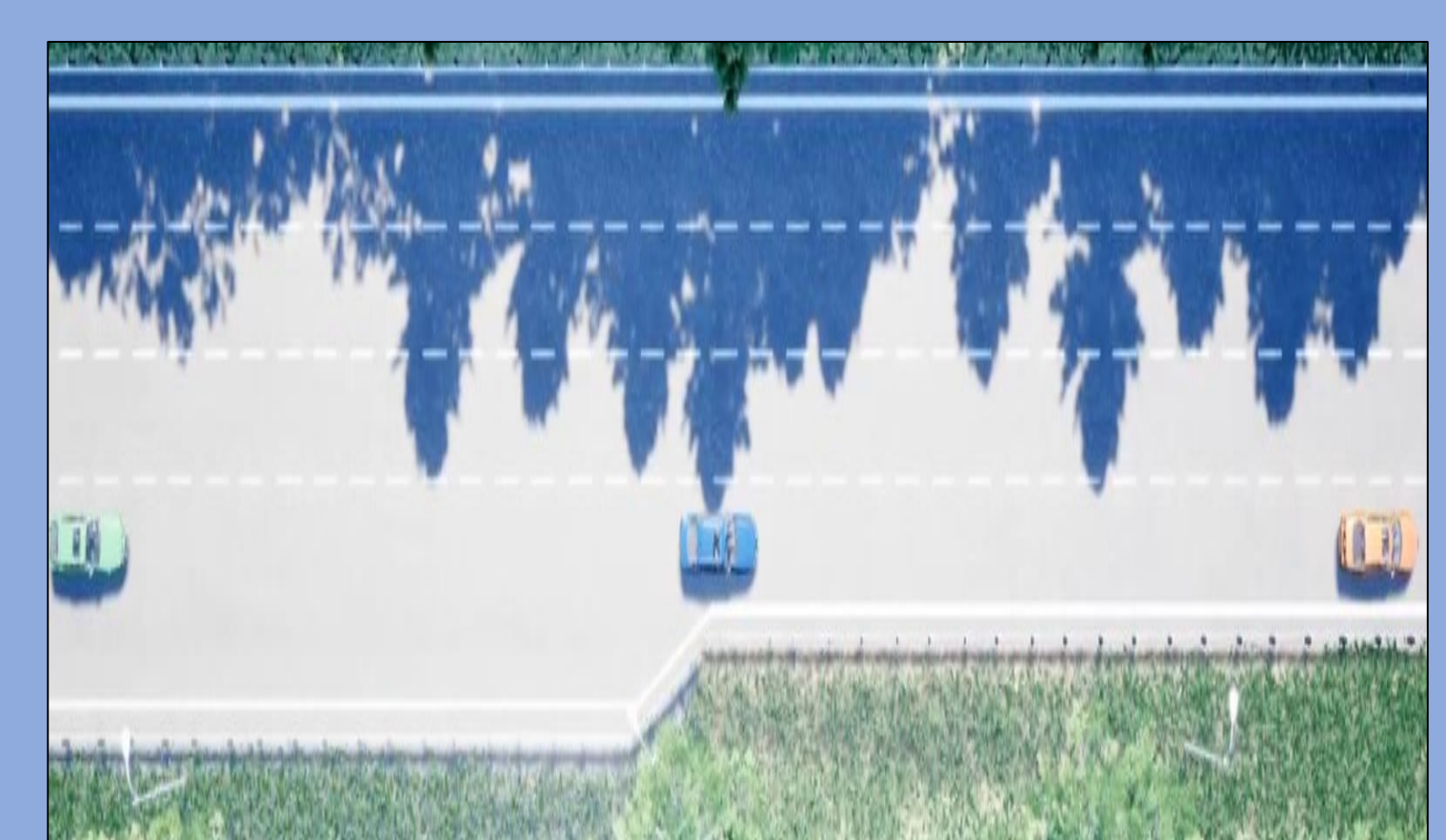
(a): $T=0s$, initial configuration: the vehicles V_1 and V_2 are in the main line. V_3 aims to merge into the main line. The three vehicles are part of a **triangular formation**.



(b): $T=2s$, reconfiguration phase: V_3 enters the merging zone. A **reconfiguration from a triangular shape toward a linear one is being performed**.



(c): $T=4.2s$, reconfiguration phase: the merging vehicle merges into the main line between V_1 and V_2 , while ensuring the respect of the minimum safety distance \underline{D}_T .



(d): $T=7s$, platoon formation: the three vehicles navigate through the main line in a **linear formation**.

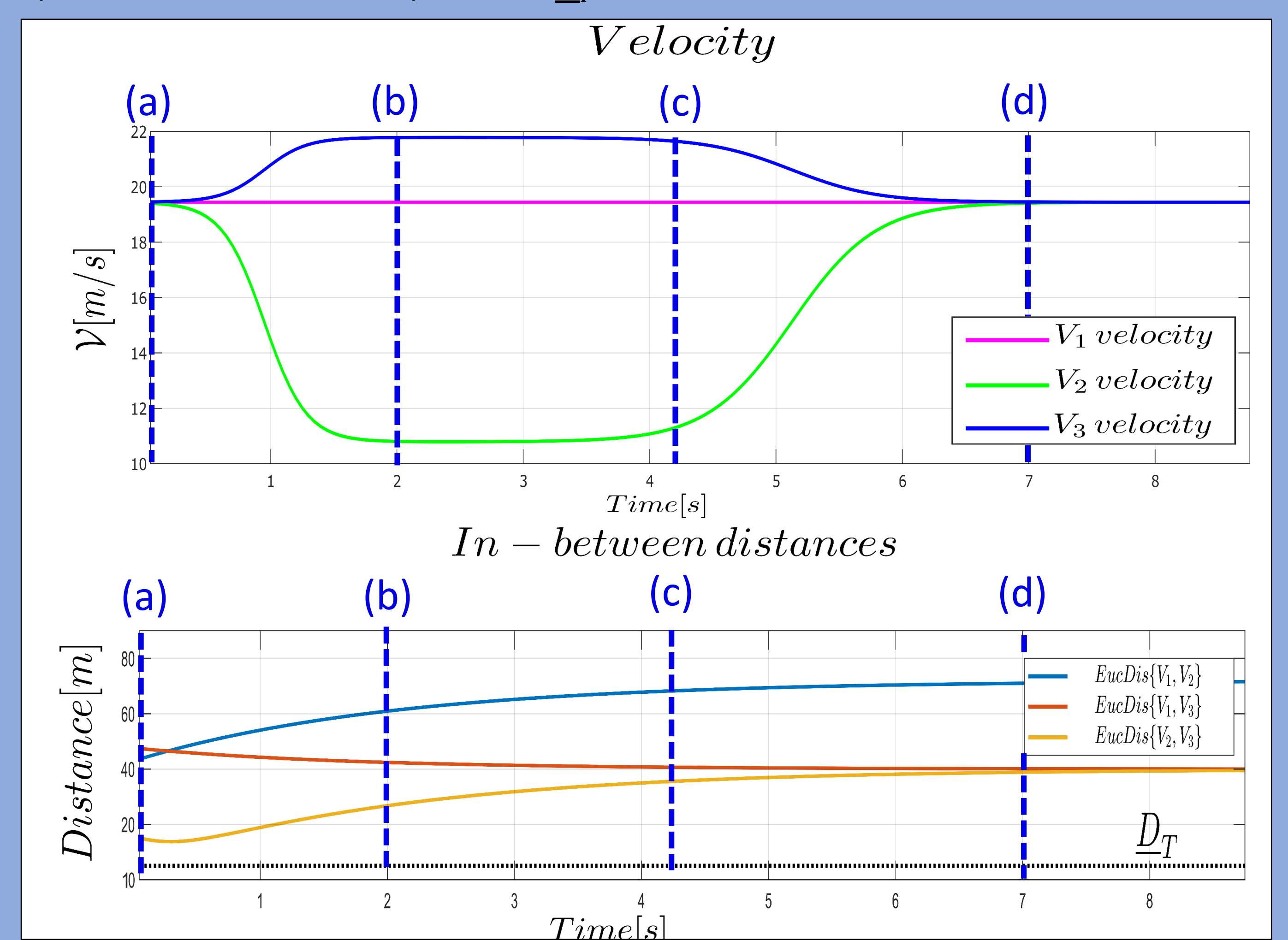


Figure 3: Velocity and in-between distance profile of each vehicle

Perspectives

- Include vehicle's dynamics on the proposed solution.
- Implement the cooperative merging strategy in the laboratory's vehicles.

