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Stand-Alone and Traffic Sensitive Speed Advisory System based on Lagrangian Traffic Indicators for Eco-Driving or GLOSA Strategies near Traffic Lights

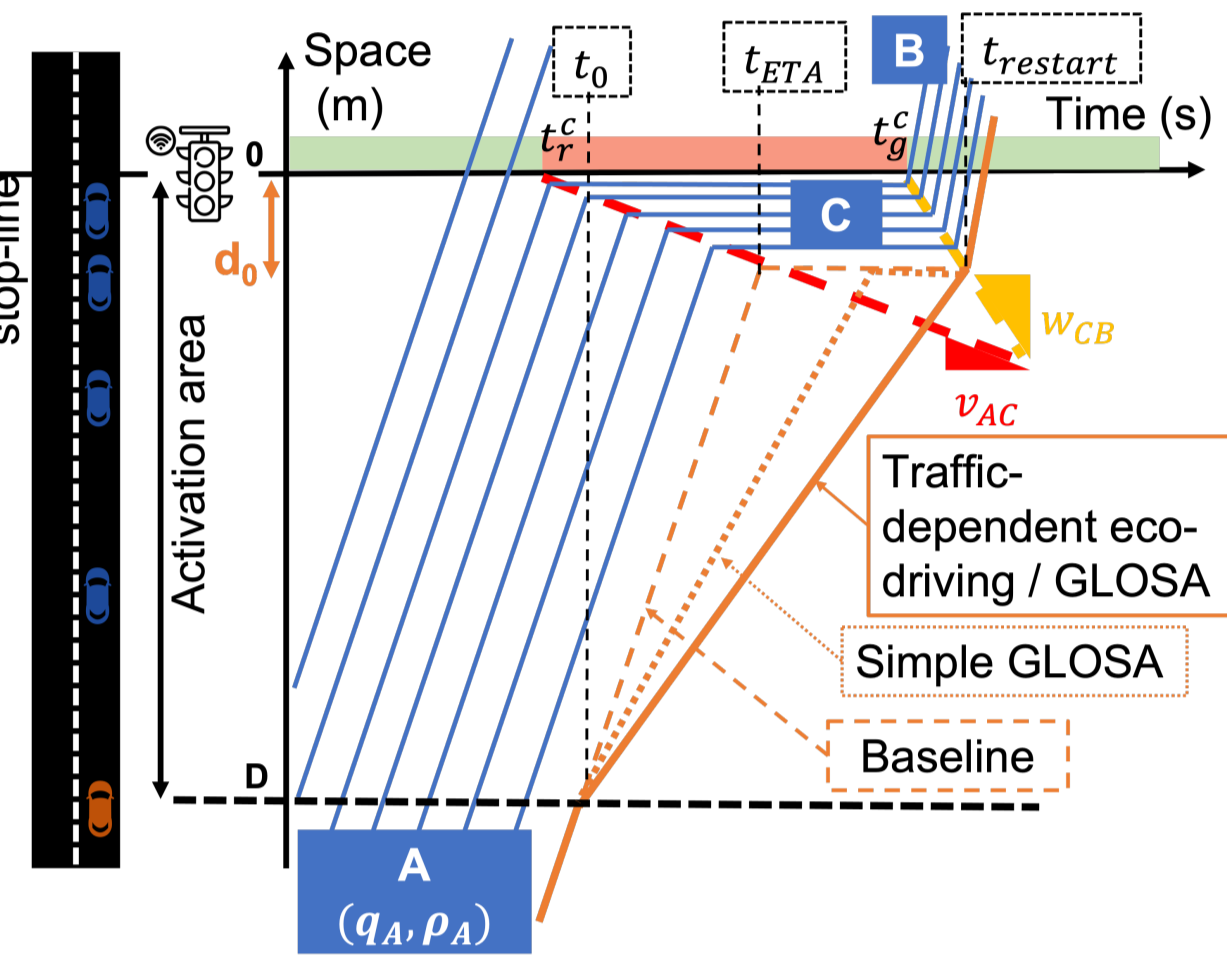
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Introduction

Context

GLOSA (Green Light Optimal Speed Advisory) or eco-driving strategies in the vicinity of intersection are widely studied systems enabling Connected Vehicles drive through the intersection without getting stopped. In its basic implementation, the 'simple GLOSA' aims at targeting the beginning of the green phases and neglect queue length. Accordingly, its area of application is restricted to medium degree of saturations ($\leq 50\%$) and the algorithm becomes inefficient with high demand.



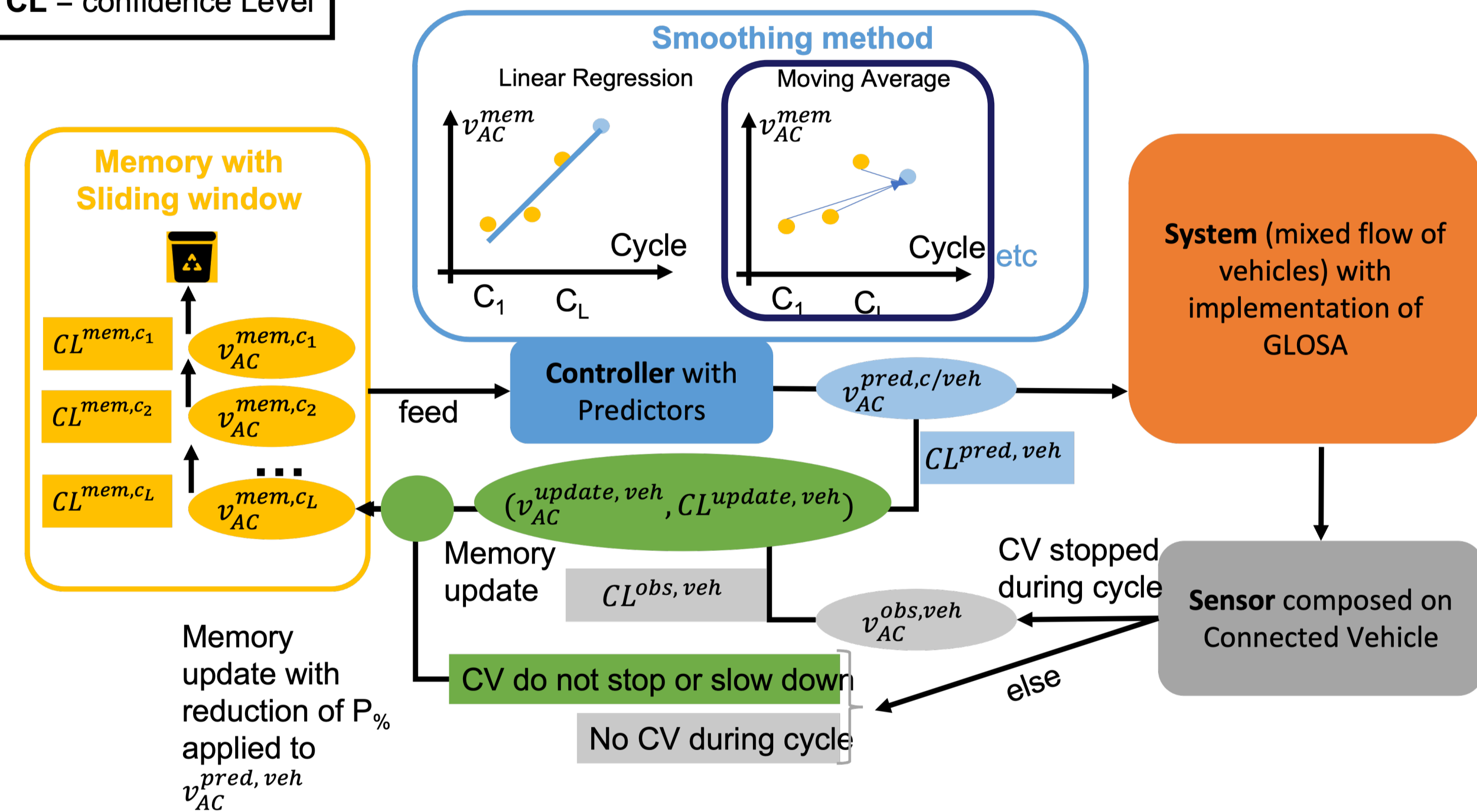
Positioning

Few studies (e.g. Yang et al.) have developed algorithms taking into consideration downstream traffic conditions, but it requires a large set of intrusive or dedicated sensors, not systematically available at any location.

Can we achieve to perform GLOSA with Queue-Length prediction only from tracks left by Connected Vehicles?

Estimation process

CL = confidence Level

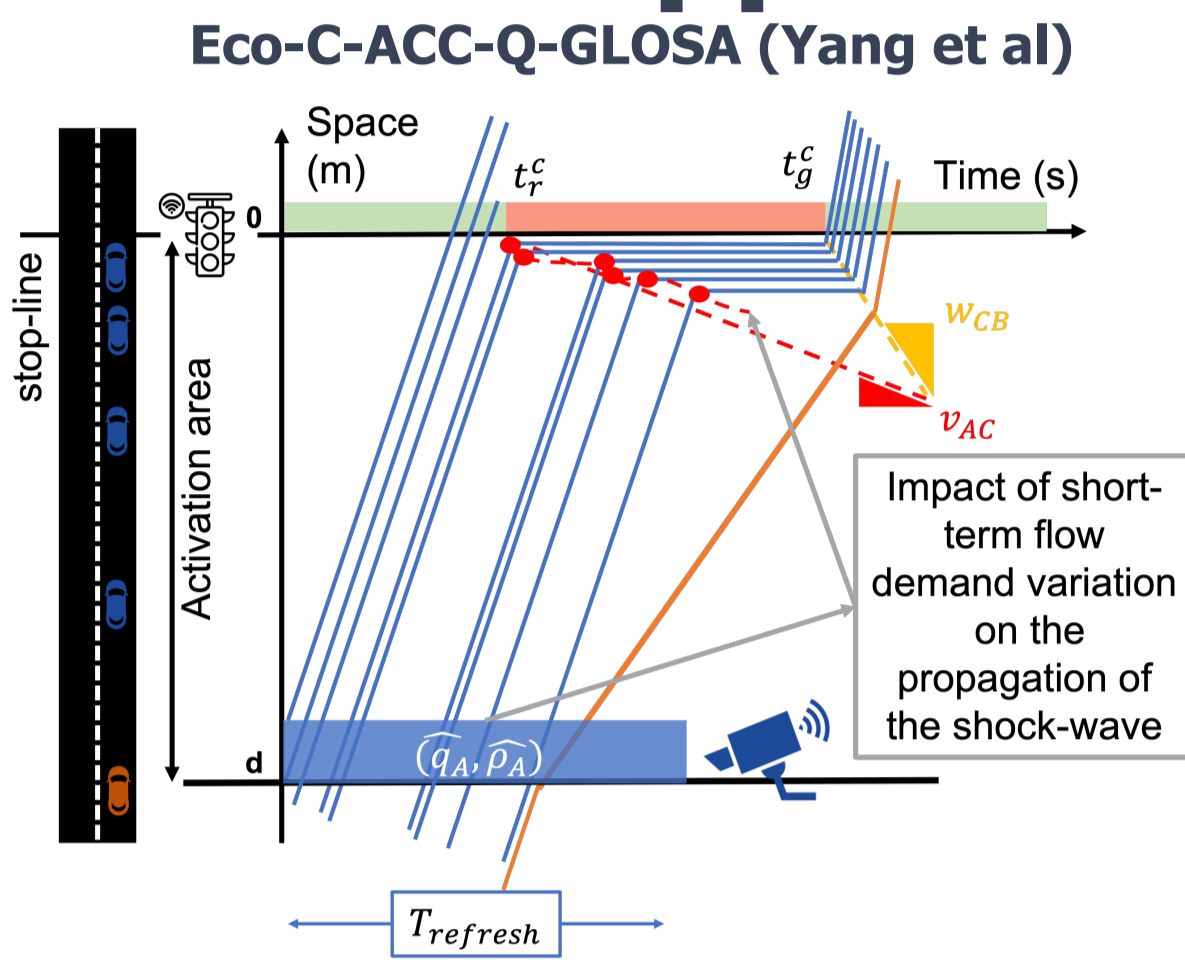


Key concepts

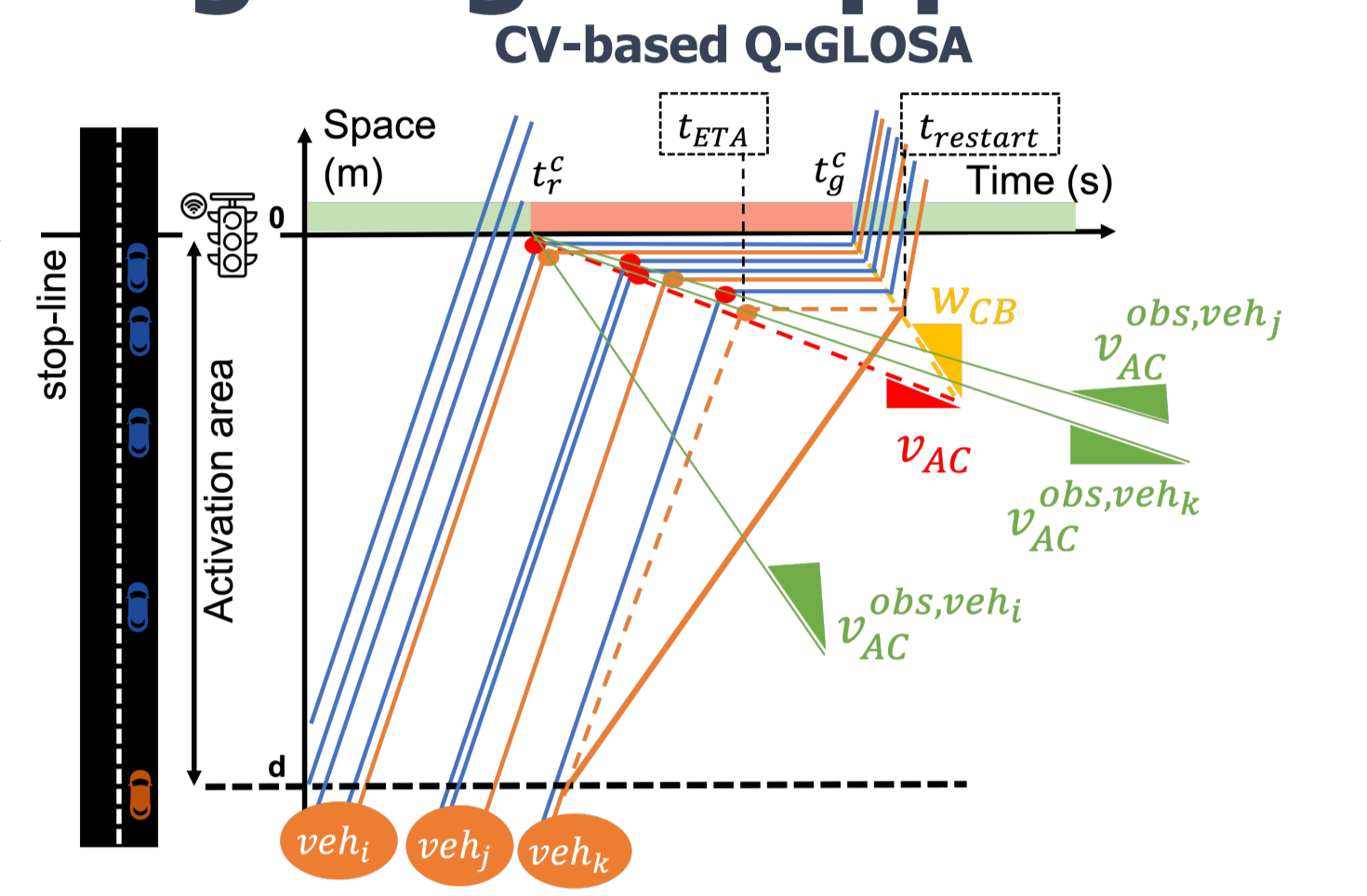
- ❖ Prediction of v_{AC} is performed at each time-step based on a subset of previous observations selected by a sliding window
- ❖ Each new measurement is weighted by a Confidence Level and combined with prediction to enhance stability
- ❖ Over-estimation is prevented by targetting a slightly sub-optimal solution (systematic reduction of $P\%$ applied to $v_{pred, veh}$ when no stops occurred)

Main challenges

Eulerian Approach



Lagrangian Approach

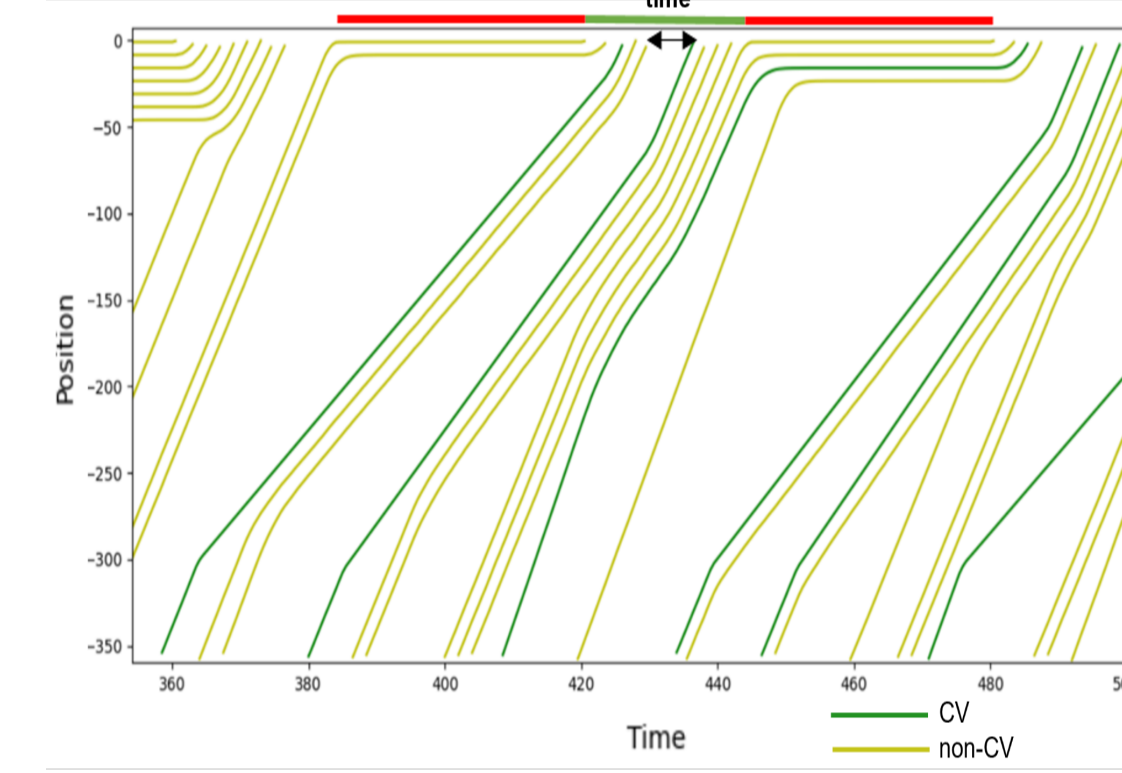


Requirements to predict Queue Length

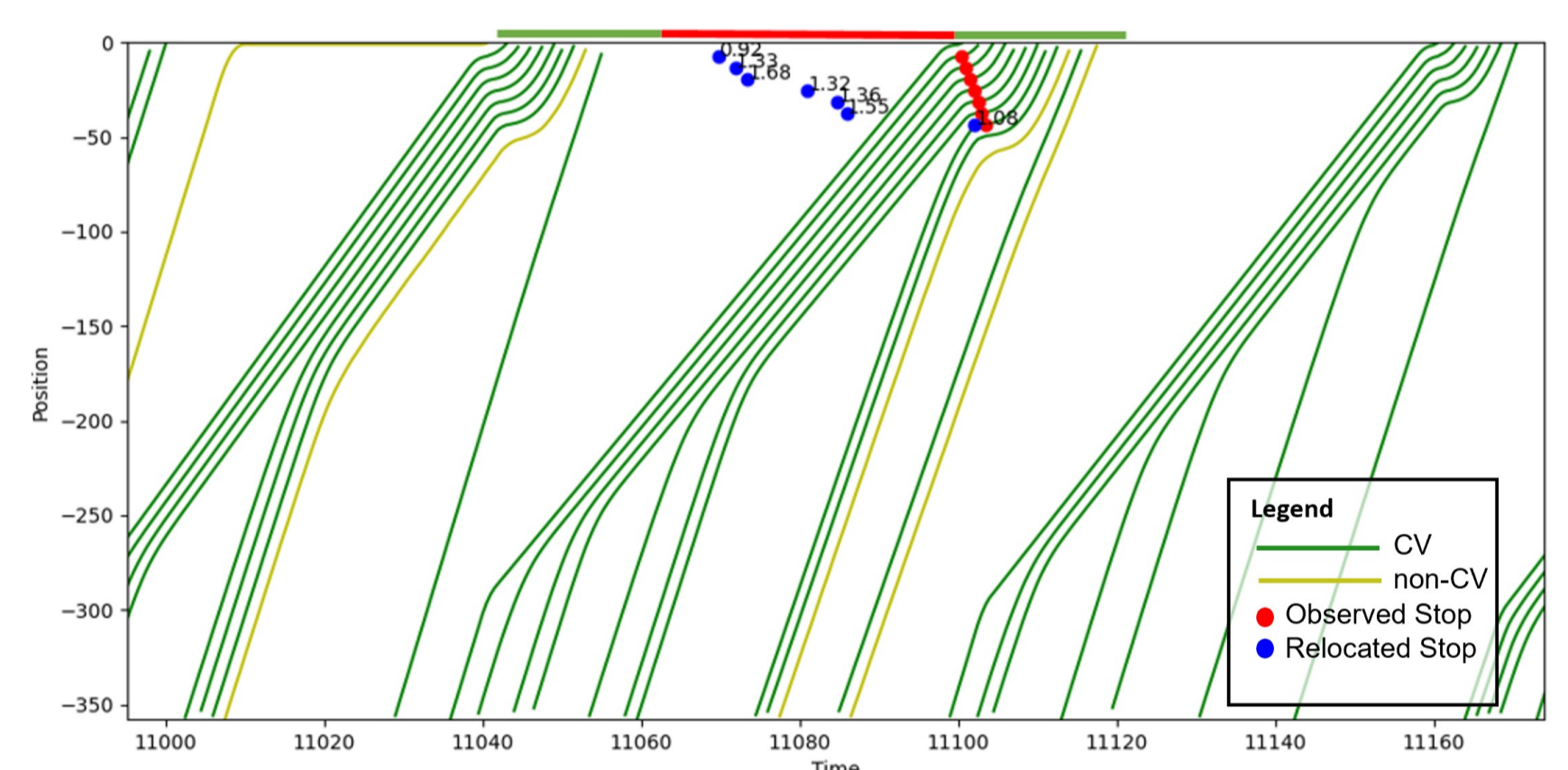
- ❖ Assess forward propagation shockwave W_{CB}
 - depend on road configuration
- ❖ Assess backward propagation shockwave V_{AC}
 - depend on traffic demand

- ❖ Eulerian estimators
 - Use loop sensor...
- ❖ Lagrangian estimators
 - Use GPS data

Identification of over-estimation cases

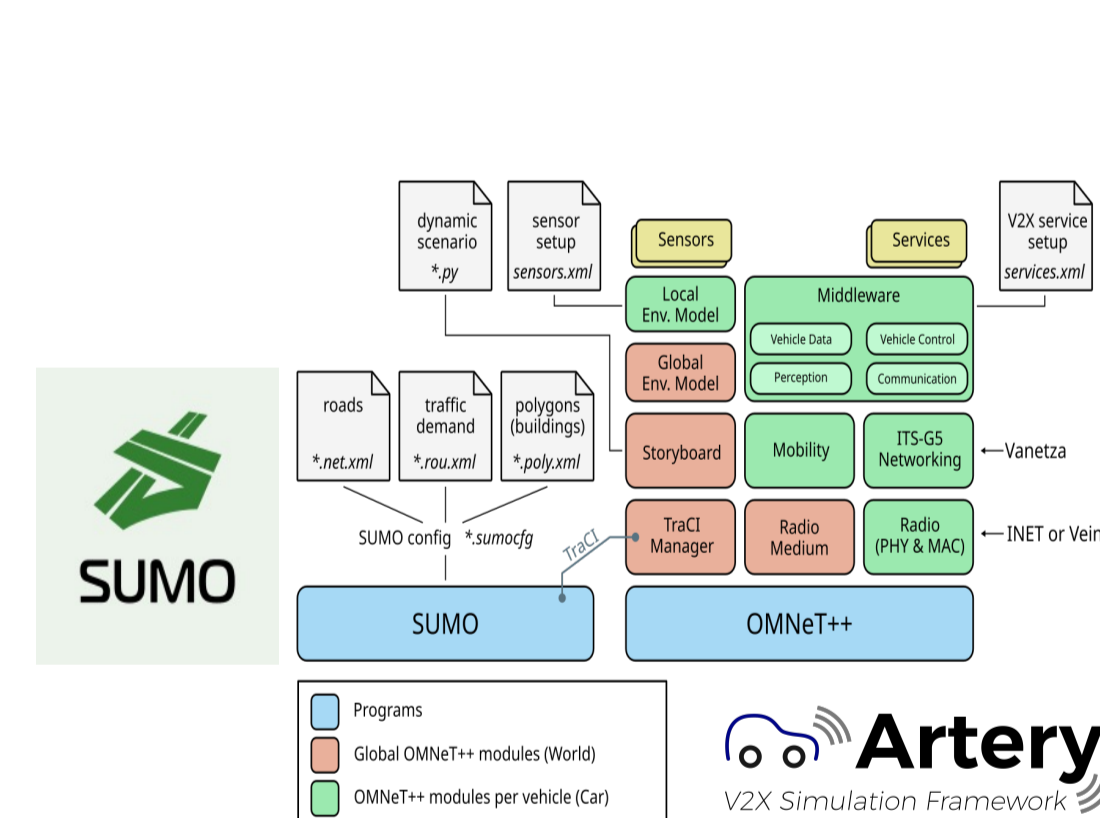


Temporal relocation of expected stops position

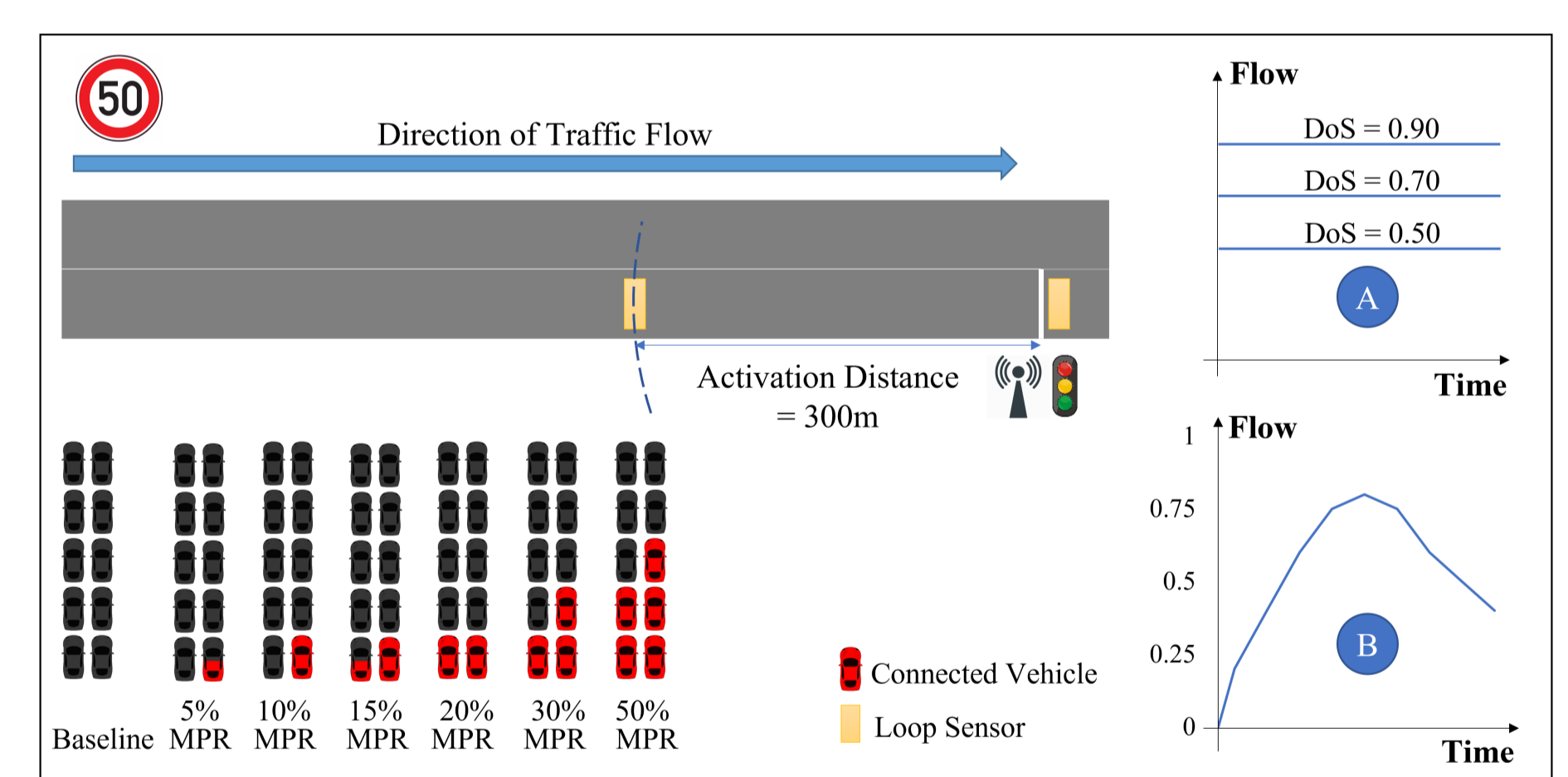


Use cases

Simulation Framework

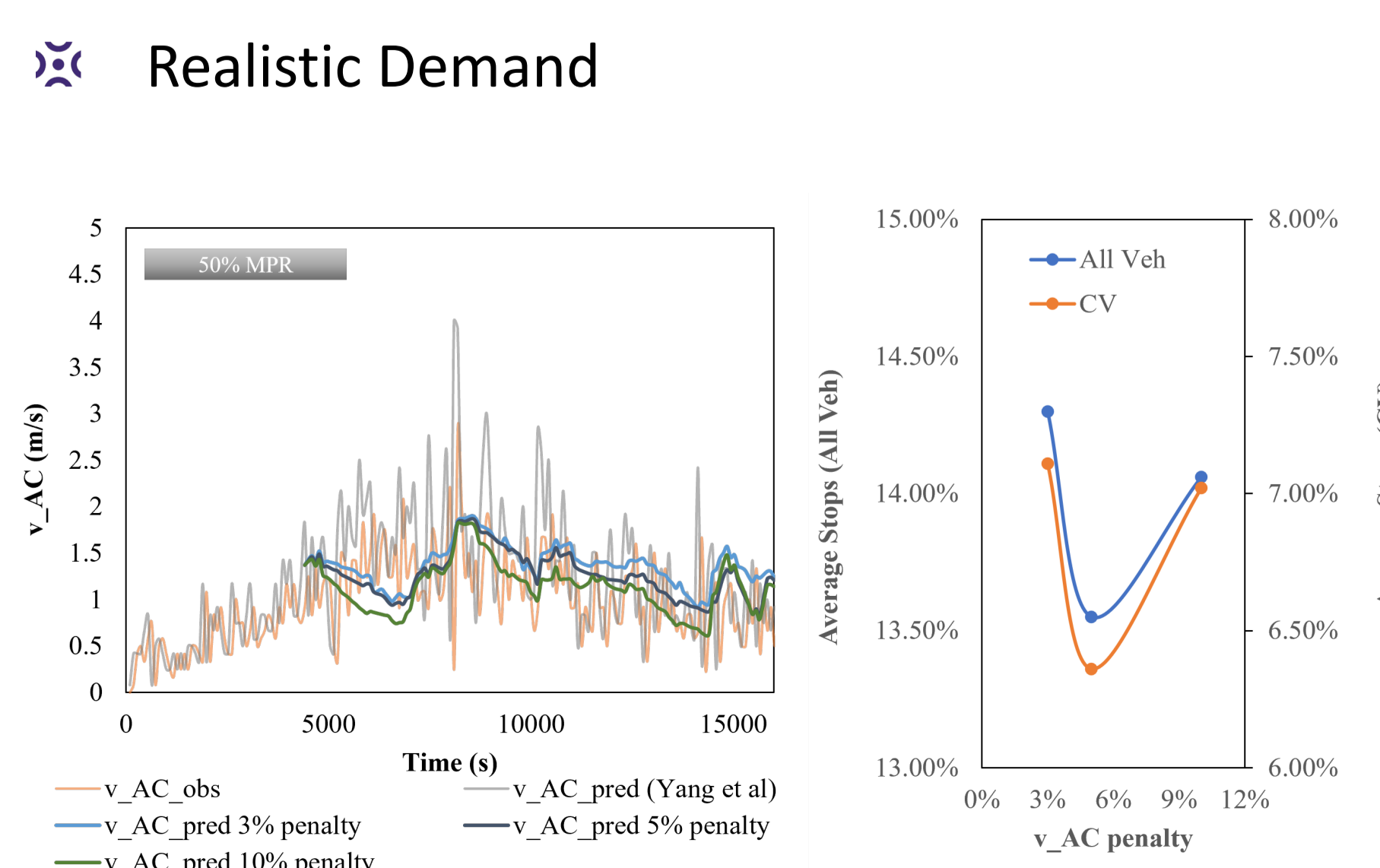
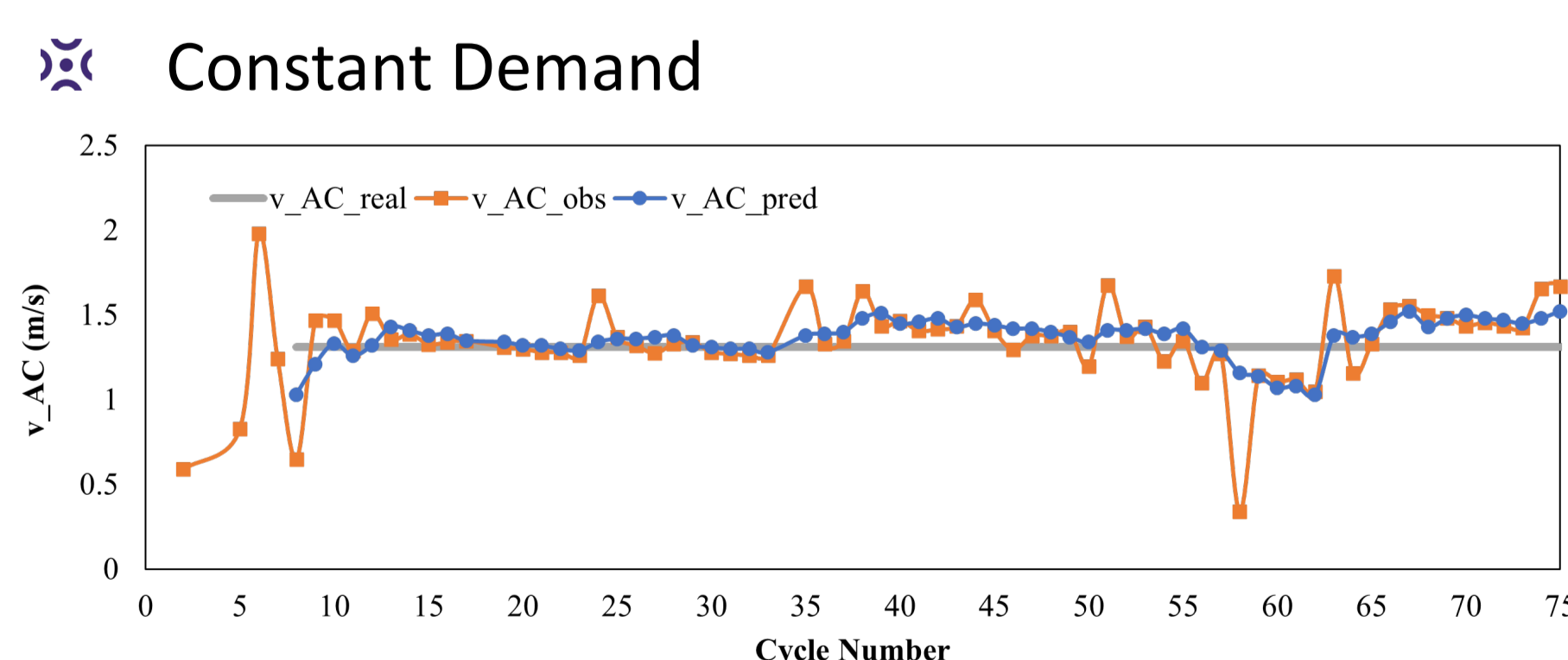


Experimental Design

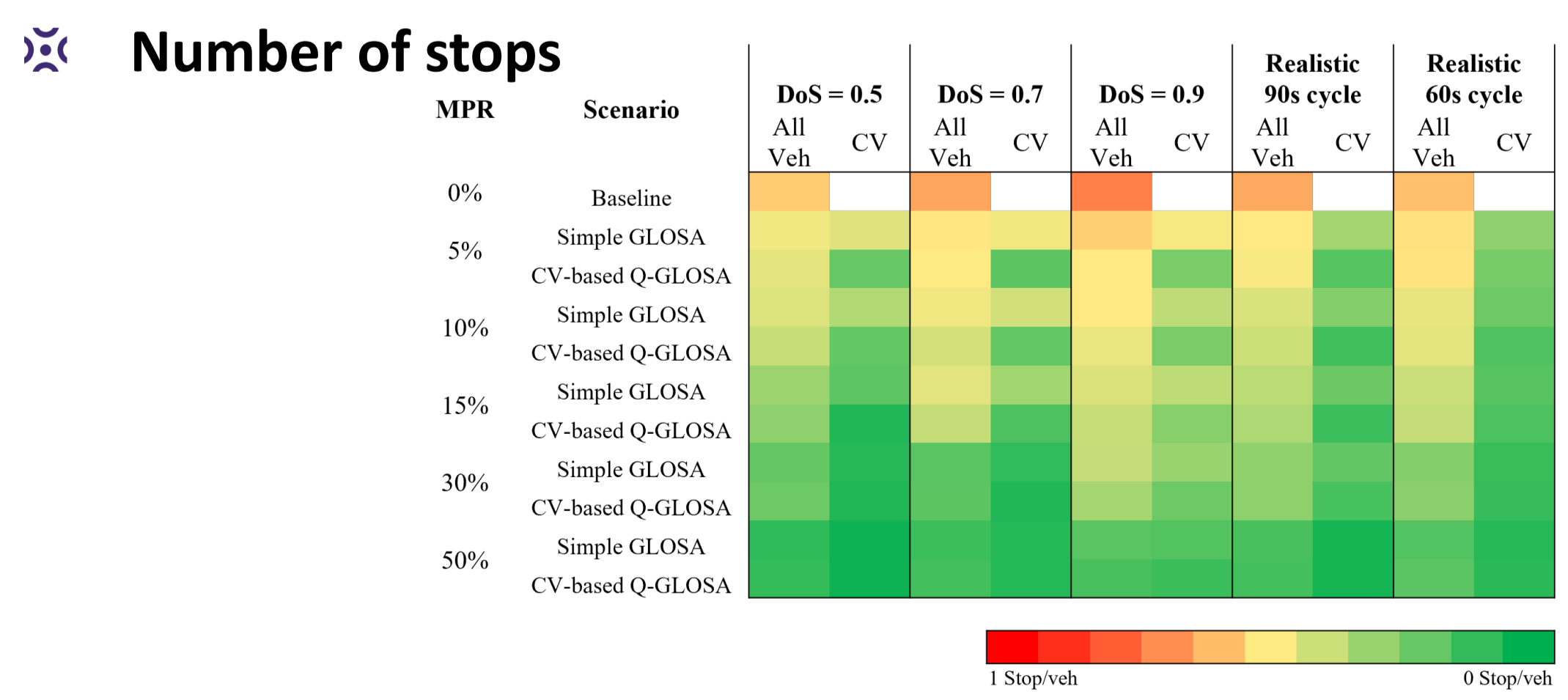


Main findings

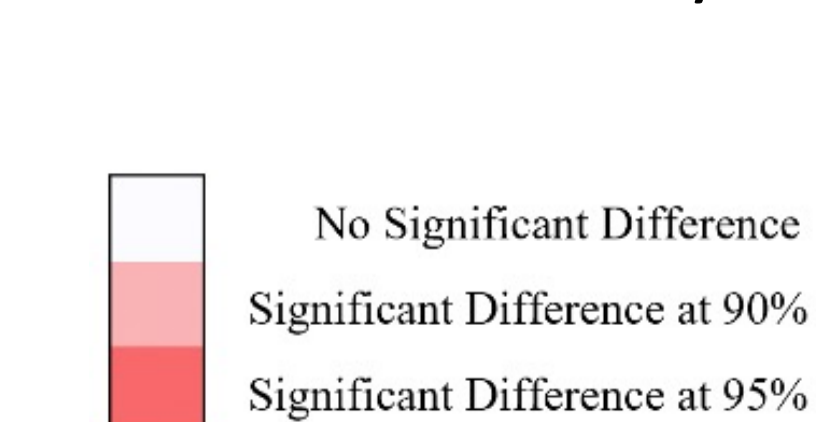
v_{AC} estimation performance



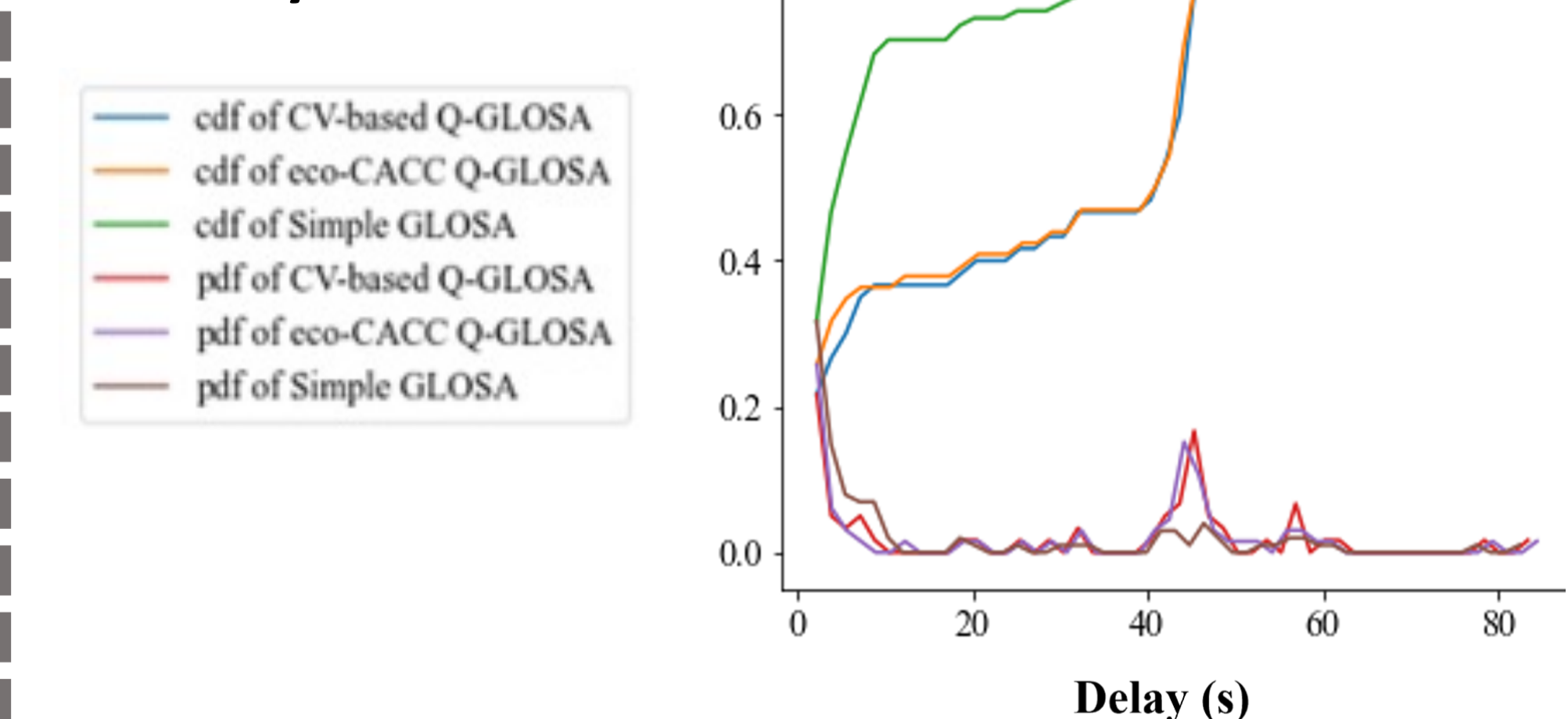
Performance comparison



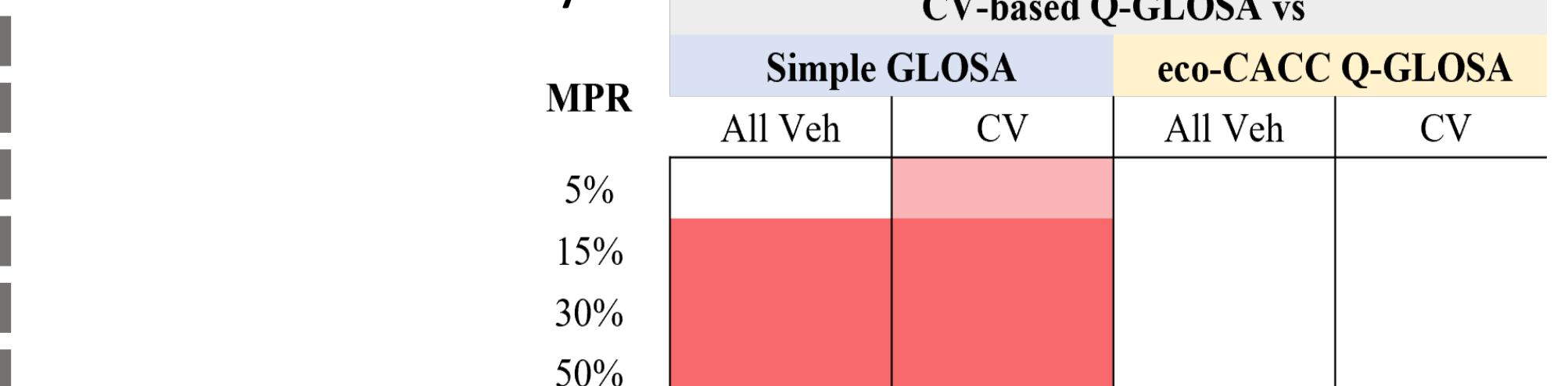
Statistical Analysis



Delays



Statistical Analysis



Reference

Yang et al – 2016 - Yang, H., Rakha, H., & Ala, M. V. (2016). Eco-cooperative adaptive cruise control at signalized intersections considering queue effects. *IEEE Transactions on Intelligent Transportation Systems*, 18(6), 1575-1585.

Acknowledgements

C-Roads (www.c-roads.eu)
 C-The-Difference (www.c-the-difference.eu)