



**HAL**  
open science

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

Pierre-Antoine Laharotte, Kinjal Bhattacharyya, Jonathan Perun,  
Nour-Eddin El Faouzi

## ► To cite this version:

Pierre-Antoine Laharotte, Kinjal Bhattacharyya, Jonathan Perun, Nour-Eddin El Faouzi. Stand-Alone and Traffic Sensitive Speed Advisory System based on Lagrangian Traffic Indicators for Eco-Driving or GLOSA Strategies near Traffic Lights. TRB Annual Meeting 2022, Jan 2022, Washington, United States. hal-04638077

**HAL Id: hal-04638077**

**<https://hal.science/hal-04638077v1>**

Submitted on 8 Jul 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



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

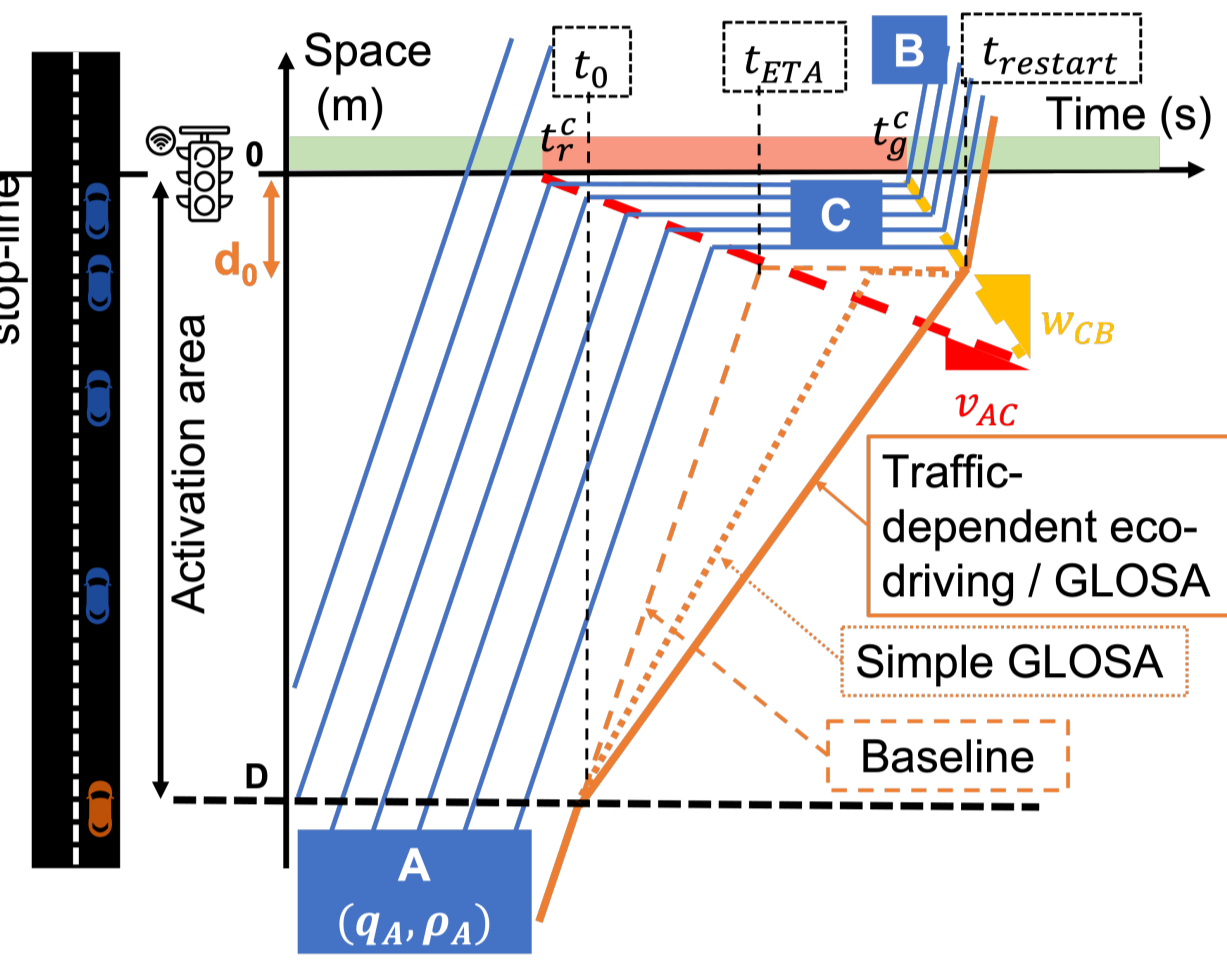
Pierre-Antoine Laharotte<sup>1</sup>, Kinjal Bhattacharyya<sup>1</sup>, Jonathan Perun<sup>1,2</sup>, Nour-Eddin El Faouzi<sup>1</sup>

<sup>1</sup> LICIT (Traffic and Transportation Engineering Laboratory, Université Gustave Eiffel, Lyon, France  
<sup>2</sup> ENTPE, Lyon, FRANCE

## 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.



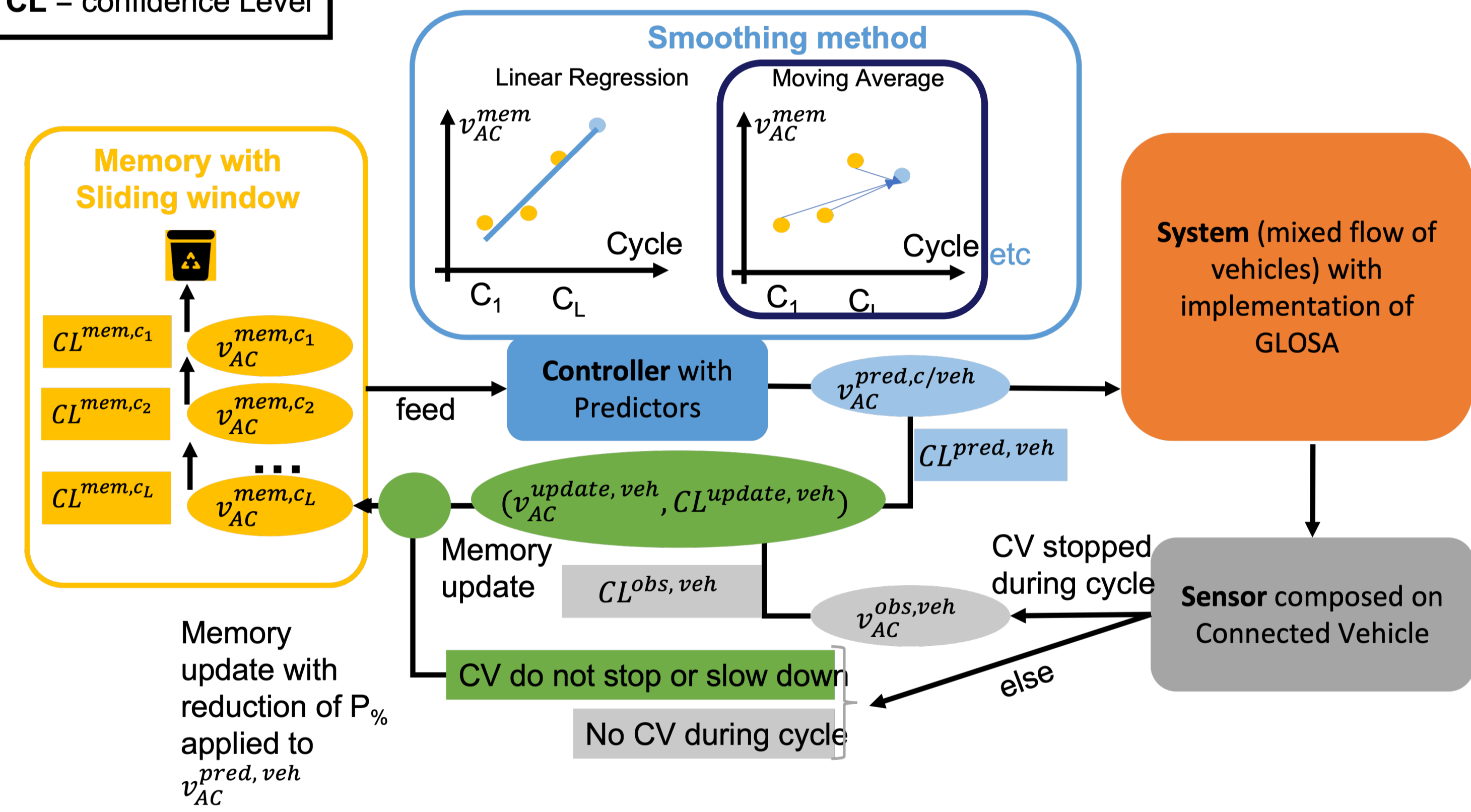
### Positioning

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

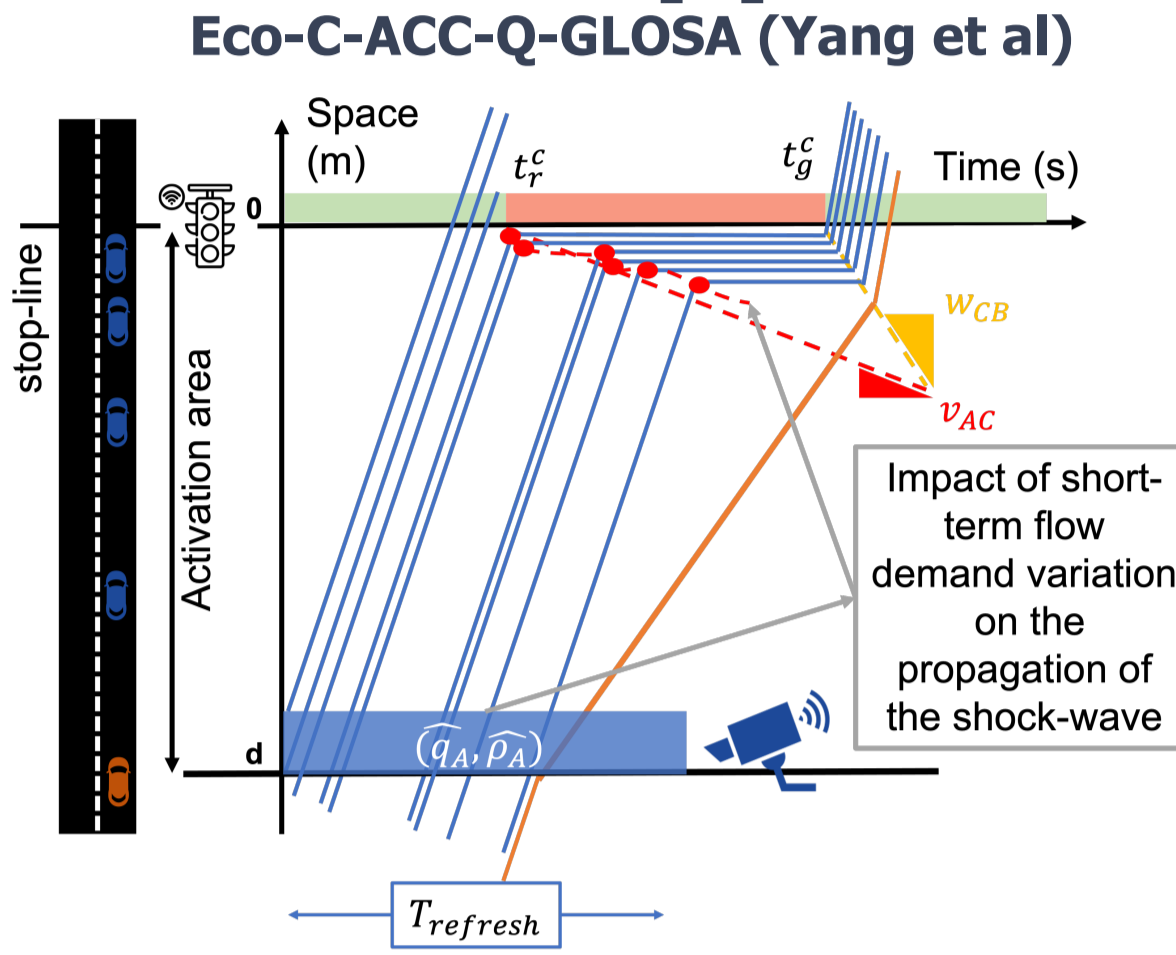


### Key concepts

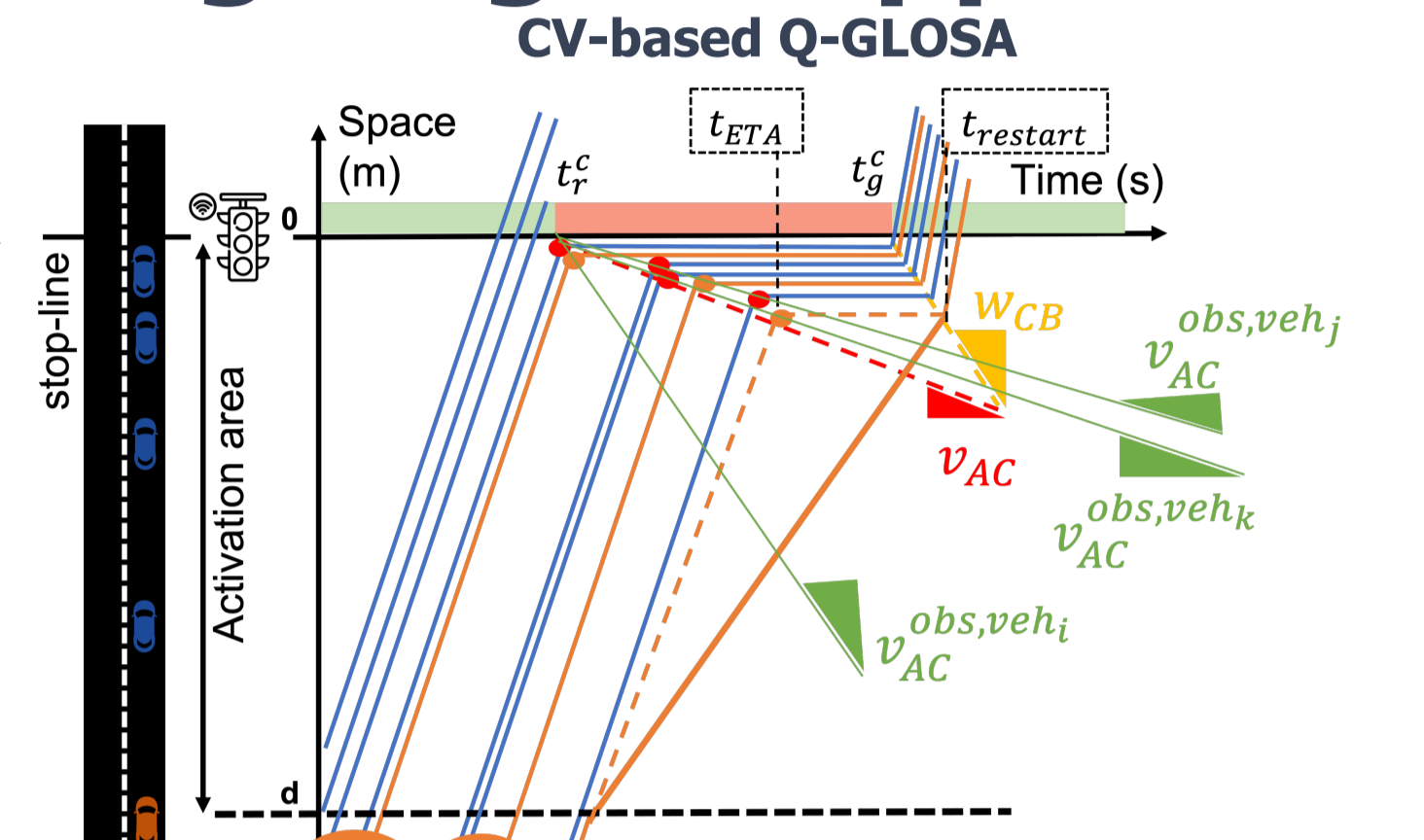
- ❖ Prediction of  $V_{AC}$  is performed at each time-step based on a subset of previous observations selected by a sliding window
- ❖ Each new measurement is weighted by a Confidence Level and combined with prediction to enhance stability
- ❖ Over-estimation is prevented by targetting a slightly sub-optimal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

## Main challenges

### Eulerian Approach



### Lagrangian Approach

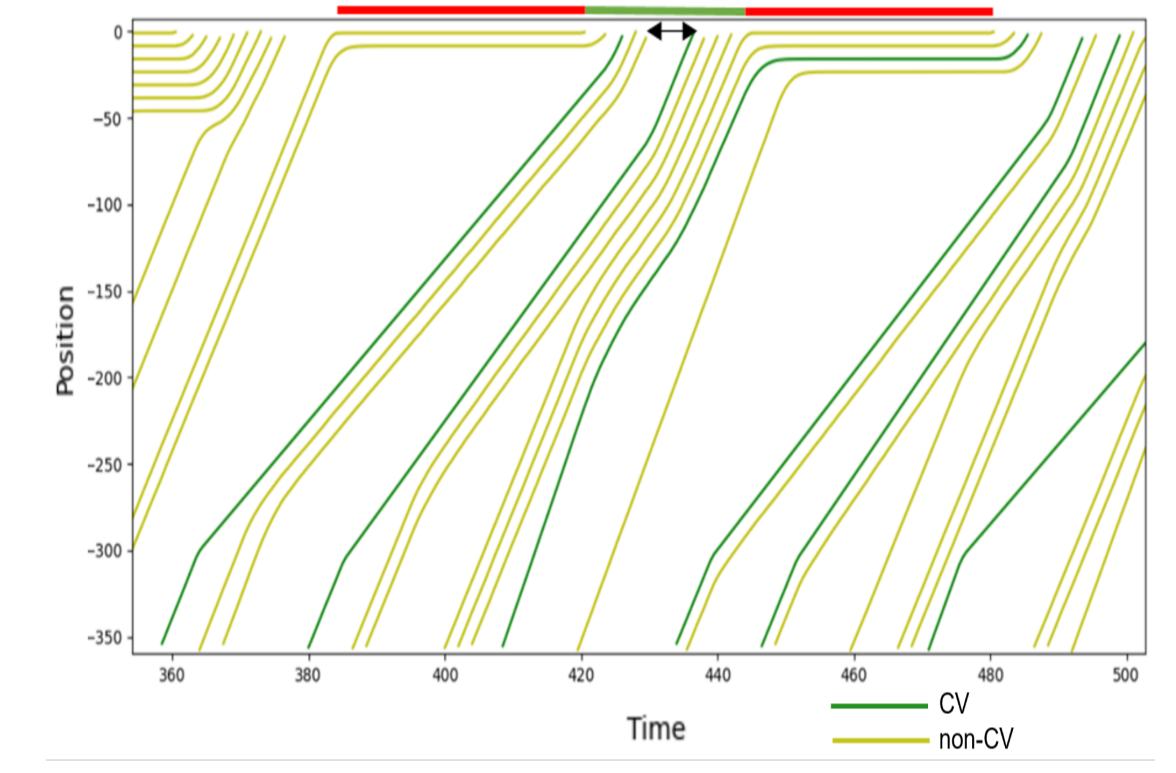


### Requirements to predict Queue Length

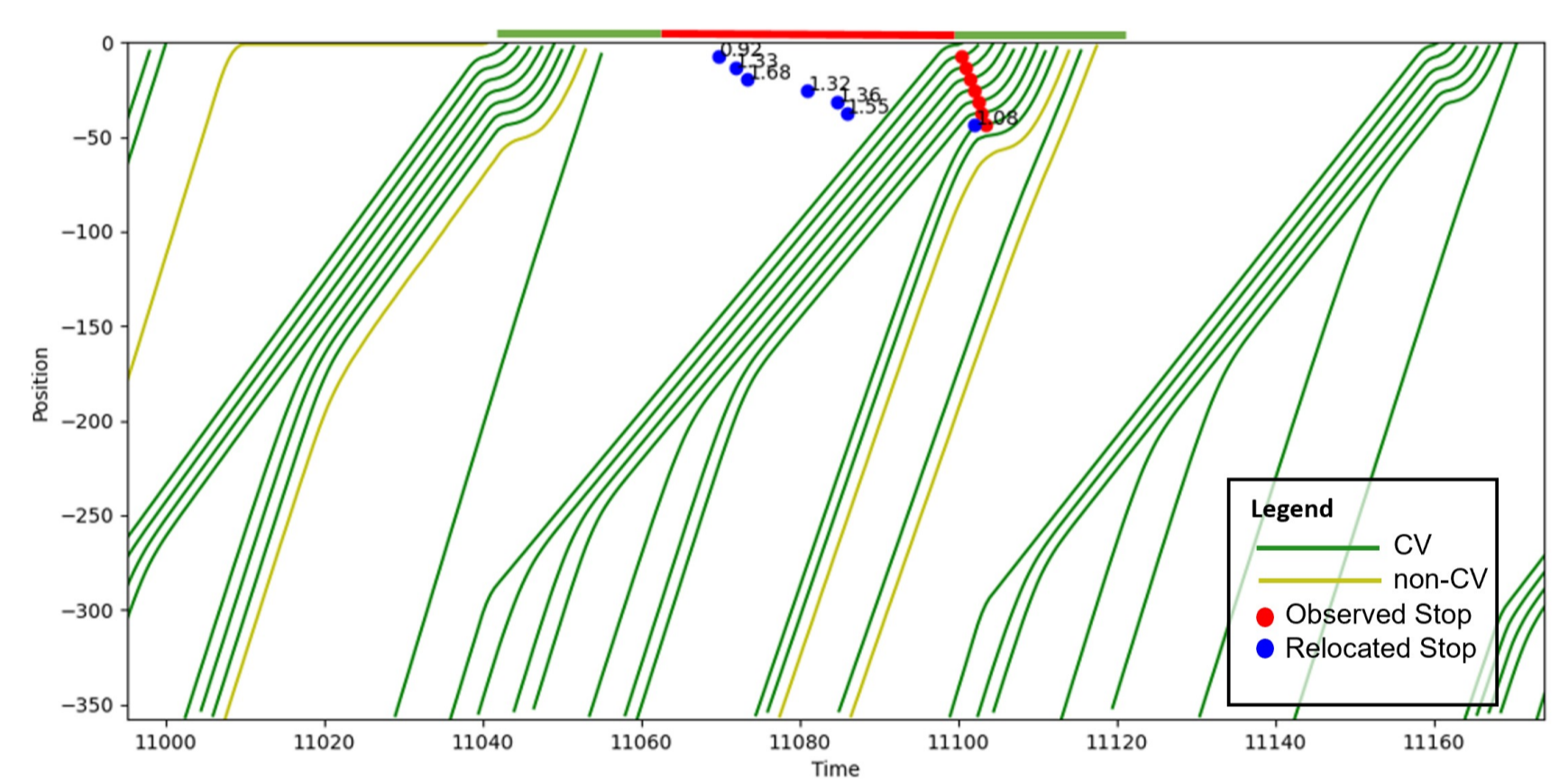
- ❖ Assess forward propagation shockwave  $W_{CB}$ 
  - depend on road configuration
- ❖ Assess backward propagation shockwave  $V_{AC}$ 
  - depend on traffic demand

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

### Identification of over-estimation cases

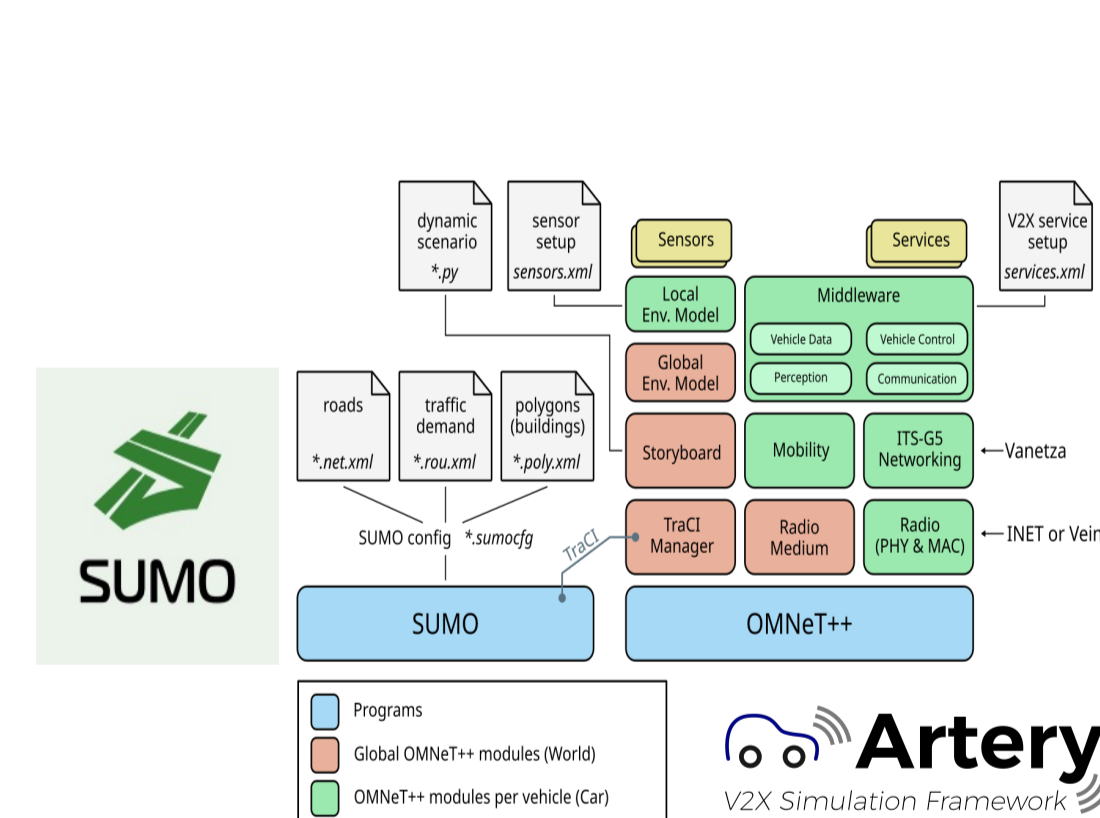


### Temporal relocation of expected stops position

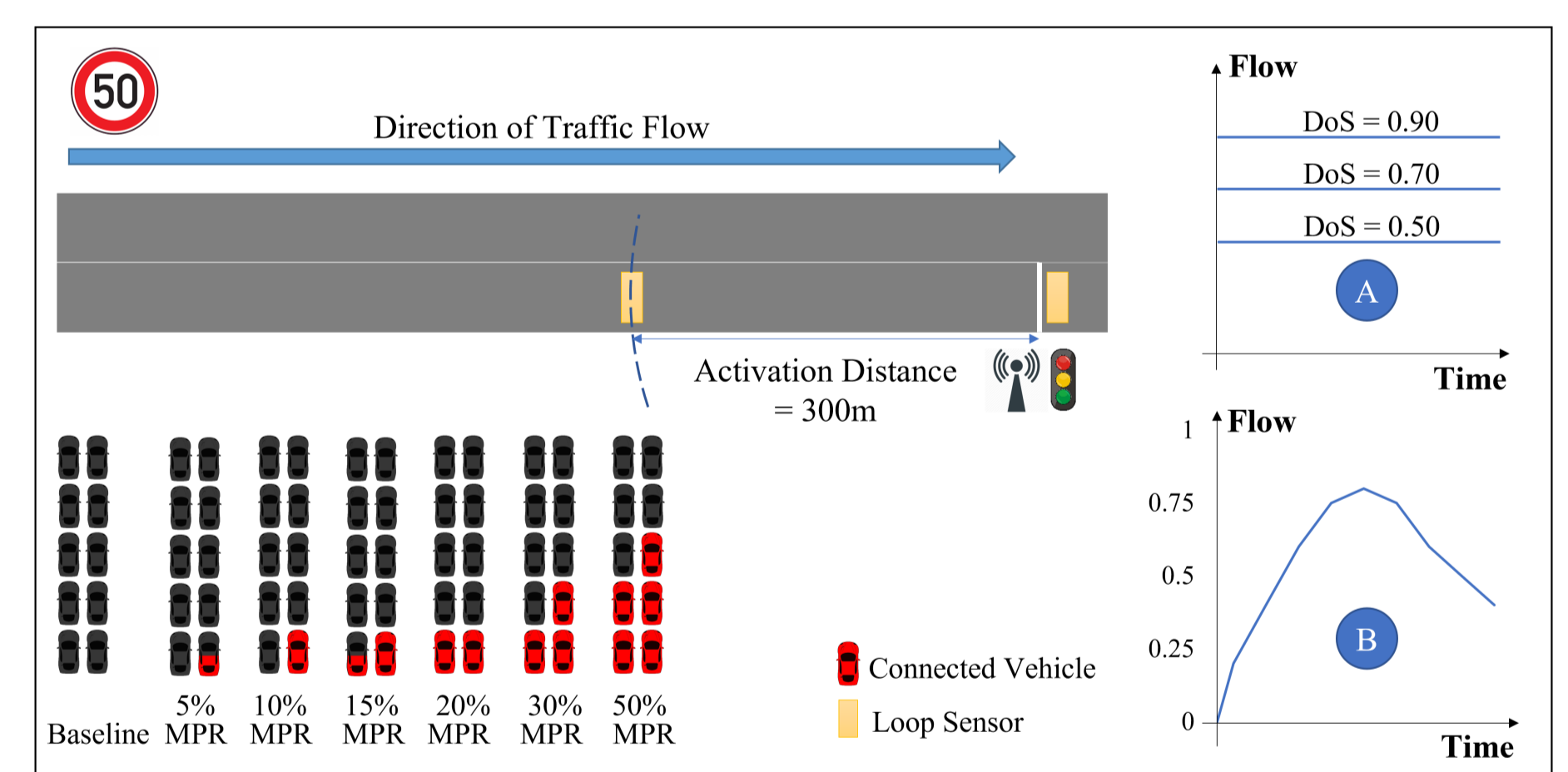


## Use cases

### Simulation Framework

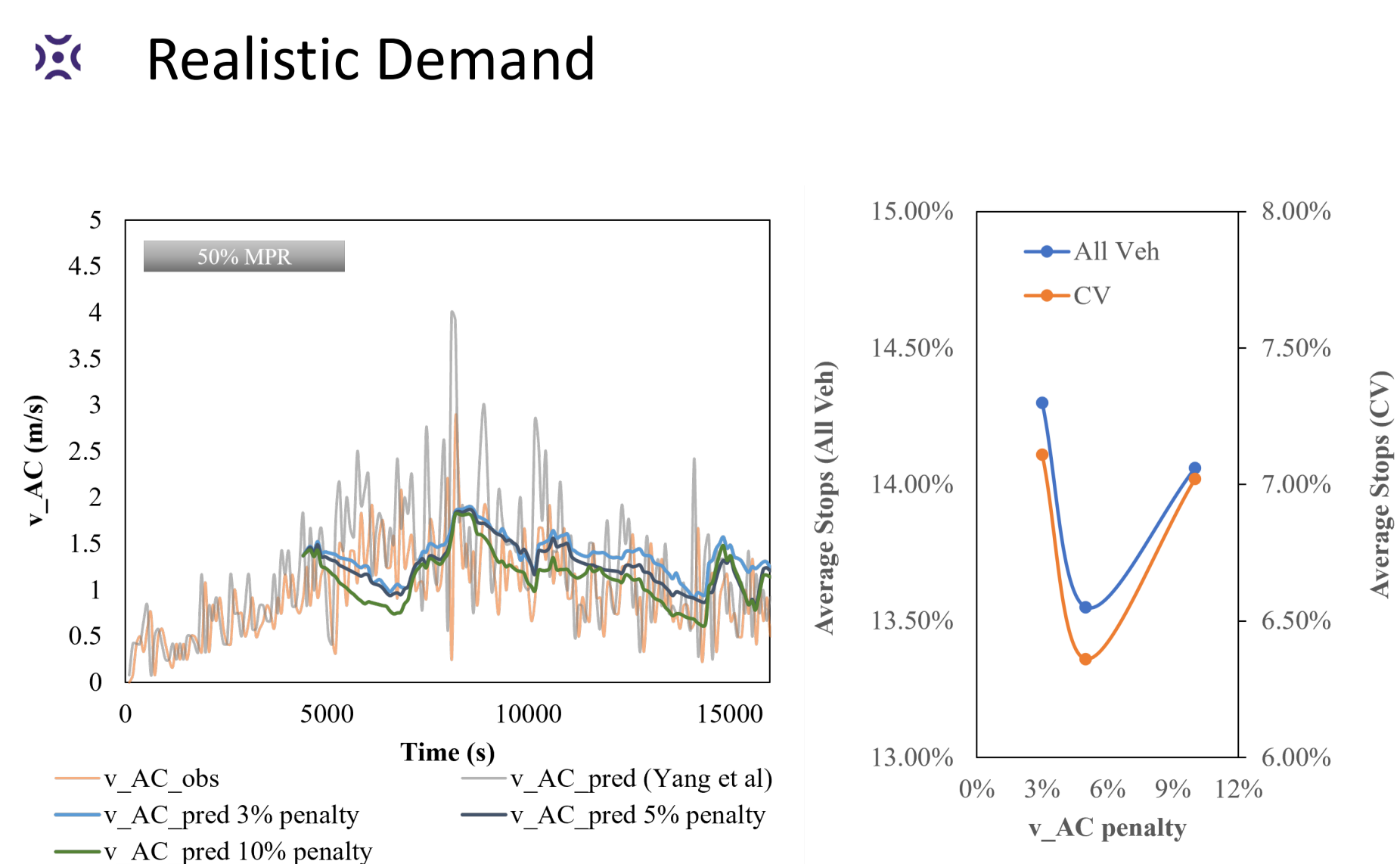
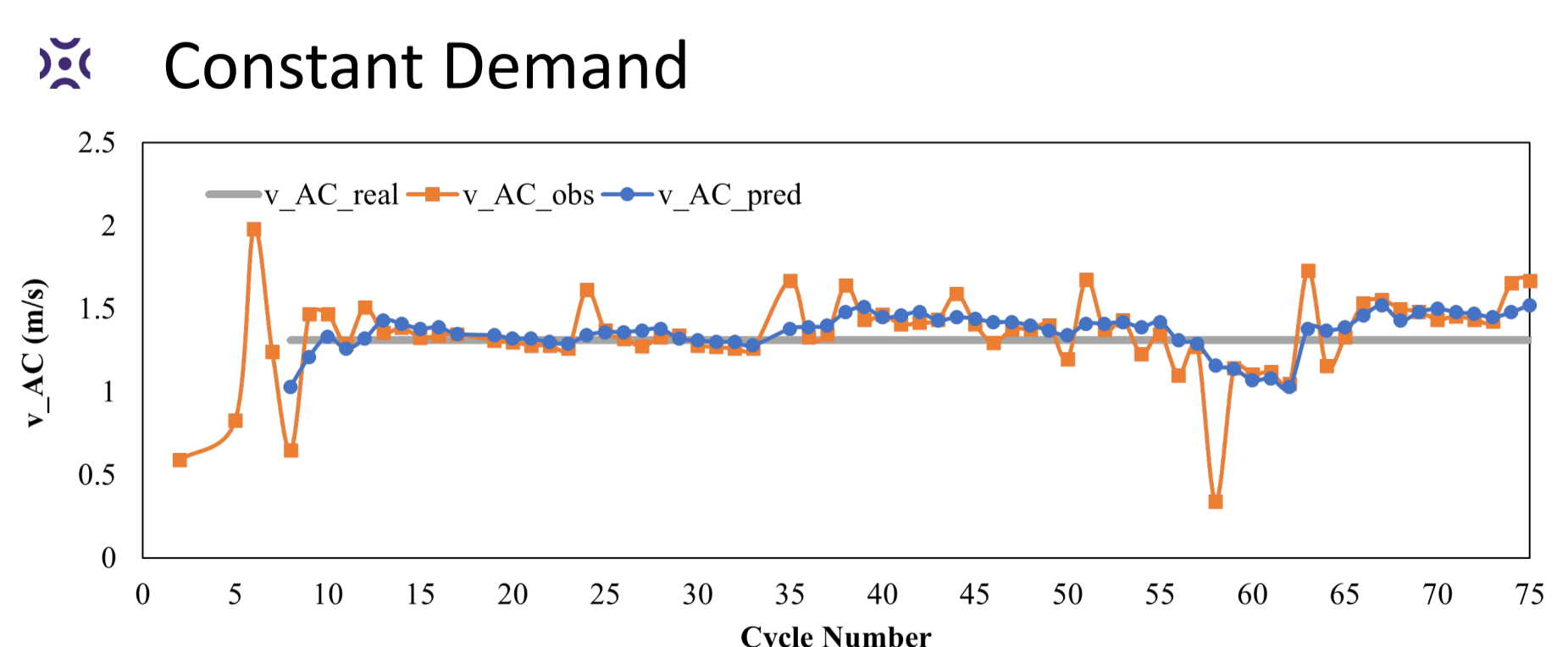


### Experimental Design

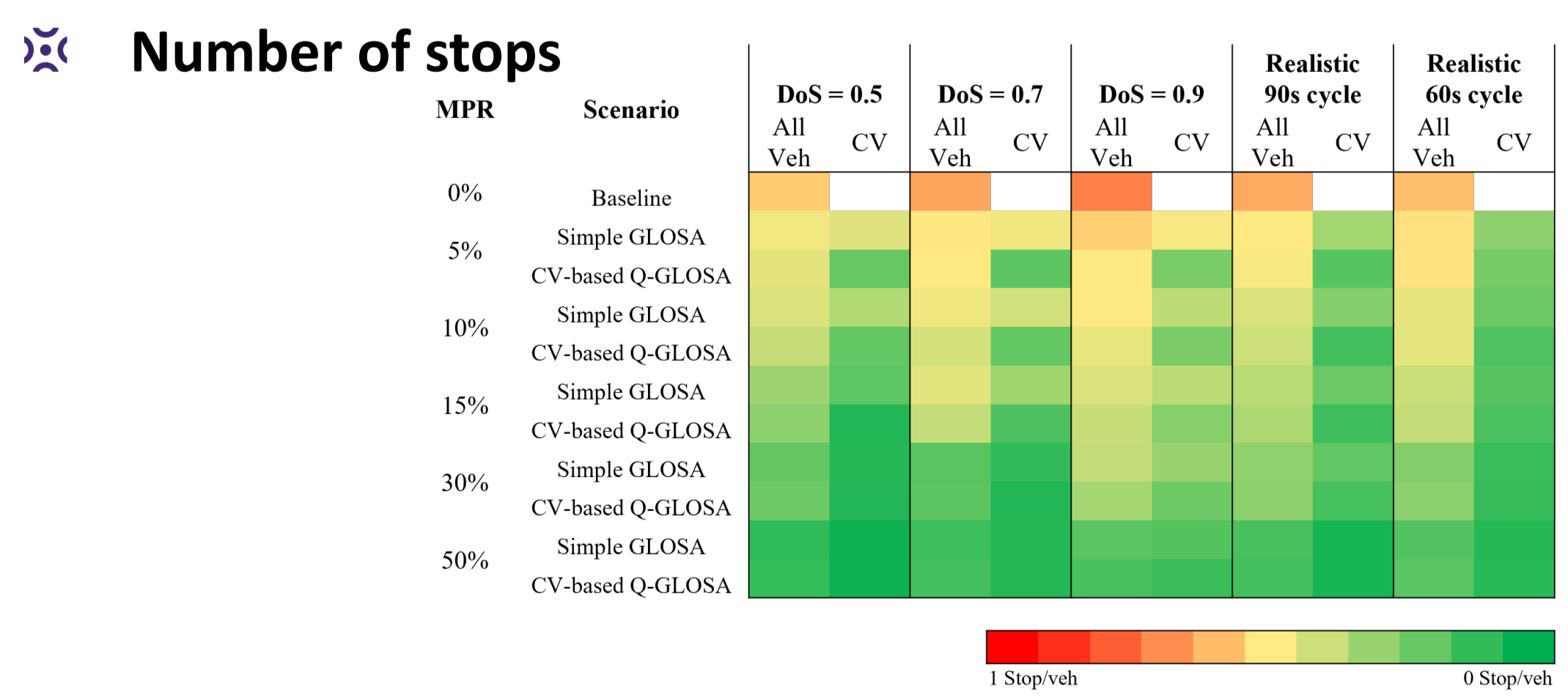


## Main findings

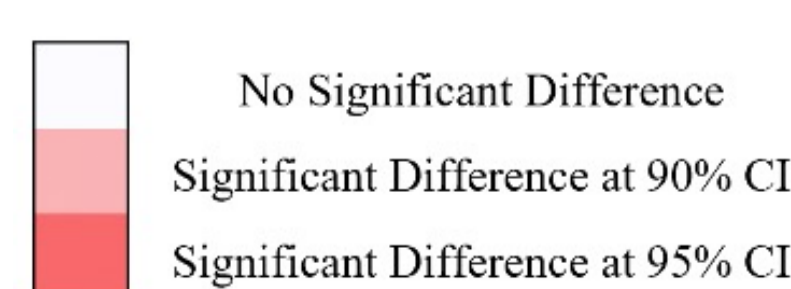
### $V_{AC}$ estimation performance



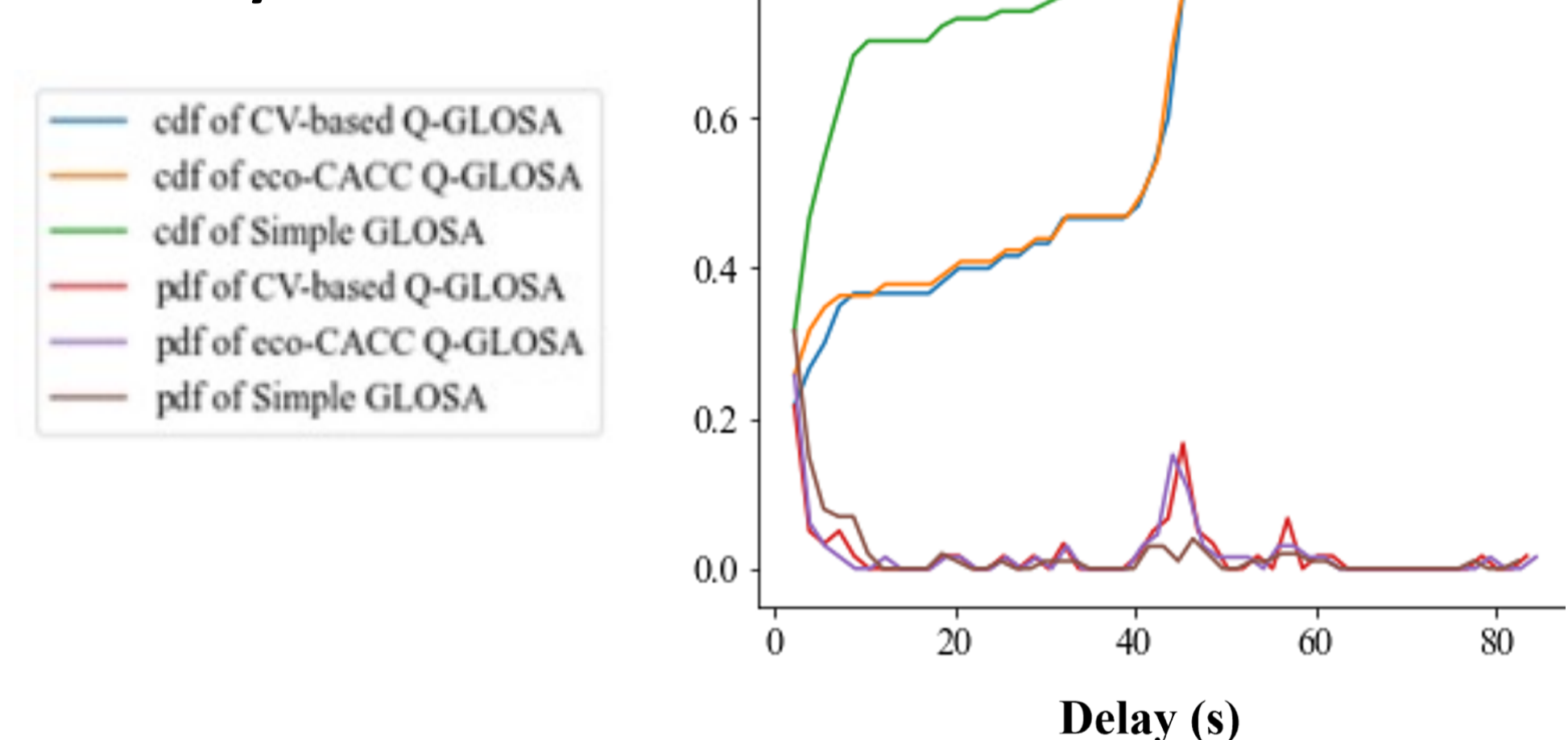
### Performance comparison



### Statistical Analysis



### Delays



### Statistical Analysis

MPR	CV-based Q-GLOSA vs Simple GLOSA			
	All Veh	CV	All Veh	CV
5%	Significant Difference at 95% CI	Significant Difference at 95% CI	No Significant Difference	No Significant Difference
15%	Significant Difference at 95% CI	Significant Difference at 95% CI	No Significant Difference	No Significant Difference
30%	Significant Difference at 95% CI	Significant Difference at 95% CI	No Significant Difference	No Significant Difference
50%	Significant Difference at 95% CI	Significant Difference at 95% CI	No Significant Difference	No Significant Difference

## 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](http://www.c-roads.eu))  
 C-The-Difference ([www.c-the-difference.eu](http://www.c-the-difference.eu))