

A Trajectory-based Method for Platoon Formation CAVs

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March 11, 2022

Introduction

Objectives

- Develop an strategy to form platoons considering CAVs
- Develop an optimization framework suitable for real-world implementations

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Results

- The proposed method reduced travel time by 10 - 23%, and the delay by 2 - 22%

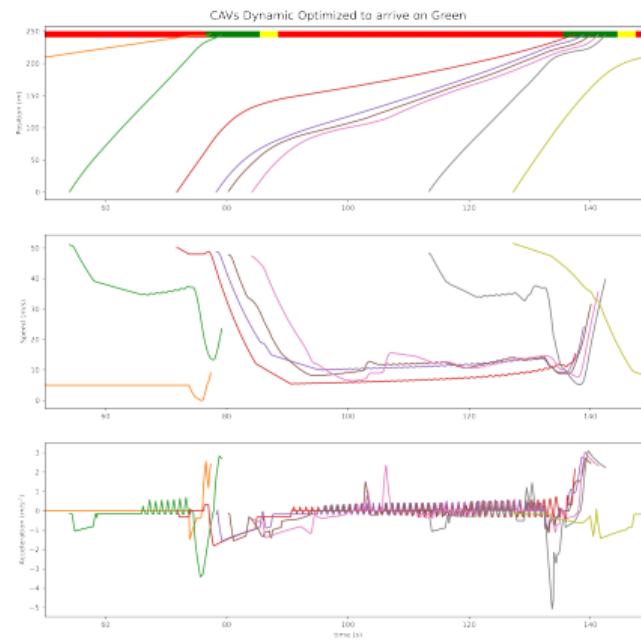
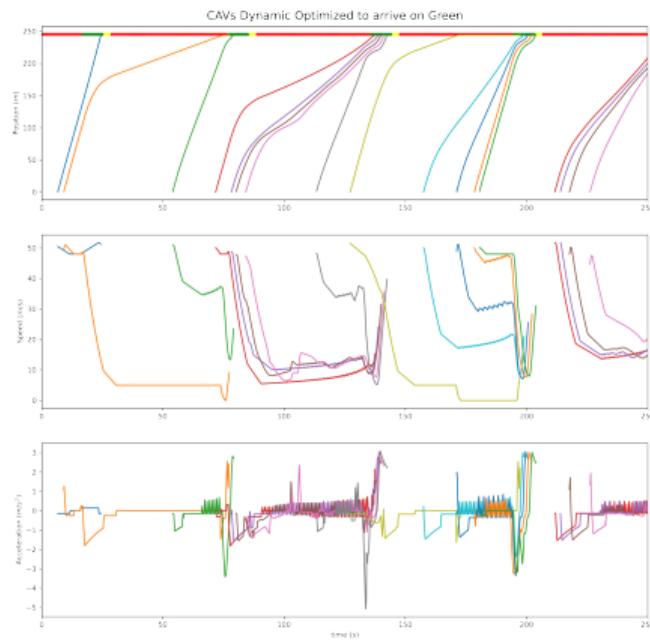
Existing Problem



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CAVs Arriving on Green



Existing Approaches



- Most the existing approaches that consider CAVs:

- ① 90% (5/45) consider single intersections

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Existing Approaches

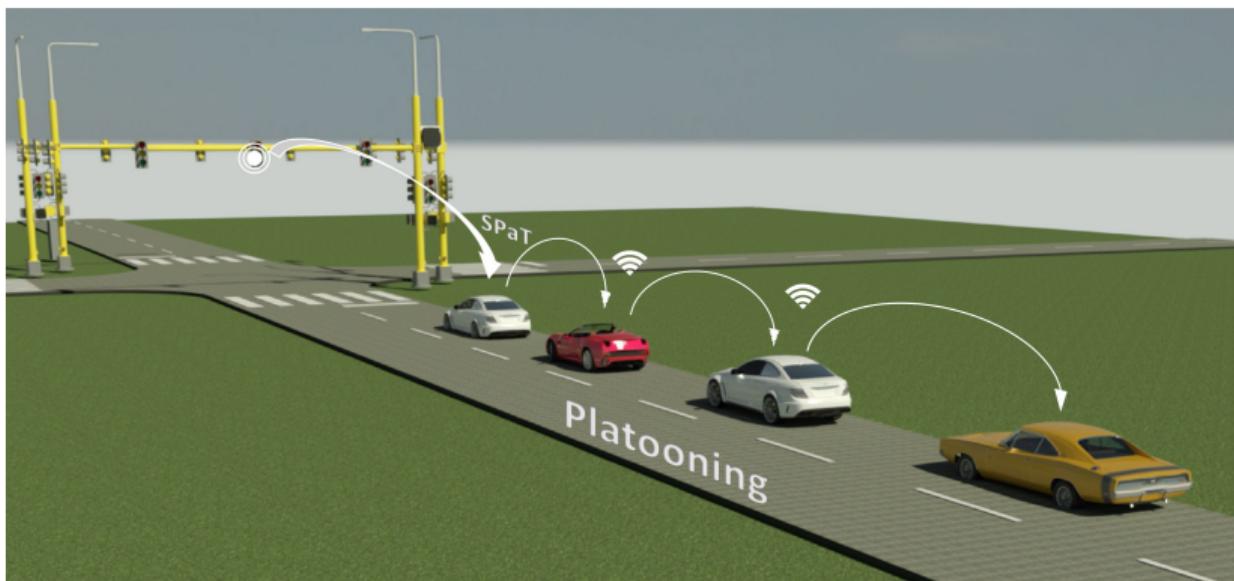


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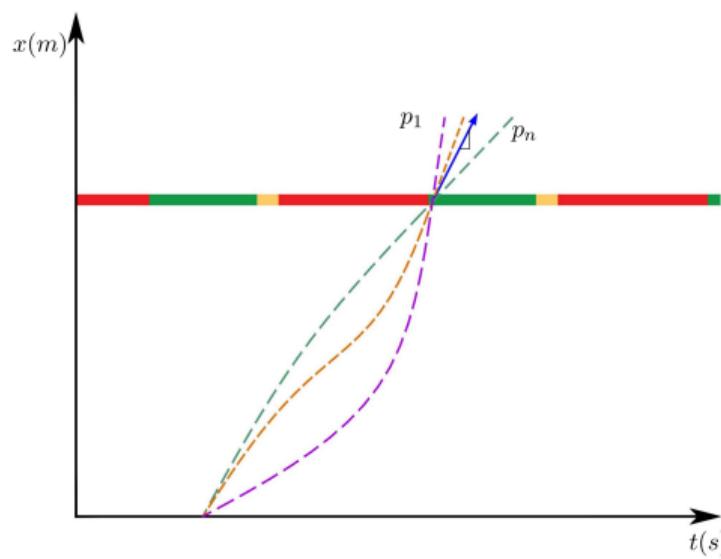
- ① 90% (5/45) consider single intersections
- ② Do not consider comfort parameters (acceleration rates)
- ③ Complexity of their formulation limits their implementation
- ④ Allow unrealistic speed profiles
- ⑤ Platoons not studied in detail

Assumptions

- Perfect communication is provided within the Optimization zone (Optimization zone correspond to the DSRC detection range)
- 100 % CAVs

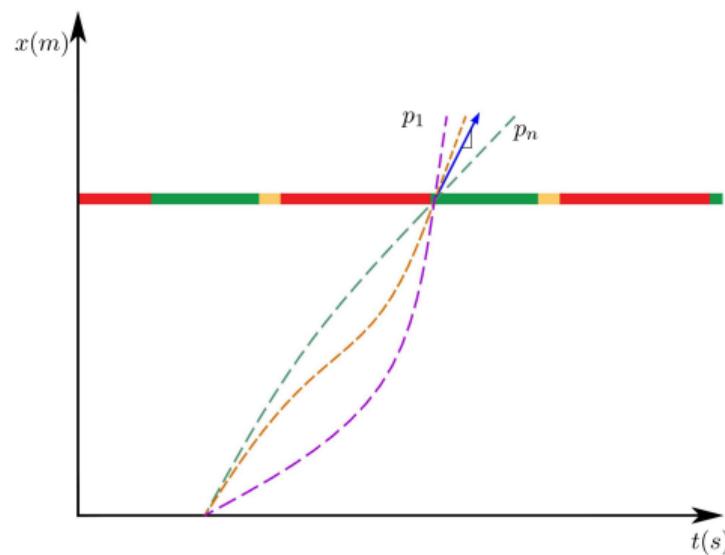


Fitting Trajectory Approach

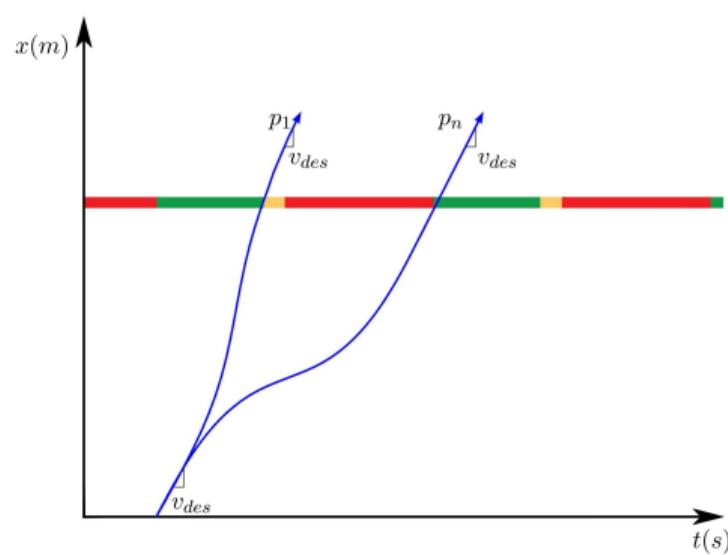


(a) No ν_{des} constraint

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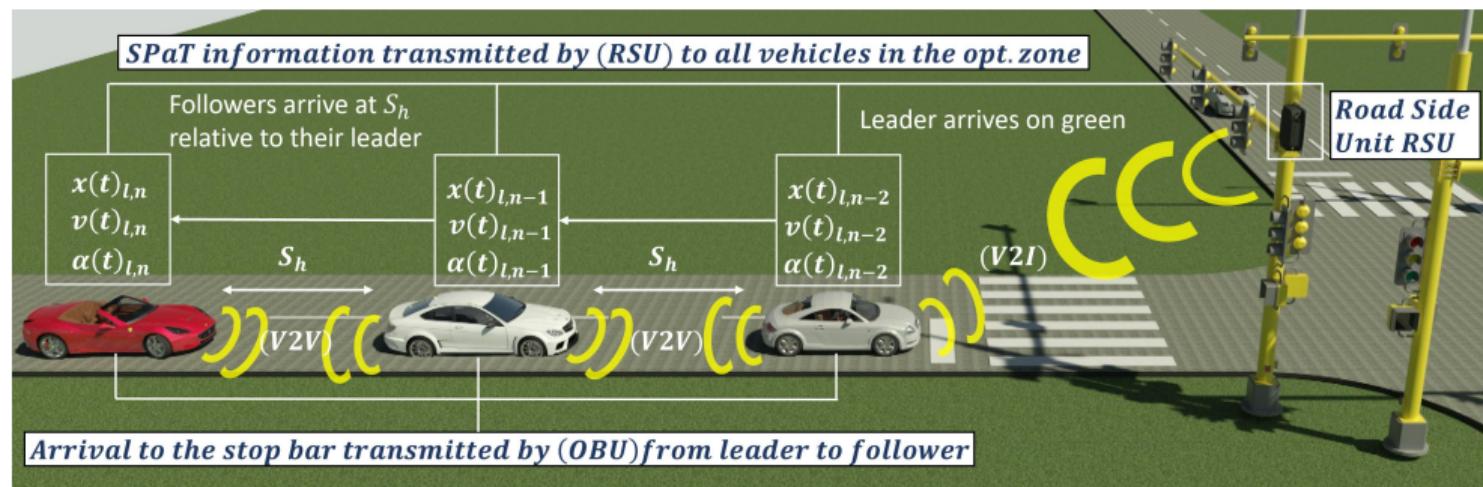


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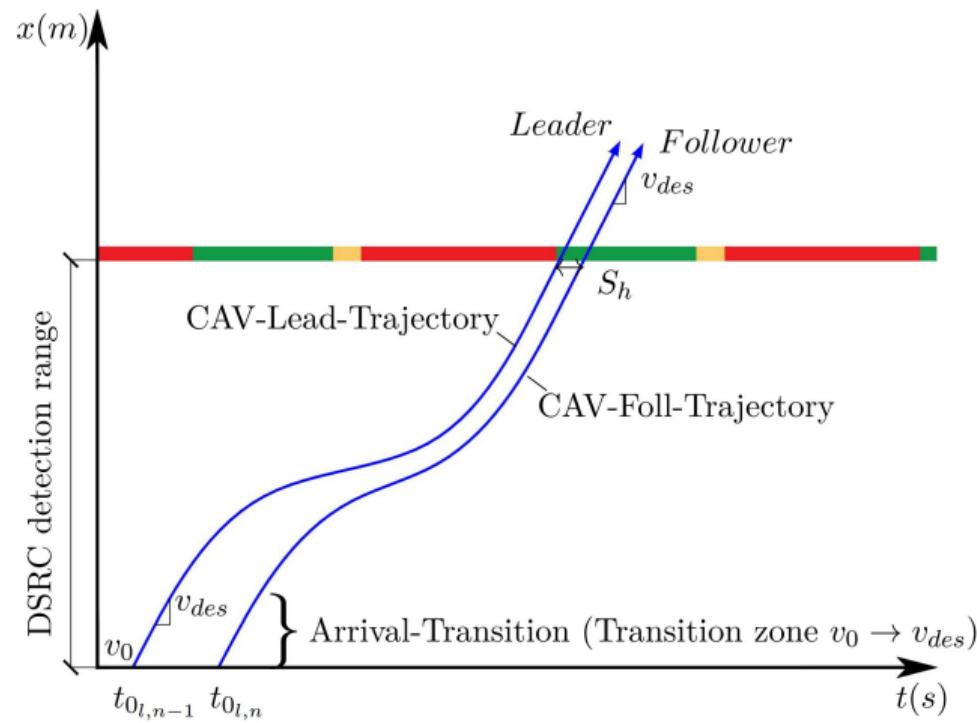


(b) with v_{des} constraint

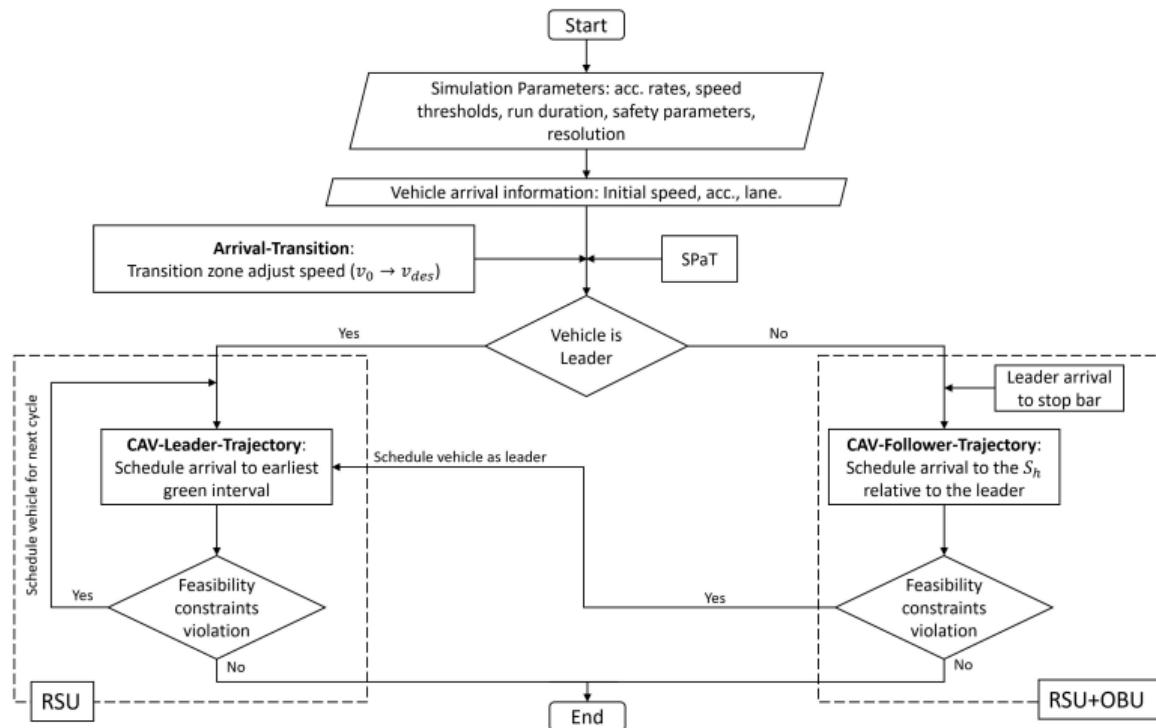
Conceptual physical framework



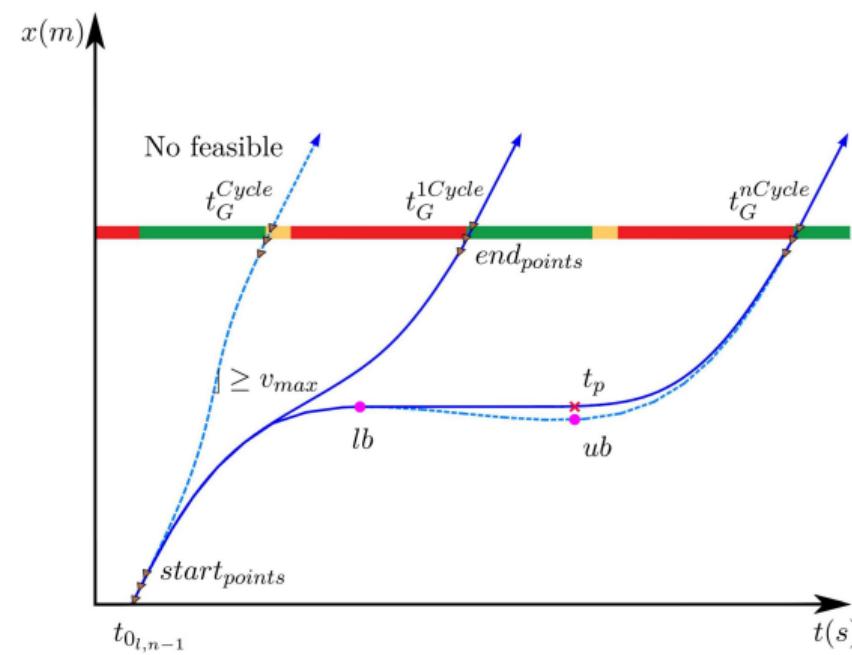
Concept of trajectory optimization algorithms



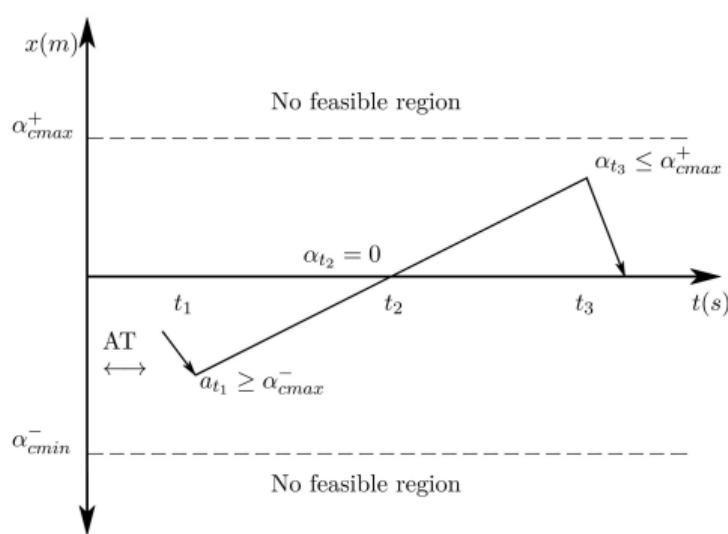
Flow Diagram



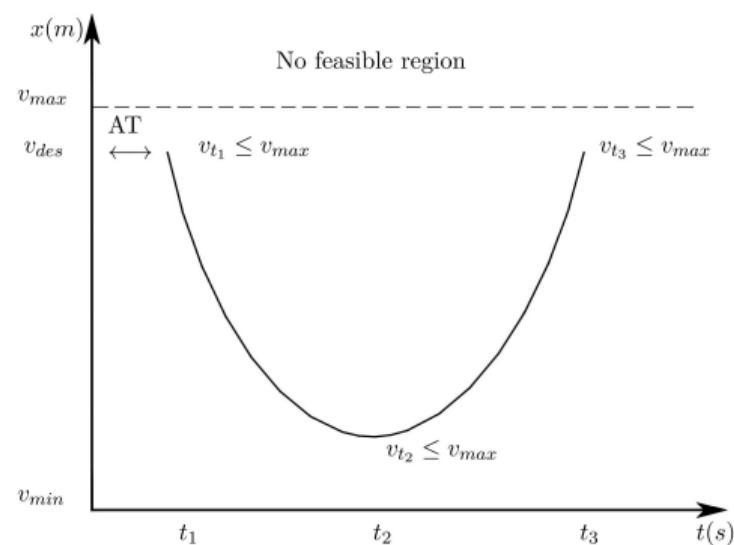
Leader Trajectory Optimization



Trajectory Constraints

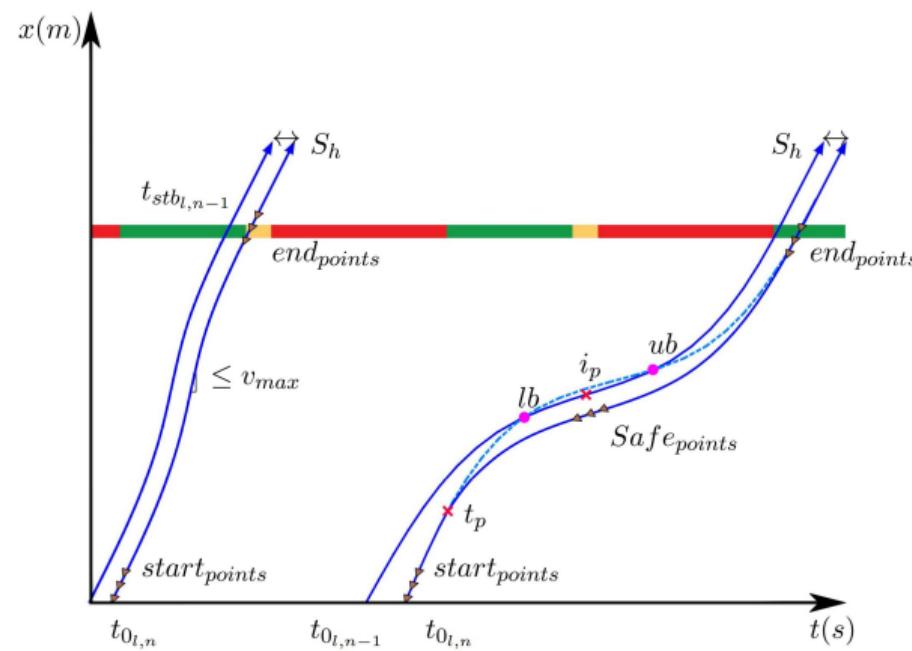


(a) Acceleration constraint evaluation

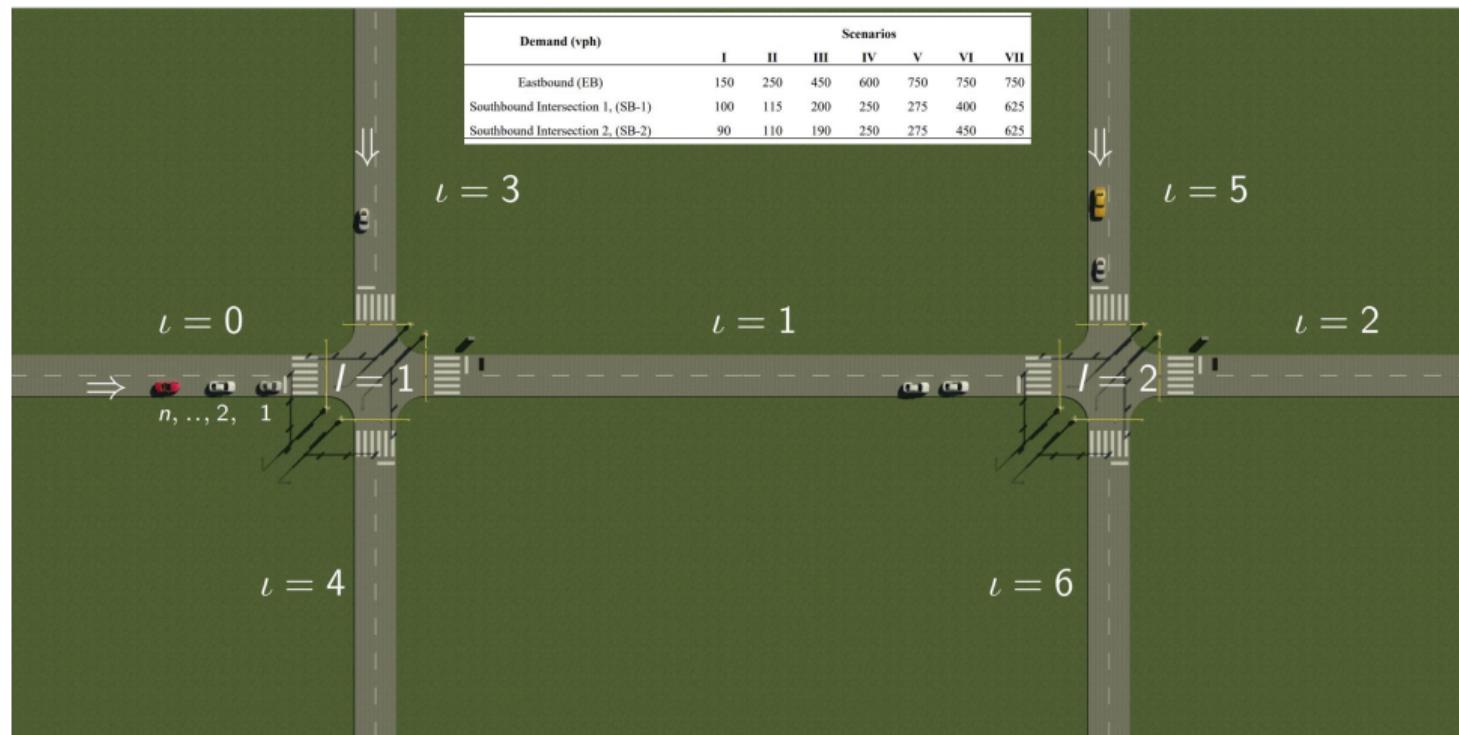


(b) Speed constraint evaluation

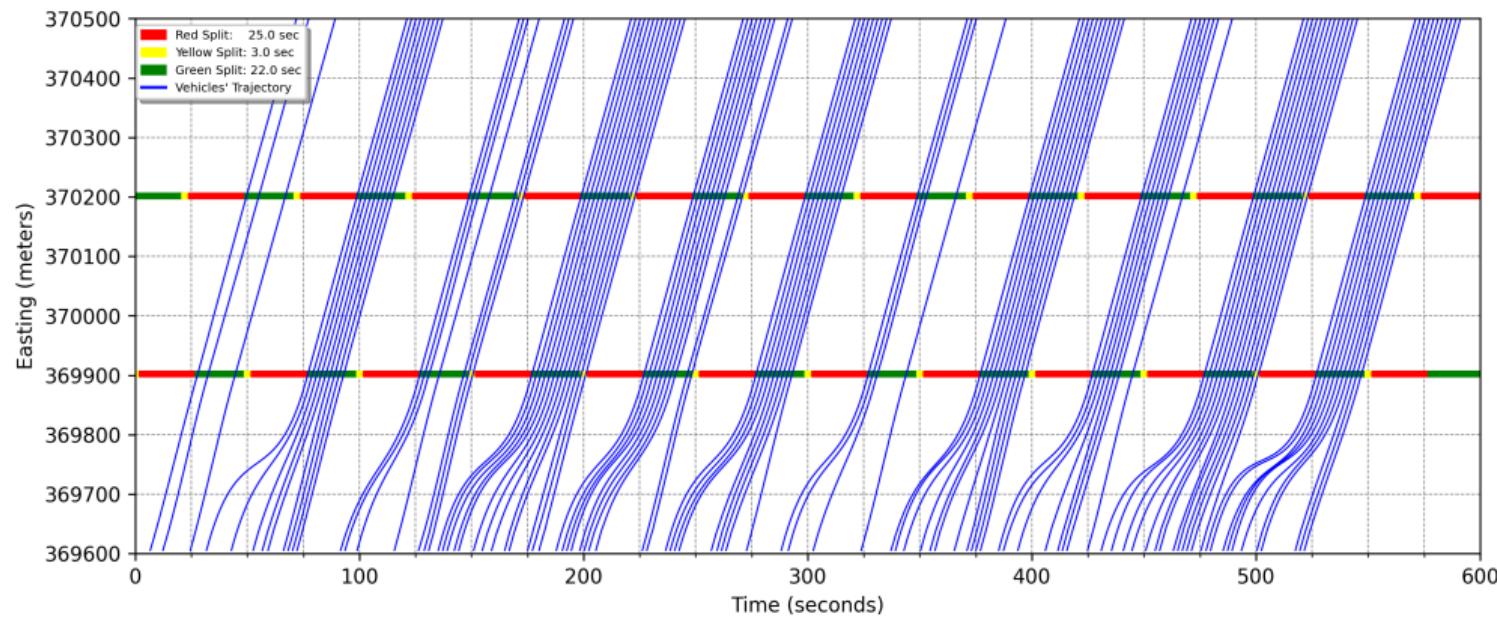
Follower Trajectory Optimization



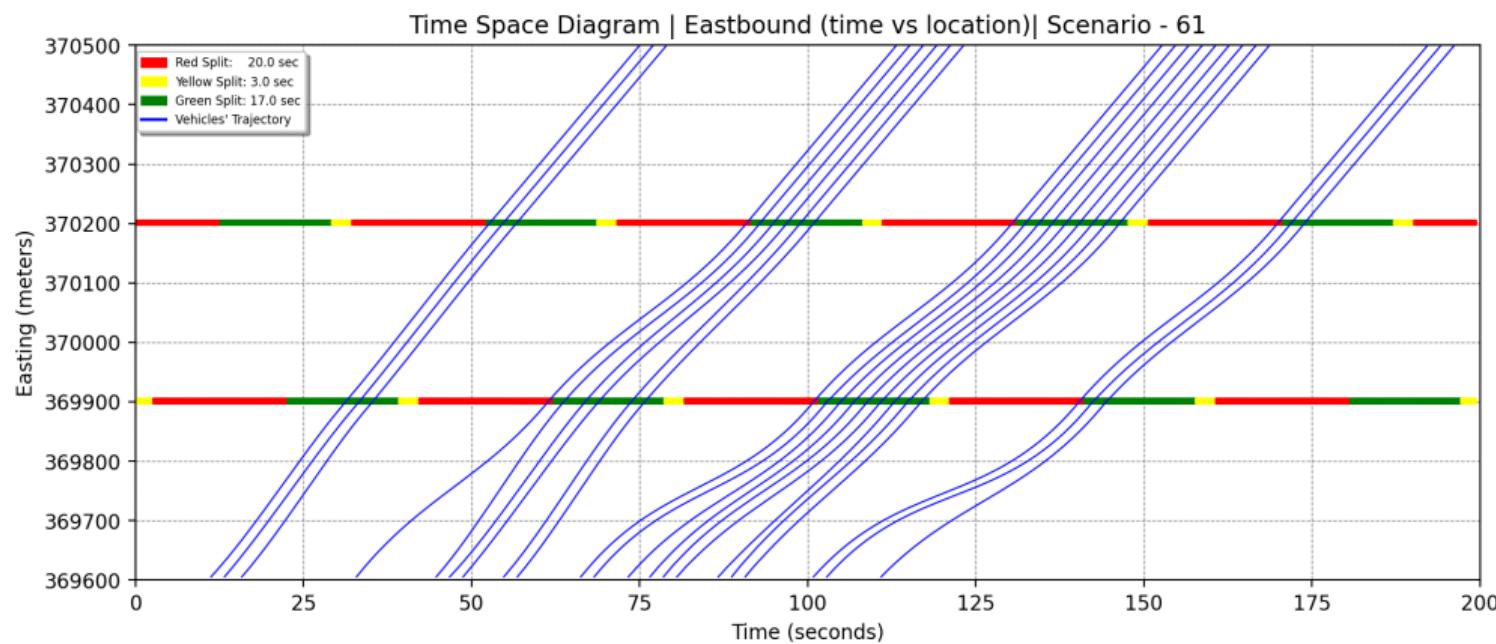
Study Arterial



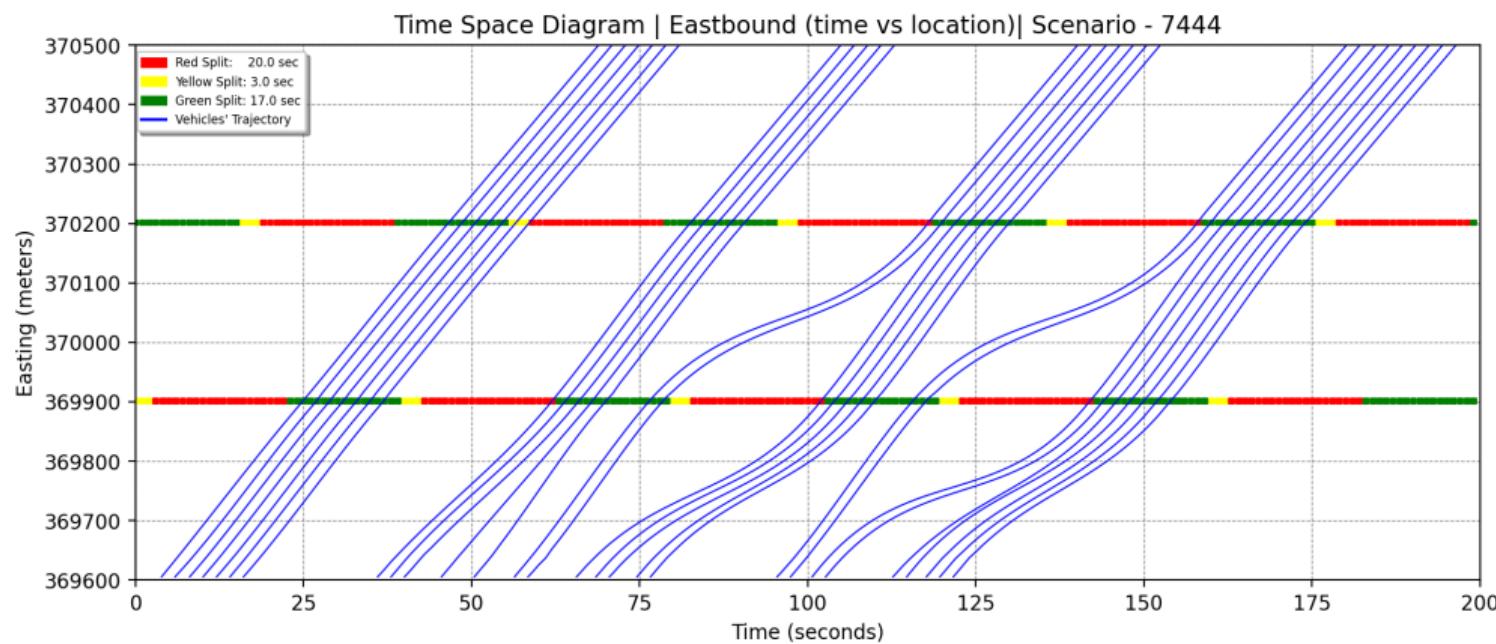
Results $Offset_{ideal}$



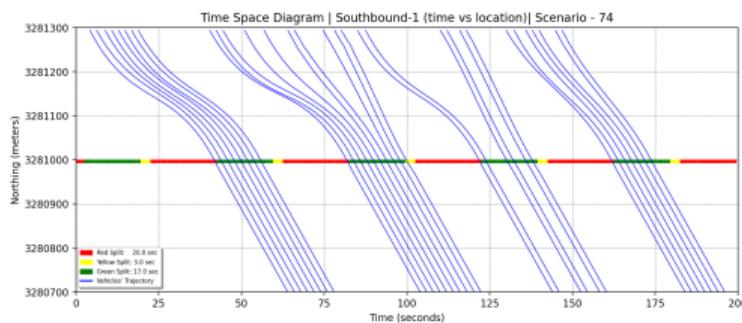
Results $Offset_{ideal}^{+8sec}$



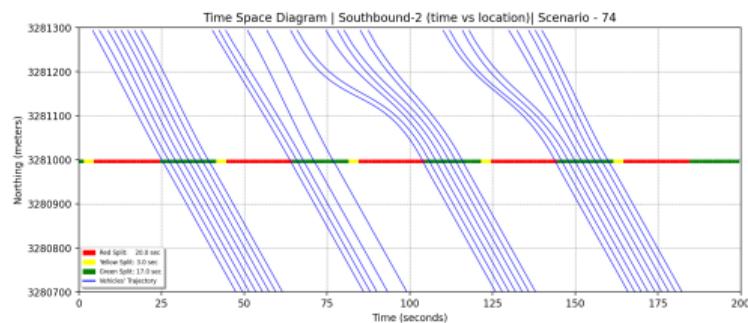
Results $Offset_{ideal} - 8sec$



Results for Southbound Approaches

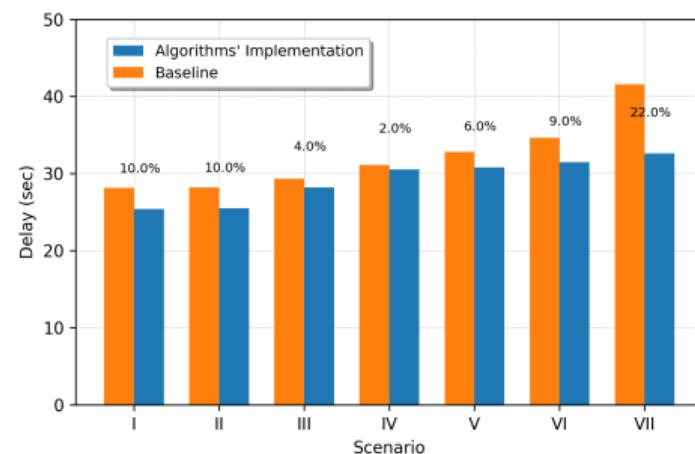


(a) SB-1



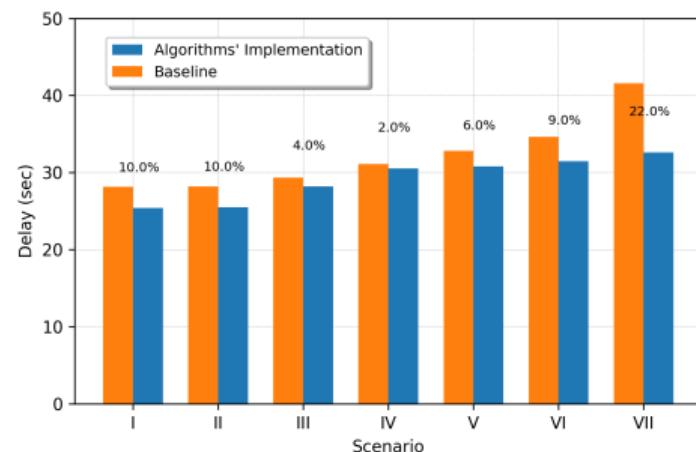
(b) SB-1

Delay and Travel Time Results

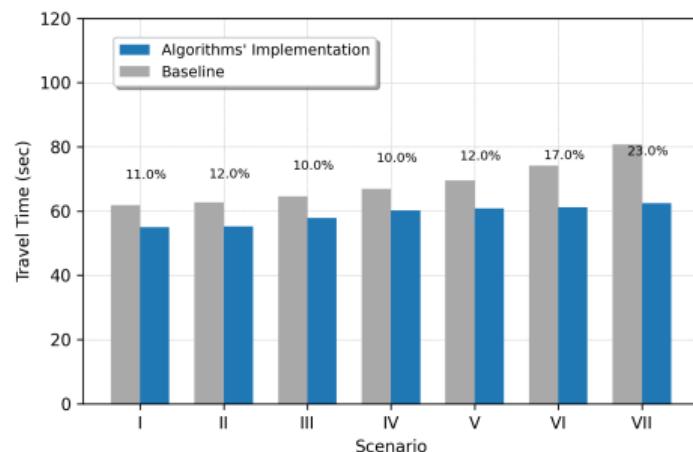


(a) Average Network Delay (2-22%)

Delay and Travel Time Results

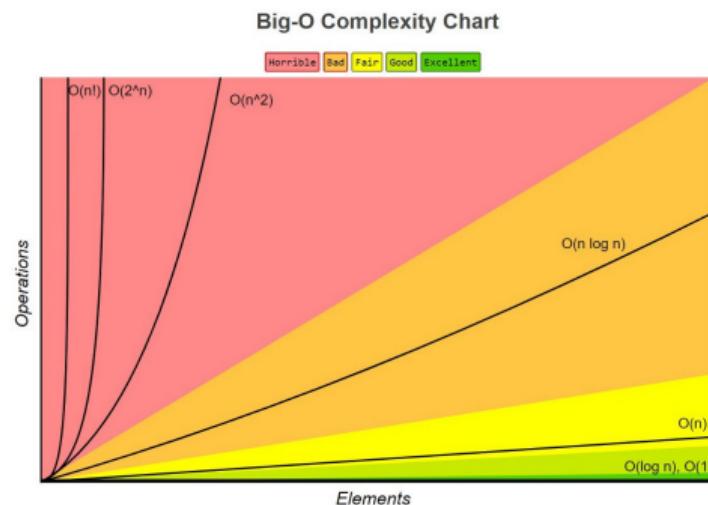


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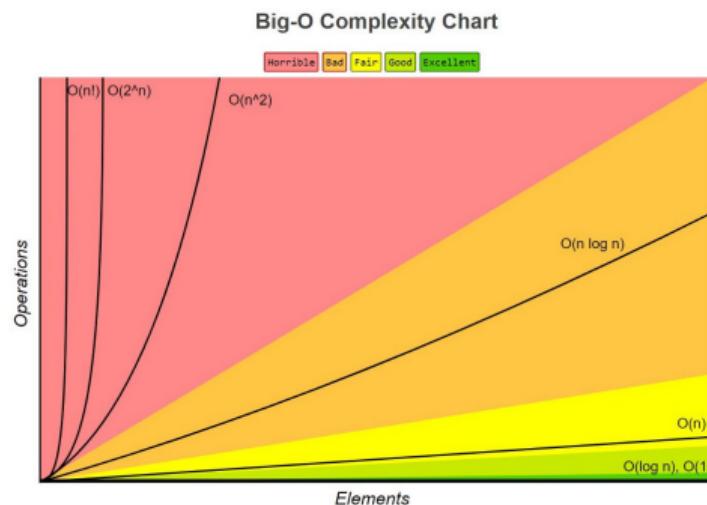
(b) Average Network Travel Time (10-23%)

Computation Time Results

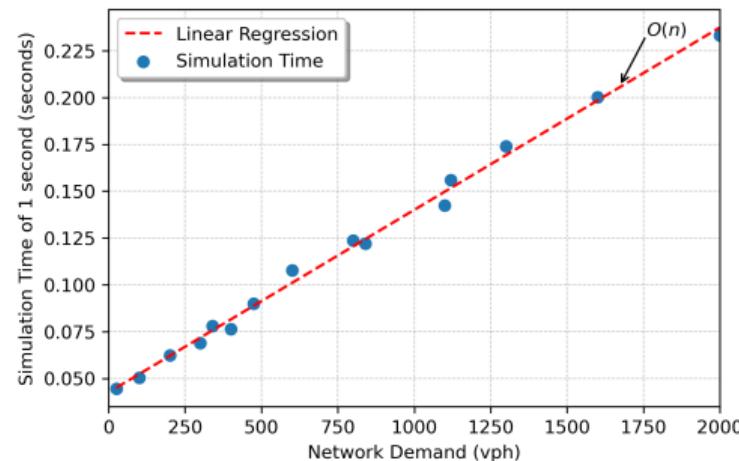


(a) Big O Notation

Computation Time Results



(a) Big O Notation



(b) Empirical Time Complexity

Thank You!

For Your Attention

Q/A