Coordinated control of connected vehicles in an intersection

Author: Lukáš Lovás
Supervisor: *Ing. Jozef Juraško*

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Introduction

- Crucial aspect of handling traffic is effectively working with availible resources.
- Transformation of human interaction with traffic management systems into communication within the infrastracture is key to improving throughput objectively.
- This study aims to improve various aspects of current traffic by utilizing principles of Vehicle-2-Everything technology in an algorithmic solution that uses platoons to form vehicles into synchronized groups.
- The solution contains an implementation of the Virtual Platooning algorithm in a simulated scenario where crucial conflict points are controlled by a server application that communicates with every vehicular object in the simulation.

Methodology

Combination of two key components: **virtual platooning** and **adaptive intersection control.**

Virtual Platooning

Vehicles traveling in the same direction are dynamically grouped into platoons based on distance and movement patterns. Each platoon has a leader, with followers adjusting their speeds to maintain safe distances. The algorithm continuously updates platoon memberships, splits overly large groups, and merges smaller ones when appropriate.

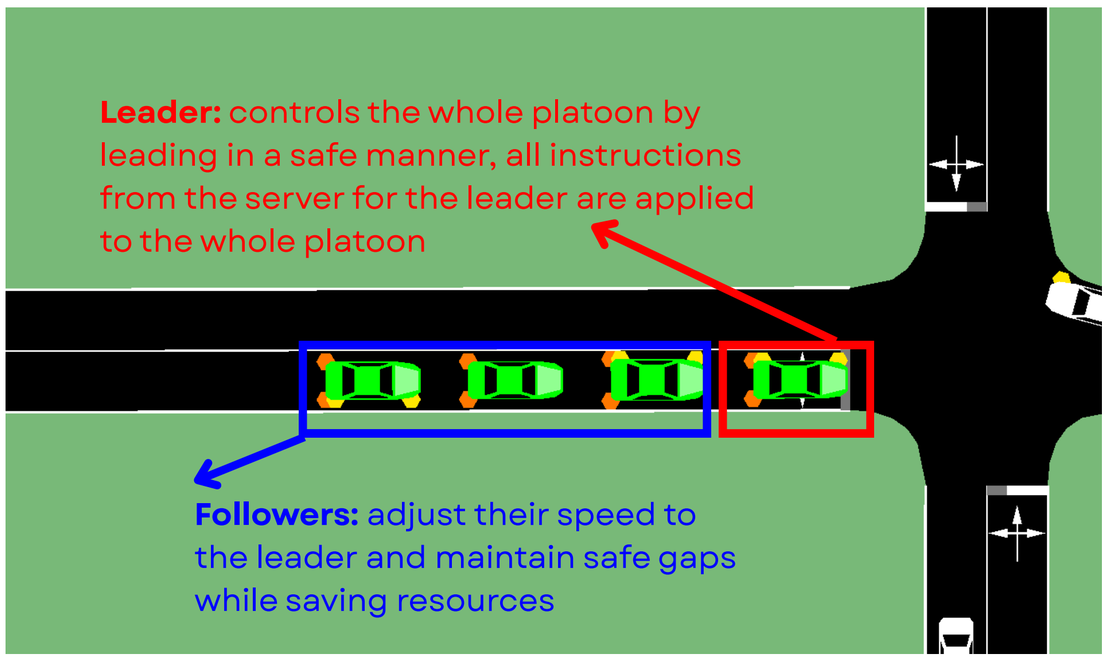

Fig 1. Vehicle control in a platoon and distinguishment between a leader and a follower

Intersection Control

Approaching platoons are detected and assessed based on size, wait time, and movement direction. The system prioritizes their passage using a dynamic scoring mechanism. Non-conflicting movements are permitted in parallel to maintain high throughput. Once through the intersection, platoons are either maintained or reorganized depending on lane transitions.

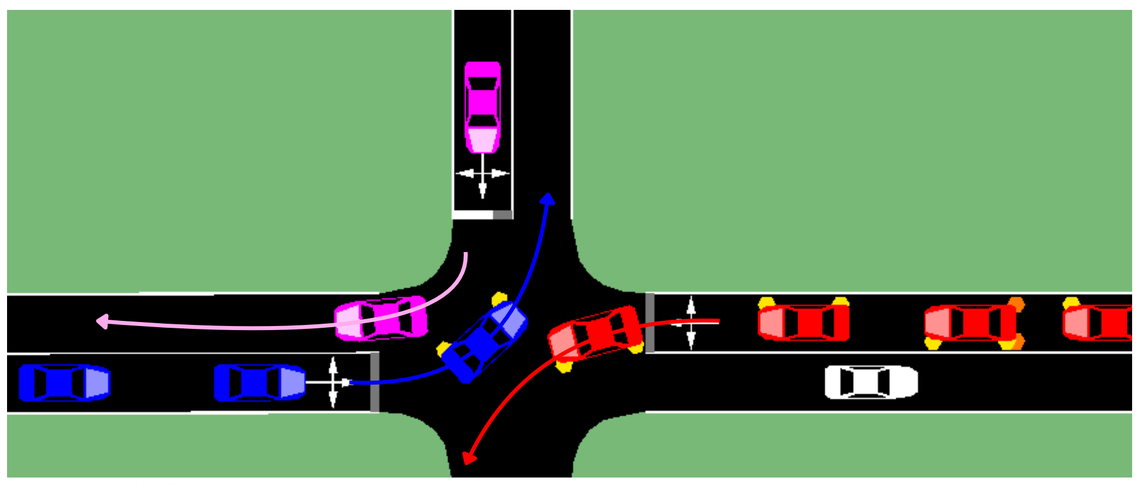

Fig 2. Visualisation of the parallel direction rule in the intersection controller

Results

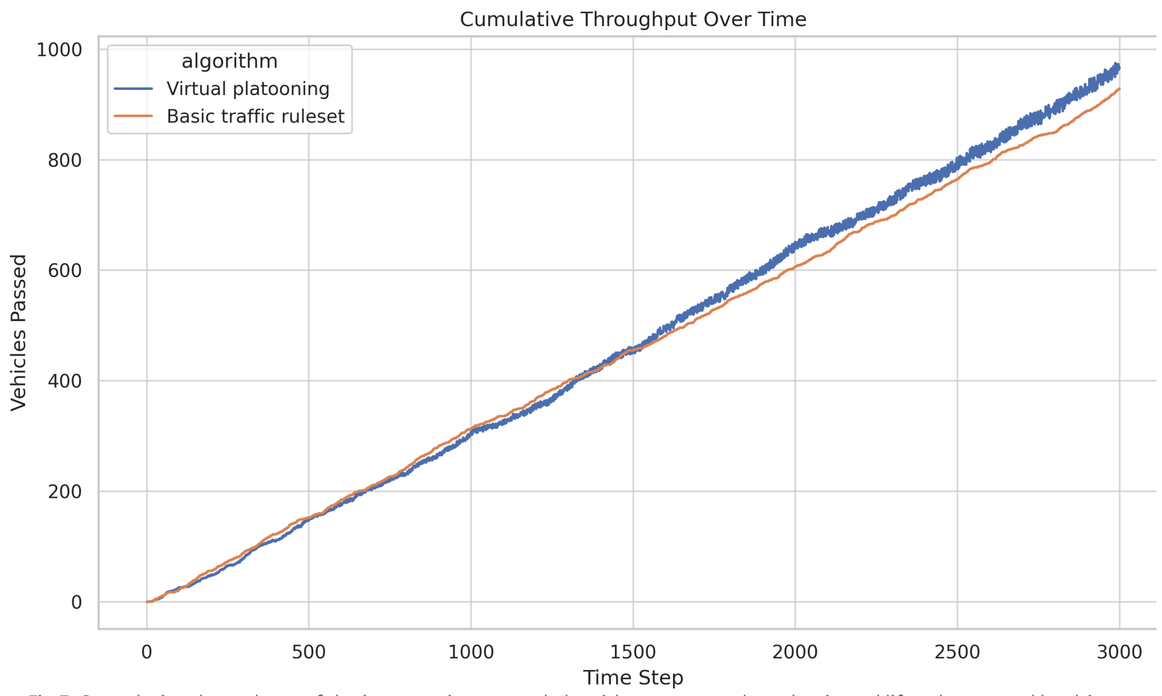

Fig 3. Cumulative throughput of the intersection control algorithm compared to a basic real life ruleset used by drivers

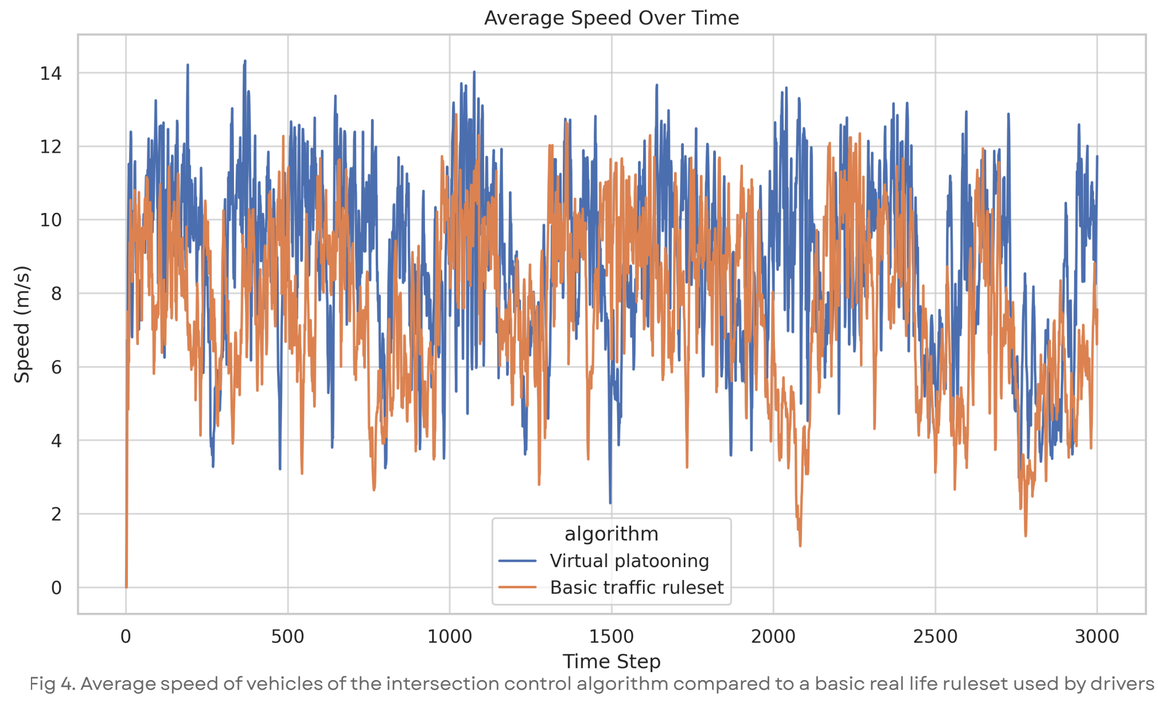

Fig 4. Average speed of vehicles of the intersection control algorithm compared to a basic real life ruleset used by drivers

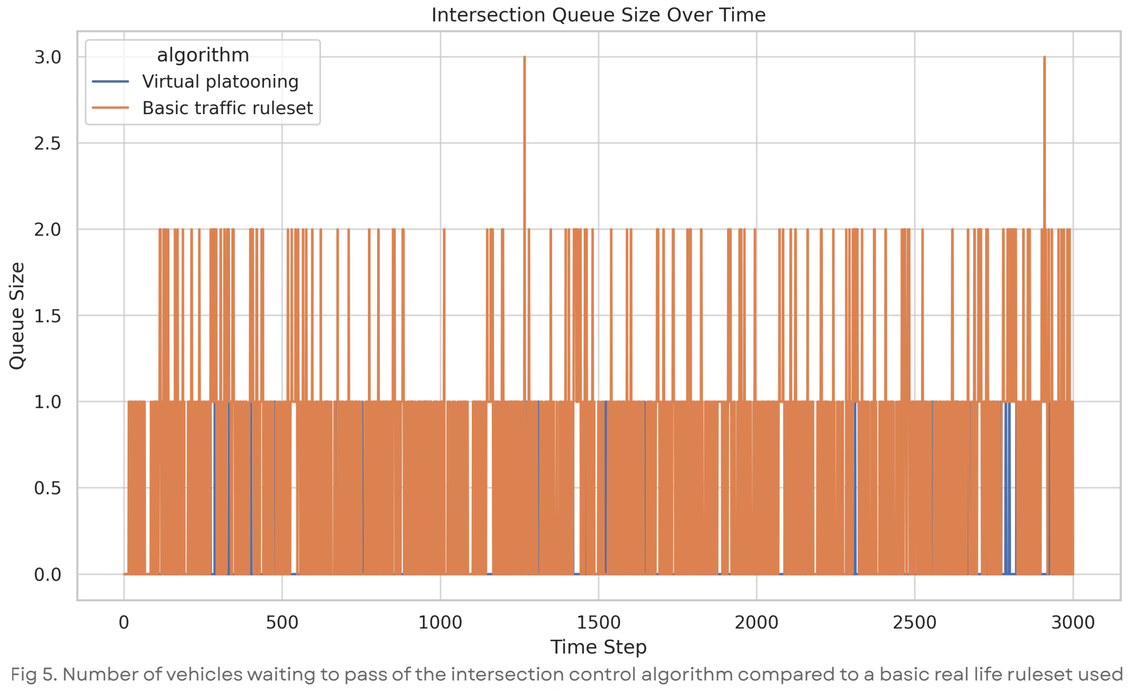

Fig 5. Number of vehicles waiting to pass of the intersection control algorithm compared to a basic real life ruleset used by drivers