Reducing Fuel Consumption by Adjusting Velocity to Traffic Lights

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Problem

Fuel is a major expenditure in traffic

Want to use as little fuel as possible

Drive at constant speed use less fuel than accelerating

Traffic Ligths

Traffic ligths disrupt the flow of traffic

Not always designed for free flow in all directions

Difficult to adjust speed to traffic light when the phases are unknown

Problem Statement

Is it possible to reduce fuel consumption by adjusting the velocity of vehicles to traffic lights in a real life setting?

Solution

Simulate real world traffic flow on a real world section of road

For a subset of vehicles:
Calculate a speed to reach the next traffic ligth as it turns green

Investigate if the fuel consumption is reducsed

Assumptions

The used simulator simulates the real world correctly

- Driving behaviour
- Fuel consumption

Information about the traffic lights can be accessed by vehicles

- The location
- The phases, i.e. light setting time frames

Vehicles

- have a predefined route that is followed and not changed
- know its location
- need not communicate with other vehicles
- have a constant acceleration and deceleration

Follow the rules of traffic, e.g.

- wait at a red light
- drives below the speed limit
- do not drive into other vehicles
- wait for crossing crossing traffic

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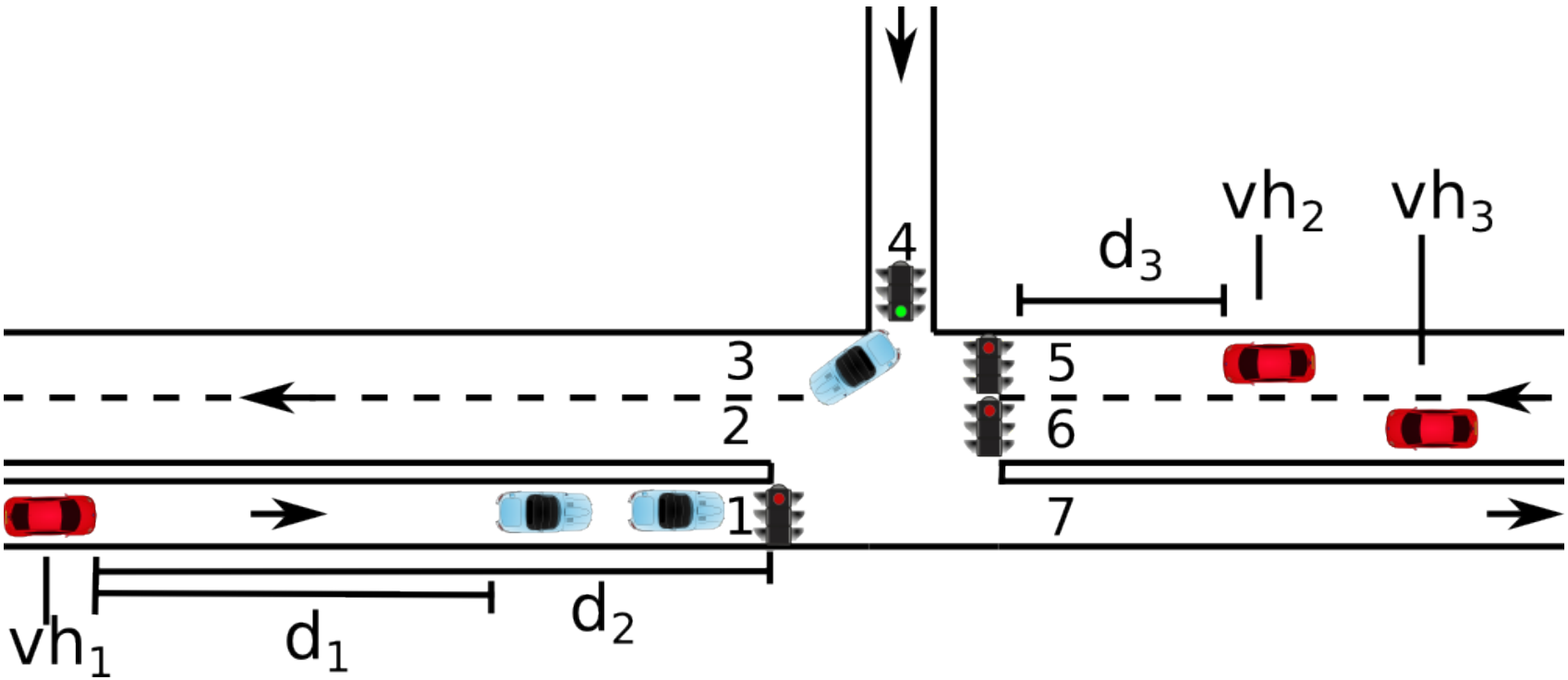
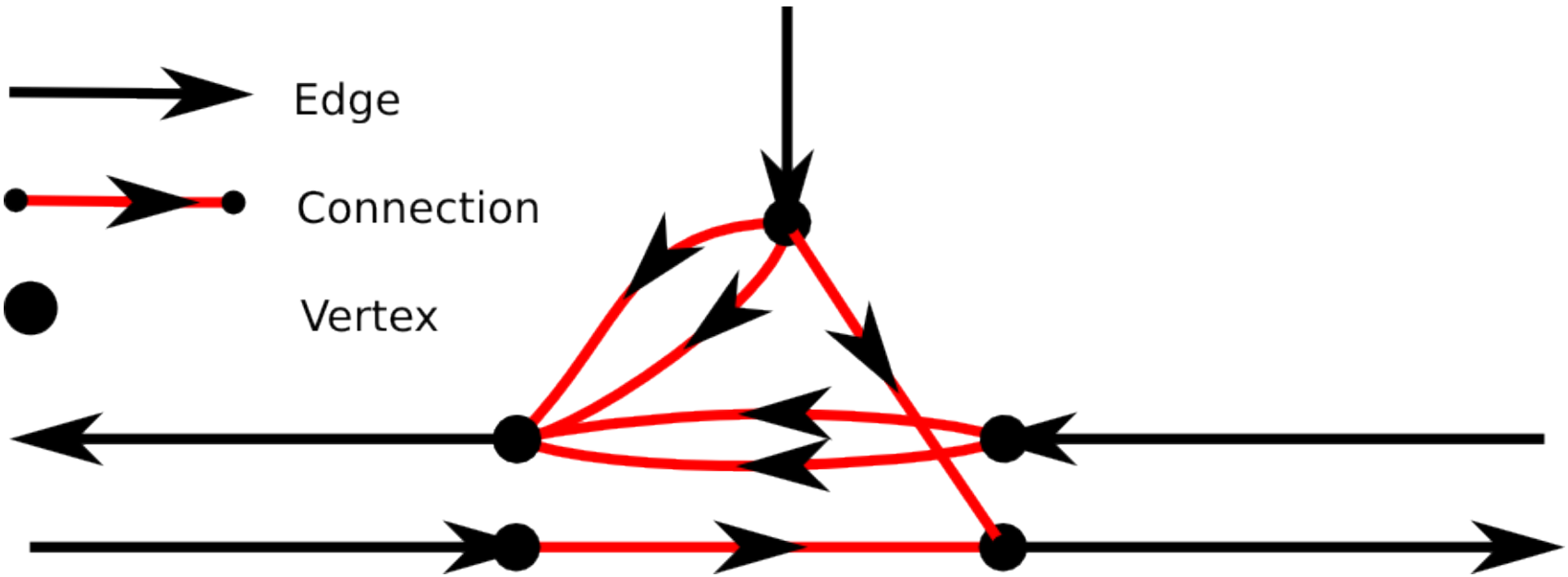
Model



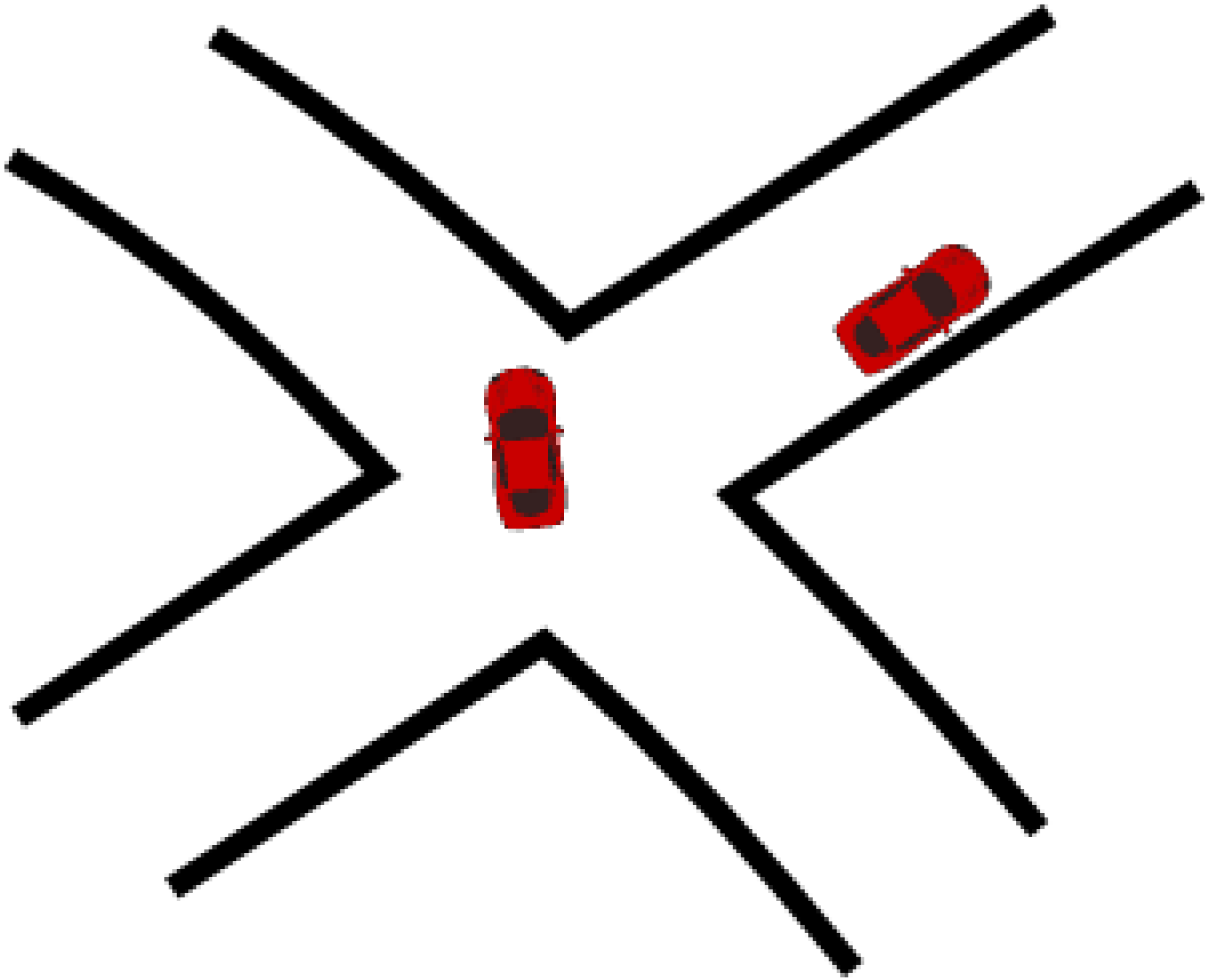
Space Model



Algorithm

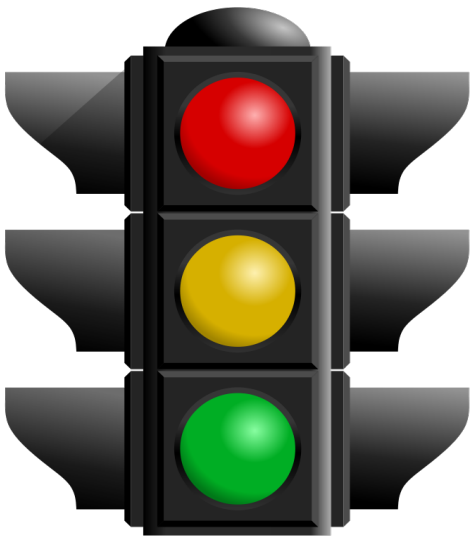
- In a junction
- Calculate distance
- Phase conversion
- Calculate velocity

In Junction



Calculate Distance

Phase Conversion



Phase:			**Green spans:**
green	:	30 s	now: 42 s
yellow	:	4 s	(51, 81)
red	:	15 s	(102, 132)
yellow	:	2 s	(153, 183)
green	:	30 s	⋮
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Calculate Velocity

$$velocity = \frac{distance}{time}$$

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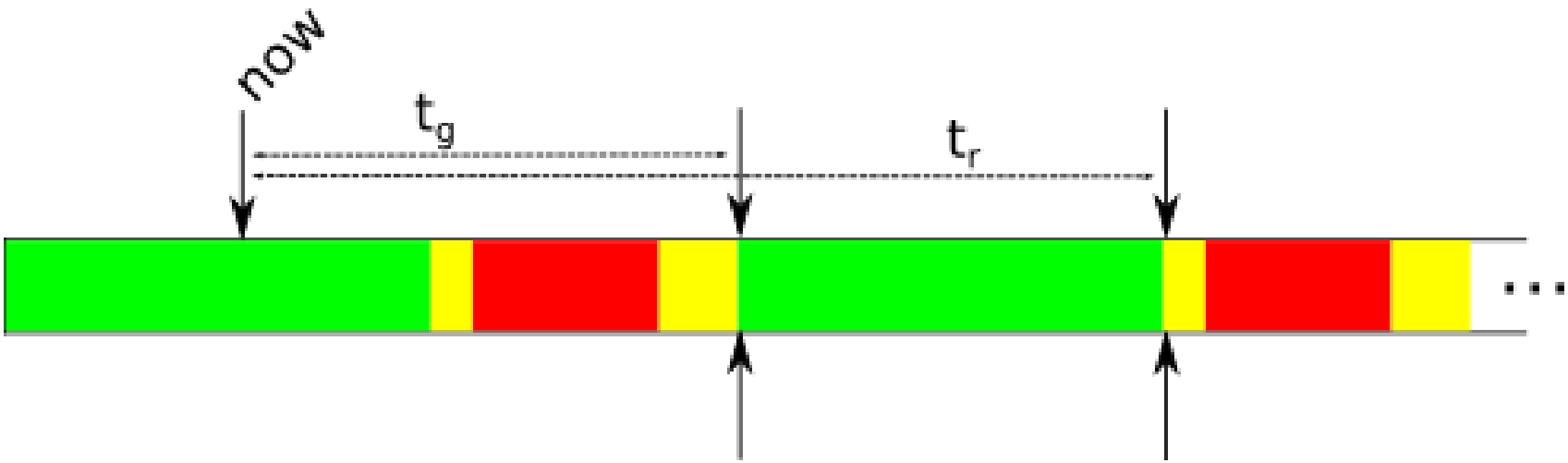
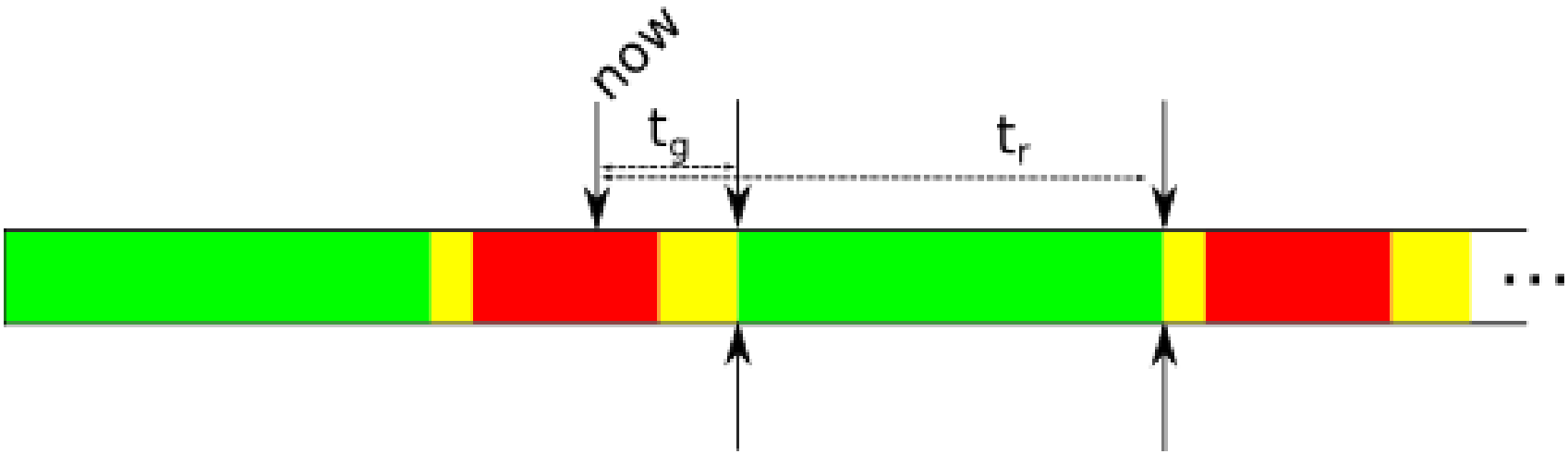


Calculate Velocity

$$velocity = \frac{distance}{time}$$



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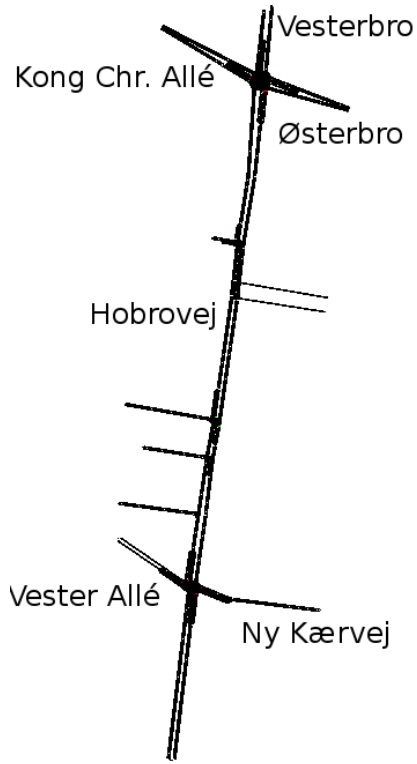
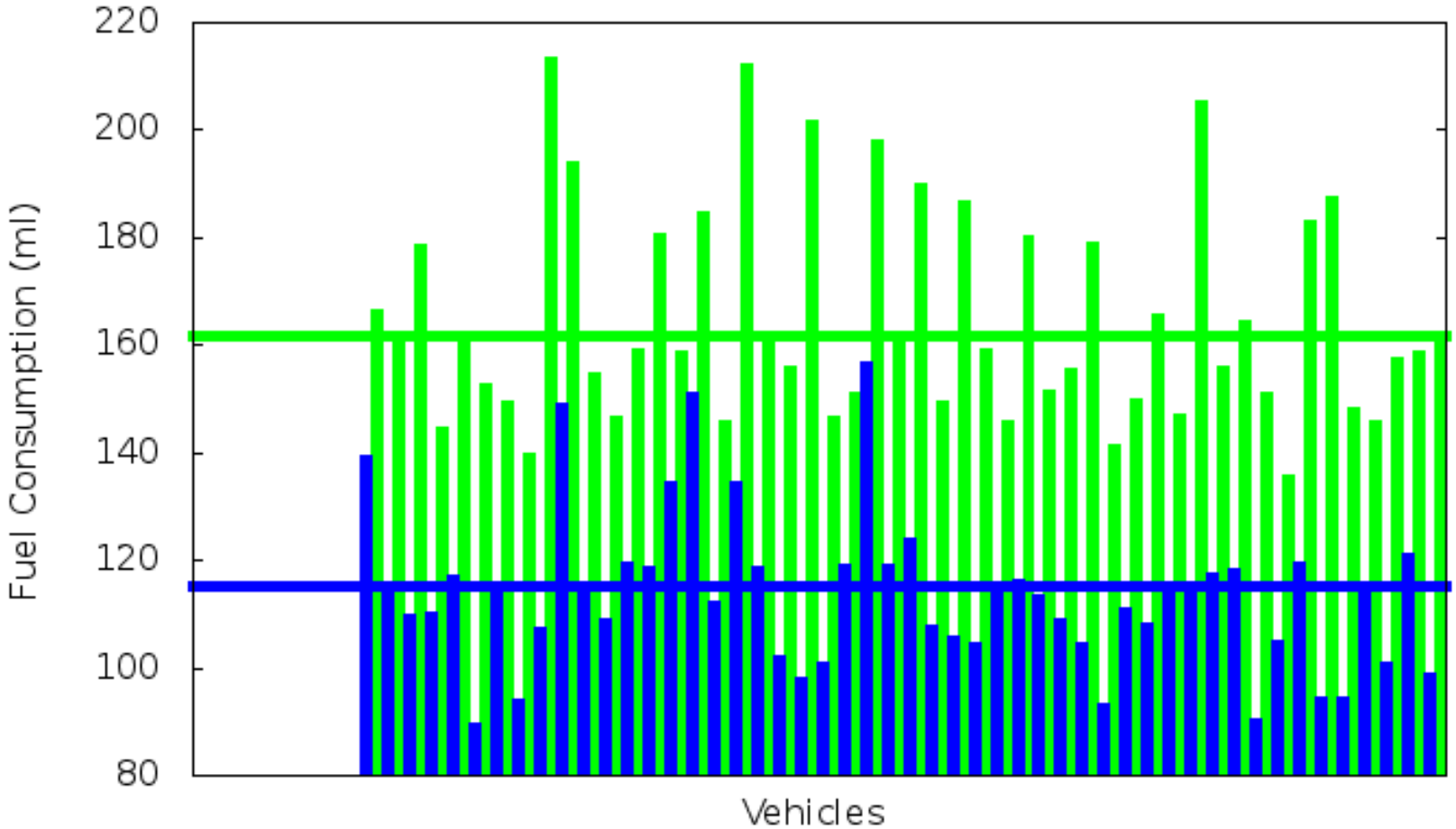
Test Setup

- SUMO- Simulation of Urban MObility
- Real world road network
- Real world Traffic light phases
- Real world OD matrix



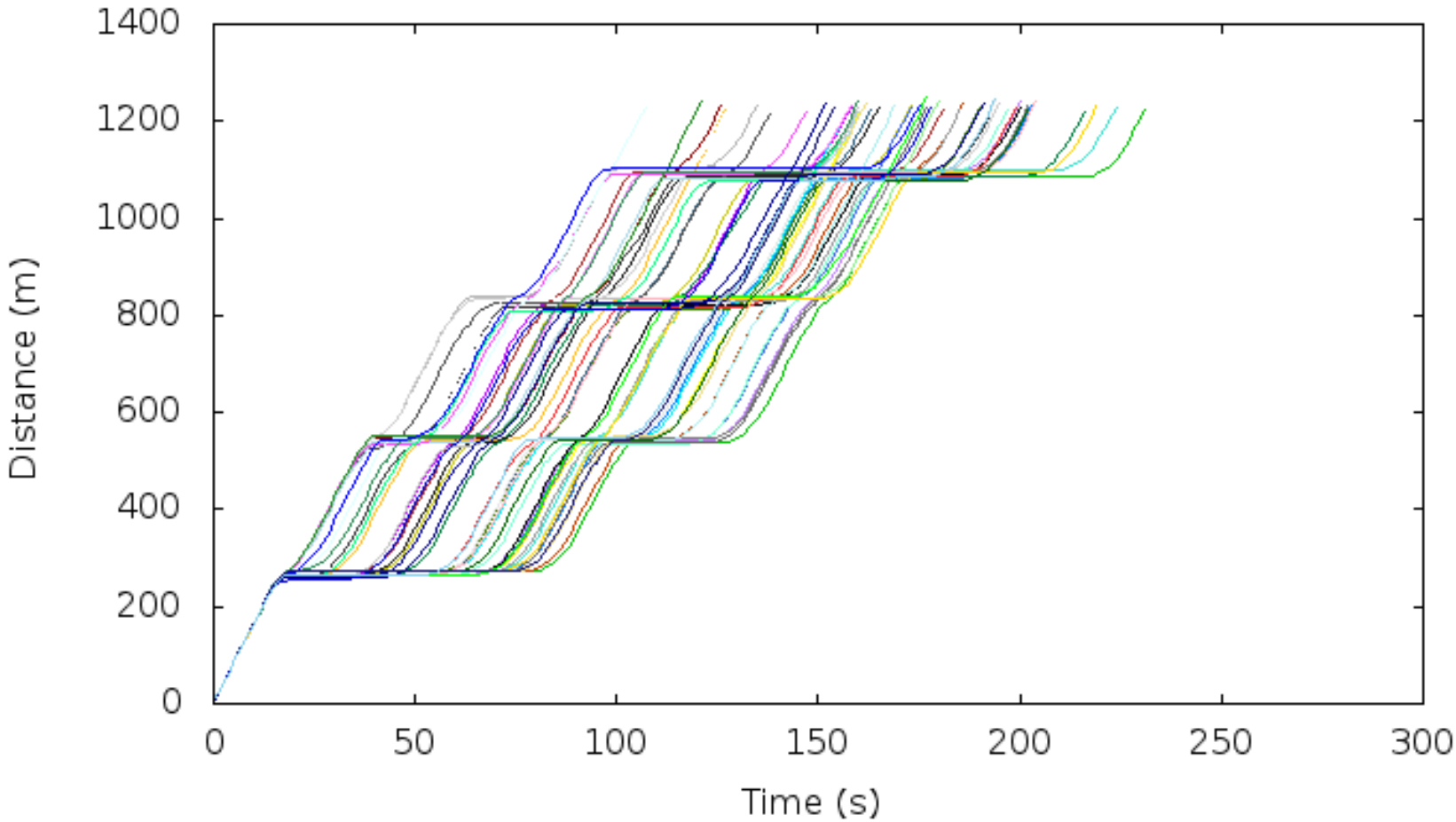
SUMO presentation

Fuelsaving



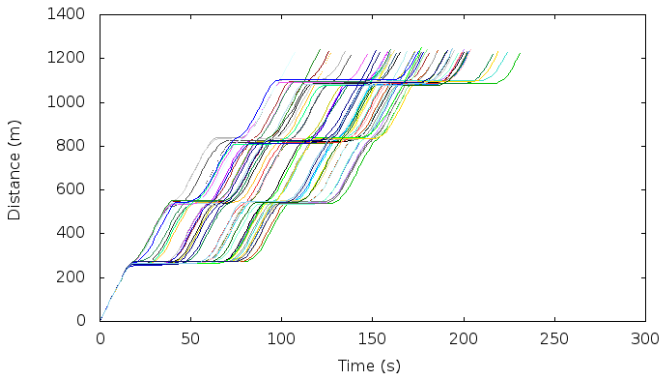
Blue: With system. Green: Without system

Distance Driven Over Time

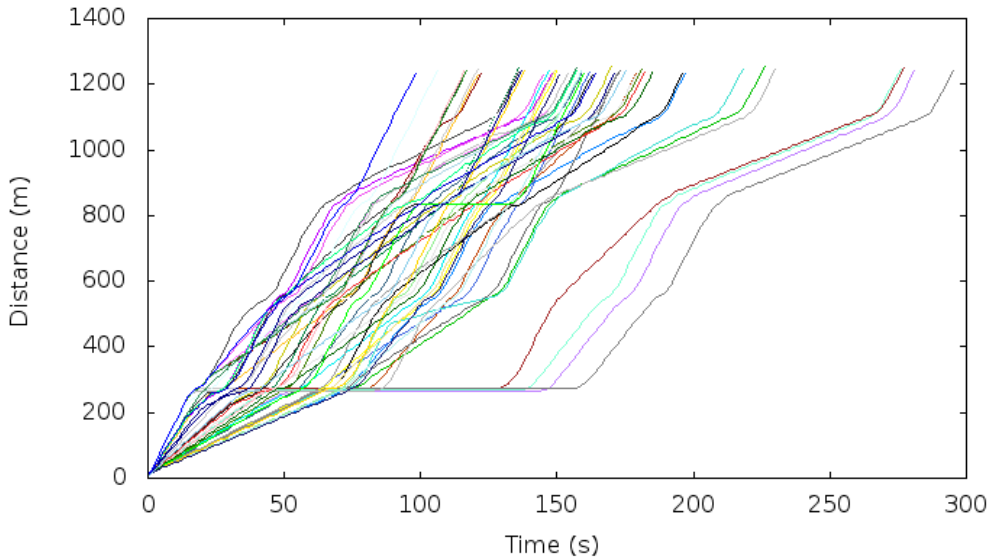


0% with the system

Distance Driven Over Time With the System

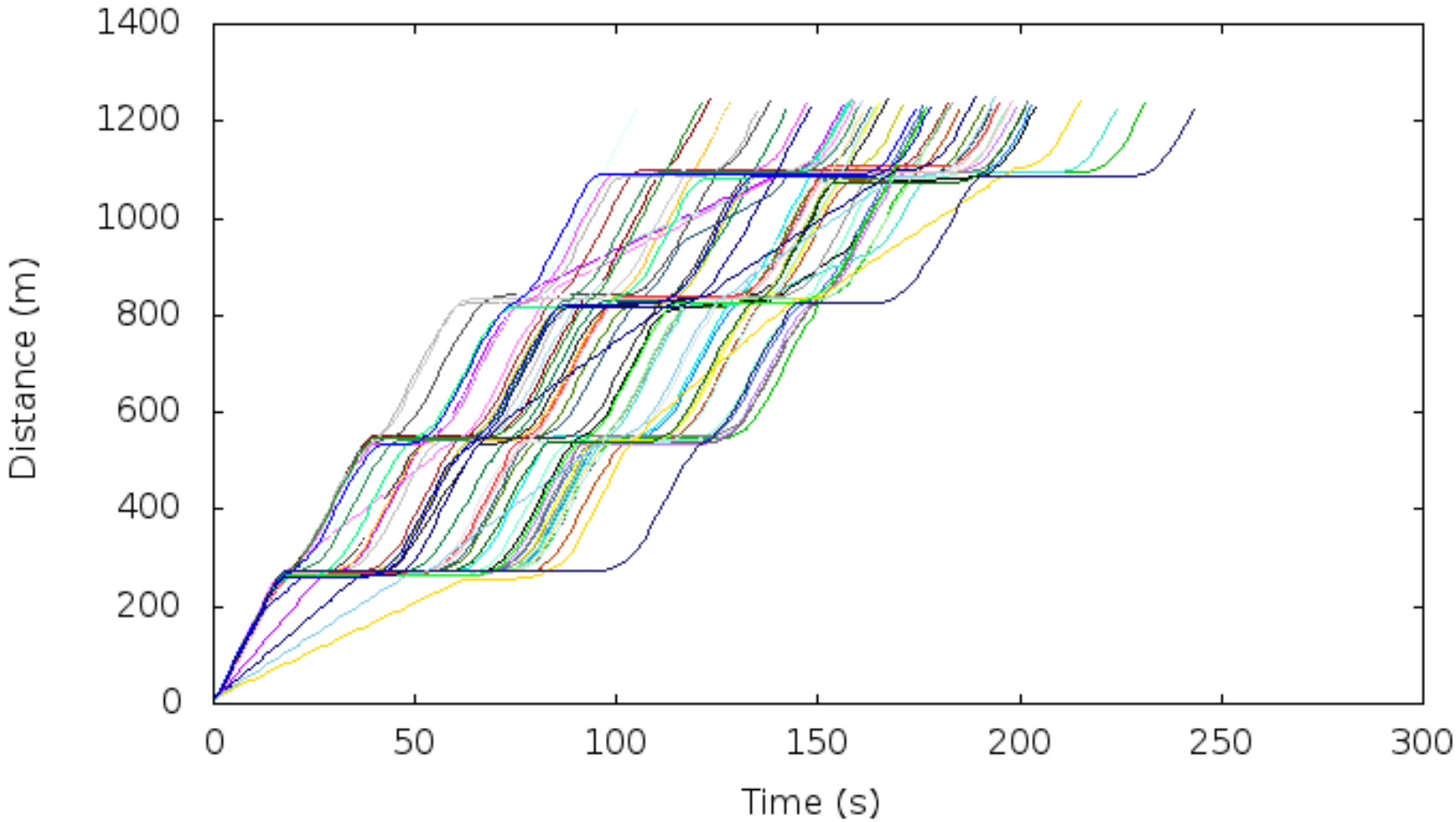


0 % with the system



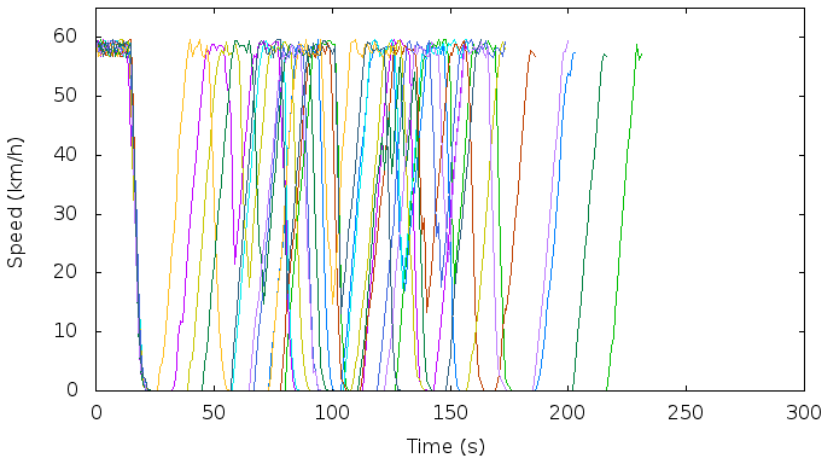
100% with the system

Bootstrap Problem

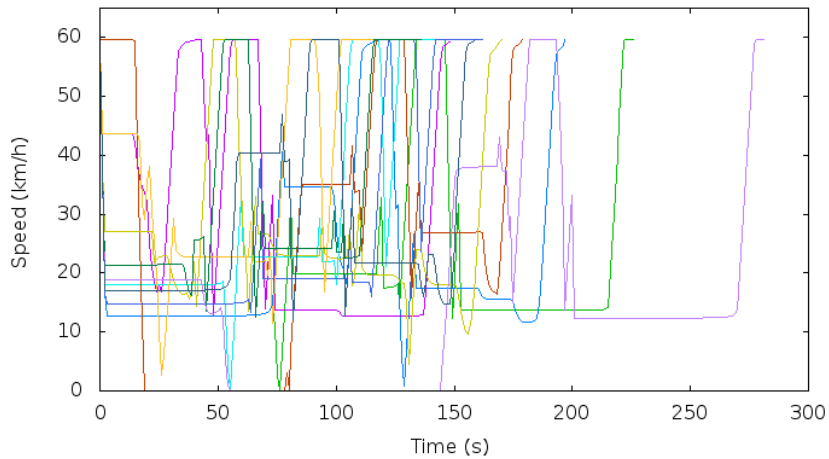


10% with the system

Velocity Over Time



0% with the system



100% with the system

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Experiment With Different Simulation Setups

- Number of heavy vehicles
- Test the influence of road-side sensors
- Get access to real time traffic light data

Next semester

Questions?