Integrating Efficient Routes with Station Monitoring for Electric Vehicles in Urban Environments: Simulation and Analysis

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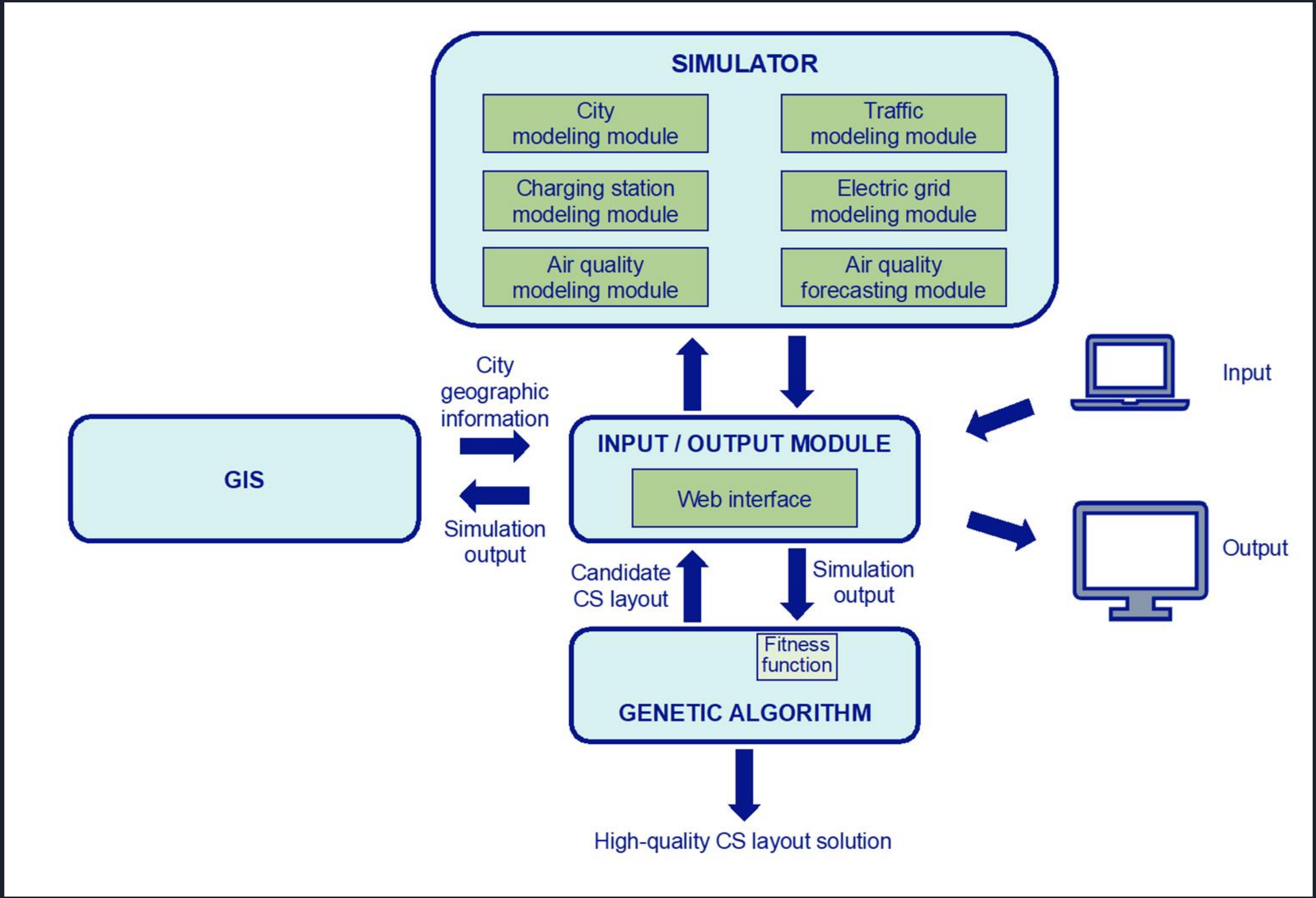
General Vision of SANEVEC PROYECT



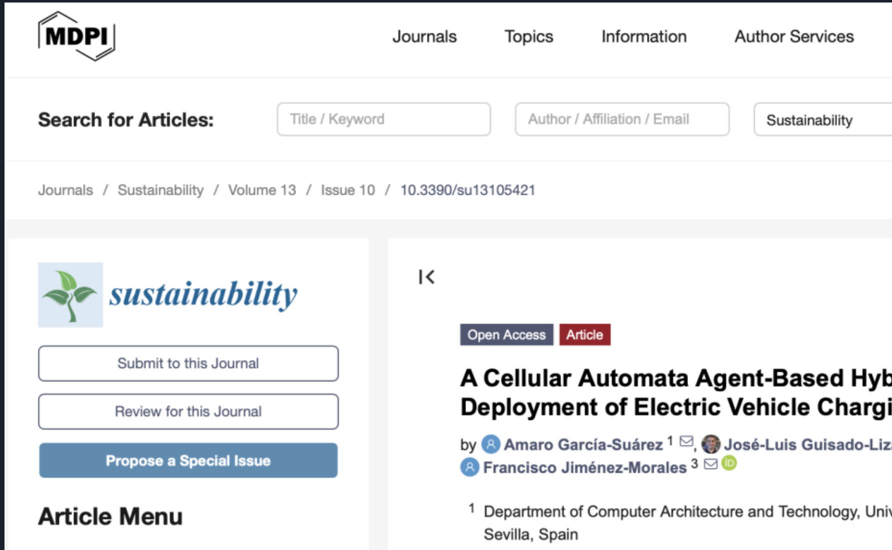
A Cellular Automata Agent-Based Hybrid Simulation Tool to Analyze the Deployment of Electric Vehicle Charging Stations

- the current occupancy level of each CS

- the current traffic state

- predictions of intelligent algorithms

https://doi.org/10.3390/su13105421



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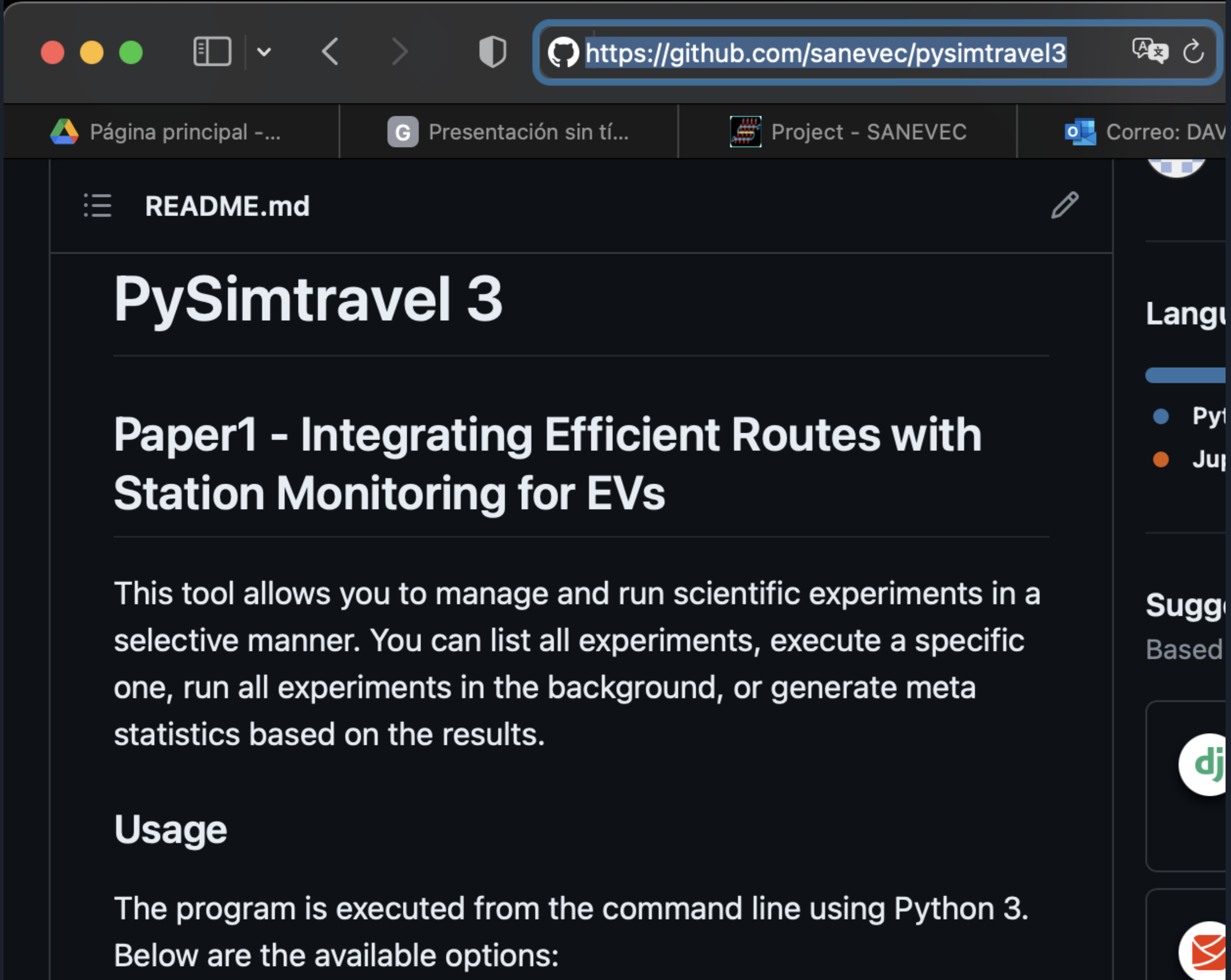
A simulation approach to determine the deployment of an urban network of electric vehicle charging stations for environmental and social benefits

Github


https://github.com/sanevec/pysimtravel3
Página principal -...
Presentación sin tí...
Project - SANEVEC
Correo: DAV
README.md
PySimtravel 3
Paper1 - Integrating Efficient Routes with Station Monitoring for EVs
This tool allows you to manage and run scientific experiments in a selective manner. You can list all experiments, execute a specific one, run all experiments in the background, or generate meta statistics based on the results.
Usage
The program is executed from the command line using Python 3. Below are the available options:
Langu
Pyt
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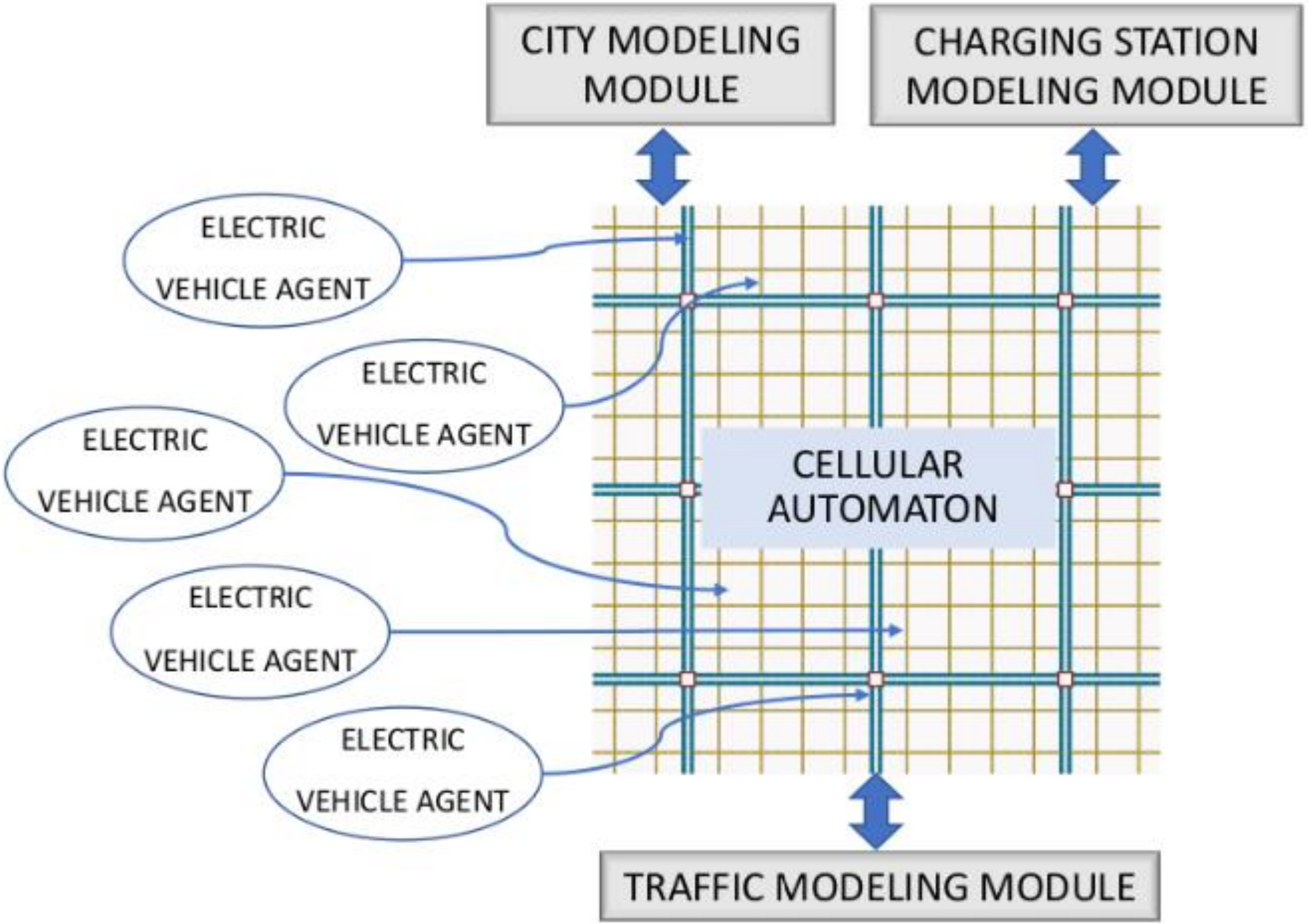
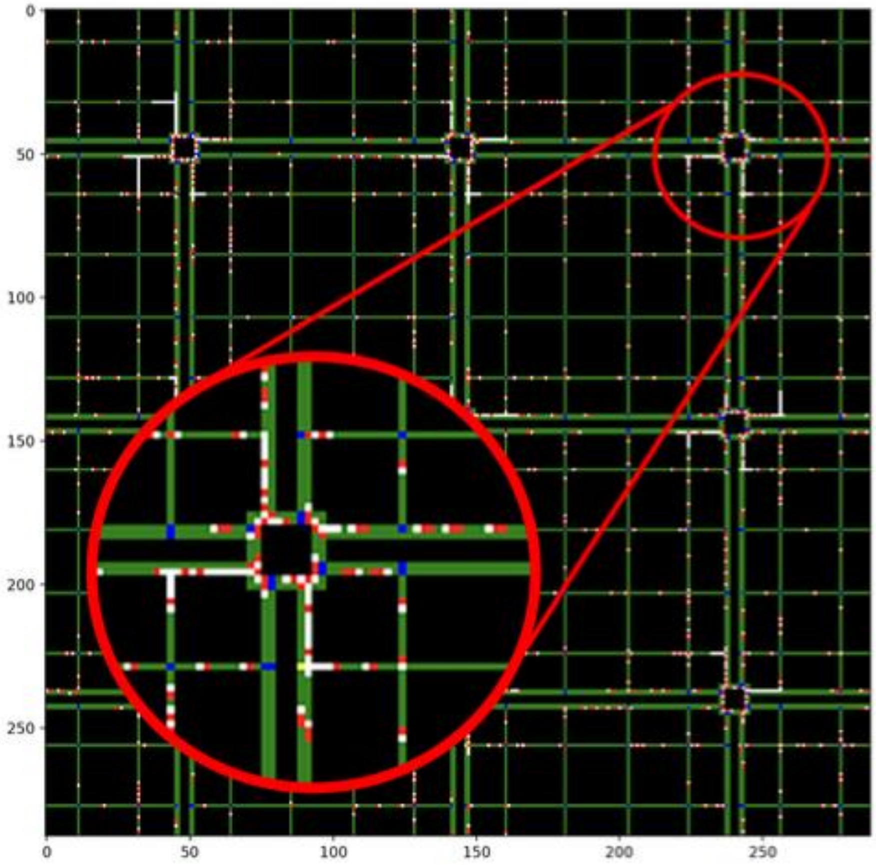
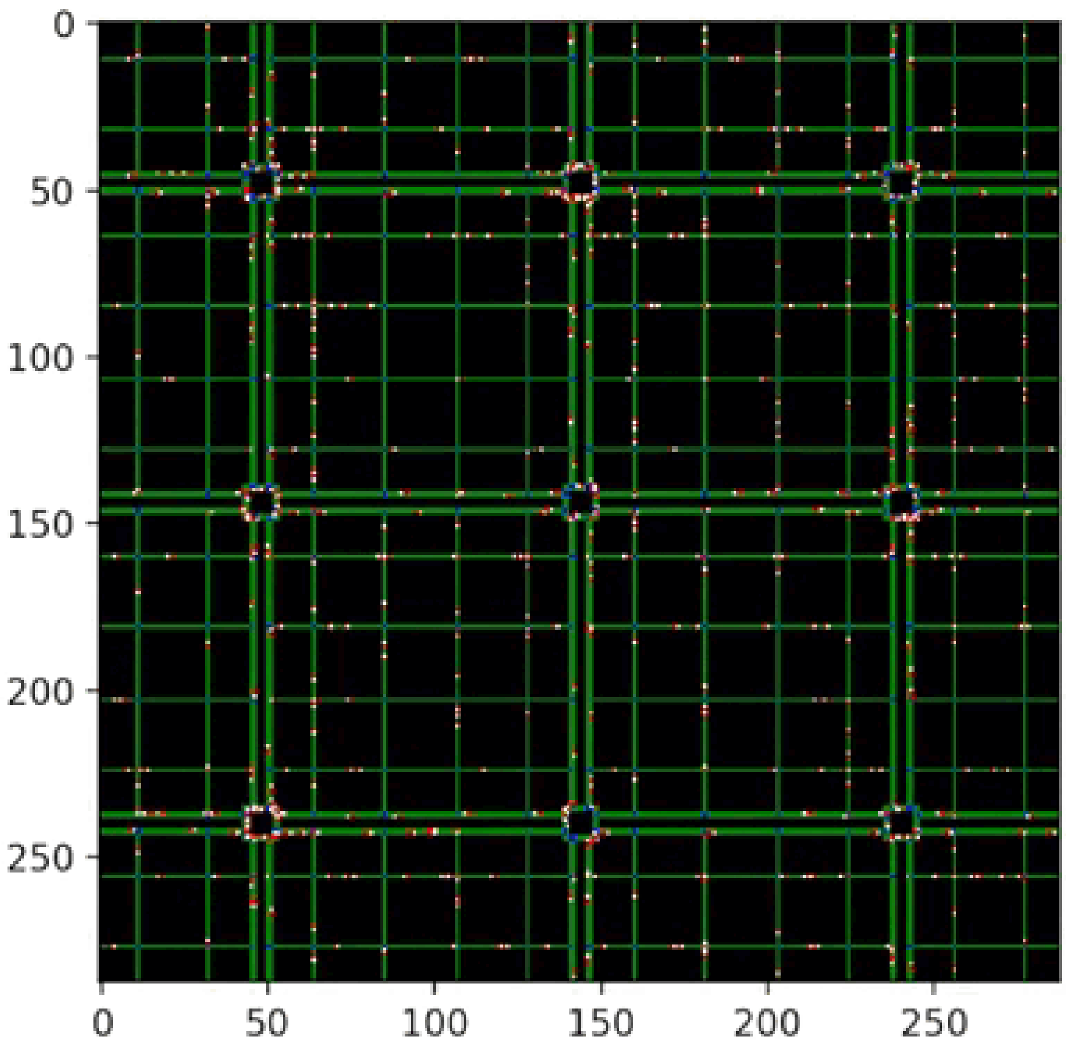
Based


CITY MODELING MODULE
CHARGING STATION MODELING MODULE
ELECTRIC VEHICLE AGENT
ELECTRIC VEHICLE AGENT
ELECTRIC VEHICLE AGENT
ELECTRIC VEHICLE AGENT
ELECTRIC VEHICLE AGENT
CELLULAR AUTOMATON
TRAFFIC MODELING MODULE



Green	A one-way street.
Blue	A street with a bifurcation.
Yellow	Charging Station (CS).
White	A car.
Red	Safety distance.

Fig. 3: Snapshot of a simulation of the city with a density of 10% of EVs

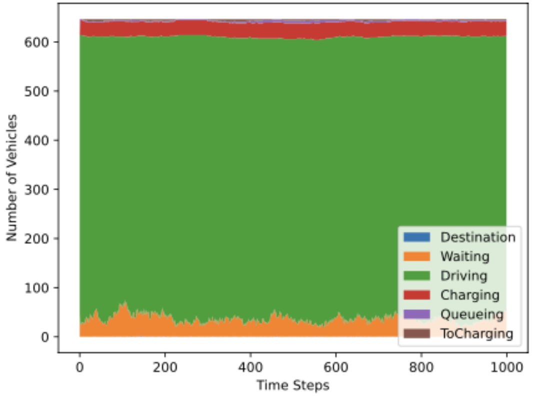


0
50
100
150
200
250
0
50
100
150
200
250

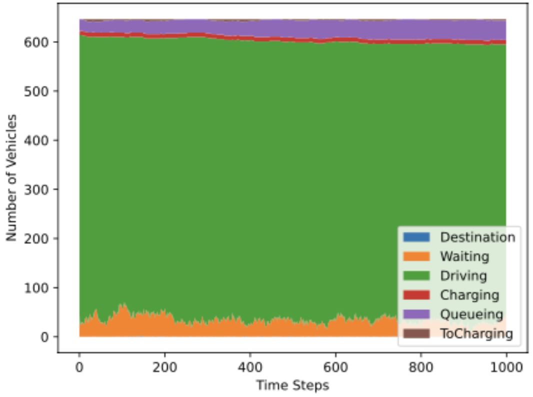
Life cycle of Electric Vehicle

Table 2: Description of vehicle states.

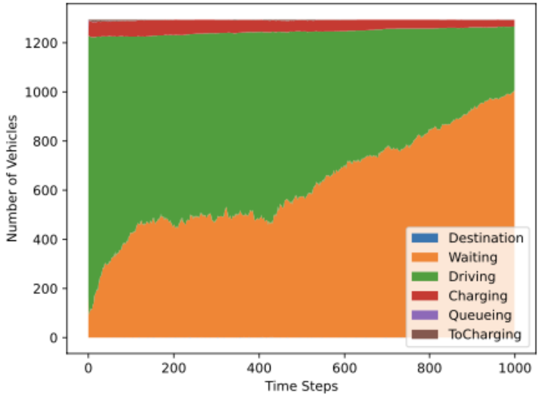
State	Description
Driving	The vehicle drives without any issues towards its destination.
Waiting	The vehicle had to stop due to non-fluid traffic.
Destination	The vehicle reaches its destination and remains there for a unit of time.
ToCharging	The vehicle is heading to the CS.
Queuing	The vehicle enters the CS and queues, waiting for an available plug.
Charging	The vehicle is at the CS, charging.



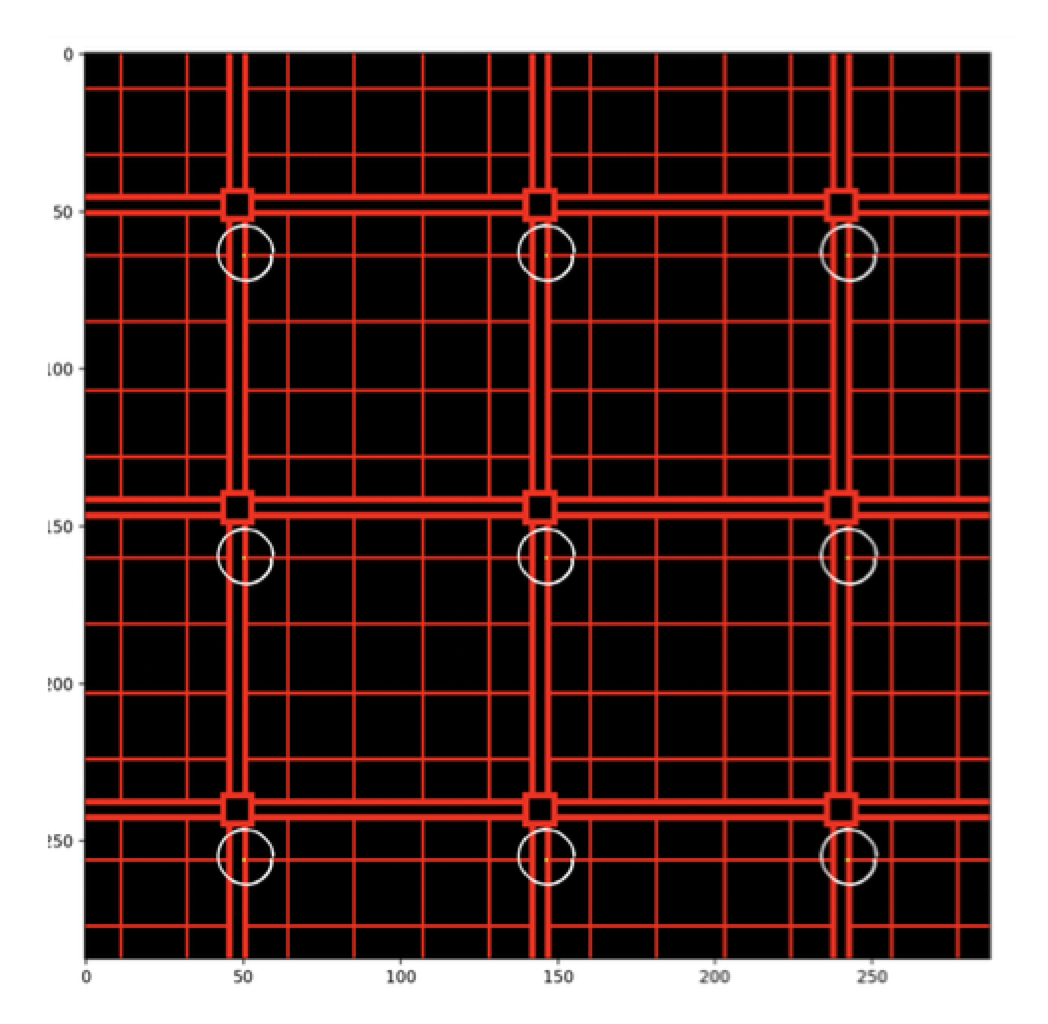
a) Stable situation



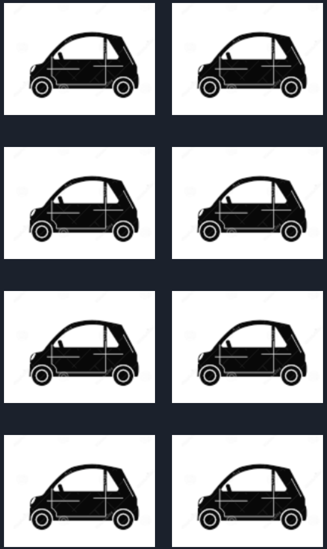
b) Energy Deficit

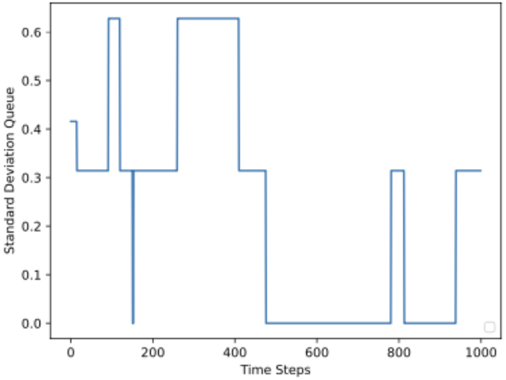


c) Traffic jam

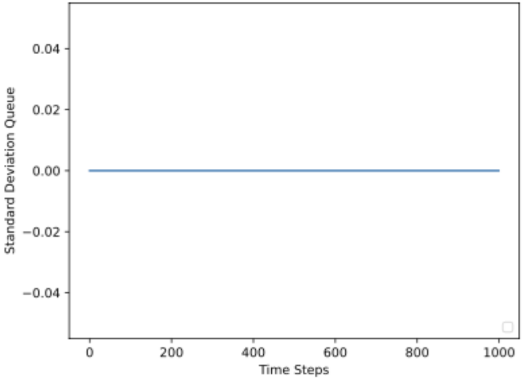

0
50
0
50
100
150
200
250

Queues of Chargings Stations

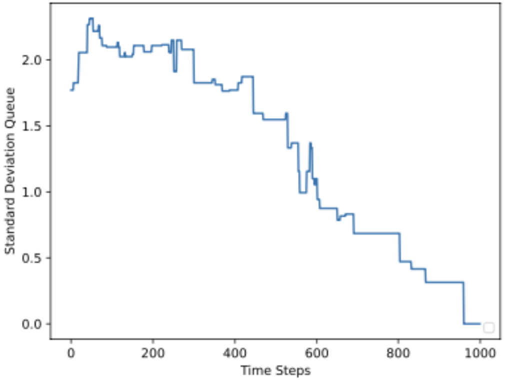
Good	Bad
	
0	1.58



a) Normal



b) Ideal



c) Improving

Parameters to study

There are 690 simulations (5x3x2x11x2+5x3x2)

Strategy: How do we route the car when we reach a fork in the road?

Plugging: What happens if there is an energy deficit?

Density: What happens if there are many cars?

Queues: What happens if cars can check the status of queues?

Table 3: Simulation Parameters

Parameter	**Values**
Strategy	Distance, Time
Number of chargers per charging station	1, 5, 10
Traffic density (percentage of occupied road cells)	5%, 10%
CS Queue Query	0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1
PCOW	0.5, 0.95

Past Cell Occupancy Weight (PCOW)

Used to estimate times heuristically at the forks of the A star method

$$O_n = w \times O_{n-1} + (1 - w) \times C_n$$

where:

O_n : Heuristic Occupancy at time n

O_{n-1} : Heuristic Occupancy at time $n-1$

C_n : Current Occupancy at time n

w : weight

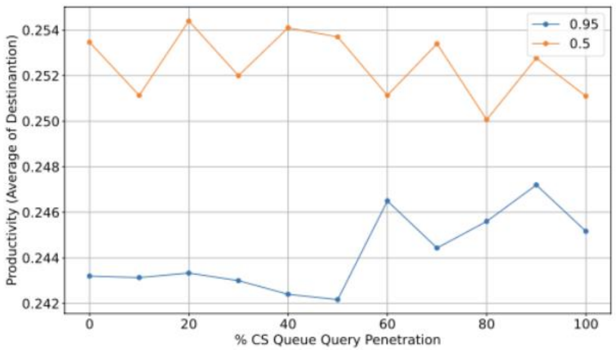


Fig. 8: Productivity for two different values of the PCOW A* parameter (Time Only)

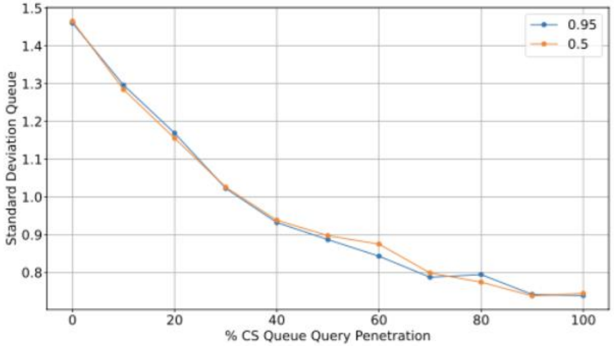
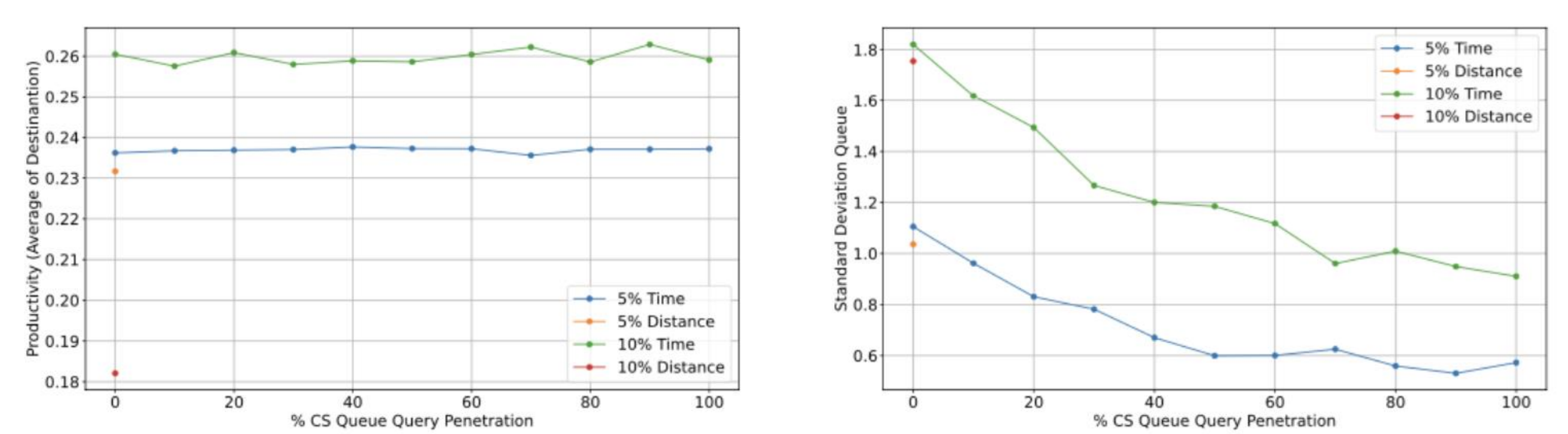


Fig. 9: Queue Standard Deviation for two different values of the PCOW A* parameter (Time Only)

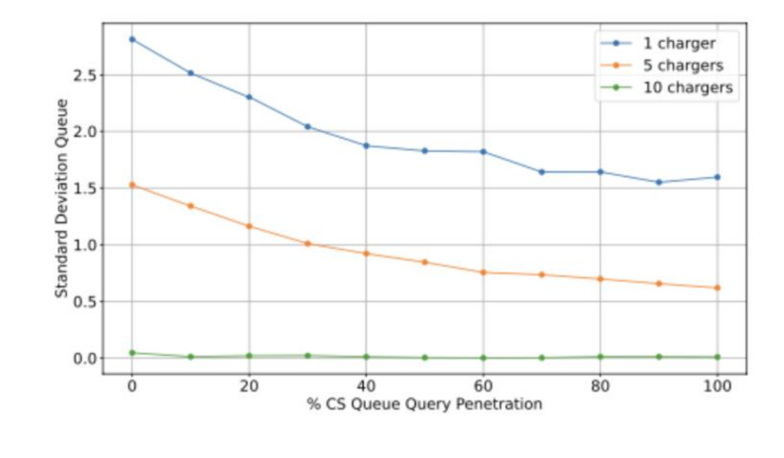
The only parameter that affects productivity but not queues!



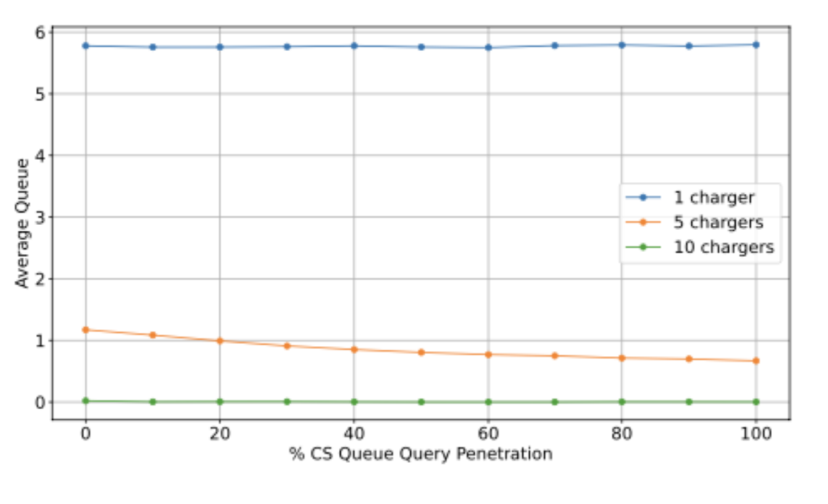
Car density.

- Time-based routing is more effective than distance-based.

- CS Queue Query generally balances out the queues.

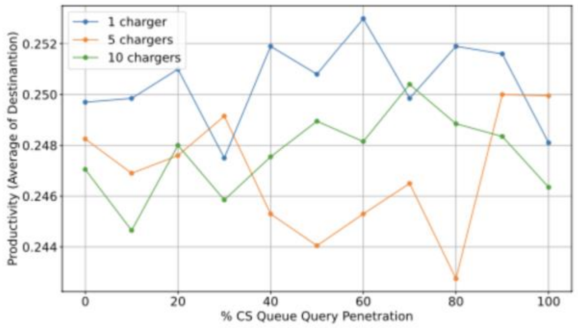


(b) Average Queue Standard Deviation



(c) Average Queue Size

- CS Queue Query generally balances out the queues, specially during energy deficits, but does not necessarily improve system productivity.



(a) Productivity

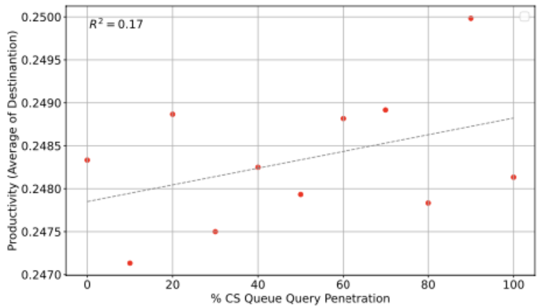


Fig. 11: Productivity vs CS Queue Query Penetration

-There seems to be an inherent transport (or production) capacity in the city that is hard to surpass.

- Productivity is mainly improved by adjusting the routing parameters (PCOW). CS Queue Query's impact on productivity is minor, but it provides a better average service for users.

For future research, we propose:

– Exploring the use of traffic lights to evaluate productivity (i.e., the capacity to increase traffic).

– Analyzing the impact of not only checking the availability of a CS slot, but also scheduling a reservation.

– Studying city topologies in relation to their electrification and solar panel setups.

– Delving into more advanced energy models instead of focusing solely on productivity.

– Adding a rasterization processes in order to simulate realistic city maps using the two-dimensional matrix proposed in this work.

– Performing simulations using real cities and not just synthetic models.

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Thank you

Questions?