

### **City Mobility Simulator**

A high-performance digital twin solution for city-scale transport systems.





# What is **Simulation?**



Simulation is the abstraction and reduction of the real world in a computer program. High-detail simulations create digital twins – virtual testbeds to develop solutions to real-world problems in a cost and time-efficient manner.

Simulations enable the analysis of "what if" questions as well as insights into otherwise unavailable metrics. As microscopic simulators such as CityMoS are able to capture the complex interactions of simulated entities, they are considered the more powerful tool over static system analysis.



### What is Mobility Simulation?

Mobility simulation aims at replicating movement patterns of people in a region. In contrast to classic traffic simulation, which primarily focuses on traffic-related aspects such as throughput or average speeds, mobility simulation also takes into account the individual person, and tries to represent their respective short and midterm travel patterns as well as route and mode choices.

Mobility simulation is useful to answer a range of urban challenges, such as "what if 100% of all vehicles were electric?" or "what is the effect on passenger travel times if the subway system is disrupted?".



### Introducing City Mobility Simulator, CityMoS







### Why is CityMoS the best choice?

CityMoS overcomes the traditonal simulation trade-offs between scalability, accuracy, and performance commonly faced by other simulators. CityMoS balances all three aspects.



**Accuracy:** CityMoS includes many participants of the transport system, ranging from private vehicles to public transport. Advanced models for motion, comfort, energy, and safety grant detailed and holistic insights into the performance of the transport system.



**Scalability:** Unlike other high-detail mobility simulators, CityMoS can simulate mobility at city and state scale. This enables insights into how local changes can have system-wide effects. CityMoS can also deliver highfidelity results for large-scale highway networks.



**Performance:** CityMoS does not require expensive supercomputers to provide performance. It runs on consumer hardware to master challenging simulation scenarios. Results for an entire week of large vehicle populations are ready in only a few hours - unrivalled in the world of microscopic mobility and traffic simulators.

### **Application Areas**

Tackling the mobility challenges of today and tomorrow





### **Application Areas of CityMoS**





### Holistic Transport System Evaluation and Exploration





### **Analysing Private, Public, and Commercial Transport**

- Extracting metrics that may not be accessible in the real world such as travel times, waiting times, change of transport mode, energy consumption, etc.
- Studying the effect of alterations to the road network such as adding or removing roads, changing speed limits, varying traffic light programs, etc.
- Simulating extreme events such as accidents, road blockages, and increased traffic caused by special events

### **Detailed Public Transport Simulation**

- Testing the effect of different schedules, headways, or vehicle capacities
- Studying the impact of new bus lines, railway lines, or completely new modes of transport
- Analysing and mitigating effects such as bus bunching or unmet passenger demand



### **Greener Transport Systems**



### **Transport System Electrification**

CityMoS can analyse spatiotemporal energy consumption and charging demand. CityMoS supports the planning of charging infrastructure, resources, and incentive policies. It can also help strategize the electrification of the public transport system by identifying the bus lines which can be electrified and the impact of taxi/private hire car fleet electrification.



#### **Environmental Aspects**

CityMoS can also be used to accurately study mobility-related environmental parameters on a city-scale such as fuel consumption, emissions of pollutants (e.g. CO<sub>2</sub> or NO<sub>x</sub>), and heat caused by traffic. Additionally, CityMoS serves as a simulation tool to study the impact of alternative fuels such as hydrogen to support more sustainable transport.



### **Holistic Analysis**

CityMoS can be integrated with other models to study the effects of, e.g, weather or complex human behaviour. It can be coupled with other software such as power systems simulators. This enables CityMoS to examine if the underlying electric grid can support the demand caused by electric vehicles, and in turn support charging infrastructure planning.



### **Commercial Fleet Analysis**

### **Operation Optimisation**

#### Logistics & Traffic Management

- Evaluating different vehicle-to-task assignment strategies
- Examining different fleet compositions
- Inspecting rebalancing strategies, effects of demand prediction, etc.
- Analysing refuelling/charging strategies



### **Charging & Energy Management**

- · Charging strategy for commercial vehicles
- Studying the potential benefit of decentralized energy storage (e.g. second-life batteries)
- Feeding in of depot-based renewable energy (e.g. PV panels)
- Analysis of specialised task assignment with the consideration of range limitations and charging requirements
- Smart charging and vehicle-to-grid communication



### **Fleet Performance**

- Evaluation of holistic operation metrics
- · Costs for fuel and energy
- Task completion times and delays
- Environmental aspects



### Intelligent Transport Systems



### **Product Offerings**

Product features, track record, and collaboration opportunities





#### **PRODUCT OFFERINGS**

### **Seamless Process**

01 (ityMoSSuite)
02

> The CityMoS Suite is an easy-to-use software tool to create and configure CityMoS simulation scenarios. Road networks, travel patterns, and simulation parameters - all accessible via a graphical user interface.

CityMoS can be run both remotely or on a local machine. Besides the command line interface, CityMoS provides a modern 3D visualisation of the simulation for instant visual feedback and easy demonstration.

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CityMoS

The simulation output is supported in a variety of formats, such as SQLite, PostgreSQL, and CSV. Enjoy the flexibility to select what best serves your needs.

PostgreSQL

SQLite

03





### Features of CityMoS Suite



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#### **Network Editing**

- Map overlay from Google Maps, OpenStreetMap, or custom tile servers
- Visualisation of different topology, connections, terrain levels
- · Creating and editing traffic lights, bus lines, bus stops, and routes



#### Interoperable

• Importing networks from SUMO, Vissim, OpenDrive, and ESRI Shapefiles



#### **Travel Demand**

• Creating different types of travel demand (e.g. zonal demand, flows, trips, etc.)



#### Calibration

• Calibration tool to automatically calibrate model parameters (e.g. driver behaviour or route choices)



#### Configuration

- Editing buildings and other visual features to be shown in the 3D version of CityMoS
- Specifying used models and parameters
- Setting output metrics and formats



#### **PRODUCT OFFERINGS**

### **Features of CityMoS**

### **Mobility Simulation**

- Private vehicles (cars, motorbikes), taxis, private hire cars, buses, trains, commercial traffic
- Behavioral models (driving behavior, route choices, decision making)
- Detailed electric and internal combustion engine models

### **Fleet Simulation**

- Support of multi-shift taxi simulation
- Private hire vehicles
- Taxi passenger demand
- Commercial fleets (e.g. delivery fleets, carriers)



### **Public Transport**

- Bus stops, termini, depots, railway, underground, etc.
- Individual passengers with origins and destinations, choosing their combination of transport modes, including walking and transfer times

### **3D Visualisation**

- Overlay of statistics, heatmaps, road colouring, vehicle information
- Features a touchscreen demo version and a full version
- Colour templates for corporate identity for easy integration



#### **PRODUCT OFFERINGS**

### **Collaboration Opportunities**

License Agreements		Simulation Studies			Partnerships
License Only	Assisted License	Scenario Study	Full Study	Tailored Study	Joint R&D Lab
Customer obtains commercial license for CityMoS		<ul> <li>Customer provides requirements and respective input data</li> <li>We create the simulation for the customer</li> <li>Includes 2-year licence after study to reproduce/further conduct simulations</li> </ul>			With the customer, we initiate a joint R&D lab for a close long-term partner- ship
Tier 1 Support (Basic Support)	Tier 3 Support (In-depth technical assistance and guidance)	Customer runs and evaluates the simulation	We run and evaluate the simulation, as well as prepare a comprehensive final report	We extend City- MoS, tailored to the customer's requirements We run and evaluate the simulation, as well as prepare a comprehensive final report	Includes perks of other partner- ships but focus- es on research and development to grant the customer a specialised version of City- MoS, tailored to their digital twin



### **Track Record**



#### **Scientific Awards**

Best Paper Award at IEEE International Symposium on Distributed Simulation and Real Time Applications, 2018

Best Paper Award at ACM SIGSIM Conference on Principles of Advanced Discrete Simulation, 2018

Best Contributed Applied Paper Award at IEEE/ACM Winter Simulation Conference, 2020



#### Media Coverage



**Channel News Asia** 



They aim to supplement Singapore's 2040 vision for energy for vehicles.

**Singapore Business Review** 









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