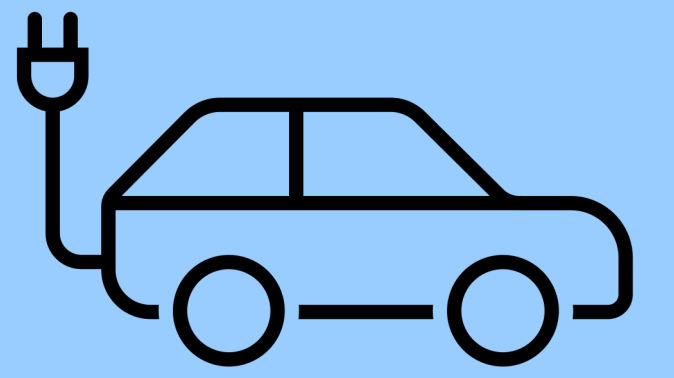




Abstract

- By 2020, over 100 countries expanded electric and plug-in hybrid electric vehicle (EV/PHEV) technologies, with global sales surpassing 7 million units.
- This article proposes an agent-based model of vehicle activity as a tool for quantifying energy consumption by simulating a fleet of EV/PHEVs within an urban street network at various spatio-temporal resolutions.
- The study found that:
 - energy consumption is lowest when speed limit adherence increases (low variance in behaviour) and is highest when acceleration/deceleration patterns vary (high variance in behaviour).
 - on average, for tested vehicles, EV/PHEVs were £116.33 cheaper to run than ICEVs across all experimental conditions.
- This research allows policymakers to forecast the demand for energy and subsequent fuel costs from EV usage in cities.

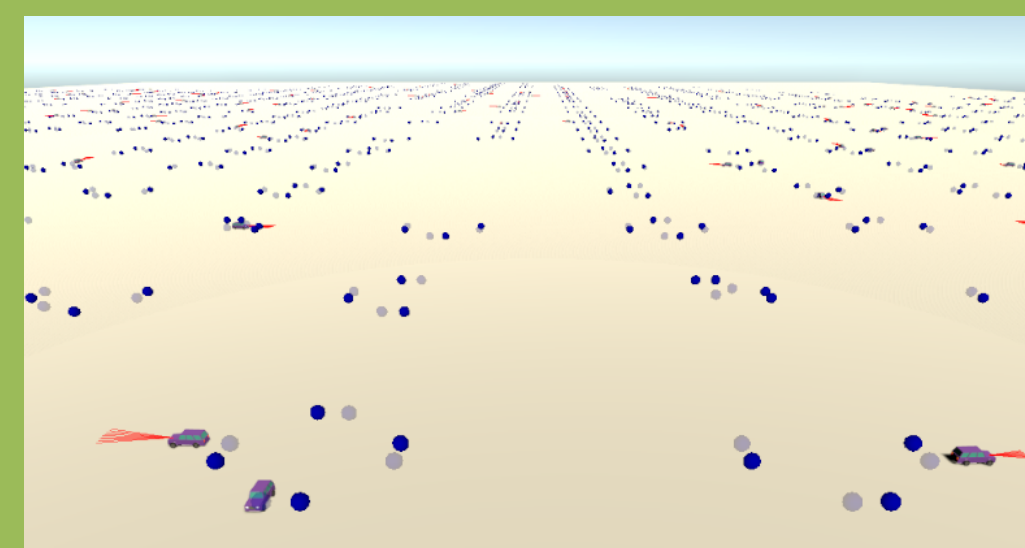
Download the UTS



SCAN ME

Methods

Classical Mechanics & Fluid Dynamics



Variable	Output Type	Example Value
VelocityChange	Float	0.139539
Acceleration	Float	4
Deceleration	Float	-2
Braking Energy (kWh) ¹	Float	0.024958
Drag_Force	Float	0.158223
Acceleration_Force	Float	2840.864617
Total_Force	Float	2843.668759
Drag_Work	Float	2.453668
Acceleration_Work	Float	2485.801176
Total_Work	Float	2488.254844
Energy_Input (kWh)	Float	0.000425
Energy_Input_Sum (kWh)	Float	0.006222

Kibble, T. and Berkshire, F.H., 2004. Classical mechanics. world scientific publishing company.
Batchelor, C.K. and Batchelor, G.K., 2000. An introduction to fluid dynamics. Cambridge university press.

Results

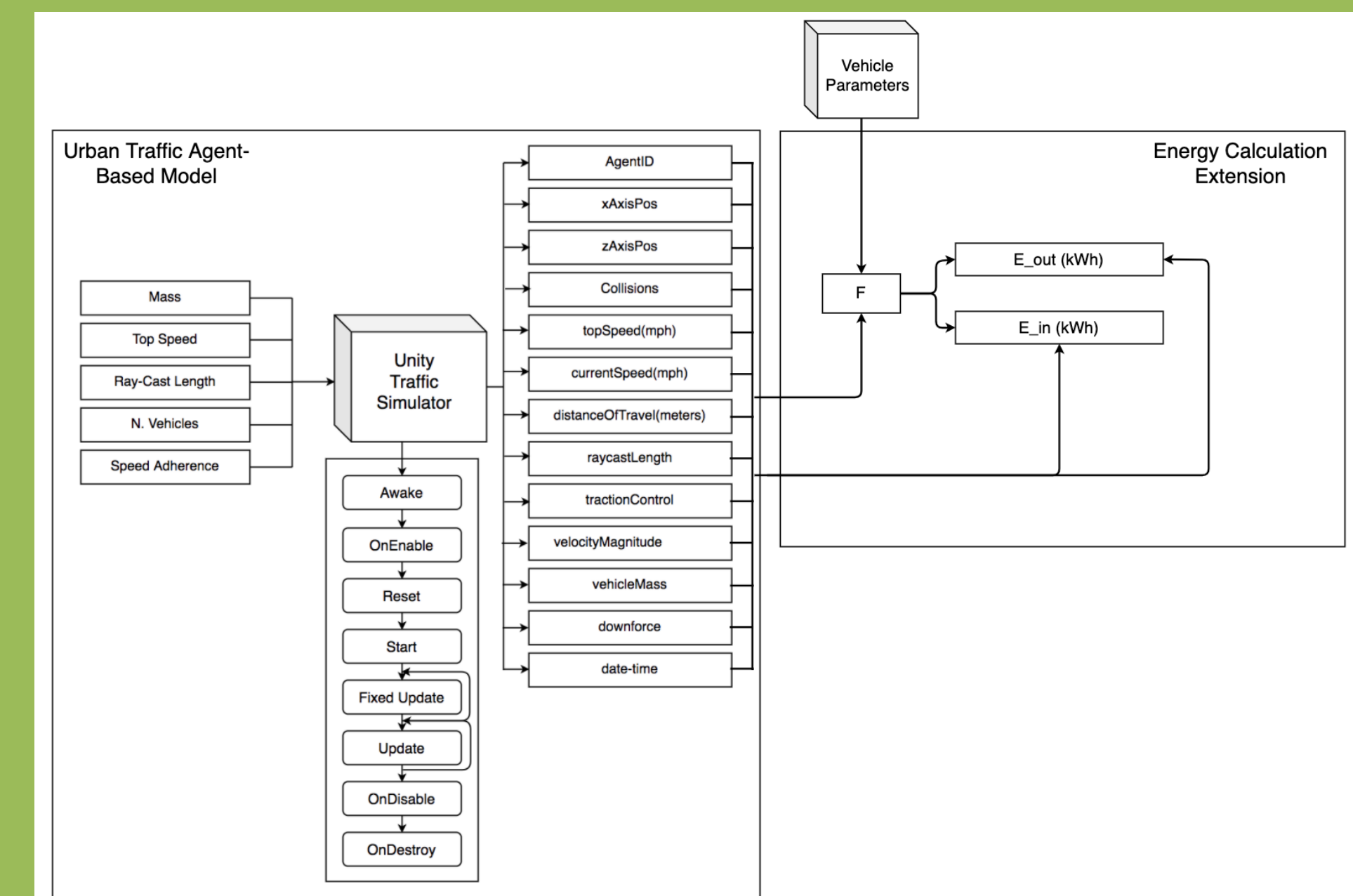


Fig 1. Workflow diagram depicting processes the UTS undergoes during run-time including the Energy Calculation Extension.

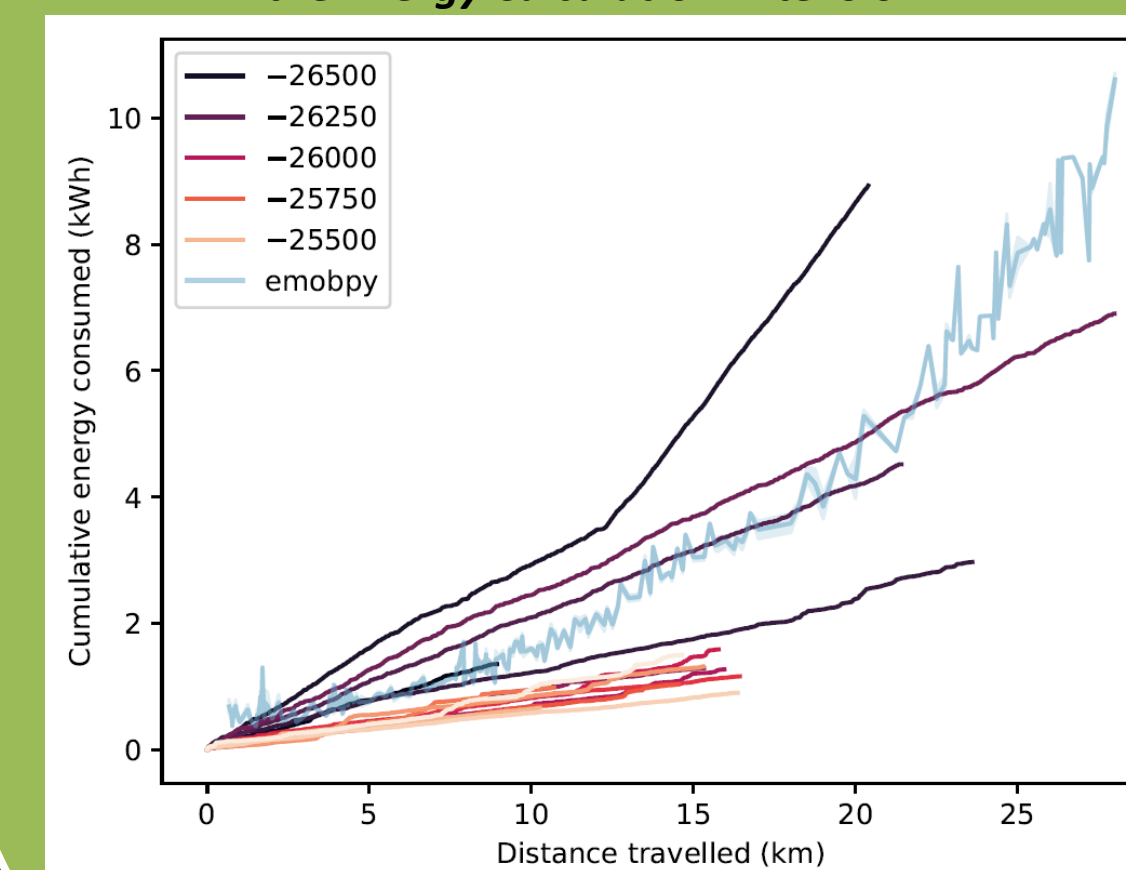


Fig 2. Electric Energy Consumption per vehicle over distance travelled, comparing UTS with embolpy.

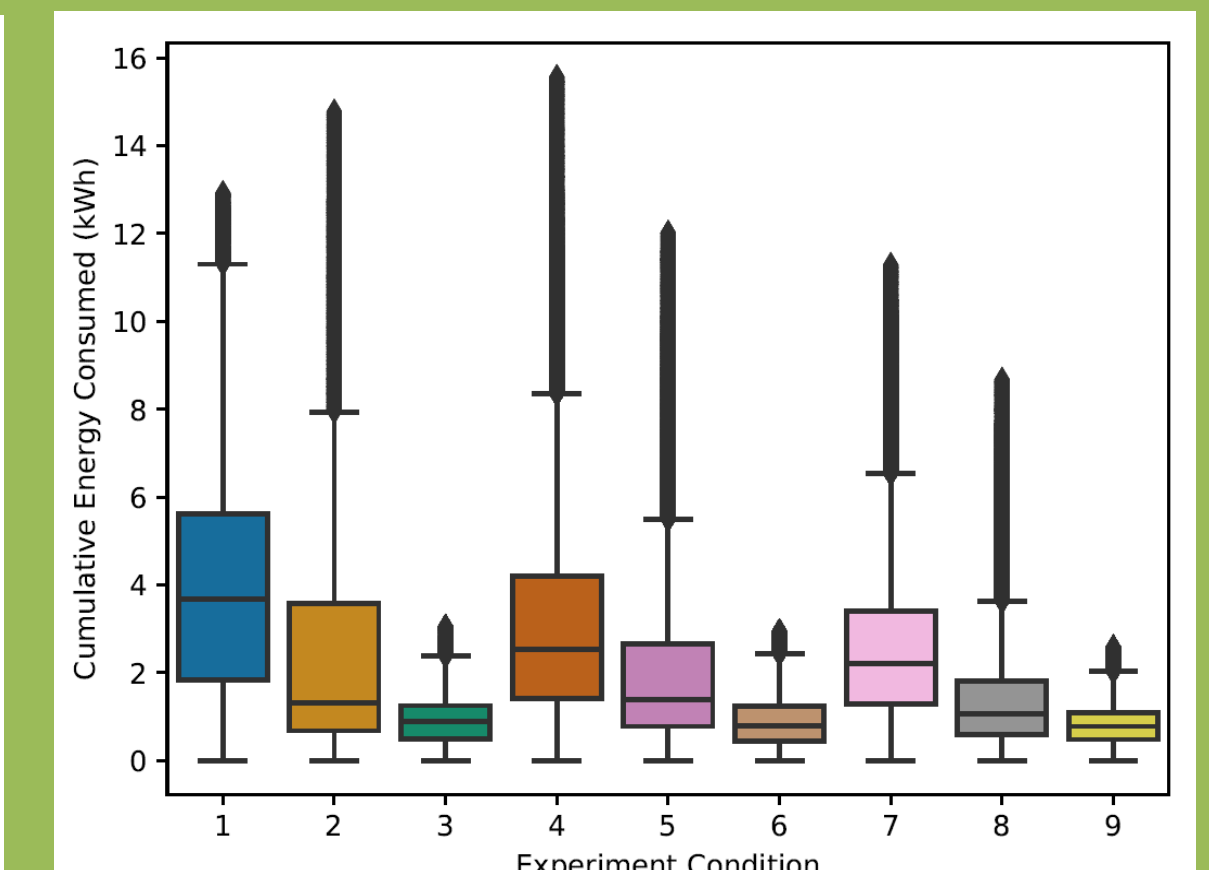


Fig 3. Energy Consumption for each experiment condition where vehicle density and acceleration/deceleration behaviour compared.

Experiment Conditions

Variable	Low Adherence	Medium Adherence	High Adherence
Low Density	1) 10 V ¹ , 10 Non-Adherence ²	2) 10 V, 5 Non-Adherence	3) 10 V, 0 Non-Adherence
Medium Density	4) 50 V, 50 Non-Adherence	5) 50 V, 25 Non-Adherence	6) 50 V, 0 Non-Adherence
High Density	7) 100 V, 100 Non-Adherence	8) 100 V, 50 Non-Adherence	9) 100 V, 0 Non-Adherence

- Number of vehicles
- Number of vehicles not adhering to speed limits

Future Directions

- An article describing the project is currently under review.
- Extend the model to utilise Autonomous Vehicles and Vehicle-2-Vehicle technology.
- Test the model on a real-world street network.