Traffic Simulation using SUMO

AI69002 | Design Laboratory

Submitted by:
Aditya Chawla
19CH3AI12

Submitted to:
Prof. Adway Mitra
Centre of Excellence in AI

Problem Statement

Explore traffic modelling tools like SUMO to analyze traffic safety and congestion in cities

Simulation of Urban Mobility (SUMO)

SUMO (Simulation of Urban MObility) is an open-source microscopic traffic simulator that can simulate traffic flows in road networks. It can model individual vehicle movements, simulate traffic light control, and generate various traffic scenarios.

There are two ways to generate a traffic network in SUMO:

1. Netedit visual network editor
2. OSM web wizard

Netedit visual network editor

Netedit is a graphical user interface (GUI) tool that comes with SUMO simulation software. It allows users to create, edit, and modify road networks for SUMO simulations visually.
It allows the user to create a simple and intuitive interface to create nodes, edges, and lanes, set speed limits, assign traffic signals, and create public transportation routes.

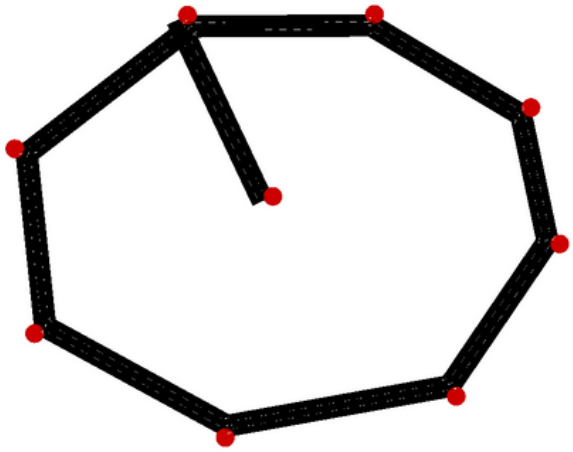

Fig1a: Network created in Netedit

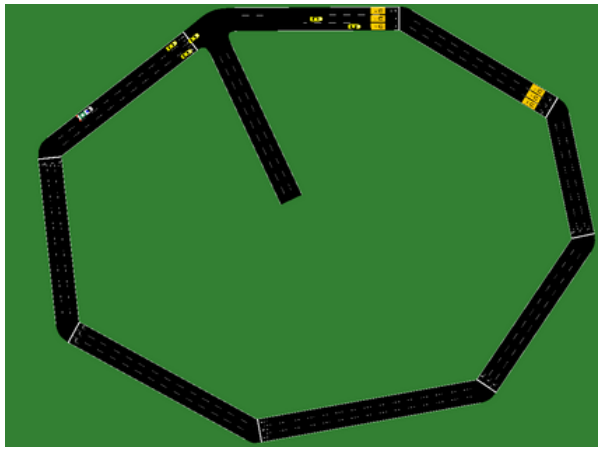

Fig1b: Simulation of the network in SUMO

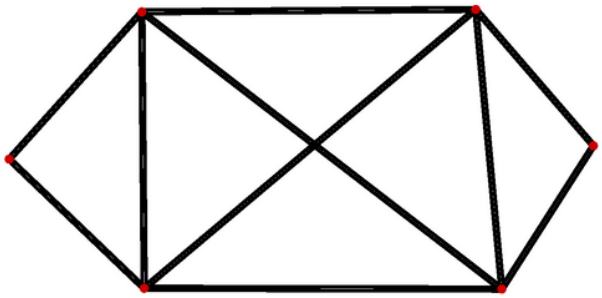

Fig2a: Network created in Netedit

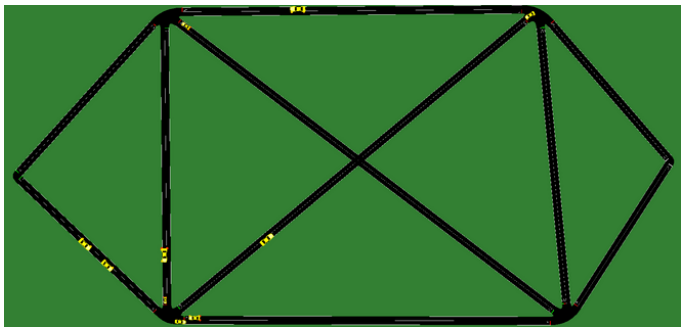

Fig2b: Simulation of the network in SUMO

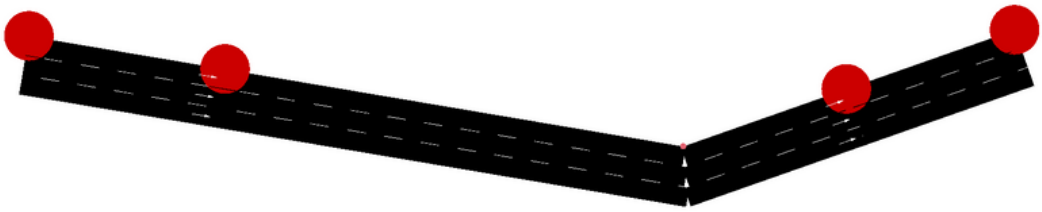

Fig3a: Network created in Netedit

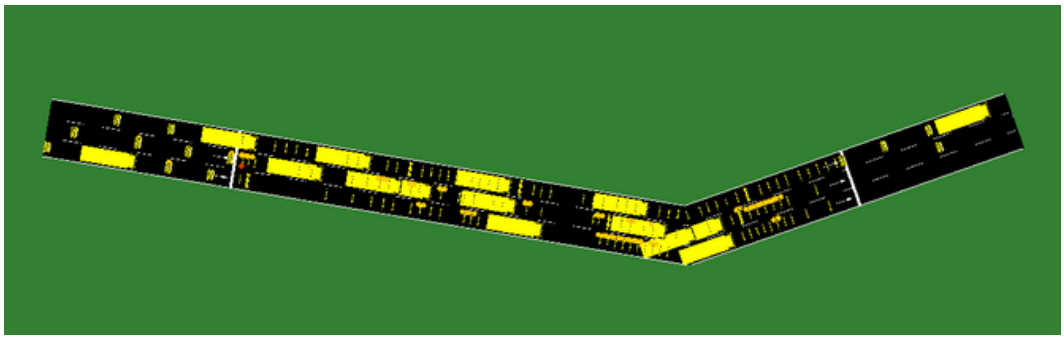

Fig3b: Simulation of the network in SUMO

OSM Web Wizard

The OSM (OpenStreetMap) Web Wizard is a web-based tool that simplifies the process of converting OpenStreetMap data into a format that can be used by SUMO. OpenStreetMap is a collaborative, open-source mapping project that provides free, detailed maps of the world. The OSM Web Wizard allows users to select an area of the map, download the corresponding OSM data, and convert it to the SUMO network format.

For this project, we have selected an area in Kolkata, India to simulate traffic.

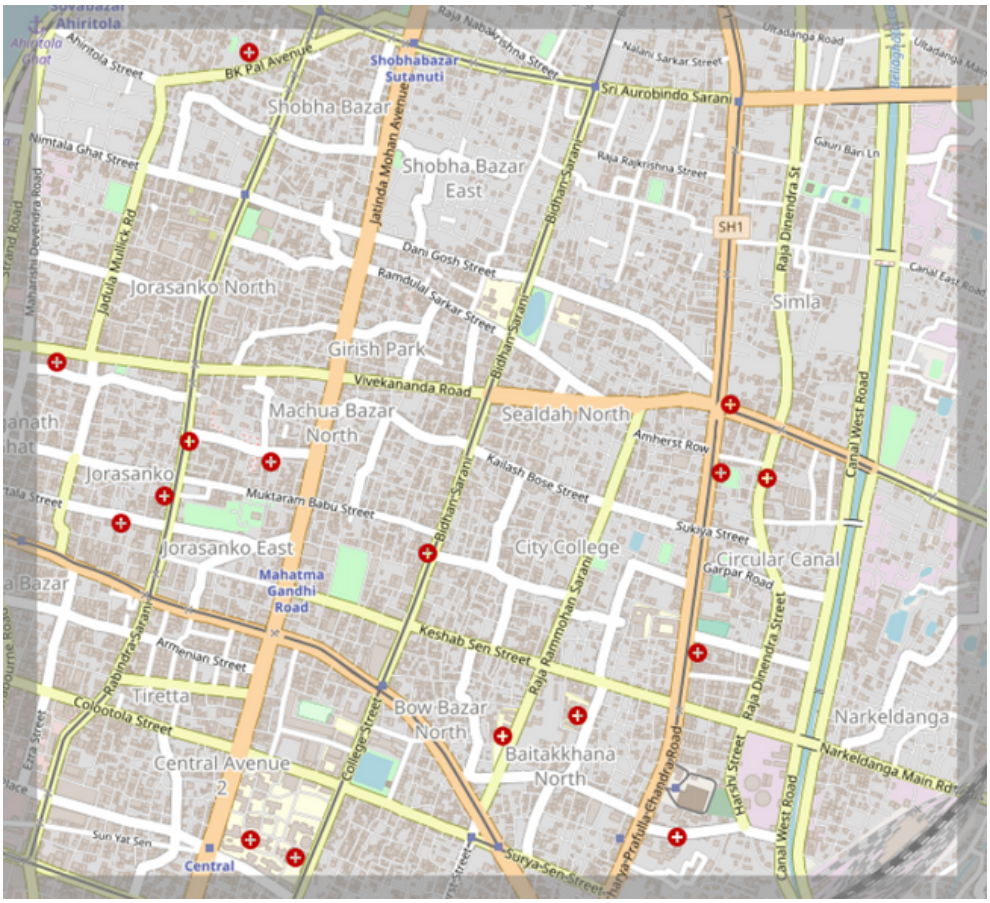

Fig4a: Area for Simulation; the highlighted portion

Fig4b: Focused Area in SUMO

The aim for the simulation is to capture different relationships by varying the number of cars and buses, i.e. increasing public transformation and decreasing private transformation simultaneously. Only cars and buses are used in these simulations to not make the simulations complex.

The Through Traffic Factor, i.e. how many times it is more likely for an edge at the boundary of the simulation area being chosen, compared to an edge entirely located inside the simulation area, is kept constant and equal to 5 for both bus and car. The count parameter that defines how many vehicles are generated per hour and lane-kilometer is set to 200 for car and 10 for bus initially. 5 more simulations are performed by increasing the bus count parameter by 10% and decreasing the car count parameter by 10% each time. All the simulations are run for 600 seconds.

The following relationships are captured from the simulations by varying the count parameter of bus and cars.

- Count of cars and buses (for give Through Traffic Factor)
- Average speed
- Average transit time
- Gas Emissions (CO2, CO, NOx, PMx, and HC: HydroCarbons)
- Fuel Consumption

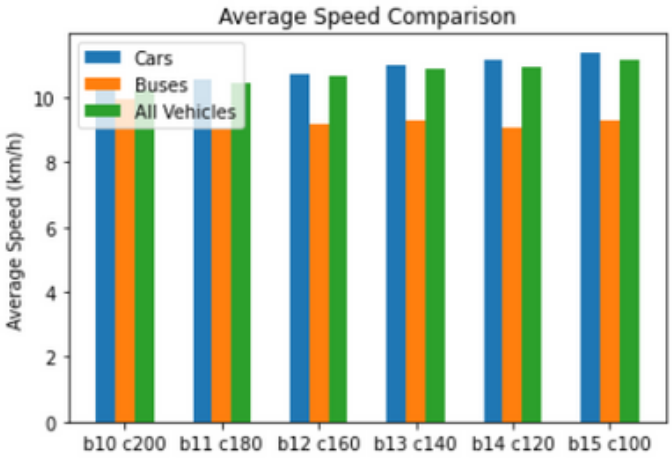

Fig5: Average Speed Plot

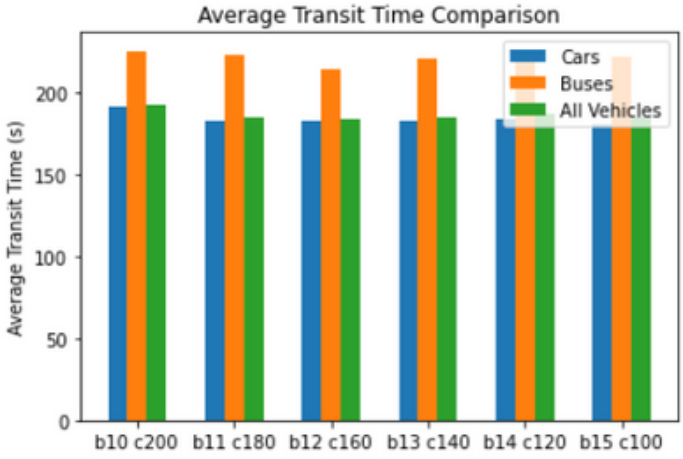

Fig6: Average Transit Time Plot

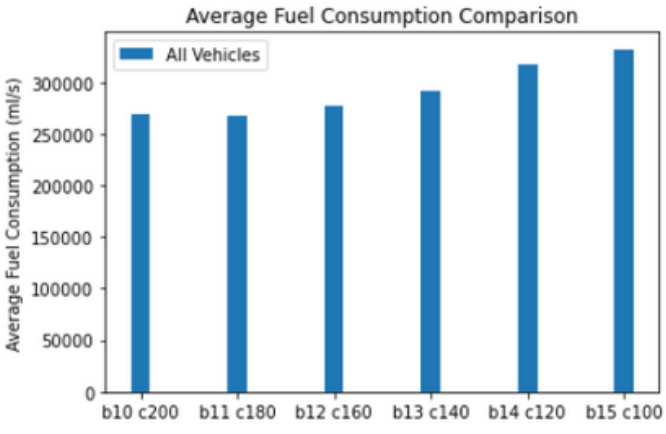

Fig7: Average Fuel Consumption Plot

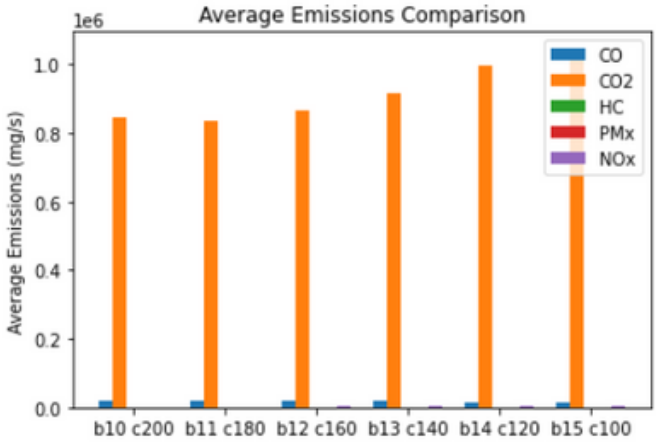

Fig8: Average Emissions Plot

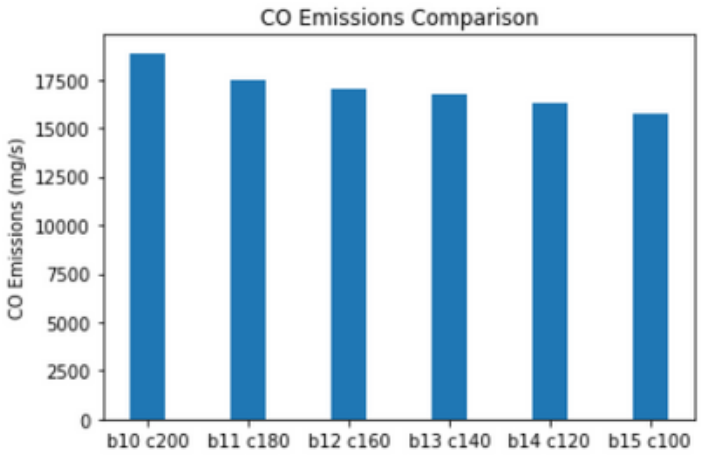

Fig9: CO Emissions Plot

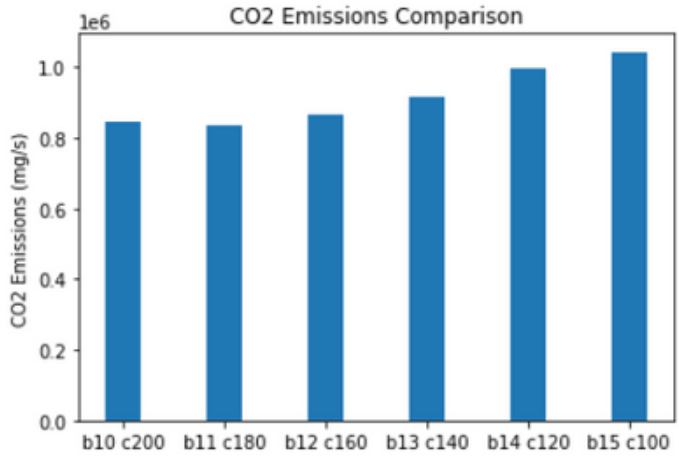

Fig10: CO2 Emissions Plot

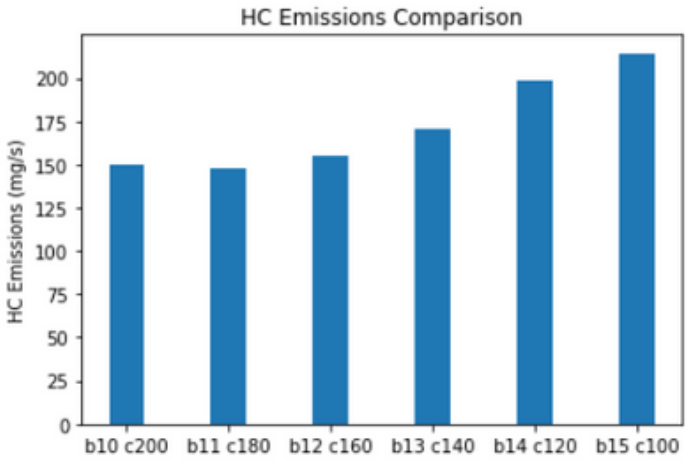

Fig11: Hydrocarbon Emissions Plot

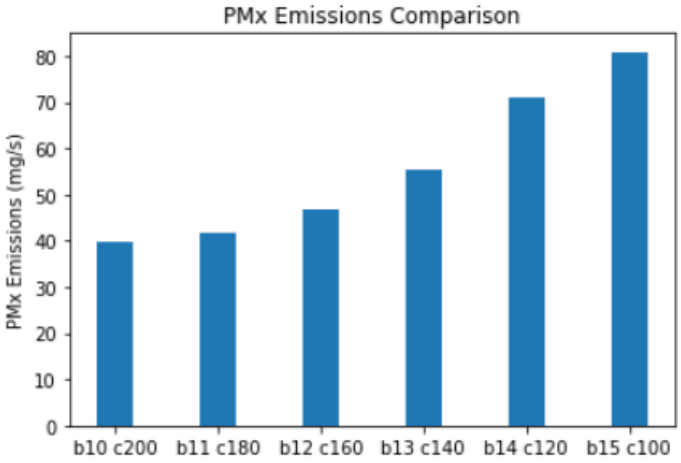

Fig12: PMx Emissions Plot

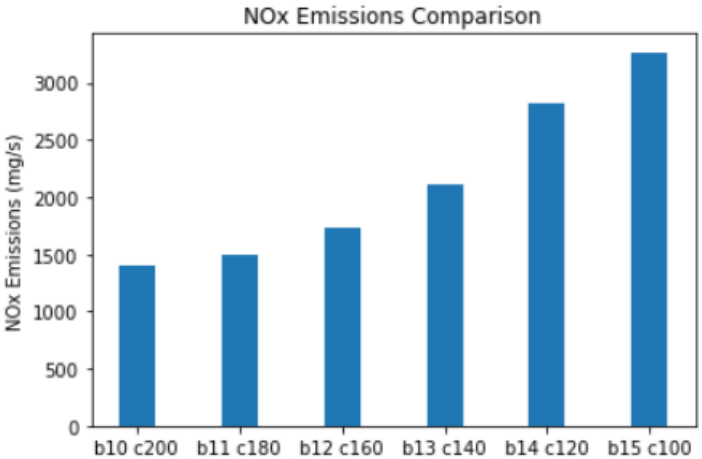

Fig13: NOx Emissions Plot

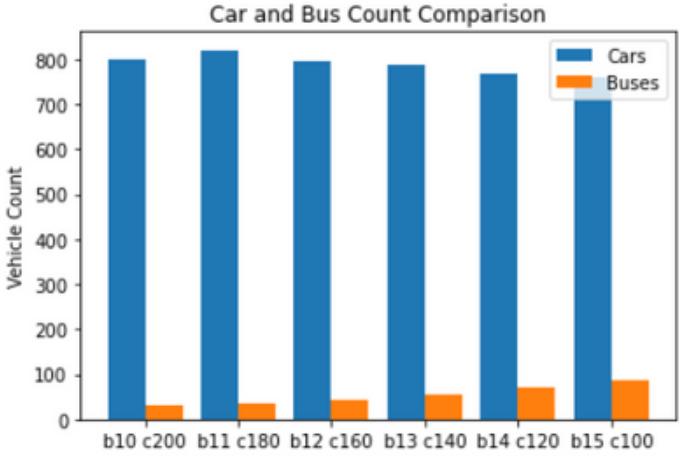

Fig14: Count of Vehicles Plot

Challenges Faced

- No proper tutorials are present for performing complex tasks in SUMO. Documentation is also there but only for some very basic tasks.
- Getting emissions output from the simulation takes up a lot of storage. Even for simpler simulations the file size go in GBs.
- Selecting area in real time map causes many routes to be cut in between which leads to problems during simulation.
- In some places in the map, the traffic gets jammed which in turn makes the simulation run very slow.