RWR 4015

Traffic Simulation for Planning Applications

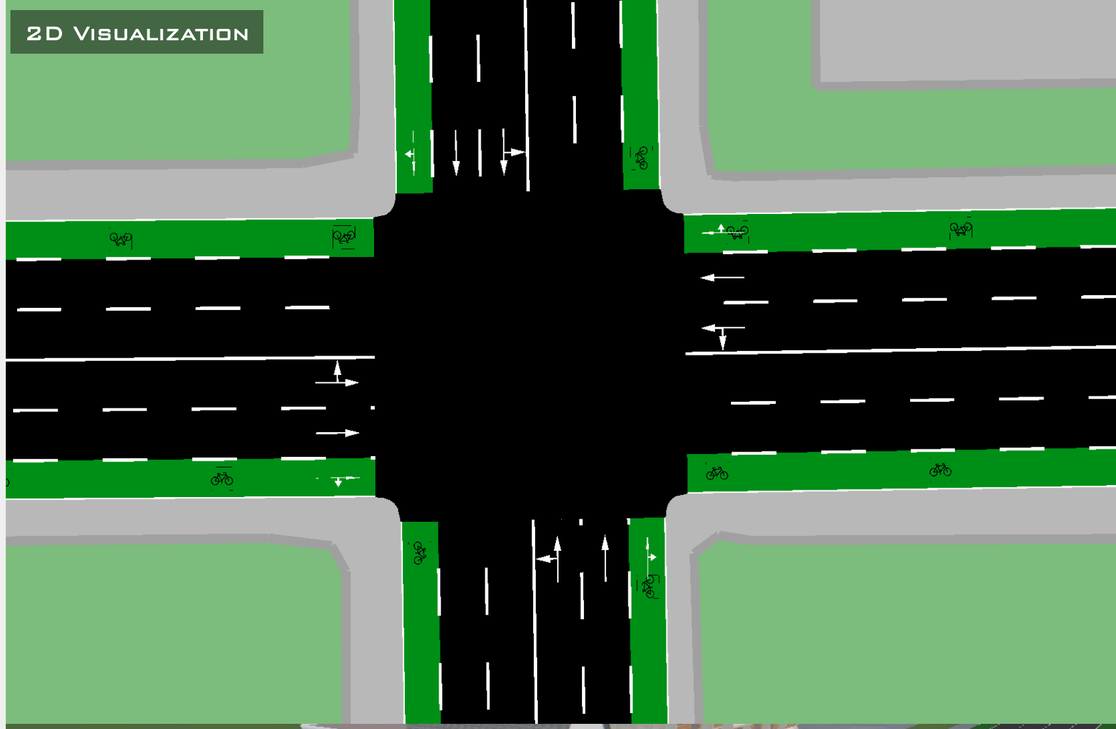
Dr. Ahmad Mohammadi

Week 5 | Lecture:
Demand Modelling and
Route Assignment

Fall 2026

RoadwayVR

roadwayvr.github.io/TrafficSimulationforPlanningApplications



Agenda

❑ Demand Modelling and Route Assignment

1. Road Network Development

2. Traffic Signal Timing

3. Traffic Movement Calibration

4. Traffic Volume Calibration

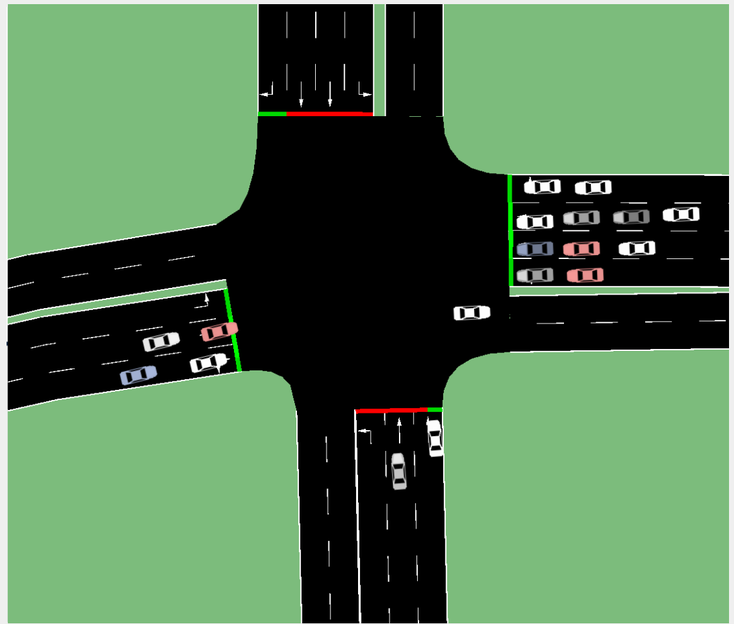
5. Traffic Speed Calibration

Demand Modelling and Route Assignment

1. Road Network Development: build an accurate road geometry and lane/connectivity model in the simulation.

2. Traffic Signal Timing: observed signal phases and timings (cycle, splits, offsets) into the simulation.

- ❑ In previous sessions, we already implemented Steps 1–2.
- ❑ This session, we will focus on Steps 3&4&5 (traffic movements, volumes, speeds).



Demand Modelling and Route Assignment

3&4&5. Traffic Movement, Volume & Speed

- **Traffic movement = the direction/turn (e.g., NBL, EBT, etc.)**
- **Traffic volume = the amount (e.g., 200 veh/h)**
- **Traffic Speed = the average speed of vehicles (e.g., 50 km/h)**

3. Traffic Movement

3&4. Traffic Movement & Volume

3&4&5. Traffic Movement & Volume & Speed

3&4&5. Traffic Movement & Volume & Speed

Quiz

- There are two Through Lanes in WBT
- What is the traffic volume and speed of each lane?

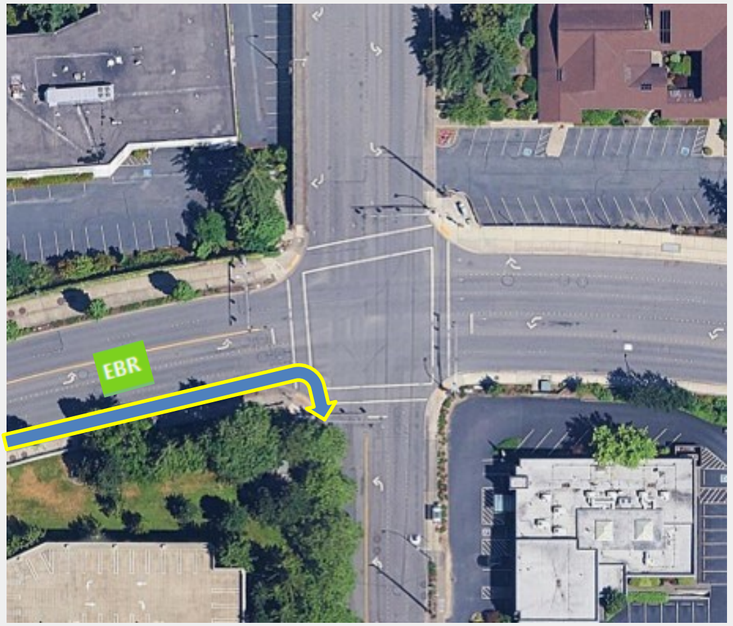
Quiz

- The right most lane in NB contains two traffic movement: Through and Right.
- What is the traffic volume and speed of through movement in the right most lane?

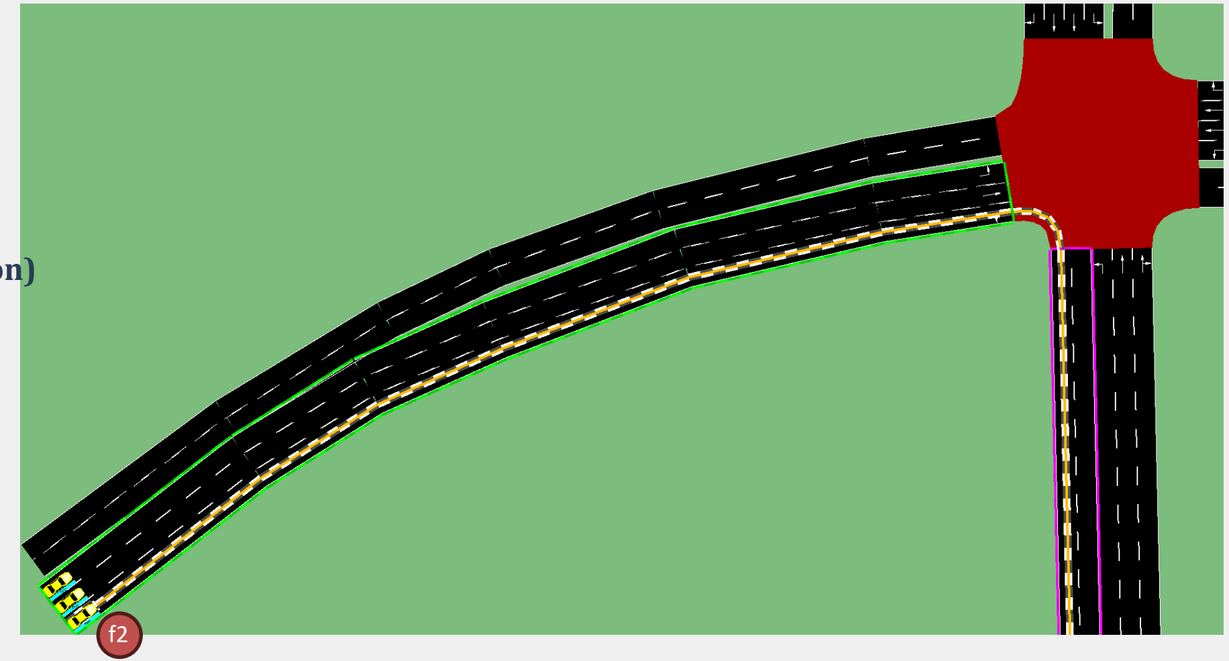
3. Traffic Movement Calibration

- In the real-world (video), each traffic demand is assigned to a specific movement by naming (e.g., NBL, NBT, NBR … WBR).
- In Simulation, each traffic demand is assigned to a specific movement by naming (f_0…f_{11})
- Traffic Movement Calibration: real-world (e.g., NBL, NBT, NBR … WBR) and simulation (f_0…f_{11}) traffic movements must be matched - this is Traffic Movement Alignment.

Traffic Movement Calibration Example for one traffic demand (EBR) - (repeat for all movements).



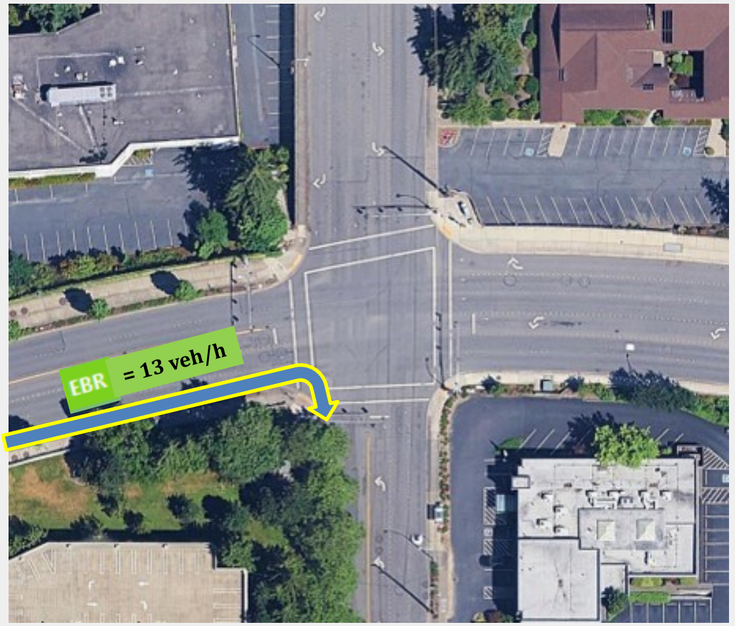
EBR (real-world) = f2 (Simulation)



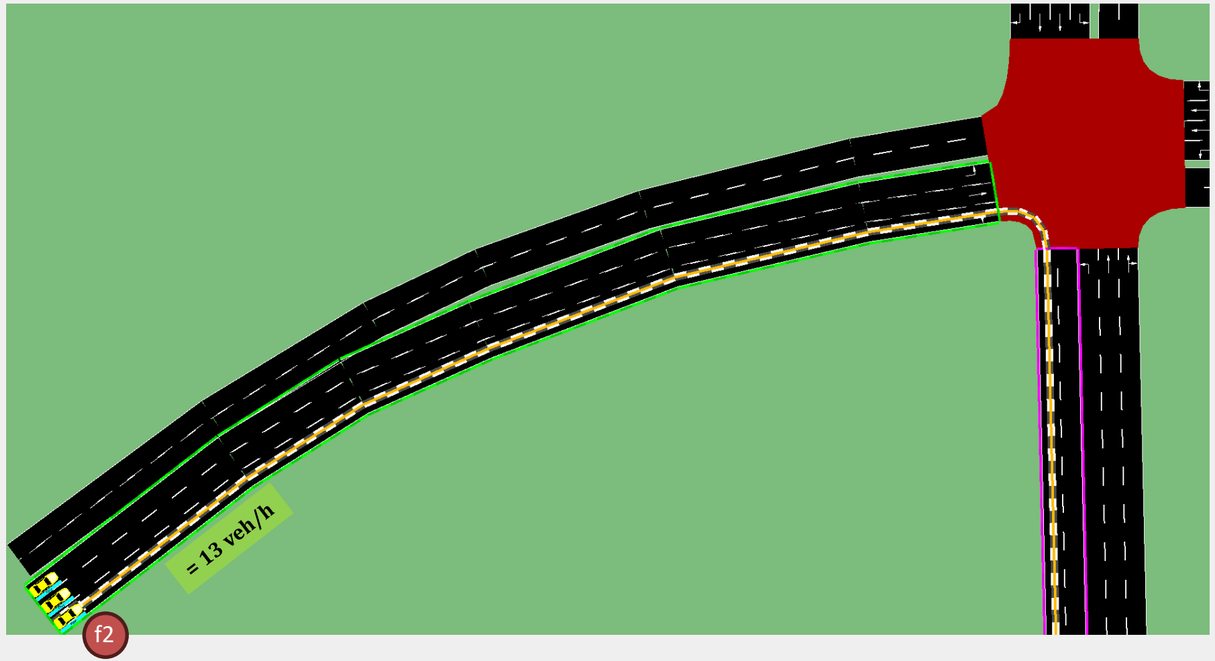
4. Traffic Volume Calibration

- ❑ In the real world(video), we observe traffic volumes for each movement (e.g., EBR = 13 (veh/h) …)
- ❑ In simulation, we set traffic volumes for each movement (e.g., f2=13 (veh/h)…)
- ❑ Traffic Volume Calibration: set simulated traffic volumes to the observed traffic volumes for each traffic movement

Traffic Movement & Traffic Volume Calibration Example for one traffic demand (EBR) - (repeat for all movements).

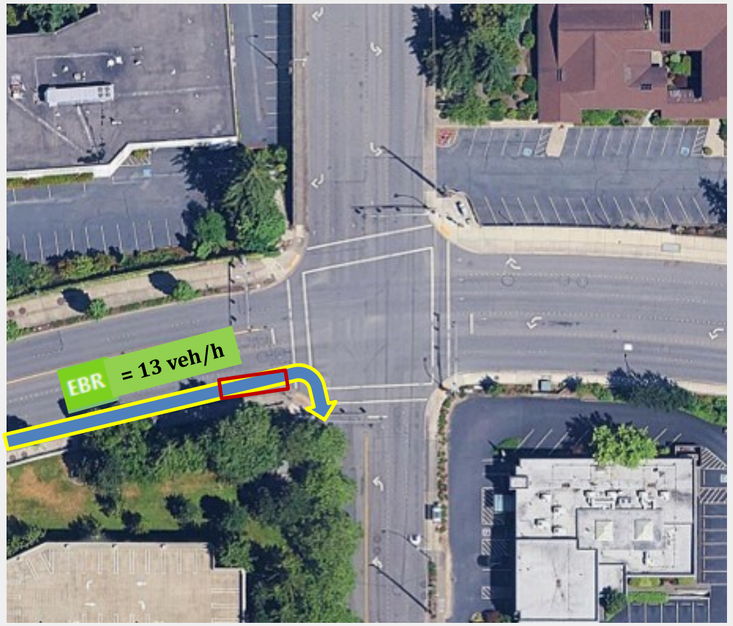


EBR (13 veh/h) = f2 (13 veh/h)

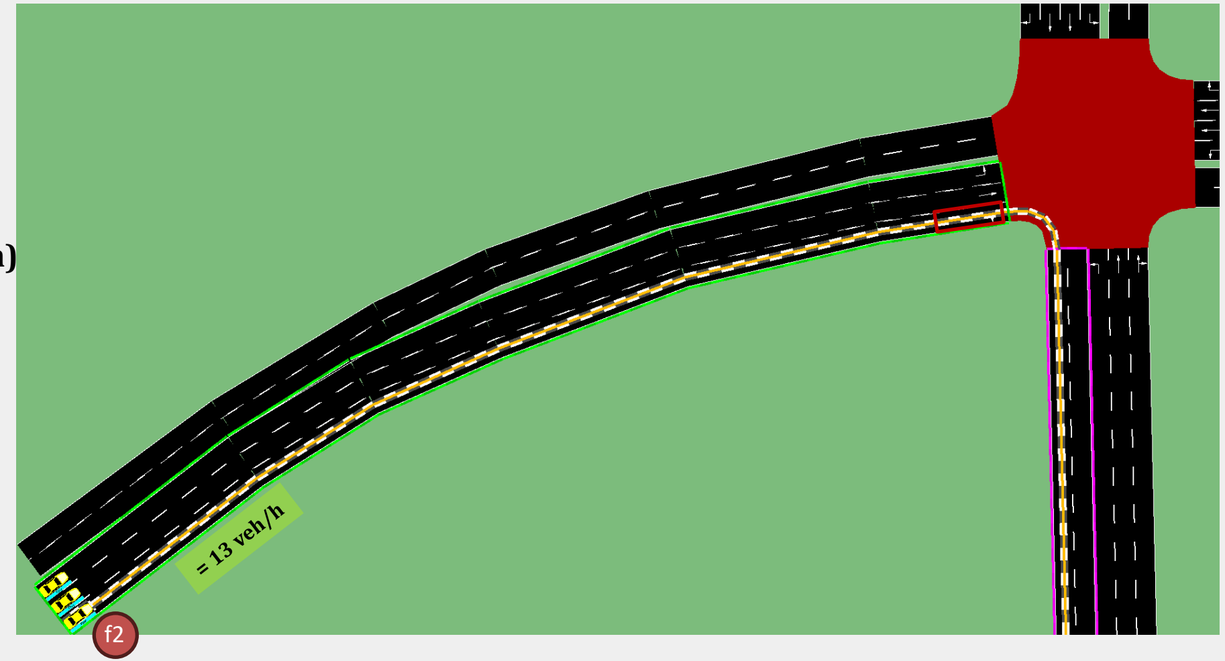


4.1. Traffic Volume Calibration using GEH

- In the real world (video), we observe traffic volumes for each movement at a measurement point (camera/detector near the intersection, red box).
- In simulation, we measure traffic volumes for each movement at the same location (virtual detector in the same red box).
- Calibration goal: adjust what we set in simulation so the measured traffic volumes (red box) match the observed traffic volumes for each movement.
- We quantify the match using the GEH statistic (lower GEH = better agreement).



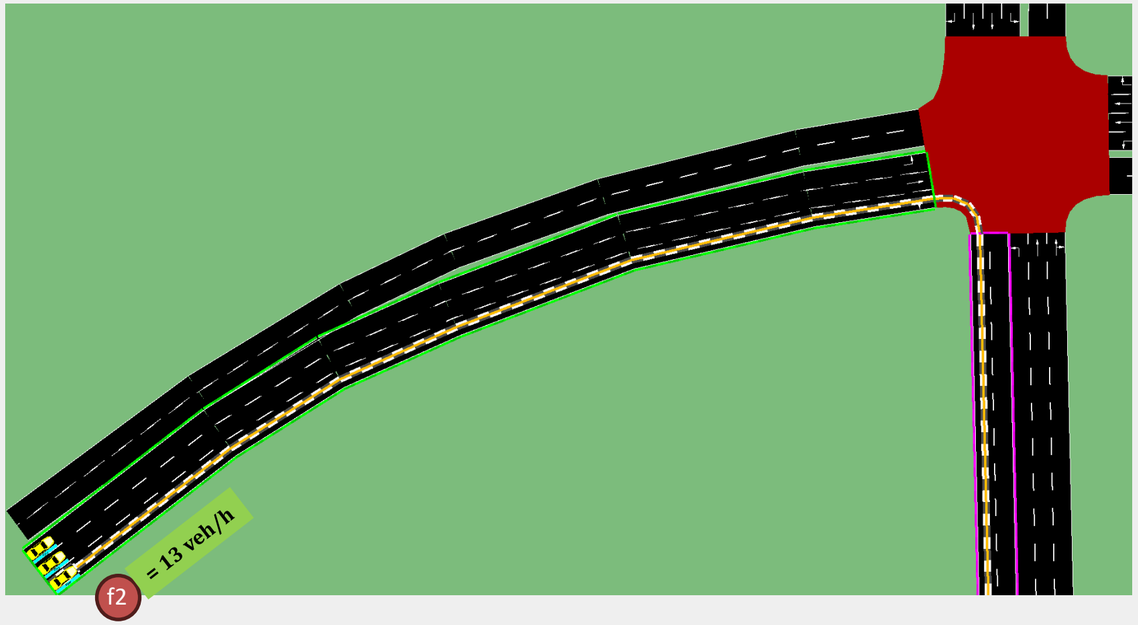
EBR (13 veh/h) = f2 (13 veh/h)



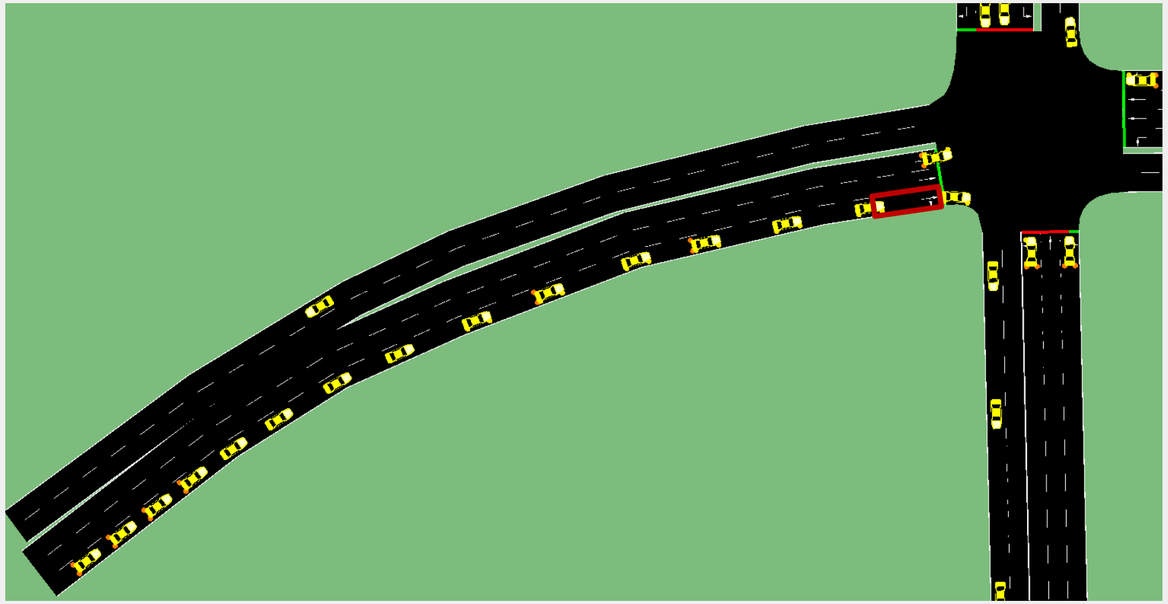
4.1. Traffic Volume Calibration using GEH

- ❑ The input traffic demand is not always the same as the traffic demand that arrives the intersection.
- ❑ **Reason:** Because congestion can block vehicles, the “requested” traffic demand ≠ the “observed” traffic demand at the intersection.

Input Traffic Demand: We set f2 = 13 veh/h in SUMO.



Measured Traffic Demand (At Red Box): Only 9 veh/h is observed at the measurement point because queues limit how many vehicles can enter and reach the intersection.



4.1. Traffic Volume Calibration using GEH

❑ We do not expect simulated and real-world traffic volumes for each movement to match exactly.

GEH Formula: $$GEH = \sqrt{\frac{2(M-C)}{M+C}}$$

$M = Simulated\ Traffic\ Volume\ (veh/h)$

$C = Observed\ Traffic\ Volume\ (veh/h)$

Interpretation:

$GEH < 5$	$Good\ match$
$5 \leq GEH < 10$	$Needs\ investigation$
$10 \leq GEH$	$Likely\ mismatch\ (check\ data, mapping, or\ model\ settings)$

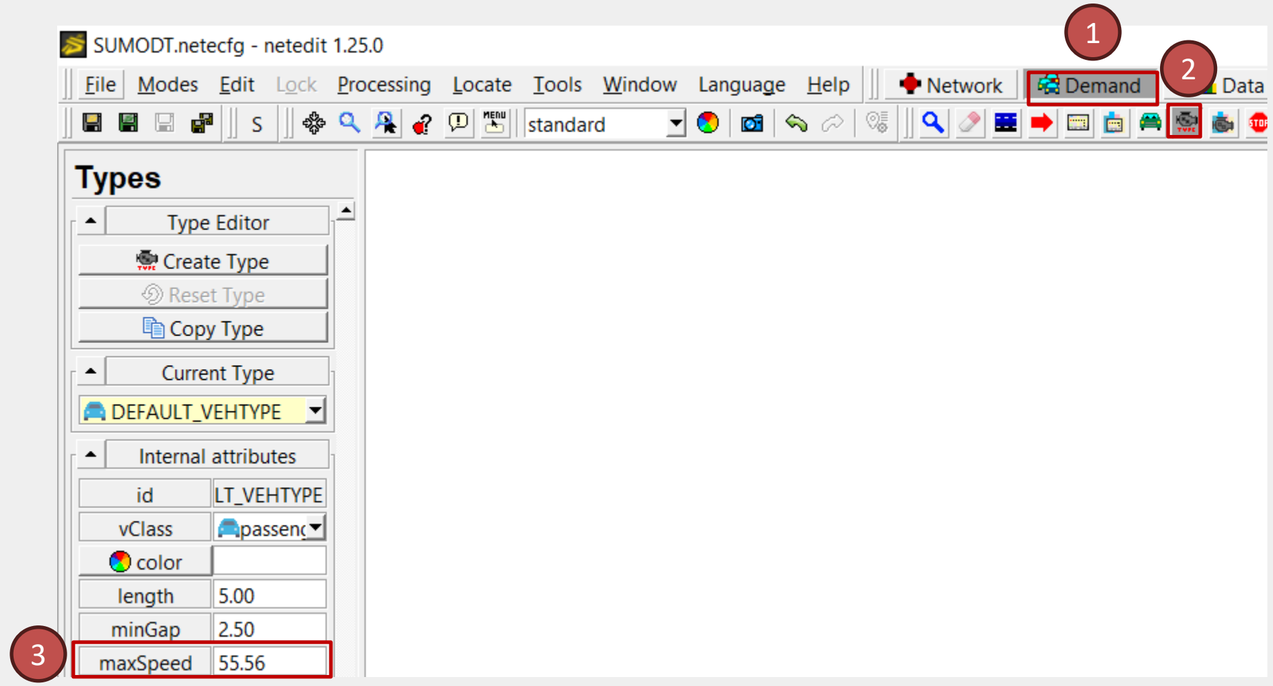
❑ Compute GEH for each traffic movement separately.

❑ Aim for GEH < 5 for at least ~ 85% of traffic movements

5. Traffic Speed Calibration

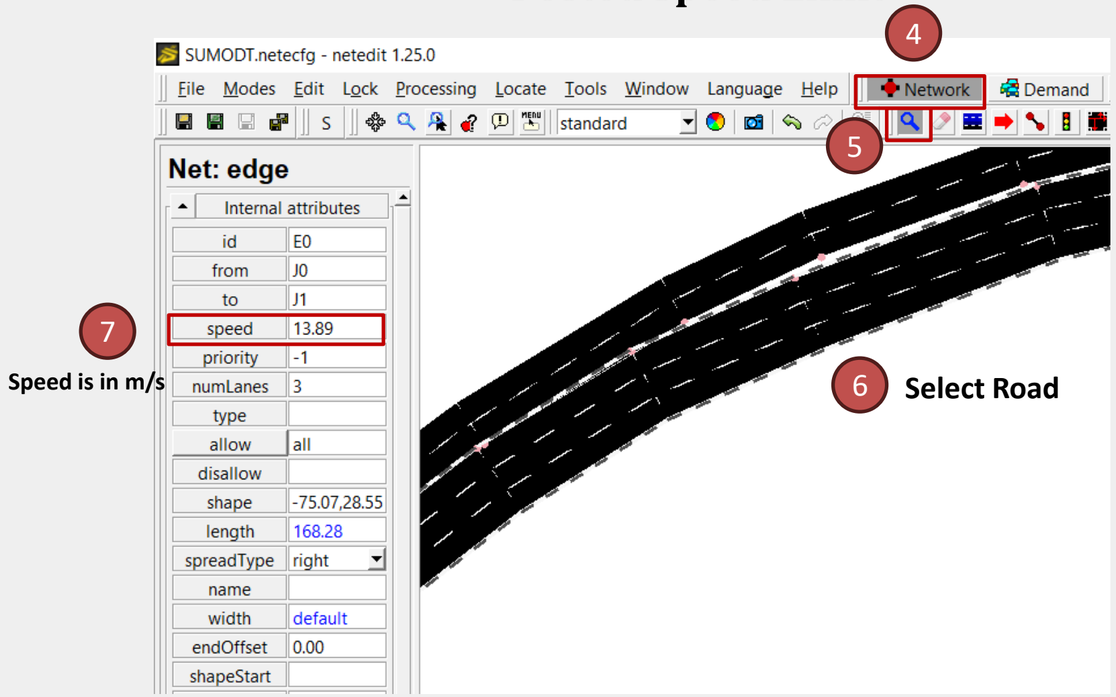
- ❑ In SUMO, Traffic Speed is defined based on Vehicle Type and Posted Speed Limit In Roads
- ❑ Check posted speed limit in Real-World and adjust the value of posted speed limit
- ❑ If we have vehicle speed for the entire link (not just nearby intersection), then we can adjust the speed values of Vehicle Type

Vehicle Type



Speed is in m/s

Posted Speed Limit

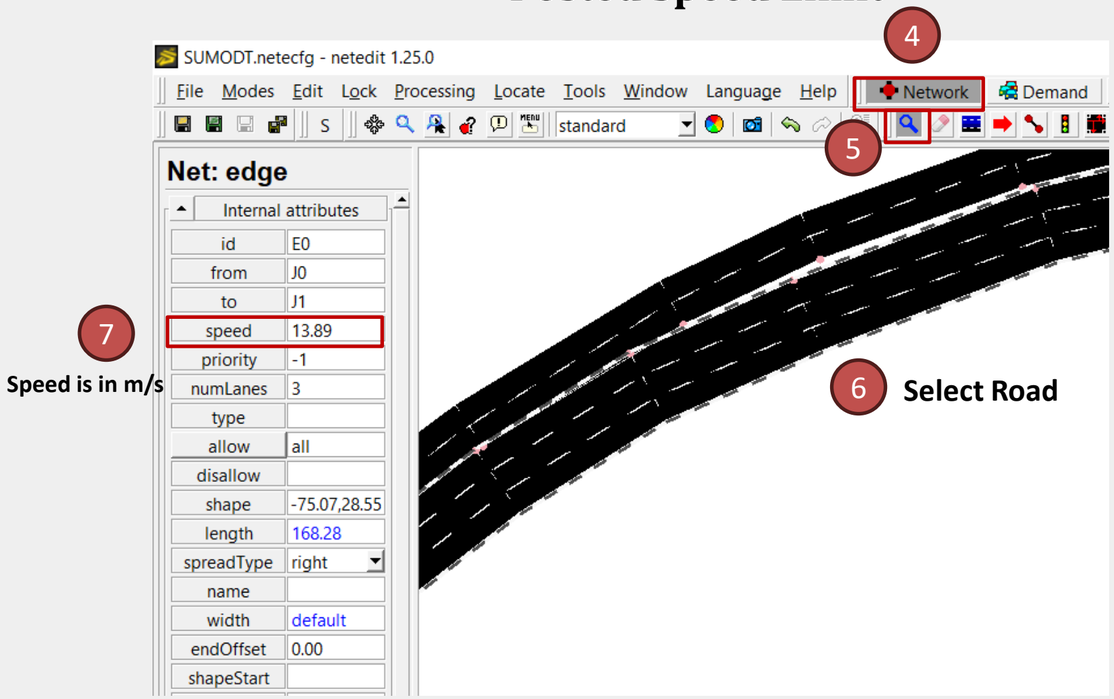


Speed is in m/s

5. Traffic Speed Calibration

❑ For this course, we only adjust value of posted speed limits since we do not have traffic speed for the entire road.

Posted Speed Limit



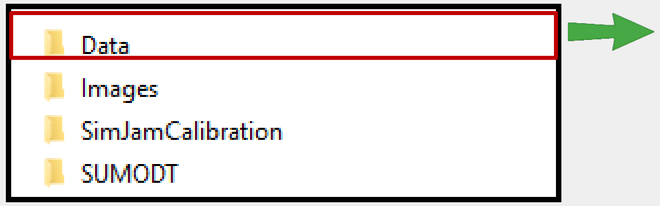
In-Class Deliverable

Download Required Materials

1. Download Required Materials

2. Extract the Zip File

3. It has below structure:



15-Min Observed Data.csv

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Minute	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	All	30	143	19	22	154	24	20	100	21	24	129	25

Interval Observed Data.csv

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Minute	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	1	2	15	1	1	10	2	1	6	1	1	6	1
3	2	3	16	1	1	11	2	1	4	1	1	7	2
4	3	1	9	1	2	9	1	1	5	3	2	8	1
5	4	2	4	1	3	8	2	1	4	1	3	8	2
6	5	3	13	1	1	10	1	2	7	3	2	6	2
7	6	1	12	2	2	12	2	2	10	1	1	12	2
8	7	2	7	1	2	13	1	1	8	1	2	8	2
9	8	3	9	1	1	11	2	2	8	1	1	5	1
10	9	2	5	2	1	10	2	1	6	1	2	10	2
11	10	1	1	2	1	11	2	1	8	1	2	11	1
12	11	2	10	2	1	9	1	2	6	1	1	8	3
13	12	2	11	1	1	12	2	1	8	1	1	12	2
14	13	3	5	1	1	10	1	2	6	3	2	10	2
15	14	1	14	1	2	8	2	1	7	1	1	9	1
16	15	2	12	1	2	10	1	1	7	1	2	9	1

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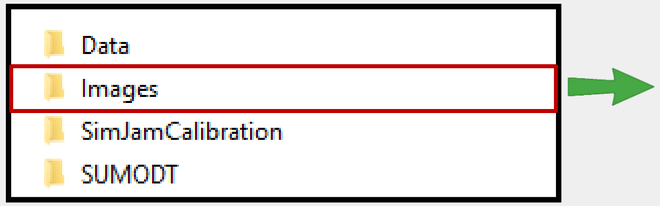
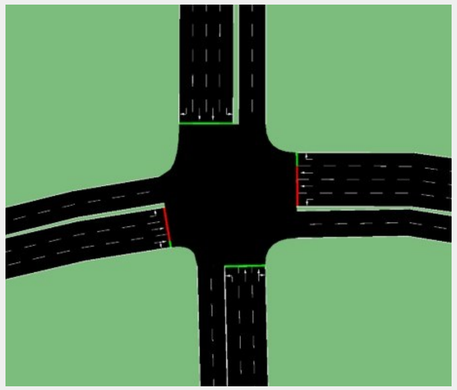


Real-World.jpg

SUMO.jpg



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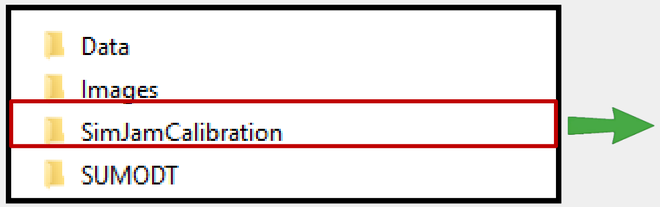
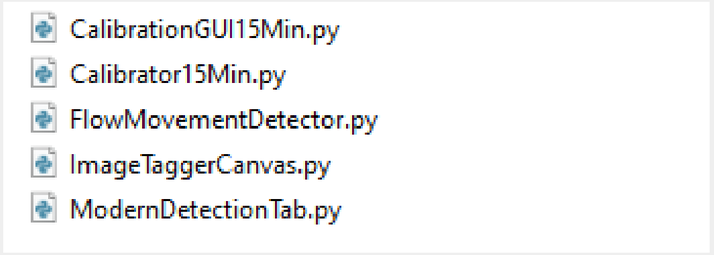


Application



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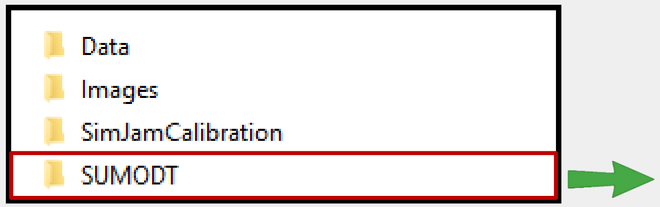
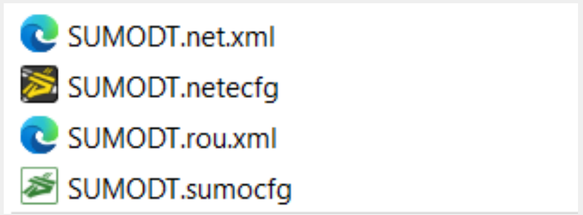


SUMO Files



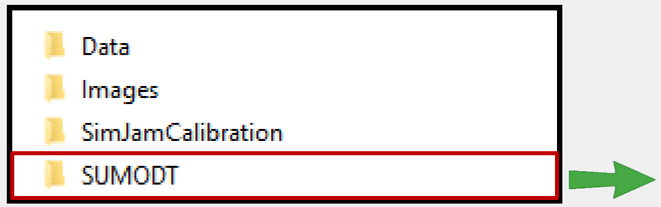
Step 1. Road Network Development & Traffic Signal Timing

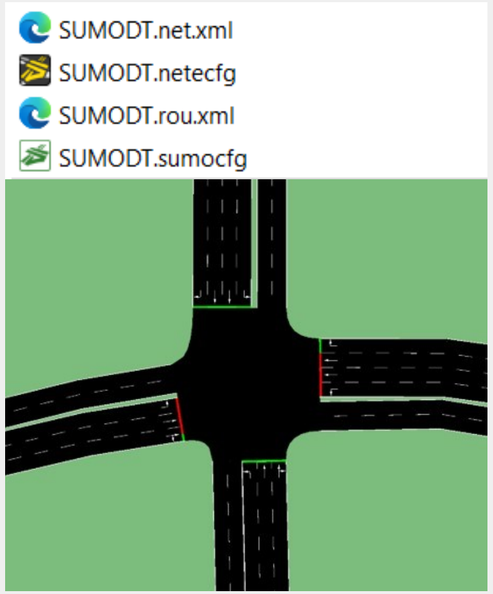
1. In Required Materials

2. Open Folder “SUMODT”

3. For this course, we already provide Road Network Development

& Traffic Signal Timing





Step 2. Traffic Movement & Volume Calibration

1. Folder “Data” → Open 15-Min Observed Data.csv

2. Find EBR and write EBR on top of real-world image with observed traffic volume for 15 min (Do this in a Powerpoint Slide)

See next slide for one example.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Minute	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	All	30	143	19	22	154	24	20	100	21	24	129	25
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16													

Step 2. Traffic Movement and Volume Calibration

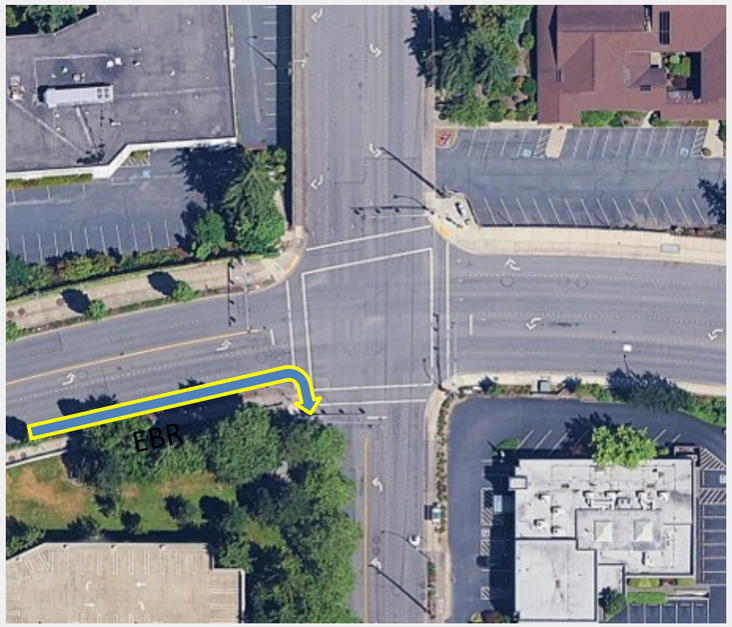
Example:

3. Open Folder “Images” → Copy and paste real-world image to a Powerpoint slide

4. In Powerpoint → Home → Drawing

5. Use below arrows and draw traffic movement and volume

Draw arrow for each traffic movement



Step 2. Traffic Movement & Volume Calibration

6. Folder “Data” → Open 15-Min Observed Data.csv

7. Find EBR and write EBR on top of real-world image with observed traffic volume for 15 min using a text Box

8. Use “Fill Shape” to give background color to text box

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Minute	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	All	30	143	19	22	154	24	20	100	21	24	129	25
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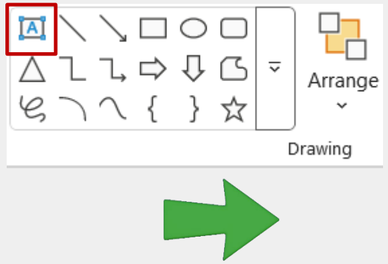

Step 2. Traffic Movement and Volume Calibration

9. Repeat the same process for all other traffic movement and volume

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Minute	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	All	30	143	19	22	154	24	20	100	21	24	129	25
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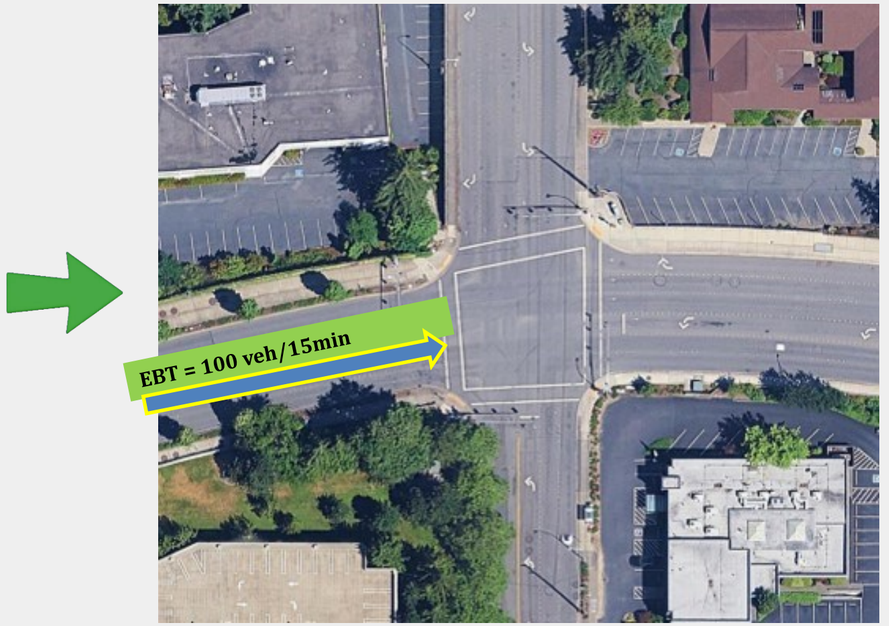

Step 2. Traffic Movement and Volume Calibration

10. Submit the deliverables to course website