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1. Introduction

This project investigates how different signal timings (70s, 90s, and 110s) and signal control modes (fixed vs. actuated) affect traffic congestion at a 4-way intersection. The study includes three traffic scenarios:

- **AM Peak** (high inbound traffic)
- **PM Peak** (high outbound traffic)
- **Off-Peak/Low Traffic**

2. Methodology (all data attatched to the csv file)

1. **Map Selection**:
    a. Downloaded a 4-way intersection from OpenStreetMap (OSM).
2. **Simulation Setup**:
    a. Ran SUMO simulations for each signal timing (70s, 90s, 110s) and traffic scenario (AM, PM, Low).
    b. Repeated the simulations with **actuated signals**.
3. **Data Collection**:
    a. Measured **Average Flow Rate** (vehicles/hour).
    b. Measured **Average Inter-Vehicular Distance** (from the other collected data).
    c. Measured **Vehicular Density** (vehicles/km).

3. Results & Discussion

3.1 Fixed Cycle Timings

We tested **70s**, **90s** (baseline), and **110s** cycles under AM, PM, and low traffic conditions. The table is attached as an excel file to this assignment.

Observations:

- **70s cycle**: Higher flow rates during AM/PM peaks but slightly denser traffic.
- **110s cycle**: Lower flow rates (more red-light waiting) but slightly increased average spacing.

Conclusion: Shorter cycles (70s) can improve throughput but may lead to denser queues at certain times. Longer cycles (110s) reduce intersection stops for some vehicles but can hurt overall flow during heavy traffic.

3.2 Actuated Signals

Next, we replaced the fixed cycles with **actuated signals**, which adapt to traffic conditions in real time.

Answer to Question:

“Did signal articulation increase or decrease congestion?”

- **Increase in throughput**: We observed higher flow rates compared to the 90s fixed cycle.
- **Slight decrease in average inter-vehicular distance**: But overall, congestion levels (queue lengths) were shorter since actuated signals clear queues more efficiently when demand is high.

Hence, **actuated signals decreased congestion** in most scenarios.

Final Remarks

This study highlights how signal timing strategies (fixed vs. actuated, short vs. long cycles, synchronized vs. unsynchronized) significantly impact traffic flow. By **collecting and comparing** average flow rates, inter-vehicular distances, and densities across multiple

scenarios, we can **quantitatively** assess congestion and optimize signal settings for better throughput.