Practical Performance Indices to Enable Ranking of Signalized Corridors

Ketan Savla
University of Southern California
ksavla@usc.edu

Project Objective

To quantify practical performance indices for signalized corridors using low-resolution traffic data

Problem Statement

Develop algorithm to estimate traffic state (e.g., queue length) from loop detector and connected vehicle data; develop analytical expressions for performance metrics in terms of latent traffic state; verify the methodological framework on sample corridors.

Research Methodology

We extended existing algorithms for estimating latent traffic state from loop detector and connected vehicle to account for spill back effects. The traffic state estimates are input to adaptive traffic signal control algorithm which dynamically updates splits and offsets. Splits are determined based on the proportionally fair rule, and the offsets are set to maximize through-band while taking into consideration the shockwave effect. The algorithm is implemented for two signalized corridors (Fig 1) in PTV VISSIM and the output emission is measured and compared against the output of a regression-based model derived using output from EPA MOVES under the same input data.

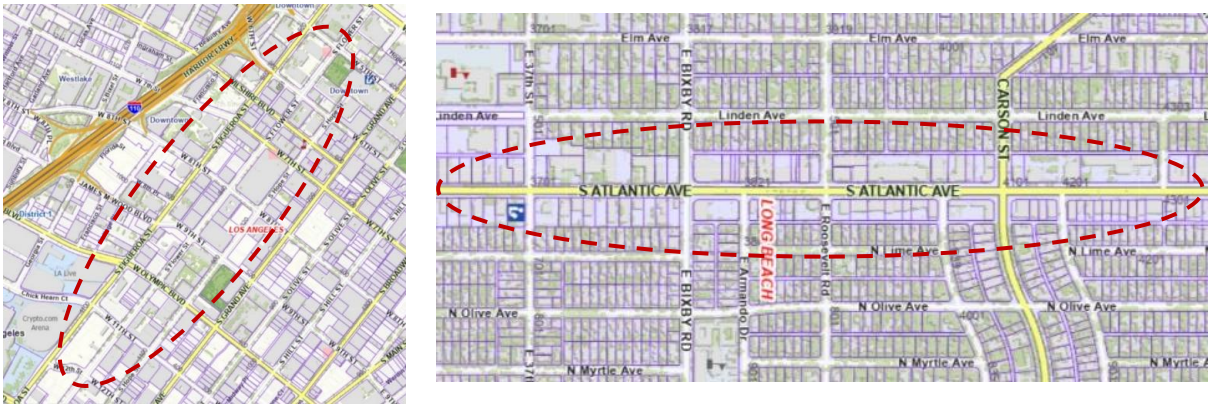

Figure 1: Signalized corridors used for illustration in downtown Los Angeles (left) and Long Beach (right)

Results

For the same traffic demand, the higher the penetration of connected vehicles (ϕ), the smaller is the error between the estimated and actual traffic queue length in PTV VISSIM. For the same ϕ, the higher the traffic demand, the smaller is the estimation error – see Fig 2 for illustration.

Linear regression for emission vs. volume yields perfect result, i.e., R-square value = 1. We conjecture that this is because PTV VISSIM internally uses a linear regression model for quantifying emissions.

However, the R-square value for linear regression using EPA MOVES was not perfect and depended on the input variables – see Fig 3.

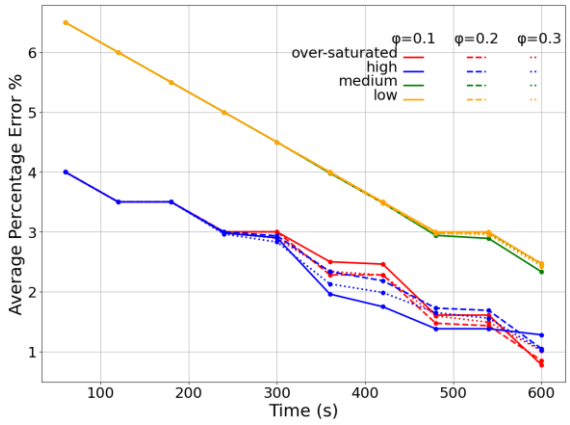

Figure 2: Traffic queue estimation error for different traffic demand and connected vehicle penetration rate.

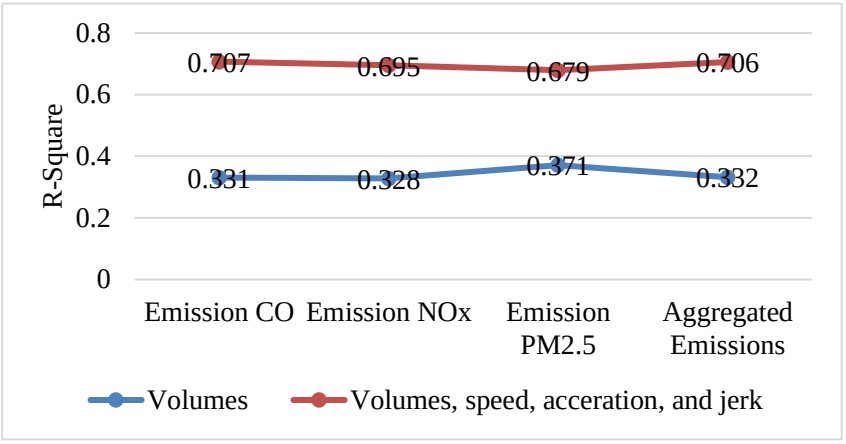

Figure 3: Linear regression results for the MOVES output data

The comparison in PTV VISSIM between fixed time traffic signal control and the proposed adaptive traffic signal control using low resolution data led to improvement in throughput on both corridors but had contrasting outcomes in terms of reduction in emissions. This indicates complex tradeoff between different performance metrics such as throughput and emissions – further research is needed to better understand this tradeoff.