Using artificial intelligence to improve traffic flows, with consideration of data privacy

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Project Objective

The quantitative and qualitative findings in this study inform a series of recommendations that research teams can follow to implement real-world test labs at busy truck intersections while fostering public trust, installing these modelling and prediction systems, and ensuring the overall safety and efficiency of the intersection's traffic flow.

Problem Statement

The study creates a method for accurately modeling and measuring the control delay of an intersection. If an intersection can be modeled accurately, it is easier to simulate different traffic scenarios and, thus, identify factors affecting delay and estimate traffic flow parameters. The project also explores residents' comfort levels and acceptance of smart technologies used for traffic modeling, given that they collect personally identifiable information.

Research Methodology

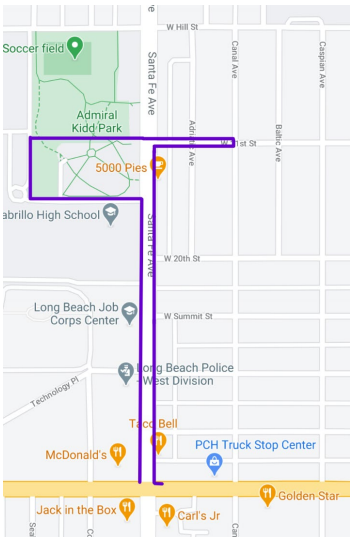
This study identifies nonlinear, time-varying mapping between the inputs to the ANN and its output, the predicted delay. The inputs to the ANN are the measured traffic flows, as well as the status of the current traffic lights. To build and verify the accuracy of the delay predictor, we identified a Long Beach intersection with significant heavy-truck penetration. We measured traffic data from this intersection on multiple days and at various times—including traffic flow information regarding passenger vehicles and heavy trucks and timing of traffic lights—in conjunction with the geometry of the intersection. The traffic data measured are used to build a realistic simulation in Vissim, a microscopic traffic flow simulator. We designed and performed experiments on the developed Vissim model to train the ANN delay predictor and validate the generalization ability of the predictor.

We also recognized that smart technologies often collect personally identifiable information, and steps should be taken to ensure these platforms avoid violating personal privacy. We designed a 40-minute community "datawalk" that encompassed a mix of residential streets, a commercial corridor lined with restaurants and stores, a police station, a public high school, an industrial block, and a city park in West Long Beach. Along the route, study participants walked by traffic cameras, Internet-connected bus kiosks, public WiFi and residential security cameras.

Ultimately, the Vissim simulation model was developed to calculate the control delay at the intersection where there are not enough sensors to measure all traffic data on site. We also described how the Vissim model can be finely calibrated to model the traffic flow at the intersection. Simulation results showed that, by carefully calibrating the simulation model, we

were able to make the Vissim model follow the real-world traffic closely. Another take away from this experiment is that to fully compare the real-world data and the Vissim simulation we need large amounts of data. Data from many different days and times are needed to better capture the dynamics of traffic flow and further improve the Vissim model.

The community datawalks conducted for this project heightened participants' awareness of data-gathering technologies in their built environment. During conversations with the study facilitator, participants said the experience boosted their knowledge regarding the types of platforms and devices that routinely collect personally identifiable information. Similarly, participants said the community datawalks revealed the ubiquitous nature of smart technologies deployed by both the City and private entities. Significantly, participants voiced concerns that these smart technologies can violate data privacy rights. This sentiment is exemplified by comments such as, "I do not like people having videos/pictures of me. Who knows what they do with that [data]." This finding suggests a clear need for the City of Long Beach to develop policies that provide transparency and accountability surrounding the deployment of devices and platforms that collect personally identifiable information.



Map of data walk route.

Furthermore, many participants recognized the potential for law enforcement technologies to disproportionately impact people of color and low-income communities due to long-standing tensions between residents and the Long Beach Police Department. These findings strongly suggest that, as cities deploy intelligent infrastructure, they must put equal effort into fostering trust, practicing transparency, and engaging the public.