

Research Title:

Evaluating the safety of signalized intersections by methods of video analytics

Primary Investigator:

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Numerous studies of driver behavior focused on signalized intersections. New technologies provide exciting opportunities to enhance understanding of this issue, utilizing data at an unprecedented scale. In particular, when the operation of traffic signals is based on video analytics, trajectory data of all vehicles can be collected continuously and provide a vast basis for a thorough evaluation. The research discussed here relies on approximately ten weeks of data containing 21 million vehicle trajectories obtained by video analytics at 29 approaches in 10 intersections.

This research examined the feasibility of using such trajectory data for three purposes: 1. Study of the yellow light dilemma, i.e. drivers decision whether to cross or not as the green light ends; 2. Deceleration profile analysis of first-to-stop vehicles at a signalized intersection; and 3. Saturation flow rates at signalized intersections.

The results regarding yellow light dilemma show substantial variation between approaches. For vehicles approaching at 15 m/s during daytime, the distance with 50% stopping probability varies from 40 m to 70 m, and the distance gap between 10% and 90% stopping probability varies from 15 meters to 50 meters.

The evaluation of the first-to-stop vehicles considered 33,480 trajectories. Only ~1% of the vehicles decelerate at a constant rate, and more than 80% change their deceleration rate at least twice. In fact, in many cases the first reaction of vehicles when the yellow ends is to accelerate. Differences were observed between day and night time, as well as between intersection approaches.

Saturation flow analysis relied on 32,500 vehicle sequences, containing 324,000 vehicles. We found a wide range of saturation flows, from 1230 to 1690 vehicles per hour of green per lane. Average reaction time ranged from 1.42 to 2.051 seconds for straight and right-turn directions, and 2.199 to 2.756 seconds for left-turn and straight-only directions.

These findings suggest that traditional guidelines for traffic signal timing should be reconsidered, taking into account the potential of customization per intersection, and the opportunities to improve traffic safety at signalized intersections.