RELATING SHOCKWAVE AND TIME USING MICROSCOPIC ANALYSIS

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From the trajectories we define flow variables such as speed, deceleration, shockwave, and reaction times. Especially for shockwave, time we provide distribution fitting results for the delivered datasets. Finally, a rational relationship between shockwave propagation speed and time headway is presented, where the numerator is a polynomial.

Key words: *traffic safety, microscopic analysis, shockwave propagation speed, time headway, incident precursor*

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The increasing frequency with which they occur, as well as the resulting time loss and cost, indicate the need for intelligent methods to reduce their number. Intelligent anticipatory methods addressing this need are preferable to costly driver warning systems.

BACKGROUND

Shockwave creation and time have been the subject of a rich literature in macroscopic and microscopic modeling. Crashes and near-crashes studies have included work on car-following models and safety analysis.

Shockwaves

The theory of traffic shockwaves was proposed by Lighthill and Whitham (1955) and has been used in the analysis of bottlenecks and traffic incidents such as accidents, red signal light violation and slow vehicles (e.g. Eddie, 1975).

$$\text{SPS} = \frac{[illegible]}{[illegible]} \qquad (1)$$

where Q1, Q2 denote the volume of traffic states 1 and 2, and K1, K2 represent density of traffic associated with traffic states 1 and 2 respectively.

Figure 1. Data collection site: a high crash-rate freeway section of Interstate-94 WB

Skabardonis et al (2007) numerically estimated the propagation speed of shockwaves on highways based on vehicle trajectory data. For any two consecutive vehicles,

$$t^{(j+1)}_{ki} > t^{(j)}_{ki} \qquad (2)$$

$$y_{j+1}\,(t^{(j+1)}_{ki}) < y_j\,(t^{(j)}_{ki}) \qquad (3)$$

SPS $V_j^{(i)}$ was estimated as:

$$V_j^{(i)}=[y_{j+1}\,(t^{(j+1)}_{ki})-\,y_j\,(t^{(j)}_{ki})]/[\,t^{(j+1)}_{ki}\ \text{ï}\ \ t^{(j)}_{ki}] \quad <0 \qquad (4)$$

where,

j - vehicle or trajectory index (each vehicle corresponds to a trajectory) in a consecutive order; two vehicles are consecutive when vehicle j +1 is behind vehicle j, both in the same lane;

Even though most car-following models can reproduce driver behavior within a platoon (Herman, 1959), their usual assumption that all drivers have rear-end collisions.

[illegible]

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