

Forecasting the Impact of Traffic Events on Road Networks



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Introduction

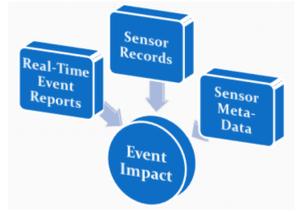
- **Motivation:** According to the annual transportation report [1], approximately 50% of freeway congestion is caused by non-recurring issues, such as traffic incidents, weather, special events.
- To avoid such congestions, we aim to predict the impact of events. The predicted result can be either used by a driver directly to avoid potential gridlocks or consumed by a smart route-planning algorithm.



Event Impact Prediction

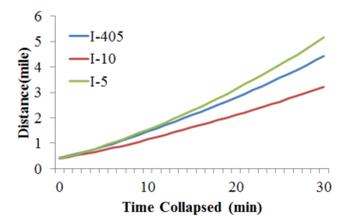
Problem Definition (Propagation phase)

- + Given an event just happened, what is the impacted distance (with speed decrease no less than $\Delta v\%$) in the next t minutes?
 (Input: Event reports, sensor readings Output: behavior vector)



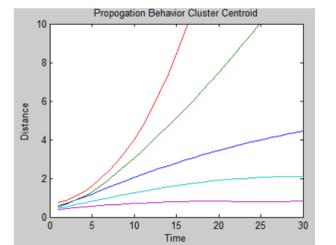
Proposed Solutions & Sample Training Result

- + Opt 1: matching Event Attributes with previous event (**EA**)
 - 1) retrieve current event attribute(s) (e.g., location represented by freeway name)
 - 2) find historical events with same attributes
 - 3) use their corresponding behavior vector for prediction



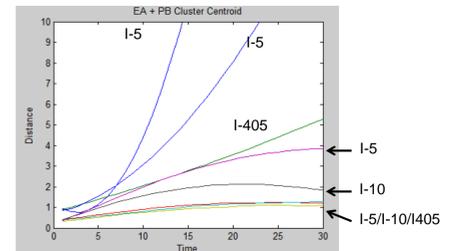
Opt 2: matching the first 5-min Propagation Behavior (**PB**)

- 1) cluster the behavior vector from all historical events
- 2) get the first 5-min propagation behavior from current event
- 3) use the closest cluster centroid for prediction



Opt 3: matching both attributes and 5-min behavior (**EA+PB**)

- 1) Cluster based on both behavior vector and event attributes
- 2) & 3) same with option 2.



Note: the training result is based on events and sensor data collected in 06/2012

Case Study

Sample Traffic Collision Event

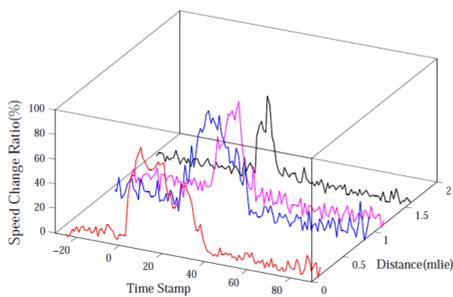
- + Location: I-5 S. at Colorado Blvd.
- + Time: 10/30/2012(Tue) 3:00 PM



Impact Measurement:

- + Speed Change Ratio:

$$\Delta v = \frac{avg(v_t) - v_t}{avg(v_t)} * 100\%$$

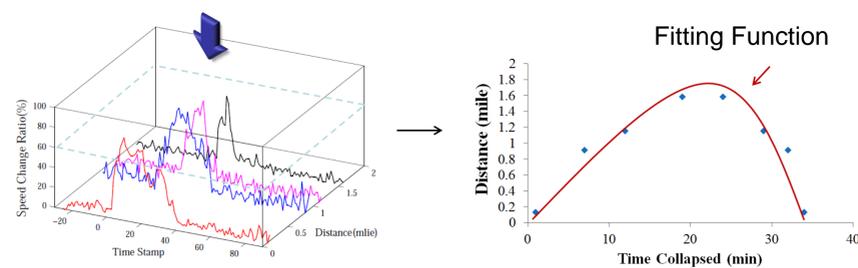


Observations:

- + further from event location later the speed decrease
- + further from event location shorter the impact period

Event Propagation Modeling

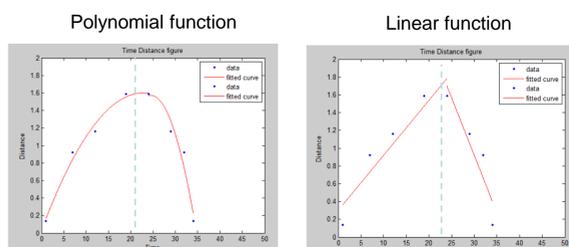
Project the propagation from 3D to 2D (fix the speed decrease)



Piecewise fitting (propagation phase, clearance phase)

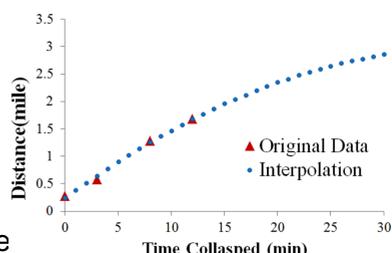
$$g = \begin{cases} h_1(x) & x \leq t_0 \\ h_2(x) & x > t_0 \end{cases}$$

- $h_1(x)$: propagation phase
- $h_2(x)$: clearance phase



Behavior Model Construction

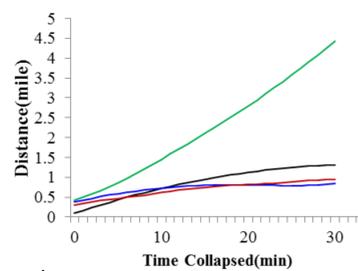
In Propagation phase:
 Behavior Vector (d_i) is defined as
 $\langle d_0, d_1, \dots, d_{30} \rangle$
 for the first 30-minute propagation



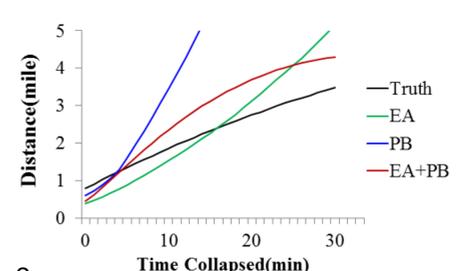
The fitting function is used to interpolate

Prediction Result on traffic collision events

- + Case 1: 07/02/2012 (Mon) 15:20 / on I-405 North at West LA
- + Case 2: 07/07/2012 (Sat) 18:19 / on I-5 South at Central LA



Case 1



Case 2

Related Research

- Predicting accumulative delays and impact region for traffic incidents with fixed thresholds
- Predicting a single clearance time for traffic accidents

Future Work and Reference

- Include more event attributes for the propagation behavior prediction
- Model and prediction events' clearance behavior

[1] FASANA MOTION,
http://www.metro.net/board/Items/2012/03_March/20120322RBMItem57.pdf