THE SECOND STRATEGIC HIGHWAY RESEARCH PROGRAM PRODUCT IMPLEMENTATION AND TESTING IN MARYLAND: ESTABLISHING MONITORING PROGRAMS FOR MOBILITY AND TRAVEL TIME RELIABILITY

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Abstract

This study aims to develop an efficient algorithm to measure travel time reliability along a corridor, using real-world data, different congestion, incident, and weather operating conditions. Three types of incidents are studied: crash, disabled-vehicle, and work-zone. The only weather condition evaluated is precipitation. The developed algorithm is a variation of the Travel Time Reliability Monitoring System (TTRMS) developed within the Strategic Highway Research Program (SHRP 2), project L62. It employs a new approach to generate a more diverse set of corridor travel time reliability scenarios and produces Cumulative Distribution Function (CDF) of travel times under each scenario. It also estimates a contribution score for each single congestion, incident, and weather operating condition, which quantifies the extent of their contribution to the travel time reliability performance of the corridor. The scores are then used to provide reliability bars aimed at decomposing the reliability in corridor travel times into its three contributors. The developed algorithm was applied on a number of sub-corridors along I-95 corridor in Maryland for the calendar year 2015. Corridors were then used as the number one contributors to travel time reliability in 75% of the sub-corridors. The results revealed that, on average, crash, precipitation and disabled-vehicle contributed respectively 45%, 15%, and 10% to the travel time reliability along the north-bound sub-corridors. On the south-bound sub-corridors, crashes and precipitation contributed, on average, 34% and 25% of travel time reliability and the rest was distributed uniformly among disabled-vehicle, work-zone and high congestion.

Methodology

Data Processing:
- Traffic Data: For each TMC along a corridor of interest, VPP speed data were accessed and downloaded with a resolution of one minute, resulting in 52,000 seconds for one calendar year and interpolation techniques were used to deal with missing values.
- Incident Data: Incidents were matched to TMCs based on their recorded latitude and longitude. The date, time, and duration of the incidents were used to log the VPP data for each TMC with the corresponding events occurred at any time of recording.
- Weather Data: Weather data for each TMC was downloaded from weather stations’ historical databases based on TMC zip codes. If historical weather data was missing for any of the weather stations for a period of time, the weather data from adjacent station was used.

Travel Time Estimation:
\[ TT_{	ext{corridor}} = TT_{	ext{base}} + \frac{TT_{	ext{incidents}}}{TT_{	ext{base}} + TT_{	ext{weather}} + TT_{	ext{traffic}}} \]
where, \( TT_{\text{incidents}} \) = travel time along the corridor at time \( t \)
\( TT_{\text{base}} = \text{travel time of TMC at time} \)

Scenario Generation:
- Scenario clustering technique was used to generate scenarios.

Congestion Level:
- Low
- Moderate
- High
- Uncongested

Weather:
- Temperature
- Precipitation

Significance of Study:
- Use of real world data for evaluating travel time reliability.
- Development of a new algorithm capable of identifying the Contribution of Travel Time under a comprehensive set of weather, incident, and congestion scenarios.
- Development of a new defined Score aimed at quantifying the contribution of different weather, incident and congestion operating conditions to travel time reliability.
- Development of Reliability bars aimed at decomposing variability in travel time to its root causes.

Data

Traffic Data was accessed and downloaded from RITS Vehicle Probe Project (VPP) database for the list of TMCs along I-95 corridor for the years 2014 and 2015.

Incident Data was accessed and downloaded from RITS incident database for the years 2014 and 2015 along I-95 corridor and contains information on the corresponding events occurred at any time of recording. The location of the incident (latitude and longitude), and Date, time and duration of the incident.

The historical weather data was accessed from Weather Underground website for the years 2014 and 2015 along I-95 corridor and contains information on weather condition such as temperature, wind speed and precipitation.

Conclusion

In overall, the developed algorithm provided a platform for the end users to first answers to the below questions:
- What is the CDF of travel time in the system under different combinations of congestion, incident and weather operating conditions?
- How to rank the contribution of travel time reliability in terms of the extent of their contribution?
- What are the top three contributors to travel time reliability along a corridor over different time periods?
- How effective are operational improvement actions in reducing the contribution of top three travel time reliability contributors resulting in more reliable travel times?

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