

# Improved Algorithm for Estimating Incident Impacts on Freeway Capacity

STRIDE Project I: Freeway Management for Optimal Reliability

## PROJECT OVERVIEW

Ensuring that people consistently arrive at their destinations on time—called travel time reliability—is a key goal of traffic management. Incidents, such as accidents, can cause delays because fewer cars move along the road (i.e., capacity). Predicting the congestion of the road during an incident can be challenging because the capacity may change over time. For example, delays are greatest right after an incident occurs. Congestion can then improve as the incident is being managed.

Engineers use models from the 6<sup>th</sup> edition of the Highway Capacity Manual (HCM6) and the freeway analysis tool, FREEVAL, to analyze conditions and ensure optimal reliability on freeways. However, the current model for measuring the impact of an incident—called the incident Capacity Adjustment Factor (CAF)—focuses only on a fixed number of available open lanes throughout the incident and does not consider that road capacity may change over time.

## RESEARCH GOALS

The research goal was to develop a new model that considers how incidents may affect freeway capacity differently over time from inception to clearance, and to verify current HCM6 normal freeway segment capacity estimates.

## FINDINGS

The research team developed a model that accounts for a change in capacity in the area that is affected by the incident. The method was calibrated using actual incident data from a freeway in Raleigh, NC.

The team also applied the time-dependent method to recurring congestion periods (e.g., rush hour traffic), and estimated that the current HCM freeway capacities are slightly overestimated by about 7 to 9%. The testing and calibration of this method was conducted on the FREEVAL model used in HCM6.

## PRODUCT

The **Freeway Time-Dependent Incident Capacity Model** provides a more accurate estimate of how incidents, such as accidents, impact congestion on freeways.

## IMPACTS

Under the MAP-21 reliability rule making provision, the Federal Highway Administration (FHWA) mandates the use of reliability measures of effectiveness for project prioritization purposes.

The new model will provide an improved prediction of freeway incident impact on capacity and reliability, which will help inform future investments for freeway operations.

## WHO BENEFITS?

- State Departments of Transportation
- Metropolitan Planning Organizations
- Cities and Municipalities
- Researchers
- FHWA Operations Group

## RESEARCHER

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## PRODUCT DESCRIPTION

### Freeway Time-Dependent Incident Capacity Model

The Freeway Time-Dependent Incident Capacity Model uses a new algorithm that varies the Capacity Adjustment Factor (CAF) in 15-minute increments, allowing for a change in capacity over time. The algorithm is only applied to the segments of the freeway that are directly affected by the incident. The algorithm minimizes a speed error function, and is to be used in FREEVAL. An important advantage of the approach is the ability to now estimate the true incident impact duration as CAF begins to approach a value of 1.0.

Speed Contour Associated with	Time Interval	Time Dependent CAF used	Error Function Value	Seg. 13	Seg. 14	Seg. 15	Seg. 16
INRIX / or TARGET Speeds	9:15 - 9:30	NA	NA	53.0	21.0	21.0	44.5
	9:30 - 9:45	NA		22.2	8.8	8.8	37.9
	9:45 - 10:00	NA		10.9	8.2	8.2	36.1
	10:00 - 10:15	NA		17.7	12.2	12.2	38.0
	10:15 - 10:30	NA		48.3	34.5	34.5	49.1
Time Dependent CAF Note: mean CAF =0.488	9:15 - 9:30	0.10	4,712	63.9	26.5	6.3	1.2
	9:30 - 9:45	0.10		27.7	1.6	1.2	1.0
	9:45 - 10:00	0.62		4.8	8.0	9.9	9.0
	10:00 - 10:15	0.71		16.1	14.2	14.1	11.4
	10:15 - 10:30	0.91		43.6	39.0	32.9	23.3
FREEVAL - HCM CAF	9:15 - 9:30	0.49	15,781	63.9	70.0	65.7	17.3
	9:30 - 9:45	0.49		64.4	70.0	66.1	13.7
	9:45 - 10:00	0.49		64.4	70.0	66.2	23.6
	10:00 - 10:15	0.49		64.6	70.0	66.6	60.2
	10:15 - 10:30	0.49		64.9	70.0	66.7	69.9

Table 1: Comparison of the measured and estimated speeds at four segments on the freeway. The new Time-Dependent model (highlighted in yellow) estimates speeds closer to measured speeds than the current HCM CAF model.

For more information on Project I: Freeway Management for Optimal Reliability, visit the [STRIDE Project page](#).

## About STRIDE

The Southeastern Transportation Research, Innovation, Development & Education Center (STRIDE) is the 2016 Region 4 (Southeast) U.S. Department of Transportation University Transportation Center headquartered at the University of Florida Transportation Institute (UFTI).

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