ATDM Strategies for Reducing the Probability of Breakdown

By

Mohammed Hadi, FIU; Lily Elefteriadou, UF; Alexandra Kondyli, UF; Yan Xiao, FIU; Clark Letter, UF; and Ali Darroudi, FIU

April 4, 2013
Project Overview

• Collaborative effort between UF and FIU

• Ramp metering with considering of breakdown previously explored by UF team members, as part of NCHRP 3-87

• The goal of this project is to explore and assess methods to improve the operations at critical bottlenecks utilizing optimal combinations of ramp metering and VSL algorithms with consideration of the probability of breakdowns
Project Objectives

• Investigate the utilization of the flow breakdown probability concept to a ramp metering implementation that is based on the fuzzy logic algorithm

• Investigate the use of VSL by itself and in combinations with ramp metering to improve traffic conditions

• Examine the use of mobile connected vehicle technologies, possibly in combinations with infrastructure-based

• Develop methods for optimizing the parameters of the algorithms examined in this study

• Develop guidelines on the use of simulation models to assess and fine-tune ATDM strategies
What is Breakdown?

- Defined as the time of transition into (recurring) congestion
- Occurs at varying freeway/ramp flows
- Occurs at “critical” ramps, i.e., bottleneck locations
- Identified within a data set as an abrupt speed change
- Breakdown occurs at a different level of freeway and ramp demand each day.
Breakdown Identification

5 16 2005

Average Speed (km/h)
Total Volume (veh/h)

Time (1 min interval)
P(B) as a function of average downstream freeway occupancy

P(B) model for NW 103rd Str. bottleneck

- PLM curve
- Weibull curve
Enhancement 1: Initialization Threshold

- Current system uses time of day operation with the option for operator override
- Addition of an initialization threshold based on the historic probability of breakdown
Enhancement 2: Adjusting the Fuzzy Logic Algorithm
Utilization of Simulation

- The complexity of simulation modeling increases with the increase in congestion level and advanced strategy modeling.

- Data from ITS combined with data from other sources can be used for:
  - More cost-effective simulation model development
  - Better calibrated and validated models
I-95 Simulated Corridor

On-ramp from NW 103rd St

On-ramp from NW 81st St

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Calibration based on ITS Data

- Allows identification of the variation in congestion between days based on detector data
- How good is a model calibrated for a specific day perform when modeling a different day with different congestion level
  - Investigate calibration based on a median day and a heavy day
- Does calibration utilizing traditional measures allow the modeling of breakdown probabilities
  - Investigate if the use of different seed numbers produce the observed breakdown probability for the demand level
  - Examine the use of new attributes (based on breakdown and queuing) for calibrating simulation models
New Attributes for Calibration?

- Speed before breakdown (mph) and average Speed of breakdown (mph)
- Probability of breakdown
- Speed Reduction due to breakdown (mph)
- Starting time and duration (hr:min)
- Maximum pre-breakdown flow upstream and downstream of ramp (veh/hr/lane)
- Breakdown flow (veh/hr/lane)
- Queue discharge (veh/hr/lane)
- Recovery flow (veh/hr/lane)
Speed Contour Plot (9 Days)

5/12/2010

Median

6/10/2010

5/11/2010

Less Congestion

Mean

1/4/2010

More Congestion

4/1/2011
Congestion Index
(9 days from 3:30 pm – 5:00 pm)

\[ CI = \frac{1}{N} \sum_{i,t} \left| \frac{S_{i,t} - S_{FFS}}{S_{FFS}} \right| \quad \forall S_{i,t} < S_{FFS} \]
Real-World versus Simulation