Development of an Optimal Ramp Metering Control Strategy for I-12

*LSU Research Team*
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Outline

• Introduction
• Objectives
• Study area
• Methodology
• Data collection
• Model development and calibration
• Results and analysis
• Conclusions
Introduction

• First use in Louisiana on I-12 beginning June 2010 (Essen lane) and ending November 2010

• 16 ramp meters along I-12 between Essen Ln. and Walker/LA

• Operation: Fixed time (2 sec green/red), WB (6:00- 9:00 am), EB (3:00- 7:00 pm)

• Previous evaluation study did not show any improvements; construction and poor data quality

• This study presents a comprehensive evaluation of various adaptive ramp metering strategies
Main Objective

Identify the optimal ramp metering strategy (combination of strategies) for I-12 on-ramps with the objective of alleviating congestion and improving the operational characteristics of the corridor.
Study Area

Ramp meter locations
Methodology
Methodology

Data Collection

Geometric Data

Traffic Data

Build Simulation Model

Current Ramp Metering Strategy Coding

Model Calibration

Test the Different Ramp Metering Strategies

Comparative Analysis & Evaluation

Selection of the Optimal strategy
Selected Ramp Metering Strategies

1. Fixed Time Strategy (current implementation)

2. ALINEA Local Ramp Metering Strategy

3. HERO (Coordinated Ramp Metering Strategy)
Simulation Scenarios

- Fixed (Base Case)

- ALINEA

- Mixed (ALINEA + HERO)
Proposed Locations for different RM strategies
Measures of Performance (MOPs)

- Travel time
- Speed
- Vehicle Hours Traveled (VHT)
Performed Analysis

- **Corridor level analysis:**
  - ANOVA analysis - significant difference in the performance
  - Post-hoc (Tukey) analysis – best performing strategy

- **Section level analysis**
  - Post-hoc (Tukey) analysis – sections benefited the most from each strategy
Model Development and Calibration
Data Collection

1- Traffic Counts
   - ATMS software page

2- Travel Times
   - BlueTOAD data - Calibration
Simulation Model
Model Calibration

• Simulation model operates at conditions close to the actual conditions
  ▫ Fixed Time
  ▫ Queue Override

• Performance measures:
  1. Traffic flow
  2. Speed profiles
Model Calibration-Traffic Flow

For the Eastbound direction, the difference in volumes does not exceed 2.0%
Model Calibration-Traffic Flow (cont’d)

For the Westbound direction, the difference in volumes does not exceed 4.0%
Model Calibration-Speed

For the Eastbound direction, the speed difference does not exceed 14.0%
Model Calibration-Speed (cont’d)

For the Westbound direction, the speed difference does not exceed 15.0%
Results and Analysis
Simulation Results

- Output from 20 simulation runs.
- Three performance measures
  - Speed
  - Travel time
  - Vehicles hours travelled (VHT)
- Analysis performed on two different levels:
  - Corridor level analysis
  - Sectional level analysis
Speed

Corridor level analysis

- ANOVA test was performed to compare between the different strategies (at 5% level of significance)

- **Eastbound direction**, no statistically significant change in the operating speed was realized

- **Westbound direction**, analysis results show statistically significant change
Speed

Corridor level analysis

- **Westbound direction**, to determine the strategy with the lowest travel times, Post Hoc tests (Tukey) were performed

\[
p-\text{values for ANOVA pairwise comparison (level of significance, } \alpha=5\%)\]

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<thead>
<tr>
<th>Strategy</th>
<th>Fixed- Time</th>
<th>ALINEA</th>
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Speed

Section level analysis

Eastbound Direction

Westbound Direction
# Speed

**Section level analysis**: p-values for ANOVA pairwise comparison (at 5% significant level)

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<table>
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Eastbound Direction

- Free flowing with the fixed-time strategy; as result, no further improvements could be achieved

- Analysis results showed that the current demand on the eastbound direction can be controlled by the Fixed Time Control strategy
Westbound Direction

- ALINEA and mixed strategies showed significant improvements compared to the fixed-time control.

- Three main locations benefited the most from both strategies, (Range-O’neal, O’neal-Millerville and Millerville-Sherwood).

- Performance of the two strategies was compared, the mixed control was superior to ALINEA local control.

- **Mixed Strategy** is recommended for implementation.
Implementation Plan

A: ALINEA strategy
H: HERO strategy
F: Fixed strategy
ALINEA Implementation

- Downstream Traffic Conditions
- Queue Detection
- Vehicle Presence
HERO Implementation

- Downstream Traffic Conditions
- Queue & Arrival Rates
- Vehicle Presence
- Departure Rates
Thank You

LSU Research Team