# Performance-Based Operations Assessment of Adaptive Control Implementation in Des Moines, Iowa

tech transfer summary

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The Midwest Transportation Center (MTC) is a regional University Transportation Center (UTC). Iowa State University, through its Institute for Transportation (InTrans), is the MTC lead institution.

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> Arterial corridor performance measures developed using probe vehicle data can help transportation agencies select corridors in need of traffic signal retiming or well suited for adaptive signal control implementation.

## Objective

The main objective of this study was to present a methodology to compare arterial corridors in terms of mobility-based performance measures using probe data. This process can help transportation agencies select the corridors that are in need of traffic signal retiming and can also help identify corridors suited for adaptive signal control implementation.

## Problem Statement

Transportation agencies and the public face many challenges related to the operational performance of high-volume arterial corridors. Resource constraints limit the number and scope of retiming and other interventions by transportation agencies, and it can be difficult to achieve consensus about priorities when arterial corridors cross or straddle jurisdictional boundaries. Consequently, there is a large and growing need for objective performance metrics that agencies can use to prioritize their signal investments.

## Research Methodology

The research team used INRIX XD segment speed data to establish performance measures for identifying problematic segments on arterial corridors.

The two-step methodology identified the number of days in a year with abnormal traffic patterns and compared the volume-normalized performance of the remaining segments to identify corridors that are problematic on normal days. Where appropriate, anomalous days can be evaluated separately to identify the extent of the anomalies and potential interventions relevant to unusual situations, such as special events, severe traffic incidents, extreme weather, and construction.

These were the relevant performance metrics used in this project:

- Median travel rate (MTR)
- Within day variability (WDV)
- Minimum travel rate dispersion (MTD)
- Overall travel rate variability 1 (OTV_POLY)
- Overall travel rate variability 2 (OTV_LINEAR)

The analysis was further stratified based on the roadway's geometric characteristics, annual average daily traffic (AADT) per lane, intersection density, or similar criteria.

The methodology was used in a case study to evaluate a total of 13 arterial corridors: 12 in the Des Moines, Iowa, area and 1 in Omaha, Nebraska. Evaluation of the Des Moines corridors was carried out for the entire year of 2016, while the Omaha evaluation was based on data from June 2016 through November 2016.

In addition, a before/after analysis was conducted to evaluate the effect of implementing adaptive signal control on University Avenue in Des Moines.

## Key Findings

This project demonstrated the use of archived INRIX data to establish performance measures for identifying problematic segments on arterial corridors. The method proved straightforward to implement and successfully flagged problematic areas. This study revealed that the performance metrics were quite flexible and robust, and were able to identify the problematic segments in each corridor with reasonable accuracy.

The tool can assist in identifying locations where delay is high, day-to-day traffic patterns are dynamic, or the minute-to-minute demand at signalized intersections is highly variable. Through the measures defined in this work, transportation agencies can more easily automate the process of monitoring the arterial network to identify, screen, and prioritize locations that require signal retiming or other traffic control upgrades.

Some key findings from the case study were as follows:

- Anomalous days were evaluated for various segments. Three corridors (University Avenue, Hickman Road, and SE 14th Street) had the highest numbers of anomalous days. Thus, it can be said that these corridors are the ones handling the most dynamic travel patterns.

- For normal days, five performance metrics were defined: median travel rate (MTR), within-day variability (WTV), minimum travel rate dispersion (MTD), and two overall travel rate variabilities (OTV_POLY and OTV_LINEAR). Based upon on these parameters, three areas (Jordan Creek Parkway, SE 14th Street, and parts of Dodge Street) were found to be the worst-performing segments.

- The before/after analysis on University Avenue where adaptive signal control was implemented showed small improvements in travel rate and within-day variation, but overall variation increased. Thus, it appears that implementation of the adaptive system was moderately beneficial overall, and may have helped mitigate some of the effects of a fall 2016 construction project on University Avenue about one mile west of the adaptive segment.

## Recommendations for Future Research

The study only analyzed main-roadway through movements on each corridor, and so the methodology was not sensitive to delays for turning movements or side-street movements. That limitation could be partially addressed by adding additional segments to the analysis to include streets that cross the major arterial corridors. The first step to expand the methodology would be to conduct a data quality evaluation for segments immediately adjacent to intersections.

Other future studies could include: a cost-benefit analysis for adaptive signal control systems; using the methodology to provide insights about relationships between operational and safety performance; and developing composite metrics based on the methodology to apply on a regional or statewide scale for objective operational performance scores that could help build consensus about priorities for urban arterial improvements.

## Implementation Readiness and Benefits

Using the methods defined in this study, agencies could more frequently monitor corridor performance, more easily identify problematic segments, and more quickly identify system management solutions. This can help transportation agencies select the corridors that are in need of traffic signal retiming and can also help identify corridors suited for adaptive signal control implementation.