DRISI
CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION
TRANSFORMING IDEAS INTO SOLUTIONS

Research Results

Reimagining Sensor Deployment

Provide practical guidance to suggest the best placement of detection stations assuming that third-party speed data are used to achieve wide geographic coverage.

Traffic Operations

OCTOBER 2023

Project Title: Alternative Data Detections

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WHAT WAS THE NEED?

The California Department of Transportation (Caltrans) collects gigabytes of data every day using a dedicated traffic sensing infrastructure. This data provides support for traffic management and system performance monitoring that are crucial for supporting Caltrans' mission, vision, and strategic goals to strengthen stewardship and drive efficiency. Operating this vast detection system is becoming unsustainable, as it requires extensive resources in the form of engineering and maintenance support along with millions in capital funds to keep it running. Recently, Caltrans programmed over $150 million to address failing or failed detection stations across the state.

Recent research has provided practical methods to integrate purchasing third-party data into Caltrans' existing reporting platform and deliverables. Based on these prior analyses, a hybrid approach or purchasing third-party data and Caltrans data provides better estimates of performance measures than using only Caltrans data. With fewer physical sensors to maintain, this should reduce the exposure of construction, maintenance, and operations personnel to traffic, which is in alignment with Caltrans' strategic goal of safety first.

WHAT WAS OUR GOAL?

The goals of this project were to achieve the following objectives:

- Provide guidance to prioritize roadside detector locations in a hybrid data solution.
- Offer a menu of sensor deployment targets that would achieve suitable accuracy while reducing the number of sensors in the field.

Caltrans

DRISI provides solutions and knowledge that improves California's transportation system.

WHAT DID WE DO?

This project reimagines sensor deployment in the context of a near-term possibility where third-party data is procured to obtain travel times and speed data across the state. In this potential future, the role of dedicated roadside detection stations will change. It would no longer be necessary to target the deployment of detection stations at every half-mile. Therefore, a new paradigm is required to guide the decisions on where detection stations should be placed to provide the most informational value.

WHAT WAS THE OUTCOME?

The suggested practice is to locate the most important freeway-to-freeway interchanges and to completely instrument them. This allows for better monitoring of area/regional trip patterns. Busy local interchanges are important in the sense that on-ramp/off-ramp data collected there facilitate a better understanding of local traffic patterns and can help explain why congestion or other problems exist at a given location. Complex interchanges often will be associated with busy interchanges.

The research provided a recommended proposed methodology can be summarized by the application of the following three analytical stages:

Stage 1

- For a freeway, generate a list of interchanges and categorize them
- Collect local factors, such as the need for ramp metering
- Incorporate these needs as topological features of importance in stage 2

Stage 2

Gather data as described and follow the process to prioritize sensors based on quantitative analysis of each period considered.

Stage 3

Combine results from all evaluated periods to develop an aggregate prioritization.

At the end of this, what is achieved should be interpreted not as a list of mainline positions, but as a list of interchanges of importance. Each interchange of high priority should be completely instrumented. Sensor location meta-data should organized so that it is possible to associate sensors with interchanges, fully accounted traffic volumes (FATVs), and freeways. This will enable the possibility to implement automatic error checking, and also make it easier to integrate the data with other sources.

WHAT IS THE BENEFIT?

This project aimed to provide practical guidance and recommendations for the best placement of detection stations assuming that third-party speed data are used to achieve wide geographic coverage. Another benefit was the reduction in the use of traditional vehicle detection stations, thereby reducing maintenance costs and addressing sustainability and stewardship goals. This also limits exposure of construction, maintenance, and operations personnel to traffic, thus improving worker safety.

IMAGES

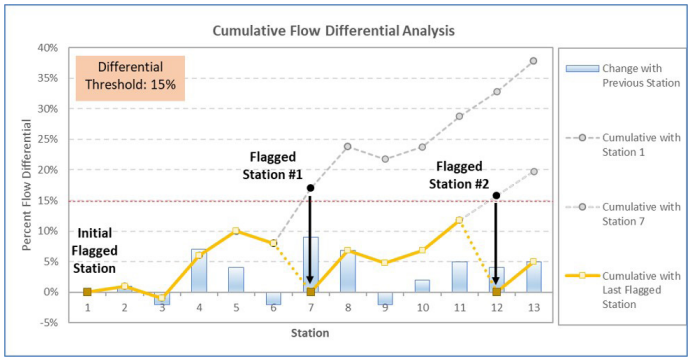

Image 1: Cumulative Flow Differential Analysis.

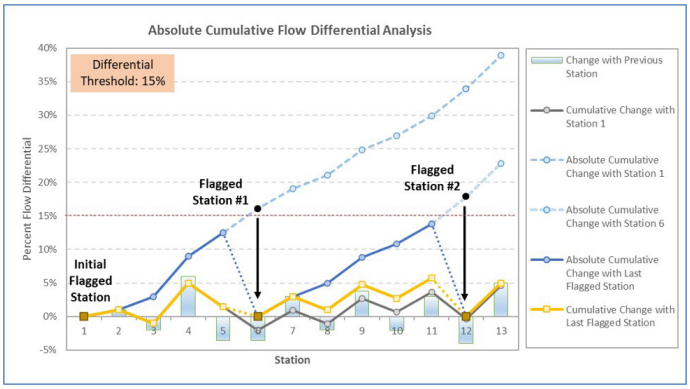

Image 2: Absolute Cumulative Flow Differential Analysis.

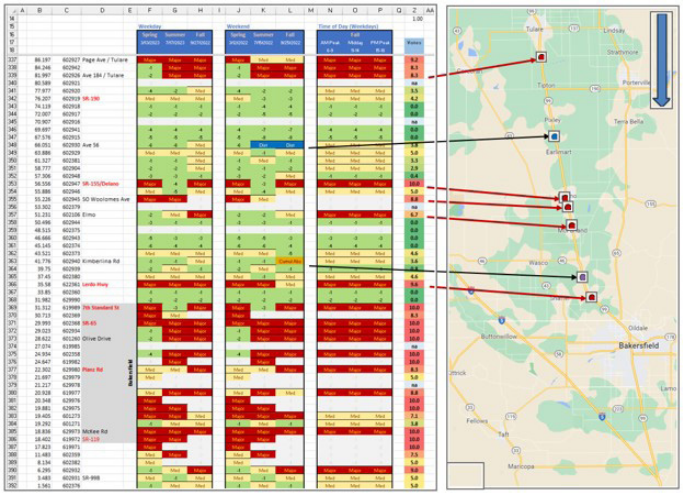

Image 3: Example of Data Analysis with Results.