DRISI
Caltrans Division of Research, Innovation and System Information

Research Results

A Dynamical Framework for Integrated Corridor Management

Built a comprehensive dynamical framework for traffic flow over integrated freeway and arterial road networks, developed stability analysis tools for such a framework, and used these tools to design dynamic traffic signal control and ramp metering policies to optimize system efficiency and resiliency.

Transportation Safety and Mobility

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Project Title:
A Dynamical Framework for Integrated Corridor Management

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WHAT IS THE NEED?

Rapid advancements in traffic sensing and control technology from loop detectors, traffic cameras and mobile phones, to electronic road signs, dynamic congestion pricing and personalized navigation devices, are facilitating dynamic traffic control. In particular, the concept of Integrated Corridor Management (ICM) aims to integrate various transportation subsystems and use the sensing and control technology with the integrated physical transportation infrastructure to improve efficiency and resiliency of our congested corridors. Solutions to engineering problems arising from such complex integration efforts needed to be researched under this task.

WHAT WAS OUR GOAL?

The goal was to have researchers investigate and develop a comprehensive dynamical framework for traffic flow over integrated freeway and arterial road networks, develop stability analysis tools for such a framework, and use these tools to design dynamic traffic signal control and ramp metering policy to optimize system efficiency and resiliency, with provable guarantees. This research focused on adaptive traffic signal control and ramp metering strategies, as these form the core of Integrated Corridor Management (ICM) control mechanisms.

WHAT DID WE DO?

Caltrans contracted the Metropolitan Transportation Center (METRANS) at the University of Southern California (USC), to research and develop a comprehensive dynamical framework for traffic flow over integrated freeway and arterial road networks, develop stability analysis tools for such a framework, and use these tools to design dynamic traffic signal control and ramp metering policy to optimize system efficiency and resiliency.

WHAT WAS THE OUTCOME?

Analysis and control synthesis tools for dynamic traffic flow over networks. Proportional policies for traffic signal control, which are decentralized, and minimalist in that they require information only about local queue lengths. Which will be beneficial to use in the immediate aftermath of traffic incidents that cause significant changes in turning ratios and flow capacities on the links. Using dynamic traffic assignment framework, researchers developed convex formulations to compute variable speed limit and ramp metering controls over control horizon to optimize objectives, such as total travel time, which can be cast as convex functions.

WHAT IS THE BENEFIT?

The benefits resulting from this task are expected to be a rigorous understanding of the dynamical behavior of traffic flow under ramp metering that would result in the development of closed-form solutions for an optimal control strategy procedure. Such a procedure would yield information on maximum flow rate possible under given ramp metering policies. This information could be used for advance notification to upstream drivers so that they can make alternate travel choices. Thus, improving traffic flow on the roads.

IMAGES

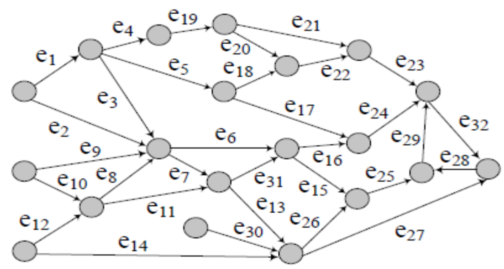

FIGURE 1: Directed Cyclic Network (with 20 nodes and 32 links)

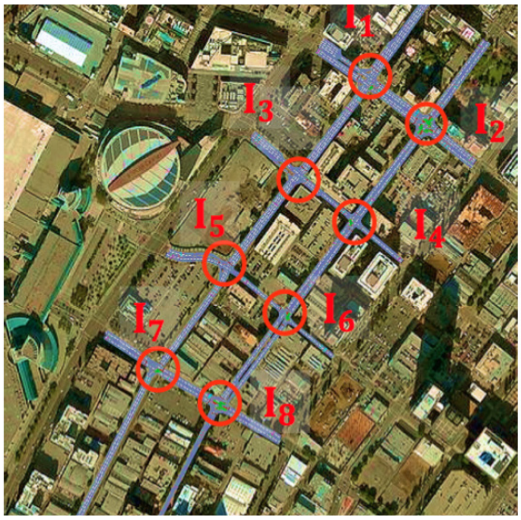

FIGURE 2: Aerial view of Los Angeles Downtown Sub-Network used in this study

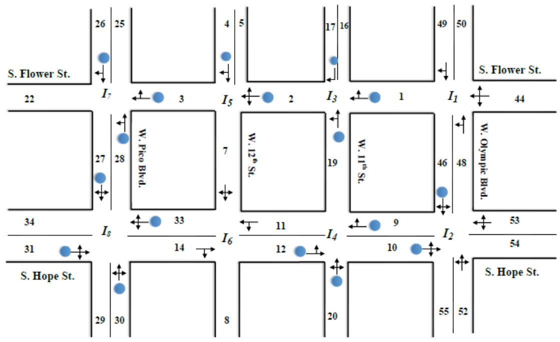

FIGURE 3: Schematic representation of Los Angeles Downtown Sub-Network used in this study

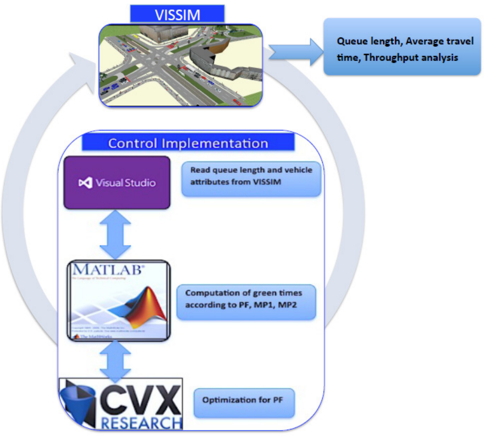

FIGURE 4: Overview of the implementation of control architecture with Verkehr in Stadten - Simulations Model (VISSIM)

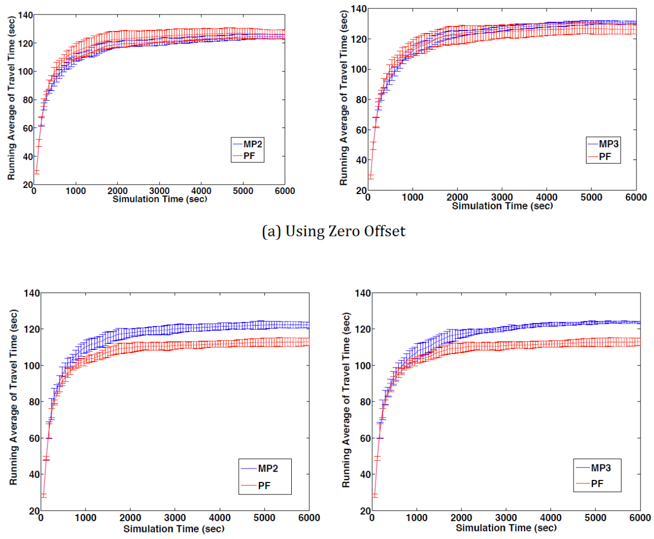

FIGURE 5: Comparison of the running average of travel time for heavy traffic under proportionally fair (PF) and max pressure (MP) controllers