

Traffic Operations

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Project Title:
Ramp Metering and HOV Lane
Degradation Mitigation

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Ramp Metering and HOV Lane Degradation Mitigation

Select several sites in California with different types of HOV lane, ramp, and traffic, where data are available and conduct analysis of the relationship between ramp metering and HOV lane operation.

WHAT IS THE NEED?

The average speeds of vehicles in the High-Occupancy Vehicle (HOV) lane must be at or above 45 miles per hour during the morning or afternoon peak period at least 90 percent of the time over a 180-day period. An HOV lane that does not meet federal performance standards is considered “degraded”. HOV lane performance must be reported annually to the Federal Highway Administration (FHWA) and states must develop a plan to bring degraded HOV lanes into compliance. Failure to comply with the performance standard may result in federal sanctions and jeopardize states from receiving federal funds or project approvals.

Ramp metering is often proposed by Caltrans districts as a strategy for addressing degradation. FHWA requested to quantify the impact of ramp metering on the HOV lane performance.

WHAT ARE WE DOING?

We start by studying Caltrans 2017, 2018 and 2019 HOV degradation reports to identify freeways with HOV facilities, where HOV performance was degraded. These will be candidate sites for our study. Then, we will narrow down this list by selecting 4 sites with diverse characteristics.

We then conduct empirical and theoretical analyses of the relationship between ramp metering and HOV lane operation. The goal is to explore different freeway configurations (e.g., full access HOV lane vs. controlled access) and to quantify the nexus between ramp metering and HOV lane performance.



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Theoretical analysis will be conducted using simulation in Operations Planning Toolbox (OPT) recently developed by PATH for Caltrans. OPT is an open-source, multi-modal traffic modeling software for quantitative assessment of operational scenarios.

WHAT IS OUR GOAL?

The project goal is: find out which types of ramp metering (e.g., local, coordinated, on HOV preferential lanes, etc.) can improve the performance of the HOV lanes with various features (full vs limited access, density of on-ramps, bottleneck cause, severity of degradation) and to what extent, which will be quantified. If for certain HOV facilities the mitigating effect of ramp metering is negligible or nonexistent, we will investigate why, and what other mitigation techniques can be in order.

WHAT IS THE BENEFIT?

The main result of the proposed project will be a quantitative assessment of the ramp metering impact on the HOV lane performance at the selected sites in terms of the metrics listed above. It will help Caltrans to develop legally defensible HOV lane degradation reports.

A byproduct of this project will be the calibrated OPT simulation models for the selected sites. These can be later re-used by Caltrans in other studies. This will demonstrate an efficient way of evaluating operational scenarios.

WHAT IS THE PROGRESS TO DATE?

Ongoing Task 4: Empirical Analysis. There are 4 selected sites that will be use for this analysis. Currently SR-118 is the only site that as been finished with the analysis and researcher has been presented their findings to Caltrans.

The before/after analysis will be based on PeMS and INRIX data, and the comparison will be done

in terms of the following performance measures. Here, we will take into account that PeMS data are differentiated between lanes, and INRIX data aren't. For those selected sites where no ramp metering has been deployed yet, only the "before" empirical analysis will be performed.

IMAGES

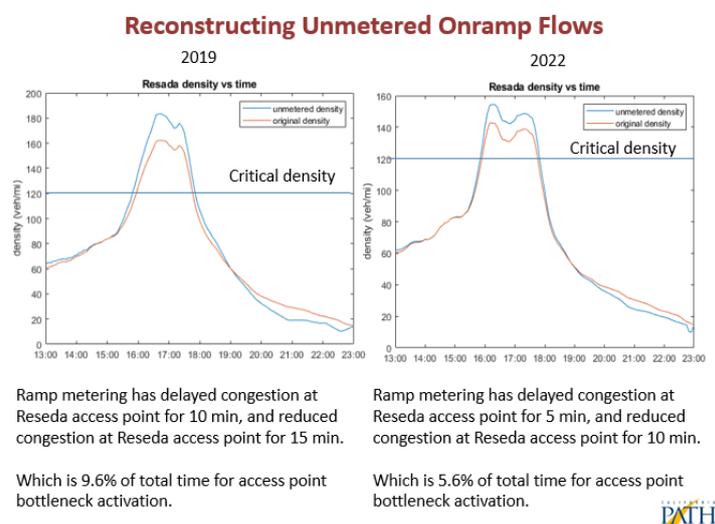


Image 1: Reconstructing Unmetered Onramp Flows in SR-118 from 2019 and 2022 data.