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Evaluation of Driver Compliance to Displayed Variable Advisory Speed Limit Systems: Comparison between Germany and the U.S.

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Abstract

Variable Speed Limit (VSL) and Variable Advisory Speed (VAS) systems are applications of a growing field of active traffic management systems (ATM). This technology aims to improve safety while reducing congestion and emissions. VSL is common on German freeways, harmonizing traffic flow during congestion and weather events. Portland, Oregon installed a VAS system (advisory meaning it is not automatically enforced) on an eleven km (seven miles) segment of heavily congested urban freeway. The Portland region maintains archived, high-resolution data of both VAS sign messages and speed detection loop feedback, permitting reconstruction of traffic and sign data. This work analyses over 30 days of archived data from the Portland site in order to study driver compliance to the VAS signs. The focus is to suggest methods and parameters to score system performance. Such an analysis could benefit new rollouts of VAS corridors by providing system performance feedback and shed light on options for improving system performance.

Keywords: Variable Advisory Speed, Variable Speed Limits, Compliance, Traffic Management, Evaluation

1 Introduction

The state of Oregon has placed itself as an early adopter of intelligent transportation systems (ITS) and active traffic management (ATM) strategies for improving traffic safety and traffic flow in the U.S. Specifically on heavily used freeways surrounding Portland, the Oregon Department of Transportation (ODOT) has implemented, among other things, a centralized traffic management center, dynamic ramp metering, incident response, variable message signs with travel times and traveler information, as well as an online archived data service. Recently, ODOT has added a variable advisory speed (VAS) limit system on several freeways in the Portland area. The VAS system responds both to weather and traffic

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conditions (Downey, 2015) and displays advisory speeds (black on yellow signs) over each lane at specific gantry locations. While some variable speed limit (VSL) systems include regulatory speeds and automated enforcement, an advisory speed limit system was chosen after discussions with the Oregon State Police, who can use the basic speed rule for enforcement where a driver is not allowed to drive at a speed greater than is reasonable and prudent for conditions.

Oregon Route (OR) 217, an eleven km (seven mile) stretch of freeway experiences frequent rear-end collisions (approximately 200 per year) and heavy congestion during rush hours extending into the off-peak hours. ODOT chose this corridor due to the perennial rush-hour congestion and almost daily crashes. ODOT is currently evaluating this application of the VAS system in order to inform further installations of VAS signs. ODOT recorded 314 crashes in 2012, roughly a crash rate of about 1.05 crashes per million vehicle miles traveled (Yanfei, 2013). The state average is 0.88 on non-interstate urban freeways. Most of these are rear-end crashes which are linked with stop-and-go traffic. Recent work has documented the preliminary impacts of the VAS system on travel time reliability, safety, and other critical performance measures (Downey, 2015).

This paper explores the potential for developing a comprehensive scoring system for tracking the compliance of drivers to displayed VAS signs. Compliance is defined as the difference between the displayed speed and the actual measured speed of traffic. This will assist in gaining a full understanding of the success of the system, and includes a corridor-level perspective depicting when the signs are being used, and what the actual traffic conditions are during those times. It should be noted that we do not know if or when enforcement was performed by state police or other law enforcement during the study period. In order to compare the Portland advisory speed limit system with another VSL, a site in Munich, Germany is also analyzed. The Munich site uses regulatory speed limits and includes an automated enforcement system (though detailed knowledge of when it is activated is not available).

This study is made possible thanks to the availability of archived freeway sensor data, in order to reconstruct the "ground truth" of actual vehicular speeds, over space and time. In addition, the VAS/VSL system logs have been archived, which allows for the reconstructing the displayed messages. A standardized algorithm compares specific hours or entire days of information in order to detect driver compliance, variations in driver compliance and situations in which vehicular compliance is better/ worse. This information can be helpful for enforcing speed limits at certain times of day, evaluating system effectiveness and providing useful information for deploying the system on other freeway corridors.

2 Background and Literature Review

OR 217, located southwest of Portland, Oregon, was converted in the past from a regional arterial to a limited access freeway corridor with frequent on/off ramps. As an alternative to considering a major widening project, ODOT recently constructed an ATM system on the eleven-km (7 mile) freeway to reduce crash frequency and decrease congestion. Figure 1 shows schematic drawings detailing the layout of the ATM system components in the northbound and southbound lanes, with the milepost (MP) reading for each detector and VAS gantry as indicated. As shown, there are 14 loop detector/radar sensor stations and seven VAS gantries northbound, and 17 loop detector/radar sensor stations and seven VAS gantries southbound. Each detector's "influence area" is also shown, which is the distance measured along the freeway bounded by the midpoints between each detector pair. The corridor runs north-south between US 26 and Interstate 5 and is a common route for commuters traveling between western and southern suburbs and downtown Portland. The corridor is generally two lanes in each direction but has auxiliary lanes near entrance ramps. OR 217 has been well outfitted with loop and radar traffic detectors, as detailed in Figure 1. Free flow speeds on OR 217 are between 89 and 97 km/h (55 and 60 mph). This can decrease by 48 km/h (30 mph) in rush hours. Rush hour peak flows reach 3,500 vehicles per hour (vph) in both directions (Downey & Bertini, 2015).