Research Problem Statement

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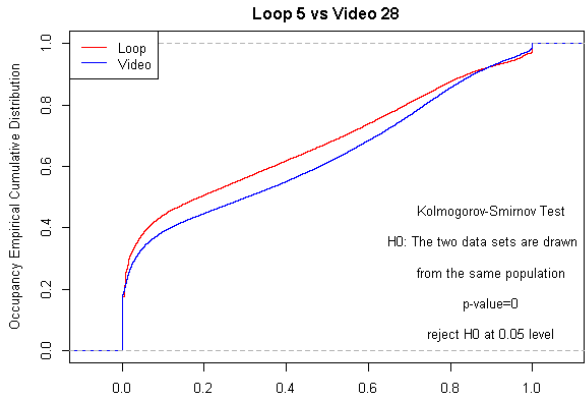
I. TITLE

17-040 Improving Adaptive/Responsive Signal Control Performance – Phase 2 (Physical and Environmental

II. PROBLEM

ODOT funded the first phase of this research proposal in September of 2014, the focus of which is to compare and contrast different signal detection technologies and determine the impact of their performance on higher level traffic control strategies (responsive, adaptive, etc.), with the overarching goal of improving traffic signal operational performance. Phase 1 (SPR 781) has been successful thus far in several ways, first in developing a portable high fidelity event based data recording device that logs detection / phase state changes as well as concurrent video, but also in developing rudimentary baseline comparative models of the operational differences between technologies monitored over long periods of time (weeks). The figure to the left displays a cumulative distribution curve comparing the occupancies, aggregated in two minute bins, developed by a loop and video detector both monitoring the same area, a 6' x 20' advance left turn detector (spanning two lanes) at the intersection of Town Center Loop West and Wilsonville Rd, one of the data collection sites in Phase 1. While the video detector lags the loop curve slightly, the similar form provides promise for developing application guidance for control systems as the difference between technologies is fairly stable.



Through a Hardware in the Loop Simulation and cost benefit analysis, Phase 1 will use the collected data to provide application guidance for detection technology selection and configuration.

While this will improve the understanding of detection equipment, errors, and limitations of detection strategies and ultimately allow ODOT to make 'smarter' investments and upgrade intersections with improved vehicle detection, ***the Phase 1 TAC noted that vehicle detection devices may not have consistent errors depending on additional factors not originally scoped within the project.*** The data logger developed for Phase 1 enabled the research team to collect a large amount of data per site (over 2,000,000 detector records for the Wilsonville site alone), but only 4 site locations were monitored. To examine the extent of other environmental issues across more sites, Phase 2 is needed, and data collection can be accomplished fairly easily due to the Phase 1 effort.

III. PROPOSED RESEARCH, DEVELOPMENT, OR TECHNICAL TRANSFER ACTIVITY

The majority of existing literature in this field assumes a 1:1 comparison between the performance of inductive loops and video detection. It should be noted that detection in itself is a means to an end, and that even if a bias exists between different detection technologies, elimination of such biases through the use of correction factors would not negatively impact signal performance. Phase 1 investigated operational differences with a focus on this impact of these differences on adaptive control. Phase 2 will widen the scope of that investigation to include analysis of many additional variables, such as weather condition, wind speeds, sun angle, pavement type, geometric skew, approach curvature, and location (urban vs. rural), among others.

Phase 2 will capitalize on Phase 1 equipment, model(s), and data collection devices to retrieve this additional information from phase one intersections along with additional intersections as needed. While most previous studies have typically used one or two sites to develop a data set, the mobile data collection technology developed in Phase 1 makes it possible to conduct a wider scale real world analysis using multiple sites. The use of multiple sites over varying terrain makes it possible to tease out transferable models from the dataset as they will not be site specific. Data will be collected during various times of the year and under moderate to severe

weather conditions to determine the effects these factors have on the previously defined conditions outlined in the Phase 1 research project. Guidelines developed in the Phase 1 work will be augmented with information from these roadway and environmental conditions. Lastly, an operational analysis will be conducted, through simulation or with real world data, to quantify the benefits of the guidelines developed in this work.

IV. POTENTIAL BENEFITS

Phase two will allow ODOT to make 'smarter' investments in vehicle detection infrastructure based upon the outcomes of scientific research as opposed to vendor recommendations and anecdotal experience. This will better serve the public by reducing costs and delay due to ineffective detection systems that are not suited for the conditions and operational objectives of individual intersections and arterial systems.

V. IMPLEMENTATION

Phase 1 is developing additional language for ODOT Traffic – Roadway Section standards of practice and manuals for design to include the recommended revisions identified by the work. Phase 2 will further refine this language to provide additional guidance regarding the influence of pavement, weather, geometry, and seasonal conditions, and other factors as guided by the TAC. Design guidelines will reflect the necessary changes to our traffic signal layout and operations to better optimize signal performance, reduce delay to the public and lower our overall long term costs due to poor detection system performance.

VI. LIST OF REFERENCES *(optional)*

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Rhodes, A., Smaglik, EJ, Bullock, D., and Sturdevant, J. "Operational Performance Comparison of Video Detection Systems. Proceedings of the 2007 ITE International Annual Meeting and Exhibit, Paper AB07H192, Pittsburgh, PA, August 5th-8th, 2007

Smaglik E.J., A. Sharma, D.M. Bullock, J.R. Sturdevant, and G. Duncan, "Event-Based Data Collection for Generating Actuated Controller Performance Measures," Transportation Research Record, #2035, TRB, National Research Council, Washington, DC, pp.97-106, 2007.

VII. CONTACT INFORMATION

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