

Research Report Summary



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A Field and Simulator Evaluation of All-Red Clearance Intervals for use in Left-Turn Applications

Research has found that the FYA indication can effectively communicate permissive left turns [1, 2]. However, the transition from a protected left-turn indication to the FYA and is not well defined and varies across the country. Specifically, there is no clear national guidance on the need for and the extent of clearance and change intervals when transitioning from a protected left-turn phase to a permissive left-turn.

Research Objectives

Research objectives were as follows:

- Gain a better understanding of driver behavior during various change and clearance interval approaches.
- Identify areas that need to be studied further using driving simulation.
- Collect data to support the development of microscopic simulation tools to evaluate the impacts of having clearance intervals for FYA scenarios.

Field Data Collection

A radar-based vehicle trajectory data collection system was used to obtain the trajectory of vehicles while navigating an approach with an FYA signal phase.

Trajectory data collected provides speed and position information every 0.5 seconds.

Computer-Based Survey

A computer-based survey was conducted to understand drivers' expectations when faced with different sequences of signal phases. The survey was administered both online and in person. When administered online, the subjects completed the survey on a browser. When it was administered in person, subjects were handed a tablet that was running the survey on a browser.

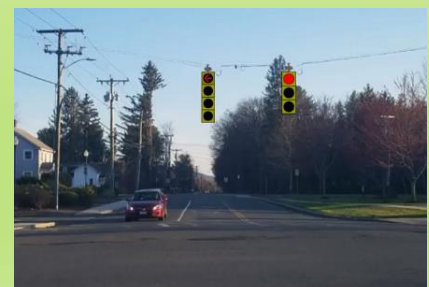
Along with survey responses, demographic information was collected to analyze results by driver groups.

Survey responses were used to narrow scenarios that will be studied using driving simulators.

Experimental Procedures



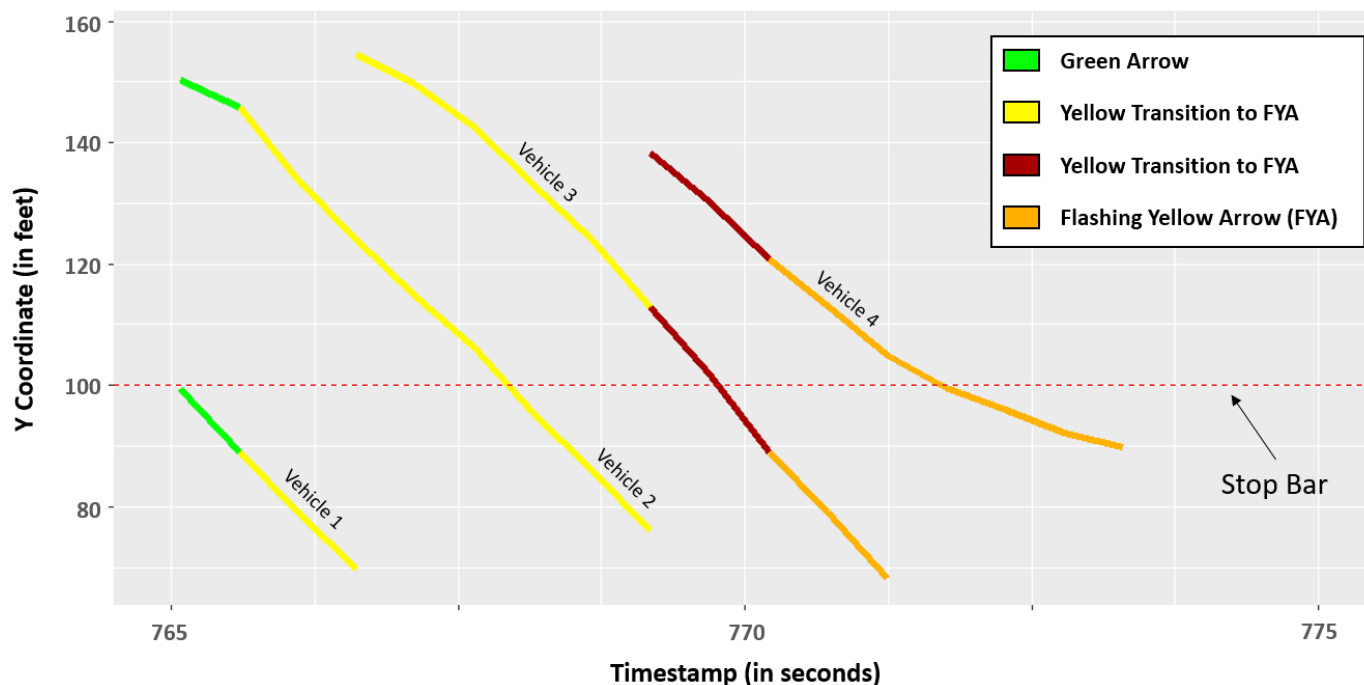
Typical installation of radar-based data collection equipment used to obtain vehicle trajectories



Screenshot of computer-based survey used to determine comprehension of sequences

Summary of Findings from Field Evaluation

Research findings based on a limited dataset suggest that there is little reaction to the clearance interval. The figure below shows sample vehicle trajectories (along with signal status information) for a cycle and as it can be seen, the relationship between distance travel does not suffer significant changes during the transition period. To further understand the actual effects on driver behavior more data is needed.



Summary of Findings from Computer-Based Survey

A static evaluation was conducted with 207 participants across 20 states in the U.S. Driver comprehension for various protected-permissive left-turns (PPLT) phase sequences for both circular green (CG) and FYA signal indications was evaluated in the survey.

An analysis of the survey results makes it apparent that drivers are more likely to understand the signal phasing with CG permissive phasing compared to the application of the FYA. With this, an assumption was made that drivers would be more willing to traverse through an intersection during the all-red clearance phase with the 5-section cluster signal (CG), than the 4-section signal (FYA).

References

1. Brehmer, C. L., K. C. Kacir, D. A. Noyce, and M. P. Manser. (2003). NCHRP Report 493: Evaluation of Traffic Signal Displays for Protected/ Permissive Left-Turn Control. Transportation Research Board of the National Academies, Washington, D.C.
2. Noyce, D. A., & Knodler, M. (2007). Implementation of the flashing yellow arrow permissive left-turn indication in signalized intersections. In Proceedings of the 14th International Conference of Road Safety on Four Continents, Bangkok, Thailand.