The Connected Vehicle enabled Freeway Merge Management system was developed by the University of Virginia Center for Transportation Studies, with the aim of reducing conflicts between merging vehicles in freeway ramp areas. Initial simulation evaluation results showed that the merge assistance system has significant potential to increase capacity of freeway merge areas and reduce accidents by minimizing the number of conflicts between vehicles. As a next step of evaluation, a field test is conducted at a Connected Vehicle test bed to investigate drivers’ response to the personalized advisories relayed by this system. This paper provides an overview of the field test methodology, system architecture, stated preference survey and presents preliminary results for this prototype freeway merge assistance system developed for the Connected Vehicle Environment. The revealed and stated preference data gathered will be used to develop an advisory response model that will incorporate drivers’ response variability in the simulation evaluation framework of the freeway merge assistance system.

BACKGROUND AND PURPOSE

Among the many factors of freeway congestion, merging conflicts in freeway ramp areas have been identified as one of the major causes of congestion. To address the limitations of current ramp management strategies, the Connected Vehicle offers the new capability to develop and deploy more proactive and sophisticated applications to address various transportation problems. Given this background, the research team has previously developed the Freeway Merge Assistance System with the aim of reducing conflicts in freeway to ensure smoother merging.

- **Variable Speed Limit (VSL)**
- **Lane Changing Advisory (LCA)**
- **Gap Responsive Signal (GAP)**
- **Merging Control Algorithm (MCA)**

RESEARCH MOTIVATION

Key assumption in FMAS:

- Drivers will comply to all the advisories sent to them
- Drivers will take necessary courses of action as advised

In real-world scenarios, 100% driver compliance may not be possible due to various reasons:

- **Driver Characteristics**
- **Situational factors**

Advisories from Mobility Applications:

- Assistive in nature
- Doesn’t require mandatory attention

Benefits from Mobility Applications depend on Driver compliance

It is important to investigate:

- How drivers will react to these personalized advisories
- How compliance behavior will affect the performance of these applications

RESEARCH GOALS & OBJECTIVES

The goal of this research is to investigate drivers’ response behavior to the advisory messages provided by the freeway merge assistance system. The main objectives of this research are as follows:

- To design a field testing methodology to collect the actual driver behavior data responding to advisory messages provided by the freeway merge assistance system;
- To conduct a field test to collect revealed preference data and administer a questionnaire survey to collect stated preference data on driver compliance to the advisories provided; and
- To analyze data to investigate the driver response behavior to personalized advisories

METHODOLOGY

**Design of Field test**

**Simplified System Architecture**

As the test bed was not fully operational, a simplified system architecture was designed to carry out the field test, where a test control application was utilized to sent the advisories to the drivers.

**Scenario Overview**

Gap size on the target lane was determined as the key factor to test drivers’ responses to the advisories under different strategies.

<table>
<thead>
<tr>
<th>Gap Sizes</th>
<th>Advisory Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large (72mph)</td>
<td>Scenario #1  Lane Changing Advisory</td>
</tr>
<tr>
<td>Moderate (61mph)</td>
<td>Scenario #2  VSL</td>
</tr>
<tr>
<td>Small (50mph)</td>
<td>Scenario #3  LCA</td>
</tr>
</tbody>
</table>

**Sampling of Participants**

The sample size was estimated to be 68 with a confidence interval of 90% and margin of error 10% using sample size formula for categorical data. Each of the participants took part in all the nine test scenarios.

**Conduct Field-test**

Typical procedural steps:

- Depending on the test scenario, all the three vehicles are positioned at designated locations.
- The experimenter on the participant vehicle instructs all the drivers to start driving at the same time and drive at a uniform speed of 30mph and maintain that speed until any advisory is displayed in the on-board display.
- Upon receiving the advisory, the participant can either comply with the advisory or not, if they can keep on driving on right lane.

**Stated Preference Questionnaire Survey**

A stated preference questionnaire survey will be conducted. After the field test, the stated preference questionnaire will be provided to the participants to give their responses to the different hypothetical situations.

RESULTS

**Revealed Preference Data**

**Variable Speed Limit**

For the VSL scenarios, the compliance is highest for the scenarios with mid-size gaps (68%) followed by scenarios with large gaps (60%).

**Lane Changing Advisory**

For LCA, all the participants accepted the gaps or changed lane for scenario with largest gap. For scenario with mid-size gap only one participant driver did not comply with LCA advisory.

**Merging Control Algorithm**

For MCA participant drivers were most comfortable in following the two advisories for the scenarios with largest gap, followed by scenarios with mid gap with 28% non-compliant for small gaps

**Compliance across strategies**

For Compliance across strategies irrespective of the gap sizes, LCA has the highest compliance followed by MCA. However, VSL has the highest non-compliance rate of 44%.

**Compliance across different gap sizes**

Participants show similar gap acceptance behavior for large and mid-size gap scenario. 40% of the drivers did not accept gaps or complied with advisory for scenarios with smallest gap size.

**Stated Preference Data**

**Compliance across different gap sizes**

Participants show similar gap acceptance behavior for large and mid-size gap scenario. 40% of the drivers did not accept gaps or complied with advisory for scenarios with smallest gap size.

CONCLUSIONS

This research provides a unique and novel opportunity to understand driver response behavior to dynamic traffic condition-based information generated by traffic management strategies in the Connected Vehicle environment. Preliminary results show similar compliance rate for large and medium gaps with lowest compliance for small gaps; indicating the potential of this system to improve freeway merge operations.