Application of a new technology for efficient left turn movements at signalized intersections

Nasima F. Bhuiyan
Congestion & Traffic ....

- Usually traffic congestion is identified as the most common reason behind delays at arterials.
- The condition becomes even worsen during the peak hour.

How congestion is forming in an arterial or in an intersection?
- Traffic flow in excess of capacity
- Undisciplined driving behavior
- Poor signal phasing system
An innovative approach to get informed about the congestion!

A newly developed GPS based technique called **Floating Car Data (FCD)** obtains information on speed and spacing between the vehicles focusing on left turn movement at signals.
Background

Significant for obtaining information on vehicular trajectories, such as speed and travel time.

Labels:
1. Equipped with satellite receiver position system
2. Central server
3. Traffic light controller
4. Traffic lights
5. Local radio signals emitters
6. Local radio receiving system
7. Wireless local area data network
8. Local radio receiving system
FCD shows promise for supporting real-time operations and provide efficient left turn plans!

System is based on the acquisition of the sequence of positions and velocities of the instrumented vehicles.

Since spacing between cars in left turn movement is a primary factor to determine the flow rate, FCD can show an effective method.
Motivation

This research is planned to

- provide a new concept and challenges connected with regulating left turning movement with FCD
- contribute on safe left turning movement and travel time comparison between general (non-equipped) and smart cars (equipped with GPS) during congestion period
Objective

Analyze
Analyze the overall capacity of signalized intersection and level of service by integrating left turning travel time into the capacity estimation.

Compare
Compare outputs and validate the developed model using simulation.

Detect
Detect the functional performance of the left turning signals.

Develop
Develop an integrated mathematical model which will apprehend the behavior of roadway users.

Analyze the overall capacity of signalized intersection and level of service by integrating left turning travel time into the capacity estimation.
The combined collected data together….

- develop a powerful model,
- gives qualified and real-time information for the mobility of persons.
- provides reliable saturation level of the road network and travel times.
Proposed Workflow chart

Choose signalized intersections with different left turn protections

Collect data on left turning vehicles during various levels of congestion

Count the number of left turning vehicles (for both using GPS and using no GPS)

Evaluate length of green period during turning left

Compare speed as well as travel times of left turning traffic with various types of protections by simulation

Provide the most efficient left turn protection
Methodology

➢ Data:
Data on number of left turning vehicles and speed can be collected for both instrumented and non instrumented vehicles.

➢ Model:
Define relative variables (speed, density and flow) at macro traffic modeling.

Primary development of an integrated model will apprehend the sensitivity of car following behavior of roadway users incorporating FCD technique.

Deterministic approach of traffic flow will be the base of the model.
Analysis

- Validation of model
- Use Simulation
- Compare output for different left turn protections
For general vehicles (with no instrument)

For connected vehicles (equipped with instrument)
Flow Vs. Density Graph

For general vehicles (with no instrument)

For connected vehicles (equipped with instrument)
Challenge

Advantages of using FCD over loop detector data:

- Inexpensive
- New algorithms for researchers and engineers
- Offer best left turn phasing (efficiency)
Expected Outcome

A manifest driver’s behavioral system might be understood during the congestion by studying their nature and by applying the technique of FCD.

Depending on the differences among the types of left turns, the reactions from the drivers can be also predicted during real-time traffic data information.

The developed model may improve the functionality of left turn protections.
Summary

✓ Develop a mathematical model based on FCD data and applying deterministic method. The model can be applied both for peak and non-peak hour congestion mitigation.

✓ Efficiency in measurement indicates drivers’ behavior during peak hour congestion as well as level of service of traffic.

✓ Saved travel time can be calculated from the developed model.
Acknowledgments

- *Dr. Emelinda M. Parentela*, Professor of Civil & Construction Engineering Management, California State University, Long Beach

- *MD R. Bhuiyan*, Civil (Transportation) Engineer, California Department of Transportation (Caltrans), Los Angeles, California
THANK YOU...