Sensors and Safety Measures for Pedestrians in Crosswalks

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Introduction

SAMS - Safety and Mobility System - Project

- Data fusion of intersection detection data (vehicles, pedestrians) and signal event data to provide analytics for intersection mobility and safety
  - Builds on existing intersection infrastructure
  - Non-intrusive: does not affect controller operations

- Uses
  - 24x7 monitoring/data collection
  - Intersection mobility performance measurement
  - Multi-modal/ Pedestrian mobility and safety analytics
  - Vehicle safety and conflict analysis
System Configuration

- Vehicle detector
- Additional vehicle detectors for SAMS
- Sensys Microradar

Test site in Danville, CA

- No controller access required.
- Quick installation/upgrade.
Pedestrian detection

**MicroRadar**

Sensys MicroRadar: parking/bicycle/pedestrian detection

- In-ground sensor transmit high frequency RF pulses and measure reflections.
- For pedestrians, detection zone covers 2-8 ft.
- Sampling rate of 1 – 8 Hz
- Can detect stationary/moving pedestrians.
Pedestrian detection

Field setup

Installation at Diablo/Green Valley
Pedestrian detection

**Data processing**

- **Generate detection events**
  - Detect event – Time corresponding to object entering zone of detection
  - Undetect event – Time corresponding to object leaving detection zone

- **Data filtering, for sensors inside crosswalk**
  - Bulk data analysis for vehicle/ped differentiation
  - Signal phase information – to segregate active pedestrian signal
  - Data fusion with magnetometers, to flag vehicle detection events
Demo - Pedestrian crosswalk active
Applications - Safety

Pedestrian safety.

- **Indirect safety/exposure statistics**
  - Cycle by cycle pedestrian occupancy, along with conflicting vehicle counts
  - Obtained with limited detection setup

- **Direct safety/exposure statistics**
  - Measure and reliably detect vehicle/pedestrians within the crosswalk
  - Obtained with enhanced coverage of crosswalk
Applications - Safety

Crosswalk occupancy/utilization with limited detection

- Cycle by cycle pedestrian occupancy obtained using data fusion.
- A proxy for pedestrian counts (which are difficult to measure).

Total Occupancy time – 1s
Applications - Safety

Crosswalk occupancy/utilization with limited detection

- Cycle by cycle pedestrian occupancy obtained using data fusion.
- A proxy for pedestrian counts (which are difficult to measure).

Total Occupancy time – 2.2s
Applications - Safety

Crosswalk occupancy/utilization with limited detection

- Cycle by cycle pedestrian occupancy obtained using data fusion.
- A proxy for pedestrian counts (which are difficult to measure).

Total Occupancy time – 12.8s
Applications - Safety

Crosswalk occupancy/utilization with limited detection

Crosswalk utilization ratio

\[
\frac{\text{Total Pedestrian occupancy}}{\text{Total Ped Walk} + \text{FDW}}
\]

- **Uses**
  - Dynamic Right turn on red signs.
  - Determine portions of day when pedestrian crosswalk usage is heavy, and dynamically not allow right turns on red.
  - Determine Time of day pedestrian signal actuation schedule.
Applications - Safety

Vehicle obstruction of pedestrian signals - Cycle by cycle measures.

- Compare proportion of time a car, pedestrian occupies the far side of the crosswalk. (Measure of conflicts).

![Graph showing pedestrian and car occupancy over time.](image)
Applications - Safety

Intersection safety characterization - Measuring rare events

- **Red Light Violations.**
  - Detect Red light violators, year round statistics.
  - Vehicle speeds for right turn on red.

- **Yellow light behavior.**
  - Determine statistics of vehicles crossing during yellow.

- **Permissive left turns.**
  - Compute headways gaps, and speeds in opposing through lanes.

- **Intersection safety analysis.**
  - Detect, capture conflicts.
Applications - Safety

Red light violations

Violator rate. All weekdays by Time of day

Total violations by weekday over 6 months by Time of day

SB – Through/Left turn shared lane
Safety-Critical Dynamics in Multi-Modal Transportation Systems

Ongoing research by SafeTREC, UC Berkeley

• Evaluating multi-modal safety at signalized intersections using surrogate measures of traffic safety

• Emphasis on routine monitoring over long periods of time so as to develop and validate theories with statistical significance

• A report card of multi-modal safety-critical dynamics:
  – Layer 1: Volume counts/mode shares
  – Layer 2: Mode-specific safety-critical dynamics (red-light running, jaywalking)
  – Layer 3: Multi-modal safety-critical dynamics (cars yielding to pedestrians)
Summary

Intersection Safety and Mobility System

- Reliable detection of pedestrians and vehicles
- Independent of controller
- 24x7 Safety Measures
  - Cross-walk Utilization
  - Vehicle-Pedestrian Occupancy
  - Red Light Violations
- 24x7 Mobility Measures
  - Turn Movement Counts
  - V/C Ratios
  - Signal Coordination
MTC - Tech Transfer Seminar
ATM Strategies for Arterials
Sept 30, 2015
Oakland, CA

Questions?
Demo - Pedestrian crosswalk active
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