Arterial Performance Measures Based on High Resolution Data

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Outline

- Background
- Signalized Intersections:
  - Performance measurement
  - Timing plan development
- Arterial Performance
  - ATCS assessment on Pacific Coast Highway
  - Proposals for control improvements
- Looking Ahead
Background (1): Traffic Flow Variability vs. Control

- Fixed-Time Plans
  - Time of Day (TOD)
  - No Detection
  - May be actuated

- Fixed time plans
- Traffic responsive plan selection
- System detection

- Traffic responsive control
- On-line timing development
- Approach & system detection

- Adaptive control
- Measure & predict arrivals per cycle
- Extensive detection
Background (2): Traffic Control Systems

- Most signal systems fixed-time control
  - Limited data
  - Out-dated timing plans

- Adaptive systems
  - High cost
  - Complex to understand and operate

Source: Alek Stevanovic, NCHRP Synthesis 403
**Approach: Use of HR data**

- **Performance measures for operators and travelers**
  - Use of existing infrastructure
  - No interference with controller operation

- **Improving Signal Timing Plans**
  - Performance derived signal settings
  - Robust timing plans

- **On-Going/Future Work**
  - Traffic volume prediction
  - Safety (red light running)
  - Multimodal (pedestrians, bicycles)

*Work with P. Varaiya & Sensys Networks
“Management of Urban Traffic with H-R Data” IEEE ITSC 2014*
Data Collection System

- Stop bar detectors
- Departure lane detectors
- Advance lane detectors

Sensys SNAPS Server
Data fusion, and application deployment

NEMA/2070/170
EDL Conflict Monitor

AP

NETWORK HUB

Cellular

Modern
Selected Test Site: Beaufort, SC
Intersection Volume: Daily Variation

2/28/2015, 7AM to 8PM

Peak Period, 4-7 PM

Total volume (veh/cycle)

Total volume (veh/15 minutes)
Approach Volumes & Turning Movements

Peak Period, 4-7 PM

Approach Volume (veh/15 min)

Turning Mov - Leg 2 (veh/15 min)
**Signal Phase Operations**

**Wasted green time**: time phase is active with no vehicle present and conflicting phase call

**Vehicle arrivals**: % arrivals on green
Performance: Average Delay (sec/veh)
HCM Level of Service (LOS)

Through movement, Leg 1

Through movement, Leg 2

Left turn movement, Leg 1

Right turn movement, Leg 2
Performance: V/c and LOS

(V/C) = (v*C/g*s)

S: Sat flow (max discharge rate)

LOS: Level of Service per HCM

Shift green time
Improving Signal Timing Plans

- Volume clustering – best set of volumes for the three timing plans available
- New timing plans reduce intersection signal delay by 10% on average
ATCS Assessment

- 5 mile Section of Pacific Coast Highway (PCH)
- Nine signalized intersections
- LADOT ATCS Control System
Data Sources

- **Data Collection Periods**
  - Preliminary ATCS Data Collection (ATCS-2012): 4 days
  - Primary ATCS Data Collection (ATCS): 8 days
  - TOD-230 Data Collection (TOD-230): 6 days
  - TOD Optimized Data Collection (TOD-Optimized): 6 days

- Detector data
- Signal Timing data
- Bluetooth data
- Probe vehicles
- Video cameras
Comparison of Data Sources

PCH Travel Times --Probe Vehicles vs. Bluetooth

SB PCH Travel Times

- Travel times based on Bluetooth data — Median and inter-quartile range
- Travel times based on probe vehicles — Median and inter-quartile range
- Difference at this time is significant at 5% level

NB PCH Travel Times
NB PCH Travel Times: ATCS vs. TOD Plan

ATCS — Travel time median and inter-quartile range
TOD-230 Timing Plans — Travel time median and inter-quartile range

Difference at this time is significant at 5% level
SB PCH Travel Times: ATCS vs. TOD Plan

- ATCS — Travel time median and inter-quartile range
- TOD-230 Timing Plans — Travel time median and inter-quartile range
- Difference at this time is significant at 5% level
Inefficient Splits:

- At the Bottleneck Location
- At intersections upstream of the Bottleneck
Wrong Offsets Downstream of the Bottleneck
Looking Ahead: Speculation

- Capacity
- Air quality
- Current technologies
- Automation
- Connected Veh
- ATM
- Safety
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