Getting There from Here: Traffic Modeling, Data Streams, and Prediction for Connected Vehicle Systems Planning and Operations

Toronto, 1959

Los Angeles, 2009

Pilot Project Evaluation - Closed Circuit Television (circa 1959)

Alexander Skabardonis

Chicago, IL, July 23, 2017
The Promise..
Data, Data, Data…..

**Conventional Paradigm:**
Collect the minimum data on a “Typical Day” at a Single Location

**Now**
Progress: HR Data – Traffic Signals

Danville Intersection

HR Data Application: Intersection Performance

15 min V/C and LOS

Shift green time
Data, Data, Data.... _CAVs

V2V: reduction in tart up lost time & saturation headway
V2I: Each Vehicle a sensor

MultiModal Intelligent Traffic Signal System (MMITSS)

L Head, Presentation, TRB Signal Systems Committee, Tucson, AZ, 2016
CAVs & Traffic Signals: Dynamic Lane Grouping

- Average Delay (sec/veh)
- % Left Turns

Graph showing the relationship between % Left Turns and Average Delay (sec/veh) for FIXED and DLG conditions.
CAVs: ECO-Driving

Messages
“Here I am”
Signal Phase & Timing (SPaT)

Speed Advisory
(source: UC PATH & BMW)

Field Test
14% Reduction in Fuel Use
Challenges

- Data
  - Penetration Rate (will change over time)
  - Communication Protocols
  - Operational Characteristics
  - Regulations

- Agencies Operational Analyses ("Highway Capacity Manual Procedures")
  - Use of “adjustment factors”
    - Example: Critical Intersection control strategy improves intersection capacity by 7%

Source of factors
- Field data (not yet available)
- Simulation (assumptions)
Impact of Penetration Rates: NGSIM Data
CAVs Saturation Headway
CAVs Freeways

Background: AHS Implementation

- Dedicated AHS lanes
- Automated Check-in
- Automated Check-out
- Lateral and Longitudinal Controls
- Automated merging/diverging
- Malfunction Management & Analysis

AHS Demo: San Diego 1997
Models: Capacity of AHS Lane

Capacity \( C = \frac{v \cdot n}{[n s + a(n - 1) + d]} \) veh / lane / hour

Assume \( v = 72 \text{ k/h}, s = 5\text{m}. \) Then

<table>
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<th>n</th>
<th>a</th>
<th>d</th>
<th>C</th>
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<tr>
<td>1</td>
<td>-</td>
<td>30</td>
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<td>15</td>
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<tr>
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Notes
- \( n=20 \) yields nearly 4 times today's capacity
- Capacity proportional to speed
Model: CACC Lane Capacity

Cooperative Adaptive Crouse Control (CACC)
Challenges

- **Data**
  
  Current TMC systems are not equipped to handle CAV data. No standards/procedures for collecting, processing, integrating CAV data into existing operations.

- **Models**
  
  - Simplified assumptions on car-following-lane changing
  - Interactions with manually driven vehicles
  - Calibration to real trajectories – not CAVs
  - Operational and communication protocols

- **Agencies on Operational & Planning Analyses**

  Use of “adjustment factors”
  
  What will be the capacity of freeway lane? What link capacity to use in 2030 transportation plans? Pool Fund Study-Oregon DOT
Implementation Challenges
Background: Initial Deployment Plans

Planned US VII Deployment’06