Modeling Autonomous Vehicles

presented by

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12/9/2015
“... a paradigm shift in travel behavior”

- **Trip Generation**
  - Increases due to non-person Trips
  - Less Reliance on Auto Ownership

- **Distribution**
  - AV Trip Length
  - Non-person Trips

- **Assignment**
  - Lane Capacity
  - Vehicle Speed
When is this going to happen?

Audi wanted to demonstrate the reality of autonomous driving by having journalists hop into a tech-packed A7 concept as it navigated 550 miles from Silicon Valley to CES. Mission accomplished, and Audi said a production version of that same technology should appear in its flagship A8 sedan in 2017.

Toyota $1B Research Labs Near Stanford, MIT to Develop Autonomous Vehicles

November 6, 2015

Tesla's new software helps Model S drive itself

With the latest version of Tesla's electric car software, drivers with year-old and newer Model S sedans get a new suite of Autopilot features that take over some driving chores from humans.

11/9/2015
How Do We Forecast AV?

- Identify AV trips
- Estimate AV effects
Test Case Implementation (D1RPM)

Assumes Level 3 Automation (driver available for occasional control)

- Estimate AV Trips by TAZ
- Estimate Roadway Capacity Adjustments
Inputs

Network

- FT 95 for AV only Facilities
Inputs

- Estimated Systemwide AV Saturation Rate {Key}

- Lookup Tables
  - Home Based AV Auto Ownership Weighted by Household Income
  - Roadway Capacity Adjustment by Facility Type / Saturation Rate
Modeling Autonomous Vehicles

Capacity Adjustment Factors - based on AV Saturation Rate by FT:

<table>
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<tr>
<th>SAT</th>
<th>FT10</th>
<th>FT20</th>
<th>FT30</th>
<th>FT40</th>
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</table>

(estimate - to be refined as more information becomes available)
Modifying Script

Factor capacity by AV saturation rate / facility type:

```
; STORE AV CAPACITY FACTOR
IF (PTYPE=10-19) FC=AV(1, [AV_SATURATION])
IF (PTYPE=20-29) FC=AV(2, [AV_SATURATION])
IF (PTYPE=30-39) FC=AV(3, [AV_SATURATION])
IF (PTYPE=40-49) FC=AV(4, [AV_SATURATION])
IF (PTYPE=50-59) FC=AV(5, [AV_SATURATION])
IF (PTYPE=60-69) FC=AV(6, [AV_SATURATION])
IF (PTYPE=70-79) FC=AV(7, [AV_SATURATION])
IF (PTYPE=80-89) FC=AV(8, [AV_SATURATION])
IF (PTYPE=90-94, 96-99) FC=AV(9, [AV_SATURATION])
IF (PTYPE=95) FC=3
```

Weight AV ownership by Income:

```
; STORE AV FACTOR
IF (_HHINC<50000) 
  FC=0.8*(AV_SATURATION)
ELSEIF (_HHINC>100000)
  FC=1.2*(AV_SATURATION)
ELSE
  FC=1.0*(AV_SATURATION)
ENDIF
```

Exclude non-AV vehicles from AV only Facilities:
Modeling Autonomous Vehicles

Outputs

- Network with AV Capacity Adjustments
- Trip Tables – AV and Non AV by Purpose

### TRIP TABLES BY PURPOSE

<table>
<thead>
<tr>
<th>Purpose</th>
<th>HBW1</th>
<th>HBW2</th>
<th>HBSH</th>
<th>HBSR</th>
<th>HBO</th>
<th>HBSC</th>
<th>HBCU</th>
<th>NHB</th>
<th>TT</th>
<th>IE</th>
<th>EE-a</th>
<th>EE-t</th>
<th>HT</th>
<th>AIR</th>
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<tbody>
<tr>
<td>NONAV</td>
<td>911,230</td>
<td>1,318,880</td>
<td>1,661,265</td>
<td>1,297,593</td>
<td>2,166,552</td>
<td>579,151</td>
<td>243,456</td>
<td>2,467,023</td>
<td>543,351</td>
<td>230,269</td>
<td>50,076</td>
<td>5,434</td>
<td>40,337</td>
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<tr>
<td>AV</td>
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<td>853,911</td>
<td>963,474</td>
<td>793,701</td>
<td>1,316,413</td>
<td>338,754</td>
<td>142,306</td>
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<td>46,224</td>
<td>5,016</td>
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<tr>
<td>TOTAL</td>
<td>1,384,349</td>
<td>2,172,791</td>
<td>2,624,739</td>
<td>2,091,294</td>
<td>3,482,965</td>
<td>917,905</td>
<td>385,762</td>
<td>4,744,275</td>
<td>1,044,906</td>
<td>442,825</td>
<td>96,300</td>
<td>10,450</td>
<td>77,571</td>
<td>23,936</td>
</tr>
</tbody>
</table>

- Loaded Network - Trip Assignment with AV purpose(s)
Assignment (45% AV Saturation)
Additional Considerations:

- Driverless Vehicles (Level 4 Automation)
- Auto Ownership Rates / Trip Generation
- AV Trip Length / Distribution
- Observed Lane Capacity with AV
- Mode Choice
- Increased VMT