**Introduction**

What Connected Automated Vehicles offer for traffic design and operation?
- V2V and V2I
- CACC for traffic stability
- Platooning for capacity increase
- Advanced merging assistance

This study is an attempt to answer two questions:

- **a)** Can we assist one vehicle merging at a time into platoons without waiting for a gap?
- **b)** Can we maintain the mainline traffic condition?

**Methods**

Hypothesis: the merging controller can improve travel time on the merge area!

Distance and Travel time estimations

On-ramp Vehicle & Platoons’ Actions
- **Speeding up** ($P_1$)
- **Slowing down** ($P_2$)
- **Changing lanes** ($P_3$)
- **Speeding up** (on-ramp vehicle, $O_1$)

The cost $C_{ij}$ for each set of concurrent $O_y$ and $P_x$ is represented by:

$$C_{ij} \big| O_y i \text{ and } P_x i = \hat{t}_j + \sum_{i} \hat{t}_i$$

**Results**

Evaluation of the merging controller in simulation model for a one-mile two-lane freeway merging area

**Table: Platoon Parameters**

<table>
<thead>
<tr>
<th>Simulation Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desired Speed (mph)</td>
<td>60</td>
</tr>
<tr>
<td>intra-platoon gap (sec)</td>
<td>0.6</td>
</tr>
<tr>
<td>inter-platoon gap (sec)</td>
<td>1.3</td>
</tr>
<tr>
<td>ramp flow (vphpl)</td>
<td>360</td>
</tr>
</tbody>
</table>

The performance of the merging controller (MC) is compared to cooperative deceleration (CD) under different traffic conditions.

### Travel Time Results in Simulation for With and Without Controller

**Conclusions**

- The proactive actions by the mainline and on-ramp vehicles in the simulation widened the gaps to merge smoothly into platoons.
- The simulation results showed that the merging algorithm reduced the onramp and the mainline travel times up to 55% and 85% for the heavier traffic conditions.

**References**