Automated and connected vehicle technology has created many opportunities for traffic control innovation. The ability to communicate from vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) along with automated vehicle technology have made it possible to optimize traffic flow more efficiently. The objective of this study is to develop an algorithm to provide a smooth and safe merging operation for fully automated connected vehicles, while minimizing the total travel time experienced by motorists. A hypothetical merging segment is created in the CORSIM microsimulator to evaluate the effectiveness of the merging algorithm based on total travel time and throughput.

**Introduction**

The developed merging algorithm divides the merging segment into three zones. Communication occurs every second between the vehicles and the controller located in the gore area. Trajectories of the vehicles entering the communication zone are optimized by minimizing the total travel time.

- **Zone I**
  - Incoming mainline vehicles communicate with the controller and are assigned speeds to harmonize the mainline traffic prior to the merging area. This allows gaps to be created more easily in Zone II where conflicts occur.
- **Zone II**
  - Gaps are created in the mainline traffic stream to allow ramp vehicles to merge. At the same time ramp vehicles are given trajectory information to perform the merge as efficiently as possible. The objective of the optimization is to minimize total travel time.
- **Zone III**
  - Mainline vehicles maintain acceptable gaps while the ramp vehicles complete the merging maneuver. Once the vehicles leave Zone II, they are no longer any influence from the controller.

**Zone II Problem Formulation**

The microsimulator CORSIM is used in conjunction with the optimization modeling software LINGO to simulate the merging segment. Results can be compared on the same merging segment with and without the merging algorithm in use.

- **Vehicle and Network Assumptions**
  - Vehicles are fully automated (Level 4 NHTSA) and equipped with DSRC capabilities
  - Data packet transmission includes vehicle position, speed, acceleration, and size
  - Simulation duration of 900 second, network free flow speed is 65 mph, no trucks
  - Mainline and ramp demand is 1700 and 800 vphl respectively
  - For testing, a saturation headway of 1 sec is used

**Simulation and Testing**

**Optimized Trajectories**

**Initial Results**

**Continued Research**

- Expand the merging algorithm to accommodate a varying number of mainline and ramp lanes
- Incorporate the error associated with data transmission accuracy and vehicle translation to guarantee the safety of the algorithm
- Evaluate the algorithm performance considering a percentage of non-equipped vehicles in the traffic stream
- Include heuristics to govern the merging during non-congested conditions to reduce computational demand