**CONTRIBUTIONS**

- A new concept of spatially and temporally heterogeneous IVSL design is proposed; i.e., a vehicle may adopt different speed limits at different portions of a road segment at different times.
- Mixed traffic, i.e., CVs and HVs, is considered in mixed traffic longitudinal trajectory control to achieve the optimal system performance for the whole vehicle platoon.

**INTRODUCTION**

Traffic signals on urban highways force vehicles to stop frequently and accelerate/decelerate abruptly, and thus cause excessive travel delay, extra fuel consumption and emissions, and increased safety hazards.

This paper proposes a Longitudinal Trajectory Control (LTC) method with pre-fixed traffic signals. This method dynamically imposes speed limits on some identified Target Controlled Vehicles (TCVs) with Vehicle to Infrastructures (V2I) communication ability at two VSLs along an approaching lane. Essentially, only TCVs trajectories need to be controlled and the other vehicles just follow TCVs with clipper self-following model. In addition, queuing effect of HVs and CVs market penetration rate are considered in mixed traffic situations.

**METHODOLOGY**

Traffic dynamics:

- For TCV (specified lead CAV in platoon):
  \[ e(p) + \Delta t = \min(e(p) + \Delta t, \max(e(p) + \Delta t, 15.0 \%)) \]
  subject to \( e(p) + \Delta t \in [0, 15.0 \%] \)

- For non-TCV (HV and part CAVs):
  \[ e(p) + \Delta t = \begin{cases} \max(e(p) + \Delta t, 0.0 \%), & \text{if } e(p) + \Delta t \leq 1.0 \% \\ \min(e(p) + \Delta t, 15.0 \%), & \text{if } e(p) + \Delta t > 1.0 \% \end{cases} \]

\( e(p) \) denotes the vehicle market penetration rate.

**NUMERICAL TESTS**

Test 1: Solution Performance

- Objective shape is not unimodal:
  - But the variation is bounded continuous

Solution converges to optimal as iteration increases

Test 2: System Performance

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**CONCLUSIONS**

- This paper proposes a novel vehicle longitudinal trajectory control method (i.e. LTC) with spatially and temporally heterogeneous design.
- LTC can find the global optimal solution due to the bounded continuous of objective function.
- LTC optimally balances trajectory smoothing and queue storage at different Volume/Capacity ratios under different traffic demands.
- Market penetration rate does affect the effectiveness of LTC, and LTC performs more robust than ASL at a low market penetration rate.