



MULTIRESOLUTION MODELING OF AUTOMATED AND CONNECTED AUTOMATED VEHICLES ON MANAGED LANES CONSIDERING COMPLEX WEAVES



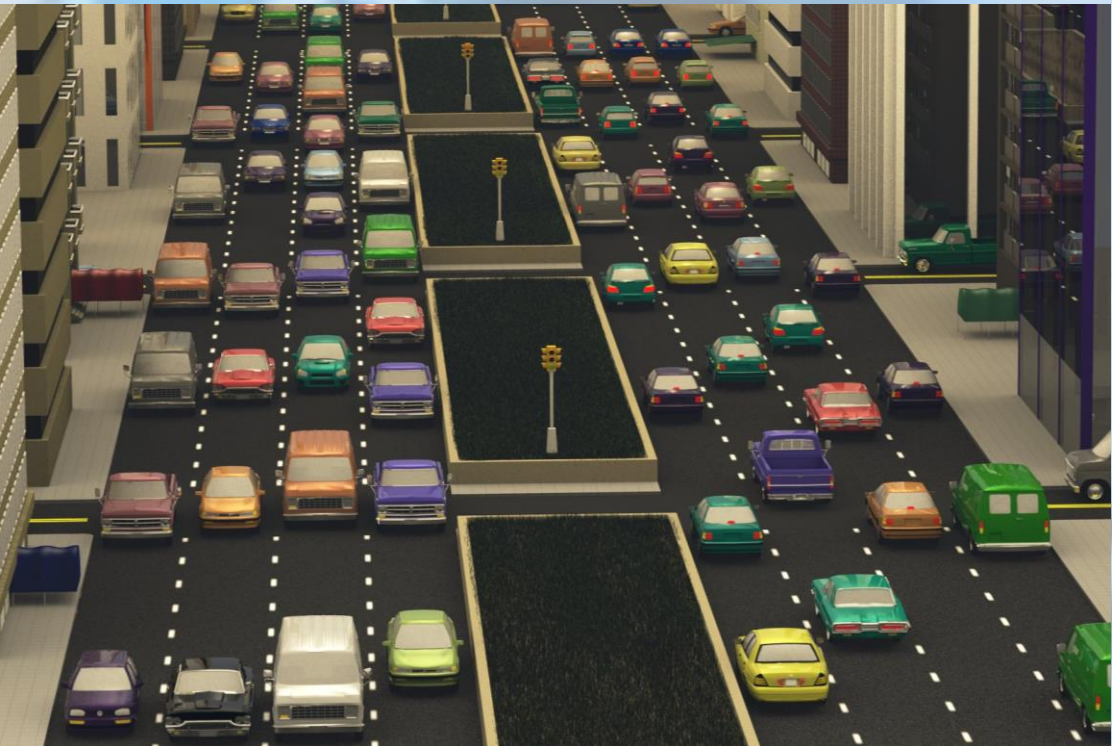
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Introduction

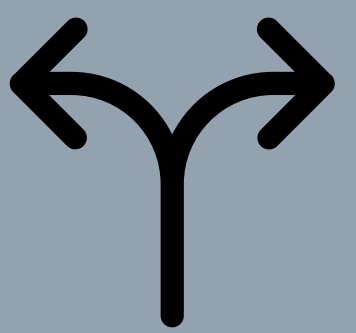
Analysts have investigated CAVs operations on managed lanes or dedicated lanes for their impact, mainly on safety. However, most managed lanes are associated with complex weaving segments.



When CAVs exit the managed lanes, whether in platoons or not, they will merge onto the weaving segment with other traffic. It is not clear how CAVs with different combinations of car-following and lane-changing algorithms will affect traffic operations of a complex weave, and whether cooperation and connectivity will block other vehicles from merging onto the complex weave

Research Objective

Develop a methodology for modeling the impact of CAVs in complex weaving segments considering the car-following and lane-changing behaviors of heterogeneous traffic in terms of vehicle technology



Methodology

- Capacity estimation of a complex weave:
 - HCM6 weaving segment methodology
 - Methods from literature
 - Real-world observations
- Calibrate complex weave in VISSIM for existing conditions by altering car-following & lane-changing parameters
- Investigate VISSIM’s default AV driving behaviors

PTV

VISSIM

Results

Calibration for Existing Conditions

Capacity estimation of a complex weave

| Model | Capacity |
|-----------------------------|-------------------------|
| HCM6 Weaving Model | 2,080 Vehicle/hour/lane |
| Roupail et al. (2021) Model | 1,882 Vehicle/hour/lane |
| Real-World Observations | 1,660 Vehicle/hour/lane |

VISSIM calibration of a complex weave for existing traffic

| | Parameter | Default Values – Freeway Segments | Calibrated Parameters – Complex Weaving Segment |
|------------------------------|--|-----------------------------------|---|
| Lane Changing | Min. Clearance (ft) | 1.64 | 1.97 |
| | Safety Distance Reduction Factor | 0.6 | 0.3 |
| | -1 ft/s ² per distance (ft) | 200 | 656 |
| | Lane Change Distance (ft) | 656 | 5280 |
| Capacity (vehicle/hour/lane) | | 888 | 1662 |

CAVs in VISSIM

CAFs for CAVs in HCM from literature

| | Volume Ratio | | |
|---------|----------------------------|------|------|
| | 0.2 | 0.3 | 0.4 |
| MPR (%) | Capacity Adjustment Factor | | |
| 0 | 1.00 | 1.00 | 1.00 |
| 20 | 1.05 | 1.05 | 1.08 |
| 40 | 1.11 | 1.13 | 1.14 |
| 60 | 1.17 | 1.20 | 1.18 |
| 80 | 1.25 | 1.26 | 1.24 |
| 100 | 1.37 | 1.38 | 1.35 |

Capacity with 100% CAVs using different models

| CAV Model | | Capacity |
|----------------------------------|---------------------------|------------------------|
| VISSIM Default Driving Behavior | AV Cautious | 840 Vehicle/hour/lane |
| | AV Normal | 1788 Vehicle/hour/lane |
| | AV Aggressive/All-Knowing | 1501 Vehicle/hour/lane |
| HCM CAFs for 100% CAVs, VR = 0.2 | | 2274 Vehicle/hour/lane |

Upcoming Tasks

- Develop and code lane-changing algorithm coupled with CACC/ACC in complex weaves
- Perform feedback loop between microscopic and mesoscopic (DTA-based simulation) resolutions

Contribution

- Providing a calibration method of a complex weaving segment in microscopic simulation
- Developing a methodology for modeling CAVs equipped with both car-following and lane-changing behaviors