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
Rouphail 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**