



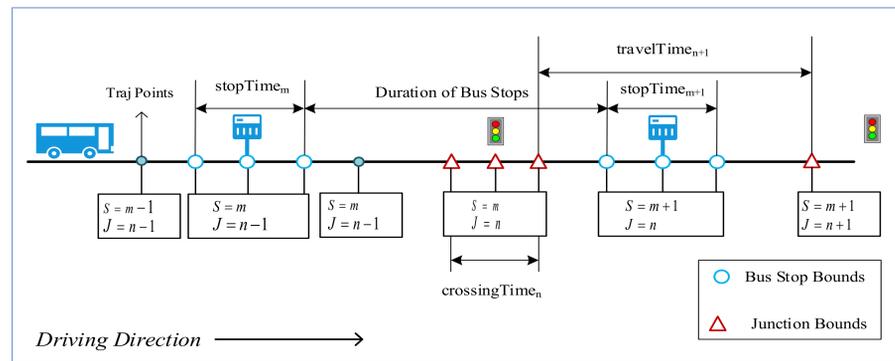
The 25th COTA International Conference of Transportation Professionals Transportation • Artificial Intelligence (AI) • Energy

July 22nd – 25th, 2025 Guangzhou, China

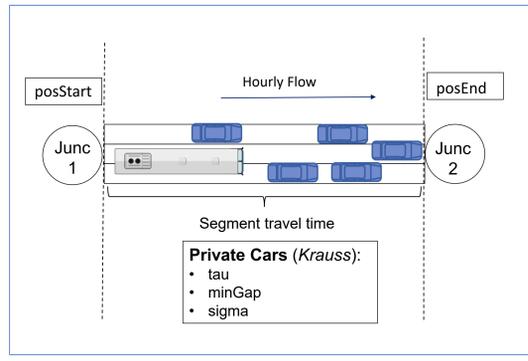
Integrating multi-source data to reconstruct the traffic flow conditions along bus routes



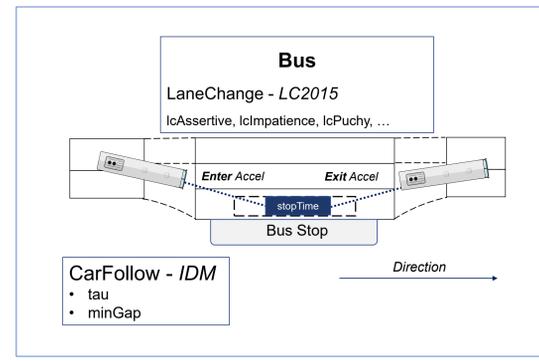
Yiyang Chen; Xu Li; Junsheng Du; Yuting Wang;
Zhenwu Chen; and Zhaocheng He*



Key state classifications of an operating bus



Scenario 1: Interference of private cars on a bus on road sections



Scenario 2: Kinematic behavior of a bus entering and exiting the station

Background

Traffic flow condition reconstruction

Sensors: AFC, GNSS

Basis: GIS map, bus GPS data, traffic volume data, ...

Application: online bus operation forecasting, public transport service scheduling optimization

Methodology

Real-to-simulation data mapping

- Segment driving: Segment generation, Edge-segment correspondence
- Station Behavior: Departure interval, Station type

Key state identification, Object position matching, Missing process completion

Travel time features, Bus stop features

Simulation data input: Edge Flow, Bus GPS Tracks

Simulation indicator statistics: Microscopic traffic simulation

Dual-layer simulation calibration

- Layer 1: segment travel time: Particle swarm optimization algorithm (PSO), Private car CF-model, Mean RMSE of travel time
- Layer 2: entry/exit station dynamics: Differential evolution algorithm (DE), Bus CF-model & LC-model, Mean RMSE of acceleration

Results verification: Bus operation duration, speed distribution on road

Case Study & Future Work

A bus loop in a megacity

21.8 kilometers, 45 stations, 29 junctions, 30 segments, 120 edges

The original data lacks accurate line information.

Segment calculation & Calibration

Period	Real	Simulation (Original)	Simulation (no stop)	Simulation (add stop)	Final Error (add stop)
8-9 a.m.	84.45	72.45	61.97	77.85	7.8%
9-10 a.m.	92.38	76.95	66.95	85.97	6.9%
4-5 p.m.	89.01	73.00	65.75	82.16	7.7%
5-6 p.m.	90.67	74.73	68.57	84.78	6.5%

Comparison of Bus Total Travel Time

Absolute Error: Total travel time (of a bus) < 8%, Average acceleration < 0.6m/s²

Future Work: AFC data

- Time: entry, exit and boarding
- Bus stop types: roadside, bay, and mid-road

Contribution

- Problem:** the reproduction of the entire operation process of a single bus route
- Method:** a segmented recognition method for bus behavior
- Framework:** a dual-layer calibration framework for bus operation process

Data Analysis

- Heterogeneity of velocity distribution in critical states
- Changes in stop duration with peak conditions
- Differences in stop behavior between different station types

Research Flow Chart

- Generation of simulation scene
- Calibration of bus operation process

- Sobol sensitivity analysis
- Particle swarm optimization
- Differential evolution
- Parallel simulation

Krauss

$$S_i = \frac{\text{Var}_{X_i}(E(Y | X_i))}{\text{Var}(Y)}$$

Parameter	Meaning	Range	Model	Method
tau	minimum headway	[1, 2]	Krauss-IDM	PSO/DE
minGap	stationary spacing	[0.5, 3]	Krauss-IDM	PSO/DE
sigma	driver imperfection	[0, 1]	Krauss	PSO
lcAssertive	gap-accept willingness	[0, 10]	SL2015	DE
lcImpatience	dynamic factor	[0, 1]	SL2015	DE
lcPushy	encroach willingness	[0, 1]	SL2015	DE

Personal Website

Contact with us:

cheny553@mail2.sysu.edu.cn
lixu53@mail2.sysu.edu.cn
hezchh@mail.sysu.edu.cn
czw@sutpc.com

The author is looking for a PhD supervisor!