

Eunhan Ka

PH.D. STUDENT · LYLES SCHOOL OF CIVIL ENGINEERING, PURDUE UNIVERSITY

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Education

Purdue University

United States

DOCTOR OF PHILOSOPHY (PH.D.), LYLES SCHOOL OF CIVIL ENGINEERING

Aug. 2020 - present

- Topic Keywords: Network Traffic Dynamics, Connected and Autonomous Vehicles, Cyber Security, Deep Learning, Network Science
- Advisor: Dr. Satish V. Ukkusuri

Seoul National University

South Korea

MASTER OF SCIENCE (M.S.), DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING

Feb. 2018

- Thesis: A Simulation Study of Demand Responsive Transport for the Disabled to Minimize User Waiting Time
- Advisor: Dr. Chungwon Lee

Seoul National University

South Korea

BACHELOR OF SCIENCE (B.S.), DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING

Feb. 2016

Research Experience

Research Assistant

Aug. 2020 - Present

PURDUE UNIVERSITY

- Develop a pioneering framework to bolster road network resilience against cyber-attacks in extensive road networks and mitigate cyber attack's impact by using defense strategies. **(Sponsor: USDOT)**
- Introduce a groundbreaking framework for modeling traffic dynamics using physics-informed deep learning, enabling predictions of traffic impacts due to connected and autonomous vehicles in cyber-physical systems within large-scale urban areas.
- Predict origin-destination (OD) matrices by using mobile location data **(Sponsor: INDOT)**
- Analyze the traffic impact of movable barrier (Alex Fraser Bridge) in Vancouver by leveraging the mobile location data with static traffic assignment **(Sponsor: Lindsay Corporation)**

Researcher

Mar. 2018 - Aug. 2020

SEOUL NATIONAL UNIVERSITY

- Led a study on designing a cluster-based route of multi-capacity vehicles of demand-responsive transport services for the disabled **(Sponsor: T-Money Welfare Foundation, South Korea)**
- Developed optimal operation strategies of Mobility-as-a-Service (MaaS) for the mobility impaired **(Sponsor: National Research Foundation of Korea, South Korea)**
- Modelled lane change behaviors on freeways and gap acceptance behaviors at roundabouts in real driving situations and virtual reality **(Sponsor: Ministry of Land, Infrastructure and Transport, South Korea)**
- Collaborated and coordinated with faculty members, businessmen, researchers, and graduate students at University of Seoul, Radius Corporation, Korea Land & Housing Institute

Research Assistant

Mar. 2016 - Feb. 2018

SEOUL NATIONAL UNIVERSITY

- Designed a real-time relocation strategy for one-way car-sharing and developed an event-based simulation for one-way car-sharing services (**Sponsor: National Research Foundation of Korea**)
- Led a study on improving demand-responsive transport services for the disabled with shared mobility in Seoul (**Sponsor: T-Money Welfare Foundation, South Korea**)
- Developed an evaluation method to evaluate drivers' behaviors with surrogate safety measures (**Sponsor: Ministry of Land, Infrastructure and Transport, South Korea**)
- Collaborated and coordinated with faculty members, businessmen, and researchers at the Korea Transport Institute, Korea Transportation Safety Authority, and InnoSim

Teaching & Mentoring Experience

Teaching Assistant

Jan. 2021 - Present

LYLES SCHOOL OF CIVIL ENGINEERING, PURDUE UNIVERSITY

- CE 597 - Network Models for Connected Autonomous Vehicles (Fall 2023, Spring 2023, Spring 2022, Fall 2021, Graduate)
- CE 597 - Smart Logistics (Fall 2021, Graduate)
- CE 597 - Data Science for Smart Cities - CE597 (Fall 2023, Spring 2021, Graduate) [link]

Lecturer

Nov. 2019

DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING, SEOUL NATIONAL UNIVERSITY

- Introduction to Civil and Environmental Engineering (Transportation Engineering)

Teaching Assistant

Sep. 2016 - Dec. 2017

DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING, SEOUL NATIONAL UNIVERSITY

- Sustainable Transportation Systems (Fall 2017, Undergraduate)
- Advanced Transportation Operation (Spring 2017, Graduate)
- Leadership for Civil Engineers (Spring 2017, Undergraduate)
- Introduction to Transportation Engineering (Fall 2016, Undergraduate)

Publications

IN REVIEW & PREPARATION

4. **Ka, E.** and Ukkusuri. S. V. (Preparation). Strategic Sampling Techniques to Boost Learning Efficiency in Physics-Informed Neural Networks with Traffic Flow Models. .
3. **Ka, E.**, Xue, J., and Ukkusuri. S. V. (Preparation). Finite-based Physics-Informed Neural Networks with Vehicular and Pedestrian Traffic Flows. .
2. Verma, R., **Ka, E.**, and Ukkusuri. S. V. (Preparation). Long-Term Forecasts of Statewide Travel Demand Patterns Using Large-Scale Mobile Phone GPS Data: A Case Study of Indiana. .
1. Xue, J., **Ka, E.**, and Ukkusuri. S. V. (In Review). Network Macroscopic Fundamental Diagram-Informed Graph Learning for Traffic State Imputation. *Transportation Research Part B: Methodological*.

REFEREED JOURNAL PUBLICATIONS

4. **Ka, E.**, Xue, J., Leclercq, L., and Ukkusuri. S. V. (Accepted, 2024). A Physics-Informed Machine Learning for Estimating Traffic State with a Generalized Bathtub Model in Large-scale Urban Networks. *Transportation Research Part C: Emerging Technologies*.
3. **Ka, E.**, Sharma, S., and Ukkusuri, S. V. (2022). Leveraging Location-Based Data for Assessing Network-Level Traffic Impact of Lane Management: A Case Study of Alex Fraser Bridge. *Journal of Transportation Engineering, Part A: Systems*, 148(12), 04022105. <https://doi.org/10.1061/JTEPBS.0000760>. [2022 Editor's Choice Collections].

2. **Ka, E.**, Kim, D. G., Hong, J., and Lee, C. (2020). Implementing Surrogate Safety Measures in Driving Simulator and Evaluating the Safety Effects of Simulator-Based Training on Risky Driving Behaviors. *Journal of advanced transportation*, 2020. <https://doi.org/10.1155/2020/7525721>.
1. Lee, D., Hwang, S., **Ka, E.**, and Lee, C. (2018). Evaluation of the Rain Effects on Gap Acceptance Behavior at Roundabouts by a Logit Model. *Journal of Advanced Transportation*, 2018. <https://doi.org/10.1155/2018/2726732>.

REFEREED CONFERENCE PROCEEDINGS

14. Xue, J., **Ka, E.**, and Ukkusuri, S. V. (2024). Network Macroscopic Fundamental Diagram-Informed Graph Learning for Traffic State Imputation. *ISTTT25: 25th International Symposium on Transportation and Traffic Theory*, Ann Arbor, MI, United States.
13. **Ka, E.**, Xue, J., and Ukkusuri, S. V. (2024). PIDL-PedFlow: A Physics-Informed Deep Learning Approach for Macroscopic Continuum Pedestrian Flow Modelling. *103rd Annual Meeting of the Transportation Research Board*, Washington DC, United States.
12. Xue, J., **Ka, E.**, Mondal, W. U., and Ukkusuri, S. V. (2024). Generating Network-Level Dynamic Traffic Equations Using Symbolic Regression. *103rd Annual Meeting of the Transportation Research Board*, Washington DC, United States.
11. Sharma, S., and **Ka, E.** (2024). Leveraging Location-Based Data for Assessing Network Level Traffic Impact of Lane Management: A Case Study of Alex Fraser Bridge. *103rd Annual Meeting of the Transportation Research Board*, Washington DC, United States. [The 3rd Journal in REFEREED JOURNAL PUBLICATIONS will be presented].
10. **Ka, E.**, and Ukkusuri, S. V. (2023). Dynamic Routing Games for Connected and Autonomous Vehicles with Traffic Congestion: A Mean Field Game Approach. *2023 INFORMS Annual Meeting*, Phoenix, AZ, United States.
9. **Ka, E.**, Ka, D., Jung, Y., and Lee, C. (2020). A Cluster-Based Route Design of Multi-Capacity Vehicle in Large-Scale Demand Responsive Transport Service for the Disabled. *99th Annual Meeting of the Transportation Research Board*, Washington DC, United States.
8. **Ka, E.**, Hong, D., Na, Y., and Lee, C. (2018). Analysis of Status in DRT Service for the Disabled in Seoul and Comparison Domestic and Foreign Cases. *International Conference for Road Engineers*, Jeju, South Korea.
7. Hong, D., **Ka, E.**, Ha, S., and Lee, C. (2018). Selection of Appropriate Hyperparameter for Waiting Time Prediction Model for Demand Responsive Transport for the Disabled in Seoul Using Long Short-Term Memory (LSTM) Network. *78th Korean Society of Transportation Conference*, Wonju, South Korea. [Out-standing Paper Award].
6. **Ka, E.**, Ha, S., Hong, J., and Lee, C. (2017). Application of Deep Learning for Demand Forecasting of Call Taxi for the Handicapped in Seoul. *77th Korean Society of Transportation Conference*, Seoul, South Korea.
5. **Ka, E.**, Kim, S., Hong, J., and Lee, C. (2017). A Preliminary Study of Comparison with Lane Changing Model Parameters in Merging Area between Normal and Raining Conditions. *12th International Conference of Eastern Asia's Society for Transportation Studies (EASTS)*, Ho Chi Minh, Vietnam.
4. **Ka, E.**, Woo, D., and Lee, C. (2016). The Importance of Demand Prediction for Vehicle Relocation Strategy Development in One-way Car-sharing System. *3rd International Conference on Computational Science and Engineering*, Ho Chi Minh, Vietnam.
3. **Ka, E.**, Kim, S., Woo, D., and Lee, C. (2016). An Estimation of Critical Gap for Gap Acceptance Model Applied to Lane Change of Surrounding Vehicles in Driving Simulator. *2016 Fall Korea Institute of ITS Conference*, Jeju, South Korea.
2. **Ka, E.**, Lee, S., Lee, J., and Lee, C. (2016). Comparison of Survival Model of Traffic Flow Deterioration due to Traffic Accident according to VDS Aggregation Level. *75th Korean Society of Transportation Conference*, Busan, South Korea.

1. Lee, S., Lee, H., Lee, J., **Ka, E.**, and Lee, C. (2016). Analysis of Traffic Flow Impacts of Highway Traffic Accidents Using Survival Analysis. *74th Korean Society of Transportation Conference*, Jeju, South Korea. [Outstanding Paper Award].

Awards, Fellowships, & Grants

Crooks Travel Scholarship	\$ 500	Sep. 18, 2023
Lyles School of Civil Engineering, Purdue University		
Outstanding Paper Award		Mar. 10, 2018
78th Conference of Korean Society of Transportation, Korean Society of Transportation		
Lecture & Research Scholarship	\$ 4,500	Sep. 2016
Dept. of Civil and Environmental Engineering, Seoul National University		
Brain Korea 21 Plus Scholarship	\$ 2,400	Mar. 2016
National Research Foundation of Korea		
Need-based Scholarship	\$ 500	Mar. 01, 2016
Dept. of Civil and Environmental Engineering, Seoul National University		
Outstanding Paper Award		Feb. 19, 2016
74th Conference of Korean Society of Transportation, Korean Society of Transportation		
Alumni Association Scholarship	\$ 3,000	Oct. 25, 2015
Alumni Association of Dept. of Civil Engineering, Seoul National University		
Bronze Award	\$ 400	June 17, 2013
6th Science and Technology Writing Excellent Research Paper Presentation Competition, College of Engineering, Seoul National University		

Professional Activities

REFeree SERVICE

- **Journal Referee:**
Transportation Research Record: Journal of the Transportation Research Board;
Journal of Transportation Engineering, Part A: Systems;
Data Science for Transportation
- **Conference Referee :**
Transportation Research Board; ISTTT25 (Co-reviewer)

Skills

PROGRAMMING

- **Python (w/ TensorFlow, PyTorch, Keras, PySpark, and GeoPandas):** Machine learning and deep learning models based on TensorFlow, Pytorch, and Keras; Massive data (e.g., mobile phone location data) preprocessing for trip data extraction based on PySpark and GeoPandas
- **R:** Time-series analysis; Data preprocessing; Data clustering; Data visualization; Discrete choice modeling; and Statistical analysis
- **Java (w/ CPLEX):** Agent-based simulation (demand responsive transport services); Event-based simulation (one-way car-sharing services); Optimization models using the API of CPLEX

SOFTWARE

MATLAB(w/ Simulink), CPLEX, SPSS, NLOGIT, TransCAD, VISSIM, LaTeX, Windows, Linux (Ubuntu), and Mac OS