



IEEE ITSC 2025

Invited Session Proposal

- **Title:**

Innovative Applications of Large Language Models in Multimodal Transportation Systems

- **Modality:**

Half-day (e.g., 3 hours plus breaks)

- **Scope (no longer than 1 page), including the following sections:**

Motivation and general scope

Modern transportation systems face unprecedented challenges due to increasing demand, dynamic environments, and the need to integrate heterogeneous data from cyber-physical-social ecosystems. Traditional methods often struggle with fragmented data pipelines, static models, and human-machine interaction bottlenecks. The rapid evolution of Large Language Models (LLMs) offers transformative potential to address these challenges. LLMs such as GPT-4 and DeepSeek-R1, with their emergent capabilities in multimodal understanding, in-context learning, and human-like reasoning, are revolutionizing intelligent transportation systems (ITS) by evolving from mere text generators into versatile, knowledge-driven task solvers. By integrating LLMs into ITS, novel solutions can bridge fragmented data pipelines, enhance predictive analytics, simulate human-like reasoning, and enable closed-loop interactions across sensing, learning, modeling, and managing tasks in multimodal transportation systems.

By exploring cutting-edge applications—from traffic prediction and signal control to safety analytics and urban transport management—this session will showcase innovative applications of LLMs in multimodal transportation systems, including language-based interactions, improved predictive analytics, automated decision-making, multimodal data fusion, and human-centric system design and optimization. By grounding LLMs in multimodal transportation systems, it will highlight how LLMs can unlock new capabilities through roles such as information processors, knowledge encoders, module generators, and decision facilitators. Our session seeks to provide a platform for interdisciplinary exchange, showcasing state-of-the-art research, emerging use cases, and forward-looking perspectives on LLM-enabled ITS solutions.

Relevance to the ITS community

The ITS community is increasingly reliant on advanced data analytics and intelligent systems to address multimodal mobility challenges. LLMs bring a novel approach by seamlessly combining textual, visual, and sensor data to drive real-time decision-making and long-term strategic planning. The integration of LLMs into transportation aligns with the ITS community's goals of advancing efficiency, safety, and sustainability. Enhancing communication interfaces between human operators and automated systems.

Recent studies in the ITS community demonstrate early successes, yet systematic frameworks and standardized evaluations remain underexplored. This session will foster cross-disciplinary dialogue to accelerate LLM-driven innovations in the ITS community while discussing challenges such as computational costs, safety alignment, and ethical concerns. These contributions are poised to directly impact the future transportation systems, making the session highly relevant to ITS researchers, practitioners, and policymakers.

Topics of interest

This session will cover theoretical, methodological, and practical advances in this emerging field, with particular emphasis on *innovative LLM-empowered solutions for multimodal transportation*, including but not limited to:

- **LLM-enhanced sensing:** Integrating LLMs or VLMs for multimodal traffic data acquisition, fusion, translation, and analysis.
- **Knowledge-driven learning:** Prompt engineering, domain-specific LLM fine-tuning, few-shot learning, retrieval-augmented generation (RAG), and knowledge representation in predictive learning tasks such as traffic prediction, demand estimation, travel forecasting, and behavior modeling.



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IEEE ITSC 2025

- **Generative modeling in ITS:** Use LLMs to generate synthetic traffic scenarios, assist in the development of digital twins and simulation systems, design heuristic algorithms and functions, and provide feedback and evaluation.
 - **Intelligent decision making:** LLM-based traffic control, network optimization, mixed traffic flows, intelligent vehicles, human-in-the-loop interfaces, agent frameworks for complex tasks, and collaborative multi-agent coordination.
 - **LLMs in transport operation and management:** Applying LLMs in real-time traffic management, safety analytics, public transit, shared mobility, multimodal integration, Mobility as a Service (MaaS) platform.
 - **Innovative case studies and demonstrations:** Presentation of pioneering deployment where LLMs have been successfully integrated into real-world multimodal transportation systems.
 - **Ethical and operational considerations:** Discussions on the challenges and implications of deploying LLMs, including data privacy, interpretability, bias mitigation, scalability, and computational efficiency.
- **Organizers (names, affiliations, emails, and short bio):**

Name: Wei Ma

Affiliation: Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University

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Bio: Dr. Wei Ma received bachelor's degrees in Civil Engineering and Mathematics from Tsinghua University, China, master's degrees in Machine Learning and Civil and Environmental Engineering, and Ph.D. in Civil and Environmental Engineering from Carnegie Mellon University, USA. He is currently an assistant professor with the Department of Civil and Environmental Engineering at the Hong Kong Polytechnic University (PolyU). His research focuses on the intersection of machine learning, data mining, and transportation network modeling, with applications for smart and sustainable mobility systems. He receives awards for research excellence and his contributions to the area, including the 2020 Mao Yisheng Outstanding Dissertation Award, and best paper award (theoretical track) at INFORMS Data Mining and Decision Analytics Workshop. Dr. Ma is now serving in the Early Career Editorial Advisory Board on Transportation Research Part C: Emerging Technologies and Associate Editor of IEEE TITS.

Name: Tong Nie

Affiliation: Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University

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Bio: Tong Nie received his bachelor's degree in Civil Engineering from Tongji University, Shanghai, China. He is now pursuing dual Ph.D. degrees in Transportation Engineering and Civil & Environmental Engineering from both Tongji University and The Hong Kong Polytechnic University. His research interests include large language models in transportation, autonomous driving, and spatiotemporal modeling. He has published his research in top-tier journals and conferences in both AI and transportation, including KDD, AAAI, CIKM, IEEE TITS, TIV, ITSC, TR-Part C, and TR-Part E. He has served as a reviewer for several leading journals, including IEEE TITS, IEEE TKDE, and TR-Part C. His research is currently funded by the National Natural Science Foundation of China, where he serves as the principal investigator.

Name: Ziyuan Gu

Affiliation: School of Transportation, Southeast University

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Bio: Ziyuan (Frank) Gu is an Associate Professor with the School of Transportation at Southeast University, China. He obtained the Ph.D. degree from the University of New South Wales, Australia in 2019. His main research interests lie in modeling, simulation, and optimization of complex transportation systems. He has led or participated in several research projects including those from the National Natural Science Foundation of China and the Natural Science Foundation of Jiangsu Province. He serves as the Associate Editor of IET ITS and the Chair of the WTC Transportation System Model and Simulation-Based Decision-Making Technical Committee. He has received several research awards including the Best Paper Awards from CTS 2023 and ISMT 2023.

Name: Hai Vu





IEEE ITSC 2025

Affiliation: Department of Civil and Environmental Engineering, Monash University

Email: Hai.Vu@monash.edu

Bio: Hai Vu is a Full Professor and the recipient of the Australian Research Council (ARC) Future Fellow Award in the area of Intelligent Transport Systems (ITS). He joined Monash University in 2016 to lead the ITS research. Prior to that, he spent 5 years at the University of Melbourne and 11 years at Swinburne University of Technology where he has had established and led the Intelligent Transport Systems Lab in a joint partnership with VicRoads. He has over 19 years' experience as an academic and researcher.

Name: Lili Du

Affiliation: Department of Civil and Coastal Engineering, University of Florida

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Bio: Dr. Du is a professor in the Department of Civil and Coastal Engineering, University of Florida. Dr. Du received her Ph.D. degree in Decision Sciences and Engineering Systems with a minor in Operations Research and Statistics from Rensselaer Polytechnic Institute in 2008. She also received her MS degree in Industrial Engineering from Tsinghua University in 2003 and BS degree in Mechanical Engineering from Xi'an Jiaotong University in 1998. Dr. Du's research is characterized by integrating operations research, network modeling, game theory, control theory, machine learning and statistical methods into transportation system analysis and network modeling. Her current research mainly focuses on AV/CV/CAV/EV impacts, mobility on demand, network resilience, and traffic flow analysis. Dr. Du's research has been published in Transportation Research Part B, Part C, and Part D, IEEE Transactions on ITS, Networks and Spatial Economics. Her research has been funded by National Science Foundation (NSF), State DOT, STRIDE UTC, and Toyota InfoTechnology Center. Dr. Du is a recipient of the NSF CAREER award in 2016. She is currently chairing TRB ADB30-5 subcommittee on Emerging Technologies in Network Modeling and ASCE-T&DI Artificial Intelligence in Transportation Committee. She serves on the editorial boards for Transportation Research Part B, Part C, and IEEE ITS.

- **List of potential contributors (including as much detail as possible):**

Potential contributors:

- *Multiscale Traffic Data Reconstruction with Large Language Models*, Tong Nie and Wei Ma, The Hong Kong Polytechnic University, Hong Kong SAR, China.
- *Mastering Basic Spatial Capabilities in Vision Language Models Elicits Generalization to Composite Spatial Reasoning*, Yihong Tang and Lijun Sun, McGill University, Canada.
- *Multimodal Transport Demand Forecasting via Large Language Models*, Can Li, Tongji University, China.
- *Adversarial Scenario Generation for Autonomous Driving with Large Language Models*, Yuewen Mei, Jian Sun, and Ye Tian, Tongji University, China.
- *Leveraging Large Language Models (LLMs) for Traffic Management at Urban Intersections: The Case of Mixed Traffic Scenarios*, Sari Masri, Huthaifa I. Ashqar, Queensland University of Technology, Australia, Mohammed Elhenawy, Columbia University, USA.
- *GPT-4V as Traffic Assistant: An In-depth Look at Vision Language Model on Complex Traffic Events*, Xingcheng Zhou, Alois C. Knoll, Technical University of Munich, Germany.
- *Benchmarking the Capabilities of Large Language Models in Transportation System Engineering: Accuracy, Consistency, and Reasoning Behaviors*, Usman Syed, Ethan Light, Xingang Guo, Huan Zhang, Lianhui Qin, Yanfeng Ouyang, Bin Hu, University of Illinois Urbana-Champaign, USA.

Potential sponsors:

This session will be sponsored by the Hong Kong Society for Transportation Studies (HKSTS), and ASCE Artificial Intelligence In Transportation Committee.

- **Intended audience and expected attendance of the invited session:**

Intended Audience

This session is designed for a broad spectrum of audience, including:



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- Academic researchers in ITS, AI, machine learning, and transportation engineering.
- Data scientists and engineers seeking to apply LLM methodologies to transportation challenges.
- Industry practitioners involved in transportation planning, traffic management, and smart city solutions.
- Government and regulatory bodies interested in the impact of emerging technologies on public transportation.
- Policymakers and stakeholders exploring LLM integration into ITS infrastructure.

Expected attendance

Given the rapid growth of LLM applications in ITS research and the interdisciplinary nature of the topic, we anticipate strong interest from both academia and industry. Based on similar sessions at recent top-tier AI conferences (e.g., CVPR, NeurIPS) and past ITSC events, we expect 50–100 attendees, including 30–40% from industry (e.g., automotive, mobility-as-a-service providers) and 60–70% from academia (from both AI and transportation communities). This diverse group is expected to foster engaging discussions, potential collaborations, and a vibrant exchange of ideas in this field.

- **Contact details of the main proposers (email & mobile number):**

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