



IEEE ITSC 2025

Invited Session Proposal

- Title:

[The 2nd SCSU-ITS: Synthetic-Data-Aided Safety-Critical Scenario Understanding in ITS]

- Modality:
 - Half-day (e.g., 3 hours plus breaks)
 - Full-day (e.g., 6 hours plus breaks)

[Half-day]

- Scope (no longer than 1 page), including the following sections:
 - Motivation and general scope
 - Relevance to the ITS community
 - Topics of interest for the invited session

[With the foundation and generative models, intelligent transportation systems have entered a new era with vast real-to-virtual simulation engines and knowledge to generate safety-critical scenarios. Various advanced techniques, such as autonomous driving, road-vehicle cooperation, high-speed railway, etc., have been facilitated by the synthetic data. With this beautiful vision for future transportation systems, safety-critical scenario understanding (SCSU-ITS) has been becoming a hot problem and a barrier that cannot be ignored. SCSU-ITS is universal and can be found in multiple applications, such as fault detection of railways and vehicles, communication interference of connected vehicles, accident detection or prediction, road crash detection, even in formation failure of logistics robots, etc. The ability to tackle these safe-critical scenarios sometimes reflects the core property for the practical implementation of transportation systems. However, because of the long-tailed distribution, SCSU-ITS is still challenging. For example, the faults in railways and vehicles have diverse patterns and are hard to find, especially for the tiny cracks. The communication interference of connected vehicles may be with irregular frequency and different attack modes. Road accidents may involve different road participants and interactions and are hard to detect especially for severe road conditions. Some recent works have been aware of this and developed many methods with the few-shot, zero-shot, and risk evaluation techniques, and various data sensors, such as vision, 3D-LiDAR, etc. have been the popular configurations in autonomous driving or road sensing systems. In addition, the synthetic data, based on diffusion models or multimodal large language models (MLLM), has demonstrated a powerful ability for safety-critical scenario generation and augmentation. Nevertheless, knowledge ambiguity, sensing error, environment noise, and scene perception bias still have a large influence on ITS. In addition, with the development of generative methods, synthetic data may introduce new issues, such as fake scenarios or adversarial attacks. Therefore, it is urgent to find new models and benchmarks in SCSU-ITS facilitated by synthetic data with positive roles, such as virtual-real data collaboration, distribution diffusion, multi-modality understanding, few or zero-shot learning, human-machine hybrid intelligence, causal inference, and so on. Based on the success of the 1st special session on SCSU-ITS in ITSC2023, we want to absorb and contribute excellent and new insight into SCSU-ITS and promote the development of intelligent transportation in the synthetic data era.

The areas of interest of this Special Session include but are not limited to the following topics:

- Few-shot or zero-shot learning in SCSU-ITS;
- Safe-critical scenario generation and domain adaptation;
- Attack detection or fake scenario detection for SCSU-ITS;
- Fault detection and prediction in various transport carriers;
- Traffic accident or anomaly detection or prediction;
- Parallel vision in SCSU-ITS;



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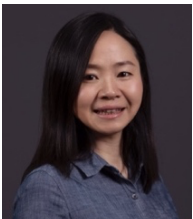
- Road damage detection and prediction;
- Object detection, re-identification, tracking, trajectory, or location prediction in SCSU-ITS;
- Communication failure detection and prevention in connected vehicles;
- Point cloud processing in SCSU-ITS;
- Mult-unit or multimodal sensor data fusion for SCSU-ITS;
- New benchmarks and models for SCSU-ITS;
- New applications within SCSU-ITS.]

- Organizers (names, affiliations, emails, and short bio):



Jianwu Fang, Xi'an Jiaotong University, fangjianwu@mail.xjtu.edu.cn.

Dr. Jianwu Fang received his Ph.D. degree in signal and information processing from the University of Chinese Academy of Sciences in July 2015. He is currently an Associate Professor at the Institute of Artificial Intelligence and Robotics of Xi'an Jiaotong University and was selected into the Youth Top Talent Support Program of Xi'an Jiaotong University. Dr. Fang went to the School of Computer Science at the National University of Singapore (NUS) as a visiting scholar (2022-2023). Dr. Fang's research interest is the intelligent understanding of driving scenarios, where he has contributed over 90 articles and 11 patents in China. He developed the largest scale (over 14 million frames) multimodal egocentric traffic accident understanding dataset for safe driving perception. He has won one first prize in the Natural Science Award of Shaanxi Province. His team received the Best Paper Nomination Award at the International Intelligent Transportation Systems Conference ITSC2023. He served as the Workshop/Session Chair many times, including the ACM Multimedia 2023, ITSC 2022-2024, etc. He serves as an Associate Editor of IEEE Transactions on Intelligent Transportation Systems and IEEE Open Journal of Intelligent Transportation Systems.



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Dr. Ruwen Qin received her Ph.D. degree in industrial engineering and operations research from Pennsylvania State University-University Park and her B.E. and M.S. degrees in spacecraft design from Beijing University of Aeronautics and Astronautics. She is an Associate Professor of civil engineering at Stony Brook University. Her current research focuses on sensory data analysis and deep learning methods with applications to intelligent transportation systems, automated driving systems, smart civil infrastructure systems, and cyber-physical-human systems, aiming to improve safety, performance, and sustainability in complex operating environments. Her current research is funded by the National Science Foundation, the Federal Railroad Administration, the US Department of Transportation, and the US Department of Education. Results from her research are disseminated in various IEEE journals and conferences including IEEE Transactions on Intelligent Transportation Systems, and IEEE Transactions on Intelligent Vehicles. She has been an IEEE member since 2018, and a member of IEEE Intelligent Transportation Systems Society since 2021. Since 2024, she serves as an Associate Editor of IEEE Transactions on Intelligent Transportation Systems.



Kailun Yang, Hunan University, kailun.yang@hnu.edu.cn

Dr. Kailun Yang received his dual B.S. degrees in Measurement Technology and Instruments from the Beijing Institute of Technology (BIT) and Economics from Peking University (PKU) in June 2024. He received his Ph.D. degree in Information Sensing and Instrumentation with distinction from the State Key Laboratory of Extreme Photonics and Instrumentation, Zhejiang University (ZJU) in June 2019. He performed a Ph.D. internship at the Robotics and eSafety (RobeSafe) research group at the University of Alcalá (UAH) from September 2017 to September 2018. He was a postdoctoral researcher with the Computer Vision for Human-Computer Interaction (CV:HCI) Lab at the Karlsruhe Institute of Technology (KIT) from November 2019 to January 2023. He is currently a full professor at the School of Robotics and the National Engineering Research Center of Robot Visual Perception and Control Technology, Hunan University (HNU), where he directs the Computer Vision for Panoramic Understanding (CV:PU) Lab. Dr. Kailun Yang has been researching



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computational imaging and computer vision for scene understanding in autonomous vehicles, human-computer interaction systems, and robotics. He serves as an Associate Editor of IEEE Robotics and Automation Letters and IEEE Transactions on Intelligent Transportation Systems.

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Dr. Zhenning Li received his Ph.D. from the University of Hawaii at Manoa, Honolulu, USA, in 2019. He is currently an Assistant Professor at the State Key Laboratory of Internet of Things for Smart City and the Department of Computer and Information Science, University of Macau. His research focuses on connected autonomous vehicles and Big Data applications in urban transportation systems. He has published over 60 papers in leading journals and conferences, including TPAMI, TRO, and Transportation Science. His contributions have earned him multiple accolades, such as the Macau Science and Technology Award, the TRB Best Young Researcher Award, the Chinese Government Award for Outstanding Self-Financed Students Abroad, and the CICTP Best Paper Award. He also served as AC/SPC/AE for various journals and conferences, such as IJCAI, ECAI, IEEE Transactions on Intelligent Transportation Systems, and Journal of Safety Research.

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Dr. Lin Li is currently a Research Fellow at the School of Mechanical and Aerospace Engineering, Nanyang Technological University, working under the guidance of Prof. Chen Lyu. She received her Ph. D degree in vehicle engineering at Nanjing University of Aeronautics and Astronautics, Nanjing, China, in 2023. Her research focuses on autonomous driving and artificial intelligence. She is aiming to develop decision-making algorithms for autonomous vehicles. Her research interests include deep learning, and reinforcement learning, applied to areas such as perception, prediction, decision-making, and simulation in autonomous driving. Her work has led to the publication of many papers in top ITS and AI journals, such as IEEE Transactions on Vehicular Technology, and IEEE/ASME Transactions on Mechatronics, etc.

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

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- Intended audience and expected attendance of the invited session:

[The scholars and students in SCSU-ITS or other related topics.]

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