

SEMINAR ANNOUNCEMENT

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
COLLEGE OF DESIGN AND ENGINEERING

Website: <https://cde.nus.edu.sg/ece>

Area: Communications & Networks (CN)

Host: Assoc Prof Mohan Gurusamy

TOPIC	:	Digital Twin Framework for Safety-Critical 360-degree Video Streaming in Autonomous Vehicles
SPEAKER	:	Mr Vijay Narasimha Graduate Student, ECE Dept, NUS
DATE	:	Monday, 20 July 2026
TIME	:	2:00PM-3:00PM
VENUE	:	E4-05-39 - ECE Conference Room

ABSTRACT

Autonomous vehicles (AVs) face severe safety risks in sudden, catastrophic scenarios where split-second decisions are required. Digital twin (DT) systems address this by simulating impending hazards. However, transmitting low-context alerts or rigid trajectory commands based on the prediction of the DT fails to equip the AV for real-world deviations. We propose a novel framework where the DT server generates a high-fidelity 360-degree video of the unfolding hazard and streams it to the AV, providing rich perceptual context for adaptable, real-time decision-making. Because immersive video overwhelms limited vehicular networks, bandwidth must be allocated via tile-based adaptive streaming, delivering only the hazard-containing safety-critical region (SCR) at high quality. To compensate for rendering and network delays, the server must accurately forecast the AV's future SCR up to five seconds in advance, utilizing solely historical perception trajectory (HPT) data. We address this time-series forecasting problem with SafeCast-TCN, a Temporal Convolutional Network-based architecture tailored for tile occupancy. SafeCast-TCN employs parallel multi-scale pooling to capture both abrupt anomalies and long-term trajectory trends, alongside a shared multi-output head. Crucially, we identify and resolve a severe class imbalance; safety-critical tiles constitute a minuscule fraction of the panoramic frame. Integrating positive class weighting decisively prevents the model from collapsing into majority-class prediction. Ultimately, SafeCast-TCN delivers highly accurate, robust hazard coverage across long horizons with marginal computational overhead, establishing the practicality of immersive DT-assisted vehicular safety.

BIOGRAPHY

Mr. Vijay Narasimha is currently pursuing a PhD degree in Prof. Mohan Gurusamy's group. His research interests include 360-degree video streaming, immersive Virtual Reality, and Digital Twin ecosystems.

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