**Conference**: IEEE ICASSP 2025, Hyderabad, India
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## Post-Conference Recommendations Report

ICASSP is the largest international conference in the field of signal processing, bringing together experts from domains such as array processing, graph signal processing (GSP), machine learning, and audio/image analysis. The methodologies presented are foundational to the development of intelligent transportation systems, particularly in areas such as sensor data fusion, vehicle tracking, traffic prediction, and anomaly detection.

Signal processing plays a critical role in smart transportation by enabling accurate modeling, analysis, and recovery of traffic-related data, which supports real-time decision-making in applications such as autonomous driving, traffic management, and infrastructure optimization.

At ICASSP 2025, I presented my paper titled **"Verifying the Smoothness of Graph Signals: A Graph Signal Processing Approach"**. This work proposes novel tools to verify a core assumption underlying many GSP and GNN-based methods—signal smoothness with respect to a given graph. In smart transportation, where traffic metrics such as vehicle flow and speed are often modeled as graph signals, verifying this assumption is crucial before applying signal recovery, anomaly detection, or forecasting methods. Our detectors enhance the reliability and interpretability of data-driven algorithms in transportation systems.

During ICASSP 2025, several sessions presented cutting-edge methodologies highly relevant to smart transportation:

1. "Cognitive MIMO Radar Beamforming for Target Tracking Using a New BCRB-based Criterion" [1] - Introduced a Bayesian beamforming technique for cognitive MIMO radar systems aimed at enhancing direction-of-arrival (DOA) estimation and target tracking. This research supports object tracking capabilities in autonomous driving systems and improves radar sensing for safer navigation.
2. "Graph-Based Signal Sampling with Adaptive Subspace Reconstruction for Spatially-Irregular Sensor Data" [2] - Presented an adaptive graph Fourier

transform (GFT) tailored to signal covariance, enabling efficient signal recovery from irregular sensor data. This research applicable to traffic systems with sparse sensor deployment, enhancing monitoring and anomaly detection.

3. “Tracking Network Dynamics using Probabilistic State-Space Models” [3] - Proposed a probabilistic framework to estimate dynamic graph topology using state-space models under uncertainty. This research Relevance: Enables real-time updates in evolving traffic networks, supporting adaptive routing and incident response.
4. Tutorial: “Graph-based Machine Learning for Wireless Communications” [4] - Surveyed applications of graph neural networks (GNNs) to wireless network control, including beamforming, scheduling, and routing. These techniques are transferable to connected vehicle systems (V2X), improving communication and traffic coordination.
5. Tutorial: “Topological Signal Processing and Learning” – Dr. Isufi [5] Introduced signal processing tools using simplicial and cell complexes for modeling higher-order interactions in data. This tutorial supports analysis of complex multimodal transportation systems, such as traffic flows across intersections and mobility layers.

ICASSP 2025 offered valuable insights and networking opportunities that directly support advances in smart transportation. The presented methods can guide future research on building safer, more efficient, and sustainable mobility systems.

Sincerely,

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[1] H. Sun, J. Tabrikian, H. Messer, and H. Gao, “Cognitive MIMO Radar Beamforming for Target Tracking Using a New BCRB-based Criterion”.

[2] D. Pakiyarajah, E. Pavez, and A. Ortega, “Graph-Based Signal Sampling with Adaptive Subspace Reconstruction for Spatially-Irregular Sensor Data”.

[3] V. M. Tenorio, E. Isufi, G. Leus, and A. G. Marques, “Tracking Network Dynamics using Probabilistic State-Space Models”.

[4] S. Segarra, A. Swami, and Z. Zhao, “Graph-based Machine Learning for Wireless Communications,” Tutorial presented at *ICASSP* 2025.

[5] E. Isufi, P. Di Lorenzo, and S. Barbarossa, “Topological Signal Processing and Learning,” Tutorial presented at *ICASSP* 2025.