Lecture 1

Human-Centered Autonomous Mobility and Sustainable Transportation: *A Symbiotic Systems Perspective*

Autonomous mobility and intelligent transportation systems are central to the future of sustainable transportation. Yet autonomy is still too often framed as a problem of building ever-smarter, vehicle-centric technologies. Persistent challenges in safety, scalability, and public trust point to a deeper limitation: intelligence has been isolated where it should be shared. This lecture challenges the prevailing paradigm and argues that sustainable autonomy will emerge only through human-centered, symbiotic transportation systems, in which cognition, perception, control, and interaction are seamlessly distributed across humans, machines, and infrastructure.

A central thesis of this lecture is that many of the hardest problems in autonomous mobility are not failures of algorithms, but failures of system boundaries—what we choose to sense, where we place intelligence, and how responsibility is shared between humans and machines. Drawing on principles from distributed, embodied, and embedded cognition, the talk reframes autonomous mobility as a systems-level challenge spanning robotics, artificial intelligence, human–computer interaction, and transportation engineering.

The lecture highlights Distributed Interactive Sensor Arrays and multi-level semantic processing architectures as foundational enablers—scalable, wide-area, multimodal systems that provide persistent situational awareness beyond the limits of single-vehicle perception. These platforms support advances in multi-view and multimodal computer vision, activity and intent recognition, and machine learning for multi-agent trajectory and behavior prediction under real-world operational constraints. Key concepts will be illustrated through concrete examples and representative results from multidisciplinary collaborative research conducted in the LISA and CVRR laboratories at the University of California, San Diego.

Building on this foundation, the lecture presents knowledge- and data-driven frameworks for shared autonomy that tightly couple human state (intent, attention, and readiness) with environmental state (dynamic agents, context, and infrastructure), enabling safer and more fluid human–AI collaboration. Recent progress in foundation models, self-supervised learning, and active learning is discussed as a pathway toward improved generalization, robustness, and explainability in safety-critical domains.

The lecture concludes by outlining open research challenges, including multimodal foundation models for traffic ecosystems, principled human–AI co-adaptation, continual learning under domain shift, and system-level evaluation frameworks essential for trustworthy autonomous mobility and a sustainable future.

Lecture 2

Safe and Trustworthy Autonomous Driving: Past, Present, and Future

Autonomous mobility systems have emerged as one of the most ambitious and influential applications of artificial intelligence, driving advances in perception, learning, planning, and control while offering the promise of safer, more efficient, and more accessible transportation. Over the past decade, significant progress has demonstrated the feasibility of automated driving in constrained environments and has enabled a growing range of assistive driving technologies that enhance safety, mobility, and independence for diverse populations.

Alongside this promise, real-world deployment has revealed important challenges. Autonomous driving systems operate in open, uncertain environments, interact closely with humans, and can have direct consequences for safety and public trust. These realities make autonomous mobility not only a technical challenge, but also a test of how AI technologies are designed, evaluated, communicated, and governed. Ensuring that such systems serve the public good requires careful attention to reliability, transparency, and responsible integration with human users.

This lecture presents a human-centered perspective on autonomous mobility, spanning fully automated driving and advanced assistive technologies. It highlights research on multimodal perception of situational criticalities, prediction of intent and uncertainty in interacting human and machine agents, and learning-based planning and control that support safe maneuvers and effective human–automation collaboration. These ideas will be presented using representative multidisciplinary collaborative research projects conducted in the LISA and CVRR laboratories at the University of California, San Diego.

These approaches both draw on and contribute to broader advances in AI and deep learning with relevance to assistive robotics, healthcare, telemedicine, environmental monitoring, agriculture, and other safety-critical domains. Looking ahead, the lecture discusses research directions aimed at guarding against misuse, over-automation, and misplaced expectations. These include system-level safety metrics, uncertainty-aware learning and decision-making, mechanisms for meaningful human oversight, robust evaluation beyond curated benchmarks, and clearer communication of system capabilities and limitations.

The lecture concludes by emphasizing the importance of not ignoring context and complexities of the real-world and issues underlying safety, trust, human impact in the design and development of autonomous systems. It invites young scholars to contribute their ideas, efforts, and perspectives to help ensure that autonomous mobility technologies are deployed responsibly and truly serve people, communities, and the public good.

Mohan Trivedi *(Life Fellow, IEEE)* is a Distinguished Professor Emeritus of Engineering at the University of California, San Diego, and the founding director of the Computer Vision and Robotics Research Laboratory (CVRR) and the Laboratory for Intelligent and Safe Automobiles (LISA). During his 45-year academic career, his primary focus has been the engineering of *human-centered intelligent systems* to enhance safety, security, reliability, and seamless interactions among intelligent agents deployed in challenging real-world environments.

Trivedi has mentored and collaborated with hundreds of creative, diligent, and passionate student teams. These efforts have resulted in innovative and impactful contributions in machine vision, intelligent transportation, advanced driver assistance, autonomous driving, and human–machine interaction. CVRR and LISA teams are recognized as among the most prolific, highly cited, and influential research groups.

Trivedi has supervised more than 35 Ph.D. scholars, 15 postdoctoral fellows, 150 M.S. students, and 1000 undergraduates. His students have received numerous prestigious awards, including Best Dissertations, Best Papers, Best Posters, and Challenge prizes. Over the years, he has established a large international network of scholars, industry partners, and students. More recently, he has been active in outreach with young researchers—particularly in Europe, Africa, and Asia—visiting over 40 institutions in the past two years to encourage global engagement in safe and trustworthy artificial intelligence and robotics. He has given over 200 invited/keynote lectures.

Trivedi also serves as a consultant to industry and government agencies in the U.S., Europe, and Asia, including major automobile manufacturers. He is a Life Fellow of IEEE, SPIE, and IAPR, and has held numerous leadership roles, including Chair of the IEEE Computer Society Robotics Technical Committee; Charter Member and Vice Chair of the University of California System's Digital Media Innovation Initiative; Elected Board member of IEEE Systems, Man & Cybernetics, IEEE Intelligent Transportation Society, Editor-in-Chief of *Machine Vision and Applications*; Founding Senior Editor of the *IEEE Transactions on Intelligent Vehicles and Associate Editor of the IEEE Trans Systems, Man & Cybernetics.* He has served on the editorial boards of several prominent technical journals. He is a Distinguished Lecturer for IEEE Robotics & Automation Society.

His contributions have been recognized with many honors, including the IEEE Intelligent Transportation Systems Society Outstanding Research Award, the LEAD Institution Award for LISA (2015), the IEEE Computer Society's TAB Pioneer Award and Meritorious Service Award, and Distinguished Alumni Awards from BITS Pilani (India) and Utah State University.

More information:

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LISA: Laboratory for Intelligent and Safe Automobiles