Department of Mechanical Engineering

UC RIVERSIDE

2025-2026 Colloquium Series

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Smith International Professorship
Viterbi School of Engineering
University of Southern California

Physical AI for Powering Smart Robotic Cells in Manufacturing Applications

Many manufacturing companies are facing an acute shortage of qualified workers. Deploying robotic cells is a potential solution to address this challenge. Historically robots have been deployed only in mass production applications in manufacturing. A large fraction of manufacturing is classified as high-mix manufacturing where a large variety of products are produced. Manual programming of robots is not a viable solution in high-mix manufacturing applications. Robotic cells need to be powered by physical AI to make them useful in high-mix manufacturing applications. Physical AI in the context of manufacturing should be viewed as a complex system that involves interactions among multiple AI components. The system should use the right functional decomposition to ensure that it is able to achieve the desired trade-off in performance and modularity. This talk highlights key requirements for developing physical AI for powering robotic cells for high-mix manufacturing applications. It also makes the case for approaches that combine model-based and data-driven AI methods to meet the needs of manufacturing applications and describes the role of generative AI approaches in smart manufacturing applications. Finally, it describes how AI can be used to enhance digital twins and augment human-machine interfaces in manufacturing applications.

NOVEMBER 6, 2025 | **WCH 205/206** | **11AM-12PM**

Dr. Satyandra K. Gupta holds Smith International Professorship in the Viterbi School of Engineering at the University of Southern California and serves as the Director of the Center for Advanced Manufacturing. He is also Co-Founder and Chief Scientist at GrayMatter Robotics. His research interests are physical artificial intelligence, computational foundations for decision-making, and human-centered automation. He has published more than five hundred technical articles in journals, conference proceedings, and edited books. He also holds twenty-eight US patents. He is a fellow of the American Association for the Advancement of Science (AAAS), American Society of Mechanical Engineers (ASME), Institute of Electrical and Electronics Engineers (IEEE), Solid Modeling Association (SMA), and Society of Manufacturing Engineers (SME). He is a former editor-in-chief of the ASME Journal of Computing and Information Science in Engineering. He has received numerous honors and awards for his scholarly contributions. Representative examples include a Presidential Early Career Award for Scientists and Engineers in 2001, Invention of the Year Award at the University of Maryland in 2007, Excellence in Research Award from ASME Computers and Information in Engineering Division in 2013, Distinguished Alumnus Award from Indian Institute of Technology, Roorkee in 2014, ASME Design Automation Award in 2021, Distinguished Alumni Award from Indian Institute of Technology, Delhi in 2022, Lifetime Achievement Award from ASME Computers and Information in Engineering Division in 2024, Eli Whitney Productivity Award from SME in 2025 and William T. Ennor Manufacturing Technology Award from ASME in 2025. He has also received eleven best paper awards at international conferences. He serves as a member of the Technical Advisory Committee for Advanced Robotics for Manufacturing (ARM) Institute, a member of A3 Robotics Technology Strategy Board, and a member of the National Materials and Manufacturing Board (NMMB).