



Sensor Symphony: Optimal Placement and Occupancy-Driven Control for a Smarter Built Environment



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ABSTRACT

As buildings become smarter, sensors play a crucial role in ensuring occupant well-being. In this talk, Dr. Sharma will explore two crucial areas: optimal sensor placement and occupancy-based control. First, the research challenge of accurate air quality monitoring amidst building uncertainties will be presented. Traditional methods often overlook factors like airflow variations and fluctuating occupancy. Dr. Sharma will propose a novel framework that accounts for these uncertainties, using "transfer operators" to identify optimal sensor locations even under unpredictable conditions. This probabilistic approach ensures reliable air quality monitoring and enhanced safety. Secondly, Dr. Sharma delves into the research question of how occupancy sensors can supercharge advanced building control systems like Model Predictive Control (MPC). The research, based on detailed simulations, demonstrates that occupancy-based MPC (OB-MPC) can significantly boost energy savings compared to traditional methods. Analyzing different sensor types and occupant densities, Dr. Sharma further reveals the factors influencing OB-MPC performance and investigates the impact of sensor inaccuracies. Through these examples, Dr. Sharma emphasizes the transformative power of strategic sensor placement and advanced control for optimizing building performance. The research paves the way for designing effective sensor networks and intelligent control systems that create healthy, sustainable, and energy-efficient buildings for the future.

BIOGRAPHY

Dr. Himanshu Sharma is a Research Scientist at Pacific Northwest National Laboratory (PNNL) who specializes in advanced modeling and optimization controls for complex physical and energy systems. His work at PNNL involves developing advanced controls and optimization techniques for complex physical systems such as energy systems and smart building systems. Dr. Sharma holds a Ph.D. in Mechanical Engineering from Iowa State University, as well as a Master's degree from the Indian Institute of Technology Gandhinagar, India. He has co-authored several peer-reviewed publications, including journal and conference papers, as well as a book chapter. Dr. Sharma's research interests include physics-informed deep learning, data-driven controls, optimization, and uncertainty quantification.