ES 300 | JANUARY 8 | 10:30AM

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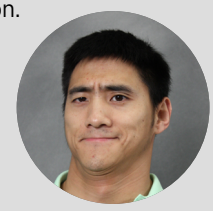
MAE SEMINAR SERIES

Physically Informed Intelligent Acoustics Technologies: acoustics simulation, control and diagnosis

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Dr. Yangfan Liu is an Assistant Professor in the School of Mechanical Engineering at Purdue University, specializing in acoustics and noise control. His research focuses on advanced signal processing and vibroacoustic simulation techniques informed by physical acoustics and psychoacoustics. Application areas include noise and vibration control for complex systems, intelligent diagnostics, human health and comfort, and environmental protection. Dr. Liu earned his Ph.D. from Purdue University in 2016, stayed in Purdue as a Post-Doctoral researcher and then joined the Purdue faculty in 2018. He has since published more than 70 journal and conference papers. He is the author of a forthcoming textbook on aeroacoustics that will be published by Springer in 2026. During his faculty career at Purdue, he has led over 20 research projects with multi-million-dollar funding from federal agencies, industry-leading corporations, and small businesses. His active noise control technologies have been successfully commercialized and translated into top-selling products worldwide.

He has advised more than 10 Ph.D. students, seven of whom have received Best Paper Awards at international conferences. In professional service, Dr. Liu is a Vice President of the Institute of Noise Control Engineering (INCE), chairs INCE's Technical Committee on Signal Processing, Active Noise Control, and Instrumentation, and serves on multiple committees of the Acoustical Society of America, including Educational Outreach, Public Policy, and International Liaison. He has been invited to deliver plenary talks, contribute flagship magazine articles for the National Academy of Engineering, teach multiple short courses, and organize approximately 20 technical sessions at international conferences.



ABSTRACT

Intelligent acoustics technologies form an integrated platform that combines advanced acoustics simulation, signal processing, and artificial intelligence, each guided by physical acoustics, computational acoustics, and psychoacoustics, to enhance the vibroacoustic performance of engineering systems. A current trend in engineering design is to target not only functional improvements, but also human perception and environmental impact, which creates the need for optimization across all levels of design. This includes materials, structures, connecting mechanisms, operation, control, self-diagnosis, and human–system interfaces. The intelligent acoustics framework includes technologies not only for intelligent design optimization at each level but also for intelligent system-level integration of design and evaluation, making it uniquely positioned to address the modern engineering design requirements.

This presentation will illustrate the capabilities of intelligent acoustics through three research examples. First, an acoustical holography-based reduced-order sound source characterization model is presented for intelligent virtual engineering design. Second, convex formulation techniques are explored for the efficient development of intelligent active noise control systems with high channel counts and realistic engineering constraints. Third, artificial intelligence-based fault diagnosis methods are introduced to improve system safety and enhance human comfort. Together, these examples demonstrate how intelligent acoustics technologies can transform the design, operation, and user experience of modern engineering systems.