DEPARTMENT OF MECHANICAL ENGINEERING SEMINAR SERIES · 26/27

Automated Design of Metasurfaces via Direct Wave-Shaping and Parametric Topology Optimization



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DATE	TIME	LOCATION
19th November 2026	**2:00pm – 3:00pm**	**ME Conference Rm – ST254**

ABSTRACT

Metasurfaces—thin, architectured structures that manipulate waves—offer a route to compact, high-performance devices for a range of applications, including energy harvesting, vibration isolation, and ultrasound medical treatment. Yet designing them well remains difficult. The dominant approach, based on the generalized Snell's law, produces surfaces that work in principle but lose substantial energy to parasitic scattering in practice. More recent impedance-matching and metagrating designs improve efficiency, but they struggle to generate complex wavefields such as tightly focused beams.

This seminar presents an alternative: a direct wave-shaping topology optimization framework that designs the metasurface as a single monolithic structure rather than as an assembly of independently designed unit cells. Because the optimization targets the wavefield itself, inter-cell coupling—a critical effect that unit-cell-based methods neglect—is captured automatically. To make full-scale optimization tractable, the design is parametrized by a set of movable, deformable, and interacting elliptical voids, which reduces the number of design variables by orders of magnitude while preserving geometric flexibility. Design examples will be presented to demonstrate the performance of the framework, and the talk concludes with a discussion of potential applications.

SPEAKER BIO

Professor Ye is a full professor in the Department of Mechanical and Aerospace Engineering at the Hong Kong University of Science and Technology. She obtained her PhD in Theoretical and Applied Mechanics from Cornell University. Prior to joining the faculty at the Hong Kong University of Science and Technology in 2007, she held positions as a postdoctoral associate at the Massachusetts Institute of Technology and later as an assistant professor in the Woodruff School of Mechanical Engineering at the Georgia Institute of Technology. Prof. Ye's research encompasses a wide range of topics including numerical techniques, topology optimization and co-design of materials and structure, metamaterials, AI and machine learning for predictive science and engineering design. She serves as an associate editor for Computer Modeling in Engineering and Science and is a member of the editorial boards for several international journals. Additionally, Prof. Ye is a member of the Scientific Advisory Committee the International Association for Boundary Element Methods and has contributed to program committees for numerous international conferences and workshops.

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