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Anisotropic Mechanical Metamaterials

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Venue：Large Conference Room, 1st Floor, Engineering Bldg. 9, Asano Campus

Abstract:
Anisotropic Mechanical Metamaterials (AMMs) are artificially engineered structures that offer a unique combination of tailored elastic anisotropy, mechanical coupling, and unconventional multi-physical interactions not found in natural materials. These capabilities open new opportunities in impact protection, soft robotics, biomedical implants, aerospace structures, and adaptive mechanical systems. Over the past decade, advances in additive manufacturing and 3D-printing technologies have enabled the fabrication of materials with arbitrarily complex micro- and nano-architectures, accelerating the transition of mechanical metamaterials from theoretical concepts to practical, real-world applications.

Recent research by the presenter has shown that a versatile family of AMMs can be designed as building blocks for functional modular metamaterials. Each module is self-contained and can be rearranged, added, or reoriented, allowing the overall mechanical response to be tuned or reconfigured with ease. This modularity enables designers to “program” force responses, creating adaptable, customizable, and multifunctional structures suitable for use in robotics, architecture, aerospace, and protective systems. The development of 3D AMMs—with tunable stiffness ranging from rigid to soft, negligible shear modulus, and negative or near-zero Poisson’s ratio—highlights their promise as functional and smart materials, including those integrated with active composites, sensors and actuators for robotic and other adaptive applications.

CV of the presenter:
Huina Mao received her Ph.D. in Engineering Mechanics from KTH Royal Institute of Technology (Sweden) in 2017. Her doctoral research (2012–2017) was carried out within several EU-funded small satellite projects, where she worked on precision attitude determination, autonomous data acquisition, high-bandwidth telemetry, and ground control system development. From 2017 to 2021, she pursued postdoctoral research focused on the numerical modeling and design of acoustic metamaterials. Her work emphasized finite element analysis, inverse estimation techniques, machine learning approaches, and the 3D printing of multifunctional acoustic metamaterials aimed at achieving lightweight, high-stiffness, and noise-reduction performance. In parallel, she contributed to sustainable engineering initiatives through ongoing involvement in low-density functional material design at the Centre for ECO^2 Vehicle Design.

In 2022, Dr. Mao was appointed Assistant Professor in the Department of Engineering Mechanics at KTH. Her current research interests span metamaterials design, smart and flexible materials, space robotics, flexible robotics and advanced additive manufacturing. She is also actively engaged in the KTH Industrial Transformation Platform, fostering collaboration between KTH researchers and partners from industry, public organizations, and academia to drive research and innovation in industrial transformation.

主催：
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