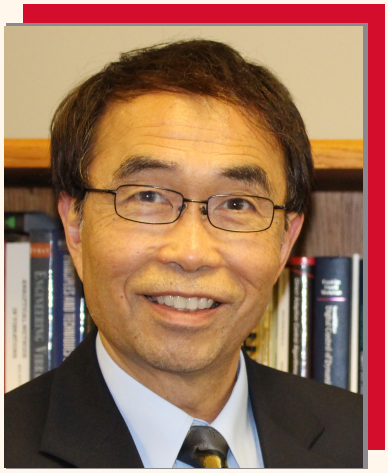
Apr 12, 2018

Learning from Muscle – Nature Inspired Multifunctional Adaptive Metastructures



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ABSTRACT:

In recent years, the concept of mechanical metastructures developed based on synergistic modular architectures has been explored and interesting results shown. Such architectures are often observed in biological systems. This presentation will provide highlights of recent interdisciplinary research in multifunctional adaptive metastructures inspired by muscle biology. The versatility of skeletal muscle is an inspiration towards the development of engineered adaptive structures and material systems. Studies suggest that some of muscle's intriguing macroscale adaptivity and functionalities result from the assembly of nanoscale, cross-bridge constituents that maintain multiple metastable configurations. Inspired by these observations, recent research explores a concept of creating modular, engineered structures from the assembly of mechanical, metastable modules, defined as modules which exhibit coexistent metastable states. Analytical and experimental results demonstrate that when metastructures are prescribed a global shape/topology, the systems may yield significant adaptivity including variation in reaction force magnitude and direction, numerous globally stable topologies, significant change in mechanical properties, energy management options, and tunable vibration and wave propagation characteristics. The influences of important parameters on tailoring the coexistent metastable states are investigated to provide insight of how the assembly strategy governs the system functionalities to be harnessed.

BIOGRAPHY:

Kon-Well Wang is the Stephen P. Timoshenko Professor and Tim Manganello/ BorgWarner Department Chair of Mechanical Engineering at the University of Michigan. He received his Ph.D. degree from the University of California at Berkeley in 1985, worked at the General Motors Research Labs as a Senior Research Engineer, and started his academic career at the Pennsylvania State University in 1988. During his Penn State years, Professor Wang has served as the William E. Diefenderfer Chaired Professor in Mechanical Engineering, Director of the Structural Dynamics and Controls Lab, Associate Director of the Vertical Lift Research Center of Excellence, and Group Leader for the Center for Acoustics and Vibration. Dr. Wang joined the University of Michigan in 2008. Professor Wang's main technical interests are in adaptive structural systems and structural dynamics & controls. He has received various recognitions for his accomplishments; such as the ASME J. P. Den Hartog Award, the SPIE Smart Structures and Materials Lifetime Achievement Award, the ASME Adaptive Structures and Materials Systems Award, the ASME N. O. Myklestad Award, the ASME Rudolf Kalman Best Paper Award, the ASME Adaptive Structures and Material Systems Best Paper Awards, the NASA Tech Brief Award, and the SAE Ralph Teetor Award. He is a Fellow of the ASME, AAAS, and IOP. Professor Wang has been the Chief Editor for the ASME Journal of Vibration & Acoustics. He is currently an Associate Editor for the Journal of Intelligent Material Systems & Structures and an Editorial Advisory Board Member for the Journal of Sound & Vibration.