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Abstract

Design of multi-functional structures and materials is an optimization-driven methodology for design exploration, synthesis and multi-disciplinary design. It generates structurally optimal design concepts from supplied information on loads, constraints and required product performance and manufacture conditions. By predicting optimal material properties and structures, the design system facilitates analysis to lead the process to innovative concepts and high-performance product designs, with a wide range of applications in multi-functional structures, materials, and compliant/soft mechanisms/robots. Together with 3D printing technologies, they aim to create functional devices with better mechanical properties and functionalities which can be used to widen industry applications and applied to industry sectors, especially in aerospace, precision engineering, and biomedical areas. In this presentation, we review recent development in two related aspects: the level-set method and applications. The level set representation has topological flexibility and inherent capabilities of geometric, physical and material modeling, incorporating dimension, shape, topology, material properties, and even micro-structures of a functionally gradient structure. The method has found a wide range of applications in the design of multi-functional structures, auxetic materials, and compliant/soft mechanisms/robots. These applications will be discussed.

Biography

Michael Yu Wang is a Professor at National University of Singapore since 2014. He earned his PhD from Carnegie Mellon University and previously taught at University of Maryland and Chinese University of Hong Kong. He has numerous professional honors–National Science Foundation Research Initiation Award, 1993; Ralph R. Teetor Educational Award from Society of Automotive Engineers, 1994; LaRoux K. Gillespie Outstanding Young Manufacturing Engineer Award from Society of Manufacturing Engineers, 1995; Boeing–A.D. Welliver Faculty Summer Fellow, Boeing, 1998; Chang Jiang (Cheung Kong) Scholars Award from the Ministry of Education of China and Li Ka Shing Foundation (Hong Kong). He received the Kayamori Best Paper Award of IEEE International Conference on Robotics and Automation in 2001, the Best Conference Paper Award of International CAD Conference & Exhibition in 2007, the Compliant Mechanisms Award of ASME 31st Mechanisms and Robotics Conference in 2007, Research Excellence Award of CUHK in 2008, China State Natural Science Prize (Second Class) from the Ministry of Science & Technology of China (2012), and ASME Design Automation Award (2013) from ASME. He is a Senior Editor of IEEE Trans. on Automation Science and Engineering, and served as an Associate Editor of IEEE Trans. on Robotics and Automation and ASME Journal of Manufacturing Science and Engineering. He was the Conference Chair of ASME 5th Design for Manufacturing Conference in 2000. He was the Program Chair (2005) and the Conference Chair (2006) of IEEE Conf. on Automation Science and Engineering. He was the Program Chair of IEEE/ASME International Conference on Advanced Intelligent Mechatronics in 2008, and General Co-Chair of IEEE International Conference on Robotics and Automation in 2011. He is a Distinguished Lecturer of IEEE Robotics and Automation Society (2006-2008). He is a Fellow of ASME, HKIE, and IEEE.

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