The Art and Signs of Smart Design

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Abstract

Design is an inextricably intertwined triple helix of materials, geometry, and manufacturing. Generally, geometry decides functionality; materials decide performance; manufacturing decides how materials can be shaped into desired geometry; and all three influence one another leading to smart design. Manufacturing at small sizes not only imposes constraints on achievable geometry with a select group of materials but also provides opportunities for good designs. Unprecedented integration of physical, chemical, and biological phenomena present in Microelectromechanical Systems (MEMS) has spurred the creativity of engineers. Consequently, MEMS designs have silently evolved in the last three decades, often unnoticed and uncelebrated because materials and their processing take the centre-stage. In this talk, we unveil the rich tapestry of smart designs that have played a vital role in the success of microsystems. Drawing from speaker's own work and the work of others, we illustrate a few clever designs in the field of MEMS. We discuss how designs can be created systematically even though design is an intrinsically intuitive and creative art. We also try to pinpoint the indicators of good design in the context of MEMS. It will be argued that modularity and hierarchy lead to not only the economy of material and manufacturing but also superior performance.

Biodata

G.K. Ananthasuresh (B. Tech. IIT-Madras, 1989; MS, U. Toledo, 1991; PhD, Michigan, 1994) is a Professor of Mechanical Engineering and Co-chair of BioSystems Science and Engineering at the Indian Institute of Science, Bangalore, India. His previous positions include post-doctoral associate at the Massachusetts Institute of Technology, Cambridge, USA; Associate Professor at the University of Pennsylvania, Philadelphia, USA; and visiting professorships in University of Cambridge, UK, and Katholike Univesiteit, Leuven, Belgium; and Indian Institute of Technology-Kanpur.

His current research interests include compliant mechanisms, kinematics, multi-disciplinary design optimization, microsystems technology, micro and meso-scale fabrication, protein design, micromanipulation, and biomechanics of cells. He served on the editorial boards of ten journals and is a co-author of 90 journal papers and more than 160 conference papers as well as three edited books, one textbook, and 14 book-chapters.

He has ten patents, five granted and six in process. He is a recipient of the NSF Career Award and SAE Ralph O Teeter Educational Award in the USA and the Swarnajayanthi Fellowship and Shanti Swarup Bhatnagar Prize in India as well as 13 best paper awards in international and national conferences and 8 prizes in design contests that his students and he participated. He advised 18 PhD students and 32 master's students so far. Two start-up companies are founded by his former PhD students based on the technology developed in his lab. Four devices and two sensors developed in his research group are commercialized or are in the process of commercialization.