



Guest Editorial

Design of Smart Structures and Systems

Smart Designs

Design of artifacts is following a natural evolution from being purely static to being “smart,” namely, fully adaptive to a changing operating environment. Although control design is an important element in smart product design, a controller can only perform as well as the design of the artifact—its configuration, structure and materials—will allow. JMD is a natural venue for research work addressing such design interests, particularly since

much product innovation is taking place in this area. This special issue highlights exciting new research and serves to welcome the broader community to continue to contribute smart design research to our journal. I am grateful to guest editors Dr. Mary Frecker and Dr. Nancy Johnson for pursuing and managing the creation of the special issue, and I am looking forward to seeing smart product design a growing area of publication in JMD.

Panos Y. Papalambros
Editor



Mary Frecker



Nancy Johnson

We are very pleased to introduce this special issue on the Design of Smart Structures and Systems. The call for papers was issued at the 2008 ASME Conference on Smart Materials, Adaptive Structures, and Intelligent Systems, as part of the Enabling Technologies and Integrated System Design symposium. As was discussed in the March 2009 editorial on Design Innovation, JMD embraces a wide variety of design-oriented research papers, including those on smart materials, structures and systems. This special issue focuses on innovative technologies and new methods to design and analyze these devices.

Smart materials and structures can be thought of as those that adapt to their environment in some way, and they often provide previously unattainable functionality and performance. Smart materials alter their mechanical properties or provide some mechanical work in response to an external, e.g., electrical, stimulus. A smart structure may incorporate smart material actuators or some other means of adapting to its surroundings. An example of a smart structure is a morphing aircraft wing that adjusts its shape to adapt to varying flight conditions. The smart morphing wing may be fully active in that sensors, actuators, and a controller are integrated into the system to adjust the shape of the wing (e.g.,

airfoil cross-section shape, span, or sweep angle) to improve performance over a range of flight conditions. Or the morphing wing may be passive where the structural properties of the wing are tailored such that the wing shape changes in response to aerodynamic surface pressure without the need for external sensors and actuators. Another example of a smart system is the use of shape memory alloys to automatically control air flow in building HVAC systems which do not need any power or wiring. In any case, there is a very wide variety of topics that encompass the research area of smart materials and structures; the papers in this special issue demonstrate this breadth.

Demonstrating the wide variety of topics, included papers cover studies ranging from experimental characterization, to response modeling, to integration of sensing and response capabilities into systems and structures. Research efforts span a wide range of smart materials including piezoelectric, shape memory alloys, magnetorheological materials, and a wide range of uses of such materials including actuation, transport, morphing, energy harvesting, and shape, flow, and vibration control. Smart structures and systems topics include design optimization of distributed actuator systems, functional gradation, and stress relief in cellular mechanisms. Indeed the breadth and depth of the papers included here demonstrate that the research area of smart materials and structures continues to expand rapidly in both breadth and importance, with the growing recognition of the enhanced functionalities and technical barrier-breaking capabilities that they provide in a multitude of engineering fields.

We gratefully acknowledge all those who served as reviewers of the papers submitted for this issue. We also appreciate the efforts of the authors in submitting their revisions and final papers in a timely manner. Finally, we thank JMD Editor Panos Papalambros and Editorial Assistant Connie Raymond-Schenk for their many efforts in making this exciting special issue a reality.

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Guest Editors