NANOHOUR

Friday, May 20, 2011 10:00am
Beckman Institute - Room 2269
(Please note the special time and place)

Recent Advances in the Modeling, Analysis, and Characterization of SMA-Based Aerospace Structures

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This talk provides an overview of fundamental and applied research being performed at Texas A&M regarding the use of active materials in the development of active or "smart" structures. Different research areas are introduced, including the work on shape memory alloys (SMAs), magnetic shape memory alloys (MSMAs), and shape memory polymers (SMPs). In particular, the phenomenological constitutive modeling of shape memory alloys, the numerical analysis of components composed of these materials, and the utilization of such components in the design of engineering applications are all discussed in detail. As the number and complexity of proposed SMA applications increases, engineers and designers must seek out or develop more capable predictive methods. A focused discussion on recent work regarding constitutive modeling and analysis tool development is therefore provided. An overview of conventional SMA modeling which considers only the martensitic transformation is first presented, including discussions of the mathematical model, its implementation, and example analyses. The concept of irrecoverable deformations in these alloys is then introduced. Such deformations include rate-independent plastic yielding, which may occur at stress concentrations such as crack tips, and rate-dependent viscoplastic creep/relaxation as observed at significantly elevated temperatures. In some materials, the processes of transformation, yield, and creep may occur simultaneously. The numerical implementation of each of these advanced models is described and example analyses relating to each are provided. The talk concludes with a discussion of SMA engineering problems at the structural and system scales. The analysis of multiple coupled physical phenomena is briefly addressed, including such concepts as heat transfer and fluid-structure interactions. Finally, current work being performed on the optimized design of SMA active structures in collaboration with The Boeing Company is discussed.

BIO

Dimitris C. Lagoudas received his B.S. from the Aristotle University of Thessaloniki, Greece in 1982 and his Ph.D. from Lehigh University in Bethlehem, PA in 1986. Dr. Lagoudas arrived at Texas A&M in 1992 and currently serves as the Department Head and the inaugural recipient of the John and Bea Slattery Chair in Aerospace Engineering. As Director for the Texas Institute for Intelligent Materials and Structures (TiiMS), his research involves the design, characterization and constitutive modeling of multifunctional material systems at various length scales and considering various functionalities, including mechanical, thermal and electrical. His research team is recognized internationally, especially in the area of modeling and characterization of shape memory alloys. He has authored or co-authored about 340 scientific publications, including 140 in archival journals, several of which are now considered classic papers in the field. The theoretical models that his research group developed have been implemented into finite element analysis software and utilized by many industrial and governmental entities (Boeing, DoD and NASA), as well as academic institutions worldwide.

Coffee and cookies will be served

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