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DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

CEVE Seminar Series

"Smart Structures in Engineering Applications"

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This presentation introduces the concept of smart structures. Three different applications of smart materials and structures in structural engineering are examined:

First, an active vibration isolation system is considered. The anti-vibration measures offered by such a system are critical to high-resolution measurement and manufacturing applications which require precise and repeatable results. In particular, the modeling, parameter identification, and model updating procedure are described. The simulated transmissibility curves for an uncontrolled (passive) system and for a controlled (active) system are presented and discussed. Different control strategies are implemented in the active system.

The second application is based on friction damping in semi-active joints in a large truss structure. The semi-active joints allow relative sliding between the connected parts. The energy dissipation due to interfacial slip in the friction joints can be controlled by varying the normal pressure in the contact area using a piezo-stack actuator. In order to enhance the damping in the structure, conventional rigid connections are replaced by friction joints at optimal locations, and different control concepts for the control of the normal forces are implemented. In conjunction with experimental measurements, a finite element model of the truss is constructed and updated using experimental modal analysis.

The third application involves structural health monitoring using elastic waves. First, a "smart layer" for damage detection is described. The smart layer consists of a matrix of piezoelectric elements which are driven in the pulse-echo mode. This smart layer can be used for monitoring thickness changes and delaminations in composite materials. Secondly, a laser-based method for detecting discontinuities in plates is discussed. Specifically, Lamb waves in thin plates are generated and detected using laser ultrasonics. The location and relative size of the discontinuity is determined via a signal processing procedure involving the spectrogram and a special correlation applied in the group velocity-frequency domain. Finally, an autonomous overhead transmission line monitoring technique is presented.

Biographical Sketch

Dr. Hurlebaus is Assistant Professor at the Zachry Department of Civil Engineering at Texas A&M University. He worked for three years as the Head of the Adaptive Structures Group in the Department of Mechanical Engineering at the University of Stuttgart, Germany. He received a Dr.-Ing. (2002) and a Dipl.-Ing. (1996) in Mechanical Engineering from the University of Stuttgart. He also received his M.S. in Engineering Science and Mechanics from Georgia Tech (1996). Dr. Hurlebaus has authored more than 50 technical papers, and performed numerous industrial research projects. His research interests are in nondestructive evaluation, structural health monitoring, laser measurement techniques, active, semi-active and passive vibration control, as well as active vibration isolation and suppression.

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