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Lecture Title: Nonlinear Targeted Energy Transfer Applications in Vibration Engineering

Friday, March 9, 2012, 2PM, Wang Center Theater

Abstract

We consider nonlinear targeted energy transfer (TET) phenomena and their applications in vibration engineering. By TET we denote passive, nearly one-way transfer of vibration or shock energy from a primary excited or self-excited system to a set of local dissipative strongly nonlinear attachments where this energy is spatially confined and locally dissipated without 'spreading back' to the primary system. These attachments then act, in essence, as passive broadband boundary controllers or passive nonlinear energy sinks. After presenting some basic theoretical concepts related to TET and the associated phenomenon of nonlinear resonance capture, we will provide applications to passive aeroelastic instability suppression of rigid wings in subsonic and transonic flow regimes, passive blast and seismic mitigation designs, control of vortex-induced vibrations, and vibration energy harvesting. If time permits, we will briefly discuss related applications in the field of ordered granular media, which due to the complete absence of linear acoustics can be characterized as ‘sonic vacua’. We will show how nonlinear resonance and anti-resonance phenomena in these systems can be employed in designs of granular media as effective shock mitigators and in developing new classes of strongly nonlinear and adaptive acoustic metamaterials.

Biography

Alexander F. Vakakis received his PhD in Applied Mechanics from Caltech (1990), an MSc from Imperial College, London (1985) and a Diploma in Mechanical Engineering from the University of Patras, Greece (1984). He has published over 170 archival journal publications, three research monographs and edited two books in the fields of nonlinear dynamics and vibrations. Currently he serves as Associate Editor of the ASME Journal of Applied Mechanics and of Meccanica, and is Member of the Editorial Board of the Journal of Multi-body Dynamics (Part K of the Proceedings of the Institution of Mechanical Engineers) and the Journal of Mechanical Science and Technology. His current research work focuses on employing strongly nonlinear methodologies in mechanical design and vibration engineering and is funded by NSF, ARO, DARPA, the Sandia National Laboratory and the Binational Science Foundation. Together with Larry Bergman he co-directs the Linear and Nonlinear Dynamics and Vibrations Laboratory of the University of Illinois (http://lndvl.mechse.illinois.edu).

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