Recent Advances in Dynamic System Research: From Vibration of Distributed Structural Systems to Vibration-based Damage Detection and Wind Energy

Weidong Zhu
Professor
Department of Mechanical Engineering
University of Maryland, Baltimore County
Baltimore, MD 21250

Some interesting results on the vibration and stability of distributed structural systems, vibration-based damage detection, and wind energy will be reviewed. The vibration and stability of translating media with time-varying lengths and/or velocities will be addressed. Two types of dynamic stability problems are considered: dynamic stability of translating media during extension and retraction, and parametric instabilities in distributed structural systems with sinusoidally or periodically varying velocities. A new spatial discretization and substructure method, which ensures that all the matching conditions of distributed components are satisfied, and hence uniform convergence of the solutions, will be discussed. The method overcomes drawbacks of classical assumed modes and component mode synthesis methods. A new nonlinear model of a slack cable with bending stiffness and arbitrarily moving ends is developed. Only one-tenth of elements are needed to achieve the same accuracy as that of the finite element method. The new methodologies are applied to elevator systems. The vibration-based damage detection will address two major challenges in model-based damage detection: accurate modeling of structures and development of a robustness algorithm for identifying locations and extent of damage. Finally, design, analysis, and control of novel infinitely variable transmissions and variable electromotive force generators will be discussed. Experimental results will be presented to validate the theoretical predictions.

Brief Biography

Weidong Zhu is a Professor in the Department of Mechanical Engineering at the University of Maryland, Baltimore County, and the founder and director of its Dynamic Systems and Vibrations Laboratory and Laser Vibrometry Laboratory. He received his double major BS degree in Mechanical Engineering and Computational Science from Shanghai Jiao Tong University in 1986, and his MS and PhD degrees in Mechanical Engineering from Arizona State University and the University of California at Berkeley in 1988 and 1994, respectively. He is a recipient of the 2003 National Science Foundation CAREER Award, the 2007 American Society for Nondestructive Testing Fellowship Award, the 2008 ChangJiang Scholar Chair Professorship in General Mechanics from the Ministry of Education of China, and the 2009 Daily Record's Maryland Innovator of the Year Award. He is a Fellow of ASME and an Associate Editor of the ASME Journal of Vibration and Acoustics. His research spans the fields of dynamics, vibration, control, applied mechanics, structural health monitoring, and wind energy, and involves analytical development, numerical simulation, experimental validation, and industrial application.