

The Department of Mechanical Engineering/College of Engineering and Applied  
Sciences

Stony Brook University

## **Mechanical Engineering Seminar**

**Faculty Candidate**



**Dr. Ya Wang, Ph.D.**  
**Virginia Tech**

### **Simultaneous Energy Harvesting and Vibration Control via Piezoelectric Materials: From Unmanned Aerial Vehicle to Spacecraft Skin**

Friday, April 19, 2013 at 2PM, Room 173 Light Engineering Building

#### **Abstract**

This work presents the engineering examples of simultaneous energy harvesting and vibration control using piezoelectric materials. The first motivating application is a multifunctional composite sandwich wing spar for a small Unmanned Aerial Vehicle (UAV) with the goal of providing self-contained gust alleviation. The basic idea is that the wing itself is able to harvest energy from the ambient vibrations along with available sunlight during normal flight. If the wing experiences any strong wind gust, it will sense the increased vibration levels and provide vibration control to maintain its stability. This work holds promise for improving performance of small UAVs in wind gusts. Another motivating application is a functional graded composite structure, which is a potential solution to lightweight skins for spacecraft, and is able to harvest energy and suppress vibration in extreme conditions. The key effects not well studied in literature but investigated in this work are 1) an equivalent electromechanical model that is able to well represent the mechanical and electrical coupling through piezoelectric harvester, sensor and actuators; 2) an innovative control law that is able to consume minimum energy with certain vibration suppression constraints; 3) a well-posed finite element model that is able to demonstrate the frequency-dependent and temperature-dependent behavior of the stiffness and damping of the viscoelastic material that directly affects system modal frequencies and damping

#### **Biography**

Ya Wang received her Ph.D. in 2012 in Mechanical Engineering at Virginia Tech. She has since worked as a postdoctoral research fellow in Aerospace Engineering at the University of Michigan. She has 10 journal articles and 27 conference papers published (or to be published). She has an M.S. degree (2007) from the University of Puerto Rico, Mayaguez, and a B.S. degree (2004) from Shandong University, both in Mechanical Engineering. She won the 2012 Student Best Hardware Award at the 2012 ASME conference on Smart Materials, Adaptive Structures and Intelligent Systems for the paper titled "Experimental Validation of Simultaneous Gust Alleviation and Energy Harvesting for Multifunctional Composite Wing Spar". She has an Invited Feature Article for the Journal of the American Ceramic Society, 2013, and an Invited Paper in the SPIE 2013 Defense Security and Sensing Symposium, titled "Adaptive Multifunctional Composites". She is a member of ASME, IEEE, AIAA and SPIE, and serves as an elected member of technical committees of ASME Aerospace Division, Adaptive Structures and Material Systems Branch. She has been a Conference Session Chair for SPIE Smart Structures/NDE 2012 and SPIE Smart Structures/NDE 2013 conferences. She has reviewed thirty manuscripts for eight outstanding journals in the fields of energy harvesting, vibration control, structural dynamics and multifunctional structures.

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Check <http://me.eng.sunysb.edu> for any changes to location or time.



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