

The Department of Mechanical Engineering  
College of Engineering and Applied Sciences  
Stony Brook University  
**Mechanical Engineering Seminar**



**Prof. Junrui Liang**  
**School of Information Science and Technology**  
**ShanghaiTech University**

**Lecture Title: Bias-Flip Interface Circuits for Piezoelectric Energy Harvesting Enhancement: Their Structural Effects, Practical Implementations, and Maximum Harvesting Capability**

Tuesday, November 10, 2015 at 10:30 AM, Room 173 Light Engineering Building

#### **Abstract**

Piezoelectric energy harvesting (PEH) systems are designed for future distributed or mobile electronics, with the purpose to make these devices energy self-sufficient by scavenging the vibration energy in their ambience. The interface circuit connects the piezoelectric transducer and the DC load; therefore it plays an indispensable role towards practical applications. Moreover, by intervening the power conversion process with the so called synchronized switch or bias-flip scheme, an interface circuit can enhance the system-level electromechanical coupling and, as a result, increase the harvested power by several hundred percent. This talk touches some fundamentals towards better *understanding, design, and future development* of PEH interface circuits. Given the design objective of energy harvesting, some basic concepts, such as the energy flow, relation between energy harvesting and vibration damping, are firstly clarified by summarizing the existing bias-flip based PEH solutions. Considering the practical application of synchronized bias-flip interface circuits in stand-alone PEH systems, the designs of an electronic self-powered solution and a mechatronic self-powered solution are introduced, respectively. The last part of the talk provides a general model for the bias-flip solutions, based on which we can mathematically discuss the best bias-flip strategy towards maximum harvesting capability. Such theoretical exploration leads to the invention of a more capable synchronized triple bias-flip (S3BF) interface circuit.

#### **Biography**

Dr. Junrui Liang has received his Ph.D. degree in Mechanical and Automation Engineering from The Chinese University of Hong Kong (CUHK), Hong Kong, in 2010. He is now an Assistant Professor at the School of Information Science and Technology, ShanghaiTech University, China; and also a Visiting Scholar at the Department of Electrical Engineering and Computer Sciences, University of California, Berkeley. Dr. Liang's most significant contribution was that he extended the impedance modeling and analysis, which conventionally was only used for linear systems, to some nonlinear power conversion systems, such as the class-E resonant inverters and piezoelectric energy harvesting systems. Besides that, he has also made some innovative designs on piezoelectric energy harvesting interface circuits. Dr. Liang's recent research interests include: mechatronics, kinetic energy harvesting and vibration control, power circuits and systems, renewable energy, etc. Since 2008, he has published more than 20 peer-reviewed technical papers on international journals and conferences and received four research awards. Dr. Liang is a member of IEEE and ASME, reviewer of more than 10 international journals and conferences, and program committee member of SPIE Smart Structure/NDE international conference.

**Directions:** Please refer to website: <http://www.sunysb.edu> or call 631-632-8310 for more information.  
Check <http://me.eng.sunysb.edu> for any changes to location or time.



**Stony Brook University**