Announcing the Final Examination of Christopher Kelley for the degree of Master of Science

Time & Location: June 8, 2016 at 11:00 AM in Engineering 1 288
Title: Optimal Switch Timing for Piezoelectric-Based Semi-Active Vibration Reduction Techniques

Semi-active vibration reduction techniques switch a piezoelectric transducer between an open circuit and a shunt circuit in a way that reduces vibration. The steady-state vibration amplitude is reduced by exploiting the change in stiffness between states, manipulating the converted electrical energy, or both. Semi-active techniques typically require four switches per vibration cycle. Control laws such as state switching and synchronized switch damping require switches to occur at every displacement extrema. Due to the complexity of analyzing a system with discrete switches, these control laws were developed based on intuition. The few analyses that attempt to determine an optimal switching law mathematically only evaluate the system at resonance. This thesis investigates the effects of switch timing on vibration reduction and the frequency dependence of the optimal switch timing control law. Regardless of the switch timing, sensing uncertainties, noise, and modeling errors can cause the switches to occur away from the designed moment. Thus, this work also quantifies the expected degradation in vibration reduction performance due to variations in the designed switch time. Experimental, numerical, and analytical solutions agree that the optimal switch timing of these semi-active techniques depends on frequency. A closed-form solution for the optimal switch timing is derived in terms of well-known, non-dimensional parameters.

Major: Mechanical Engineering

Educational Career:
Bachelor's of Mechanical Engineering, BS, 2013, University of Florida

Committee in Charge:
Jeffrey L Kauffman, Chair, Mechanical and Aerospace Engineering
Tuhin Das, Mechanical and Aerospace Engineering
Yunjun Xu, Mechanical and Aerospace Engineering

Approved for distribution by Jeffrey L Kauffman, Committee Chair, on May 24, 2016.

The public is welcome to attend.