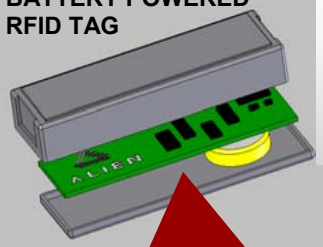
ENERGY SCAVENGING FROM VIBRATIONS

Elaine Lai • Professor Paul Wright

A MATLAB Program to Aid in Resonator Design and an Experiment in Powering a Semi-Active RFID tag

BATTERY POWERED RFID TAG



VIBRATION POWERED RFID TAG

Vision

To scavenge energy from ambient vibrations to power nodes of a wireless sensor network. In order to realize this vision, a systematic approach to piezoelectric power generator design must be developed. Furthermore, experiments have shown that the Crossbow Mica2Dot Mote is not a feasible load application for energy scavenging due to relatively large power demands. A better load solution needs to be found.

Research Questions

- **Given a vibration source and load application, what is the optimal resonator design for scavenging energy and powering the load?**
- **Can a piezoelectric power generator effectively power a battery-assisted passive RFID tag?**
- **If so, how do the results compare to powering a Crossbow Mica2Dot Mote?**

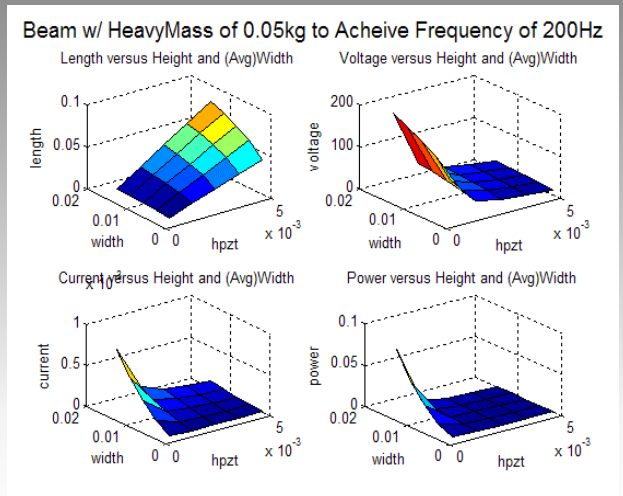
Methods

Modeling

- **An end-to-end design flow using MATLAB**
- **Detailed graphical and tabular outputs of electrical and mechanical behavior results from an input of source vibration characteristics, volumetric constraints, and material properties**
- **Versatile program which is capable of analyzing various beam composites and configurations**

Teeny Temp

- **Design and fabrication of a piezoelectric power generator and power conditioning circuit which will power an Alien battery-assisted passive RFID tag**
- **Analysis of system characteristics as compared to earlier experiment in powering a Crossbow Mica2Dot Mote**



Findings

- **A MATLAB program was built to analyze various resonator designs in order to find the optimum for a given vibration source and load characteristics. Results showed voltage, current, power, stress, and displacement characteristics for various designs.**
- **An experiment in powering an RFID tag with onboard temperature sensor proved successful**
  - **8mW of power was needed for the reader to reliably read the tag; cycle time to charge the capacitors was 1 minute with a modest vibration source**
  - **compared to the mote, this experiment saw a 88% decrease in power consumption and 90% decrease in cycle time**

Elaine Lai
510.643.6546