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MEMS Power Harvesting Concepts

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ABSTRACT

Electromagnetic and piezoelectric concepts for power harvesting are analyzed and compared for application in MEMS devices implanted in hovering insects. MEMS solenoids are described including their fabrication and dynamics. A micro unimorph piezoelectric bender is also described and equations of motion are derived. These systems are then coupled to power harvesting circuitry whence transfer functions are computed from base excitation accelerations to voltage across an example damping element. System geometries are set for resonance at the expected excitation frequency. Variation of the piezoelectric bender's width profile is considered to optimize the strain energy collected from the first mode of vibration.

Keywords: Power harvesting, Piezoelectric, Solenoid.

INTRODUCTION

Smart materials have found themselves ubiquitous in modern sensors, which are deployed in previously unobservable environments. A main shortcoming to these sensors is their reliance on power to operate the sensor and to transmit the data. Thus power harvesting emerges as a focus of smart materials research.

Harvesting electrical power from vibration sources is a concept with strong recent history. Roundy et al. [1] and Paradiso and Starner [2] give an overview of the various technologies available for this purpose. Roundy compared three simple methods to convert vibration energy to electrical energy: electro-magnetic, electrostatic, and piezoelectric. Electro-magnetic conversion uses oscillating magnetic fields to induce current and voltage in the harvesting circuit, but produces (in Roundy's case) a voltage too low to rectify (0.1-0.2 V). Electrostatic systems have the drawback that they require a separate voltage source.