Public Abstract

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Graduation Term:SP 2015
Department:Electrical Engineering
Degree:PhD
Title:MEMS Energy Harvesters with a Wide Bandwidth for Low Frequency Vibrations

In this research wideband electrostatic and electromagnetic power harvesters for low frequency vibrations were presented. The device harvests the wasted energy from the unwanted mechanical vibrations that can be used to power micro sensors and actuators widely found in smart structures and systems. The harvested power, though very small, can have a profound effect on the usage of microsensors. First, the self-powered sensors will no longer require regular battery maintenance. Second, the harvested power will remain fixed even with an unstable structure or system vibration frequency. Third, the self-powered chip is a liberating technology. For example, on a circuit board, it can simplify the connection. On a commercial jet, the sensors can greatly reduce and possibly eliminate cabling.
Batteries, powering most portable and wireless sensors, and electronics, become the bottle neck to take full advantage offered by the latest innovations in electronics since they have limited energy capacity and life span. Research in energy harvesting from environmental mechanical vibration becomes the popular choice among other renewable sources since it is widely available.
Inertial forces are widely used in MEMS power harvesters for energy conversion from unwanted ambient vibration into electrical energy with high enough voltage level to power up wireless sensors used in construction, security, aviation and biometry.
We have designed and built wideband MEMS electrostatic power harvesters for low frequency vibration. The results demonstrate that the device was able to harvest power on a wide range from 14 to 39 Hz with maximum harvested power 96 nW at 1 g acceleration. We also studied a macro-scale electromagnetic power harvester with multi-impact oscillations to achieve a broad bandwidth at low frequency vibrations from 11-62 Hz with a maximum output power of 23.5 ?W at 1 g acceleration.