Topology Optimization of Magnetic Vibration Energy Harvesters

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Abstact:

   Vibration energy harvesters draw a lot of attention as future power sources, applicable for portable electronics. Energy conversion processes of vibration energy harvesters generally employ one of the following methods: electrostatic (capacitive), piezoelectric, and magnetic (inductive) conversions. Few works have been performed on the topology optimization of magnetic energy harvesters compared to other conversion methods.

   This paper presents topology optimization applied for the design of magnetic vibration energy harvesters. The structure of harvesters consists of coils, and a permanent magnet attached to a mechanical spring. The optimization finds the shape and locations of a permanent magnet for maximizing the average output voltage generated by external oscillation. To calculate the output voltage, the magnetic field analysis is performed using the finite element method. The design sensitivity is calculated using the adjoint method. The optimization problem is formulated and solved using Method of Moving Asymptotes (MMA). In addition, the effect of volume constraint and magnetization direction of the permanent magnet is investigated and discussed.