MEMS-based Reconfigurable Energy harvesting Device Using the Couple Cantilevers

A. L. G. N. Aditya[1], E. Rufus[1]

1. School of Electronics Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, India

INTRODUCTION: To bring forward the alternative methods for conventional power sources and generators at micro-scale, for integrated systems & Wearable alternative energy source are required to overcome the challenges of Lithium ion batteries. Techniques using the ambient energy present in the environment where photovoltaics and micro vibrational harvesters are the important contenders at micro/nanoscale. Considering the limitation of photovoltaics, vibrational energy harvesters can be contenders for devices like wearables, and Biomedical devices. The main principle of vibrational energy harvesting is to covert the Kinetic energy available in the environment. Once the ambient vibrational frequency changes these devices are to be tuned and it is very difficult once the devices are fabricated as they made for certain natural frequency.

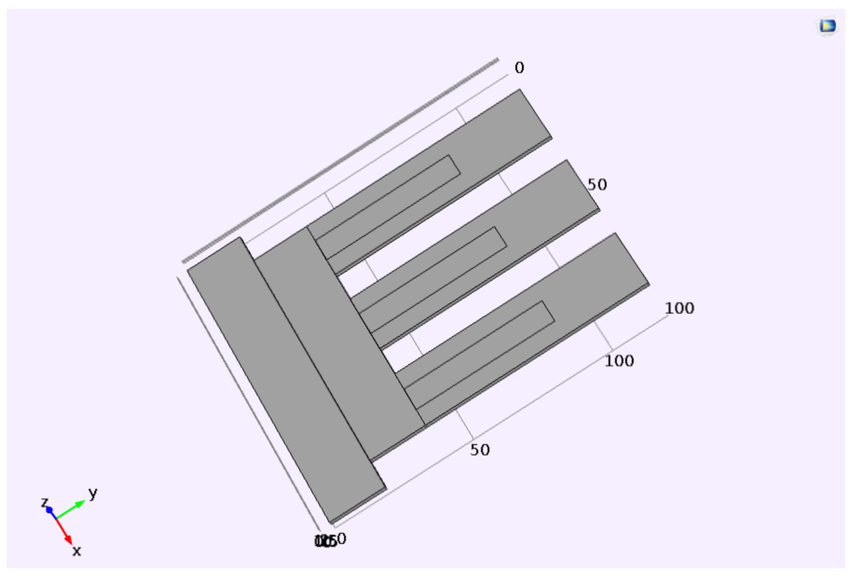


Figure 1.Triple Couple Cantilever

COMPUTATIONAL METHODS: The geometry is designed using work plane in 3D with Z-plane having the device thickness of 2 micron. The MEMS and AC/DC modules have been used to check the principle stress/strain, Eigen frequency and Voltage induced in the device with Eigen frequency analysis under no load conditions.

The Eigen frequency analysis is used to determine the principle mode or lateral movement of the structure, upon which the frequency analysis is carried out at the principle mode with material sweep and parametric sweep for load condition.

$$-\rho\omega^2\mathbf{u} - \nabla\cdot\sigma = \mathbf{F}_V, \quad -i\omega = \lambda$$

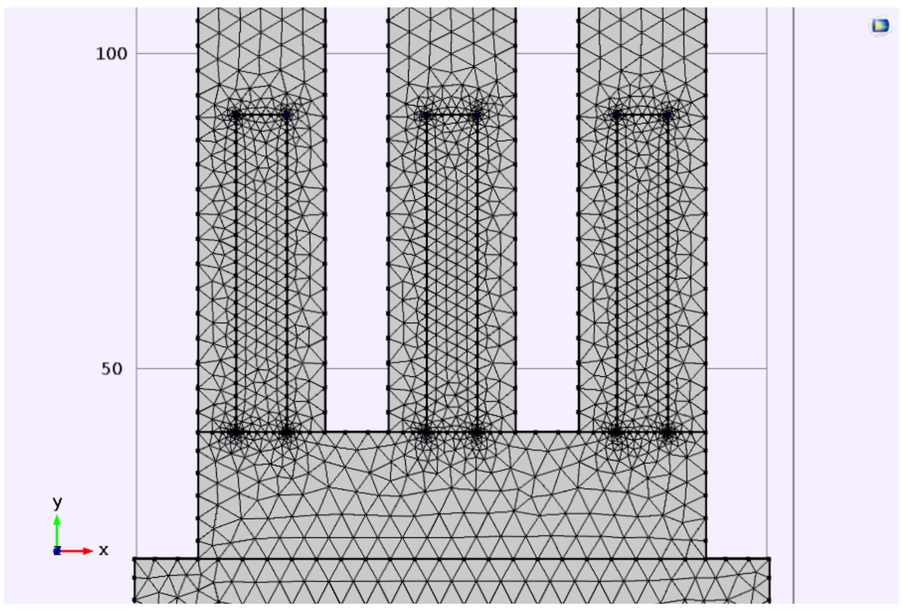
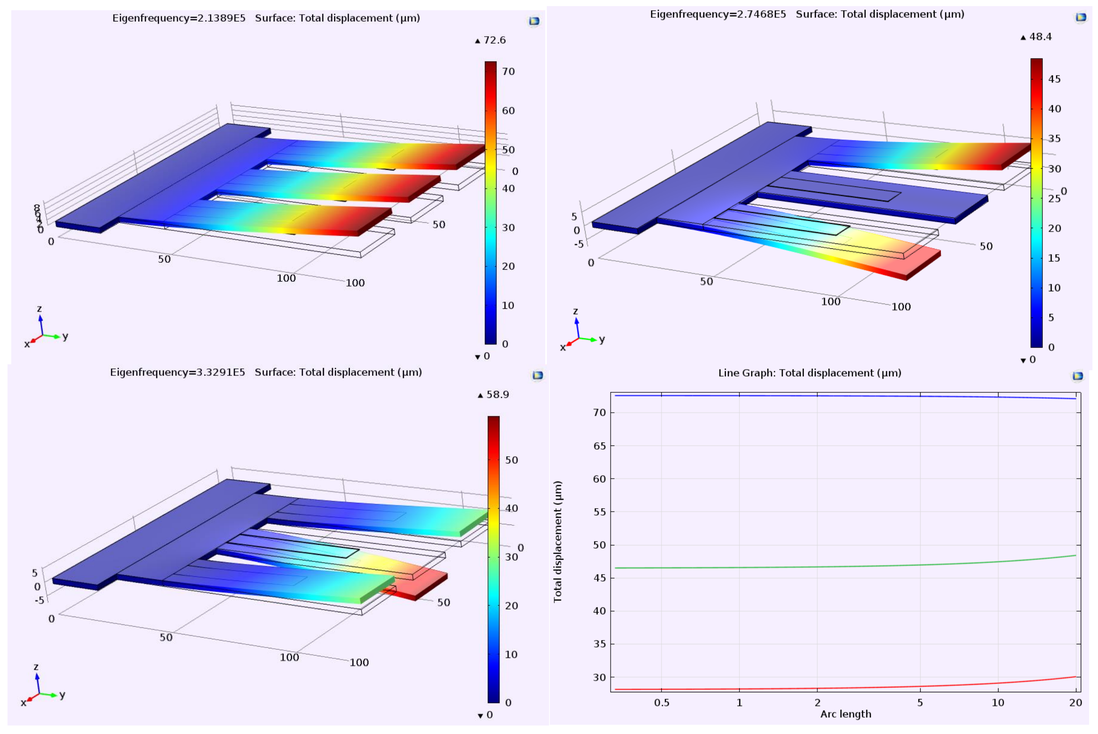
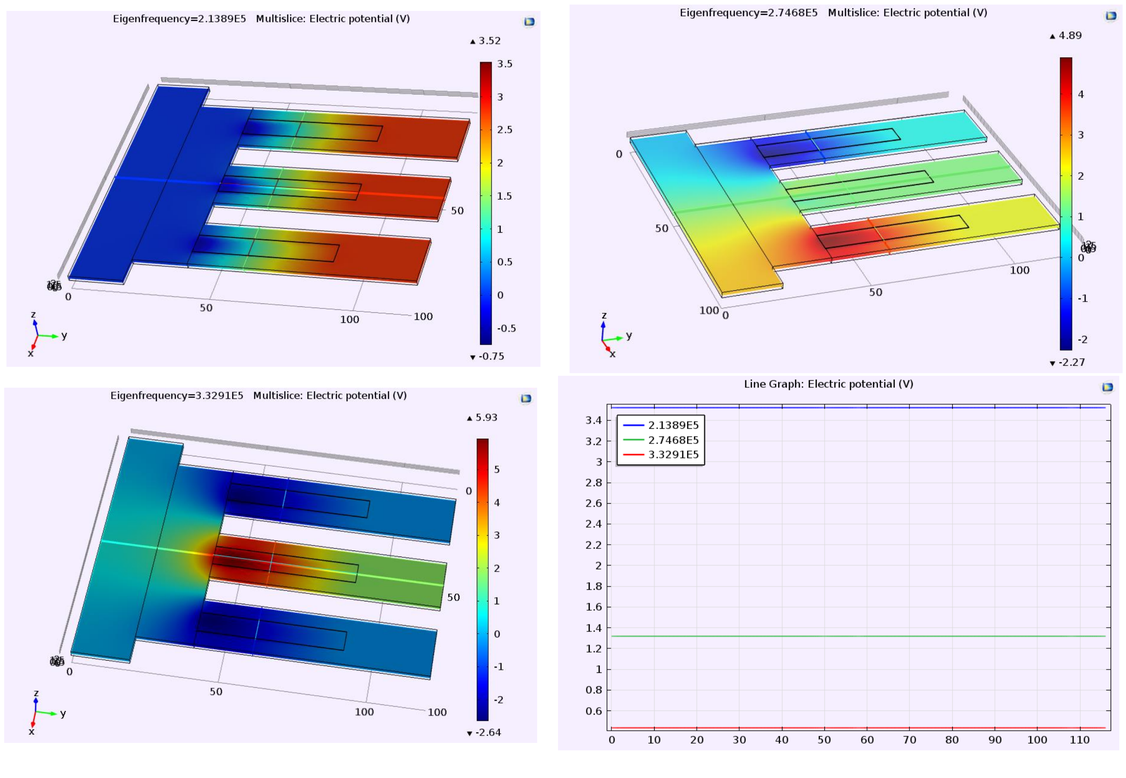


Figure 2.Triple Couple Cantilever with Physics Controlled Mesh technique.

RESULTS: The material consideration of the devices are assigned from the MEMS material library and Piezo-electric material PZT-2 from piezo-electric library. The material properties like elastic matix and coupling matrix are induced by the literature survey that relates to silicon. The boundary conditions to where the overhang is fixed. The Eigen Frequency analysis for 6 modes. In among that 3 principle modes are considered, feasible for the energy harvesting methods in unidirectional forces. The frequency modes of the device 213KHz, 274KHz, and 332KHz. Where the modes shapes and deflections are depicted in figure 3 & corresponding voltage induced in Fig.4





CONCLUSIONS: The triple couple cantilever can be a device that can vibrate for three principle frequency where the induced voltage due to piezo-electric effect can be enhanced due to coupling mechanism of the cantilevers in certain modes and this can operated at 3 different frequencies.

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