

## **A low frequency hybrid harvester with ring magnets**

### **Abstract**

Although many hybrid EH devices had been investigated by researchers, their performances at different operating resonance frequencies were not reported. Radial magnetic field was reported as the most efficient architecture to use in electromagnetic energy conversion, this was utilized in the design of a low frequency and efficient hybrid harvester comprising piezoelectric (PZT) and electromagnetic generators. FE simulation was used to obtain the magnetic field, design the coil and locate its position relative to the magnets. The electromagnetic generator consists of ring magnets which act as proof mass, with a hanging coil inside. The harvester was tested at frequency range of (34-40) Hz, produced maximum power of (710) $\mu$ W. The maximum normalized power density and maximum efficiency of the harvester are (2.272) mW/cm<sup>3</sup>/g<sup>2</sup> and (30.1%) respectively, at frequency of 36Hz and induced acceleration of (0.25)g. The new hybrid harvester has a higher normalized power density compared with others.