Design and Simulation of Unimorph Piezoelectric Energy Harvesting System

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Abstract

With recent advancements in wireless technology, energy harvesting is considered as a potential alternative for conventional batteries. The piezoelectric energy harvesting is a potential power for power generation in terms of milli and micro watts. For this purpose, piezoelectric unimorph cantilever with proof mass is used. The piezoelectric unimorph cantilever is designed using COMSOL Multiphysics®. The unimorph cantilever consists of stainless steel as substrate material, PVDF as piezoelectric material and titanium as proof mass.The d31 mode is used for power generation. The power would be maximum only when the resonant frequency of the cantilever matches the vibration frequency. For this purpose, a brief study has been carried out to study the influence of device dimensions on the resonant frequency of cantilever[Fig1,2,3]. The design parameters are optimized for achieving the frequency in the range of environmental vibration frequencies which is in between 60 Hz and 200 Hz[1]. A unimorph cantilever with a frequency of 153 Hz is designed using comsol[Fig 4]. The comparision of analytical and simulated results is done. The device parameters are chosen in centimetre range. The affect of device parameters on charge, voltage and energy of unimorph cantilever is studied. The comparision of three piezoelectric materials namely PVDF,PZT-5H and PMN-0.33%Pt is done. The PVDF(piezopolymer) is chosen as an appropriate material for energy harvesting.

Reference

1.S Roundy, PK Wright, J Rabaey. "A study of low level vibrations of power sources for wireless sensor nodes." Computer communications 26 (11), 1131-1144.

Figures used in the abstract

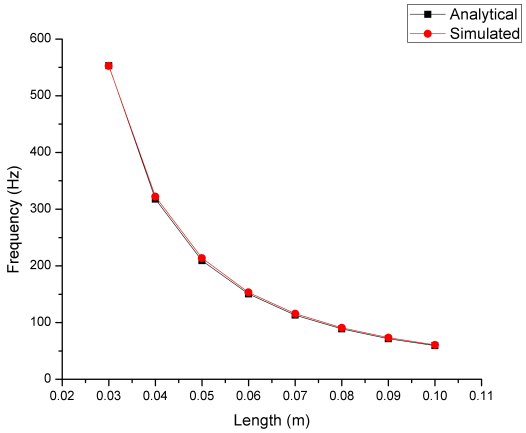

Figure 1: length of beam vs frequency of unimorph cantilever

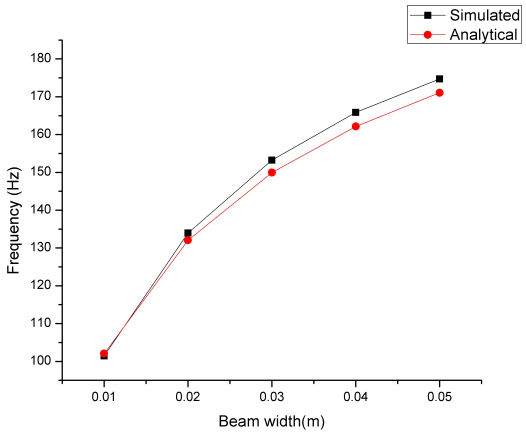

Figure 2: Width of beam vs frequency of unimorph cantilever

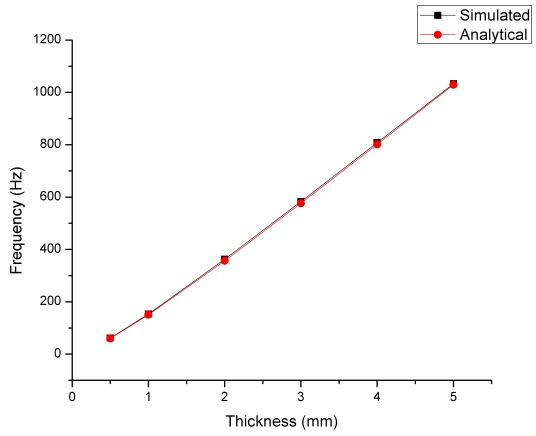

Figure 3: Thickness of beam vs frequency of unimorph cantilever

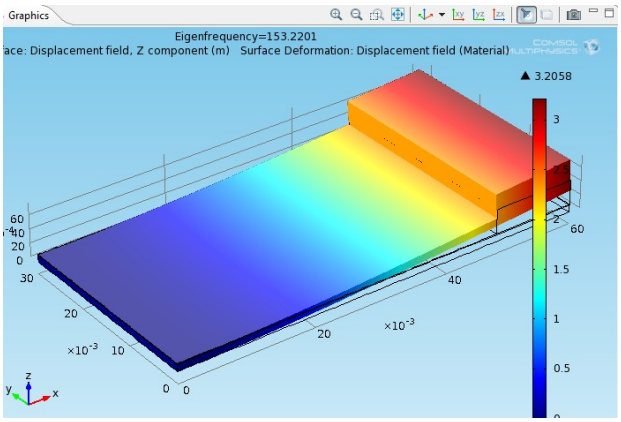

Figure 4: Frequency of unimorph cantilever