An asymptotically correct beam type piezoelectric energy harvester model

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ABSTRACT

There has been an increasing demand for wireless electronic devices which led to substantial research efforts in major fields like energy storage and energy harvesting. Among all other materials mostly piezoelectrics has grabbed attention for energy harvesting application because of its high electromechanical coupling property. The present study talks about developing an asymptotically correct electromechanical model of a vibration based piezoelectric energy harvester model and validate it with experimental studies published in past literature. The present study is based on a well renowned theory Variational Asymptotic Method (VAM). This theory is a rigorous mathematical technique which asymptotically split the original three dimensional electromechanical problem into two dimensional electromechanical cross sectional analysis and one dimensional beam analysis. As an example problem a bimorph configured energy harvester under a harmonic base excitation has been studied. Coupled voltage, power and current response under a harmonic base acceleration has been mathematically derived and obtained. The model is also capable of analysing the system response with varying load resistance. Close circuit and open circuit voltage ar are obtained and validated. Thus the present study is all about developing an efficient and reliable mathematical technique which can capture all the important multiphysics involved in any kind of a generalized piezoelectric energy harvester model.

Keywords: Piezoelectric energy harvester, Variational asymptotic method, Bimorph.

REFERENCES

