

Multi-domain Simulations for Increasing the Efficiency of Energy Harvesting

* Matthias Kurch¹, Heiko Atzrodt², Christoph Klein³ and Dirk Mayer⁴

^{1–4}Fraunhofer Institute for Structural Durability and System Reliability LBF
Bartningstr. 47, 64289 Darmstadt, Germany
www.lbf.fraunhofer.de

¹matthias.kurch@lbf.fraunhofer.de

²heiko.atzrodt@lbf.fraunhofer.de

³christoph.klein@lbf.fraunhofer.de

⁴dirk.mayer@lbf.fraunhofer.de

Key Words: *Energy Harvesting, Multi-Domain Simulations, Optimal Efficiency.*

ABSTRACT

The main focus of this contribution is to highlight some of the design technologies to utilize piezoelectric materials for energy harvesting successfully. Therefore the multi-domain system including mechanical and electrical components is modeled and analyzed. The paper focuses on the increasing the total systems' efficiency. To get a general idea the work starts with an analytical modeling of the system. Based on this, numerical simulations of the mechanical and electrical subsystems are set up. Hence methods for the optimal placement and dimensioning of the piezo transducers by means of the finite element method are presented. Thereafter it is demonstrated how such numerical models can be reduced using model order reduction to fit the needs of transient simulations. Such simulations are needed for coupled multi-domain simulations. Furthermore we show the design and simulation of special circuits for energy harvesting. Finally all subsystem models are assembled to optimize the efficiency of the total system. To validate the numerical results the computed design parameters are verified by measurement data.