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Optimization Computational Model for Piezoelectric Energy Harvesters Considering Material Piezoelectric Microstructure

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In this work we want to present a computational model for the optimization of the performance of piezoelectric energy harvesters for micro/nano applications. In this model both piezoelectric single-crystals and poly-crystals can be used. For poly-crystals a homogenization method is used to characterize the piezoelectric properties considering random Gauss distributions of the crystals orientation (1). The optimization computational model is setup coupling a simulating annealing optimizer(2) together with Ansys software for the analysis of the piezoelectric performance. The optimization will consider several different perspectives: changing material and material orientations, changing the material microstructure for poly-crystals, changing the electric configuration, and changing geometry. Examples will be presented to establish the performance of the developed computational model and its flexibility to address different problems. The results will be analyzed and discussed.

[1] Jayachandran, K. P. ,Guedes, J. M. , and Rodrigues,H. C., "Homogenized electromechanical properties of crystalline and ceramic relaxor ferroelectric 0.58Pb(Mg1/3Nb2/3)O3–0.42PbTiO3", Smart Mater. Struct. 16, 1534 (2007). http://dx.doi.org/10.1088/0964-1726/16/5/005

[2] Jayachandran, K. P., J. M. Guedes, et al. (2012). "A Stochastic Optimization Procedure Applied to Ferroelectrics for Piezoelectric Applications." Ferroelectrics 427(1): 63-69.

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Optimization of a Material with a Negative Stiffness Provided by an Inherent Bistable Element

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Recent interest in material design optimization can be attributed to the significant progress in material processing. Material properties can be tailored by optimization techniques to achieve an optimal response to a given solicitation, which serves as an input to the