# SYSTEM-LEVEL AND MULTISCALE MODELLING OF ENERGY HARVESTERS FOR WIRELESS AUTONOMOUS TRANSDUCER SYSTEMS

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Development of energy harvesting technologies is crucial to drive applications such as self-powered sensors for smart energy and transport network as well as for structural health monitoring. Unfortunately, the efficiency of harvesting devices is still too small, moreover from the designer perspective, energy harvesters (EHs) must be designed as systems interacting with the ambient energy source. In this framework, advanced modelling of each element of an EH (input/energy source, generator, processing unit, energy storage, output/DC power) is important. In this work, a novel multiscale and multiphysics hybrid approach is proposed to assess the linear and nonlinear dynamic response of piezoelectric energy harvesting devices at multiple scales. Three levels are considered in the analysis: the microscale, the macroscale and the system scale. Transition from micro to macro quantities is based on classical Hill's energy principle while reduced order model approaches (based on modal superposition techniques) are employed to bridge the macro and the system scales. At the system level, a generalized kirchhoffian network model is employed to assess the overall performances. Finally, some recent experimental results are presented to validate the numerical predictions. The attractive features of this computational procedure are that an enhanced reduced-order model is derived, where the global dynamic response is formulated in the state-space using lumped coefficients enriched with the information derived from the microscale. Furthermore, from a numerical standpoint, the FE analyses are performed to solve a static problem, which is less time consuming than a dynamic problem. The advantage of the proposed approach is that the overall computational and experimental efforts are reduced while preserving a satisfactory accuracy in the assessment of the global behavior.

## REFERENCES

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