# Identification and Uncertainty Quantification Problems in Magnetostrictive Energy Harvesting

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## Abstract

Magnetostrictive materials change their shape or dimensions during the process of magnetization. An inverse effect can also be observed: the magnetic susceptibility changes if mechanical stress is applied to a magnetostrictive material. The latter effect can be employed in magnetostriction-based energy harvesting, that is, a technique for converting mechanical energy into electrical energy.

A harvesting device, see [1], comprises a coil with a magnetostrictive core. A bias magnetic field affects the device. Moreover, an external periodic stress load is applied to the magnetostrictive core and gives rise to variations of the magnetic field. Then, an electric current flows through a resistor connected to the coil and representing an electric load.

A nontrivial mathematical model of the harvester was published and partly numerically tested in [1] and [2]. It takes into consideration hysteretic characteristics of magnetostrictive materials modeled by the Preisach hysteresis operator.

Our contribution concerns uncertainty in output data (the harvested energy, for instance) caused by the uncertainty in input data, particularly in the Preisach density function. To model the uncertainty, a fuzzy set approach is applied.

If the amount of hysteresis is small (as in Galfenol, for example), a hysteresis-free nonlinear model of the harvester (that is, a model without the Preisach operator) is worth considering. The inner parameters of the simplified model have to be identified from measured data. Again, the propagation of fuzzy uncertainty is investigated.

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## References

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