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Nonlinear behaviors of micromachined SOI devices for energy harvesting application

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This study is part of a research that targets the exploitation of novel nonlinear MEMS architectures for energy harvesting applications from vibrating sources. The increasing demand for completely self-powered devices and autonomous sensor node has pushed the research toward power harvesting devices in recent years: the interest to save energy from the environment is highly felt in macro scale but also in small and integrated scale. Energy harvesting can be obtained from different energy sources, in particular, here we focus the attention on mechanical vibrations.

A common approach is based on vibrating mechanical bodies that collect energy through the adoption of "active materials" (e.g. piezoelectric layers). This family of systems shows good performance around its natural frequency; however, this is not generally suitable for energy recovery in a wide spectrum of frequencies as it is expected in the vast majority of cases when ambient vibrations assume different forms and the energy is distributed over a wide range of frequencies (such as naturally noise sources, induced oscillations, vehicle motions, multi tone vibrating systems and noisy environments).

The idea pursued and presented here consists in considering the nonlinear behavior of some micromachined devices that we have designed and fabricated in by using Silicon On Insulator (SOI) and integrated piezoelectric transducers (PiezoMUMPs technology).

This presentation covers several complementary aspects that we have deeply explored on the general subject "nonlinear devices for vibration energy harvesting": methodologies, design, microscale fabrication based on PZT layers and experimental results.

***Keywords**: MEMS; PiezoMUMPs technology; Integrated energy harvesters; Nonlinear behaviors*