Micro-/nano-power systems for energy harvesting

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The present interest in pervasive sensor networks and the steady development of electronic devices with low power consumption motivates the research on electronic systems capable of harvesting energy from the surrounding environment. Currently, most practical energy harvesters can provide an output power density of about 10-100 μW/cm^3 [1]. In this scenario, mechanical vibrations, thermal gradients, and photovoltaics represent the most promising power sources for supplying portable low-power electronic equipment.

For successful applications, it becomes essential to efficiently convert such low levels of input power. In this context, electronic interfaces based on recent commercial discrete components provide a cost-effective and easily implementable solution. Notable examples are reported in [2–5], where intrinsic consumptions down to 1 μA or less are achieved. However, in discrete electronics it is hard to reach a convenient trade-off between overall conversion efficiency and circuit complexity.

The use of integrated micro-/nano-electronic technologies allows possibilities of circuit optimizations paving the way towards the exploitation of sub-μW power regimes, thanks to significant reductions in the intrinsic consumption of power converters, so that the break-even point in the power budget is achieved with smaller transducers or lower input power densities. Notable examples are reported in [6–10], where several types of energy transducers providing up to a few μW are efficiently managed by full-custom integrated circuits dissipating down to 544 pW.

In this talk a series of state-of-the-art energy harvesting transducers and power conversion interfaces will be described. The talk will focus on power management systems, both in discrete or integrated electronics, specifically designed for operating with power sources at μW levels.

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