Master Thesis

Implementation of a Synchronous Magnetic Flux Extraction Interface for an Inductive Energy Harvester

Energy harvesting from human walking is challenging due to the relatively long strokes and low frequencies. Spring-mass-damper based energy harvesters usually have to be excited at their natural frequency (several 100 Hz) in order to provide maximum power. Frequency-up converters like the “push-button generator” (Fig. 1) can be used to close the gap between this high natural frequency and the low-frequent human walking (~ 1 Hz). The push-button generator converts kinetic energy into electrical energy by means of the inductive conversion mechanism. The high step force causes the permanent magnets to resonate relative to the fixed coil at the natural frequency of the spring-mass-damper structure (Fig. 2). For inductive harvesters, the Synchronous Electric Flux Extraction (SMFE) technique is a promising approach to extract more power than the widely applied and well-known full-bridge rectifier.

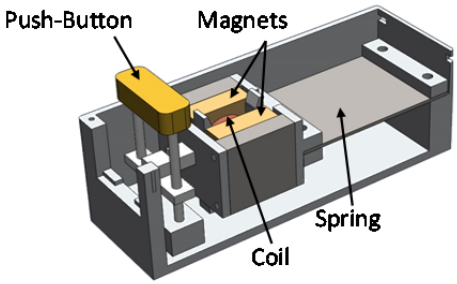

Figure 1: Push-button generator

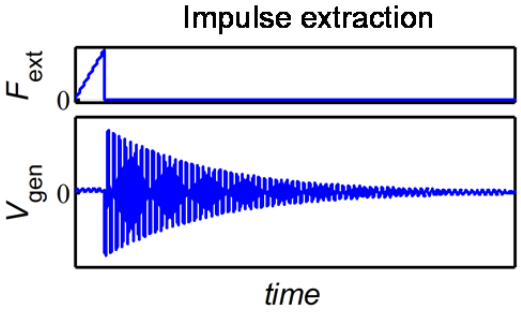

Figure 2: External force (top) and open-circuit voltage

The task of this master thesis is to develop and implement a low-power circuit implementation of the SMFE technique for the push-button generator shown in Fig. 1. Analog and digital control techniques are to be evaluated and implemented using the CADENCE Virtuoso design suite. Since the harvested energy is limited, the power consumption of the control circuit represents a key design parameter and should be as low as possible.

What we expect:
Having fun in designing and implementing integrated microelectronic circuits, highly independent working style, and accurate documentation of the findings

What we offer:
Intensive supervision of the thesis, convenient work environment, latest simulation and software tools, excellent lab equipment, and creative leeway for developing and implementing your ideas

Starting Date: as soon as possible.

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