

# ABSTRACT

## Energy Harvesting for Self-Powered Wireless Sensors

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A wireless sensor system is proposed for a targeted deployment in civil infrastructures (namely bridges) to help mitigate the growing problem of deterioration of civil infrastructures. The sensor motes are self-powered via a novel magnetic shape memory alloy (MSMA) energy harvesting material and a low-frequency, low-power rectifier multiplier (RM). Experimental characterizations of the MSMA device and the RM are presented. A study on practical implementation of a strain gauge sensor and its application in the proposed sensor system are undertaken and a low-power successive approximation register analog-to-digital converter (SAR ADC) is presented. The SAR ADC was fabricated and laboratory characterizations show the proposed low-voltage topology is a viable candidate for deployment in the proposed sensor system. Additionally, a wireless transmitter is proposed to transmit the SAR ADC output using on-off keying (OOK) modulation with an impulse radio ultra-wideband (IR-UWB) transmitter (TX). The RM and SAR ADC were fabricated in ON 0.5 micrometer CMOS process. An alternative transmitter architecture is also presented for use in the 3-10GHz UWB band. Unlike the IR-UWB TX described for the proposed wireless sensor system, the presented transmitter is designed to transfer large amounts of information with little concern for power consumption. This second method of data transmission divides the 3-10GHz spectrum into 528MHz sub-bands and "hops" between these sub-bands during data transmission. The data is sent over these multiple channels for short distances (?3-10m) at data rates over a few hundred million bits per second (Mbps). An UWB TX is presented for implementation in mode-I (3.1-4.6GHz) UWB which utilizes multi-band orthogonal frequency division multiplexing (MB-OFDM) to encode the information. The TX was designed and fabricated using UMC 0.13 micrometer CMOS technology. Measurement results and theoretical system level budgeting are presented for the proposed UWB TX.