

PhD Final Oral Presentation, Oct 31, 2022.

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Title: Synchronous switched circuits for enhanced energy extraction from triboelectric kinetic energy harvesters

Abstract: One of the major challenges faced in expanding Internet of Things (IoT) sensors for the ongoing Industry 4.0 transformation is its limited battery life. Integration of miniaturized energy harvester to harness the background kinetic energy is an attractive green solution towards *maintenance-free* IoT sensor nodes in applications such as Structural Health Monitoring (SHM) and Machine Health Monitoring (MHM). Recently, a new class of mechanical to electrical energy transducers termed Triboelectric Nanogenerator (TENG) that enjoys wide choice in materials and operation modes has been developed. For practical integration of TENG with the IoT, Energy Extraction Circuit (EEC) is further required to act as a rectifying interface between the TENG and the onboard battery/capacitor load. This research fundamentally studies the TENG's cyclic transduction operation and proposes multiple novel synchronous switched EEC architectures that enhance the per-cycle energy extracted from the TENG beyond the simple full-wave-rectification approach. The design, mathematical modeling, simulation, and experimental implementation of the newly developed circuit architectures are all reported and compared in a common framework to guide the choice and design of EEC for any given TENG.