Developing a Novel Aeroelastic Flutter Based Piezoelectric Energy Harvester (AERO)

Mendu, Maanasa

This multiphase project explores the feasibility of harvesting electrical energy from aeroelastic flutter through the piezoelectric effect. This research responds to the growing demand for a low cost, and globally applicable renewable energy source. The Piezoelectric effect is the ability of certain materials to generate electricity when subject to mechanical stress. Piezoelectric beams were tested in low wind speeds of 1.5-3.5 m/s in both open wind tunnel, and ambient settings using an oscilloscope/multimeter setup. In Phase 1, multiple appendages were designed, and attached to the PVDF to induce tip deflection, the foam based appendage resulted in a 627% power output increase. Each appendage consists of a flexible beam cantilevered at one end with a Styrofoam oscillator attached on the free end. When applied with air flow, the periodic oscillation of the lightweight Styrofoam triggers the AC power generation of the PVDF. In Phase 2, a series of matrix experiments testing appendage length, oscillator shape, size, orientation, and load resistance were executed for optimization. In phase 3, an entire system of these optimized energy harvesters – AERO – was tested with LED, and sensing applications. AERO 1.5 produced over 775 uW of power, and lit up 8 miniature LEDs simultaneously, validating the hypothesis/criteria. AERO 2.0 was sourced from 90% recycled materials, and costs approximately $5. The researcher envisions the application of AERO 1.5 in urban areas to harvest low wind speeds, or generate onsite power for WSNs + MEMs applications, or even as a panel of foam oscillators on the sides of buildings/roads/bridges.

Awards Won: