Capitol Graduate Research Summit

SMALL SCALE ENERGY DEVICES USING VORTEX INDUCED VIBRATION

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Small-scale off-grid energy devices are an increasingly important part of the energy mix today, as seen in small solar panels and micro wind turbines that power road signs or heat livestock water troughs. Solar panels are the most commonly used solutions. However, a device that uses Vortex Induced Vibration (VIV) as its basis can provide a low-cost alternative. Flow of air around a bluff body leads to vortex shedding in its wake. Asymmetric shedding of vortices can result in oscillatory forces on the body, and cause large amplitude oscillations (VIV). Vortex shedding frequency and oscillations amplitude is primarily dependent on body geometry and flow velocity. In this study, the design methodology for a device that extracts energy from VIV is presented. A semi-empirical model is developed to predict shedding frequency and forces due to vortex shedding for the canonical case of flow around a circular cylinder. Shedding behavior of different geometries is related to that of a cylinder through conformal mapping. In this manner, forces due to vortex shedding for various geometries and their applicability in energy devices can be quickly predicted. Validation is done through water table and wind tunnel tests. Emphasis is laid on ensuring the device is low-cost and constructed from readily available or repurposed material, and require no specialized knowledge to maintain. Such a device can find use in rural communities and regions throughout Kansas.