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An Experimental Study of Downstream Structures on the Flow-Induced Vibrations Energy Harvester Performances

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Abstract : This paper presents an experimental investigation for the characteristics of an energy harvesting device exploiting flow-induced vibration in a wind tunnel. A stationary bluff body is connected with a downstream tip body via an aluminium cantilever beam. Various lengths of aluminium cantilever beam and different shapes of downstream tip body are considered. The results show that the characteristics of the energy harvester’s vibration depend on both the length of the aluminium cantilever beam and the shape of the downstream tip body. The highest ratio between vibration amplitude and bluff body diameter was found to be 1.39 for an energy harvester with a symmetrical triangular tip body and L/D₁ = 5 at 9.8 m/s of flow speed (Re = 20077). Using this configuration, the electrical energy was extracted with a polyvinylidene fluoride (PVDF) piezoelectric beam with different load resistances, of which the optimal value could be found on each Reynolds number. The highest power output was found to be 3.19 µW, at 9.8 m/s of flow speed (Re = 20077) and 27 MΩ of load resistance.

Keywords : downstream structures, energy harvesting, flow-induced vibration, piezoelectric material, wind tunnel
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