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Fluid-Structure Interaction Analysis on Cantilever Beams for Micro-Energy Harvesting of Cross-flow Turbine

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Extended Abstract

The harvested electrical energy is used in a variety of electronic equipment such as remote sensors, automobiles, medical or military equipment, etc. As the energy demand increases, the need for an efficient energy harvesting system increases and the relevant researches are actively carried out [1-5]. Cross-flow turbine is a water impulse turbine with relatively low efficiency, but it can be adjusted at various flow rates and is easy to maintain. As the working fluid passes through the impeller of the cross-flow hydraulic turbine and forms a vortex field at downstream, the induced vortex flow can be used for converting the kinetic energy inherent in vibrations to electricity using energy harvesters such as cantilevers, membranes or other structures. In this study, the cantilever beams were located at the downstream of cross-flow hydraulic turbine for micro-energy harvesting. Numerical analysis was conducted using the commercial code, ANSYS CFX 18.1 with the k-ω based shear stress transport (SST) turbulence model. The effect of distance between cantilever beams on stress and strain was evaluated using 2-way fluid-structure interaction (FSI) analysis. As a result, the maximum von-Mises stress of the cantilever beam was calculated as 163.5MPa, and the maximum deformation was calculated as 2.29mm. In addition, the results were graphically depicted with various geometrical and flow conditions.

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