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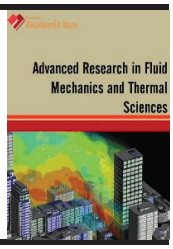

OpenFOAM Implementation for The Study of Streamwise Vortex-Induced Vibration-Based Energy Harvester for Sensor Networks

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ABSTRACT

The study of streamwise vortex induced vibration has reached a level of maturity that allows it to be harnessed to generate power. However, studies have primarily concentrated on the variables that measured through point-based instruments. This severely limits our understanding of the fluid forcing mechanism that results in the vibration of the elastically supported bluff body. We proposed the usage of computational fluid dynamics: the open source C++ libraries of OpenFOAM. To implement this successfully to the streamwise vortex-induced vibration problem, which involves near-wall fluid-structure interaction, we explored the method of dynamic mesh handling in OpenFOAM for six degrees of freedom motion of a rigid body fully submerged in fluid. Finally, we argued for the usage of arbitrarily coupled mesh interface to overcome the problem of severely distorted mesh in tight gaps between two walls. We run a short simulation to test this setup and found that the case runs uninterrupted, unlike its former counterpart that relies solely on cell displacement diffusion, suggesting the potential success of a further converged solution of the setup when running on a more powerful machine.

1. Introduction

1.1 Off-Grid Operation of Sensor Networks

The growing demand for real-time monitoring and management of agriculture [29], civil structures [44], machinery [9], and hydrological systems [5] led towards widespread adoption of sensors networks in these disciplines. Under the desired operating conditions, most of the application of the sensors are at sites where power from the national grid is either difficult to source, or non-existent. Sometimes, the issue is not so much on the fact that power lines from the national grid are out of reach, as it is related to the involvedness of the means to distribute the power, e.g.,

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