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Virtual Wave Flume and Oscillating Water Column modelled by LBM

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Abstract

The purpose of this study is to validate the capability and the accuracy of the lattice Boltzmann method to model a virtual wave flume and an Oscillating Water Column wave energy converter. The physics of such a device potentially involves a strong interaction between water and air. As a first step, a 3D lattice Boltzmann virtual flume has been created, with a free-surface using Volume-of-Fluid approach. Simulations show that virtual waves propagate realistically, although a strong numerical dissipation has to be taken into account for certain values of the lattice space resolution. Then, the energy converter has been modelled through a two-ways coupling between 3D water and 0D air. Different waves and converter parameters have been simulated in order to compare the numerical model to experimental results. This comparison shows the ability of the numerical model to approach the reality, despite some differences appear, partially due to the absence of an accurate model describing the air flow through the turbine. Beyond the wave energy process, it can be shown that such a numerical model can be useful to study the hydrodynamic impact of the converter design on its surrounding area with reasonable computing resources.