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Editorial

Advances in Numerical Techniques for Modelling Water Flows

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This special issue aims to present recent advances in approaches to modelling water flows and their applications in engineering. Water occupies about 71% of the earth's surface area and is essential for the survival of human beings, but natural disasters pose substantial societal, environmental, and economic hazards. Important and extremely challenging research topics arise from the need to understand water flows and develop mitigation measures against potential adverse impacts, such as urban flooding and coastal storm surge inundation.

Advances in modern computer technology have made it possible for computational models to be intensively applied to the study of water flow problems in science and engineering. In this special issue, X. Li et al. describe the numerical simulation of an offset jet in bounded pool. P. Qian and Q. Xu present an embedded element technique for the permeability analysis of cracked porous media. Y. Yi et al. describe a one-dimensional model that is applied to a water transfer project with multihydraulic structures. X. Tang et al. examine the cavitation characteristics of a double-suction centrifugal pump. H. Ai et al. simulate earthquake-induced water waves using a numerical solver based on the shallow water equations.

As computational methods progress, numerical models of free surface flow are becoming increasingly effective as routine analysis tools to improve infrastructure resilience and identify countermeasures against natural disasters related to water flows. T. Cheng et al. apply a coupled hydrological and hydrodynamic model to study flood risks in the main urban area of Jinan, China. Z. Bai and J. Zhang study the effect of different turbulence models on numerical simulations for understanding of pressure distribution in V-shaped stepped spillways. X. Chen et al. numerically study the behaviour of near-bed variables in velocity-skewed oscillatory sheet flow. S. Wang et al. undertake a numerical investigation into the characteristics of fluid-structure interaction for turbulent flow through a turbine. M. S. Ali et al. carry out numerical simulation of two-dimensional flows in an open channel with groin-like structures.

Meanwhile, new and increasingly accurate, robust numerical methods are being developed to solve the governing equations for water flows. Herein, Y. Peng et al., H. Liu et al., and S. H. Shafiai et al. use the lattice Boltzmann method to investigate two-phase flows, wave-current interaction, and flood inundation. S. Zhang et al. compare three different parallel computation methods and apply the methods to the simulation of a two-dimensional dam-break with a case study for the Pangtoupao flood storage in Songhua River basin, China. Y. Liu et al. describe a new numerical method for solving the problem of cuttings transport in drilling horizontal wells. Y. Peng et al. show that a multispeed lattice Boltzmann model with space-filling lattice is able to simulate transcritical shallow water flows with Froude number larger than one. X. Chen et al. propose a coupled model for Rossby solitary waves using a multiple-scales perturbation method and derive its analytical solution.

The aforementioned examples reflect the development and application of numerical techniques for water flows and demonstrate the sheer variety of engineering problems that are tractable through modern numerical models. Although there is much still to be done to simulate accurately complicated environmental water flows involving multiple scales in space and time, the editors hope that this special issue meets its primary aim of reporting on recent progress towards better modelling techniques by which to study complicated free surface flow problems, leading to a better understanding of water flows in the natural environment.

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Composition Comments