Mathematical Problems in Engineering

Special Issue on

Advances in Numerical Techniques for Modelling Water Flows

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Water occupies about 71% of the earth's surface area and is encountered in groundwater, reservoirs, channels, lakes, rivers, glaciers, and oceans. Water is essential for the survival and prosperity of human beings, but natural flood and drought disasters pose substantial societal and economic hazards. Understanding water flows and developing mitigation measures against potential negative impacts such as urban flooding and coastal storm surge inundation are important and extremely challenging research topics.

Advances in modern computer technology have meant that computational models have been routinely applied to the study of water flow problems in science and engineering since the late 1980s. Meanwhile, increasingly accurate and robust numerical methods have been developed for the solution of the equations that govern water flows. Typical methods include the conventional schemes, such as the finite difference method, finite volume method, and finite element method, and the relatively new approaches such as the lattice Boltzmann method, smoothed particle hydrodynamics, spectral element method, and discontinuous Galerkin method. However, new mathematical models and reliable numerical solvers have still to be developed for demanding applications to difficult environmental water flow problems involving multiple scales in space and time such as urban flooding in complicated street systems and violent wave impacts on coastal structures. Such models and solvers are being developed at present, and consequently it is timely to report the new and on-going research developments for the purposes of a better understanding of complicated water flows in the natural environment and effective management of the associated risks.

This special issue aims to publish state-of-the-art research on advances in numerical techniques for modelling water flows, including details of verification, validation, and performance tests. Original researches on all aspects of water flow modelling and its applications, including analytical solutions, mathematical models, and numerical techniques, are invited and will be considered for publication in this issue.

Potential topics include but are not limited to the following:

- Mathematical models and analytical solutions
- Computational or numerical methods
- Acceleration techniques including GPU parallel computing
- Verification and validation of new modelling techniques
- High speed flows with turbulence
- Flow-structure/vegetation interaction
- Two-phase flows
- Flooding and storm surge
- High performance computing
- Large-scale practical simulation
- Big data analysis and visualization

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