

Meshless and Particle Methods for Complex Multiphysics Flows

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ABSTRACT

Complex multiphysics flows involving free surfaces, fluid–structure interaction, granular materials, fracture, and multi-phase coupling arise in many engineering and geophysical applications, including coastal and hydraulic engineering, dam-break flows, sediment transport, debris flows, and impact problems. Accurate and robust numerical simulation of these problems remains highly challenging due to strong nonlinearities, moving interfaces, large deformations, and multi-scale interactions.

In recent years, high-order numerical methods and particle-based approaches have demonstrated significant potential for addressing these challenges. High-order discretization techniques provide improved accuracy and numerical efficiency for complex flow structures,

while particle methods offer natural advantages in handling large deformations, free surfaces, fracture, and evolving interfaces. Increasing attention has therefore been devoted to the development of advanced computational frameworks that combine high-order accuracy, numerical stability, conservation properties, and multiphysics coupling capabilities.

This minisymposium aims to bring together researchers working on high-order and particle-based numerical methods for complex multiphysics flows. Topics of interest include, but are not limited to: Smoothed Particle Hydrodynamics (SPH), meshfree and hybrid numerical methods, fluid–structure interaction, multi-phase and granular flows, free-surface and dam-break problems, fracture and large deformation modeling, geomechanics and hydraulic engineering applications, and high-performance computing for multiphysics simulations.

The minisymposium will provide a platform for discussing recent theoretical developments, numerical algorithms, and engineering applications, while promoting interdisciplinary interactions between researchers in computational fluid dynamics, computational mechanics, applied mathematics, and scientific computing.

PROSPECTIVE SPEAKERS

1. Can Huang (North China University of Technology, China, huangcancan@163.com): SPH Modeling of Coupled Water–Soil–Structure Interaction Problems
2. Ahmad Shakibaeinia (Polytechnique Montréal, Canada, ahmad.shakibaeinia@polymtl.ca): Advanced Particle Methods for Multiphysics Flow Simulations
3. Abdelraheem M. Aly (*King Khalid University, Abha, Saudi Arabia, ababdallah@kku.edu.sa*):
4. Davide Meringolo (Università degli Studi Mediterranea di Reggio Calabria, Italy, davide.m86@gmail.com):
5. Tingting Bao (Beijing Institute of Technology, tianyuan2679@163.com): High-Fidelity Simulation of Free-Surface Flows Using Meshfree Methods
6. Fang He (Zhejiang University, China, hefang@zju.edu.cn)
7. Zhang Shaoxiong (Shijiazhuang Tiedao University, China, zhangsx@stdu.edu.cn)