ONE-DAY WORKSHOP ON MPS (MOVING PARTICLE SEMI-IMPLICIT) METHOD FOR INCOMPRESSIBLE NAVIER-STOKES EQUATIONS

WORKSHOPS

理論科學研究中心

Center for Advanced Study in Theoretical Sciences

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Point-implicit diffusion operator in moving particle method (MPPM)

Prof. Yao-Hsin Hwang

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MPS Simulation on Flow Sequence of Liquid Particles

Prof. Khai Ching Ng

Mathematically, it can be proven that those tanks which are having cross-sectional areas expressed in the form of higher-order polynomial are prominent in reducing the drainage time (efflux time). Here, a Lagrangianparticle method (MPS) is adopted to improve the physical understanding of this phenomenon. For the analytical part of the work, the J-factor is introduced in the current work and it can be easily proven that that there exists a theoretical minimum of efflux time as the order (n) approaches +∞. The execution of flow sequence technique in lower order tank (which is relatively easy to be performed by using the particle method) reveals that fluid particles with identical range of efflux time are clustered within an inverted U-shape layer observed from the current study. On the other hand, flattening of draining layers can be seen in a higher-order tank which will consequently lead to a significant reduction of efflux time.

On the moving particle methods

Prof. Yao-Hsin Hwang

In this talk, we will discuss two novel moving particle methods, MPPM (moving particle with embedded pressure mesh) and CPM (characteristic particle method). MPPM is developed to solve incompressible flow by incorporating a stationary pressure mesh to handle flow continuity constraint. All pressure-related operators are realized on this supplementary mesh, which is constructed by the motivation that pressure should be treated as a field variable rather than material one moving with flow trajectory. In addition, two effective schemes (smoothing difference and local mesh) to improve conventional differenced diffusion terms derived from particle smoothing procedure are also proposed. It will result in efficient and accurate discretizations for incompressible flow equations. On the other hand, CPM is employed to solve hyperbolic equation systems. Computational particles are designed to move flow characteristic curves rather than flow paths. Locations of solution discontinuities can be accurately identified and traced by additional shock particles according to Rankine-Hugoniot relations. In this manner, highly accurate simulations can be obtained. Numerical results on water hammer, open channel and traffic flows are provided to verify the simulation accuracy of present formulation.

Opportunities and Computational Challenges in MPS method

Prof. Tony Wen-Hann Sheu

Opportunities and Computational Challenges in MPS method

Particle Simulation on Various Laminar Mixing Enhancement Strategies using Plate Impeller

Prof. Khai Ching Ng

In order to address the limitation of radial mixing in laminar flow by using steady mixing (impeller moves at a constant rotational velocity), various strategies (e.g. baffling, eccentricity and unsteady mixing) have been proposed in the literature in order to reduce the overall mixing time. In order to understand the mechanisms on how these strategies would enhance the mixing performance, a particle method (MPS) has been used to trace the motion of each fluid particle. A numerical procedure proposed by Sun et al. (2009), which is suitably for particle method, has been used to quantify the mixing performance. In general, it is found that the unsteady mixing procedure outperforms all the mixing procedures considered in the current work, mainly due to the generation of additional secondary flow vortices which play an important role in promoting radial mixing.