2016 FALL PROGRESS IN MATHEMATICAL AND COMPUTATIONAL STUDIES ON SCIENCE AND ENGINEERING PROBLEMS

WORKSHOPS

理論科學研究中心
Center for Advanced Study in Theoretical Sciences

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Smoothed Particle Hydrodynamics, a meshfree Lagrangian approach

Prof. Gui-Rong Liu

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Smoothed Particle Hydrodynamics, a meshfree Lagrangian approach

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Smoothed Particle Hydrodynamics, a meshfree Lagrangian approach

SPH and EBG coupled modeling of fluid-fiber interactions

Prof. Moubin Liu

For material related to this talk, click here.

Dissipative Particle Dynamics (DPD) - some recent developments

Prof. Moubin Liu

For material related to this talk, click here.

A coupled 1D and 2D SPH-SWEs model for open channel flows in complex channel geometries

Prof. Kao-Hua Chang

For material related to this talk, click here.

Unstructured Moving Particle Pressure Mesh (UMPPM) method for Complex Flow Domain

Prof. Khai Ching Ng

For material related to this talk, click here.

Applications of Direct Forcing Immersed Boundary Method on Calculation of Loading in Smooth Particle Hydrodynamics Method

Prof. Ming-Jyh Chern

For material related to this talk, click here.

Error Minimization of Diffusion Operator in Randomly Distributed Particle Clouds

Prof. Yao-Hsin Hwang

For material related to this talk, click here.

Essential Features of Moving Particle with Pressure Mesh

Prof. Yao-Hsin Hwang

For material related to this talk, click here.

Mixed Lagrangian-Eulerian Particle Method with Mass Preserving for Solving Fluid Flow Problem

Dr. Yee Luon Ng

For material related to this talk, click here.

Rectification of a Nano-swimmer System : A Dissipative Particle Dynamics Study

Prof. Yu-Jane Sheng

For material related to this talk, click here.

Mixed Lagrangian-Eulerian Particle Method with Mass Preserving for Solving Fluid Flow Problem

Dr. Yee Luon Ng

The new mixed Lagrangian-Eulerian particle method improve the stability of the pressure solution in incompressible fluid flow by solving the pressure equation on Eulerian grid, while retaining the viscous and convective terms to be solved on Lagrangian particles. This hybrid approach, however, involves the solution step in two different grids system and requires frequent data transfer between different grids in every time step. To improve the accuracy of the data transfer process, a new interpolation scheme following the idea of the multiquadric Radial Basis Function (RBF-MQ) interpolation is developed to achieve higher accuracy of the mixed Lagrangian-Eulerian particle method. The shape parameter in the developed interpolation scheme is optimized in rigorous way based on the local information. For the preservation of the continuity constraint enforced on Eulerian grid, a new divergence-free vector interpolation scheme is developed to interpolate the velocity back to Lagrangian particles as to preserve the continuity constraint condition.

A New Particle Method Developed in a Mixed Lagrangian-Eulerian Coordinate System

Dr. Kuan-Shuo Liu

In this paper, anewmixed Lagrangian-Eulerian (MLE) particle method is proposed to improve the solution quality of MPS and MPPM methods. Our strategy is to simulate more efficiently the Naver-Stokes equations on moving particles with background mesh. A second-order velocity Laplacian scheme is proposed which is better than other implicit first-order fully-Lagrangian schemes, for example, the smoothing difference scheme in MPPM and the generalized finite difference method (GFDM). Simulation studies show the advantage of solving flow equations ranging from low to high Reynolds numbers without additional treatment to the convection term.

The governing equations to be simulated are two-dimensional Navier-Stokes equations. It's also easy to be extended to three-dimensional cases. In the conventional MPS method, the accuracy order of velocity Laplacian term is first order. Since the spatial derivative term on a particle is approximated by weighted averaging the function value on the surrounding particles, the accuracy strongly depends on the distribution of the particles. If particles are more uniformly distributed, solution of higher accuracy can be obtained. Therefore, we calculate velocity Laplacian term by high order combined compact difference (CCD) scheme on Cartesian grid points first and a simple second-order bilinear interpolation is employed to interpolate the velocity Laplacian value from the fixed grids to the moving particles. Both numerical verification and validation studies are conducted to show the advantages of applying mixed Lagrangian- Eulerian method.

Rectification of a Nano-swimmer System : A Dissipative Particle Dynamics Study

Prof. Yu-Jane Sheng

For the abstract of this talk, please click here.

Review of Development of the Reproducing Kernel Particle Method

Prof. Pai-Chen Guan

We would like to review the development of reproducing kernel particle method (RKPM) in the area of solid mechanics and fluid dynamics. The RKPM method was first introduced in 1995 by Liu et al. as an advanced method from element free Galerkin (EFG) method, and then quickly become popular in the area of solid mechanics. The reproducing kernel shape function has high smoothness and flexible order of accurate approximation, which was soon realized and applied in the area of nonlinear material, contact/ impact, and plate and shell. It can improve the volumetric locking of incompressible material, sufficiently describe the highly complex contact surface and curved plate and shell geometry with flexible enrichments without extra computation cost. The RKPM method has also been widely used in the penetration and crack propagation problems. It can describe the evolving crack by using the discontinuity enriched kernel and can capture new contact forming by using the natural kernel contact algorithm.

The domain integration of the Galerkin weak form RKPM method is also a major research field of study. The stabilized conforming (SCNI) /nonconforming nodal integration (SNNI) and the hyper-version of SCNI are highly cited and used in the area of meshfree methods. The domain integration can be performed nodally, and the tensile instability of nodal integration is removed by the smoothed integration around the node. The hyper-version SCNI improved the original SCNI from the linear-order-accurate integration to flexible high order method.

In the recent years, the effort of using RKPM method in the area of fluid dynamics has been contributed, such as the parallel computation. Also, shock capturing, cavitation and fluid-structure interaction are all potentially interesting topics that could be invested by using the RKPM method. We will also present the recent work done in these areas.