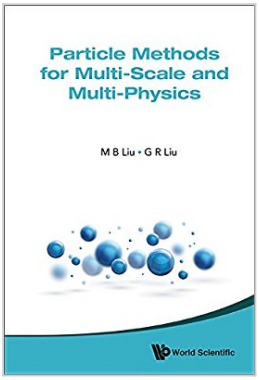

Particle Methods for Multi-Scale and Multi-Physics

By M B Liu, G R Liu

Particle Methods for Multi-Scale and Multi-Physics By M B Liu, G R Liu

Multi-scale and multi-physics modeling is useful and important for all areas in engineering and sciences. *Particle Methods for Multi-Scale and Multi-Physics* systematically addresses some major particle methods for modeling multi-scale and multi-physical problems in engineering and sciences. It contains different particle methods from atomistic scales to continuum scales, with emphasis on molecular dynamics (MD), dissipative particle dynamics (DPD) and smoothed particle hydrodynamics (SPH).

This book covers the theoretical background, numerical techniques and many interesting applications of the particle methods discussed in this text, especially in: micro-fluidics and bio-fluidics (e.g., micro drop dynamics, movement and suspension of macro-molecules, cell deformation and migration); environmental and geophysical flows (e.g., saturated and unsaturated flows in porous media and fractures); and free surface flows with possible interacting solid objects (e.g., wave impact, liquid sloshing, water entry and exit, oil spill and boom movement). The presented methodologies, techniques and example applications will benefit students, researchers and professionals in computational engineering and sciences.

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Editorial Review

From the Inside Flap
This is the book first-ever published to date that comprehensively and systematically addresses the major particle methods for modelling different problems in engineering and sciences. It covers different particle methods from small scales to continuum scales, with emphasis focused on three attractive and most popular meshfree particle methods: molecular dynamics, dissipative particle dynamics, and smoothed particle hydrodynamics.

The book covers theoretical background, numerical techniques, code implementation, and many interesting, novel, and practical applications in 1) microfluidics and micro drop dynamics, 2) environmental and geophysical flows, 3) coast hydrodynamics and offshore engineering, and 4) high energy phenomena such as explosion and impact. Example source codes are also provided to make this book friendly and easy to read.

About the Author
Mou-Bin Liu received his B E and M E degrees from Xi'an JiaoTong University (XJTU), China, in 1993 and 1996, respectively, and received his PhD from the National University of Singapore (NUS) in 2003. He is currently a professor at the College of Engineering and the Institute of Ocean Research of Peking University. He has authored more than 100 reviewed technical papers and one monograph, with more than 2000 SCI citations. He has received a number of prestigious awards from universities and scientific organizations worldwide, including the **100 Talent Program Award** from the Chinese Academy of Sciences (CAS) in 2009, the **Young Investigator Award** from the Asia Pacific Association of Computational Mechanics (APACM) in 2007 and the **Lee Kuan Yew Fellow Award** from Nanyang Technological University (NTU), Singapore, in 2005. He is interested in computer modeling of complex flows with different coupling effects, and has developed some original numerical methods, both grid-based and meshfree particle-based, for modeling fluid dynamics and fluid-solid interactions, including high energy explosive detonation and explosion, underwater explosion, high strain hydrodynamics with material strength, wave breaking and interaction with structures (e.g., sloshing and slamming), and water entry and exit.

Gui-Rong Liu is currently a Professor and Ohio Eminent Scholar (State Endowed Chair) at the Department of Aerospace Engineering and Engineering Mechanics, University of Cincinnati, USA. He received his PhD from Tohoku University, Japan, in 1991, and was a Post-Doctoral Fellow at Northwestern University, USA, from 1991–1993. He has served as the School Faculty Chair for the School of Aerospace Systems, University of Cincinnati, USA; a Deputy Head of the Department of Mechanical Engineering, and Director of the Centre for Advanced Computations in Engineering Science (ACES), National University of Singapore; and the President of the Association for Computational Mechanics (Singapore). He was the President of the Asia-Pacific Association for Computational Mechanics (APACM), and is now an Executive Council member of the International Association for Computational Mechanics (IACM). He authored a large number of international journal papers and books including two bestsellers: "Mesh Free Method: moving beyond the finite element method" and "Smoothed Particle Hydrodynamics: a Meshfree Particle Methods." He recently authored books on *Smoothed Finite Element Methods and The Smoothed Point Interpolation Methods — G Space Theory and Weakened Weak Forms* that are now used for various types of problems. He is Editor-in-Chief of the *International Journal of Computational Methods*, Associate Editor of the international technical journal *Inverse Problems in Science and Engineering (IPSE), and served as an editorial member of five other journals including the International Journal for Numerical Methods in Engineering*. He is the recipient of numerous awards, including the Singapore Defence Technology Prize, the

NUS Outstanding University Researcher Award, the APACM Computational Mechanics Awards, the ICACM (International Chinese Association for Computational Mechanics) Computational Mechanics Awards, the JSME (The Japan Society of Mechanical Engineers) Computational Mechanics Awards and the ASME (American Society of Mechanical Engineers) Ted Belytschko Applied Mechanics Award. He is listed by Thomson Reuters as one of the world's top 1% most influential scientist (Highly Cited Researchers) in 2014.

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