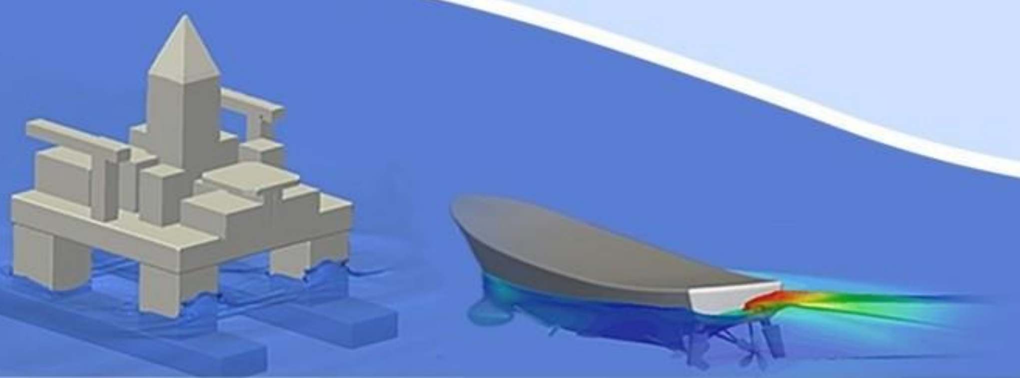
The 7th Symposium on

Computational Marine Hydrodynamics

第七届 CMHL 船舶与海洋工程计算水动力学国际研讨会

(The 7th CMHL Symposium 2024)

Beijing Time 09:00-20:20, Jan. 27, 2024, Online Meeting



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Organized by

Computational Marine Hydrodynamics Lab (CMHL)

Co-Organized by

Journal of Hydrodynamics (JHD)

Taihu Laboratory of Deepsea Technological Science

National Key Laboratory of Hydrodynamics

Preface

Welcome to the 7th CMHL Symposium 2024 online virtual meeting!

Computational Marine Hydrodynamics Laboratory (CMHL) was founded by Prof. Decheng Wan in 2006. To meet the requirements of marine structures design for digitization, refinement, intelligence and system synthesis, CMHL has long been devoted to the researches of advanced CFD methods for marine hydrodynamics, developments of CAE software and platform, as well as applications of CAE software for complex flows in the fields of integrated ship, marine structures, underwater vehicles, offshore renewable energy devices, etc.

CMHL Symposium (Symposium on Computational Marine Hydrodynamics) is named after "CMHL". The first CMHL Symposium was held in 2018, since then it has been held every year to provide a forum for promoting scientific advancement, technological progress, information exchange, and innovative cooperation among scientists, researchers, engineers, developers, modellers and users of CAE software for solutions of marine hydrodynamics and other related fields. It is an attractive event opening to scientists, scholars, engineers, students, developers and users from universities, institutes as well as industries to exchange ideas and share recent advances on computational marine hydrodynamics and applications of CFD simulations for naval architecture and ocean engineering.

Many outstanding and reputable professors and experts on computational marine hydrodynamics, including Prof. Frederick Stern from University of Iowa, USA, Prof. Hamn-Ching Chen from Texas A&M University, USA, Prof. Chaoqun Liu from University of Texas at Arlington, USA, Prof. Michel Visonneau from Centrale Nantes, France, Prof. Moustafa Abdel-Maksoud from Hamburg University, Germany, Prof. Xiangyu Hu from Technical University of Munich, Germany, Prof. Rickard Bensow from Chalmers University of Technology, Sweden, Prof. Hrvoje Jasak from University of Cambridge, UK, Prof. Atilla Incecik from University of Strathclyde, UK, Prof. Gavin Tabor from University of Exeter, UK, Prof. Qing Xiao from Strathclyde University, UK, Prof. Jun Zang from University of Bath, UK, Prof. Takanori Hino from Yokohama National University, Japan, Prof. Changhong Hu from Kyushu University, Japan, etc., had delivered very excellent and splendid invited presentations in the previous CMHL symposiums. Several papers based on the invited keynote presentations had been published in Journal of Hydrodynamics as a special column for the CMHL symposium.

The coming 7th CMHL Symposium 2024 organized by CMHL and co-organized with *Journal of Hydrodynamics (JHD)*, *Taihu Laboratory of Deepsea Technological Science*, as well as *National Key Laboratory of Hydrodynamics of China* will be taken place online (virtual meeting) on Jan. 27, 2024. There will be 13 invited keynote presentations with 45 minutes, covering a wide range of hot topics.

Many advanced and innovative numerical methods for marine hydrodynamics will be presented, such as meshless SPH methods, combination of particle-based techniques and finite element/finite volume methods, Eulerian-Lagrangian methods, numerical methods on multi-scale and multiphase flows, wall-stress model for large-eddy simulation of turbulent flows in high Reynolds number, and so on. Excellent applications of CFD in ship and ocean engineering will be also presented, including deep-sea mooring system, offshore wind turbines, wave energy converters, water-wave interaction, ship-propeller-rudder interaction, tsunami, ice-water-ship interaction, sloshing, cavitation, hydroelasticity, ship bow wave breaking, bubbly dynamics, and flow-induced noise, etc. In addition, the symposium also includes many interesting topics such as CFD in aerodynamics, multiphase combustion, biologically inspired flows, machine learning and AI, which provides a good opportunity for researchers in computational marine hydrodynamics to learn the best practices from other related fields and make cross-disciplinary exchange.

The 13 distinguished speakers are well renowned professors, expert and scholars from all around the world. They are Prof. Krish T Sharman from the University of Massachusetts Amherst, USA, Prof. Tomoki Ikoma from Nihon University, Japan, Prof. Eugenio Oñate from Universitat Politècnica de Catalunya (UPC), Spain, Prof. David LE TOUZÉ from Ecole Centrale Nantes, France, Prof. Bettar el Moctar from the University of Duisburg-Essen, Germany, Prof. Gabriel Weymouth from Technische Universiteit Delft, Netherlands, Prof. Carlos Guedes Soares from the Universidade de Lisboa, Portugal, Prof. Mehmet Atlar from the University of Strathclyde, UK, Dr. Huangwei Zhang from the National University of Singapore, Prof. Weiwei Zhang from Northwestern Polytechnical University, Dr. Siming Zheng from Zhejiang University, Prof. Wentao Wang from the China Ship Scientific Research Center, as well as Dr. Weiwen Zhao from Shanghai Jiao Tong University, respectively. Some of them are world-renowned experts and professors of high rank in the field of computational marine hydrodynamics, while others are outstanding experts or active young scholars in the fields of numerical simulations.

The 7th CMHL Symposium will undoubtedly be a splendid academic event in the history of the CMHL Symposium, and benefit every listener and audience a lot once more.

Wan Decheng

Prof. Dr. Decheng Wan
Chair of the 7th CMHL Symposium 2024
Director of Computational Marine Hydrodynamics Lab (CMHL)
Shanghai Jiao Tong University

Online Virtual Meeting Information

Tencent Meeting Webinar (ID: 706 680 867) has been set up for the online virtual meeting of the 7th CMHL Symposium 2024 during 09:00-20:20 (GMT+8, Beijing time) of Jan. 27, 2024. You can scan the following QR code or click the following link to join in the Webinar 30 minutes early as planned.

https://meeting.tencent.com/dm/9Wkke7EepWJ9

We also prepare three live broadcasts of the 7th CMHL Symposium 2024 on the Bilibili website, KouShare website and Fangzhenxiu website. In case the above Tencent Meeting room are full and you cannot join in, you can watch the live stream online via the following QR code or links:

Bilibili: http://live.bilibili.com/24017914
KouShare: https://www.koushare.com/lives/room/908786
Fangzhenziu: https://www.fangzhenxiu.com/live/1194622840366501888/

Bilibili KouShare Fangzhenxiu

Instruction for Invited Speakers

Each keynote presentation is allocated 45 minutes (40-min presentation + 5-min discussion). The invited speakers are suggested to join in above Webinar 30 minutes before your scheduled keynote presentation.

Secretariat of the 7th CMHL Symposium 2024

Dr. Yuan Zhuang, CMHL, Shanghai Jiao Tong University, Email: nana2_0@sjtu.edu.cn
Dr. Zheng Ma, Editorial Board, Journal of Hydrodynamics (JHD), Email: mazh8888@sina.com
Mr. Wei Liu, China Ship Scientific Research Center (CSSRC), Email: liuwei@cssrc.com.cn

Program of the 7th CMHL Symposium 2024

Beijing Time 09:00-20:20, Saturday, Jan. 27, 2024, Online Virtual Meeting

09:00-09:05 Opening Speech and Chair Prof. Decheng Wan

09:05-09:50 Keynote Presentation 1 (Jan. 26, 20:05-20:50 EST Time)

Mooring systems for Offshore Wind and Marine Energy

Prof. Krish T Sharman, Professor and Endowed Chair Emeritus in Renewable Energy, University of Massachusetts Amherst, USA.

09:50-10:35 Keynote Presentation 2 (Jan. 27, 10:50-11:35 Japan Time)

Development and Estimation of a Novel OWC Type Wave Energy Converter

Prof. Tomoki Ikoma, Professor of Oceanic Architecture and Engineering, Nihon University, Japan.

10:35-11:20 Keynote Presentation 3

Eulerian-Lagrangian Modelling of Dilute and Moderately Dense Two-Phase Compressible Reactive Flows

Dr. Huangwei Zhang, Assistant Professor in Department of Mechanical Engineering, National University of Singapore (NUS), Singapore

11:20-12:05 Keynote Presentation 4

Machine Learning for Complex Flow and Flow Active Control

Prof. Weiwei Zhang, Chang Jiang Scholars and Excellent Young Scientists, Northwestern Polytechnical University, China

12:05-13:30 Break for Lunch and Rest

13:30-14:15 Keynote Presentation 5

Water Wave Interaction with An Array of Submerged Circular Plates

Dr. Siming Zheng, ZJU100 Young Professor, Zhejiang University, China

14:15-15:00 Keynote Presentation 6

KCS Unsteady Bow Wave Breaking Experiments for Physics and CFD Validation

Prof. Wentao Wang, Research Professor of China Ship Scientific Research Center (CSSRC) and the Director of Hydrodynamics Research Department of CSSRC, China

15:00-15:45 Keynote Presentation 7

Wall Pressure Fluctuations of Turbulent Boundary Layer for Axisymmetric Body of Revolution

Dr. Weiwen Zhao, Computational Marine Hydrodynamics Laboratory (CMHL), Shanghai Jiao Tong University, China

15:45-16:30 Keynote Presentation 8 (Jan. 27, 08:45-09:30 Spain Time)

Advances in the Coupling of Particle-Based Methods and Finite Element/Finite Volume Methods for Solving Problems in Computational Marine Hydrodynamics

Prof. Eugenio Oñate, Emeritus Professor and Founder of International Center for Numerical Methods in Engineering (CIMNE), Universitat Politècnica de Catalunya (UPC), Barcelona, Spain

16:30-17:15 Keynote Presentation 9 (Jan. 27, 09:30-10:15 France Time)

Modeling Complex Free-Surface Flow with the Smoothed Particle Hydrodynamics Method, From Theory To Application

Prof. David LE TOUZÉ, Ecole Centrale Nantes and Director of the Research Laboratory on Hydrodynamics, Energetics and Atmospheric Environment (LHEEA) laboratory (ECN and CNRS), France

17:15-18:00 Keynote Presentation 10 (Jan. 27, 10:15-11:00 Germany Time)

Multiscale and Multiphase Flows in Interaction with Structures

Prof. Bettar el Moctar, Professor for Ship Technology and Ocean Engineering, University of Duisburg-Essen and Member of the Board of Directors of the Shallow Water Model Basin (DST), Germany

18:00-18:45 Keynote Presentation 11 (Jan. 27, 11:00-11:45 Holland Time)

Prediction and Modelling of Biologically-Inspired Fluid Structure Interactions

Prof. Gabriel Weymouth, Chaired Professor of Ship Hydromechanics in the Mechanical Engineering faculty, Technische Universiteit Delft, Netherlands

18:45-19:30 Keynote Presentation 12 (Jan. 27, 10:45-11:30 Portugal Time)

Hydrodynamic Analysis of Double Chamber Oscillating Water Column Wave Energy Converters

Prof. Carlos Guedes Soares, Scientific Coordinator of Centre for Marine Technology and Ocean Engineering (CENTEC), Instituto Superior Técnico, Universidade de Lisboa, Portugal

19:30-20:15 Keynote Presentation 13 (Jan. 27, 11:30-12:15 London Time)

H2020 GATERS Project – A Computational Design Analysis of the Gate Rudder System for Propulsive Performance Using the Design of Experiments Methods

Prof. Mehmet Atlar, Professor of Naval Hydrodynamics in the Department of Naval Architecture, Ocean and Marine Engineering, The University of Strathclyde, Glasgow, UK

20:15-20:20 Closing Speech Prof. Decheng Wan

Introduction of Invited Speakers and Keynote Presentation Abstracts

09:05-09:50 Keynote Presentation 1 (Jan. 26, 20:05-20:50 EST Time)

Mooring systems for Offshore Wind and Marine Energy

Prof. Krish T Sharman, Professor and Endowed Chair Emeritus in Renewable Energy, University of Massachusetts Amherst, USA.

Brief CV of Invited Speaker:

Krish Thiagarajan Sharman is a Professor of marine and offshore wind energy in the Department of Mechanical & Industrial Engineering, University of Massachusetts Amherst, USA. He is also an Endowed Chair Emeritus in Renewable Energy. He holds a PhD in Naval Architecture and Marine engineering from the University of Michigan, and has been an academic at various universities in Australia and the US over the past 25 years. His areas of interest focus on design and fluid-structure interaction analysis of floating offshore wind systems, wave and tidal energy systems, coastal food production systems and offshore platforms in general.

Abstract:

Moorings are one of the more vulnerable components of an offshore system. In offshore wind and marine renewables sectors, there is increasing use of synthetic material for mooring systems. Many mooring failures in the oil and gas industry have gone unreported, and those that had a consequence and thus reported, gave an impression of high levels of unknown risk. This talk will discuss two research studies conducted on mooring systems and examine challenges in station keeping and integrity of mooring lines. We will also present broad challenges moving forward, including effects of climate change.

09:50-10:35 Keynote Presentation 2 (Jan. 27, 10:50-11:35 Japan Time)

Development and Estimation of a Novel OWC Type Wave Energy Converter

Prof. Tomoki Ikoma, Professor of Oceanic Architecture and Engineering, Nihon University, Japan.

Brief CV of Invited Speaker:

Prof. Tomoki Ikoma is a professor of the department of oceanic architecture and engineering in the college of science and technology (CST) at Nihon University, Japan. He graduated from the department of oceanic architecture and engineering, the college of science and technology at Nihon University, Japan in 1992 and completed the master course of the department in 1994. In addition, he completed the PhD course of the department at Nihon University and received the PhD degree in engineering (Dr. of Engineering in Japan) from Nihon University in 1997. He had worked for the institute of industrial science at the university of Tokyo as a post-doctor and a research associate from 1997 to 2001. After moving onto Nihon University as a research associate in 2001, he has been a professor in 2015. Also, he has been a vice dean of CST. When he was as associate professor, he had stayed in the department of naval architecture and ocean engineering at the University of Strathclyde, Glasgow as an academic visitor for a year since September in 2012. Prof. Ikoma is an executive committee member of the ocean energy association – Japan, a vice president at the Japanese association for coastal zone studies and the symposium coordinator of OSU-SYMP-5 at ASME international conference on OMAE. Also he will be a co-conference chair of OMAE 2026 in Tokyo. Prof. Ikoma has studied on hydrodynamics, in particular, wave-structure interaction problems of offshore floating systems including the hydroelasticity of very large floating structures. Also he has studied hydrodynamic predictions and estimation of its performance to harvest wave power on oscillating water column type wave energy converters. In addition, he studies floating offshore wind turbine systems and tidal turbine systems too.

Abstract:

There are many kinds of wave energy converters (WECs) and their developments have been still continued by many researchers. Oscillating water column (OWC) types are one of major and historical WECs and several sea tests have been conducted in the world. This presentation focuses on OWC type WECs and in particular a novel OWC WEC type. To attach projecting walls (PWs) onto an OWC WEC which had inlet-out-let of water (waves) toward front of itself has been proposed. This is called as a PW-OWC type. Although mechanism to produce electricity by OWC type WECs are simple and reasonable, other WEC types more mechanical have been preferred despite using an oil pressure system. The presentation will highlight the benefits of OWC types. Besides, the presentation offers theoretical treatments to predict hydrodynamic forces and PTO performance of OWC types by using a linear potential theory-based method.

10:35-11:20 Keynote Presentation 3

Eulerian-Lagrangian Modelling of Dilute and Moderately Dense Two-Phase Compressible Reactive Flows

Dr. Huangwei Zhang, Assistant Professor in Department of Mechanical Engineering, National University of Singapore (NUS), Singapore

Brief CV of Invited Speaker:

Dr. Huangwei Zhang is an assistant professor in Department of Mechanical Engineering at National University of Singapore (NUS). He received his bachelor's degree in engineering mechanics and master's degree in fluid mechanics in 2007 and 2009 respectively from Beihang University. He worked as a research associate in Peking University from 2009 to 2011. He obtained his PhD in energy and combustion at the University of Cambridge in

2015. He then worked as a post-doctoral research associate from 2015 to 2017 at Cambridge. His research covers detonation, engine and propulsion, multiphase combustion, zero-carbon fuels, as well as thermal management and safety of lithium-ion batteries. His research is funded by Singapore Ministry of Education, Ministry of Defense, National Research Foundation, and involves substantial industrial collaborations. He is the principal investigator in NUS (Chongqing) Research Institute and Center for Hydrogen Innovations. He has published more than 90 peer-reviewed journal papers in the areas of combustion, energy, and fluid mechanics. He is a senior member of AIAA and member of The Combustion Institute.

Abstract:

This talk will present the latest developments of the Eulerian-Lagrangian method based on the open-source code OpenFOAM for simulating compressible reactive flows. Dilute and moderately dense particle-laden flows are considered, targeting the different flow regimes in engineering applications. For the dilute regime, the influences of the ratio of the Lagrangian particle size to the Eulerian mesh size on the droplet behaviors will be first discussed and the strong convection effects in the high-speed flows will be highlighted. Then the different problems will be discussed, including the droplet evaporation and autoignition under isochoric conditions and the spray detonation wave propagation (including shock wave and reaction front). For the dense regime, the MPPIC (multiphase particle-in-cell) method is developed and implemented for the compressible flows. The theoretical aspects will be first introduced, followed by the introductions of the numerical implementations based on OpenFOAM. Then the interactions between an incident shock wave and dense particle curtain are studied and the particle collision effects on the gas dynamics and curtain morphology under different curtain and particle conditions are evaluated. Finally, some open questions in modelling the two-phase compressible reactive flows will be presented at the end of this talk.

11:20-12:05 Keynote Presentation 4

Machine Learning for Complex Flow and Flow Active Control

Prof. Weiwei Zhang, Chang Jiang Scholars and Excellent Young Scientists, Northwestern Polytechnical University, China

Brief CV of Invited Speaker:

Professor Weiwei Zhang is Chang Jiang Scholars and Excellent Young Scientists in Northwestern Polytechnical University. He made his bachelor and master of science in 2001 and 2004 respectively, both at Northwestern Polytechnical University, China's premier institution in aerospace science. In 2006 he continued with a PhD on an Efficient Analysis for Aeroelasticity Based on Computational Fluid Dynamics. His research is on artificial intelligence applications in fluid mechanics including unsteady aerodynamics, aeroelastics, and flow control. He has won youth science and technology award of the Chinese aerodynamics society and Chinese aeronautic society. He has received the National Excellent Youth Fund and the Ministry of Education's New Century Talents Award. He has published over 100 articles in premier international journals. He is now Vice Chairman of the China Aerodynamics Society and Director of the International Joint Institute of Intelligence in Fluid Mechanics. He is Associate Editors of 10 premier international and domestic journals.

Abstract:

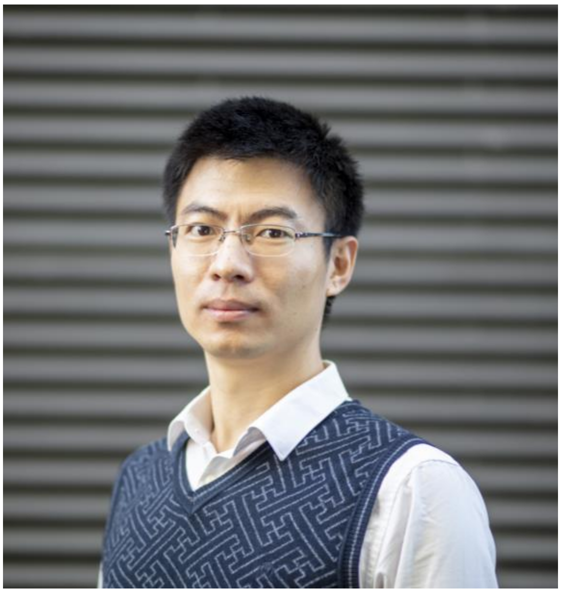
Traditionally the underlying physics of fluid mechanics is being explored by theoretical and computational methods along with experimental measurements. Recently there is a resurgence of data-driven methods and machine learning to provide a fourth pillar as a unifying force towards improved understanding and controlling of fluid flow. This presentation includes three parts, the first is about Data Fusion Aerodynamic modeling for dynamic stall of airfoils and an aircraft, the second is about Turbulence machine learning for high Re numbers flow, the third is about adaptive control of transonic buffet flow. Those works show the recent advances in AI techniques in fluid mechanics.

13:30-14:15 Keynote Presentation 5

Water Wave Interaction with An Array of Submerged Circular Plates

Dr. Siming Zheng, ZJU100 Young Professor, Zhejiang University, China

Brief CV of Invited Speaker:



Dr. Siming Zheng currently holds the position of ZJU100 Young Professor at Ocean College, Zhejiang University (ZJU), starting from 2023. He is a recipient of National-level Youth Talent Program. Before joining ZJU, he served as a lecturer at the University of Plymouth (UoP), previously working as a research fellow there. Prior to joining UoP, Dr. Zheng worked as a postdoctoral researcher at Tsinghua University, where he successfully earned his PhD in 2016. During his PhD program, he worked as a visiting PhD student at University College Cork (UCC) in Ireland for a duration of one year. Dr Zheng's research interests include but are not limited to marine renewable energy, marine hydrodynamics, wave potential flow theory, and metamaterials. He worked as a PI/Co-I for an EPSRC supported project, a Supergen ORE Hub Early Career Researcher (ECR) project, a PRIMaRE ECR research project, and a UoP CDORE Seedcorn Project. He was also in charge of four projects supported by the Open Research Fund Program from different State Key Laboratories in the field of hydraulic engineering and ocean engineering. He has published more than 60 peer-reviewed papers in famous journals, including Journal of Fluid Mechanics, Physical Review Fluids, Physics of Fluids, Proceedings of the Royal Society A, etc. He has published a book with Springer and edited two chapters in a book published with CRC. He is a member of the (youth) editorial board for IET Renewable Power Generation, Journal of Marine Science and Engineering, and China Ocean Engineering, etc. He serves as a leading guest editor of special issues for several international journals, including but not limited to Renewable Energy and Physics of Fluids, which are two high-reputation journals in the field of energy and fluid mechanics, respectively. He is a member of the technical program committee of the International Society of Offshore & Polar Engineers (ISOPE). He also worked as a track director for the European Wave and Tidal Energy Conference (EWTEC).

Abstract:

Two different models (Models A and B) are proposed to investigate water wave interaction with an array of thin submerged horizontal circular plates within the framework of linear potential flow theory. The circular plates studied with both models are not limited to be rigid and impermeable, and instead, they can be porous or/and elastic. The traditional eigenfunction matching method is employed in Model A, in which the kinematic and dynamic conditions of the plates are incorporated into a complex dispersion equation. For impermeable plates, the roots of the dispersion equation can be obtained by means of bisection method and Muller's method. For the porous plates, the roots are derived by using the homotopy method, starting with the corresponding roots for the impermeable cases. In Model B, a Hankel transform approach is employed to formulate integral equations in terms of unknown functions related to the jump in velocity potential across each plate. A Galerkin method is adopted to the solution of these integral equations, and the velocity potential jump across the plate is expressed in terms of Fourier-Gegenbauer series, incorporating the known square-root behaviour at the edge of the plate in a rapidly convergent numerical scheme. Model B is found to be valid for multiple plates distributed arbitrarily, including the staggered arrangement, for which the traditional eigenfunction matching method (Model A) would not work.

14:15-15:00 Keynote Presentation 6

KCS Unsteady Bow Wave Breaking Experiments for Physics and CFD Validation

Prof. Wentao Wang, Research Professor of China Ship Scientific Research Center (CSSRC) and the Director of Hydrodynamics Research Department of CSSRC, China

Brief CV of Invited Speaker:

Prof. Wang Wentao is currently a research professor of China Ship Scientific Research Center (CSSRC) and the director of Hydrodynamics Research Department of CSSRC. He was the member of Resistance Committee of 28th International Towing Tank Conference (ITTC) and the member of Resistance and Propulsion Committee of 29th ITTC. He is now the CSSRC's representative of Advisory Council of 30th ITTC. He is the member of Ship Mechanics Committee of CSNAME. He leads ten national research projects on resistance & propulsion, ship flow measurement, and uncertainty analysis etc. He was awarded on Science and Technology Progress several times by CSNAME and CSSC for his project achievements. He published more than 40 papers and standards, and he is the author of more than 100 technical reports of CSSRC.

Abstract:

Wave breaking phenomena often occur on bow area of middle/high speed ship. Such complex unsteady wave breaking induced resistance component is a large amount of total resistance of the ship. Spilling, plunging, collapsing and surging are typical wave breaking types and difficult to be captured by CFD. The previous wave breaking studies for surface ships were for naval surface combatants 5415 and mostly focused on single-phase free-surface modeling, quasi-steady plunging bow and steady spilling shoulder breaking waves. More violent plunging-type bow breaking waves were observed for the KRISO Container Ship (KCS). The objective of the present study is to conduct KCS unsteady bow wave breaking experiments for physics and CFD validation in the model scale. Experimental results are presented on KCS bow wave breaking with two different scaled models at a high Froude number (Fr = 0.35), including photo studies combined with POD analysis, resistance tests, wave elevation measurements with both acoustic and servo-type wave probes, and velocity field measurements with a 5-hole pitot probe. Three different CFD solvers, i.e., Fluent, naoe-FOAM-SJTU, and CFDShip-Iowa, are used for the numerical study of the unsteady KCS bow wave breaking with quantitative comparisons on forces, wave elevation, and velocities for two scaled ship models. Photographic studies of both models indicate that the intensity and

area of the breaking interfaces in terms of RMS values increase with the trim angle. Two evident scars are identified visually from the high-speed camera photos and quantitatively from the wave elevation measurements at the most violent Case C (1° by bow). Significant differences between acoustic and servo-type wave probes on RMS and FFT of wave elevations are observed. The servo-type wave probes allow better identification of the inner scar along the hull, which is evident in photographic studies, and are more reliable for unsteady wave elevation measurements. Scale effects on wave breaking are investigated with both EFD and CFD. The large-scale model shows more violent plunging wave breaking and sprays, where larger RMS of the wave elevation in the wave breaking region can be observed. The difference in velocity under the free surface cannot be identified based on the present CFD results.

15:00-15:45 Keynote Presentation 7

Wall Pressure Fluctuations of Turbulent Boundary Layer for Axisymmetric Body of Revolution

Dr. Weiwen Zhao, Computational Marine Hydrodynamics Laboratory (CMHL), Shanghai Jiao Tong University, China

Brief CV of Invited Speaker:

Dr. Weiwen Zhao is currently a research associate in Computational Marine Hydrodynamics Laboratory (CMHL), Shanghai Jiao Tong University(SJTU). He received his BSc and MSc in Naval Architecture and Ocean Engineering from Huazhong University of Science and Technology, and his PhD from Shanghai Jiao Tong University. He is currently a member of the 30th specialist committee on Ocean Renewable Energy in the International Towing Tank Conference (ITTC). He is also an editorial board member of the Journal of Hydrodynamics. His research interest mainly focuses on the development and application of high-fidelity numerical methods for marine dynamics, such as the wall-stress models for large-eddy simulations, pressure fluctuations spatial-temporal characteristics of turbulent boundary layers for channel flow and underwater vehicles, hydrodynamics and acoustics of flow over underwater vehicles.

Abstract:

When turbulent boundary layer passing over an axisymmetric body of revolution (BOR), it exhibits extremely complex flow characteristics despite the simple geometry of the system. The eddies in the turbulent boundary layer will induce the wall pressure fluctuations on the hull surface, which is the main sources of flow-induced noise for submerged bodies. In this talk, we implemented a wall-stress model for large-eddy simulation based on solving the simplified thin-boundary-layer equation. The implemented model is firstly validated against channel flow and flow past a circular cylinder. It is then applied to the simulation of turbulent boundary layer for an axisymmetric body of revolution. The mean flow characteristics are compared with experimental data. The effects of different mesh resolutions and subgrid-scale models are discussed. Spatial and temporal characteristics of the wall pressure fluctuations on mid-body are analyzed. The wake profiles after flow separation due to adverse pressure gradient are also presented and discussed.

15:45-16:30 Keynote Presentation 8 (Jan. 27, 08:45-09:30 Spain Time)

Advances in the Coupling of Particle-Based Methods and Finite Element/Finite Volume Methods for Solving Problems in Computational Marine Hydrodynamics

Prof. Eugenio Oñate, Emeritus Professor and Founder of International Center for Numerical Methods in Engineering (CIMNE), Universitat Politècnica de Catalunya (UPC), Barcelona, Spain

Brief CV of Invited Speaker:

Prof. Dr. Eugenio Oñate is a Civil Engineer and Emeritus Professor of Structural and Continuum Mechanics at the School of Civil Engineering in the Technical University of Catalonia (UPC, www.upc.edu). His research has focused on the development of numerical methods for solving problems in structural mechanics, fluid dynamics and coupled situations in engineering sciences. His scientific contributions are of particular relevance for solving complex multidisciplinary problems in the fields of civil, industrial, aerospace, marine and naval engineering, among others. He has supervised 70 PhDs (completed). He has supervised the career towards tenure of 49 PostDocs. He has published 498 articles in JCR journals. He has 33.300 citations and an h-index of 85 (Google Scholar). He is the highest cited civil engineer in Spain. He is author of 2 text books and editor of 3 international Book Series and of 57 books on different topics of computational mechanics. He is editor of the JCR journals "Archives of Computational Methods in Engineering" (since 1994, Springer), "Computational Particle Mechanics" (since 2014, Springer) and "Métodos Numéricos para Cálculo y Diseño en Ingeniería" (since 1985, Scipedia). He was founder of CIMNE (www.cimne.com) in 1987 and its and Director up to May 2022. He was founder and first president of the Spanish Society of Numerical Methods in Engineering (1989–2004), founder and president of the European Community for Computational Mechanics in Applied Sciences (2000–2004) and president of the International Association for Computational Mechanics (2002-2010). He has received numerous awards, distinctions and honorary degrees at international level. He is the Scientific Director of the research programme of the Severo Ochoa Center of Excelence in Research awarded to CIMNE for the period 2020-2023. He has organized and chair/co-chair 58 scientific conferences worldwide. He has promoted the creation of several technology-based companies in Spain. Five of these companies' market software and products derived from outcomes of his research. More information in www.cimne.com/eo.

Abstract:

We present advances in the development and applications in Computational Marine Hydrodynamics of a new generation of numerical methods based on the blending of an enhanced discrete element method (DEM) for non-cohesive and cohesive materials [1] with an innovative combination of particle-based techniques and finite element/finite volume methods (PFEM [2,3]). The hereafter called PDFEM allows the study of particulate flows incorporating particles of different sizes and their interaction with ships and marine structures. The goal is to solve particulate fluid-solid-structure interaction problems at the scales that are necessary for accurately predicting the response and safety of ships and marine constructions under different sea conditions. In the talk we present advances in the PDFEM for studying the frictional contact between a particulate flow and deforming structures, surface erosion and multi-fracture situations in a structure under particulate flows incorporating micro, meso and macro particles [4]. We present examples of application of the PDFEM to particulate flow problems in naval, marine and harbour engineering such as the stability of breakwaters to sea

waves, the motion of floating/submerged bodies in tsunami flows and their interaction with structures, lean edge erosion of wind turbine blades due to raindrops, underwater drilling and cuttings transport in the oil/gas industry and the motion of vessels in icy waters, among others.

References

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[4] Idelsohn S.R., Giménez J.M., Löhner R., Oñate E., A multiscale approach for the study of particle-laden flows using a continuous model, Computer Methods in Applied Mechanics and Engineering, Vol. 401, Part A, 115174, 2022, 10.1016/j.cma.2022.115174

16:30-17:15 Keynote Presentation 9 (Jan. 27, 09:30-10:15 France Time)

Modeling Complex Free-Surface Flow with the Smoothed Particle Hydrodynamics Method, From Theory To Application

Prof. David LE TOUZÉ, Ecole Centrale Nantes and Director of the Research Laboratory on Hydrodynamics, Energetics and Atmospheric Environment (LHEEA) laboratory (ECN and CNRS), France

Brief CV of Invited Speaker:

Prof. David LE TOUZÉ is 46 years old. He got his MSc in Hydrodynamics and Ocean Engineering from Ecole Centrale Nantes (Nantes, France) in 2000. Ecole Centrale Nantes is a highly competitive French « Grande Ecole » which awards MScs and PhDs only. He got his PhD with honors in 2003, whose topic was modeling gravity wave generation and propagation by spectral methods. He spent 2 years of post-doc at CNR-INM (Rome, Italy) in 2004-05 where he started working on the SPH method. He became Assistant Professor of Ecole Centrale Nantes in 2007, then Associate

Professor in 2010 and Full Professor in 2012. His researches revolve mainly around free-surface flows. From 2012 to 2021 he led a 30-staff research group on Hydrodynamics, Interfaces and Interactions (H2i). Since 2022 he is the Director of the research Laboratory on hydrodynamics, energetics and atmospheric environment (LHEEA) which is a joint research unit of Ecole Centrale Nantes and CNRS. His research topics cover different numerical methods and techniques: SPH, incompressible (OpenFOAM) and weakly-compressible Finite Volumes, Adaptive Mesh/Particle Refinement, Immersed Boundary Method, Vortex Method, Lattice-Boltzmann Method. He is also working on different method couplings: potential flow (waves) to Navier-Stokes Finite Volume Method for wave-structure interactions, SPH to Finite Element Method for Fluid-Structure Interaction, SPH to Finite Volume Method for efficient solutions of complex flows. Main applications of his research are in the fields of marine, automotive and health (cardio-vascular flows) engineering. He is the author of ~75 journal publications. He was awarded twice the Joe Monaghan prize together with his Italian colleagues of CNR-INM. He is also a former Chair of the SPHERIC international community.

Abstract:

The Smoothed Particle Hydrodynamics (SPH) method development is rapidly expanding, with the majority of applications focused on geometrically complex free-surface/interface flow, potentially involving multi-physics. This particle method based on evaluating space differential operators on a scattered set of calculation points representing macroscopic fluid elements, raises theoretical and numerical issues mainly linked to its meshless and Lagrangian features which are rather unusual in hydrodynamics numerical modeling. Current progress on its theoretical and numerical development is examined, and the links with convergence and accuracy are discussed. This permits to highlight the current successful SPH schemes, their accuracy, efficiency, limitations and target types of applications. The interest and feasibility of coupling to other methods is also highlighted.

17:15-18:00 Keynote Presentation 10 (Jan. 27, 10:15-11:00 Germany Time)

Multiscale and Multiphase Flows in Interaction with Structures

Prof. Bettar el Moctar, Professor for Ship Technology and Ocean Engineering, University of Duisburg-Essen and Member of the Board of Directors of the Shallow Water Model Basin (DST), Germany

Brief CV of Invited Speaker:

Bettar el Moctar, studied Naval Architecture and Ocean Engineering at the University of Hamburg/Germany. He graduated in 1997 and has since then worked as a research assistant in different departments of the University of Technology Hamburg, where he has specialized in computational fluid dynamics. He completed his doctorate at the University of Technology Hamburg with a dissertation entitled "Numerical Computation of Forces Acting on Maneuvering Ships." In 2000 he joined the Hamburg Ship Model Basin (HSVA) and worked as a research engineer. He was head of department of fluid dynamics at Germanischer Lloyd/Germany from 2002 to 2008 and global head of research at DNV GL advisory services/Germany from 2013 to 2016. Since 2008 he has been working at the University Duisburg-Essen as a full professor for ship technology and Ocean Engineering and member of the Board of Directors of the shallow water model basin DST/Germany. He is editor and co-editor for several international journals and has been member of different international committees. His publications cover various aspects of hydrodynamics and Fluid-Structure-Interaction. The focus of his research is the development of numerical and experimental methods for cavitation, sloshing, hydroelasticity, slamming, seakeeping, maneuvering and propulsion in waves. (https://www.uni-due.de/IST/ismt_elmoctar.php).

Abstract:

The lecture deals with numerical investigations of multiphase flows at different scales interacting with structures in the maritime context. The focus is on cavitation, sloshing and hydroelasticity effects on impact loads and on bubbly dynamics. First, state-of-the-art numerical methods and their limits are discussed. Second, methods to quantify numerical errors are presented. Finally, selected examples are presented. The lecture concludes with an outlook on future developments.

18:00-18:45 Keynote Presentation 11 (Jan. 27, 11:00-11:45 Holland Time)

Prediction and Modelling of Biologically-Inspired Fluid Structure Interactions

Prof. Gabriel Weymouth, Chaired Professor of Ship Hydromechanics in the Mechanical Engineering faculty, Technische Universiteit Delft, Netherlands

Brief CV of Invited Speaker:

Professor Gabriel Weymouth is the Chaired Professor of Ship Hydromechanics in the Mechanical Engineering faculty at Technische Universiteit Delft (TU Delft). His research has made fundamental contributions to the study of nonlinear flow physics, development of physics-based and machine-learning numerical methods, and biologically inspired fluid-structure devices. His research has been funded by industry and government agencies in the US, Singapore, UK and EU, and his open-source software for education and research is used around the world.

Abstract:

Unsteady fluid loading and fluid structure interaction are ubiquitous problems in marine hydrodynamics, and their computational prediction can be difficult and time-consuming. In particular, biologically inspired flows being studied for the development of manoeuvrable underwater vehicles are universally unsteady and feature large amplitude structural deformations. In this talk I will discuss a range of such nonlinear fluid structure interaction systems, and our methods for predicting and modelling their response; from analytic oscillator equations to fully coupled solvers with immersed shell elements, to machine learned equations for dynamic loading.

18:45-19:30 Keynote Presentation 12 (Jan. 27, 10:45-11:30 Portugal Time)

Hydrodynamic Analysis of Double Chamber Oscillating Water Column Wave Energy Converters

Prof. Carlos Guedes Soares, Scientific Coordinator of Centre for Marine Technology and Ocean Engineering (CENTEC), Instituto Superior Técnico, Universidade de Lisboa, Portugal

Brief CV of Invited Speaker:

Carlos Guedes Soares is a Distinguished Professor of the Engineering School (Instituto Superior Técnico) of the University of Lisbon and Scientific Coordinator of the Centre for Marine Technology and Ocean Engineering (CENTEC), which is a research centre of the University of Lisbon that is rated as "Excellent" and funded by the Portuguese Foundation for Science and Technology. He concluded his postgraduate studies at the Massachusetts Institute of Technology, USA in 1976, and at the Norwegian Institute of Technology of the University of Trondheim, in 1984 and has since then been at the University of Lisbon (Technical University of Lisbon until 2013). He has supervised and co-supervised more than 75 PhD students and has about 35,000 citations in the Web of Science. He has been Chair or Co-Chair of various conferences in the series of OMAE, ESREL, IMAM, ISSC, ICCGS, MARSTRUCT, MARTECH and RENEW. He has been Editor of the Reliability Engineering and Systems Reliability Journal for about 30 years, the last 10 of which as Editor-in-Chief. He is Co-Editor-in-Chief of the Journal of Marine Science and Application and is member of the Editorial Board of more than 15 Journals. He is a Fellow of SNAME, RINA, IMarEST, ASME and the Portuguese Engineering Association (Ordem dos Engenheiros). He is also a Fellow of the Portuguese Academy of Engineering.

Abstract:

An overview is presented of hydrodynamic studies that led to the development of double chamber oscillating water column wave energy converter concepts both fixed for shoreline applications and floating for offshore use. One concept that is explored is the existence of one step at the entrance of the water chamber, which leads to an accelerated flow of water at the entrance of the chamber, improving performance. The exitance of the step transforms the dynamics of the water masses from a one degree of freedom to two degrees of freedom by modelling the water inside the chamber and the water at the entrance, over the step. The adoption of two chambers brings additional flexibility to the concept allowing more optimized solutions. A floating dual chamber oscillating water column wave energy converter concept is also developed by combining in the floater a direct oscillating water column solution with a backward bent concept. Numerical and experimental studies have documented the performance of various concepts.

19:30-20:15 Keynote Presentation 13 (Jan. 27, 11:30-12:15 London Time)

H2020 GATERS Project – A Computational Design Analysis of the Gate Rudder System for Propulsive Performance Using the Design of Experiments Methods

Prof. Mehmet Atlar, Professor of Naval Hydrodynamics in the Department of Naval Architecture, Ocean and Marine Engineering, The University of Strathclyde, Glasgow, UK

Brief CV of Invited Speaker:

Mehmet Atlar (PhD, MSc, BSc, CEng, MRINA, MSNAME) is the Professor of Naval Hydrodynamics in the Department of Naval Architecture, Ocean and Marine Engineering at the University of Strathclyde. He has forty years of experience in experimental and theoretical hydrodynamics with special emphasis on ship powering, cavitation and

URN. He has been participating in and coordinating many projects funded by the EU FP, H2020, UK EPSRC, MoD, Government and industry. He led the design and commissioning of Newcastle University's catamaran Research Vessel "The Princess Royal" as the Professor and director of the Emerson Cavitation Tunnel until 2016 when he moved to the Strathclyde. He is currently leading the H2020 Project GATERS with 18 partners to retrofit a novel gate rudder propulsion system for energy-saving, GHG reduction and URN mitigation. Prof Atlar published over 300 publications on Int'l refereed journals, conferences, and technical reports and received awards, including the most recent TRAVISION 2022 Senior Researcher award based on his activities in the GATERS project.

Abstract:

The European collaborative project GATERS has brought together 18 technology experts and prime stakeholders to demonstrate and exploit the benefits of the innovative energy-saving propulsion & steering device, "Gate Rudder System (GRS)", on ships as a retrofit. This 3-year Innovation Action project (Grant Agreement: 860337) led by the University of Strathclyde recently demonstrated the first retrofit application of the GRS on the project target vessel MV ERGE, a 90m General Cargo Ship, successfully. During the execution of the GATERS project, several computational, experimental, and full-scale trial campaigns were conducted by the partners. The campaigns were to support the development of various design and analysis tools, apply them to the GRS design for MV ERGE, and validate it. During the computational campaign, the novel arrangement and multitude of the design parameters of the GRS with its twin rudders, which can be controlled independently, required its optimal design, at least from the powering performance point of view. This talk, therefore, presents the application of "the Design of Experiment (DoE)" approach to investigate the sensitivity of key design variables of the GRS on MV ERGE's powering performance. Computational Fluid Dynamics (CFD) analysis was employed to calculate the respective flow variables at each design point generated by the Sobol algorithm, and the most effective geometrical parameter was identified from the propulsive performance point of view. The investigation indicated that the powering performance of MV ERGE was most sensitive to the rudder angle arrangement. The DoE application demonstrated a 4% gain on the vessel's delivered power. Further insight into the effects of the critical design parameters through the DoE indicated that the design objective of the GRS should not be based on maximising the system's thrust. Instead, the interaction between the GRS and the hull should also be considered.

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