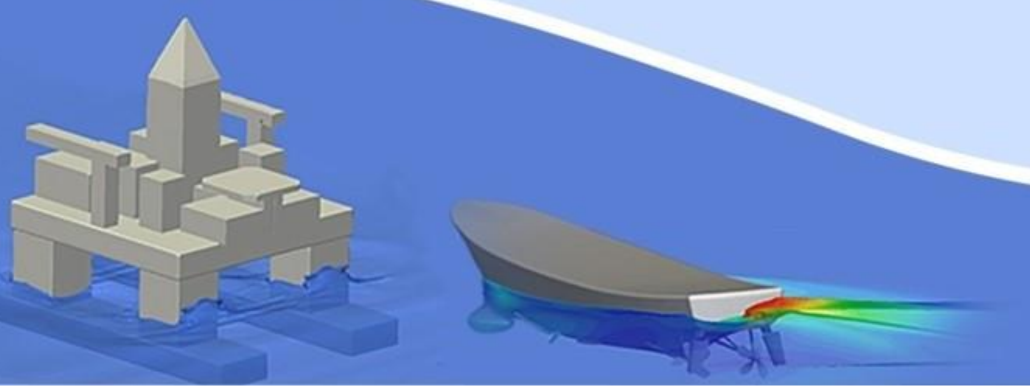
The 6th Symposium on Computational Marine Hydrodynamics

第六届 CMHL 船舶与海洋工程计算水动力学研讨会

(The 6th CMHL Symposium 2023)

January 14, 2023, Online Virtual Meeting

CMHL
SJTU



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(The 6th CMHL Symposium 2023)

January 14, 2023, Online Virtual Meeting

Organized by

Computational Marine Hydrodynamics Lab (**CMHL**)

Co-Organized by

Journal of Hydrodynamics (JHD)

Ocean College, Zhejiang University

School of Shipping and Naval Architecture, Chongqing Jiao Tong University

Preface

Welcome to the 6th CMHL Symposium 2023 online virtual meeting!

Computational Marine Hydrodynamics Lab (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 is named after "CMHL" and 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.

The first CMHL Symposium was held on Dec. 27-28, 2018. The 2nd CMHL Symposium was held on May 7-8, 2019. The 3rd CMHL Symposium was held on Dec. 12-13, 2019. The 4th CMHL Symposium was held online (virtual meeting) on Jan. 14, 2021. The 5th CMHL Symposium was held online (virtual meeting) on Jan. 18, 2022. Many outstanding and reputable experts on computational marine hydrodynamics, including Prof. Frederick Stern from University of Iowa, USA, Prof. Atilla Incecik from University of Strathclyde, UK, Prof. Michel Visonneau from Centrale Nantes, France, Prof. Chaoqun Liu from University of Texas at Arlington, USA, Prof. Rickard Bensow from Chalmers University of Technology, Sweden, and Prof. Hrvoje Jasak from University of Cambridge, UK, had carried on very excellent and splendid invited presentations in the previous CMHL symposiums.

The coming 6th CMHL Symposium 2023 organized by CMHL and co-organized with *Journal of Hydrodynamics (JHD)*, *Ocean College of Zhejiang University as well as School of Shipping and Naval Architecture of Chongqing Jiao Tong University* will be taken place online (virtual meeting) on Jan. 14, 2023. There will be 13 famous professors and outstanding researchers who are invited to give 45 minute keynote presentations, respectively. Several papers based on the invited the keynote presentations will be published in *Journal of Hydrodynamics* as a special column for the 6th CMHL Symposium 2023.

Online Virtual Meeting Information

Tencent Meeting Webinar (ID: 778-625-617) has been set up for the online virtual meeting of the 6th CMHL Symposium 2023 during 09:00-20:20 (GMT+8, Beijing time) of Jan. 14, 2023. 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/dw/j43YWgXBkXK3

We also prepare three live broadcasts of the 6th CMHL Symposium 2023 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/13140777
KouShare: https://www.koushare.com/lives/room/829822
Fangzhenziu: https://www.fangzhenxiu.com/live/1057252896654823424

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 6th CMHL Symposium 2023

Dr. Weiwen Zhao, CMHL, Shanghai Jiao Tong University, Email: weiwen.zhao@sjtu.edu.cn
Dr. Zheng Ma, Editorial Board, Journal of Hydrodynamics (JHD), Email: mazh8888@sina.com
Dr. Yangyang Gao, Ocean College, Zhejiang University, Email: yygao@zju.edu.cn
Dr. Nan Ji, School of Ship. and Naval Archit. of Chongqing Jiao Tong Univ, Email: jinan@cqjtu.edu.cn

Program of the 6th CMHL Symposium 2023

Beijing Time 09:00-20:20, Saturday, Jan. 14, 2023, Online Virtual Meeting

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

09:05-09:50 Keynote Presentation 1 (Jan. 14, 10:05-10:50 Japan Time)

Ship Resistance Component Decomposition using Viscous/Inviscid CFD

Prof. Takanori Hino, Professor Emeritus of Yokohama National University, Japan.

09:50-10:35 Keynote Presentation 2 (Jan. 13, 19:50-20:35 Texas Time)

CFD Simulation of Extreme Wave Impact on Ships and Offshore Structures using Coupled Level-Set and Volume-of-Fluid Method

Prof. Hamn-Ching Chen, A.P. & Florence Wiley Professor of Civil Engineering and Professor of Ocean Engineering at Texas A&M University, USA

10:35-11:20 Keynote Presentation 3 (Jan. 13, 20:35-21:20 CST)

Adaptive Mesh Refinement (AMR) and its application in Two-phase Flow and Fluid-Structure Interaction problems

Dr. Yadong (Jordan) Zeng, Altair Engineering Inc, USA

11:20-12:05 Keynote Presentation 4

Experimental and numerical study of an evolutionary algorithm-based optimization approach for multi-mode wave energy converter

Prof. Dahai Zhang, Ocean College, Zhejiang University, China

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

13:30-14:15 Keynote Presentation 5 (Jan. 14, 11:00-11:45 India Time)

Hybrid Modelling - Past, Present and Future

Prof. V. Sriram, Department of Ocean Engineering, IIT Madras, India

14:15-15:00 Keynote Presentation 6

The cloaking phenomenon in arrays of truncated surface-piercing cylinders

Prof. Guanghua He, School of Ocean Engineering, Harbin Institute of Technology, China

15:00-15:45 Keynote Presentation 7

Free Surface Characteristics of a Generic Submarine in Density Stratified Fluid

Dr. Liushuai Cao, CMHL, Shanghai Jiao Tong University, China

15:45-16:30 Keynote Presentation 8 (Jan. 14, 10:45-11:30 Moscow Time)

Mathematical modeling of icing process of the outer surface of the hull for a marine vessel

Dr. Strijhak Sergei, ISP RAS, Moscow, Russia

16:30-17:15 Keynote Presentation 9 (Jan. 14, 10:30-11:15 Finland Time)

Fluid structure interaction models for the analysis of the dynamic response of ships in intact and damaged conditions

Dr. Spyros Hirdaris, Associate Professor of Marine Technology at Aalto University, Finland

17:15-18:00 Keynote Presentation 10 (Jan. 14, 10:15-11:00 Germany Time)

Advances on numerical and experimental investigation of ship roll damping

Prof. Moustafa Abdel-Maksoud, Head of the Institute of Fluid Dynamics and Ship Theory (FDS) of Hamburg University, Germany

18:00-18:45 Keynote Presentation 11 (Jan. 14, 11:00-11:45 Germany Time)

Mesh or Meshless for CFD?

Prof. Xiangyu Hu, Adjunct Professor, Technical University of Munich, Germany

18:45-19:30 Keynote Presentation 12 (Jan. 14, 10:45-11:30 London Time)

Making Waves; OpenFOAM and Offshore Hydrodynamic Simulation

Prof. Gavin Tabor, Professor of Computational Fluid Dynamics, University of Exetern, UK

19:30-20:15 Keynote Presentation 13 (Jan. 14, 11:30-12:15 London Time)

A new approach for computing violent wave loading on offshore wind turbine foundations

Prof. Jun Zang, Chair Professor of Coastal and Ocean Engineering, University of Bath, 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. 14, 10:05-10:50 Japan Time)

Ship Resistance Component Decomposition using Viscous/Inviscid CFD

Prof. Takanori Hino, Professor Emeritus of Yokohama National University, Japan.

Brief CV of Invited Speaker:

Takanori Hino is a Professor Emeritus of Yokohama National University, Japan. He received his Bachelor's degree in Naval Architecture from the University of Tokyo, and also Masters and Doctor of Engineering degrees from the same university. He started his professional career as a researcher at Ship Research Institute, Japan in 1984. Institute was reorganized into National Maritime Research Institute in 2001 where he served as Director of Center for CFD Research for seven years until 2011. He moved to Yokohama National University in 2011 as a professor in the Specialization in Ocean and Space Engineering and was appointed professor emeritus in 2022. Takanori Hino's research involves numerical ship hydrodynamics including code development, turbulent free surface flow analysis around ships and design optimization of ship hull forms. He is a member and the former vice-president of the Japan Society of Naval Architects and Ocean Engineers. He organized two CFD Workshops, Tokyo 2005 and Tokyo 2015, dedicated to numerical ship hydrodynamics. He is a recipient of the Best Paper Award from the Society of Naval Architects of Japan in 1996, the Best Development Award in 2017 and the Best Book Award in 2021 from the Japan Society of Naval Architects and Ocean Engineers. He has received the Best Researcher Award from Yokohama National University in 2018. Also, he has been selected as the Weinblum Memorial Lecturer in 2017/2018.

Abstract:

Resistance of a ship consists of friction, viscous pressure and wave making components. In order to estimate resistance of a full-scale ship from model-scale

values obtained by tank tests, it is necessary to decompose resistance components and extrapolate each component considering scale-effect based on the classical Froude's hypothesis. However, the assumptions behind Froude's hypothesis are not rational from the hydrodynamic point of view. Due to the complicated flow physics of ship flow and the strong interaction among the resistance components, it is not easy to accurately separate each component from total resistance which is the only quantity directly measured in a towing test even with the assistance of CFD. Although CFD analysis provides the total resistance with the sum of frictional and pressure components, the separation of viscous pressure component and wave making component cannot be achieved easily. In the present study, based on flow analysis around ships using the combination of viscous and inviscid CFD methods, a new resistance decomposition method based on flow physics is explored.

09:50-10:35 Keynote Presentation 2 (Jan. 13, 19:50-20:35 Texas Time)

CFD Simulation of Extreme Wave Impact on Ships and Offshore Structures using Coupled Level-Set and Volume-of-Fluid Method

Prof. Hamn-Ching Chen, A.P. & Florence Wiley Professor of Civil Engineering and Professor of Ocean Engineering at Texas A&M University, USA

Brief CV of Invited Speaker:

Dr. Hamn-Ching Chen, A.P. & Florence Wiley Professor of Civil Engineering and Professor of Ocean Engineering at Texas A&M University, received his B.S. and M.S. degrees in Power Mechanical Engineering from National Tsing Hua University, Taiwan, in 1976 and 1978, respectively; and his Ph.D. in Mechanical Engineering from the University of Iowa in 1982. After working as a research scientist at the Iowa Institute of Hydraulic Research (1982-88) and a senior research scientist at Science Applications International Corporation (1988-90), he joined the faculty of Texas A&M University in 1991. He is the originator and primary developer of the Finite-Analytic Navier-Stokes (FANS) and CHimera finite Analytic Method Potential-flow Solver (CHAMPS) codes which have been widely used for applications in ocean, civil, mechanical, and hydraulic engineering problems. His research interests include computational fluid dynamics, turbulence modeling, submarine hydrodynamics, ship berthing operations, passing ship effects, vortex-induced vibrations of deepwater risers, free-span offshore pipelines, nonlinear pipe-soil interactions, vortex-induced motions of deep-draft semisubmersibles, hurricane wave impact on offshore structures, floating offshore wind turbines, bridge scour, channel migration, and internal cooling and film cooling of turbine blades. Dr. Chen is a Fellow of ASME and an Associate Fellow of AIAA. He was the Chair of ASCE Turbulence Committee (2000-2002), and an associate editor for the ASCE Journal of Engineering Mechanics (2000-2002) and ASCE Journal of Waterway, Port, Coastal and Ocean Engineering (2002-2011). Currently, he is an Editor for the International Journal of Offshore and Polar Engineering (2011-present), and a member of Editorial Board for Ocean Systems Engineering Journal.

Abstract:

A local-analytic-based Finite-Analytic Navier-Stokes (FANS) numerical method has been employed for computational fluid dynamics (CFD) simulation of fluid-structure interaction problems including violent free surface flows and extreme wave impacts. The method solves unsteady Navier-Stokes equations in moving curvilinear coordinate system using a chimera domain decomposition approach with moving overset grids. Simulation of moving bodies and fluid-structure interaction problems can be readily accomplished by allowing for arbitrary motions among various computational grid blocks without tedious grid-regeneration or mesh deformations. For problems involving violent free surface flows, a coupled level-set and volume-of-fluid (CLSVOF) method has been incorporated to provide detailed resolution of the air-water interface including breaking waves with small droplets and air bubbles. The coupled level-set and volume-of-fluid (CLSVOF) method is widely accepted as one of the most advanced interface-capturing methods. In this implementation, the level-set function is solved using the 5th-order WENO (weighted essentially non-oscillatory) scheme, and the VOF function is calculated using piecewise linear interface construction (PLIC) with mixed Euler-implicit Lagrangian-explicit (EI-LE) advection scheme. For overset grids involving embedding or overlapping grids, the VOF function depends on the cell size and cannot be interpolated between two grid blocks. A new inter-grid VOF interpolation technique has been developed to enforce mass conservation and maintain smooth interface across non-matching block boundaries. The new CLSVOF method has been employed for time-domain simulation of extreme wave impact and greenwater on two offshore platforms under Hurricane Katrina with highly localized impact force produced by random 3D short-crested waves. The CLSVOF simulation results successfully captured the breakup of overtopping wave into numerous small droplets after the massive wavefront slams into the platform deck and top-side equipment. More recently, the

coupled FANS-CLSVOF method was further generalized for wave-current-structure interaction problems involving moving overset grids. CFD simulation of heave and pitch motions of a containership in random waves has been performed under both the head sea and following sea conditions. Both bow slamming at a speed of 6 knots, and stern slamming at 0 and 5 knots were investigated. These simulation results clearly demonstrated that the CLSVOF method can be effectively used for time-domain simulation of extreme wave impacts on floating offshore structures and moving vessels.

10:35-11:20 Keynote Presentation 3 (Jan. 13, 20:35-21:20 CST)

Adaptive Mesh Refinement (AMR) and its application in Two-phase Flow and Fluid-Structure Interaction problems

Dr. Yadong (Jordan) Zeng, Altair Engineering Inc, USA

Brief CV of Invited Speaker:

Yadong (Jordan) Zeng finishes his Ph.D. in Mechanical Engineering at the University of Minnesota and his bachelor's degree in Ocean Engineering at Shanghai Jiao Tong University (SJTU). His main interests are numerical schemes in Adaptive Mesh Refinement (AMR), especially focusing on how these schemes can help save computational resources in High-Performance Computing (HPC) area and how they can help to simulate the multiphase flow and Fluid-Structure Interaction (FSI) problems. Currently, he is working as a CFD Solver Developer in Altair Engineering Inc.

Abstract:

Numerical simulations of two-phase flow and fluid structure interaction problems are of great interest in many environmental problems and engineering applications. To capture the complex physical processes involved in these problems, a high grid resolution is usually needed. However, one does not need or maybe cannot afford a fine grid of uniformly high resolution across the whole domain. The need to resolve local fine features can be addressed by the adaptive mesh refinement

(AMR) method, which increases the grid resolution in regions of interest as needed during the simulation while leaving general estimates in other regions. In this work, we propose a block-structured adaptive mesh refinement (BSAMR) framework to simulate two-phase flows using the LS function with both the subcycling and non-subcycling methods on a collocated grid. To the best of our knowledge, this is the first framework that unifies the subcycling and non-subcycling methods to simulate two-phase flows. The use of the collocated grid is also the first among the two-phase BSAMR framework, which significantly simplifies the implementation of multi-level differential operators and interpolation schemes. We then develop another consistent scheme, in which the conservative momentum equations and the mass equation are solved in the aforementioned BSAMR framework. This consistent mass and momentum transport treatment greatly improves the accuracy and robustness for simulating two-phase flows with a high-density ratio and high Reynolds number. For solving single- and multiphase fluid-structure interaction (FSI) problems, we present an adaptive implementation of the distributed Lagrange multiplier (DLM) immersed boundary (IB) method. We demonstrate the versatility of the present multilevel framework by simulating problems with various types of kinematic constraints imposed by structures on fluids, such as imposing a prescribed motion, free motion, and time-evolving shape of a solid body. The accuracy and robustness of the codes are validated using several canonical test problems.

11:20-12:05 Keynote Presentation 4

Experimental and numerical study of an evolutionary algorithm-based optimization approach for multi-mode wave energy converter

Prof. Dahai Zhang, Ocean College, Zhejiang University, China

Brief CV of Invited Speaker:

Professor Dahai Zhang, Secretary-General of Division of Ocean Technology System, Chinese Society of Oceanography; Deputy Director of the Institute of Advanced Technology, Zhejiang University of (ZJU), received PhD from ZJU of Mechanical and Electronic Engineering in 2010. He worked as a postdoc at Department of Mechanical Engineering at ZJU in

2011 and worked as a postdoc at Department of Engineering in Lancaster University from 2012 to 2013. Afterwards, he joined Zhejiang University, where he is currently a Professor with Ocean College. His research interests include mechatronic systems and ocean engineering. He served as an IET Fellow and IEEE Senior Member respectively, in 2019 and 2020. Professor Zhang has worked with various research projects dealing with modelling, design and measurements of ocean renewable energy electrical machines such as wave energy converter, tidal current turbine and offshore wind turbine. He has published over 80 peer-reviewed journal/conference papers in proposed areas, and chaired 5th China Marine Renewable Energy Conference in 2016, the 3th China Ocean Technology Conference in 2017 and the 6th Asian Wave and Tidal Energy Conference (AWTEC) as organizing president in 2022.

Abstract:

Wave energy technologies have the potential to play a significant role in the supply of renewable energy around the world. One of the most promising designs for wave energy converters (WECs) are multi-mode WECs. In this work we explore the optimization of multi-mode WECs consisting of a floating buoy at the surface and multi-axis power-take-off (PTO) systems. This type of WECs can be optimized for total power generation by adjusting both the geometry of the buoy and also the PTO design. The whole optimization problem is complex and computationally expensive due to multiple and mutually interacting parameters. An optimization approach based on evolutionary algorithms was created, which allows simultaneous optimization of the geometry of the buoys, the damping coefficient of PTOs in each axis and the geometrical layout of the multi-axis structure. For assessing the effectiveness of the proposed approach, numerical simulations with different objective functions and search space are carried out with realistic wave conditions. Finally, an experimental study with standard models and optimized devices was conducted in order to compare the numerical results with experimentally acquired data. The results identify optimal design and configurations for multi-mode WECs, and demonstrate that the proposed optimization approach can significantly enhance the efficiency.

13:30-14:15 Keynote Presentation 5 (Jan. 14, 11:00-11:45 India Time)

Hybrid Modelling - Past, Present and Future

Prof. V. Sriram, Department of Ocean Engineering, IIT Madras, India

Brief CV of Invited Speaker:

Dr. V. Sriram is currently working as professor at the Department of Ocean Engineering, IIT Madras. He received his Direct PhD after bachelors from IIT Madras. His research work focuses on computational and experimental hydrodynamics. He has developed state-of-the-art numerical models applied to ocean engineering. He received the Newton International Fellowship (from the Royal Society, UK) in 2009, Alexander Von Humboldt Fellowship (from AvH foundation, Germany) in 2011, DST INSPIRE Faculty award (from DST), RJ Garde Research award (from Indian Society of Hydraulics), ISOPE Conference best session organiser award 2021 and DFG- Mercator Fellowship, 2023 for his contributions in the field. He was a visiting researcher at City University of London and visiting professor at Leibniz Universität Hannover, Germany. He has published more than 100 papers in international journals and conferences. He has guided 8 PhD students and currently guiding 10 more PhD students. He is presently serving as an Associate Editor in IJOPE.

Abstract:

Numerical modelling plays an important role in understanding the complex wave structure interaction (WSI) phenomenon and assisting in the design of marine structures. A typical feature of numerical modelling in WSI problems is simultaneously considering large-scale wave propagations and small-scale physics in the near field of the structures, such as nonlinear wave-elastic structure interactions, breaking wave impact, aeration and turbulence. This brings challenges for the single-model approach, e.g. the fully or weakly nonlinear potential theory and the Navier-Stokes solvers, which is either over-simplified for small-scale physics or too time-consuming for large-scale wave propagation. Over the last decade, after the successful implementation of strong coupling between the 2D FNPT – Particle based NS solver. It has been developed for 3D and various applications are attempted. In this talk, the past implementation, the learnings and present state of the art in coupling will be discussed. Both domain based approach and functional decomposition approaches will be discussed. The developments in

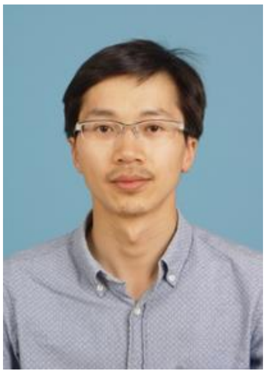
particle method based MLPG, IITM-RANS3D and Boussinesq model coupling will be discussed. An overview about the future perspective such as coupling the numerical model and experimental facility will be provided.

14:15-15:00 Keynote Presentation 6

The cloaking phenomenon in arrays of truncated surface-piercing cylinders

Prof. Guanghua He, School of Ocean Engineering, Harbin Institute of Technology, China

Brief CV of Invited Speaker:



Dr Guanghua He is a Taishan Scholar, doctoral supervisor, Marine Hydrodynamics Professor, worked at School of Ocean Engineering, Harbin Institute of Technology. He is the Editorial Board member of Ocean Engineering Journal, Journal of Hydrodynamics. He received his B.E, M.E. and Ph.D degrees in Coastal and Offshore Engineering from Tianjin University, Dalian University of Technology, China, and Kyushu University, Japan, respectively. After that, he has been employed by Department of Naval Architecture & Ocean Engineering, Osaka University, as an Assistant Professor, and worked in Prof. Mashashi Kashiwagi group for more than 4 years. His research is focused on Wave cloaking, Wave Loads on Marine Structures, Strongly Nonlinear Wave-Structure Interaction, Ship hydroelasticity, and Ocean Renewable Energy.

Homepage：http://homepage.hit.edu.cn/GuanghuaHE

Abstract:

The water wave is always a significant factor that should be considered in the marine environment. The hydrodynamic interactions among adjacent bodies in waves are expected to be complex with an increase in number of floating bodies. Recently, a cloaking phenomenon has been introduced to water wave filed to reduce the scattered wave energy of offshore structures. In a diffraction problem, the term cloaking refers that there is no wave scattering in the form of radial outgoing waves. To achieve numerical accuracy and efficiency, wave interaction theory is adopted to evaluate the wave drift force acting on bodies, and a boundary integral equation based on a higher-order boundary element method (HOBEM) is employed to obtain this numerical solution. The 3-D calculation for the

arrangement of several small cylinders regularly on a circle concentric with a fixed floating body is conducted in this paper. The influence of wave direction on wave drift force acting on floating bodies is systematically investigated and discussed.

15:00-15:45 Keynote Presentation 7

Free Surface Characteristics of a Generic Submarine in Density Stratified Fluid

Dr. Liushuai Cao, CMHL, Shanghai Jiao Tong University, China

Brief CV of Invited Speaker:

Dr. Liushuai Cao is a research associate at CMHL (Computational Marine Hydrodynamics Laboratory), where he leads a research field in submarine hydrodynamics. He achieved his BSc degree in Naval Architecture and Ocean Engineering from Harbin Engineering University in 2010 and his PhD degree from Naval Engineering University in 2015. After that, he served as an engineer in the navy for four years. His research focuses on the development of numerical methods for practical applications in the marine industry, such as propulsion and maneuvering performance prediction of submarines and underwater vehicles in the homogenous and density stratified fluid, cavitation simulation and suppression based on the active and passive methods.

Abstract:

When a submarine travels in the stratified oceans, the internal waves and anisotropic turbulence produced by the moving submarine will induce wakes and waves on the free surface. These characteristics will be detected by the synthetic aperture radar, which is of great importance for non-acoustic detection. At CMHL, we proposed a methodology capable to predict the hydrodynamics and free surface characteristics of a fully appended submarine maneuvering in the density stratified fluid. This presentation will firstly introduce the background information and theory of ocean pycnocline. Then, a numerical method based on the Boussinesq approximation is implemented to simulate the stratified fluids. A generic submarine Joubert BB2 model travels both in the homogenous and linearly stratified fluids are investigated. The resistance, downstream wakes, internal waves as well as free surface characteristics are analyzed to show the specialty of stratified fluids. A noteworthy anisotropy of the surface wave crest and trough, and

a larger influencing zone of the Kelvin waves are shown for the stratified cases.

15:45-16:30 Keynote Presentation 8 (Jan. 14, 10:45-11:30 Moscow Time)

Mathematical modeling of icing process of the outer surface of the hull for a marine vessel

Dr. Strijhak Sergei, ISP RAS, Moscow, Russia

Brief CV of Invited Speaker:

Dr. Sergei Strijhak born in 1970, graduated from Bauman Moscow State University (1993). He has a PhD degree of Technical Science in Aerodynamics and Heat Transfer (2012). He is the senior researcher from Ivannikov Institute for System Programming of the RAS. Sergei worked 25 years in IT industry, HPE Russia Company, specializing in high performance computing, disk arrays, high availability cluster, OS Unix/Linux. His research interests are in architecture of supercomputers, parallel file systems, machine learning algorithms, data science, Computational Fluid Dynamics, ice accretion modeling for aircrafts and wind blades, rotating geophysical flows, large eddy simulation, turbulence subgrid-scale models, renewable energy, wind farms, optimization methods, FSI, noise prediction. He developed a novel architecture of neural network for ice prediction on different airfoils. Sergei is Associate Professor of 806 department in Moscow Aviation Institute (MAI), the leader of Master of Science Program in IT-Center MAI. The list of courses taught are: Architecture of Supercomputers, Mathematical Modelling and Numerical Methods, Parallel algorithms, Remote Sensing and Artificial Intelligence. He is a reviewer for scientific journals: MDPI Aerospace, MDPI Mathematics, MDPI Journal of Marine Science and Engineering, Engineering Applications of Computational Fluid Mechanics. Sergei was responsible for 5 grants from the Ministry of Science and Higher Education of the Russian Federation and supervisor of two RFBR grants. He is the author of 105 scientific papers in Russian database and 30 Scopus papers.

Abstract:

The report is dedicated to the topical issue of studying the formation of ice on the surface of a marine vessel. This topic is relevant in connection with development

of the Northern Sea Route and operation of ships, offshore structures in difficult climatic conditions of the Arctic. Currently, there are both experimental and computational methods for studying the growth of various types of ice for both in full and model scales. This report gives a brief overview of Euler-Euler, Euler-Lagrange models for describing gas-droplet flow and thermodynamic models of ice accretion using a film model. The description is given for the iceFoam solver, which was developed at ISP RAS using OpenFOAM library, and the results for numerical calculations with different flow parameters of the ice growth for a fishing marine vessel are given.

16:30-17:15 Keynote Presentation 9 (Jan. 14, 10:30-11:15 Finland Time)

Fluid structure interaction models for the analysis of the dynamic response of ships in intact and damaged conditions

Dr. Spyros Hirdaris, Associate Professor of Marine Technology at Aalto University, Finland

Brief CV of Invited Speaker:

Dr. Spyros Hirdaris is Associate Professor of Marine Technology at Aalto University, Finland. He completed his PhD in 2002 on Ship Science (Hydroelasticity of Ships) at the University of Southampton, UK. To date he has been sponsored by the EU, Lloyd's Register and their Foundation, British Maritime Technology and the Academy of Finland. His research focuses on the prediction of sea loads and the analysis of the performance of floating assets operating in extreme conditions. He is also interested in the de-risking emerging technologies for use in the design and operations of safe and sustainable ships. He is European Engineer, Chartered Engineer, Fellow of the Royal Institution of Naval Architects (FRINA, UK) and Fellow of the Society of Naval Architects and Marine Engineers (FSNAME, USA). He has been participating in the International Ships and Offshore Structures Congress since 2006, serving as member in various committees and chair of committee I.2 on Loads and member of the International Towing Tank Conference since 2021. Before joining Aalto university he worked for 14 years for Lloyd's Register Classification Society and spent short spells with UK based engineering consultancy firms. This work involved research and product development, planning and strategy for R&D, consultancy and marine new construction activities. His editorial duties involve Associate Editorship of the IMechE Proceedings Part M : Journal of Engineering for the Maritime Environment (Sage Ltd.) and membership in the editorial board of Ocean Engineering (Elsevier).

Abstract:

The analysis of the dynamic response of ships in intact and damage conditions requires a realistic idealization of environmental and operational conditions by multi-physics methods. This keynote will outline recent research on the development and implementation of fluid structure interaction models and procedures that can be used to idealise the influence of strongly coupled effects on wave loads and responses. The methods presented combine explicit discretization schemes that couple structural dynamics with hydrodynamic actions. It is demonstrated hydro - structural effects may be critical for those cases that stochasticity and/or hull flexibility influence the response. Whereas monolithic schemes are still relevant, two-way coupled partitioned methods are useful for the estimation of peak transient values of at early stages of the dynamic response.

17:15-18:00 Keynote Presentation 10 (Jan. 14, 10:15-11:00 Germany Time)

Advances on numerical and experimental investigation of ship roll damping

Prof. Moustafa Abdel-Maksoud, Head of the Institute of Fluid Dynamics and Ship Theory (FDS) of Hamburg University, Germany

Brief CV of Invited Speaker:

Prof. Moustafa Abdel-Maksoud is head of the Institute of Fluid Dynamics and Ship Theory (FDS) of Hamburg University. He was coordinator of the Maritime Systems Research Centre at TUHH from 2017 to 2021. Since 2016 he is Deputy Chairman of the Supervisory Board of Friendship System GmbH and Member of the Supervisory Board of the Potsdam Model Basin. He was awarded the silver commemorative medal of the German Society for Maritime Technology (STG) for the excellent contributions to the German shipbuilding community in 2019. After graduating as Ph.D. from the Institute of Ship and Ocean Technology at the Technical University of Berlin in 1992, he worked for the Potsdam Model Basin, where he was appointed as Head of

Department "Numerical Simulation" in 1995. In 2003 he became Professor of ship technology and director of the Institute of Ship Technology and Transport systems, Duisburg-Essen University. Since 2007, he leads the FDS institute at the Hamburg University of Technology. His research fields cover a variety of marine engineering topics, such as maritime transport systems, ship dynamics, ship manoeuvring, hydrodynamics of high-speed ships, propulsion systems, wave energy conversion. He has published more than 280 papers and he is a member of the editorial board of Journal of Ship Research, Ship technology Research and Journal of Engineering for the Maritime Environment.

Abstract:

The study focuses the recent developments towards an efficient and reliable method for roll damping estimation based on numerical simulations as well as model tests using the harmonic excited roll motion technique (HERM). A newly designed automatic roll damping estimation procedure shows the advantage of a just-in-time post processing of experimental measurement results. A method for real-time analysis of the measured roll damping values is introduced to avoid unnecessarily long testing times. This facilitates comprehensive investigations on different experimental setups with relatively low effort. Examples of studies on the influence of the different size of bilge keels or a variation of the Froude number are shown. Furthermore, results of HERM measurements at different scale factors will be presented and the application of different excitation schemes to the investigation of the memory effect will be discussed. The RANS-based simulations of rolling motion are very demanding in terms of computation. Therefore, a method is developed that significantly reduces the simulation time. This is mainly achieved by introducing artificial damping. The results confirm that the method can be successfully applied both numerically and experimentally. Furthermore, numerical simulations show the influence of the rudder on the results during the HERM tests at forward speed, which influences roll damping and cannot be neglected.

18:00-18:45 Keynote Presentation 11 (Jan. 14, 11:00-11:45 Germany Time)

Mesh or Meshless for CFD?

Prof. Xiangyu Hu, Adjunct Professor, Technical University of Munich, Germany

Brief CV of Invited Speaker:

Dr. Xiangyu Hu obtained his PhD degree from Beijing Institute of Technology in 1999. After the post-doctoral researches Beijing, Singapore, and Dresden. He joined Technical University of Munich as Scientific Assistant in 2006. He is now serving the Institute of Aerodynamics and Fluid Mechanics as Adjunct Teaching Professor. He is also serving the international SPHERIC steering committee from 2008. Dr. Hu have been engaged in researches on computational fluid dynamics (CFD). His main research fields are multi-resolution and multi-scale modeling of multiphase flow, smoothed particle hydrodynamics (SPH) method, high-order numerical schemes and others. He has authored or co-authored more than 100 papers in scientific journals and more than 150 presentations in international conferences. He has given more than 30 invited talks in research institutes and universities. Recently, has been listed among the 2% scientist in the world according to a study from Stanford University.

Abstract:

In this lecture, I discuss one important general problem in CFD community, i.e. mesh-base and meshless methods. Begin from the basic concept of discretization, I review the essential conditions for proper CFD discretization, and the concept of neighborhood, configuration and topology. From here, I revisit the reasons why a mesh is use in the traditional CFD methods. Based on these reasons, I argue that a properly designed meshless method is also able to satisfy the same conditions offered by a mesh. Furthermore, the defined topology which constrains the flexibility of mesh can also be released. At last, I outlook the potential of meshless method as a unified framework for modeling beyond CFD, i.e. multiphysics modeling.

18:45-19:30 Keynote Presentation 12 (Jan. 14, 10:45-11:30 London Time)

Making Waves; OpenFOAM and Offshore Hydrodynamic Simulation

Prof. Gavin Tabor, Professor of Computational Fluid Dynamics, University of Exetern, UK

Brief CV of Invited Speaker:

Prof. Tabor's research is on the computational simulation of fluid flows, using both physics-based methods (Computational Fluid Dynamics or CFD) and also Machine Learning (ML) approaches. He is a professor of Computational Fluid Dynamics, Department of Engineering, Faculty of Environment, Science and Economy, University of Exeter, UK. He has spent nearly 30 years working in CFD, both on fundamentals of the subject such as turbulence modelling, and also its application in a wide range of engineering and other disciplines, recently including offshore marine renewable energy, sustainable urban drainage, and biomechanics. He is a significant contributer to the OpenFOAM community, as Chair of the Joint Technical Committees for the OpenFOAM Governance project and member of the OpenFOAM Workshop international committee; he is also involved with the Isambard Tier 2 HPC project and the CCP-WSI+ collaboration on Wave-Structure Interaction. In addition to his work on CFD he is also involved in research on optimisation using Bayesian Machine Learning, and also on other applications of ML such as for fault detection and plasma simulation. He is the author of more than 80 journal papers across the full range of the work described here.

Abstract:

Since its release as an open source code in 2004, OpenFOAM has grown to be probably the most used CFD code in both academia and industry. One area in which it has had the most impact has been in free surface modelling, particularly using the Volume of Fluid methodology, and its application in areas such as offshore renewables, offshore structural engineering and marine engineering. In my keynote, I will discuss a number of projects I am involved in which are of significance for the OpenFOAM project. These include the Governance structure set up by OpenCFD to bring the OpenFOAM community together and link developers and code users; the CCP-WSI+ collaborative project on Wave-Structure Interaction; and the Isambard Tier-2 HPC machine; both these being UK-EPSRC funded initiatives with OpenFOAM at the core. I will also look to the future and talk about how CMH may develop with Machine Learning and Data Science- based tools becoming more developed as part of our simulation toolkit.

19:30-20:15 Keynote Presentation 13 (Jan. 14, 11:30-12:15 London Time)

A new approach for computing violent wave loading on offshore wind turbine foundations

Prof. Jun Zang, Chair Professor of Coastal and Ocean Engineering, University of Bath, UK

Brief CV of Invited Speaker:

Prof. Jun Zang is a Chair Professor of Coastal and Ocean Engineering, Deputy Head of the Department of Architecture and Civil Engineering, and a member of the Senate of the University of Bath, UK. She is also the Chair of PRIMaRE, a Partnership of world-class research institutions based in the UK for research in Marine Renewable Energy. She led/participated in several large national and international research projects that underpin the current development of open-source engineering tools, and open-source numerical models to help accelerate the development of marine renewable energy and improve the resilience and adaptation of coastal areas under extreme wave conditions. Apart from her other roles, she is also an Associate Editor of the International Journal on Offshore Mechanics and Arctic Engineering, Frontiers in Marine Science, and an editorial board member of several other journals. She chaired the prestigious 30th International Workshop on Water Waves and Floating Bodies (IWWWFB) in 2015, the China-UK Bilateral Workshop on Coastal Zone Disaster Early Warning and Mitigation under Extreme Weather in 2021, and a couple of other international conferences in recent years. She will chair the 10th PRIMaRE Conference in Bath on the 27th - 28th June 2023.

Abstract:

This presentation will give a brief overview of the recent studies on violent wave loading on offshore structures with a particular focus on monopiles, typical offshore wind turbine foundations. New findings from large-scale experiments performed at DHI, Denmark, and Kelvin Hydrodynamics Laboratory, UK, funded by the EU and EPSRC, will be discussed in this talk. The presentation will also discuss and compare the performance of several numerical methods on this

problem ranging from potential flow solver to particle method. Particular attention will be paid to the importance of high-order non-linear wave loading, and the newly proposed novel approach and engineering tool for computing these high-order non-linear wave loading components.

The 6th CMHL Symposium 2023 website:

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