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Conference Organization

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The Chinese Society of Theoretical and Applied Mechanics (CSTAM), China

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College of Civil Engineering and Architecture, Zhejiang University, China

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Welcome Message

Dear Colleagues and Friends,

We are delighted to extend our heartfelt welcome to you for the 16th International Conference on Computational Methods (ICCM2025), which is hosted by Zhejiang University (ZJU) in Hangzhou, China from September 27 to 30, 2025. The ICCM conference was founded by Professor Guirong Liu in 2004 and organized for the first time in Singapore. Since then, the conference has evolved into a series of global platform for discussions conducted in numerous nations worldwide.

The ICCMs are now widely recognized as an international venue for academic and industrial researchers to share knowledge, gain new perspectives, and push the limits of computational methodologies. The conference's subjects reflect multidisciplinary studies on contemporary approaches as well as the application of artificial intelligence in a variety of technological fields. Throughout the conference days, international specialists will present captivating keynote addresses, panel discussions, and technical sessions.

Authors at the conference have presented extremely meaningful discoveries covering both theoretical and practical aspects, highlighting emerging trends. All submissions have undergone a rigorous peer review process, and accepted papers will be presented orally during the event, while exceptional contributions will be considered for publication in a special issue of prestigious journals.

In addition to educational presentations, this conference provides an excellent opportunity for academic conversations, networking, and collaborations. The sharing of perspectives and ideas is essential for excellent future research and ground-breaking developments. We encourage you to engage with other participants, cultivate profound friendships, and create incredible possibilities for future collaborations.

We would like to express our sincere thanks to each member of the Organizing Committee, the International Scientific Committee, and all other supporters who have worked tirelessly to make this conference a reality. We would also like to express our deepest gratitude to the international reviewers for their diligent work in examining submitted manuscripts and abstracts.

Finally, we want to express our acknowledgment of your valuable contributions to the ICCM2025 conference. We are delighted with your participation in this event and eagerly looking forward to your continued involvement in and support to future ICCM conferences.

Professor Weiqiu Chen
Conference Chairman
Zhejiang University, China

Professor Guirong Liu
Honorary Conference Chairman
University of Cincinnati, USA

Conference Information

◆ Conference Venue

Venue: Grand Parkray Hangzhou

Address: 108 Shixin North Road, Xiaoshan District, Hangzhou

◆ Registration

The registration desk will be open at the lobby of Grand Parkray Hangzhou during:

September 27th 14:00–22:00

September 28th 07:30–18:00

September 29th 07:30–18:00

September 30th 07:30–12:00

◆ Catering

Date	Time	Place
September 27	18:00–20:30 (Dinner)	Feili Hall I 1F
September 28	12:10–13:30 (Lunch)	Feili Hall I 1F
	18:00–20:00 (Dinner)	Feili Hall I 1F
September 29	12:00–13:30 (Lunch)	Feili Hall I 1F
	18:00–20:00 (Dinner)	Feili Hall I 1F
September 30	12:00–13:30 (Lunch)	Feili Hall I 1F

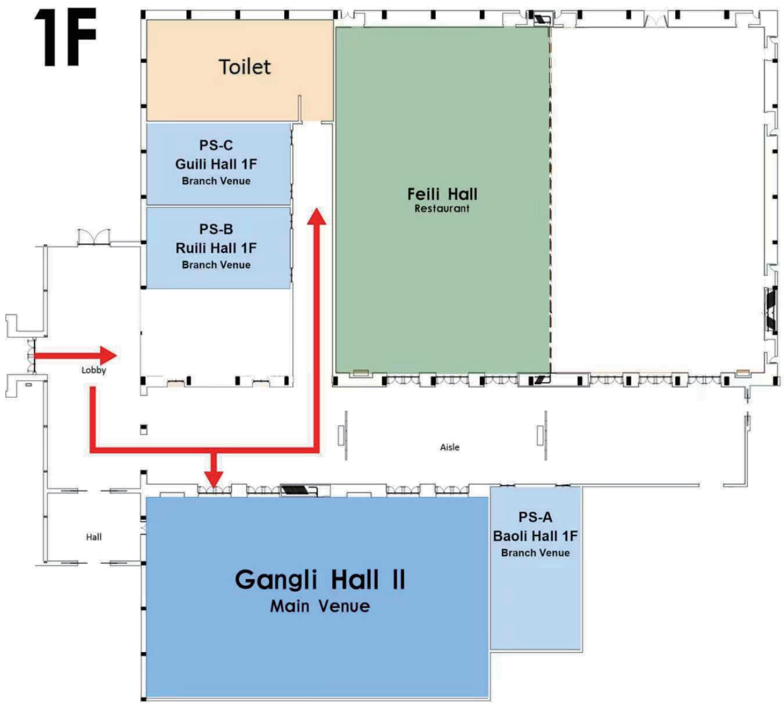
Please bring your meal voucher to the dining place.

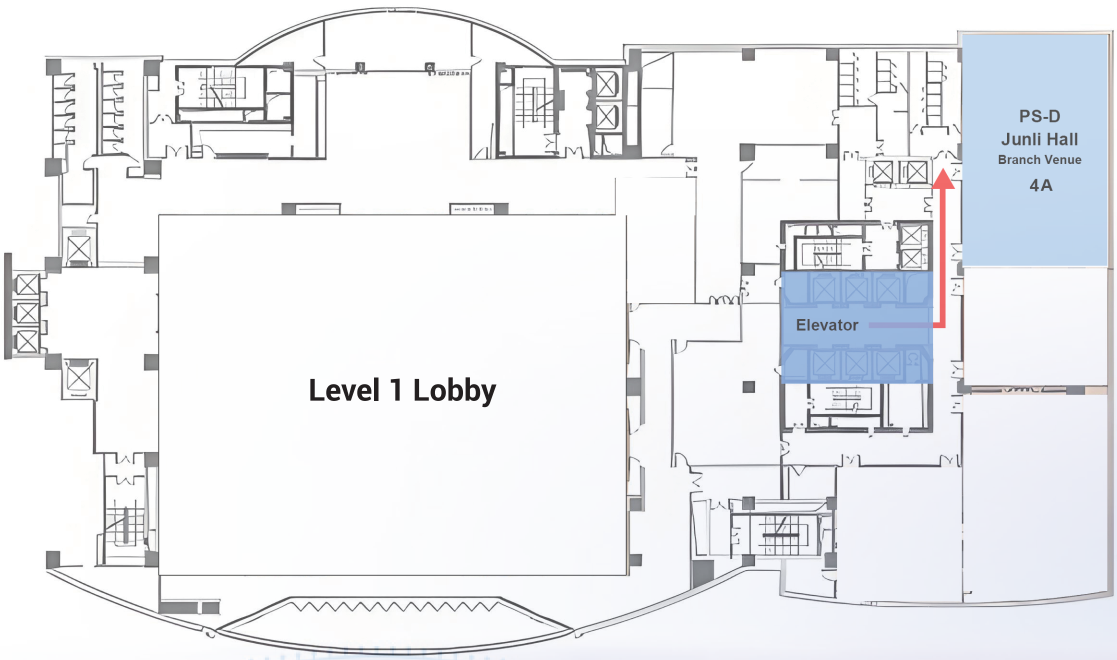
◆ Internet

WIFI：iparkray

Password：Room number

Floor Maps of Grand Parkray Hangzhou





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Program Overview

Date	Time	Hotel Lobby			
Day 0 9.27	14:00 - 22:00	Registration			
	18:00 - 20:00	Welcome Reception			
Day 1 9.28 Sunday	Room	Gangli Hall			
	08:00 - 08:30	Opening Speeches			
	08:30 - 09:50	Plenary Talk			
	09:50 - 10:10	Morning Tea			
	10:10 - 12:10	Plenary Talk			
	12:10 - 13:30	Lunch			
	Room	A: Baoli Hall	B: Ruili Hall	C: Guili Hall	D: Junli Hall
	13:30 - 14:00	SPL	SPL	SPL	SPL
	14:00 - 15:20	SPL & PS (A1−1)	PS (B1−1)	SPL & PS (C1−1)	PS (D1−1)
	15:20 - 15:40	Afternoon Tea			
	15:40 - 16:10	SPL	SPL	SPL	SPL
	16:10 - 18:00	PS (A1−2)	PS (B1−2)	PS (C1−2)	PS (D1−2)
	18:00 - 19:30	Dinner			
	19:00 - 20:30	Poster Q&A			
Day 2 9.29 Monday	Room	Gangli Hall			
	08:20 - 09:40	Plenary Talk			
	09:40 - 10:00	Morning Tea			
	10:00 - 12:00	Plenary Talk			
	12:00 - 13:30	Lunch			
	Room	A: Baoli Hall	B: Ruili Hall	C: Guili Hall	D: Junli Hall
	13:30 - 15:20	PS (A2−1)	PS (B2−1)	PS (C2−1)	PS (D2−1)
	15:20 - 15:40	Afternoon Tea			
	15:40 - 18:00	PS (A2−2)	PS (B2−2)	PS (C2−2)	PS (D2−2)
	18:00 - 20:30	Dinner			
Day 3 9.30 Tuesday	Room	A: Baoli Hall	B: Ruili Hall	C: Guili Hall	D: Junli Hall
	08:00 - 10:00	PL & PS (A3−1)	PS (B3−1)	PS (C3−1)	PS (D3−1)
	10:00 - 10:15	Morning Tea			
	10:15 - 12:00	PS (A3−2)	PS (B3−2)	PS (C3−2)	PS (D3−2)
	12:00 - 13:30	Conference Close & Lunch			

Note: Plenary Talk (PL); Semi−Plenary Talk (SPL); Parallel Session (PS)

Detailed Program

Plenary Talks

Day 1: September 28, 2025, Sunday, Gangli Hall

08:30–09:10 PL-01	Characterization, Simulation and Design of Cross-scale Mechanics Properties of Advanced Materials, **Yueguang Wei**
09:10–09:50 PL-02	Blue Economy CRC Aquaculture Projects: SeaFisher and SubSCI, **Chien Ming Wang**
	Chair: Chaofeng Lü
09:50–10:10	Morning Tea
10:10–10:50 PL-03	Computational Methods Based on Peridynamics and Nonlocal Operators, **Timon Rabczuk**
10:50–11:30 PL-04	Numerical Methods for System Design of Aerospace Vehicles, **Yao Zheng**
11:30–12:10 PL-05	Machine Learning Assisted Multiscale Modelling and Design of Flexoelectric Nanostructures, **Xiaoying Zhuang**
	Chair: Guozheng Kang

Day 2: September 29, 2025, Monday, Gangli Hall

08:20–09:00 PL-06	AI-assisted Engineering – Our understanding and Typical Applications, **Weihong Zhang**
09:00–09:40 PL-07	Modelling Nonlinear Damping in Large-Amplitude Bibrations of Structures, **Marco Amabili**
	Chair: Shaohua Chen
09:40–10:00	Morning Tea
10:00–10:40 PL-08	Conquering Generalization Challenges – A Problem-Independent Machine Learning (PIML) Approach for AI enhanced Computational Mechanics, **Xu Guo**
10:40–11:20 PL-09	Is Physics-informed Machine Learning the Next Powerful Modelling Tool for Engineering and Science? **Yuantong Gu**
11:20–12:00 PL-10	On Mixed Mode Crack Propagation Analyses Using Fragile Points Method (FPM), **Okada Hiroshi**
	Chair: Jizeng Wang

Day 3: September 30, 2025, Tuesday, Baoli Hall

08:20–09:00 PL-11	A Boundary-Based Machine Learning Approach for Elastic and Piezoelectric Crack Analysis, **Chuanzeng Zhang**
	Chair: Yuantong Gu

Day 1: September 28, 2025, Sunday

Parallel Session A: Baoli Hall

Session A1–1: Theory and Formulation for Novel Computational Methods

13:30–14:00 SPL-01	Interval Field Model and Interval Finite Element Methods, **Chao Jiang**
14:00–14:30 SPL-02	Vibration of Strain Gradient Nano Structures Via a Mesh–free Moving Kriging Interpolation Method, **Lifeng Wang**
	Chair: Francesco Pellicano
14:30–14:45 MS-01.09	*Invited:* Time–Frequency Signal Analysis Based on the Gauge Theory, **Zhihai Xiang**
14:45–15:05 MS-01.05	*Invited:* On Some Novel Analytic Methods in Mechanics of Plates and Shells and Their Applications, **Rui Li**
15:05–15:20 MS-00.08	Development, Verification and Validation of a Dedicated FEM Code for Simulating Masonry Structures, **Maddegedara Lalith**
	Chairs: Zhihai Xiang, Rui Li

Session A1–2: Theory and Formulation for Novel Computational Methods

15:40–16:10 SPL-03	Ghost Hammering Phenomena in Stochastically Driven Shells, **Francesco Pellicano**
	Chair: Lifeng Wang
16:10–16:30 MS-01.01	A Novel Temporal Finite Element Method to Solve Static Viscoelastic Problems, **Fengling Chen**
16:30–16:45 MS-01.04	A Computational Homogenization Method for Thin Composite Beams/Shells, **Qun Huang**
16:45–17:00 MS-01.08	Analytical and Numerical Studies on Mode Selection in Proper Generalized Decomposition Methods, **Kang Wang**
17:00–17:15 MS-00.05	GraphBRep: Explicit Graph Diffusion of BRep Topology for Efficient CAD Generation, **Weilin Lai**
17:15–17:30 MS-01.03	A Fusion Topology Optimization Strategy of CutFEM and MMC for Improving Computational Efficiency and Geometric Accuracy, **Zhiqiang Guan**
17:30–17:45 MS-01.06	Suppressing Grayscale for Multiphysics Topology Optimization of Multiphase Smart Materials and Structures via a dual projection, **Cheng Liu**
17:45–18:00 MS-00.13	Comprehensive Performance Assessment of Isolation Piles on Existing Tunnel–Deep Foundation Pit System Under Construction Disturbance Based on Adaptive Genetic Algorithm, **Yiqing Zhu**
	Chairs: Zhihai Xiang, Maddegedara Lalith

Day 1: September 28, 2025, Sunday

Parallel Session B: Ruili Hall

Session B1–1: Machine–learning based Computational Mechanics

13:30–14:00 SPL-04	A Novel Approach for Deriving A State–Dependent Soil Constitutive Model Using Stress Probing, **Zhongxuan Yang**
	Chair: Qing Li
14:00–14:20 MS-23.02	*Invited:* Several Novel Physics–Informed Neural Networks for Solving Varied PDEs, **Zhuojia Fu**
14:20–14:35 MS-23.03	A Profile Structure Model Based on Model Driven and Data–Driven Coupling Approach, **Yangchuan Hui**
14:35–14:50 MS-23.02	Acceleration of Stiffness Matrix Numerical Integration Using a Finite Element Inspired Neural Network, **Haderbache Amir**
14:50–15:05 MS-23.05	Rapid Prediction of Textile Forming Deformation via a Graph–Based Learning Approach, **Junjie Rong**
15:05–15:20 MS-14.06	Hybrid deep Learning and Iterative Methods for Accelerated Solutions of Viscous Incompressible Flow, **Heming Bai**/Xin Bian
	Chairs: Shan Tang, Lihua Wang

Session B1–2: Machine–learning based Computational Mechanics

15:40–16:10 SPL-05	Computational Design of Multifunctional Lattice Structures, **Qing Li**
	Chair: Zhongxuan Yang
16:10–16:30 MS-23.06	*Invited:* Large Language Model–inspired Mechanics Design for Engineering Materials and Structures, **Shan Tang**
16:30–16:50 MS-23.07	*Invited:* Improved Artificial Neural Network Algorithms And Its Engineering Applications, **Lihua Wang**
16:50–17:05 MS-23.08	FEM–PIKFNN for Structural Vibration Induced Underwater Acoustic Propagation, **Qiang Xi**
17:05– 17:20 MS-18.02	A Novel Mesh–Based Data–Driven Approach for Optimization of Tidal Turbine Blades, **Longyan Wang**
17:20–17:35 MS-23.04	A Large Language Model–inspired Data–driven Mechanics Framework for Viscoelastic Soft Structures, **Yicheng Lu**
17:35–17:50 MS-18.01	Physics–Informed Neural Networks for Modeling Moving Boundaries and Capturing Fine–Scale Flow Structures, **Yongzheng Zhu**//Xin Bian
17:50–18:05 MS-23.09	Novel Actuator Lines Method Accounting for Structural Geometries, **Yisheng Yao/ Decheng Wan**
	Chairs: Zhuojia Fu, Qiang Xi

Day 1: September 28, 2025, Sunday

Parallel Session C: Guili Hall

Session C1–1: Computational Particle Dynamics

13:30–14:00 SPL-06	Conservative Sharp Interface Methods for Interfacial Flows: Development and Simulations, **Hang Ding**
14:00–14:30 SPL-07	Numerical Study of Droplet Impact on a Deep Pool by CLSVOF Method, **Decheng Wan**
	Chair: Guiyong Zhang

14:30–14:50 MS-17.04	*Invited:* Multiphase Continuous–Discrete Modelling of Geo–Hazards with Particle Method, **Chong Peng**
14:50–15:10 MS-02.07	*Invited:* Study on the SPH Method for Macro–Meso Mechanical Behavior of Porous Media by Considering Fluid–Solid Interaction, **Lisha He**
15:10–15:30 MS-02.02	*Invited:* Numerical Modeling of Bacterial Multi–physical Processes with SPH, LBM and Finite Element Methods, **Dianlei Feng**
	Chairs: Dianlei Feng, Chong Peng

Session C1–2: Fluid Structure Interaction and Application in Engineering

15:40–16:10 SPL-08	Wavelet Methods for Solving Hyperbolic Conservation Laws, **Jizeng Wang**
	Chair: Hang Ding

16:10–16:30 MS-15.02	*Invited:* Evolution of Large–Scale Vortices and Its Influence on Flow and Flexible Vegetation Dynamics of A Finite–Length Canopy in A 2–D Laminar Flow, **Chuning Ji**
16:30–16:50 MS-15.05	*Invited:* Research Progress of Fluid–Solid Interaction about Hydroelectric Unit, **Wenquan Wang**
16:50–17:10 MS-15.01	*Invited:* Development of High Reynolds Number Immersed Boundary Methods, **Shang–Gui Cai**
17:10–17:30 MS-15.03	*Invited:* Investigation on Wake Hydrodynamics under Multi–Operating Conditions of A Marine Propeller Based on Immersed Boundary Method, **Kan Kan**
17:30–17:45 MS-15.04	Coupled Peridynamic and Lattice Boltzmann–Immersed Boundary Method for Fluid Solid Interaction, **Weizhong Li**
17:45–18:00 MS-15.06	Analysis of Vibration Characteristics of a Pelton Turbine Based on Two–Way FSI, **Xiu Wang**
	Chairs: Wenquan Wang, Shang–Gui Cai, Chuning Ji

Day 1: September 28, 2025, Sunday

Parallel Session D: Junli Hall

Session D1–1: Computational Biomechanics

13:30–14:00 SPL-09	Phase Field Modelling of Spinodal Decomposition and Nucleation in Ferritic Alloys, **Raj Das** **Chair: Wenhua Zhao**
14:00–14:20 MS-12.04	*Invited:* Wall Shear Stress Oscillation in Microvascular Network Arising from Red Blood Cell Motions, **Ken–ichi Tsubota**
14:20–14:35 MS-12.10	Cellular Blood flow Modeling with Smoothed Dissipative Particle Dynamics, **Ting Ye**
14:35–14:50 MS-12.07	Numerical Simulation and Lift Force Analysis for Cross–streamline Migration of Slip Particles in Viscoelastic Microchannel Flow, **Shuhao Ma**
14:50–15:05 MS-12.09	Auxiliary Quantitative Methods For The Selection of Preoperative Surgical Plans for Aortopulmonary Septal Defect, **Qingyu Wang**
15:05–15:20 MS-12.01	Multi–patient Study for the Correlation Between Carotid Artery Vascular Elasticity and Clinical Biomarkers, **Jian Cai** **Chairs: Xiaobo Gong, Ken–ichi Tsubota**

Session D1–2: Computational Biomechanics

15:40–16:10 SPL-10	Uncovering the Mystery of Floating Wind Turbine Modelling, **Wenhua Zhao** **Chair: Raj Das**
16:10–16:30 MS-12.08	Numerical Investigation of Fixation Plate Mechanics in Mandibular Reconstructive Surgery, **Boyang Wan**
16:30–16:45 MS-12.02	Age–Related Changes in Dermal Elastin Fiber Architecture and Their Impact on Skin Firmness: A Finite Element Analysis, **Fei Jiang**
16:45–17:00 MS-12.05	Lateral Migration Patterns of Deformable WBC and CTC in Microchannels: Effects of Geometry and Hematocrit, **Yonggang Li**
17:00– 17:15 MS-12.03	An Efficient Multiscale Computational Framework for Glycocalyx–Modulated Microvascular Blood Flow, **Xinhao Jin**
17:15–17:30 MS-12.06	Motion of Capsules in Curved Tube, **Deyun Liu/Xiaobo Gong**
17:30–17:45 MS-00.10	Mechanics of Multiphase Media Under Hypergravity, **Hongrui Yang**
17:45–18:00 MS-06.01	XFEM based on VCCT for Composite Delamination, **Yong Jiang** **Chairs: Ken–ichi Tsubota, Xiaobo Gong**

Day 2: September 29, 2025, Monday

Parallel Session A: Baoli Hall

Session A2-1: Smoothed Finite Element Methods and Related Techniques
Chairs: Yuki Onishi, Shuhao Huo

13:30-13:50 MS-05.05	*Invited:* Pressure Checkerboarding Suppression in the Next-Gen Smoothed Finite Element Method: EC-SSE-SRI-T4, **Yuki Onishi**
13:50-14:05 MS-05.04	A Novel Implementation of Efficient Inertia Relief Analysis Using Smoothed Finite Element Method for Unconstrained Structures, **Shuhao Huo**
14:05-14:20 MS-05.02	Cut-Cell Cartesian Meshes for Incompressible Laminar and Turbulent Flows based on n-sided Cell-based Smoothed FEM, **Chen Hong**
14:20-14:35 MS-05.03	Development of the Coupled Smoothing Technique λS-FEM for Mechanical Analysis of Twist Drills, **Qianqian Hua/Qiuxia Fan**
14:35-14:50 MS-05.01	Optimization Design of Out-of-Plane Stability Bracing System for Double-Arch Structures Based on the Matrix Stiffness Method, **Yilei Ge**
14:50-15:05 MS-05.06	Polyhedral and Polygonal Smoothed Finite Element Method for Engineering Analysis, **Shijie Zhao**
15:05-15:20 MS-00.07	Diffusion-induced Stress Analysis of Lithium-ion Battery Layered Electrode Based on the Boundary Element Method, **Jingwen Liu**

Session A2-2: AI and Advanced Computational Methods for Soft and/or Smart Materials and Structure
Chairs: Yanzheng Wang, Aihong Zou

15:40-16:00 MS-04.05	*Invited:* A Refined Higher-order Finite Dtrip Formulation Based on Carrera Unified Formulation for the Free Vibration Analysis of Axially Moving Laminated Composite Plates, **Yanzheng Wang**

16:00–16:20 MS-00.14	*Invited:* Influence of Back Pressure on the Flow Characteristics of Hydrogen Supersonic Two-Phase Expander, **Aihong Zou**
16:20–16:35 MS-04.07	Unusual Stretching–Twisting of Liquid Crystal Elastomer Bilayers, **Ya Wen**
16:35–16:50 MS-04.04	A Generative Model Approach for Topological Design of Nonlinear Mechanical Metamaterials, **Huiyu Wang**
16:50– 17:05 MS-04.06	Deep-Learning Based Prediction of Chemo-Mechanics and Damage in Battery Active Materials, **Zehou Wang**
17:05–17:20 MS-04.02	A Lightweight Mesh-Free Network for Strain Field Prediction under Small Geometric Perturbations, **Minxue Liu**
17:20–17:35 MS-04.03	Machine Learning Surrogate Models of Many-Body Dispersion Interactions in Soft Polymer Systems, **Zhaoxiang Shen**
17:35–17:50 MS-04.01	A Graph-Based Spatio-Temporal Operator Learning Method for Structural Dynamics, **Xinkai Du**
17:55–18:05 MS-04.08	A Gaussian Kernel Deep Operator Network for Efficient Full-Field Prediction of Dynamic Responses on Variable 3D Geometries, **Chi Zhang**

Day 2: September 29, 2025, Monday

Parallel Session B: Ruili Hall

Session B2–1: Optimization Design, Manufacturing and Reliability of Materials and Structures
Chairs: Shujuan Hou, Wenyang Liu

13:30–13:50 MS-22.03	Plant–inspired Crashworthiness Design for Composite Materials, **Shujuan Hou**
13:50–14:05 MS-22.04	Programming Nonlinear Thermo–Mechanical Intelligence via Topology Optimization, **Weichen Li**
14:05–14:20 MS-22.11	Data–driven Thermo–mechanical Interfaces: Thermal Mismatch Induced Interface Debonding, **Lizhenhui Zhou**
14:20–14:35 MS-22.07	An Efficient Approach to Shape Optimization of Structures with Viscous Dampers for Strain Energy Minimization, **Zhiqiang Wu**
14:35–14:50 MS-00.15	Concurrent Topology–Path Optimization and Vacuum–Assisted Reprocessing for Continuous–Fiber 3D–Printed CFRP, **Yanan Xu**
14:50–15:05 MS-22.06	Design Soft Pneumatic Actuator via Explicit Topology Optimization, **Xueyan Hu**
15:05–15:20 MS-22.05	Information Geometry Perspective on Constitutive Models and Its Inspired Dual–Space Model Optimization, **Wenyang Liu**

Session B2–2: Optimization Design, Manufacturing and Reliability of Materials and Structures
Chairs: Wenbin Fei, Jie Hou

15:40–16:00 MS-22.02	***Invited:*** Multi–scale Collaborative Optimization Design Method for Multi–Layer Thermal Protection Structures, **Jie Hou**

16:00–16:20 MS-21.01	*Invited:* Numerical Simulation and Theoretical Prediction of Ultimate Tensile Capacity for Screw Piles, **Wenbin Fei**
16:20–16:40 MS-11.01	*Invited:* On–Chip Surface Acoustic Wave Metasurfaces, **Yabin Jin**
16:40–16:55 MS-22.10	High–Fidelity Process Modeling of Alumina Melt Pool Dynamics in Laser Powder Bed Fusion, **Zhilang Zhang**
16:55– 17:10 MS-22.01	Self–consistent Clustering Analysis–Based Dual–scale Ablation Mechanism and Performance Prediction of Silica Fiber–Reinforced Phenolic Resin Composites (SiFPRCs), **Shuo Cao**
17:10–17:25 MS-09.01	Computational Analysis of Contact Wear with Pressure–Dependent Friction Coefficients, **Yan Li**
17:25–17:40 MS-22.08	Robust Topology Optimization of FRP Composite Structures under Uncertain Dynamic Excitations, **Furong Xie**
17:40–17:55 MS-00.09	Semi–Analytical Evaluation for Nearly Singular Integrals in Isogeometric Thermoelasticity BoundaryElement Method, **Feiyang Wang**

Day 2: September 29, 2025, Monday

Parallel Session C: Guili Hall

Session C2–1: Computational Nanomechanics
Chairs: Shuze Zhu, Xin Yan

13:30–13:50 MS-13.04	*Invited:* Phase–Field Modeling of Flexoelectricity and Dislocation Effects in Ferroelectrics, **Lihua Shao**
13:50–14:10 MS-16.07	*Invited:* A Super–Coarse–Grained Simulation Method for Cellulose Nanofiber Networks, **Shuze Zhu**
14:10–14:25 MS-16.05	Computational Simulations of Interfacial Heat Transfer and Crystallization in 3D–Printed Continuous Fiber–Reinforced Thermoplastic Composites, **Xin Yan**
14:25–14:40 MS-16.04	Sliding Behaviour of Carbon Nanothread within a Bundle Embedded in Polymer Matrix, **Chengkai Li**
14:40–14:55 MS-20.01	Analysis of the Effect of an Electric Field on the Vibrational Properties of Hexagonal Boron Nitride and Boron Nitride Nanotubes, **Hongqiang Pang**
14:55–15:10 MS-16.06	Theoretical Prediction of stress–tunable Optoelectronic and Thermal Properties of GaSeI: A Novel 1D Helical van der Waals Crystals, **Jian Zhang**
15:10–15:25 MS-16.01	Re–understanding and Application of Quasi–Coarse–Grained Dynamics, **Dongdong Jiang**

Session C2–2: The Numerical Methods for Nonlocal Problems and its Application
Chairs: Yufeng Nie, Xu Xu

15:40–16:00 MS-13.03	*Invited:* Re–derivation and Mathematical Analysis for Linear Peridynamics Model for Arbitrary Poisson Ratio's Material, **Yufeng Nie**

16:00–16:20 MS-13.02	***Invited:*** Manifold Adaptive Method for Thermo–Mechanical Coupled Fatigue Phase–Field Model, **Yu'e Ma**
16:20–16:40 MS-20.03	***Invited:*** Hybrid Depth Physics–Informed Neural Network for Solving Partial Differential Equation, **Xu Xu**
16:40–16:55 MS-20.04	Vibrational Analysis of Sp3 Carbon Nanostructures Via Atomistic Simulations and Continuum Mechanics Models, **Zhuoqun Zheng**
16:55– 17:10 MS-20.02	Advanced Hygrothermal Flexural Analysis of Functionally Graded Plates Using Generalized Differential Quadrature and Higher–Order Haar Wavelet Methods, **Mahaveer Sree Jayan**
17:10–17:25 MS-13.01	Efficient Spectral Methods for Volume–Constrained Nonlocal Models, **Jiashu Lu**
17:25–17:40 MS-13.05	Computable Peridynamics: Enhancing Asymptotic Compatibility and Suppressing Zero–Energy Modes, **Hao Tian**
17:40–17:55 MS-00.06	The State–Space FEM: Formulation and Analysis for Laminated Composite Plates Subjected to Body Forces, **Haifei Liao**

Day 2: September 29, 2025, Monday

Parallel Session D: Junli Hall

Session D2-1: Computational Particle Dynamics
Chairs: Dianlei Feng, Yonggang Zheng

13:30-13:50 MS-02.06	*Invited:* Adaptive Phase-field Material Point Framework for Large-Deformation Fracture Modelling and Structural Optimization, **Yonggang Zheng**
13:50-14:10 MS-03.04	S-PINN: Stabilized Physics-Informed Neural Networks for Alleviating Barriers Between Multi-Level Co-Optimization, **Tengmao Yang**
14:10-14:25 MS-03.03	Lagrangian-Eulerian Stabilized Collocation Method and Its Applications in Fluid-Structure Interaction Problems, **Zhihao Qian**
14:25-14:40 MS-03.06	Rayleigh Bénard Convection Under the Coupled Effects of A Side-Heated Wall and Bottom Charge Injection, **Jiachen Zhao**
14:40-14:55 MS-03.01	An Enhanced Numerical Wave Tank Based on DualSPHysics+,**Guozhen Cai**
14:55-15:10 MS-03.05	Numerical Study on Debris Flow-Turbidity Currents Transformation Process of Submarine Landslides, **Can Yi**
15:10-15:25 MS-03.02	A GPU-Accelerated SPH Framework for Patient-Specific Simulations of Vascular Fluid-Structure Interactions, **Yao Lu**

Session D2-2: Advanced Particle Methods in Geophysics and Geotechnical Engineering: DEM, SPH, MPM and Beyond
Chairs: Jian Chen, Mikito Furuichi

15:40-16:00 MS-17.03	*Invited:* Granular Simulation of Earthquakes in Geological-Scale Structural Evolution, **Mikito Furuichi**

16:00–16:20 MS-17.05	*Invited:* A Coarse–Grained Model for Gas Transport in Swelling Porous Media, **Luming Shen**
16:20–16:40 MS-17.09	*Invited:* Three–dimensional Micromechanical Expression for the Average Strain Tensor of Granular Materials, **Chaofa Zhao**
16:40–17:00 MS-17.06	*Invited:* Pullout of a Plate Anchor from A Granular Medium Beyond Material Failure, **Shun Nomura**
17:00– 17:15 MS-17.01	Numerical Sandbox Experiments with DEM: Frictional and Structural Controls on Prism Deformation, **Jian Chen**
17:15–17:30 MS-17.02	Micromechanical Simulation of Liquefaction using 2D Solid–DEM and Liquid–FEM Coupling with Body–fitted Mesh, **Gamaliel Jeevan Dewanto**
17:30–17:45 MS-17.07	Unveiling Heat Transfer Pathways in Unsaturated Granular Materials via Network Modeling, **Tairu Chen/Wenbin Fei**
17:45–18:00 MS-17.08	A Coupled 3D MPS–NOSB–PD Model for Fluid–Structure Interaction with Large Deformation, **Fengze Xie/Decheng Wan**

Day 3: September 30, 2025, Tuesday

Parallel Session A: Baoli Hall

Session A3–1: Numerical Modelling Methods and Their Applications Empowered by Physics–informed Artificial Intelligence
Chairs: Xinqun Zhu, Ying Zhou

08:40–09:00 MS-14.05	*Invited:* Structural Parameter Identification with Neural Ordinary Differential Equations, **Xinqun Zhu**
09:00–09:15 MS-14.01	Enhanced Identification of the Parameters of a Jeffcott Rotor from Run–up Transients using Physics–informed Neural Networks with Sinusoidal Activations, **Gabriel Cabaj**
09:15–09:30 MS-14.04	A Machine Learning–Driven Decoupling Framework for Efficient Prediction of Cohesive Zone Model Parameters in Polymer Composites, **Li Zheng**
09:30–09:45 MS-14.02	LP–PINN: A Locally Connected Physics–Informed Neural Networks Based on Local Boundary Knot Method, **Le Liu**
09:45–10:00 MS-14.03	Wind Turbine Wake Prediction by Deep Convolutional Neural Networks with Spatial–Coordinate Embedding, Maokun Ye/**Decheng Wan**

Session A3–2: High–Performance Methods in Mechanics Computation
Chairs: Jiaqing Jiang, Gabriel Cabaj

10:15–10:35 MS-08.02	*Invited:* Accurate Analysis of General Composite Structures Using Mixed Finite Element and DQM, **Jiaqing Jiang**
10:35–10:50 MS-17.05	An Efficient Isogeometric Collocation Method for Superconvergent Analysis of Sixth–Order Elastic Gradient Kirchhoff Plates, **Ao Shen**
10:50–11:05 MS-17.09	A Novel Unsymmetric Quadrilateral Plate Element Based on Reissner–Mindlin Theory Using Radial–Polynomial Interpolation, **Yanliang Ju**
11:05–11:20 MS-17.06	Exact Second–Order Dynamic Stiffness Matrix for Torsion and Warping of Axially Loaded Members, **Xiao Du**
11:20–11:35 MS-17.01	Nonlinear Analysis of Steel Frames with Semi–Rigid Joints under Thermal Loading, **Joe Petrolito**
11:35–11:50 MS-17.02	Study on the Response of elastic Wheel to Excitation, **Yu Cao**
11:50–12:05	

Day 3: September 30, 2025, Tuesday

Parallel Session B: Ruili Hall

Session B3−1: Uncertainty Qualification, Machine Learning and Optimization
Chairs: Hanshu Chen, Jian Zhang

08:00−08:20 MS-24.01	*Invited:* Unified Theory and Method for Computational Stochastic Mechanics, **Guohai Chen**
08:20−08:40 MS-24.02	*Invited:* DPIM−based Neural Network Model for Stochastic Acoustic−vibration Response of Underwater Structure, **Hanshu Chen**
08:40−08:55 MS-24.06	High−dimensional Reliability Analysis using Combined Dimensionality Reduction and Adaptive Sparse Polynomial Chaos Expansion, **Jian Zhang**
08:55−09:10 MS-24.04	Rare Event Probability and Global Reliability Sensitivity Analysis for Engineering Structures Based on Direct Probability Integral Method, **Hui Li**
09:10−09:25 MS-24.07	Research on Adaptive Loss Physics−Informed Neural Network Algorithm Based on KAN Network for Heat Conduction Equation, **Tao Zhang**
09:25−09:40 MS-24.03	Structural Design and Intelligent Optimization of a Combined Seismic Metamaterial, **Yu Ding**
09:40−09:55 MS-24.05	Multiscale Constitutive Modeling of Cohesive Granular Materials, **Zeyong Liu**
09:55−10:05 MS-00.11	Long−term Adhesion Durability Revealed through a Rheological Paradigm, **Rui Wu**

Session B3-2: Metamaterials and Metastructures
Chairs: Weichen Li, Longyan Wang

10:15–10:30 MS-11.02	Analytical Realization of Complex Thermal Meta-Devices for Omnidirectional Heat Manipulation, **Weichen Li**
10:30–10:45 MS-11.06	Experimental Study on Shpb Impact Deformation of Metastable V10cr10co30fe50-Xnix High Entropy Alloy in Wide Temperature Range, **Zehui Wang**
10:45–11:00 MS-11.03	Optimization Design and Dynamic Control of Anisotropic Intelligent Elastic Wave Metasurface Exciter, **Zhenyu Lin**
11:00–11:15 MS-11.05	Multiplexing Same-Order Acoustic Spiral Waves by Generalized Impedance metasurfaces, **Yu-Ze Tian**
11:15–11:30 MS-11.04	Shear Localization in Gradient High-entropy Alloy at High Strain Rates: Crystal Plasticity Modeling, **Chuanzhi Liu**

Day 3: September 30, 2025, Tuesday

Parallel Session C: Guili Hall

Session C3–1: High Performance Computing and Related Topics
Chairs: Lijun Liu, Zhuoqun Zheng

08:00–08:15 MS-07.07	Scalable molecular dynamics with deep potential long–range framework, **Liju Liu**
08:15–08:30 MS-07.05	Machine Learning Techniques in the Three–omega Method to Predict Thermophysical Properties with Low Variation, **Yasuaki Ikeda**
08:30–08:45 MS-07.02	First–principles Study of Thermal Conductivity in Ti2CT2 and Ti3C2T2 MXenes: Roles of Surface Terminations and Structural Features, **Yuki Nagao**
08:45–09:00 MS-07.04	Simulations, Design and Experimental Validation of a High–Speed Electrically Powered Rocket Oxidizer Pump, **Ondřej Pavlík**
09:00–09:15 MS-07.03	Verification of PDS–FEM for Simulation of 3D Dynamic Fault Rupture Using Consistent Fault Stress Induced by Far–field Loading, **Elia Nicolin**
09:15–09:30 MS-10.01	Crack Velocity, Oscillations, and Acoustic Emission in Rock Fracture: Insights from Numerical and Analytical Models, **Xu Li**
09:30–09:45 MS-16.02	Bending Behavior of Diamane and Twisted Bilayer Graphene: Insights from Four–point Bending Deformation, **Shangchun Jiang**
09:45–10:00 MS-16.03	Molecular Dynamics Investigation of Hydrogen Diffusion in Polycrystalline α–Iron Under Multiaxial Stress States, **Changyou Li**

Session C3–2: Particle Based Methods
Chairs: Ning Guo, Ping Wang

10:15–10:35 MS-21.02	*Invited:* GPU–Accelerated MPM–LSDEM Approach for Particle–Continuum Interaction, **Ning Guo**
10:35–10:50 MS-02.03	Threshold of Sediment Particle in Turbulent Flow, **Ping Wang**
10:50–11:05 MS-02.04	Numerical Analysis of Lunar 3D Printed Concrete Construction Based on Discrete Particulate Liquid Bridge Theory, **Yu–Ching Wu**
11:05–11:20 MS-02.05	An Efficient Collocation–Type Meshfree Method for Nonlinear Problems, **Zhiyuan Xue**
11:20–11:35 MS-02.01	PH Simulation of the Rock Cutting Process by A Conical Pick, **Xiangwei Dong**
11:35–11:50 MS-00.12	Multi–Physics Coupled Solid–Liquid Phase Transition Under Hypergravity, **Yinnan Zhang**

Day 3: September 30, 2025, Tuesday

Parallel Session D: Junli Hall

ession D3–1: Multiscale Modelling of FRP Reinforced Structures
Chairs: Zihua Zhang, Yi Tao

08:00–08:20 MS-19.02	*Invited:* Research on the Prediction Model of Axial Compression Bearing Capacity of FRP, Steel Pipe and Concrete Composite Column Based on Stacking Ensemble Learning, **Yi Tao**
08:20–08:35 MS-19.03	*Invited:* Macroscale and mesoscale modelling of interfacial debonding between FRP and concrete, **Zihua Zhang**
08:35–08:50 MS-19.01	Simulation of Bond Failure Between FRP Bar and Concrete Based on A Full Mesoscale Model, **Shuwei Li**
08:50–09:05 MS-00.04	Seismic Resilience Assessment Method of A Multi–Story Underground Structure, **Xiyue Du**
09:05–09:20 MS-00.02	Mechanism of Isolation Piles on Displacement Control of Adjacent Tunnels under Foundation Pit Unloading and Surcharge Loading Conditions, **Hongyi Chen**
09:20–09:35 MS-00.03	Seismic Performance of Central Columns for A Multi–Story Subway Station Under Vertical Earthquake Excitations, **Wei Chen**
09:35–09:50 MS-01.02	Multi–Objective Optimization Method for Metro Wheel Reprofiling, **Yuzhi Cheng**
09:50–10:05 MS-01.10	Efficient Numerical Simulation and Design Method for Bidirectional Steel–Concrete Composite Floors, **Mingyue Zhou**

Session D3–2: Advanced Computation in Nuclear Energy Systems
Chairs: Quanyao Ren, Junwei Kang, Shuyong Duan

10:15–10:35 MS-25.03	*Invited:* Numerical Method for Irradiation Deformation of Rod–Bundle Fuel Assemblies Based on Beam Model, **Quanyao Ren**
10:35–10:50 MS-25.05	Optimized Bubble Suppression in Piezoelectric Jet Dispensing for Microelectronic Packaging, **Yunshu Zhang**
10:50–11:05 MS-25.02	Generalization Analysis of Direct Weights Inversion Method for Small datasets, **Yijun Lu**
11:05–11:20 MS-25.04	Coupled Autoencoder for Joint Dimensionality Reduction and Inversion, **Zhijun Shen**
11:20–11:35 MS-25.01	Mechanical Property Evaluation of Nuclear Fuel Assembly Spacer Grids under Extreme Service Conditions, **Junwei Kang**

Poster Presentations

Poster List

Presenting Time: September 28th and September 29th
Q&A Session: September 28th 19:00–20:30

ID	Title	Presenter
PS–01	A High–Order Accurate Wavelet Method for Two–Dimensional Turbulence	**Peize Wan**
PS–02	Wavelet Solution for Moving Point Heat Source Problems	**Jian Tao**
PS–03	Study on Seismic Resilience Assessment Method of a Multi–Story Underground Structure	**Xiyue Du**
PS–04	Acetone Adsorption Behavior on Two–Dimensional ZnO Regulated by Doping Engineering: A DFT Study	**Hongping Zhang**
PS–05	From Molecule to Membrane: Integrating Molecular Dynamics and in vitro Experiments for Tyrosinase Inhibition Mechanism Discovery	**Changji Yin**
PS–06	The Optimized Runge–Kutta–Chebyshev Method for Semi–Discretizations of Hyperbolic Conservation Equations	**Zihao Duan**
PS–07	Surface Strengthening of Laser Additive Manufactured AlSi10Mg Alloy: A Multiscale Numerical Simulation Study Based on SPH–FEM Coupling	**Yingpeng Hou**
PS–08	SPH Simulation of Dual Roller Cutters Penetrating into Coal Seam with Hard Nodules	**Zhihao Guo**
PS–09	Application of the Lattice Boltzmann Flux Solver in Large–Scale Hydrodynamic Numerical Problems	**Yunpeng Lu**
PS–10	Effect of Particle Shape on Cohesion and Friction Angle in Clay Studied by DEM Biaxial Shear Simulations	**Zhipeng Yu**
PS–11	Impact of Physical Constraints on Spatio–Temporal Neural Networks for Predicting Cylinder Water Entry Flow Fields	**Chongbin Shi**
PS–12	A Multiscale Continuum Model for the Mechanics of Cross–Linked Elastomer Composites Reinforced with Nanofibers.	**Jianzheng Cui**
PS–13	An Efficient Approach to Shape Optimization of Structures with Viscous Dampers for Strain Energy Minimization	**Zhiqiang Wu**
PS–14	Layout Design of Complex Multi–Connected Fluid Channel System with Multi–Material Topology Optimization Method	**Qijin Zeng**
PS–15	Feature–Driven Topology Optimization of Complex Fluid Channel Network with Predefined Inlet–Outlet Parings	**Ze Zheng**
PS–16	Transformed Tensor Decomposition Method for Topology Optimization	**Jiayi Hu**
PS–17	Mechanical Response of Protein–Embedded Vesicles Under Osmotic Pressure: A Monte Carlo Simulation	**Li Long**
PS–18	A Robust E–Cusp Method for Compressible Fluid–Solid Multiphase Diffuse Interface Model	**Yi Cheng**
PS–19	Machine–Learning Enabled Atomic Insights into the Phase Diagram of Lead Zirconate Titanate	**Xiaohan Huang**
PS–20	Density of States Engineering: A Physics–Inspired Framework for Efficient Topology Optimization of Phononic Bandgaps	**Zonghao Li**
PS–21	Nonlinear Flutter Analysis of Orthotropic Laminated Thin Rectangular Plates	**Chao Ye**
PS–22	Symplectic Contact Analysis of Inhomogeneous Media	**Lizichen Chen**
PS–23	SPH Method With Self–Contact Treatment For Simulation of Transient Deformation of Soft Structures	**Yihua Xiao**
PS–24	Topology Optimization with Node Density Adaptation and Geometric Multigrid Solving	**Zhanbin Yuan**

Plenary Speakers

(alphabetical order based on surname)

Modelling Nonlinear Damping in Large-amplitude Vibrations of Structures

Marco Amabili
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ABSTRACT: An increase in damping is relevant for the passive control of vibrations and noise; therefore, it is very relevant in design. Experimental data show a strong and nonlinear dependence of damping on the vibration amplitude for beams, plates (see Fig. 1), and shells of different sizes and made of different materials (metal, composite materials, silicone rubber, and graphene) [1, 2]. While the frequency shift of resonances due to stiffness nonlinearity is 10 to 25 % at most for common structural elements, a damping value up to several times larger than the linear one can be obtained for vibrations of thin plates when the vibration amplitude is about twice the thickness. This is a huge change in the damping value! Therefore, the nonlinear nature of damping affects structural vibrations much more than stiffness nonlinearity. Despite this experimental evidence, nonlinear damping has not been sufficiently studied yet. A model of nonlinear damping was derived from linear viscoelasticity for single-degree-of-freedom systems [3, 4] and rectangular plates [5] by taking into account geometric nonlinearity. The resulting damping model was nonlinear, and the model parameters were identified from experiments. Numerical results for forced vibration responses of different structural elements in large-amplitude (nonlinear) regimes were obtained and successfully compared to experimental results, validating the nonlinear damping model.

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[2]Amabili M., Alijani, F., Delannoy J. (2016) Damping for large-amplitude vibrations of plates and curved panels, part 2: identification and comparison. Int. J. Non-lin. Mech. 85, 226-240.
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[5]Amabili M (2018) Nonlinear damping in nonlinear vibrations of rectangular plates: derivation from viscoelasticity and experimental validation. J. Mech. Phys. Solids 118, 275-292.

Marco Amabili is a Changjiang Chair professor at Westlake University, Hangzhou, China, and Emeritus Distinguished James McGill professor at McGill University, Montreal, Canada. He is an International Member of the National Academy of Engineering of the USA, a Fellow of the Royal Society of Canada (Academy of Sciences), and the Canadian Academy of Engineering. He is also member of Academia Europaea, European Academy of Sciences and Arts, European Academy of Sciences and Fellow of the Engineering Institute of Canada. In 2008, Amabili wrote the monograph "Nonlinear Vibrations and Stability of Shells and Plates" published by Cambridge University Press. For this influential book, he received the Worcester Reed Warner Medal of the ASME (American Society of Mechanical Engineers) in 2020. Amabili received the 2022 Guggenheim Fellowship in Engineering, the 2021 Raymond D. Mindlin medal of the American Society of Civil Engineers (ASCE), the 2021 Gili-Agostinelli International prize of the "Lincei" National Academy of Sciences of Italy, the 2022 Blaise Pascal medal of the European Academy of Sciences and the 2022 Rayleigh Lecture Award of the ASME. He was elected Honorary Member of the ASME in 2024. Amabili served as the Chair of the Executive Committee of the Applied Mechanics Division of the ASME, and the chair of the Canadian National Committee for IUTAM (International Union of Theoretical and Applied Mechanics).

Is Physics-informed Machine Learning the next Powerful Modelling Tool for Engineering and Science?

Yuantong Gu
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ABSTRACT: In recent years, Physics-informed Neural Networks (PINNs) have revolutionized the application of Machine Learning to solving Partial Differential Equations (PDEs). By integrating data-driven learning with physics-based modelling, PINNs combine the strengths of both approaches and demonstrate exceptional potential in tackling a wide range of complex problems—particularly those with strong nonlinearities. As a result, PINNs are rapidly emerging as game-changers in computational modelling and simulation for Engineering and Science. This talk will first review the latest advancements in applying PINNs to various mechanics problems, including solid mechanics, nonlinear mechanics, fracture analysis, structural optimization, and fluid mechanics. Recent research from the speaker's group will be presented, covering topics such as novel neural network architectures for PINNs, PINN-based structural topology optimization, food drying modelling, dynamic and nonlinear problem solving, and inverse problems. Finally, the discussion will then highlight key challenges in employing PINNs for mechanics.

Professor Gu is the Pro Vice-Chancellor and Head of School at Queensland University of Technology, Australia. He is also the Director of the Australian ARC national centre for Joint Biomechanics. His broad research areas include Mechanical engineering, Computational mechanics, Biomechanics, and Machine learning for engineering. His research in advanced computer modelling and digital techniques for engineering and science has not only significantly contributed to the creation of new knowledge but also had a significant impact on real-world applications. He has published over 400 refereed journal papers. Most of his publications are in highly ranked journals, including Nature Communications. His publications have attracted over 24000 citations (h-Index=76). He has secured over $30M in research grants. His research has been widely recognised through more than 50 plenary and invited talks, editorial roles with 10 academic journals, and multiple international awards, including the Computational Mechanics Award from the Asian Pacific Association for Computational Mechanics. He is a Fellow of both Engineers Australia and the International Association of Applied Mechanics, and has served as an elected member of the National College Board of Engineers Australia. Additionally, he has chaired three international conferences and is currently organising the 9th Asian Pacific Congress on Computational Mechanics, to be held in 2025.

Conquering Generalization Challenges—A Problem-Independent Machine Learning (PIML) Approach for AI enhanced Computational Mechanics

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ABSTRACT: Artificial Intelligence (AI) for computational mechanics is one of the current research focuses in the field of solid mechanics. The field of computational mechanics involves complex physical phenomena and diverse engineering scenarios. Traditional end-to-end AI models often perform well on specific datasets but exhibit significant loss of generalization ability when facing new boundary conditions, material properties, or geometries. To address this challenge, a problem-independent machine learning (PIML) enhanced large-scale structural analysis and topology optimization framework is developed. The main idea is to focus on the origin of finite element analysis method—the shape function. This is achieved by using machine learning to establish an implicit mapping between the material distribution within coarse mesh elements and corresponding numerical Green's functions. The proposed PIML algorithm is truly independent of specific analysis and topology optimization problems. This is because the numerical shape functions of coarse mesh elements are uniquely determined by the material distribution inside, and do not depend on the external loads, boundary conditions, or shapes of design domain. Numerical examples demonstrate that this algorithm can achieve a two-order-of-magnitude improvement in optimization efficiency for million-scale three-dimensional topology optimization problems compared to mainstream commercial topology optimization software, under the same computational resources. In a 6750-core parallel environment, a 3D topology optimization problem with 10 billion degrees of freedom requires only 42 seconds per iteration. In the future, it is possible to develop a universal CAE software framework based on this technology by integrating AI with traditional numerical methods, enabling more efficient and intelligent engineering simulation and design.

Keywords: AI enhanced computational mechanics; Generalization; Problem-Independent Machine Learning (PIML); Large-scale structural analysis and topology optimization

References

[1]M.C. Huang, ⋯, X. Guo*. A mechanics-based data-free problem independent machine learning (PIML) model for large-scale structural analysis and design optimization. Journal of the Mechanics and Physics of Solids 193,105893,2024.
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Professor Xu Guo, a member of the Chinese Academy of Sciences, is from the Dalian University of Technology, P.R. China. He once served as the Vice President of the Chinese Society of Theoretical and Applied Mechanics and the President of the Chinese Association of Computational Mechanics. Currently, he is the Vice President of International Society for Structural and Multidisciplinary Optimization, and one of the editorial board members of Computer Methods in Applied Mechanics and Engineering and International Journal for Numerical Methods in Engineering.
Xu Guo has been working in the field of computational mechanics, solid mechanics and structural optimization He has published more than 270 SCI papers in renowned scientific journals including JMPS, CMAME, IJNME, IISS, PRL, etc.

On Mixed Mode Crack Propagation Analyses using Fragile Points Method (FPM)

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ABSTRACT: In the presentation, Fragile Points Method (FPM), its applications to fracture mechanics problems in linear elastic fracture mechanics problems are discussed. FPM is a new point base meshless analytical methodology based on a local weak formulation (Yang, Dong and Atluri [1], Wang et al. [2]) and the generalized finite difference method (Liszka and Orkisz [3]). The discretization in FPM is based on points distributed in the problem domain. Test and trial functions are established based on the distributed points and the generalized finite difference scheme. Connections between the points across the crack face are discarded for modeling the displacement discontinuity. A Local Galerkin symmetric weak form is established in each subdomain determined for each point. Then, pointwise stiffness matrix is constructed at each point. Subdomains cover the the problem domain. The integration of the local weak form can be achieved without any difficulty. Recently, FPM with an explicit formulation for dynamic fracture mechanics problem was presented by Li et al. [4]. The authors developed a strategy to perform mixed mode fracture mechanics. The most recent outcomes of the authors' research will be presented in the conference.

References

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Hiroshi Okada has worked on the Boundary Element Method, Automobile Crash Analysis, Computational Meso-mechanics analysis such as Homogenization Method and the s-FEM (superposition-FEM), Wavelet Finite Element Method and Computational Engineering Fracture Mechanics. He has made a numerous international and domestic conference presentations including Semi-Plenary Lecture in WCCM-PANACM 2018, New York. He was the recipient of Achievement Award (2009, Computational Mechanics Division, Japan Society of Mechanical Engineers), JACM Fellows Award (2009, Japan Association for Computational Mechanics, JACM), JACM Computational Mechanics Award (2016, Japan Association for Computational Mechanics, JACM), Computational Mechanics Award (2018, Computational Mechanics Division, Japan Society of Mechanical Engineers) and IACM Fellows Award (2020, International Association for Computational Mechanics). He is a fellow of JSCES (The Japan Society for Computational Engineering and Science) and of JSME (The Japan Society of Mechanical Engineers).

Computational Methods Based on Peridynamics and Nonlocal Operators

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ABSTRACT: Peridynamics (PD) has emerged as a powerful nonlocal modeling framework in fracture mechanics, yet its conventional formulations encounter challenges such as constant horizons, explicit algorithms, and hourglass modes. To address these issues, we revisit the notion of nonlocality and introduce several new concepts, including Dual-Horizon PD (DH-PD), Dual-Support SPH (DS-SPH), and the nonlocal operator method (NOM). The dual formulations of PD and SPH enable inhomogeneous discretizations and adaptive refinement while preserving conservation laws, whereas the introduction of dual-support provides a mathematically rigorous variational foundation and a natural generalization of conventional integral formulations.

A key feature of NOM is its compatibility with both the variational principle and weighted residual methods, allowing for direct numerical implementation and efficient computation of residuals and tangent stiffness matrices. In continuous form, NOM offers a unified framework for deriving diverse nonlocal models, where nonlocal operators play an analogous role to shape function derivatives in FEM and meshless methods. This framework has been successfully applied to a broad spectrum of physical models, ranging from fracture mechanics and gradient elasticity to Kirchhoff-Love plates, hyperelasticity, von Kármán plate theory, the Schr-dinger equation, Maxwell equations, and phase-field models such as the Cahn-Hilliard equation.

Together, these developments establish a general and versatile foundation for advancing nonlocal modeling in computational mechanics, extending its applicability from fracture mechanics to a wide class of multiphysics and higher-order problems.

Timon Rabczuk is the Chair Professor of Computational Mechanics at Bauhaus University Weimar. He is a member of the European Academy of Sciences and Art, Academia Europea and Europe Academy of Science. His key research area is computational mechanics, AI for mechanics and advanced computational materials design. Prof. Rabczuk obtained his doctoral degree from Karlsruhe Institute of Technology (KIT) in Germany in 2002 which is followed by his postdoctoral research with Prof. Ted Belytschko in University of Northwestern. He became the Chair Professor in Computational Mechanics in his current institution in 2009. He has published so far 3 academic monographs, over 700 SCI papers, with H-Index of 120, attracting over 50000 times citations in Web of Science core collection. He has been awarded with the ERC Consolidator Grant from European Union, Feodor-Lynen Fellow from Humboldt Foundation and was listed as Highly Cited Researcher in both 'Engineering' and 'Computer Science' in ISI Web of Science. Over the past ten years, Prof. Rabczuk has graduated and supervised more than 30 PhD students and postdoctoral fellows from China, and 10 of them have been awarded with Chinese National Talent Program, Humboldt Fellow and other international talent awards. Three of his collaborators have been awarded with the prestigious Humboldt Research Prize with him as the host.

Blue Economy CRC Offshore Aquaculture Projects: SeaFisher and SubSCI

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ABSTRACT: As global demand for sustainable food and marine biomass intensifies, offshore aquaculture has become an increasingly vital contributor to food security and environmental resilience. This talk focuses on two Blue Economy Cooperative Research Centre's offshore aquaculture projects: the SeaFisher – a submersible offshore fish pen and the SubSCI – a submersible seaweed cultivation infrastructure that can perform depth cycling in deep offshore waters. The conceptual design, modeling, structural and hydroelastic analyses, and testing of these two offshore aquaculture systems will be presented.

Professor Wang is a Chartered Structural Engineer, a Fellow of the Australian Academy of Technology and Engineering, a Fellow of Academy of Engineering Singapore, a Fellow of the Institution of Engineers Singapore, a Fellow of the Institution of Structural Engineers and a Fellow of the Society of Floating Solutions (Singapore). His research interests are in the areas of structural stability, vibration, optimization, plated structures and Mega-Floats. He has published over 480 journal papers and coauthored 10 books. He is an Editor-in-Chief of the International Journal of Structural Stability and Dynamics and an Editorial Board Member in several journals including Engineering Structures, International Journal of Applied Mechanics, Structures, and Ocean Systems Engineering. He holds patents on floating pontoons, floating hydrocarbon storage facility and floating breakwater-windbreak structure. Currently, he is the Leader of the Offshore Engineering Program of the Blue Economy Cooperative Research Centre to conduct research projects that combine seafood, renewable energy and offshore engineering for the first time, underpinned by a $329 million from the Australian Government and 45 industry partners over a 10-year period. He is the Chairman of the East Asia Pacific Conference on Structural Engineering and Construction steering committee and a member of the International Advisory Committee of the Research Institute of Land and Space, The Hong Kong Polytechnic University. His many awards include the 2019 Nishino Medal, 2019 JN Reddy Medal, 2018 Singapore's Minister of National Development's R&D Award (Special Mention Category), 2018 IStructE Singapore Structural Awards, 2014 Keith Eaton Award, 2009 Lewis Kent Award, 2013 IES Prestigious Engineering Achievement Award, 2011 IES/IStructE Best Paper Award and the Grand Prize of the 2013 Next Generation Container Port Challenge.

Characterization, Simulation and Design of Cross-scale Mechanics Properties of Advanced Materials

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ABSTRACT: The principle of "maximum strain energy density" is introduced, and one can find that there exists a normal-inverse Hall-Petch effect between the "maximum strain energy density" and grain size, but its turning point is in micron scale. Based on the principle of "maximum strain energy density", a special variational principle is developed, which can be used to simulate the mechanics properties of advanced materials. The representation theory and method of cross-scale mechanics behavior are established, and the "ghost force" of macro-micro correlation is eliminated. By establishing the theory of strain gradient viscoelasticity, the strengthening-softening behavior of nanostructured materials is effectively characterized.

Yueguang Wei is a mechanician and an Academician of the Chinese Academy of Sciences. He serves as the Director of the Beijing Advanced Innovation Center for Engineering Science and Advanced Technology, Vice President of the Chinese Society of Theoretical and Applied Mechanics, Standing Director of the China Overseas Friendship Association, and a member of the National Committee of the Chinese People's Political Consultative Conference. He has previously held positions such as Deputy Director of the Academic Committee of the Institute of Mechanics, Chinese Academy of Sciences, Director of the Solid Mechanics Professional Committee of the Chinese Society of Theoretical and Applied Mechanics, and Editor-in-Chief of the Acta Mechanica Sinica. He primarily engages in research on cross-scale mechanics, elastoplastic fracture mechanics, and composite material mechanics. He has served as Chief Scientist for projects such as the Ministry of Science and Technology's 973 Program, innovation groups and major projects of the National Natural Science Foundation of China, and international academic teams of the Chinese Academy of Sciences. His honors include twice receiving the second prize of the National Natural Science Award, once receiving the third prize, the China Young Scientist Award, the Young Scientist Award of the Chinese Academy of Sciences, the National Science Fund for Distinguished Young Scholars, and the Peking University Guohua Distinguished Scholar Award.

AI-assisted Engineering
Our Understanding and Typical Applications

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ABSTRACT: Design and manufacturing of lightweight & high-performance structures are eternal goals in aeronautic and aerospace industries to meet the serious loading conditions. Nowadays, AI is an attractive topic and plays a more and more important role worldwide. How to combine AI with engineering scenarios in advanced design and manufacturing of aerospace structures is a motivating and challenging problem. This lecture aims to share some experience of our research team at Northwestern Polytechnical University.

First, some basic concepts related to Neural Network (NN) are introduced based on our understanding. The contents are then focused on additive manufacturing process, curing process of composite structures, metal cutting process including milling process with robots, design optimization of smart SMA structures. Typical industrial applications are presented. Perspective developments are discussed.

Prof. Weihong ZHANG is currently the member of Chinese Academy of Sciences, professor in the School of Mechatronic Engineering of Northwestern Polytechnical University, China. He received his PhD degree from University of Liege, Belgium in 1991. He worked as researcher fellow, Senior Researcher and Associate Professor in University of Liege, Belgium. He joined Northwestern Polytechnical University and was honored as Cheung Kong Chair Professor (1999) and Distinguished Young Scholar of National Natural Science Foundation of China (2009).

His research interests cover advanced structure design and manufacturing. He obtained the Second Prize of National Award for Natural Science and Technological Invention, five First-Prizes of Provincial Awards for Science and Technology, as well as Asian Society for Structural and Multidisciplinary Optimization (ASSMO) Award and Fellow award. He serves as the associate editor of Acta Aeronautica et Astronautica Sinica, Science China-Technological Sciences, editorial board member of Structural and Multidisciplinary Optimization, EC member of ASSMO, etc. He has more than 100 national invention patents and published more than 500 peer-reviewed journal papers including papers on CMAME, IJNME, IJMTM and 8 monographs with more than 17000 citations.

He is the director of State Joint Research Center of Aerospace Materials and Structure Design and Additive Manufacturing of Ministry of Science and Technology, recognized as the distinguished expert of All-China Federation of Returned Overseas Chinese, assessment expert for "Recruitment Program of High-end Foreign Experts" of Chinese government.

A boundary-based Machine Learning Approach for Elastic and Piezoelectric Crack Analysis

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ABSTRACT: A novel boundary-based machine learning (BBML) approach for two-dimensional (2D) crack analysis in linear elastic and piezoelectric materials will be presented. The proposed approach integrates the machine learning (ML) technique based on artificial neural networks (NNs) with the boundary integral equation (BIE) method, which enables an efficient and accurate evaluation of the characteristic fracture mechanics parameters. The local asymptotic behavior of the crack-tip field is properly captured by the developed novel special crack-tip elements based on NNs (CTNNs), which ensures the modelling accuracy of the displacement and stress fields near the crack-tips. In the developed special CTNNs, the local asymptotic characteristics of the crack-tip field are embedded into the NNs to guarantee the high accuracy for describing the inherent stress singularities and high deformation gradients near the crack-tips. In comparison to many conventional numerical methods in fracture mechanics, the proposed BBML approach exhibits several distinct advantages. Firstly, by embedding higher-order terms of the asymptotic crack-tip field into the NNs, the proposed approach can achieve a more accurate and reliable description of the crack-tip field, even by using relatively large crack-tip elements. Secondly, the proposed approach can be easily extended to other crack problems involving complex material properties and crack-tip geometries, because the CTNNs can incorporate important information about the variable singularity orders of the crack-tip field, and thus ensuring the versatility and robustness of the approach. In addition, in comparison to the domain-based ML (DBML) approach, the proposed novel BBML approach boasts an excellent computational efficiency due to the dimension-reduction and analytical/semi-analytical nature of the involving BIEs. Several numerical examples will be shown to demonstrate that the proposed novel BBML approach can offer certain significant advantages over many other conventional numerical methods, and hence provide a reliable, robust and accurate numerical simulation tool for solving 2D linear elastic and piezoelectric crack problems.

Professor Chuanzeng Zhang has received his Master (Dipl.-Ing.) in 1983 and his PhD (Dr.-Ing.) in 1986 at the Technical University Darmstadt (Germany). From 1986 to 1988, he was a postdoctoral fellow with Professor Achenbach at the Department of Civil Engineering, Northwestern University (USA). Before his appointment as Professor at the Ningbo University (China) in 2024, he was Associate Professor and Professor at the Department of Engineering Mechanics of Tongji University (China), Professor at the Department of Civil Engineering, University of Applied Sciences Zittau/Görlitz (Germany), and Professor at the Department of Civil Engineering, Faculty of Science and Technology, University of Siegen (Germany). His research interests include computational mechanics, structural mechanics, fracture and damage mechanics, mechanics of advanced materials, and acoustic/elastic metamaterials. He has published 2 monographs and over 600 papers in peer-reviewed scientific journals with more than 22,000 citations, h-index 72 and i10-index 405 (Google Scholar, as of 23.11.2024). He has over 600 publications in referred scientific journals. He is Co-Chief Editor of a book series, Associate Editor of 3 international journals, Advisory Editor, Guest Editor and Editorial Member of over 10 other scientific journals. He is Adjunct Professor, Guest Professor, Consulting Professor and Honorary Professor of about 10 universities. He was awarded as honorary doctorate (Dr. h.c.) of the Slovak University of Technology in Bratislava, honorary doctorate (Dr. h.c.) of the Aristotle University of Thessaloniki, member of the European Academy of Sciences, member of the European Academy of Sciences and Arts, and member of the Academia Europaea.

Numerical Methods for System Design of Aerospace Vehicles

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ABSTRACT: In the design and development process of aerospace vehicles, multidisciplinary integrated design plays a crucial role in enhancing the system performance of aerospace vehicles, shortening the development cycle, and improving flight reliability. To address the complex issues of multidisciplinary coupling design in aerospace vehicles, we have addressed key technologies such as overall design, integrated aerodynamic/structural design, and multi-system collaborative control, resulting in a multidisciplinary comprehensive design platform for aerospace vehicles. For the multidisciplinary coupling overall collaborative design of complex aerospace vehicles, we have developed multidisciplinary design optimization software based on reinforcement learning, which solves mixed integer nonlinear programming problems, breaks through the traditional serial design paradigm, and achieves high-efficiency parallelization of the entire process from rapid generation to comprehensive evaluation to iterative optimization, significantly improving the design efficiency of aerospace vehicles. For the integrated aerodynamic/structural design of aerospace vehicles, we have developed software for aerodynamic-structural coupled analysis. By establishing real-time data-efficient iteration between the fluid dynamics solver and the structural mechanics solver, the efficiency of bidirectional data transfer between aerodynamic and structural iterations has improved by more than 10 times compared to traditional methods. For the multi-system collaborative control of aerospace vehicles, we have developed an integrated design and optimization platform for body-power-operation. We have integrated multiple key subsystems such as manipulation, energy, navigation, communication, and payload, into a collaborative control system, significantly enhancing the autonomous decision-making efficiency and flight performance of the aerospace vehicles.

Keywords: System Design of Aerospace Vehicles, Multidisciplinary Coupling Overall Collaborative Design, Integrated Aerodynamic/Structural Design, Multi-System Collaborative Control

Dr. Yao ZHENG is a Cheung Kong chair professor with Zhejiang University, appointed by the Ministry of Education of China since 2001. He has been the director of Center for Engineering and Scientific Computation (2002-), the founding deputy dean of School of Aeronautics and Astronautics (2007-2013), and the vice dean of Faculty of Engineering (2014-2019), all in Zhejiang University, China, and the director of Zhejiang Institute of Turbomachinery and Propulsion Systems (2019-), China. He has authored or co-authored eight books, and over 500 papers. He serves as one of Editors-in-Chief (2022-) of Aerospace Research Communications (ARC), and one of Series Editors (2020-), Springer Aerospace Technology, Book Series, Springer Nature.

His awards include Finalist 2 of ACM Gordon Bell Prize (2023), Best HPC Application (CCF HPC China) (2023), a First Prize of Natural Science Award of Zhejiang Province (2020), the Qian Ling-Xi Achievement Awards for Computational Mechanics (2018), a First Prize of Scientific and Technological Progress Award of Zhejiang Province (2016), ICACM (International Chinese Association for Computational Mechanics) Congress Award (2016), the Du Qing-Hua Award of Computational Method in Engineering (2015), and the APACM (Asian-Pacific Association for Computational Mechanics) Computational Mechanics Award (2013). He serves as the President (2022-2025) of the Asian-Pacific Association for Computational Mechanics (APACM), and the President of International Chinese Association for Computational Mechanics (ICACM) (2016-). He had been a Vice President (2005-2020) of the Chinese Association of Computational Mechanics (CACM).

Machine Learning Assisted Multiscale Modelling and Design of Flexoelectric Nanostructures

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ABSTRACT: In this talk, I will present machine learning-assisted flexoelectric materials characterization and the use of topological optimization for single and multi-phase flexoelectric structures across atomistic to continuum scales. New formulations for nonlinear topological optimization of flexoelectric structures, accounting for nonlocal stress and large deformation processes considering the environmental medium, will be presented. Different from pure data-driven area, in Engineering and Science, AI is transforming research with domain specific physical and mathematical knowledge. Materials exploration and design could be accelerated by orders of magnitude, which cannot be conceived decades ago. I will give some interesting examples that I have carried out with my team for 2D flexoelectric materials exploration with various thermal, optical, mechanical and electrical properties.

Prof. Xiaoying Zhuang's key research area is computational mechanics and materials design for nano composites, metamaterials and nanostructures as well as computational methods for multiphysics and multiscale modelling. Prof. Zhuang was elected as member of the European Academy of Science and Art in 2024. She has published over 300 papers with more than 20000 times citations in ISI web of science. Her scientific impact is recognized by international community including Leibnitz Prize from DFG (2018), the International Chinese Computational Mechanics Fellowship Award (2017), Heisenberg-Professor from DFG (2020), KJ Bathe Prize (2023) and Qidi Prize (2024).

Semi-Plenary Speakers

(alphabetical order based on surname)

Phase Field Modelling of Spinodal Decomposition and Nucleation in Ferritic Alloys

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Abstract

Understanding and predicting phase separation in alloys enables evaluation of the resulting hardening and embrittlement under a range of processing or service conditions. Fe-Cr-based ferritic alloys are desirable structural materials for high-temperature, corrosive environments. However, Fe-Cr alloys are susceptible to thermal embrittlement by phase separation, which increases the tendency for brittle fractures, limiting the safe service life of these materials in pressure vessel structural applications. Numerical methods have been used to simulate microstructural evolution in alloy systems. The phase field method, a common numerical approach for microstructural evolution, is effective at describing phase separation at long timescales, as it can model diffusion and segregation in a continuum system. However, further study needs to be performed to integrate physically-based parameters of the free energy, mobility and interfacial width into phase field models, to facilitate accurate modelling of phase transformations. This paper employed the phase field method to model phase separation under elevated temperatures in the Fe-Cr alloy system. The phase field model integrated the essential physically-based parameters, including a CALPHAD free energy function, measurements of substitutional diffusion in Fe and Cr, measurements of the Fe-Cr single-crystal elastic properties, and a calibrated interfacial width. To implement nucleation in the phase field method, a discrete logical algorithm was used. The phase field method was then used to model $\alpha-\alpha'$ nucleation, or $\alpha-\alpha'$ continuous transformation, at 773 K. The simulated phase evolution has been quantified and critically compared to the applicable experimental measurements. It was shown that phase field modelling has the potential for quantitative, physically-based modelling of metallurgical phase transformations, especially in the Fe-Cr system. The use of physically-based parameters, particularly the CALPHAD free energy function, facilitates accurate modelling of phase transformations at high temperatures. Importantly, the implemented phase field model with carefully selected parameters demonstrates improved accuracy at modelling key features of spinodal decomposition compared to simplified phase field models. For example, the model elucidates the significant difference in kinetics of the Fe- and Cr-rich phases. Finally, the discrete nucleation algorithm was shown to facilitate non-classical nucleation characteristics of some Fe-Cr alloys exhibited in practice, including nuclei with intermediate compositions, without significantly penalising the computational cost of the model. In future, this work will investigate phase transformation induced by displacement damage from high energy radiation.

Keywords: Phase field modelling, CALPHAD method, Stainless steel, Fe-Cr alloy, Phase separation

Conservative Sharp Interface Methods for Interfacial Flows: Development and Simulations

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Abstract

Interfacial flows can be numerically considered as a class of deformable boundary problems, and interfaces between different phases have different jump conditions (or boundary conditions). These conditions, which define the coupling between phases such as transfer of mass, momentum, and energy, are fundamental in determining the resulting flow characteristics. Consequently, high-fidelity simulation of interfacial flows necessitates not only high-order numerical discretization of the governing equations but also a high-resolution representation of the interface geometry and an accurate approximation of its jump conditions. Cut cell method addresses these requirements by reconstructing the interface on a regular grid and generating dynamic meshes that realign with the interface. This approach provides a foundation for high-resolution interface tracking and high-order approximation of jump conditions at interfaces. Recently, we have developed a series of conservative sharp interface methods based on this cut-cell strategy. This report will introduce the core concepts and current developments of this conservative sharp interface method and demonstrate its application to several key problems in fluid dynamics.

Keywords: Computational fluid dynamics, interfacial flows, sharp interface method

Interval Field Model and Interval Finite Element Methods

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Abstract

Uncertain parameters with inherent spatial or spatiotemporal variability are commonly encountered in engineering. These include material properties of the heterogeneous media, such as concrete or porous rock, external loads such as wind loads applied to structures, etc. This type of uncertain parameters are traditionally quantified by the random field model, while the large amount of information required in the construction of the precise probability distribution functions is often difficult to obtain for many practical engineering problems. For this reason, the authors proposed an interval field model to represent the spatial and spatiotemporal uncertainties with insufficient information, in which the variation of the parameter at any spatial or spatiotemporal location is quantified only by an interval with the upper and lower bounds. In the interval field model, the spatial and spatiotemporal dependency can be measured by a covariance function or a correlation coefficient function that is defined for the interval variables at different locations or space-time points. Based on the correlation information, an interval K-L expansion is formulated for the proposed interval field model, by which the continuous spatial uncertainty can be expressed through a series of deterministic functions with uncorrelated interval coefficients. Particularly, a spatiotemporal uncertain parameter could be decomposed into a series of interval processes firstly, which relates only to time and can be furtherly represented by time-independent interval variables. By introducing the interval field model into the finite element analysis, the interval finite element method (IFEM) is then formulated to predict the response bounds of structures with spatial or spatiotemporal uncertainties. The primary challenge of interval finite element analysis lies in solving a class of non-deterministic interval linear equilibrium equations. The solution of the interval equations formulates an NP-hard problem, which cannot be precisely obtained in most cases. To compute an interval vector that approximates the exact solution set, the authors proposed a series of IFEMs, including the sequential simulation method, interval iterative method, field optimization method, etc., which provide either an inner enclosure or outer enclosure for the structural response bounds. With both the outer and inner enclosures obtained, the exact solution as well as the prediction error can then be demarcated, which is very beneficial to the subsequent structural reliability analysis and design.

Keywords: Interval field, spatial uncertainty quantification, structural response bounds, interval finite element analysis.

Computational Design of Multifunctional Lattice Structures

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Abstract

While additive manufacturing has offered substantially new opportunities and flexibility for fabricating 3D complex lattice structures, effective design of such sophisticated structures with desired multifunctional characteristics remains a demanding task. To tackle this challenge, we develop an inventive multiscale topology optimisation approach for additively manufactured lattices by leveraging a derivative-aware machine learning algorithm [1]. Our objective is to optimise non-uniform unit cells for achieving an as uniform strain pattern as possible. The proposed approach exhibits great potential for biomedical applications, such as implantable devices mitigating strain and stress shielding. To validate the effectiveness of our framework, we present two illustrative examples through the dedicated digital image correlation (DIC) tests on the optimised samples fabricated using a powder bed fusion (PBF) technique. Furthermore, we demonstrate a practical application of our approach through developing bone tissue scaffolds composed of optimised non-uniform iso-truss lattices for two typical musculoskeletal reconstruction cases [1,2]. These optimised lattice-based scaffolds present a more uniform strain field in complex anatomical and physiological condition, thereby creating a favourable biomechanical environment for maximising bone formation effectively. The proposed approach is anticipated to make a significant step forward in design for additively manufactured multiscale lattice structures with desirable mechanical characteristics for a broad range of applications [3].

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Ghost Hammering Phenomena in Stochastically Driven Shells

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Abstract

Random phenomena are widespread in disciplines such as Engineering, Physics, Geophysics, and Medicine, reflecting the inherent variability of natural and artificial systems. In Structural Mechanics, stochasticity arises from environmental loads like wind and seismic activity, as well as from manufacturing tolerances and operational uncertainties. These factors can induce vibrations with non-deterministic features that challenge predictability. Linear models, long employed to study vibrations, remain valuable but often fail to capture the rich spectrum of behaviours produced by nonlinear dynamics. The combination of stochastic forcing and nonlinear structural response can generate highly complex patterns beyond the reach of traditional theories.

This study examines the nonlinear dynamic response of a circular cylindrical shell subjected to strong, narrowband random excitation representative of seismic events. Laboratory experiments revealed striking phenomena: sporadic, large-amplitude spikes in the vibrational response, occurring irregularly in time and without any external impulses. Such bursts cannot be explained within a linear framework and instead reflect emergent dynamics rooted in the nonlinear character of the system.

The observed spikes bear strong resemblance to phenomena in other fields. They recall Extreme Events (EE) in oceanography and finance, Stochastic Resonance (SR) enhancing weak signals in physics and biology, and Bursting Behaviour (BB) reported in neuroscience. Yet, in Solid Mechanics, such phenomena are rarely documented, in this experimental work we observed a special type of EE that we called "Ghost Hammering (GH)," which appears as transient oscillations having a spectral content populated by the natural frequencies of the shell, creating the illusion of sudden impacts despite the absence of external hammer strikes.

The evidence suggests that GH is produced by nonlinear interactions activated under random excitation, driving the system into states where energy is suddenly released. Similar mechanisms are well described in models of nonlinear physics and neuroscience, such as the FitzHugh Nagumo systems and stochastic Langevin formulations. These models provide conceptual and mathematical frameworks that could clarify the dynamics responsible for GH, highlighting the value of adopting cross-disciplinary approaches.

The work outlines the experimental setup and modal analysis of the tested shell, followed by a focused discussion of the GH. The findings emphasize the need to extend nonlinear stochastic modelling to structural systems, where randomness and nonlinearity can combine to produce rare but significant behaviours. This perspective offers new opportunities for understanding, predicting, and eventually controlling the unexpected dynamics of mechanical structures operating in uncertain environments.

Keywords: Random vibration, Shells, Nonlinear dynamics, Stochastic resonance, Complexity

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Numerical Study of Droplet Impact on a Deep Pool by CLSVOF Method

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Abstract

A coupled Level–Set and Volume–of–Fluid (CLSVOF) method was implemented in the open–source multiphase flow solver Basilisk to investigate droplet impact on a deep water pool. The approach combines the geometric reconstruction capability of the PLIC–VOF method with the geometric accuracy of the Level–Set function, ensuring sharp interface representation and improved mass conservation. Validation against the single vortex benchmark confirmed the superiority of CLSVOF over the Level–Set method, particularly in maintaining interface integrity under severe deformation and reducing sensitivity to grid resolution. Numerical simulations for droplets with different aspect ratios revealed distinct impact behaviors: elongated droplets penetrated deeper, generated stronger vortex rings, and induced large bubble entrapment and vertical jets, while spherical and flattened droplets produced shallower cavities and smaller bubbles. Analysis of energy evolution further highlighted the role of droplet geometry in controlling turbulent kinetic energy and potential energy exchange. The results highlight CLSVOF as a robust and accurate tool for capturing complex multiphase free–surface flows.

Keywords: Free–surface flows, CLSVOF method, Droplet impact, Multiphase simulation.

Wavelet Methods for Solving Hyperbolic Conservation Laws

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Abstract

Compressible flow problems governed by hyperbolic conservation laws typically involve various strong discontinuities and multiscale structures. Over the years, a range of grid-based high-order numerical methods has been developed for such problems. However, these methods can truly achieve high-order accuracy only when high-order meshes are employed on regular domains. For problems defined on complex domains, it is very difficult to generate sparse high-order meshes; in practice, fine global meshes are often required to successfully capture discontinuities and localized small-scale features, leading to a challenging trade-off between computational accuracy and efficiency. Wavelet theory, developed in recent decades, offers closure under nonlinear approximation, as well as multiresolution analysis and time-frequency localization. Moreover, its rich families of basis functions provide potentially effective tools for efficiently solving problems with discontinuities and multiple scales. In this work, by constructing wavelet basis functions with specific symmetries, we develop a high-order, adaptive, multiresolution wavelet collocation upwind method within a meshless framework. A variety of classic one- and two-dimensional benchmark tests demonstrate the superior accuracy and efficiency of the proposed wavelet method.

Vibration of Strain Gradient Nano Structures Via a Mesh-free Moving Kriging Interpolation Method

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Abstract

Nanoscale structures, serving as core components in M/NEMS devices, exhibit outstanding dynamic behaviors such as ultra-high resonant frequencies, high quality factors, and exceptional sensitivity. It is of significant practical importance to establish appropriate dynamic research methodologies and achieve a comprehensive understanding of their size-dependent dynamic characteristics. Strain gradient theory is widely employed to account for size-dependent material behavior. In this work, the Moving Kriging Interpolation (MKI) method is utilized to systematically investigate the vibration characteristics of nanostructures, taking into account van der Waals forces, interlayer shear effects, and scale phenomena. The accuracy and stability of the conventional Moving Least Squares (MLS) approximation and the MKI method are compared through function fitting and their first three derivatives. The vibrational frequencies of nanoplates are computed using both MLS and MKI approaches. Dynamic models for nanoplates and nanoshells are established based on strain gradient theory. Furthermore, a meshfree method based on Moving Kriging Interpolation that satisfies C2 continuity requirements is employed to study vibration problems in strain gradient-based nanoplates and nanoshells. Results indicate that the natural frequencies of nanoplates and nanoshells modeled via strain gradient theory are lower than those predicted by classical plate theory. Additionally, ultra-high-order mode shapes associated with lower frequencies are observed in the meshfree computational results. It is also demonstrated that the meshfree MKI method offers high accuracy and robust stability when solving higher-order partial differential equations.

Keywords: Size effect, Nano structure, Meshfree method, Moving Kriging interpolation.

A novel approach for deriving a state-dependent soil constitutive model using stress probing analysis

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Abstract

Nonlinearity, irreversibility, and state-dependency are fundamental characteristics of soil mechanics. To develop a constitutive model that accurately captures these features, a comprehensive understanding of the incremental stress-strain response is crucial. In this study, a numerical stress probing technique is employed in conjunction with the discrete element method to investigate the strain response of soil under stress increments along different directions. The impact of density and stress state on the incremental behavior is systematically analyzed. Leveraging the strain response envelopes obtained from the probing tests, explicit formulations of key components of the constitutive model are derived, including the yield surface, plastic potential surface, plastic modulus, and dilatancy function. Subsequently, a state-dependent constitutive model is established within the critical state framework. The predictive capability of the model is demonstrated through simulations of soil behavior in both discrete element tests and laboratory experiments under varying loading conditions. This research contributes to the development of a robust constitutive model for soil, facilitating improved predictions of soil behavior in geotechnical engineering applications.

Uncovering the Mystery of Floating Wind Turbine Modelling

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Abstract

Floating offshore wind energy is poised to be the next frontier in marine renewable energy, unlocking the immense potential of marine resources. It is essential to accurately predict the responses of floating wind turbines. Potential flow calculations seem to deviate from experimental studies, particularly under severe sea states where viscosity plays a significant role. Focusing on a semi−submersible type of floating wind turbine, a series of experiments in a wave basin have been re−analyzed using novel data analysis techniques. New phenomena have been observed through the analysis of the experiments. Viscosity is found to affect both the response amplitude (via damping) and the natural frequency (via extra added mass) − way beyond the damping effect in a damped spring system. This study will present how these insights have been integrated into improved numerical modelling.

Mini-symposium List

MS-01 **Theory and Formulation for Novel Computational Methods**
Guirong Liu (University of Cincinnati)

MS-02 **Particle Based Methods**
Zhen Chen (University of Missouri); Yan Liu (Tsinghua University)
Xiong Zhang (Tsinghua University)

MS-03 **Computational Particle Dynamics**
Dianlei Feng (Tongji University); Moubin Liu (Peking University)

MS-04 **AI and Advanced Computational Methods for Soft and/or Smart Materials and Structures**
Hua Li (Nanyang Technological University)

MS-05 **Smoothed Finite Element Methods and Related Techniques**
Chen Jiang (Hunan University); Yuki Onishi (Institute of Science Tokyo)

MS-06 **Computational Methods for Aerospace Engineering**
Jianyao Yao (Chongqing University)

MS-07 **High Performance Computing and Related Topics**
Lijun Liu (Osaka University); Masao Ogino (Daido University)
Ryuji Shioya (Toyo University); Hongjie Zheng (Toyo University)

MS-08 **High–Performance Methods in Mechanics Computation**
Jizeng Wang (Lanzhou University)

MS-09 **Mechanics of Surface/Interface and Biomimetics**
Shaohua Chen (Beijing Institute of Technology)
Lihong Liang (Beijing University of Chemical Technology)

MS-10 **High–Fidelity Simulation of Geohazard and Geotechnics**
Ping Shen (University of Macau)

MS-11 **Metamaterials and Metastructures**
Feng Jin (Xi'an Jiaotong University)

MS-12 **Computational Biomechanics**
Xiaobo Gong (Shanghai Jiao Tong University); Ken–ichi Tsubota (Chiba University)

MS-13 **The Numerical Methods for Nonlocal Problems and its Application**
Yufeng Nie (Northwestern Polytechnical University)

MS-14 **Numerical Modelling Methods and Their Applications Empowered by Physics–informed Artificial Intelligence**
Jinshuai Bai (Tsinghua University); Yuantong Gu (Queensland University of Technology)
Xiqiao Feng (Tsinghua University)

MS-15 **Fluid Structure Interaction and Application in Engineering**
Wenquan Wang (Kunming University of Science and Technology)
Shang-Gui Cai (University of Chinese Academy of Sciences)
Chunning Ji (Tianjin University)

MS-16 **Computational Nanomechanics and Nanoscale Thermal Transport**
Haifei Zhan (Zhejiang University); Jianli Shao (Beijing Institute of Technology)

MS-17 **Advanced Particle Methods in Geophysics and Geotechnical Engineering: DEM, SPH, MPM and Beyond**
Jian Chen (Japan Agency for Marine-Earth Science and Technology)
Mikito Furuichi (Japan Agency for Marine-Earth Science and Technology)

MS-18 **Data Driven Fluid Mechanics and Optimization Design**
Longyan Wang (Jiangshu University)

MS-19 **Multiscale Modelling of FRP Reinforced Structures**
Zihua Zhang (Ningbo University); Yi Tao(Xi'an University of Architecture and Technology)
Xiaoqin Li (Kunming University of Science and Technology); Zhenjun Yang (Zhejiang University)

MS-20 **Advanced Computation in Complex Dynamic Systems**
Lifeng Wang (Nanjing University of Aeronautics and Astronautics)
Xu Xu (Nanjing University of Aeronautics and Astronautics); Eric Li (Teesside University)
Zhuoqun Zheng (Nanjing University of Aeronautics and Astronautics)

MS-21 **Advanced Computation in Granular Mechanics**
Jidong Zhao (Hong Kong University of Science and Technology)
Shiwei Zhao (Hong Kong University of Science and Technology); Ning Guo (Zhejiang University)

MS-22 **Optimization Design, Manufacturing and Reliability of Materials and Structures**
Shujuan Hou (Hunan University)

MS-23 **Machine-learning Based Computational Mechanics**
Shan Tang (Dalian University of Technology); Lihua Wang (Tongji University)
Zhuojia Fu (Hohai University); Qiang Xi (Hohai University)

MS-24 **Uncertainty Quantification, Machine Learning and Optimization**
Dixiong Yang (Dalian University of Technology); Zeng Meng (Hefei University of Technology)
Weifei Hu (Zhejiang University); Hanshu Chen (Hohai University)

MS-25 **Advanced Computation in Nuclear Energy Systems**
Shuyong Duan (Hebei University of Technology); Quanyao Ren (Nuclear Power Institute of China)
Kun Zhang (Nuclear Power Institute of China); Congyi Lei (Hebei University of Technology)
Junwei Kang (Hebei University of Technology)

Travel Information

A Hangzhou Xiaoshan International Airport → GRAND PARKRAY HANGZHOU

(1) By Taxi

- Distance by Taxi : 19.5 km
- Time by taxi: 23 minutes
- Taxi Charge (one way): About 66 CNY

(2) Public Transport

- Take Subway Line 7 (towards Wushan Square) to Jianshesan Road Station−−Exit C.
- Walk 452 m to GRAND PARKRAY HANGZHOU.
- It takes about 35 minutes and costs about 5 CNY.

B Hangzhou East Railway Station → GRAND PARKRAY HANGZHOU

(1) By Taxi

- Distance by Taxi : 13.8 km
- Time by taxi: 29 minutes
- Taxi Charge (one way): About 56 CNY

(2) Public Transport

- Take Subway Line 6 (towards West Guihua Road) to Qianjiang Century Road Station.
- Transfer to Line 2 (towards Chaoyang) to Jianshesan Road Station−−Exit C.
- Walk 452 m to GRAND PARKRAY HANGZHOU.
- It takes about 47 minutes and costs about 6 CNY.

C Hangzhou South Railway station → GRAND PARKRAY HANGZHOU

(1) By Taxi

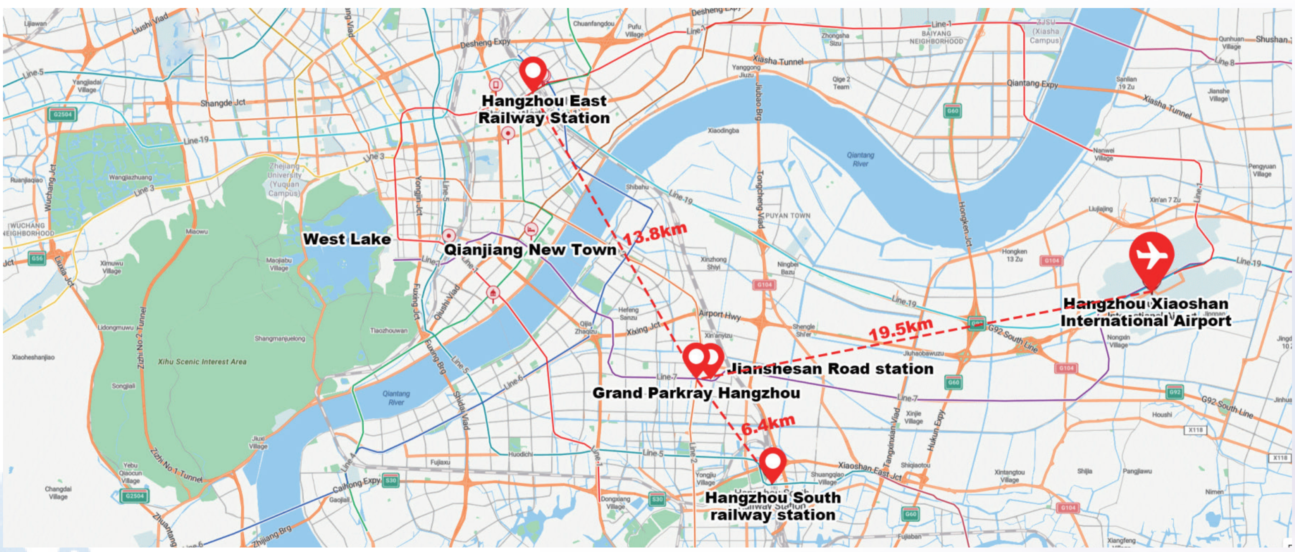
- Distance by Taxi: 6.4 km
- Time by taxi: 15 minutes
- Taxi Charge (one way): About 30 CNY

(2) Public Transport

- Take Subway Line 5 (towards Eest Nanhu) to People's Square Station.
- Transfer to Line 2 (towards Liangzhu) to Jianshesan Road Station−−Exit C.
- Walk 452 m to GRAND PARKRAY HANGZHOU.
- It takes about 22 minutes and costs about 3 CNY.

D Jianshesan Road Station--Exit C（Nearest subway station）→ GRAND PARKRAY HANGZHOU

- Walk 452 m to GRAND PARKRAY HANGZHOU.



Local Tourist Information

West Lake - the Legend of Hangzhou

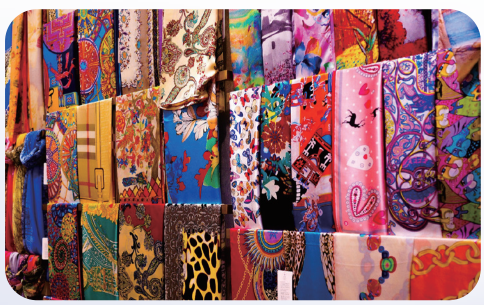
The West Lake Cultural Landscape of Hangzhou, encompassing the West Lake and the hills that embrace it on three sides with the city gracing its fourth, has been a profound source of inspiration for poets, scholars, and artists since the Tang Dynasty (AD 618–907). This landscape masterfully integrates natural beauty with human creativity, featuring numerous temples, pagodas, pavilions, gardens, ornamental trees, causeways, and artificial islands. It was inscribed on UNESCO's World Heritage List in 2011 as a cultural property, recognized as an outstanding example of a cultural landscape that vividly reflects the ideals of Chinese landscape aesthetics.

Hangzhou City Balcony

Hangzhou City Balcony is located in the Qianjiang new CBD. There is one major and two sub–balconies in total, and all are open and vibrant modern city parks that integrate relaxation and entertainment.

Hangzhou Silk

Hangzhou is regarded as the cradle of the Chinese silk culture and production. With ahistory of over 2,500 years, Hangzhou Silk is renowned for its gentle texture, gorgeous colorsand wide varieties.



Notes

曙光智算

Sugon

Conference Hosts: The Chinese Society of Theoretical and Applied Mechanics (CSTAM), China

Conference Organizers: College of Civil Engineering and Architecture, Zhejiang University, China
College of Aeronautics and Astronautics, Zhejiang University, China
Faculty of Mechanical Engineering & Mechanics, Ningbo University, China

Supporting Organizers: Zhejiang Society of Theoretical and Applied Mechanics, China
Huanjiang Laboratory, Zhejiang, China
Innovation Center of Yangtze River Delta, Zhejiang University, China
ZJU-ZCCC Institute of Collaborative Innovation, Zhejiang University, China
Computing Center for Geotechnical Engineering, Zhejiang University, China