

YIZHONG SUN

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RESEARCH PROFILE

My research focuses on (i) numerical analysis and scalable solvers for interface-coupled multiphysics problems (Stokes–Darcy, free-flow–poroelasticity, FSI/ALE), and (ii) meshfree strong-form discretisations for PDEs on curved surfaces and thin shells. I combine rigorous analysis with reproducible implementations and benchmarking (convergence, stability/conservation, error estimation, iterations and wall-time metrics). International mobility includes a visiting research stay at the University of Calgary (Canada) and my current postdoctoral appointment at HKBU (Hong Kong).

APPOINTMENTS AND EDUCATION

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| 10/2024–present | Postdoctoral Researcher, Computational Mathematics
Host: Head & Prof. Leevan Ling
Department of Mathematics, Hong Kong Baptist University, Hong Kong
Topic: <i>Meshfree Methods for Surface PDEs on High-dimensional Manifolds</i>
<i>Advancements in Meshfree Methods for Hyperbolic Conservation Laws</i> |
| 09/2020–07/2024 | Ph.D. in Science, Computational Mathematics
Supervisor: Prof. Haibiao Zheng .
School of Mathematical Sciences, East China Normal University, China
Thesis: Robin-type Domain Decomposition Methods for Fluid Multi-physics Coupled Systems
Topic: <i>Multi-domain and Multi-physics Problems:</i>
Free fluid coupled with porous media problems
Convection-Diffusion-Reaction equations (Convection dominant)
<i>Fluid-Structure Interaction Problems:</i>
Blood Solute Dynamics Models
Flow-Vegetation Interaction Models |
| 09/2017–07/2020 | M.Sc. in Science, Computational Mathematics
Supervisor: Prof. Haibiao Zheng .
School of Mathematical Sciences, East China Normal University, China
Thesis: Nitsche’s Type Stabilized Finite Element Method for the Fully Mixed Stokes-Darcy System |
| 09/2013–07/2017 | B.Sc. in Science, Mathematics and Applied Mathematics
School of Mathematical Sciences, Qufu Normal University, China |

INTERNATIONAL MOBILITY & COLLABORATION

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| 10/2023–01/2024 | Visiting Research Student
Host: Prof. Zhangxing (John) Chen
Department of Chemical and Petroleum Engineering
University of Calgary, Canada
Topic: <i>Reservoir Engineering and Numerical Reservoir Simulation for Conventional and Unconventional Oil and Gas Reservoirs</i>
Focus: Learned state-of-the-art reservoir simulation toolkit
Modelling of dynamic wellbore–reservoir interaction
Verification via benchmark simulations and sensitivity studies |
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- 10/2024–present** **Postdoctoral Researcher**
 Host: Head & Prof. **Leevan Ling** (Hong Kong Baptist University)
 Topic: *Meshfree Methods, Surface PDEs, Hyperbolic Conservation Laws*
 Focus: Trajectory-based schemes for surface advection–diffusion equations
 Sobolev-scale regularity estimation for meshfree PDE solvers
- 08/2018–09/2018** **Exchange Student**
 Host: Prof. **Lili Ju** (University of South Carolina)
 Dr. **Yifan Wang** (Texas Tech University)
 (that time, a Postdoc of Prof. **Suncica Canic** in the UCB)

RESEARCH INTERESTS

- **Interface-coupled multiphysics and scalable solvers:** domain decomposition and partitioned time-stepping schemes; conservative/stability-robust interface enforcement (Robin/Nitsche-type couplings); convergence and performance analysis (iterations, wall time, scalability).
- **Meshfree strong-form methods for PDEs on manifolds/thin shells:** RBF collocation / RBF-FD and kernel-based discretisations for surface PDEs; trajectory-based schemes for surface advection–diffusion (advection-dominated regimes); geometry-aware surface operators and regularity/error indicators.
- **Coupled flow models and applications:** Stokes–Darcy and free-flow–poroelasticity couplings; FSI/ALE formulations for moving-interface settings, with applications to vascular flow and porous-media interaction.
- **Uncertainty quantification for interface problems:** (multi-level) Monte Carlo / ensemble acceleration for stochastic PDEs with random coefficients; efficient reuse of linear-algebra structures across samples.
- **Phase-field and diffuse-interface models:** Cahn–Hilliard / Allen–Cahn type systems and coupling with flow/porous-media models as reduced or surrogate descriptions of evolving interfaces. Such models can also be used as diffuse-interface descriptions in FSI and moving-boundary settings.

TECHNICAL SKILLS

- **Scientific computing & PDE solvers:** **FreeFEM++** (FEM for incompressible flow and coupled PDEs), **Python (FEniCS)** and **MATLAB**; meshfree implementations in MATLAB/Python (RBF collocation / RBF-FD, point-cloud surface operators).
- **Geometry/meshing & vascular workflows:** CAD basics, **Gmsh**, **SimVascular** (surface/volume mesh generation and preprocessing for patient-inspired geometries).

AWARDS & SERVICE

- Doctoral Student Innovation Ability Enhancement Program (Project Award).
- Outstanding Ph.D. Thesis Award.
- Journal referee for *International Journal for Numerical Methods in Engineering*, *Numerical Algorithms*, *ZAMM – Zeitschrift für Angewandte Mathematik und Mechanik*, *Journal of Computational and Applied Mathematics*, *Applied Numerical Mathematics*.

ACADEMIC LEADERSHIP & PRESENTATIONS

- **Organizing Committee:** [Conference on Modern Kernel Methods and Applications](#) — on the occasion of **Robert Schaback**’s 80th birthday (2026, Hong Kong).
- **Special Session Organizer:** The 15th AIMS Conference, [SS163: Mathematical Modeling of Multiphysics Coupled Systems — Models, Algorithms, and Scalable Computing](#) (2026 upcoming, Athens, Greece).
- **Subsection Invited Talk:** [Constructive Functions 2025](#) — in conjunction with the 37th Shanks Lecture celebrating Ed Saff’s 80th birthday (2025, Nashville, US).
 Title: “*Trajectory-Based RBF Collocation Method for Surface Advection–Diffusion Equations*”.
- **Selected Invited Talks (China):** The 13th National Conference on Computational Mathematics (2023), The 20th Symposium on Numerical Methods in Fluid Mechanics (2023), Shanghai Jiao Tong University (2023), Harbin Institute of Technology (2021), Xinjiang University (2024).

PUBLICATIONS

Notation: * indicates corresponding author, mostly sorted by surname.

1. Chunchi Liu, Yao Rong*, **Yizhong Sun***, Jiaping Yu, Haibiao Zheng (2026). *Multi-Level Monte Carlo Ensemble Domain Decomposition Method for the Random Stokes-Darcy Models with Uncertain Parameters*. **Journal of Computational Physics**, 556, 114800.
2. Shihan Guo, **Yizhong Sun**, Yifan Wang*, Xiaohe Yue, Haibiao Zheng (2025). *A fully parallelizable loosely coupled scheme for fluid-poroelastic structure interaction problems*. **SIAM Journal on Scientific Computing**, 47(4), B951–B975.
3. Ziwei Liu, Li Shan*, **Yizhong Sun**, Haibiao Zheng (2025). *SAV decoupled ensemble algorithm for the dual-porosity–Stokes model with uncertainty quantification*. **Numerical Methods for Partial Differential Equations**, 41, e70037.
4. Zheng Li, Feng Shi, **Yizhong Sun***, Yuhong Zhang, Haibiao Zheng (2024). *Parallel domain decomposition method for the fully-mixed Stokes–dual-permeability fluid flow model with Beavers–Joseph interface conditions*. **Communications in Computational Physics**, 36(2), 551–580.
5. **Yizhong Sun**, Jiangshan Wang*, Haibiao Zheng (2024). *Novel partitioned time-stepping algorithms for fast computation of random interface-coupled problems with uncertain parameters*. **Numerical Mathematics: Theory, Methods and Applications**, 17(1), 145–180.
6. Chunchi Liu, **Yizhong Sun***, Jiaping Yu (2024). *SAV unconditional stable estimate of parallel decoupled stabilized finite element algorithm for the fully mixed Stokes–Darcy problems*. **Applied Mathematics Letters**, 109393.
7. Feng Shi, **Yizhong Sun***, Haibiao Zheng* (2023). *Ensemble domain decomposition algorithm for the fully-mixed random Stokes–Darcy model with the Beavers–Joseph interface conditions*. **SIAM Journal on Numerical Analysis**, 61, 1482–1512.
8. **Yizhong Sun**, Weiwei Sun, Haibiao Zheng* (2021). *Domain decomposition method for the fully-mixed Stokes–Darcy coupled problem*. **Computer Methods in Applied Mechanics and Engineering**, 374, 113578.
9. **Yizhong Sun**, Feng Shi, Haibiao Zheng*, Heng Li, Fan Wang (2021). *Two-grid domain decomposition methods for the coupled Stokes–Darcy system*. **Computer Methods in Applied Mechanics and Engineering**, 385, 114041.
10. Jiaping Yu, **Yizhong Sun**, Feng Shi*, Haibiao Zheng (2020). *Nitsche’s type stabilized finite element method for the fully mixed Stokes–Darcy problem with Beavers–Joseph conditions*. **Applied Mathematics Letters**, 110, 106588.
11. Xiaobin Li, Leevan Ling, **Yizhong Sun*** (2025). *Trajectory-based RBF collocation method for surface advection–diffusion equations*. arXiv:2601.18186. (submitted to SISC)
12. Zijuan Xin, Cheoyao Wang, Feng Shi, **Yizhong Sun*** (2025). *PINN-based Kolmogorov–Arnold Networks with RAR-D adaptive sampling for solving elliptic interface problems*. arXiv:2602.01876. (submitted to JSC)
13. Xiaobin Li, Leevan Ling, **Yizhong Sun*** (2026). *Local regularity estimation through Sobolev-scale norm profile*. arXiv:2601.20207. (submitted to SISC)