Shihua Gong: Curriculum Vitae

ZR314, School of Science and Engineering
The Chinese University of Hong Kong, Shenzhen
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Research Interests

- numerical analysis, finite element methods, multigrid, domain decomposition, nonlinear solvers;
- high-frequency wave propagation, fluid-structure interaction;
- scientific computing and artificial intelligence for multiphysics simulation.

Education

Peking University, Beijing, China
Sept. 2013 - July 2018, PhD in Computational Mathematics, Advisors: Jinchao Xu and Jun Hu
Thesis: Finite element discretization and fast solvers for elastic problems

Sun Yat-sen University, Guangzhou, China
Sept. 2009 - June 2013, BS in Information and Computational Science,
Thesis: Accurate and fast Fourier transform using non-uniformly sampled data

Work Experience

School of Science and Engineering, The Chinese University of Hong Kong, Shenzhen, GD, China
Dec. 2021 – present, Assistant Professor

Department of Mathematical Sciences, University of Bath, Bath, UK
Mar. 2019 – Dec. 2021, Research associate, Mentors: Ivan G. Graham and Euan A. Spence
Project: Fast solvers for frequency-domain wave scattering problems

Department of Mathematics, Pennsylvania State University, State College, USA
Aug. 2018 - Mar. 2019, Postdoctoral scholar, Mentor: Jinchao Xu
Project: Discontinuous Galerkin methods for wave equations

Publications

* indicates that I am the corresponding author

[1] J. Galkowski, **S. Gong**, I. G. Graham, D. Lafontaine, E. A. Spence. Convergence of overlapping domain decomposition methods with PML transmission conditions applied to nontrapping Helmholtz problems *arXiv:2404.02156*. (2024) PDF (58 pages) **submitted to Communications on Pure and Applied Mathematics, under minor revision**

[2] Q. Xin, **S. Gong***, L. Shen, P. Wen, Y. Zhang, Y. Chen, J. Han, J. Xu, High-order DLM-ALE discretizations with robust operator preconditioning for fluid-rigid-body interaction, *arXiv:2602.01094*, (2026), PDF

[3] L. Shen, Q. Xin, Y. Chen, J. Han, J. Xu, Y. Zhang, **S. Gong***, A monolithic localized high-order ALE finite element method for multi-scale fluid-structure interaction problems , *arXiv:2602.02003*, (2026), PDF

[4] Y. Xie, **S. Gong***, I. G. Graham, E. A. Spence, C.-S. Zhang, Massively parallel Schwarz methods for the high frequency Helmholtz equation, *the proceeding of 29th Domain Decomposition Conference.* (2026) PDF

[5] Y. Zhang, X. Cheng, D. Yi, **S. Gong**, M. Zhou, and C. Nan. Dislocation-induced giant dielectric and piezoelectric responses in BaTiO3 single crystals by phase-field simulations. *Acta Materialia*, p.121469. (2025)

[6] **S. Gong**, Y. J. Lee, Y. Li, Y. Yu, Positivity and maximum principle preserving discontinuous Galerkin finite element schemes for a coupled flow and transport. Journal of Scientific Computing 103, no. 1 (2025): 20. PDF

[7] J. Galkowski, **S. Gong**, I. G. Graham, D. Lafontaine, E. A. Spence. Schwarz methods with PMLs for Helmholtz problems: fast convergence at high frequency. *the proceeding of 28th Domain Decomposition Conference.*. (2025) PDF

[8] S. Fu, **S. Gong**, G. Li, Y Wang. On Edge Multiscale Space based Hybrid Schwarz Preconditioner for Helmholtz Problems with Large Wavenumbers. *arXiv:2408.08198* . (2024) PDF

[9] **S. Gong**, I. G. Graham, E. A. Spence. Convergence of Restricted Additive Schwarz with impedance transmission conditions for discretised Helmholtz problems, ***Math. Comp.***. 92.339 (2023): 175-215. PDF (48 pages)

[10] **S. Gong**, M. J. Gander, I. G. Graham, D. Lafontaine, E. A. Spence. Convergence of parallel overlapping domain decomposition methods for the Helmholtz equation. ***Numer. Math.***. 152.2 (2022): 259-306. PDF (41 pages)

[11] **S. Gong**, I. G. Graham, E. A. Spence, Domain decomposition preconditioners for high-order discretizations of the heterogeneous Helmholtz equation. ***IMA J. Numer. Anal.***. 41(3):2139-85 (2021). PDF (46 pages)

[12] **S. Gong**, M. J. Gander, I. G. Graham, E. A. Spence. A variational interpretation of Restricted Additive Schwarz with impedance transmission condition for the Helmholtz problem. the proceeding of 26th Domain Decomposition Conference. (2021). PDF

[13] **S. Gong**, X.-C. Cai. A nonlinear elimination preconditioned inexact Newton method for heterogeneous hyperelasticity. **SIAM J. Sci. Comp.**. 41(5): S390-S408 (2019). PDF (highly cited by nonlinear preconditioning papers)

[14] **S. Gong**, S. Wu, J. Xu. New hybridized mixed methods for linear elasticity and optimal multilevel solvers. ***Numer. Math.***. 141: 569-604 (2019). PDF (35 pages)

[15] S. Wu, **S. Gong**, J. Xu. Interior penalty mixed finite element methods of any order in any dimension for linear elasticity with strongly symmetric stress tensor. ***Math. Models Methods Appl. Sci.***. 27.14:2711-2743 (2017). PDF (32 pages)

[16] **S. Gong**, X.-C. Cai. A nonlinear elimination preconditioned Newton's method with applications in arterial wall simulation. *the proceeding of 24th Domain Decomposition Conference.* 353-361, (2018) PDF

[17] W. Hao, **S. Gong**, S. Wu, J. Xu, M. R. Go, A. Friedman, D. Zhu. A mathematical model of aortic aneurysm formation. *PloS one*, 12(2): e0170807, (2017). PDF

In progress

[18] Y. Xie, **S. Gong**, I G. Graham, E. Spence, Massively parallel domain decomposition methods for solving the Helmholtz equations in $\mathcal{O}(k)$ runtime, in preparation

[19] L. Cen, **S. Gong**, E. A. Spence, Y. Yu, Restricted additive Schwarz method with local impedance boundary conditions for the time-harmonic Maxwell equation, in preparation

[20] X. Qi, **S. Gong**, Y. Zhang, L. Shen, P. Sun, J. Xu, J. Han, Y. Chen, A comparison of different computational models for numerical simulation of particulate flow in DLD microfluidics chips, in preparation

Grants

1. 2025 - 2026, Novel Technology Program for Industrial Software, Guangdong ZHGC (RMB 8,861,300), *Novel Structured Arbitrary-Lagrangian–Eulerian Solvers for Fluid–Structure Interactions*, **Technical Coordinator** (led the overall algorithmic strategy, coordinated technical efforts across five subprojects involving over 20 researchers, chaired regular research and development meetings, and reviewed research progress and milestone deliverables), (PI: Jinchao Xu @KAUST and SRIBD)
2. 2024 - 2026, International Cooperation and Exchange Program, National Natural Science Foundation of China, (RMB 100,000). *Iterative Solvers and Analysis for High-Frequency Hodge Wave Equations*, collaborating project with Kaibo Hu@University of Edinburgh, ***PI***
3. 2024 - 2027, General Program, National Natural Science Foundation of China, (RMB 435,000, 16% in CUHK-SZ). *Novel high-order adaptive FEM methods for antenna simulation in frequency-domain*, Co-PI (PI: Huayi Wei @Xiangtan University)
4. 2023 - 2024, Research and Development Program, Huawei Technologies Co., Ltd, (RMB 787,800) *Domain decomposition methods for the time-harmonic Maxwell equation*, ***PI***
5. 2023 – 2025, Young Scientists Program, National Natural Science Foundation of China, (RMB 300,000), *Iterative solvers for Helmholtz equation at high and multi frequencies and convergence analysis*, ***PI***
6. 2023 – 2025, General Program Guangdong Basic and Applied Basic Research Found., (RMB 100,000), *Nonlinear and linear preconditioners for multiscale fluid-structure interaction problems with collisions*, ***PI***
7. 2022 – 2025, Stable Support Plan Program, Shenzhen Natural Science Foundation, (RBM 287,500), *Scalable solvers for frequency-domain wave equations in complex geometric domain and heterogeneous media*, ***PI***
8. 2022 – 2025, General Program, Shenzhen Natural Science Foundation, (RBM 300,000), *The effects of geometry and topology on the nonlinear partial differential equations*, Participant (PI: Xingbin Pan)

Teaching Experiences

* indicated that I taught for the first time

1. * Lecturer, MAT5120, Functional Analysis (graduate level), CUHK-SZ, Jan-May 2026,
2. Lecturer, MAT4010, Functional Analysis, CUHK-SZ, Jan-May 2026,
3. * Lecturer, MAT5620, Methods of Applied Math., CUHK-SZ, Sept.-Dec. 2025,
4. Lecturer, MAT7620, Topics in Scientific Computing, CUHK-SZ, Jan-May 2025,
5. * Lecturer, MAT2040, Linear Algebra, CUHK-SZ, Sept.-Dec. 2024,
6. Lecturer, MAT1002, Calculus II, CUHK-SZ, Jan-May 2024,
7. * Lecturer, MAT4240, Numerical Methods for Diff. Equations, CUHK-SZ, Jan-May 2024,
8. * Lecturer, MAT1002, Calculus II, CUHK-SZ, Jan-May 2023,

9. * Lecturer, MAT7620, Topics in Scientific Computing, CUHK-SZ, Sept-Dec 2022,
10. * Lecturer, MAT4010, Functional Analysis, CUHK-SZ, Jan-May 2022,
11. Tutor, Programming and discrete mathematics, University of Bath, UK, Jan-May 2021
12. Teaching Assistant, Finite Element Methods, Pennsylvania State University, USA, Aug-Dec 2018
13. Teaching Assistant, Introduction to Fluid Mechanics, Peking University, Mar-Jul 2015
14. Teaching Assistant, Functions of Real Variable and Functional Analysis, PKU, Sept 2014 - Jan 2015
15. Teaching Assistant, Linear Algebra, Peking University, Mar-Jul 2014

Mentoring

- Postdocs: Tian Tian (2025-2027), Luyu Cen (2023-2025)
- PhD students: Qi Xin (2023-2027), Yue Yu (2023-2027), Jiahao Ma (2026-2030), Liuming Zeng (2026-2030), Yuziheng Wu (2026-2030)
- MPhil students: Xiang Zhou (2025-2027), Jinkai Zheng (2023-2025)
- Visiting students: Linhan Huang (2025-2026), Yan Xie (2024-2025)

Seminar and Conference Organization

- Minisymposia in DD29: *Robust parallel solvers for linear, nonlinear, and multi-physics problems*, 12 talks, The 29th International Domain Decomposition Conference, in Milan, Italy. June 23-27, 2025. Organized with Wei Wang and Chensong Zhang, `http://dd29.polimi.it`
- Workshop on Advanced Solvers for Frequency-Domain Wave Problems and Applications, 50 participants, Hosted at Tsinghua Sanya International Mathematics Forum, January 20-24, 2025, Served as the leading organizer, `http://www.tsimf.cn/meeting/detail?id=394`
- Summer School on Scientific Computing and Machine Learning, 28 lecturers and 104 students, Joint Organizing by CUHK-SZ, CUHK, and Shenzhen Research Institute of Big Data, July 08-19, 2024. Served as the chair in the organizing committee, `http://multigrid.org/school24/`
- Workshop on Numerical Algorithms for Microfluidic Chip Simulations, 13 talks, Hosted at Shenzhen International Center for Industrial and Applied Mathematics, May 18-20, 2024. Serve as the leading organizer
- Minisymposia (mixed mode) DD27: *Parallel Solvers for Helmholtz Problems*, 10 talks, The 27th International Domain Decomposition Conference, in Prague, Czech Republic. July 25-29, 2022. Served as the leading organizer, `https://www.dd27.cz/program/minisymposia`

Academic Visits

* indicates that financial support was given by the host

*** June 9-15, 2025**	School of Math., The University of Edinburgh	Host: Kaibo Hu
June 1-8, 2025	Depart. of Math. Sci., University of Bath	Host: Euan A. Spence
*** Sept. 26-31, 2024**	Depart. of Math., Tongji University	Host: Xuejun Xu
*** Mar. 2-7, 2020**	Section de Mathématiques, Université de Genève	Host: Martin J. Gander
Jan. 26-31, 2020	Depart. of Math. & Stat., University of Strathclyde	Host: Victorita Dolean
*** Dec. 15-21, 2019**	School of Math. Sci., Peking University	Host: Shuonan Wu
*** Dec. 1-12, 2019**	Depart. of Math., The Chinese University of Hong Kong	Host: Jun Zou
Nov. 2016 - Sep. 2017	Depart. of Comput. Sci., University of Colorado Boulder	Host: Xiao-Chuan Cai
*** Sep. 2015 – Mar. 2016**	Depart. of Math., Pennsylvania State University	Host: Jinchao Xu

Honor and Awards

- 2025-2026, **Presidential Young Fellow, Talent Program of High-Level University, CUHK, Shenzhen**
- 2024-2026, **Pearl River Young Talent, Guangdong Provincial Talent Programme**
- 2016-2017, National Scholarship, Department of Education, China
- 2013-2016, Graduate Scholarship, Peking University
- 2010-2012, Undergraduate Scholarship, Outstanding Graduate Award 2013, Sun Yat-sen University
- 2011, the second prize, China Undergraduate Mathematical Contest in Modeling, CSIAM
- 2009-2010, National Scholarship, Department of Education, China

Plenary / Invited Conference Talks

- **Plenary talk**, IMG, International Research Conference on Multi-Grid and Multi-Scale Methods in Computational Science, KAUST, Feb 3-5, 2025, `https://www.kaust.edu.sa/html/img25/`
- Invited Conference talk, 2025 International Congress of Chinese Mathematicians, 04-01-2026

Invited Minisymposium Talks

- Invited Minisymposium talk, Fast Solvers for Numerical PDEs, HKSIAM Biennial Conference, CUHK, Hong Kong, July 07-11 2025
- Invited Minisymposium talks, International Conference of Domain decomposition methods, Milano, **Italy**, June 23- 27, 2025
- Invited Minisymposium talks, 15th International Conference on Large-Scale Scientific Computations, **Sozopol, Bulgaria** June 16-20, 2025,
- Invited Minisymposium talk, **PREC24** @ Georgia Tech, Atlanta, **USA**, 11-06-24, `https://www.math.emory.edu/~yxi26/Precond24/accepted.html`
- Invited Minisymposium talk, International Conference of Domain decomposition methods, KAUST, Jeddah, **Saudi-Arabia**, Jan 28- Feb 1, 2024

Seminar & Colloquium & Workshops, Contributed Talks

- Colloquium talk, SSE Weekly Colloquium, CUHK-SZ, 30-11-2025
- Workshop talk, Seminar on fast solvers in scientific computing, Tongji University, 27-11-25
- Workshop talk , JingJinJi+Jinan Computational Mathematics Conference, 22-08-2025
- Workshop talk, The 14th China Mathematical Society Computational Mathematics Biennial Conference, 20-08-2025
- Seminar talk invited by Kaibo Hu, Edinburgh University, June 09 2025
- Seminar talk invited by Huayi Wei, Shuyun Seminar at Xiangtan University, May 24 2025
- Workshop talk, The 4th Guangdong-Hong Kong-Macao Conference on Computational Science, May 17 2025
- Workshop talk, Seminar on Mathematical Theory for FEM and DL, Nanjing Normal University, Mar. 28-31, 2025
- Workshop talk, Seminar on Numerical Computational Methods and Applications, Sichuan University, Mar. 28-31, 2025
- Workshop talk, Workshop on Advanced Solvers for Frequency-Domain Wave Problems and Applications, TSIMF, Jan 20-24, 2025
- Seminar talk invited by Zihao Ge, Henan University, 10-01-2025
- Workshop talk, Mathematics and Interdisciplinary Research Seminar, Tongji University, 15-12-2024
- Seminar talk invited by Huangxing Chen, Xiamen University, 29-11-2024
- Workshop talk, Workshop on SC and AI @ BIMSA, 03-11-2024
- Workshop talk, CSIAM, Nanjing, 27-10-2024
- Seminar talk invited by Prof. Xuejun Xu, Tongji University, 27-09-2024
- Workshop talk, The 1st Young Scholars's Workshop on Finite Element Method, Chengdu, 18-08-2024
- Workshop talk, 2024 J^{3+} Computational Mathematics Workshop, Hohhot, 23-08-2024
- Summer Course, CUHK-SZ and CUHK join summer school on scientific computing and machine learning, (08-19)-07-2024,
- Seminar talk invited by Prof. Yong Liu at LSEC, Academy of Math. and Systems Sci., 24-06-2024
- Workshop talk, Guangdong–Hong Kong–Macao Workshop on Computational Science, 15-06-2024
- Workshop talk, International Conference on Applied Mathematics, CityU of Hong Kong, 01-06-2024
- Workshop talk, **PIERS24** @ Chengdu, 24-04-2024
- Workshop talk, Workshop on Efficient Numerical Methods for PDEs, Xiangtan Univerisity, 13-04-2004
- Seminar talk, Tianyuan Mathematical Center in Central China, Wuhan University, Nov 08, 2023
- Contributed talk, International Congress of Industrial and Applied Math, Tokyo, **Japan**, Aug 20-25, 2023
- Seminar talk, Seminar on fast solvers for PDEs, Xiangtan University, Nov 12, 2023
- Seminar talk, Guangdong Province Key Laboratory of Computational Science, SYSU, June 16, 2023

- Seminar talk, Seminar on numerical PDEs, Zhejiang University, May 25, 2023
- Workshop talk, Annual Academic Conference of Guangdong Mathematical Society, Jan 06, 2023
- Poster, International Workshop On Mathematical Issues In Information Sciences, Dec 17, 2022
- Workshop talk, Forum on Mathematics and Interdisciplinary Sciences (SICIAM), Dec 14, 2022
- Workshop talk, CSIAM TM32 Non-standard Finite Element Methods, Nov 20, 2022
- Seminar talk invited by Prof. Xiaoxu Xu, Seminar at Xi'an Jiaotong University, Dec 08, 2022
- Seminar talk, SSE Weekly Colloquium at CUHK-Shenzhen, Oct 28, 2022
- Seminar talk by Prof. Shuonan Wu, Seminar at Peking University, Oct 27, 2022
- Invited MS talk, International conference of Domain Decomposition Methods, Prague (mixed mode), July 25-29, 2022
- Workshop talk, Seminar "fast algorithms and applications of solvers", Chongqing July 21, 2022
- Workshop talk, Huawei-CUHKSZ Workshop – Mathematical Problems in Industry, Shenzhen, July 08, 2022
- Seminar talk invited by Yuwei Fan, Huawei Hong kong Theory Lab, May 22, 2022
- Seminar talk invited by Prof. Guanglian Li at The Hong Kong University, March 23, 2022
- Seminar talk invited by Prof. Chensong Zhang at LSEC, Academy of Math. and Systems Sci., Dec. 2021
- Seminar talk invited by Prof. Ping Lin at School of Sci. and Eng., University of Dundee, **UK**, Dec. 2021
- Contributed talk, SIAM Conference on Computational Science and Engineering, Online, Mar. 2021
- Contributed talk, the 26th International Domain Decomposition Conference, Online, Dec. 2020
- Seminar talk, LSEC, CAS, Beijing, Dec. 2019
- Seminar talk, CAM seminar, Peking University, Dec. 2019
- Contributed MS talk, DD26 Satellite Workshop, CUHK, Hong Kong, Dec. 2019
- Contributed talk, Parallel Solution Methods for Systems Arising from PDEs, CIRM, **Luminy**, Sept. 2019
- Contributed talk, WAVES 2019, TU Wien, Vienna, Aug. 2019
- Contributed talk, 28th Biennial Numerical Analysis Conference, University of Strathclyde, June, 2019
- Seminar talk, Bath Numerical Analysis Seminar, University of Bath, Mar. 2019
- Workshop Joint Mathematics Meetings: Special Session on Numerical Methods for PDEs, Baltimore, Jan. 2019
- Seminar talk, Inverse Problems and Analysis seminar, University of Delaware, Neward, Nov. 2018
- SIAM PP18: Highly Scalable Solvers for Computational PDEs. Waseda University, Tokyo. Mar. 2018
- Seminar talk, High Performance Numerical Algorithms and Applications, TSIMF, Sanya, Jan. 2018
- The 15th Annual Meeting of CSIAM, Qindao, Oct. 2017
- Portable, Extensible Toolkit for Scientific Computation Annual Meetings, Boulder, USA, Jun. 2017
- The 18th Copper Mountain Conference on Multigrid Methods, Copper Mountain, USA, Mar. 2017

- The 9th National Finite Element Conference, E'mei, China, Aug. 2016
- The 14th Annual Meeting of CSIAM, Xiantan, Aug.2016
- Seminar talk at LSEC, Chinese Academy of Sciences, Beijing, Mar. 2016
- Seminar talk, CCMA PDEs and Numerical Methods Seminar, Penn State University, USA, Jan. 2016
- The 8th International Congress on Industrial and Applied Mathematics (ICIAM), Beijing, Aug. 2015

Skills

- **Programming**: Latex, C\C++, Matlab, MPI, Boost, Python, **iFEM**, **FreeFEM++**, **FEniCS**, **PETSc**, Paraview, CMake, Gmesh, CUDA
- **Languages**: Cantonese, Mandarin, English
- **Hobby**: Cantonese cuisine, Swimming

Last updated: May 19, 2026