Shubin Fu

Contact Information	Eastern Institute for Advanced Study, Ningbo, China shubinfu@eias.ac.cn
Personal information	Date of Birth: Feb. 1989 Place of Birth: JiuJiang, JiangXi

Research Interests	Multiscale Model Reduction, Scientific Computing, Subsurface Modeling, Data Assimilation, Uncertainty Quantification.

Education

Texas A&M University, College Station, TX, USA

Ph.D., Mathematics, Aug. 2017

- Thesis Topic: *Some Applications of the Generalized Multiscale Finite Element Method*
- Advisor: Yalchin Efendiev

Sichuan University, Chengdu, China

B.S., Mathematics, Jun. 2011

Employment

Assistant Professor, Eastern Institute for Advanced Study Jan. 2023 – present
Research Associate, The Chinese University of Hong Kong Aug. 2022 – Dec. 2022
Van Vleck Visiting Assistant Professor, University of Wisconsin – Madison Mar. 2020 – Jul. 2022
Postdoctoral Fellow, The Chinese University of Hong Kong Jul. 2018 – Feb. 2020
Research Assistant, The Chinese University of Hong Kong Jan. 2018 – Jun. 2018

Accepted Journal papers (**underline** indicates first author or corresponding author)

35. Zhongqian Wang, **Shubin Fu** and Eric Chung. Local multiscale model reduction using discontinuous Galerkin coupling for elasticity problems. *Computer Methods in Applied Mechanics and Engineering* 403 (2023):115713.
34. **Shubin Fu**, Eric Chung and Lina Zhao. Generalized multiscale finite element method for highly heterogeneous compressible flow. *SIAM Multiscale Modeling & Simulation* 20(4), (2022): 1437-1467.
33. Yiran Wang, Eric Chung and **Shubin Fu**. A deep learning based reduced order modeling for stochastic underground flow problems. *Journal of Computational Physics* 467 (2022): 111449.
32. Tak Shing Au Yeung, Charles Cheung, Eric Chung, **Shubin Fu** and Jianliang Qian. Learning rays via deep neural network in a ray-based IPDG method for high-frequency Helmholtz equations in inhomogeneous media. *Journal of Computational Physics* 465 (2022): 111380.
31. Yanfang Yang, **Shubin Fu** and Eric Chung. An adaptive generalized multiscale finite element method based two-grid preconditioner for large scale high-contrast linear elasticity problems. *Journal of Scientific Computing* 92(1) (2022):1-22.
30. Yiran Wang, Eric Chung and **Shubin Fu**. A local-global generalized multiscale finite element method for highly heterogeneous stochastic groundwater flow problems. *Computer Methods in Applied Mechanics and Engineering* 392 (2022):114688.
29. Nan Chen, **Shubin Fu** and Georgy Manucharyan. An efficient and statistically accurate Lagrangian data assimilation algorithm with applications to discrete element sea ice models. *Journal of Computational Physics* 455 (2022): 111000.

28. Nan Chen, **Shubin Fu** and Georgy Manucharyan. Lagrangian data assimilation and parameter estimation of an idealized sea ice discrete element model. *Journal of Advances in Modeling Earth Systems*, 13, e2021MS002513.

27. Yiran Wang, Eric Chung, **Shubin Fu** and Michael Presho. Online conservative generalized multiscale finite element method for flow models. *Computational Geoscience* 25 (2021), 997-1010.

26. **Shubin Fu**, Eric Chung and Guanglian Li. An Edge Multiscale Interior Penalty Discontinuous Galerkin method for heterogeneous Helmholtz problems with large varying wavenumber. *Journal of Computational Physics* 441 (2021): 110387.

25. Yiran Wang, Eric Chung, **Shubin Fu** and Zhaoqin Huang. A comparison of mixed multiscale finite element methods for multiphase transport in highly heterogeneous media. *Water Resources Research* 57 (5): e2020WR028877.

24. **Shubin Fu** and Zhidong Zhang. Application of the generalized multiscale finite element method in an inverse random source problem. *Journal of Computational Physics* 429 (2021): 110032.

23. Xia Wang, Eric Chung, **Shubin Fu** and Zhaoqin Huang. Mixed GMsFEM for linear poroelasticity problems in heterogeneous porous media. *Journal of Computational and Applied Mathematics* 390 (2021): 113383.

22. **Shubin Fu**, Guanglian Li, Richard Craster and Sébastien Guenneau. Wavelet-based Edge Multiscale Finite Element Method for Helmholtz problems in perforated domains. *SIAM Multiscale Modeling & Simulation* 19(4), (2021): 1684-1709.

21. Weijun Ma and **Shubin Fu**. A hybridizable discontinuous Galerkin Generalized Multiscale Finite element method for highly heterogeneous linear elasticity problems. *Journal of Computational and Applied Mathematics* 383 (2021) 113124.

20. **Shubin Fu**, Eric Chung and Tina Mai. Constraint energy minimizing generalized multiscale finite element method for nonlinear poroelasticity and elasticity. *Journal of Computational Physics* 417 (2020):109569.

19. Yanfang Yang, **Shubin Fu** and Eric Chung. Online mixed multiscale finite element method with oversampling and its applications. *Journal of Scientific Computing* 82(2) (2020):1-20.

18. **Shubin Fu** and Eric Chung. Constraint Energy Minimizing Generalized Multiscale Finite Element Method for high-contrast linear elasticity problem. *Communication in Computational Physics* 27(3) (2020): 809-827.

17. **Shubin Fu** and Eric Chung. A local-global multiscale mortar mixed finite element method for multiphase transport in heterogeneous media. *Journal of Computational Physics* 399 (2019):108906.

16. **Shubin Fu**, Kai Gao and Eric Chung. A high-order multiscale finite-element method for time-domain elastic wave modeling in strongly heterogeneous media. *Journal of Applied Geophysics* 170 (2019): 103852.

15. **Shubin Fu**, Eric Chung and Guanglian Li. Edge Multiscale Methods for elliptic problems with heterogeneous coefficients. *Journal of Computational Physics* 396 (2019): 228-242.

14. Yanfang Yang, Ke Shi and **Shubin Fu**. Multiscale hybridizable discontinuous Galerkin method for flow simulations in highly heterogeneous media. *Journal of Scientific Computing* 81(3) (2019):1712-1731.

13. **Shubin Fu**, Robert Altmann, Eric Chung, Roland Maier, Daniel Peterseim and Sai-Mang Pun. Computational Multiscale Methods for Linear Poroelasticity with High Contrast. *Journal of Computational Physics* 395 (2019): 286-297.

12. **Shubin Fu**, Kai Gao, Eric Chung and Richard L. Gibson. An efficient high-order multiscale finite-element method for frequency-domain elastic wave modeling. *Computational Geoscience* 23 (2019): 997-1010.

11. Yanfang Yang, **Shubin Fu** and Eric Chung. A two-grid preconditioner with an adaptive coarse space for flow simulations in highly heterogeneous media. *Journal of Computational Physics* 391 (2019): 1-13.

10. **Shubin Fu**, Eric Chung and Tina Mai. Generalized multiscale finite element method for a strain-limiting nonlinear elasticity model. *Journal of Computational and Applied Mathematics* 359 (2019): 153-165.

9. Yongchae Cho, Richard L. Gibson Jr, Shubin Fu and Yalchin Efendiev. Frequency-domain reverse-time migration with accelerated wave simulation via generalized multiscale finite element. *Journal of Applied Geophysics* 160, (2019):103-120.

8. Kai Gao, **Shubin Fu** and Eric Chung. An Efficient Multiscale Finite Element Method for Frequency-Domain Seismic Wave Propagation. *Bulletin of the Seismolo gical Society of America* 108, no. 2 (2018): 966-982.

7. Kai Gao, **Shubin Fu** and Eric Chung. A high-order multiscale finite-element method for time-domain acoustic-wave modeling. *Journal of Computational Physics* 360 (2018): 120-136.

6. Yanfang Yang, Eric Chung and **Shubin Fu**. Residual driven online mortar mixed finite element methods and applications. *Journal of Computational and Applied Mathematics* 340 (2018): 318-333.

5. Yanfang Yang, Eric Chung and **Shubin Fu**. An Enriched Multiscale Mortar Space for High Contrast Flow Problems. *Communication in Computational Physics* 23(4) (2018): 476-499.

4. **Shubin Fu** and Kai Gao. A fast solver for the Helmholtz equation based on the generalized multiscale finite-element method. *Geophysical Journal International* 211, no. 2 (2017): 819-835.

3. Kai Gao, Eric Chung, Richard L. Gibson Jr, Shubin Fu and Yalchin Efendiev. A numerical homogenization method for heterogeneous, anisotropic elastic media based on multiscale theory. *Geophysics* 80, no. 4 (2015): D385-D401.

2. Kai Gao, Shubin Fu, Richard L. Gibson, Eric Chung and Yalchin Efendiev. Generalized multiscale finite-element method (GMsFEM) for elastic wave propaga tion in heterogeneous anisotropic media. *Journal of Computational Physics* 295 (2015): 161-188.

1. Eric Chung, Yalchin Efendiev and **Shubin Fu**. Generalized multiscale finite element method for elasticity equations. *GEM-International Journal on Geomathe matics* 5, no. 2 (2014): 225-254. (authors are ordered in alphabetic).

Papers under review

4. Nan Chen, **Shubin Fu**. Uncertainty Quantification of Nonlinear Lagrangian Data Assimilation Using Linear Stochastic Forecast Models. arXiv:2210.16432.

3. Zhongqian Wang, **Shubin Fu**, Zishang Li and Eric Chung. A discontinuous Galerkin based multiscale method for heterogeneous elastic wave equations. arXiv:2207.04567.

2. **Shubin Fu**, Eric Chung and Lina Zhao. An efficient multiscale preconditioner for large-scale highly heterogeneous flow. (Submitted to *SIAM Journal on Scientific Computing*, under review).

1. Yiran Wang, Eric Chung and **Shubin Fu**. A conservative multiscale method for stochastic highly heterogeneous flow. arXiv:2203.11735 (Submitted to *Computer Methods in Applied Mechanics and Engineering*, under review).

Accepted conference papers

4. Yiran Wang, Eric Chung and Shubin Fu. Adaptive Multiscale Model Reduction for Nonlinear Parabolic Equations Using GMsFEM. *International Conference on Computational Science*. Springer, Cham, 2020: 116-132.

3. Yongchae Cho, Richard L Gibson and Shubin Fu. A model reduction approach for full-waveform inversion via generalized multiscale finite elements. In *SEG Technical Program Expanded Abstracts* 2018, pp. 1113-1117. Society of Exploration Geophysicists, 2018.

2. Richard L. Gibson and Shubin Fu. Reverse time migration based on generalized multiscale finite element forward modeling. In *SEG Technical Program Expanded Abstracts* 2015, pp. 4137-4142. Society of Exploration Geophysicists, 2015.

1. **Shubin Fu**, Yalchin Efendiev, Kai Gao and Richard L. Gibson. Multiscale modeling of acoustic wave propagation in 2D heterogeneous media using local spectral basis functions. In *SEG Technical Program Expanded Abstracts* 2013, pp. 3553-3558. Society of Exploration Geophysicists, 2013.

Talks & Poster Presentations

- 6^{th} Coastal Bend Mathematics & Statistics Conference, Texas Apr. 2022
- Hong Kong University Numerical Analysis Seminar, Hong Kong SAR Feb. 2022
- AGU Fall Meeting 2021, New Orleans, LA Dec. 2021
- 26th International Domain Decomposition Conference, Hong Kong SAR Dec. 2020
- SIAM Conference on Applied Linear Algebra 2018, Hong Kong SAR May. 2018
- Society of Exploration Geophysicists 85th Annual Meeting, New Orleans, LA Oct. 2015
- 8th International Congress on Industrial and Applied Mathematics (ICIAM), Beijing, China Aug. 2015
- Society of Exploration Geophysicists 83rd Annual Meeting, Houston, TX Sep. 2013

Research Visits

- Guangzhou University, Guangzhou, China Jun. 2018
- Hunan University, Changsha, China Dec. 2016
- The Chinese University of Hong Kong, Hong Kong SAR Dec. 2016
- Hunan University, Changsha, China Aug. 2015
- The Chinese University of Hong Kong, Hong Kong SAR Jul. 2015
- The Chinese University of Hong Kong, Hong Kong SAR Aug. 2014
- Numerical Porous Media SRI Center, Thuwal, Saudia Arabia Jun. 2014

Students mentored

- Xia Wang (2017-2021, Ph.D. CUHK, placement obtained after graduation: HuaWei)
- Yiran Wang (2018-2022, Ph.D. CUHK, placement obtained after graduation: Golomb Visiting Assistant Professor at Purdue University)
- Zhongqian Wang (2020-present, Ph.D. Candidate, CUHK)

Teaching Experience

Instructor Spring 2022
Math 321 - Applied Mathematical Analysis

Instructor Fall 2021

Math 211 - Calculus

Instructor — Spring 2021
Math 320 - Linear Algebra and Differential Equations

Instructor — Fall 2020
Math 320 - Linear Algebra and Differential Equations

Grader — Spring 2017
Math 642 - Analysis for Applications II

Recitation — Fall 2016
Math 437 - Principles of Numerical Analysis

Instructor — Summer 2016
Math 131 - Mathematical Concepts-Calculus

Recitation — Spring 2014
Math 148 - Calculus II for Biological Sciences

Recitation — Fall 2012
Math 151 - Engineering Mathematics I

Grader — Spring 2012
Math 414 - Fourier Series and Wavelets

Help Session — Fall 2011
Math 409 - Advanced Calculus I

Referee for

Journal of Computational Physics
Computer Physics Communications
SIAM Multiscale Modeling & Simulation
Geophysics
Journal of Computational and Applied Mathematics
Journal of Advances in Modeling Earth Systems
Applied Mathematics and Computation
Journal of Petroleum Science and Engineering
Composite Structures
International Journal of Computer Mathematics
IMA Journal of Numerical Analysis
Calcolo