LU ZHANG

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Department of Applied Physics and Applied Mathematics
Columbia University, 500 W. 120th Street Num. 200, New York, NY 10027

EMPLOYMENT

Columbia University, New York, NY, USA Jul. 2020 - now
Assistant Professor of Applied Mathematics (non-tenure track)

EDUCATION

Southern Methodist University, Dallas, TX, USA Aug. 2017 - May 2020
Ph.D. in Computational and Applied Mathematics
Advisor: Prof. Thomas Hagstrom
Department of Mathematics

Southern Methodist University, Dallas, TX, USA Aug. 2015 - May 2017
M.S. in Computational and Applied Mathematics
Advisor: Prof. Thomas Hagstrom
Department of Mathematics

RESEARCH INTERESTS

- **Numerical Analysis**: finite element methods, discontinuous Galerkin methods, summation-by-parts finite difference methods
- **Data-Driven Computational Inversion**: inverse problems, imaging, fast algorithms, deep learning
- **Computational Optimization**: optimization under uncertainty, robust optimization
- **Mathematical Biology**: chemotaxis, population dynamics, pattern formation

GRANTS

- **AMS-Simons Travel Grant** ($5,000) Jul. 2022 - Jun. 2024

PUBLICATIONS

- **Journal Papers:**

19. *An energy based discontinuous Galerkin method with tame CFL numbers for the wave equation*, D. Appelö, **L. Zhang**, T. Hagstrom and F. Li, **accepted by BIT Numer. Math.**, (2022)
18. *A high order finite difference method for the elastic wave equation in bounded domains with nonconforming interfaces*, **L. Zhang**, S. Wang. **SIAM J. Numer. Anal.**, 60(3), 1516-1547 (2022)
17. *Energy-based discontinuous Galerkin difference methods for second-order wave equations*, **L. Zhang**, D. Appelö and T. Hagstrom. **Comm. Appl. Math. Comput.**, 4, 855-879 (2022)
16. *Understanding the effects of on- and off-hotspot policing: Evidence of hotspot, oscillating and chaotic activities*, N. Rodriguez, Q. Wang, and **L. Zhang**. **SIAM J. Appl. Dyn. Syst.**, 20(4), 1882-1916 (2021)
15. *Elastic wave propagation in curvilinear coordinates with mesh refinement interfaces by a fourth order finite difference method*, **L. Zhang**, S. Wang and N.A. Petersson. **SIAM J. Sci. Comput.**, 43(2), A1472-A1496 (2021)
14. *An energy-based discontinuous Galerkin method for semilinear wave equations*, D. Appelö, T. Hagstrom, Q. Wang and **L. Zhang**. **J. Comput. Phys.**, 418, 109608 (2020)

13. *Phase transitions and bump solutions of the Keller–Segel model with volume exclusion*, J. A. Carrillo, X. Chen, Q. Wang, Z. Wang and **L. Zhang**. **SIAM J. Appl. Math.**, 80(1), 232-261(2020)
12. *An energy-based discontinuous Galerkin method for the wave equation with advection*, **L. Zhang**, T. Hagstrom and D. Appelö. **SIAM J. Numer. Anal.**, 57(5), 2469-2492(2019)
11. *Convergence analysis of a discontinuous Galerkin method for wave equations in second-order form*, Y. Du, **L. Zhang** and Z. Zhang. **SIAM J. Numer. Anal.**, 57(1), 238-265(2019)
10. *Time-periodic and stable patterns of two-competing Keller–Segel chemotaxis model: Effect of cellular growth*, Q. Wang, J. Yang, and **L. Zhang**. **Discrete Contin. Dyn. Syst. Ser. B**, 22(9), 3547-3574(2017)
9. *On the multi-dimensional advective Lotka–Volterra competition systems*, Q. Wang, and **L. Zhang**. **Nonlinear Anal. Real World Appl.**, 37, 329-349(2017)
8. *Global existence and steady states of a two competing species Keller–Segel chemotaxis model*, Q. Wang, **L. Zhang**, J. Yang and J. Hu **Kinet. Relat. Models**, 8(4), 777-807(2015)

- **Conference Proceedings:**

7. *Discontinuous Galerkin Methods for Electromagnetic Waves in Dispersive Media,* T. Hagstrom, D. Appelö, and **L. Zhang. 2021 International Applied Computational Electromagnetics Society Symposium**, 1-4 (2021)

- **Preprints:**

6. Data-driven joint inversion for PDE models, K. Ren, **L. Zhang**, submitted, **arxiv: 2210.09228**
5. *Coupling deep learning with full waveform inversion*, W. Ding, K. Ren, **L. Zhang**, submitted, **arxiv: 2203.01799**
4. *An energy-based discontinuous Galerkin method for a nonlinear variational wave equation*, joint with D. Appelö, and T. Hagstrom, **available on request**
3. *Discontinuous Galerkin methods for a first-order semi-linear hyperbolic continuum model of topological resonators*, joint with Q. Du, and M. Weinstein, **available on request**
2. *A discontinuous Galerkin method for nonlienar biharmonic Schrödinger equations*, **L. Zhang**. submitted, **arxiv: 2109.07034**
1. *A local energy-based discontinuous Galerkin for fourth order semilinear wave equations*, **L. Zhang**. submitted, **arxiv: 2109.07033**

PRESENTATIONS

- **Invited and Contributed:**
  - University of Maryland College Park (Seminar) Nov. 2022
  - 5th Annual Meeting of the SIAM Texas-Louisiana Section, University of Houston Nov. 2022
  - Workshop on New Ideas in Computational Inverse Problems, Banff International Research Station, Banff, Alberta, Canada Oct. 2022
  - Dartmouth College (Seminar) Oct. 2022
  - Karlsruhe Institute of Technology, Germany (Seminar) Oct. 2022
  - 7th Annual Meeting of the SIAM Central States Section, Oklahoma State University Oct. 2022
  - Sayas Numerical Day 2022, University of Maryland, Baltimore County Sep. 2022
  - North American High Order Methods Conference, San Diego State University Jul. 2022
  - 4th Annual Meeting of the SIAM Texas-Louisiana Section, University of Texas Rio Grande Valley, TX Nov. 2021
  - SIAM Conference on Computational Science and Engineering, Virtual Mar. 2021
  - 3nd Annual Meeting of SIAM Texas-Louisiana Section, Virtual Oct. 2020
  - Columbia University in the City of New York (Seminar) Jan. 2020
  - 2nd Annual Meeting of SIAM Texas-Louisiana Section, Southern Methodist University, Dallas, TX Nov. 2019

- 1st North American High-Order Methods Conference, San Diego State University JUN., 2019
- Finite Element Rodeo, University of Texas at Austin MAR. 2019
- Research Day, Southern Methodist University MAR., 2019
- SIAM TX-LA Sectional Meeting and LSU-UH-TAMU Undergraduate Conference, Louisiana State University OCT., 2018
- Argonne National Laboratory AUG. 2018
- 13th World Congress on Computational Mechanics, New York JUL. 2018
- Research Day, Southern Methodist University MAR. 2018
- Texas Applied Mathematics and Engineering Symposium, University of Texas at Austin, Austin, TX SEP. 2017
- Finite Element Rodeo, University of Houston MAR. 2017

EXPERIENCE

- **Student Research Assistant:**
  - Development of high-order methods for wave propagation, Department of Mathematics, **Southern Methodist University (SMU)**, *Advisor:* Thomas Hagstrom AUG. 2015 - MAY. 2020
- **Student Intern:**
  - Developing high-order accurate scheme for seismic problem, Computation Scholar Program in **Lawrence Livermore National Laboratory**, *Mentor:* Anders Petersson SUMMER 2019
  - Implement Multirate Solver to PETSc Library, Mathematics and Computer Science in **Argonne National Laboratory**, *Mentor:* Hong Zhang SUMMER 2018

TEACHING

- **Columbia University - Instructor**
  - Methods in Computational Science (APMA E4302) Spring 2023
  - Numerical Analysis for PDEs (APMA E6302) Spring 2022
  - Numerical Analysis and Optimization (APMA E4990) Spring 2021, Fall 2021, Fall 2022
  - Principles of Applied Mathematics (APMA E4001) Fall 2020
- **Southern Methodist University - Teaching Assistant**
  - Introduction to Scientific Computing (Math 3315) Spring 2019
  - Boundary Value Problems and Partial Differential Equations (Math 4337) Spring 2019
  - Introduction to Mathematical Sciences (Math 1307) Fall 2016, Spring 2017
  - Introduction to Linear Algebra (Math 3353) Spring 2016
  - Introduction to Calculus for Business and Social Science (Math 1309) Fall 2016

SUPERVISING

- **Ph.D. students** (Columbia University)
  - Wen Ding. Computational inversion with Wasserstein distances and neural network induced loss functions (with K. Ren) graduated in AUG. 2022
  - Yin Zhou. An energy-based discontinuous Galerkin method for nonlinear Schrödinger equations with wave operator (with K. Ren) expected graduate in MAY. 2025
- **M.S. students** (Columbia University)
  - Steve Li. An energy-based discontinuous Galerkin method for wave equations with random coefficient expected graduate in MAY. 2023
  - Kaisun Lin. An energy-based discontinuous Galerkin method for wave equations with random coefficient expected graduate in MAY. 2023
- **Undergraduates** (Columbia University)
  - Joonsoo Lee. Finite element analysis expected graduate in MAY. 2024

SCHOLARSHIPS AND AWARDS

- **Dean's Dissertation Fellowship**, SMU — Sep. 2019 - May. 2020
- **Travel Award**, North American High Order Methods Conference — Jun. 2019
- **Graduate Student Travel Grant Award**, Dedman College, SMU — Mar. 2019
- **Betty McKnight Speairs Math Award**, Department of Mathematics, SMU — May. 2019
- **Betty McKnight Speairs Math Award**, Department of Mathematics, SMU — May. 2017
- **National Scholarship**, Ministry of Education of the People's Republic of China — Nov. 2013

PROFESSIONAL SERVICE

- **Referee:** SIAM J Sci. Comput., Mathematical Reviews
- **Mini-symposium:**
  - Numerical Methods for Time Dependent PDEs, SIAM Conference on Computational Science and Engineering (with D. Appelö, and T. Hagstrom) — Mar. 2021
  - Inverse Problems and Reduced Order Modeling for Wave Propagation, 17th U.S. National Congress on Computational Mechanics (with D. Appelö, and T. Hagstrom) — Jul. 2023
- **Workshop:**
  - Recent Advances and Developments in Computational Mathematics, Columbia University (with Q. Du, and K. Ren) — May. 2023
- **Departmental Service at Columbia University**
  - Seminar organizer of the APAM Friday Research Conference — fall 2020, fall 2021, fall 2022
  - Secretary of the Faculty — spring 2021, fall 2021, fall, 2022
- **Ph.D. Thesis Committee**
  - Wen Ding (Advisor: Kui Ren, Columbia University) — Aug. 2022