

# Curriculum Vitae

Zhengfu Xu

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## Education

- *Ph.D. in Applied Mathematics, Brown University, Providence, RI, May 2005.*  
**Thesis Title:** Anti-diffusive Flux Corrections for High Order Finite Difference WENO Schemes.  
**Advisor:** Professor Chi-Wang Shu
- *M.Sc. in Computational Mathematics, Peking University, Beijing, P.R. China, June 2000.*  
**Thesis Title:** Stability of Boundary Integral Method for Water Wave.  
**Advisor:** Professor Pingwen Zhang
- *B.Sc. in Computational Mathematics, Peking University Beijing, P.R. China, June 1997.*

## Academic Experience

- Associate Professor: Department of Mathematical Sciences, Michigan Technological University, 2014 – present.
- Assistant Professor: Department of Mathematical Sciences, Michigan Technological University, 2011 – 2014.
- Visiting Assistant Professor: Department of Mathematics, Michigan State University. Supervisors: Gang Bao, Andrew Christlieb, 2008 – 2011.
- S. Chowla Research Assistant Professor: Department of Mathematics, Penn State University. Supervisor: Jinchao Xu, 2005 – 2008.
- Research Assistant: Division of Applied Mathematics, Brown University, 2003 – 2005.
- Teaching Assistant: Division of Applied Mathematics, Brown University, 2002 – 2003.

## Awards and Grants

- Junior faculty research award, Department of Mathematical Sciences, Michigan Technological University, 2012 – 2013.
- Sole PI, NSF grant- DMS-1316662 “High Order Maximum Principle Preserving Finite Difference Schemes for Hyperbolic Conservation Laws,” in the amount of \$226,349, 2013–2016.
- Co-PI, Elastography-based Analytics for Benign and Malignant Breast Disease, expected to be funded on August.

## Peer-Reviewed Publications

1. S.L. Wang, Z. Xu, *Total variation bounded flux limiters for high order finite difference schemes solving one-dimensional scalar conservation laws*, Mathematics of Computation 2018, DOI: <https://doi.org/10.1090/mcom/3364>.
2. Z. Xu, X. Zhang, *Bound-preserving high order schemes*, Handbook of Numerical Methods for Hyperbolic Problems: Part B, Elsevier 2017.
3. D.C. Seal, Q. Tang, Z. Xu and A.J. Christlieb, *An explicit high-order single-stage single-step positivity-preserving finite difference WENO method for the compressible Euler equations*, Journal of Scientific Computing, 67-1 (2016), 171–190.
4. T. Xiong, J.-M Qiu and Z. Xu, *Parametrized positivity preserving flux limiters for high order finite difference WENO scheme solving compressible Euler equations*, Journal of Scientific Computing, 67-3 (2016), 1066–1088.

5. A. Christlieb, Y. Liu, Q. Tang and Z. Xu, *Positivity-preserving finite difference weighted ENO Schemes with Constrained Transport for Ideal Magnetohydrodynamic Equations*, SIAM Journal on Scientific Computing, 37-4 (2015), A1825–A1845.
6. P. Yang, T. Xiong, J.-M. Qiu, and Z. Xu, *High order maximum principle preserving finite volume method for convection dominated problems*, Journal of Scientific Computing, 67-2 (2016), 795–820.
7. A. Christlieb, Y. Liu and Z. Xu, *High order operator splitting methods based on an integral deferred correction framework*, Journal of Computational Physics, 294 (2015), 224–242.
8. T. Xiong, J. Qiu and Z. Xu, *High order maximum-principle-preserving discontinuous Galerkin method for convection-diffusion equations*, SIAM Journal on Scientific Computing, 37-2 (2015), 583–608.
9. L. Guo, J.-F. Jiang, Y. Xu, and Z. Xu, *A PDE-based regularization algorithm toward reducing speckle tracking noise: A feasibility study for ultrasound breast elastography*, Ultrasonic Imaging, 37-4 (2015), 277–293.
10. A. Christlieb, Y. Liu, Q. Tang and Z. Xu, *Parametrized Maximum-principle-preserving and positivity-preserving flux limiter for WENO schemes on unstructured meshes*, Journal of Computational Physics, 281(15) (2015), 334–351.
11. R. Guo, Y. Xu, and Z. Xu, *Local discontinuous Galerkin methods for the functionalized Cahn-Hilliard equation*, Journal of Scientific Computing. 63(3) (2015), 913–937.
12. T. Xiong, J.-M. Qiu, A. Christlieb and Z. Xu, *High order maximum principle preserving semi-Lagrangian finite difference WENO schemes for the Vlasov equation*, Journal of Computational Physics, 273 (2014), 618–639.
13. Y. Jiang, Z. Xu, *Parametrized maximum principle preserving limiter for finite difference WENO schemes solving convection-dominated diffusion equations*, SIAM Journal on Scientific Computing, 35(6) (2013), 2524–2553.
14. T. Xiong, J.-M. Qiu and Z. Xu, *A parametrized maximum principle preserving flux limiter for finite difference RK-WENO schemes with applications in incompressible flows*, Journal of Computational Physics, 252 (2013), 310–331.
15. C. Liang, Z. Xu, *Parametrized maximum principle preserving flux limiters for high order schemes solving multi-dimensional scalar hyperbolic conservation laws*, Journal of Scientific Computing, 58 (2014), 41–60.
16. Z. Xu, *Parametrized maximum principle preserving flux limiters for high order schemes solving hyperbolic conservation laws: one-dimensional scalar problem*, Mathematics of Computation, 83 (2014), 2213–2238.
17. K. Promislow, J. Jones, Z. Xu, N. Gavish and A. Christlieb, *Variational models of pore networks in ionomer membranes: The role of electrostatics*, DOI: 10.1149/05002.0161ecst ECS (The Electrochemical Society) Trans., 50 (2013) 2,161–173.
18. Z. Xu, A. Christlieb and K. Promislow, *On the nonlinear unconditionally gradient scheme for Cahn-Hilliard equation and its implementation with Fourier method*, Communications in Mathematical Sciences, 11(2)(2013), 345–360.
19. N. Gavish, J. Jones, Z. Xu, A. Christlieb, and K. Promislow, *Variational Models of Network Formation and Ion Transport: Applications to Ionomer Membranes*, Polymers, 4(1) (2012), 630–655.
20. G. Bao, Z. Xu and J. Yuan, *Continuation finite element simulation of second harmonic generation*, Communications in Computational Physics, 10 (2011), 57–69.
21. Z. Xu, J. C. Xu and C.-W. Shu, *A high order adaptive finite element method for solving nonlinear hyperbolic conservation laws*, Journal of Computational Mathematics. 29 (2011), 491–500.
22. G. Bao, Y. Dou, T. Ehlers, P. Li, Y. Wang, and Z. Xu, *Quantifying tectonic and geomorphic interpretations of thermochronometer data with inverse problem theory*, Communications in Computational Physics, 9 (2011), 129–146.
23. Z. Xu, and G. Bao, *A numerical scheme for nonlinear Helmholtz equations with strong nonlinear optical effects*, Journal of the Optical Society of America A, 27 (11) (2010), 2347–2353.

24. W. Shen and Z. Xu, *Vanishing viscosity approximation to hyperbolic conservation laws*, Journal of Differential Equations, 244 (2008), 1697–1711.
25. Z. Xu and C.-W. Shu, *Anti-diffusive finite difference WENO methods for shallow water with transport of pollutant*, Journal of Computational Mathematics, 24 (2006), 239–251.
26. Z. Xu and C.-W. Shu, *Anti-diffusive high order WENO schemes for Hamilton-Jacobi equations*, Method and Application of Analysis, 12 (2005), 169–190.
27. Z. Xu and C.-W. Shu, *Anti-diffusive flux corrections for high order finite difference WENO schemes*, Journal of Computational Physics, 205 (2005), 458–485.
28. Z. Xu and P. Zhang, *Stability of boundary integral method for water wave*, Math. Numer. Sin. 24 (2002), no. 3, 311–318.

## Conference Proceedings

29. J. Jones, Z. Xu, A. Christlieb and K. Promislow, *Using GPGPU to Enhance Simulation of the Functionalized Cahn-Hilliard Equation*, 2012 Symposium on Application Accelerators in High-Performance Computing, (SAAHPC 2012).
30. J. F Jiang, Z. Xu, *Regularization of phase-contrast MRI velocity measurements: Initial in VIVO experience in a canine aneurysm model*, extended abstract accepted by ASME 2013 Summer Bioengineering Conference for podium presentation.

## Papers in Preparation

- J. Jones, Z. Xu, A. Christlieb and K. Promislow, *Fast and accurate simulation of long-time adiabatic evolution of functionalized polymer solvent with gradient stable scheme.*
- H. Yang, F. Li, Z. Xu, *Positivity-preserving and locally divergence-free discontinuous Galerkin methods for the magneto-hydrodynamic equations.*
- Y Jiang, Z. Xu, *Maximum principle preserving high order IMEX methods for convection diffusion equations.*
- L. Guo , B. Peng , K. Flinckinger , Z. Xu , J. Jiang, *Noise Reduction in Velocity Measurements of Phase-Contrast Magnetic Resonance Angiography (PC-MRA) toward Characterization of Intra-aneurismal Hemodynamics in Cerebral Aneurysms*, under revision.

## Research Interests

- Extensive study and application of high order finite difference and finite volume ENO/WENO methods: anti-diffusive flux correction method for hyperbolic conservation laws and Hamilton-Jacobi equations; maximum principle and positivity preserving flux limiters for high order methods solving conservation laws, Vlasov equations and compressible fluid problems. Also interested in other high order numerical methods: discontinuous Galerkin method, spectral method and their applications in multi-phase fluid and plasma simulation.
- Nonlinear optics: numerical methods and computation for second harmonic generation and Kerr type nonlinear optical phenomena.
- Mathematical image processing: mathematical imaging approach for evaluating the rupture risk of intracranial aneurysm; the breast lesion mobility assessment through mathematically reducing the noise in ultrasound elastography.
- Computational polymer chemistry: macroscopic phase field modeling of curvature driven flow; designing accurate, stable numerical schemes for simulation.

## Teaching Experiences

- Taught undergraduates Calculus, Elementary Differential Equations and Boundary Value Problems at Pennsylvania State University, 2005 – 2008.

- Taught undergraduates Calculus at Michigan State University, 2008 – 2010.
- Taught undergraduates Calculus and graduates Numerical Partial Differential Equations (finite element methods), Numerical Partial Differential Equations (finite difference methods), 2011 – 2013.

### **Student Advising at Michigan Technological University**

- Advisor of master’s degree candidate Ms Yi Jiang (graduated on July 2013), PhD candidate Andrew Boettcher (dropped out of PhD program) and PhD candidate Ms Ying Zhang.
- Member of the thesis committee for Mr David Fritz (PhD), Yichao Deng, Lengfei Han and Mr Rohan Sali from Engineering department, Mr Ahmad Baniabedlruhman and Mr Chao Liang (PhD) from Mathematical Science department.
- Project advisor for undergraduate Zejia Zhou on “Fourier Spectral Methods Solving Differential Equations”, 2012. Project advisor for undergraduate Holly Zehfus on “Improve Magnetic-Resonant-Imaging Using Mathematical Regularization”, 2014.
- Advisor for Summer Undergraduate Research Fellowship (SURF) undergraduate student Kimberly Stanke on “Mathematical Image Processing of MRI Images”, 2012 – 2013.

### **Professional Services at Michigan Technological University**

- Member of the department graduate committee, 2011 – 2012.
- Member of the department faculty recruiting committee, 2012 – 2013.
- Member of the department advisory committee and faculty recruiting committee, 2013 – 2014.

### **Conferences/Seminars**

Organizer of:

- The mini-symposium “High Order WENO and DG Methods for Hyperbolic Conservation Laws and Hamilton-Jacobi Equations” at the ICOSAHOM, Salt Lake City, June 23 – 27, 2014.
- ICERM workshop “Bridging Scales in Computational Polymer Chemistry”, Brown University, Providence, RI, August 6 – 10, 2012.
- The mini-symposium “Theory, Modeling and Simulation of Polyelectrolyte Membranes” at the 7th International Congress on Industrial and Applied Mathematics - ICIAM, Vancouver, BC, Canada, July 18 – 21, 2011.

Speaker at:

- The 8th International Congress on Industrial and Applied Mathematics, Beijing China, August 8-14, 2015.
- Beijing Computational Science Research Center (CSRC) seminar, Beijing, China, July 2, 2014.
- The 11th Young Scholars Forum at Beijing University of Posts and Telecommunications, Beijing, China, July 1, 2014.
- Department of Mathematics and Statistics, Wuhan University, Wuhan, China, June 12 – 14, 2014.
- Institute of Applied Physics and Computational Mathematics of China (IAPCM), Beijing, China, May 27, 2014.
- Sino-German Symposium on Modern Numerical Methods for Compressible Fluid Flows and Related Problems, Sino-Germany center, Beijing, China, May 21 – 27, 2014.
- “Graduate Education Innovation Program: High-Level Academic Forefront of Talks”, University of Science and Technology of China, Hefei, China, May 12 – 14, 2014.

- SIAM annual meeting, San Diego, July 2013; SIAM PD13 mini-symposium, Orlando, December 2013.
- The 1st Chongqing Workshop on Computational and Applied Mathematics, Chongqing University, Chongqing, China, May 30 – June 2, 2013.
- The 2nd International Workshop on Development and Application of High-Order Numerical Methods, Xiamen University, Xiamen, China, May 18 – 21, 2013.
- The Scientific Computing seminar, Department of Mathematics, University of Houston, 2012.
- The Applied Mathematics seminar, Department of Mathematics, Michigan State University, 2012.
- SIAM annual meeting in Minneapolis, July 2012.
- International Conference on Applied Mathematics, City University of Hong Kong, Hong Kong, May 2012.
- Computational and Applied Mathematics seminar, Iowa State University, March 28, 2011.
- Participant at NSF workshop on “Mathematical Modeling and Computer Simulation for Soft Materials”, Colorado State University, Fort Collins, Colorado, September, 2010.
- SIAM annual meeting, Pittsburgh, July 2010.
- The MCIAM workshop on inverse problems, Michigan State University, 2010.
- “Multi-Scale Modeling, Analysis, and Simulations” workshop, Michigan State University, 2008.
- Regular participant in Computational and Applied Mathematics colloquium and lunch seminar, Pennsylvania State University, 2005 – 2008.
- CCMA PDE’s and Numerical Methods Seminar Series, Pennsylvania State University, 2005.
- FRG workshop on “Multi-dimensional Hyperbolic Conservation Laws”, Department of Mathematics, University of Wisconsin at Madison, June 8 – 12, 2005.
- Participant of the International Conference on the Research Trend for PDE Modeling and Computation (in honor of Prof. David Gottlieb’s 60th Birthday), Brown University, November 7 – 8, 2004.
- Participant of the ICOSAHOM, Brown University, June 21 – 25, 2004.

**Outreach** Referee for the following journals:

- Recognized by Elsevier as Outstanding Reviewer
- Mathematics of Computation
- ACM Transactions on Mathematical Software
- Journal of Scientific Computing
- SCIENCE CHINA Mathematics
- International Journal for Numerical Methods in Fluids
- Communication in Computational Physics
- Computer & Fluids
- Journal of Computational Physics
- SIAM Journal on Scientific Computing
- Applied Numerical Mathematics
- Methods and Applications of Analysis