Yunrong Zhu: Curriculum Vitae

Department of Mathematics & Statistics
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Appointments

Associate Professor	Idaho State University	Aug. 2016 –
Assistant Professor	Idaho State University	Aug. 2012 – Aug. 2016
PostDoc Fellow	University of California, San Diego	Oct. 2008 – Aug. 2012
Summer Intern	Sandia National Labs, Livermore	May 2007 – Aug. 2007

Education

Pennsylvania State University	Mathematics	Ph.D.	Aug. 2008
Pennsylvania State University	Computational Science	Minor	Aug. 2008
Southeast University (China)	Applied & Computational Mathematics	M.S.	Jun. 2003
Southeast University (China)	Computational Mathematics	B.S.	Jun. 2000

Research Interests

Numerical Analysis and Scientific Compting
Numerical Approximation of PDEs
Adaptive Finite Element Methods
Multilevel Preconditioning Techniques

Funding

Simons Foundation Collaboration Grants	$35,000	Submitted in 2020, Pending
Undergraduate Research Mentoring Funds	$ 2,500	Aug. 2019 - Dec. 2019
NSF Grant (PI) DMS-1319110	$ 85,646	Sept. 2013 - Aug. 2016
URC Grant (PI) ISU F119	$ 13,308	May 2013 - Dec. 2014

Honors and Awards

2019: *CoSE Internal Travel Award*, Idaho State University
2019: *ICUR Travel Award*, Boise State University
2014: *IMA Travel Award*, University of Minnesota
2007 : *Pritchard Dissertation Fellowship*, Penn. State University
2002 : *NI & LI Alumni Scholarship*, Southeast University

Teaching Experience

Idaho State University, Pocatello, ID

- Spring 2020: MATH 3360 - Differential Equations; MATH 4442/5542 Intro to Numerical Analysis II.
- Fall 2019: MATH 2275 - Calculus III; MATH 4441/5541 - Intro to Numerical Analysis I.
- Summer 2019: MATH 1170 - Calculus I.
- Spring 2019: MATH 3360 - Differential Equations; MATH 6663 Differential Equation II.
- Fall 2018: MATH 1144 - Trigonometry; MATH 6662- Differential Equation I.

- Spring 2018: MATH 4499/5599 - Numerical Linear Algebra; MATH 3360 - Differential Equations; MATH 2240 - Linear Algebra.
- Fall 2017: MATH 2275 - Calculus III; MATH 4499/5599 - Numerical Linear Algebra.
- Spring 2017: MATH 3360 - Differential Equations; MATH 2275 - Calculus III; MATH 2240 - Linear Algebra.
- Fall 2016: MATH 2240 - Linear Algebra; MATH 1160 - Applied Calculus; MATH 1143 - College Algebra.
- Spring 2016: MATH 4442/5542 - Intro to Numerical Analysis II; MATH 1147 - Precalculus.
- Fall 2015: MATH 4441/5541 - Intro to Numerical Analysis I; MATH 1147 - Precalculus.
- Spring 2015: MATH 3360 - Differential Equations; MATH 1170 Calculus I.
- Fall 2014: MATH3326-Elementary Analysis; MATH 4441/5541-Intro to Numerical Analysis I.
- Spring 2014: MATH 1143-College Algebra; MATH 4442/5542-Intro to Numerical Analysis II.
- Fall 2013: MATH 1143 - College Algebra; MATH 4441/5541 - Intro to Numerical Analysis I.
- Spring 2013: MATH 1147 - Precalculus; MATH 1170 - Calculus I.
- Fall 2012: MATH 1147 - Precalculus; MATH 1170 - Calculus I.

Pennsylvania State University, University Park, PA

- Fall 2007: MATH 220 *Matrices*.
- Fall 2006: MATH 017 - Finite Mathematics.
- Spring 2006: MATH110 - Techniques of Calculus I.
- Fall 2005: MATH110 - Techniques of Calculus I.
- Spring 2005: MATH110 - Techniques of Calculus I.

Services

ISU Service Activities

- AY 2019: Applied Mathematics Committee (Chair: Yury Gryazin)
- Fall 2019: PDE Qualify Exam Committee
- Fall 2019: Early College Program Faculty Liaison
- Spring 2019: Ph.D. Qualify Exam Committee
- Fall 2019: Dr. Gryazin's Promotion and Tenure Committee.
- Fall 2018 – Present: Graduate Director
- Fall 2018 – Present: Career Path Internship Program (CPI) Advisor
- Fall 2018: Department Assessment Committee
- AY 2017: Applied Mathematics Program Committee.
- AY 2017: Functional Analysis Qualify Exam Committee.
- AY 2017: Department Promotion and Tenure Committee.
- AY 2016: Mathematics Department Assistant Professor Hiring Committee.
- Fall 2015: Mathematics Department Visiting Assistant Professor Hiring Committee.
- AY 2015: Mathematics Department Promotion and Tenure Committee.
- AY 2015: External Member of Physics Department Promotion and Tenure Committee. (Chair: Dan Dale).

- AY 2015 – Present: Member of Academic Dishonesty and Scholastic Appeals Board.
- AY 2014: Career Path Internship Program (CPI) Advisor for Wumaier Maimaitiyiming.
- AY 2014 – Present: Mathematics Department Graduate Committee. (Chair: Yu Chen for 2014-2018)
- AY 2013 and AY 2014: Mathematics Department Undergraduate Scholarships Committee. (Chair: Tracy Payne)
- AY 2013: Career Path Internship Program (CPI) Advisor for Matthew Schroeder.

Organizer

- Co-organizer of REB60: *Adaptive and Multilevel Methods for Partial Differential Equations (In honor of Randolph Bank's 60th Birthday).* November 13-14, 2009, UC San Diego in La Jolla, CA.
- Co-organizer of PCGM26: *26th Pacific Coast Gravity Meeting* . Mar. 26-27, 2010, UC San Diego in La Jolla, CA.
- Co-organizer of DDXX: *20th International Conference on Domain Decomposition Methods.* Feb. 07-11, 2011, UC San Diego in La Jolla, CA.
- Co-organizer of Minisymposium: *"Optimal Solvers from Multi-grid and Two-grid to One-grid and No-grid" in DD20.* Feb. 07-11, 2011, UC San Diego in La Jolla, CA.
- Co-organizer of GPDE2011: *Workshop on Geometric Numerical Methods for PDE.* Nov. 2011, UC San Diego in La Jolla, CA.
- Co-organizer of Minisymposium: *"Physics-compatible Discretization on Multiphysics Systems and Efficient Multilevel Solvers" in 2015 SIAM Conference on Computational Science and Engineering Meeting (CSE15).* Mar. 2015, Salt Lake City, Utah.
- Co-organizer of Minisymposium: *"Efficient Numerical Methods for Nonlinear PDE" in 2017 SIAM Conference on Computational Science and Engineering (CSE17).* Feb. 27-Mar. 3 2017, Atlanta, Georgia.
- Co-organizer of Minisymposium: *"Discrete Comparison Principles for Nonlinear Elliptic PDE" in 2018 SIAM Annual Meeting.* Jul. 9-13, 2018, Portland, Oregon.
- Co-organizer of Minisymposium: *"Discretization and Multilevel Methods for Nonstandard FEM" in DD25.* Jul. 23-27, 2018, St. John's, Newfoundland, Canada.
- Co-organizer of SCUDEM 2018 Math Modeling Competition, Idaho State University, Oct 27, 2018.
- Co-organizer of SCUDEM 2019 Math Modeling Competition, Idaho State University, Nov. 09, 2019.

Reviewer

- NSF Panel Reviewer;
- Review the textbook *A First Course in Analysis* by John B. Conway;
- Mathematics of Computation (4);
- Numerische Mathematik (7);
- SIAM Journal on Scientific Computing (3);
- SIAM Journal on Multiscale Modeling and Simulation (5);
- SIAM Journal on Numerical Analysis (4);
- Journal of Computational Mathematics (4);
- Journal of Computational and Applied Mathematics (3);

- Numerical Linear Algebra with Applications (9);
- Applied Mathematics and Computation (2);
- Nonlinear Analysis (1);
- International Journal of Computer Mathematics (2);
- Nonlinear Analysis: Theory, Methods & Applications (1);
- Central European Journal of Mathematics (2);
- Communications in Computational Physics(2);
- Domain Decomposition Proceedings (5);
- Journal of Supercomputing (1);
- Journal of Scientific Computing (2);
- International Journal of Nonlinear Sciences and Numerical Simulation (2);
- East Asian Journal on Applied Mathematics (1);
- Computers & Mathematics with Applications (7);
- Journal of Mathematical Analysis and Applications (1);
- Mathematical Methods in the Applied Sciences (2);
- Computational Methods in Applied Mathematics(1);
- Numerical Mathematics: Theory, Methods and Applications (1);

Publications

Journal Publication

13. ***Stablizer-free Weak Galerkin Methods for Monotone Quasilinear Elliptic PDEs.*** X. Ye, S. Zhang, and Y. Zhu, Results in Applied Mathematics. Published online at: `https://www.sciencedirect.com/science/article/pii/S2590037420300078`. Preprint available arXiv:1911.12390.
12. ***A matrix analysis approach to discrete comparison principles for nonmonotone PDE.*** S. Pollock and Y. Zhu, Numerical Algorithms, 2020, 83, 1007–1027. Published online at: `https://doi.org/10.1007/s11075-019-00713-x`. Preprint available arXiv:1711.07506
11. ***Uniqueness of discrete solutions of nonmonotone PDEs without a globally fine mesh condition.*** S. Pollock and Y. Zhu, Numer. Math., 2018, 139(4) 845–865. Published Online at `https://doi.org/10.1007/s00211-018-0956-4`. Preprint available arXiv:1704.04319
10. ***Finite Element Exterior Calculus for Evolution Problems.*** Andrew Gillette, Michael Holst and Y. Zhu, Journal of Computational Mathematics, 2017, 35(2) 187–212. Preprint available arXiv:1202.1573
9. ***Multilevel Preconditioners for Reaction-Diffusion Problems with Discontinuous Coefficients.*** T.V. Kolev, J. Xu and Y. Zhu, Journal of Scientific Computing, 2016, 67(1) 324–350. Preprint available arXiv:1411.7092
8. ***Convergence of Goal-Oriented Adaptive Finite Element Methods for Semilinear Problems.*** M. Holst, S. Pollock and Y. Zhu, Computing and Visualization in Science, 2015, 17(1) 43–63. Preprint available arXiv:1203.1381
7. ***Multilevel Preconditioners for Discontinuous Galerkin Discretizations for Jump Coefficient Problems.*** B. Ayuso de Dios, M. Holst, Y. Zhu and L. Zikatanov, Mathematics Computation, 83, 1083-1120, 2014 (published online Oct. 2013), Preprint available arXiv:math.NA/1001.1382.

6. ***Analysis of a multigrid preconditioner for Crouzeix-Raviart discretization of elliptic PDE with jump coefficient.*** Y. Zhu, Numerical Linear Algebra and Applications, 21(1) 24-38, 2014, Published online in Sept. 2012, Preprint available arXiv:1110.5159v1
5. ***Two-grid Methods for Semilinear Interface Problems.*** M. Holst, R. Szypowski and Y. Zhu, Numerical Methods for Partial Differential Equations 29(5) 1729-1748, 2013, Preprint available arXiv:1203.0339v1
4. ***Local Multilevel Preconditioners for Elliptic Equations with Jump Coefficients on Bisection Grids.*** L. Chen, M. Holst, J. Xu and Y. Zhu, Computing and Visualization in Science, 15:271-289, 2012, DOI 10.1007/s00791-013-0213-4 Preprint available arXiv:1006.3277.
3. ***Adaptive Finite Element Modeling Techniques for the Poisson-Boltzmann Equation.*** M. Holst, J, McCammon, Z. Yu, Y.C. Zhou and Y. Zhu, Communications in Computational Physics, 11(1),179-214, 2012 (Published Online: September 8, 2011).
2. ***Uniform Convergent Multigrid Methods for Elliptic Problems with Strongly Discontinuous Coefficients***, J. Xu and Y. Zhu, Mathematical Models and Methods in Applied Sciences Vol. 18, No.1, 77–105, 2008.
1. ***Domain Decomposition Preconditioners for Elliptic Problems with Jump Coefficients***, Y. Zhu, Numerical Linear Algebra with Applications Vol. 15, No. 2-3, 271–289, 2008.

Journal publication in review

- ***Auxiliary space preconditioners for virtual element methods on polytopal meshes.*** Y. Zhu, Submitted 2018. Preprint available arXiv:1812.04423.
- ***Discrete comparison principles for quasilinear elliptic PDE.*** S. Pollock and Y. Zhu, Submitted, 2017. Preprint available arXiv:1708.02301.

Refereed Proceeding

- ***Auxiliary Space Preconditioners for Mixed Finite Element Methods.***, R. Tuminaro, J. Xu and Y. Zhu, In Domain Decomposition Methods in Science and Engineering XVIII, 99-109, Springer, 2009.
- ***Robust Preconditioner for H(curl) Interface Problems.*** J. Xu and Y. Zhu, In Domain Decomposition Methods in Science and Engineering XIX, 173-180, Springer, 2011.
- ***Multigrid Preconditioner for Nonconforming Discretization of Elliptic Problems with Jump Coefficients.*** B. Ayuso De Dios, M. Holst, Y. Zhu and L. Zikatanov, Domain Decomposition Methods in Science and Engineering XX, Lecture Notes in Computational Science and Engineering Volume 91, pp 183-190, 2013, Preprint available arXiv:1107.2160
- ***Adaptive Finite Element Methods with Inexact Solvers for the Nonlinear Poisson-Boltzmann Equation.*** M. Holst, R. Szypowski and Y. Zhu, Domain Decomposition Methods in Science and Engineering XX, Lecture Notes in Computational Science and Engineering Volume 91, pp 167-174, 2013, Preprint available arXiv:1107.2143
- ***Auxiliary Space Preconditioners for Linear Virtual Element Method.*** Y. Zhu, Domain Decomposition Methods in Science and Engineering XXV, 2019 (Accepted).

Technical Report

- ***Convergence Analysis of Adaptive Finite Volume Element Methods for General Elliptic Equations***, J. Xu, Y. Zhu and Q. Zou, Tech. Report AM296, 2006.
- ***Compatible Gauge Approach for*** $H(\mathrm{div})$ ***Equations***, P. Bochev, C. Siefert, R. Tuminaro, J. Xu and Y. Zhu, SNL-CSRI Summer Proceeding, 2007.
- ***Local Convergence of Adaptive Methods for Nonlinear Partial Differential Equations.*** M. Holst, G. Tsogtgerel and Y. Zhu, 2009, Available as arXiv:math.NA/1001.1382.

- ***Finite Element Error Estimates for Critical Exponent Semilinear Problems without Angle Conditions.*** R. E. Bank, M. Holst, R. Szypowski and Yunrong Zhu, 2011, Available as arXiv:1108.3661.

Ph. D. Thesis

- ***Robust Preconditioners for $H($grad$)$, $\mathbf{H}($curl$)$ and $\mathbf{H}($div$)$ Systems with Strongly Discontinuous Coefficients***, Ph.D Thesis, Penn. State Univ., 2008.

Student

Graduate Intership

- Matthew Schroeder: Career Path Internship, Summer 2013.
- Wumaier Maimaitiyiming: Career Path Internship, Summer 2014.

Undergraduate Students

- J. Tolman, Career Path Internship, Fall 2018 - Spring 2019.
- J. Tolman, Undergraduate Student Research Project; Math honors contract project, Fall 2019.
- Garrett Stouffer, Career Path Internship, Fall 2019

Presentation

Invited Talks

- *Uniqueness of FEM Solutions for Nonmonotone PDEs.*, The 1st Conference on Computational Mathematics and Applications, at the University of Nevada, Las Vegas, NV, Oct. 25-27, 2019.
- *On the Uniqueness of Discrete Solutions for Nonmonotone PDEs.*, The 1st Annual Meeting for the Northern States Section of SIAM, at the University of Wyoming, Laramie, WY, Sep. 27-29, 2019.
- *Auxiliary Space Preconditioners for Virtual Element Discretization*, DD25, St. John's Newfoundland, Canada, Jul. 23-27, 2018.
- *Efficient Solvers for Some Partial Differential Equations in Physics*, Physics Department Colloquium, ISU, Mar. 6, 2017.
- *Some Geometric Multigrid Methods for Maxwell's Equations*, SIAM Conference on Computational Science and Engineering, Atlanta, Georgia, Feb. 27-Mar. 3, 2017.
- *Multilevel Solvers for PDE with Discontinuous Coefficients*, , LSEC Seminar, Institute of Computational Mathematics and Scientific/Engineering Computing, Chinese Academy of Science, Jul. 12, 2016.
- *FASP for H*(curl) *and H*(div) *Problems with Jump coefficients*, , IAPCM Seminar, Institute of Applied Physics and Computational Mathematics, Beijing, China, Jul. 6, 2016.
- *Auxiliary Space Preconditioner for the Linear Elasticity Equations with Weakly Imposed Symmetry*, MAFELAP, Brunel University London, London, UK, Jun. 14-17, 2016
- *Multilevel Solvers for PDE with Discontinuous Coefficients* , Mathematics Colloquium, Nanjing Normal University, Nanjing China, Jun. 1, 2016.
- *Auxiliary Space Preconditioners for the Linear Elasticity Equations with Weakly Imposed Symmetry*, in Minisymposium on Numerical Simulations in Poromechanics, the 8th International Congress on Industrial and Applied Mathematics (ICIAM), Aug. 10-14, 2015.

- *Auxiliary Space Preconditioners for the Linear Elasticity Equations with Weakly Imposed Symmetry*, , In Whorkshop on Finite Element Methods in Beijing University of Technology, Beijing, Aug 7-9, 2015.
- *Multilevel Solvers for PDE with Discontinuous Coefficients*, Mathematics Colloquium, Shanghai University of Finance and Economics, July 30, 2015.
- *Iterative Solvers for Discontinuous Galerkin Methods*, Mathematics Colloquium, South China Normal University, Guangzhou, China, July 11, 2015.
- *Multilevel Methods for Reaction-Diffusion Equations*, , LSEC Seminar, Institute of Computational Mathematics and Scientific/engineering Computing, Chinese Academy of Science, Jul. 8, 2015.
- *Auxiliary Space Preconditioner for the Linear Elasticity Equation with Weakly Imposed Symmetry*, Applied and Computational Mathematics Seminar, Portland State University, Portland, OR, May 18, 2015
- *Robust Multilevel Preconditioners for Reaction-Diffusion Equation with Discontinuous Coefficients*, AMS Spring Western Sectional Meeting, University of Nevada, Las Vegas, NV, Apr. 2015
- *Robust Multilevel Preconditioners for Elliptic Problems with Discontinuous Coefficients*, SIAM Conference on Computational Science and Engineering, Salt Lake City, Utah, Mar. 2015
- *Convergence of goal-oriented adaptive finite element methods for semilinear problems*, AMS Spring Central Sectional Meeting, Texas Tech University, Apr. 2014
- *Multilevel preconditioners for jump problems with mass term*, CCMA PDEs and Numerical Methods Seminar, Penn. State University, Mar. 2014
- *Adaptive Finite Element Methods for Nonlinear PDE*, Mathematics Colloquium, Idaho State University, Mar. 2012
- *Design and Analysis of Adaptive Finite Element Methods for Nonlinear PDE*, ICES Seminar, University of Texas at Austin, Jan. 2012
- *A Two-grid Method for Semilinear Interface Problems*, In "AMS-SIAM Special Session on the Mathematics of Computation: Differential Equations, Linear Algebra, and Applications", JMM 2012, Boston, Jan. 2012
- *A Priori Estimates and Adaptive Methods for Geometric Partial Differential Equations*, In Minisymposia on "Exploiting Geometry in the Development of Numerical Methods for Partial Differential Equations", SIAM PD11, San Diego, Jul. 2011
- *Multilevel Preconditioners for Interior Penalty Discontinuous Galerkin Approximations of Elliptic Problems with Variable Coefficients*, In Minisymposium on "Discontinuous Galerkin Methods", 11th USNCCM, Minneapolis, Jul. 2011
- *FEM for Semilinear Elliptic PDEs with Critical/Subcritical Exponent without Angle Condition*, In Minisymposium on "Computational Methods for Geometric PDEs", ICIAM11, Vancouver (Canada), Jul. 2011
- *Multilevel Preconditioners for Interior Penalty Discontinuous Galerkin Discretizations of Elliptic Problems with Jump Coefficients*, In Minisymposia on " Advances in Locally Mass Conservative Discretizations for Fluid Flows", ICIAM11, Vancouver (Canada), Jul. 2011
- *Convergence of Adaptive Finite Element Methods with Inexact Solvers for Poisson-Boltzmann Equations*, In Minisymposia on "Multilevel Mesh Adaptation and Beyond: Computational Methods for Solving Complex Systems", AMS Sectional Meeting, UNLV, May 1, 2011

- *Multilevel Preconditioners for CR Discretization of Second Order Elliptic Equations with Jump Coefficients*, In Minisymposia on "Optimal Solvers from Multi-grid and Two-grid to One-grid and No-Grid", DDXX, Univ. of California at San Diego, Feb. 2011
- *Convergence of Adaptive Finite Element for the Nonlinear Poisson-Boltzmann Equation*, In Minisymposia on "Theory and Application of Adaptive and Multilevel Methods", DDXX, Univ. of California at San Diego, Feb. 2011
- *Multilevel Preconditioners for DG Approximations of PDEs with Variable Coefficients*, Applied Mathematics Colloquium, Univ. of California at Irvine, Jan. 31, 2011
- *Convergence of adaptive finite element methods for nonlinear PDEs*, In Minisymposia on "Mathematics of Computation", JMM, San Francisco, Jan 13-16, 2010
- *Robust Multilevel Preconditioners for Elliptic Equations with Jump Coefficients on Bisection Grids*, In Minisymposium on "Coarse Spaces for Multiscale Heterogeneous Problems", DD19, Zhangjiajie (China), Aug. 18, 2009

Contributed and Seminar Talks

- Cascade RAIN Meeting, Portland State University, Portland, OR, Apr. 4, 2015
- LSEC Seminar, Institute of Computational Mathematics and Scientific/engineering Computing, Chinese Academy of Science, Jun. 2014
- Peking University, Jun. 2014
- Brownbag Seminar, Idaho State University, Sep. 27 2011
- CCoM Seminar, Univ. of California at San Diego, Oct. 4 2011
- Workshop on Multilevel and Adaptive Methods, Peking Univ. (China), Aug. 28, 2009
- MCP Group Meeting and CSME Journal Club, UCSD, Oct. 30, 2008
- Center for Computational Mathematics (CCoM) Seminar, Oct. 28, 2008
- CCMA Luncheon Seminar, Penn. State University, University Park, PA, Nov. 02 2007.
- Finite Element Circus, Cornell University, NY, Oct. 19 2007.
- Thirteenth Copper Mountain Conference on Multigrid Methods, Copper Mountain, March 2007.