

CURRICULUM VITAE

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Education:

D.Sc.(Applied mathematics), Shanghai University of Science and Technology, China, 1989.
M.Sc.(Applied mathematics), Shanghai University of Science and Technology, China, 1986.
B.Sc.(Computational mathematics), Nanjin University, China, 1983.

Teaching, Research, and Industrial Experience:

Associate Professor (09/2004-present)
Department of Mathematics, The University of Texas at San Antonio.
Assistant Professor (01/2000-08/2004)
Department of Mathematics, The University of Texas at San Antonio.
Research Associate (07/1996-12/1999)
Department of Mathematics and Statistics, Simon Fraser University, Canada.
Postdoctoral Fellow (01/1995-06/1996)
Department of Applied Mathematics, University of Manitoba, Canada.
Visiting scholar (09/1994-12/1994)
Department of Mathematics, Politecnico di Milano, Italy
Lecturer (06/1990-08/1994)
Department of Mathematics, Shanghai University of Science of Technology, China
Software Engineer (07/1989-05/1990)
CIM-Xinchao Software Enterprises Co., China.

List of Refereed Publications:

- [1] Weiming Cao, *Superconvergence of a quadratic finite element method on adaptively refined anisotropic meshes*, International Journal of Numerical Analysis and Modeling, 15(2018), 288-306.
- [2] H. Kim, E.H. Brookes, W. Cao, and B. Demeler, *Two-dimensional grid optimization for sedimentation velocity analysis in the analytical ultracentrifuge*, European Biophysics Journal, 47(2018), 837-844.
- [3] Weiming Cao, *Superconvergence analysis of the linear finite element method and a gradient recovery postprocessing on anisotropic meshes*, AMS Mathematics of Computation, 84(2015) 89-117.

- [4] Weiming Cao, *On the superconvergence patch recovery techniques for the linear finite element approximation on anisotropic meshes*, Journal of Computational and Applied Mathematics, 265(2014), 33-51.
- [5] Emre Brooks, Weiming Cao, and Borries Demeler, *A two-dimensional spectrum analysis for sedimentation velocity experiments of mixtures with heterogeneity in molecular weight and shape*, European Biophysical Journal, 39(2010), 405-414.
- [6] Weiming Cao, *An interpolation error estimate in R^2 based on the anisotropic measures of higher order derivatives*, AMS Mathematics of Computation, 77(2008), 265-286.
- [7] Weiming Cao and Borries Demeler, *Modeling analytical ultracentrifugation experiments with an adaptive space-time finite element solution for multi-component reacting systems*, Biophysical Journal, 95(2008), 54-65.
- [8] Weiming Cao, *An interpolation error estimate on anisotropic meshes in R^n and optimal metrics for mesh refinement*, SIAM Journal of Numerical Analysis, 45(2007), 2368-2391.
- [9] Weiming Cao, *Anisotropic measures of third order derivatives and the quadratic interpolation error on triangular elements*, SIAM Journal of Scientific Computing, 29(2007), 756-781.
- [10] Weiming Cao, *On the error of linear interpolation and the orientation, aspect ratio, and internal angles of a triangle*, SIAM Journal of Numerical Analysis, 43(2005), 19-40.
- [11] Weiming Cao and Leszek Demkowicz, *Optimal error estimate of a projection based interpolation for the p -version approximation in three dimensions*, Computers and Mathematics with Applications, 50(2005), 359-366.
- [12] Weiming Cao and Borries Demeler, *Modeling analytical ultracentrifugation experiments with an adaptive space-time finite element solution of the Lamm equation*, Biophysical Journal, 89(2005), 1589-1602.
- [13] Weiming Cao, Ronald D. Haynes, and Manfred R. Trummer, *Preconditioning for a class of spectral differentiation matrices*, Journal of Scientific Computing, 24(2005), 343-371.
- [14] Weiming Cao and Benqi Guo, *Preconditioning for the p -version boundary element method in three dimensions with triangular elements*, Journal of Korean Mathematical Society, 41(2004), 345-368.
- [15] W. Cao, R. Carretero-González, W. Huang, and R. D. Russell, *Variational mesh adaptation methods for axisymmetrical problems*. SIAM Journal of Numerical Analysis, 41(2003), no.1, 235-257.
- [16] Weiming Cao, Weizhang Huang, and Robert D. Russell, *Approaches for generating moving adaptive meshes: location versus velocity*, Applied Mathematics and Computation, 47(2003), 121-138.
- [17] Jens Lang, Weiming Cao, Weizhang Huang, and Robert D. Russell, *A Two-dimensional Moving Finite Element Method with Local Refinement Based on a Posteriori Error Estimates*. Applied Numerical Mathematics, 46(2003), 75-94.
- [18] W. Cao, W. Huang, and R. D. Russell, *A moving mesh method based on the geometric conservation law*. SIAM Journal of Scientific Computing, 24(2002), 118-142.
- [19] Weiming Cao and Benqi Guo, *A preconditioner with inexact element face solver for three dimensional p -version finite element methods*. Journal of Computational and Applied Mathematics, 144(2002), 131-144.

- [20] W. Cao, W. Huang, and R. D. Russell, *An error indicator monitor function for an r -adaptive finite-element method*. Journal of Computational Physics, 170 (2001), no. 2, 871–892.
- [21] W. Cao, W. Huang, and R. D. Russell, *Comparison of two-dimensional r -adaptive finite element methods using various error indicators*. Mathematics of Computation and Simulation, 56 (2001), no. 2, 127–143.
- [22] W. Cao, and B. Guo, *Preconditioning on element interfaces for the p -version finite element method and spectral element method*. SIAM Journal of Scientific Computing 21 (1999), no. 2, 522–551
- [23] W. Cao, W. Huang, and R. D. Russell, *A study of monitor functions for two-dimensional adaptive mesh generation*. SIAM Journal of Scientific Computing, 20 (1999), no. 6, 1978–1994.
- [24] W. Cao, W. Huang, and R. D. Russell, *An r -adaptive finite element method based upon moving mesh PDEs*. Journal of Computational Physics, 149 (1999), no. 2, 221–244.
- [25] W. Cao, W. Huang, and R. D. Russell, *A moving mesh method in multiblock domains with application to a combustion problem*. Numerical Methods for Partial Differential Equations, 15 (1999), no. 4, 449–467.
- [26] J. Li, Benyu Guo, and W. Cao, *Fourier-Chebyshev pseudospectral method for three-dimensional vorticity equation*. Journal of Computational Mathematics, 16 (1998), no. 5, 417–436.
- [27] B. Guo and W. Cao, *An additive Schwarz method for the h - p version of the finite element method in three dimensions*. SIAM Journal of Numerical Analysis, 35 (1998), no. 2, 632–654.
- [28] B. Guo and W. Cao, *Domain decomposition method for the h - p version finite element method*. Computer Methods Applied Mech. Engrg. 157 (1998), no. 3-4, 425–440. 65N55
- [29] B. Guo and W. Cao, *Inexact solvers on element interfaces for the p and h - p finite element method*. Computer Methods Applied Mech. Engrg. 150 (1997), no. 1-4, 173–189.
- [30] W. Cao and G. He, *Rigorous analysis of an implicit spectral method for KdV equation*. Arab. Journal of Science and Engineering, Section C, Theme Issues 22 (1997), no. 2, 159–167.
- [31] W. Cao and B. Guo, *A pseudospectral method for vorticity equations on spherical surface*. Acta Mathematica Applicae Sinica, 13 (1997), no. 2, 176–187.
- [32] B. Guo and W. Cao, *Additive Schwarz methods for the h - p version of the finite element method in two dimensions*. SIAM Journal of Scientific Computing, 18 (1997), no. 5, 1267–1288.
- [33] B. Guo and W. Cao, *An iterative and parallel solver based on domain decomposition for the h - p version of the finite element method*. Journal of Computational and Applied Mathematics, 83 (1997), no. 1, 71–85.
- [34] B. Guo and W. Cao, *A preconditioner for the h - p version of the finite element method in two dimensions*. Numerische Mathematics, 75 (1996), no. 1, 59–77.
- [35] W. Cao and C. Carlenzoli, *A projection method for long-term computation of Navier-Stokes equations*. Journal of Scientific Computing, 11 (1996), no. 4, 373–395.
- [36] Benyu Guo and W. Cao, *A spectral method for the fluid flow with low Mach number on the spherical surface*. SIAM Journal of Numerical Analysis, 32 (1995), no. 6, 1764–1777.
- [37] A. Rashid, W. Cao and Benyu Guo, *Three level Fourier spectral approximations for fluid flow with low Mach number*. Applied Mathematics and Computation, 63 (1994), no. 2-3, 131–149.

- [38] W. Cao and Benyu Guo, *Spectral-finite element method for solving three-dimensional unsteady Navier-Stokes equations*. Acta Mathematica Sinica, 9 (1993), no. 1, 27–38.
- [39] W. Cao and Benyu Guo, *Fourier collocation method for solving nonlinear Klein-Gordon equation*. Journal of Computational Physics, 108 (1993), no. 2, 296–305.
- [40] Benyu Guo and W. Cao, *A combined spectral-finite element method for solving two-dimensional unsteady Navier-Stokes equations*. Journal of Computational Physics, 101 (1992), no. 2, 375–385.
- [41] Benyu Guo, H. Ma, W. Cao, and H. Huang, *The Fourier-Chebyshev spectral method for solving two-dimensional unsteady vorticity equations*. Journal of Computational Physics, 101 (1992), no. 1, 207–217.
- [42] W. Cao and Benyu Guo, *A pseudospectral method for solving Navier-Stokes equations*. Journal of Computational Mathematics, 9 (1991), no. 3, 278–289.
- [43] Benyu Guo and W. Cao, *Spectral-finite element method for compressible fluid flows*. RAIRO Mathematical Modeling and Numerical Analysis, 26 (1992), no. 4, 469–491.
- [44] Benyu Guo and W. Cao, *Spectral-finite element method for solving three-dimensional vorticity equations*. Bulletin of Greek Mathematical Society, 32 (1991), 83–108.
- [45] Benyu Guo and W. Cao, *Spectral-finite element method for solving two-dimensional vorticity equations*. Acta Mathematica Applicatae Sinica, 7 (1991), no. 3, 257–271.
- [46] Benyu Guo and W. Cao, *A combined spectral-finite element method for solving unsteady Navier-Stokes equations*. Computational techniques and applications: CTAC-89 (Brisbane, 1989), Edited by W. L. Hogarth and B. J. Noye, 253–259, Hemisphere, New York, 1990.
- [47] Benyu Guo and W. Cao, *The Fourier pseudospectral method with a restrain operator for the RLW equation*. Journal of Computational Physics, 74 (1988), no. 1, 110–126.
- [48] Benyu Guo, H. Ma, and W. Cao, *A new Fourier pseudospectral method*. BAIL IV (Novosibirsk, 1986), Edited by S. K. Godunov, J. J. H. Miller and V. A. Novikov, 69–79, Boole Press Conf. Ser. 8.
- [49] Benyu Guo and W. Cao, *Spectral method for fluid flow with low Mach number*. Science Bulletin of China, 31 (1986), no. 16, 1081–1086.

Presentations in Conferences and Seminars:

- [1] *A Superconvergence Analysis of the Quadratic Finite Element Method Based on Unstructured Anisotropic Meshes*, Joint Mathematics/MAA/SIAM Meeting, San Antonio, Texas, January, 2015.
- [2] *Recovery type a-posteriori error estimators for the finite element methods based on anisotropic meshes*, International Conference on Computational Sciences, Shanghai, China, June 2012.
- [3] *Superconvergence of the linear finite element solution of second order elliptic problems based on anisotropic meshes*, Talk at Baylor workshop on splitting and multiscale methods for PDEs, Baylor University, Texas, September 2011.
- [4] *Superconvergence of the linear finite element approximation based on anisotropic meshes*, seminar talk at Shanghai Normal University, Shanghai, China, June 2010.
- [5] *Adaptive finite element methods for the analytical ultracentrifugation analysis*, AMS regional conference, Baylor University, Texas, Oct 2009.

- [6] *Adaptive finite element methods based on recovery techniques and anisotropic mesh metric controls*, International Conference on Applied Analysis and Scientific Computation, Shanghai Normal University, Shanghai, China, June 25-28, 2009.
- [7] *Finite element methods based on anisotropic mesh metric controls*, Seminar talk at Texas A&M University, College Station, Texas, May 13, 2009.
- [8] *Anisotropic finite element methods based on recovery techniques and mesh metric controls*, Invited talk at the workshop on “Approximation Theory, Numerical Analysis and Applications”, Sam Houston State University, Oct 25, 2008.
- [9] *Measuring the anisotropic behavior of higher order derivative tensors and optimal meshes for piecewise polynomial interpolation*, Seminar talk at University of California at Irvine, Dec. 3, 2007.
- [10] *Optimal mesh metrics for anisotropic mesh refinement based on interpolation error estimates*, SIAM Geometric Design and Computing, San Antonio, Nov. 7, 2007.
- [11] *Interpolation error estimates on anisotropic meshes and optimal metrics for mesh refinement*, Seminar talk at Wayne State University, October 23, 2007
- [12] *Interpolation error estimates on anisotropic meshes and optimal metrics for mesh refinement*, the 9th International Conference of Spectral and Higher Order Methods, Beijing, June 23, 2007.
- [13] *Measuring anisotropic behavior of higher order derivatives for mesh adaptation* SIAM Annual Meeting, Boston, July 2006.
- [14] *An interpolation error estimate in \mathbf{R}^n based on the anisotropic measure of higher order derivatives*, 12th International Conference on Mathematical Analysis of Finite Elements and Applications (MAFELAP), Uxbridge, UK, June 13-16, 2006.
- [15] *An interpolation error estimate based on anisotropic measures of higher order derivatives in R^2* Contributed talk in the conference “Adaptivity & Beyond”, in honor of Bob Russell’s 60th birthday. August 3-6, 2005. Vancouver, Canada
- [16] *Some interpolation error estimates for the adaptive finite element method*, seminar talk in Dept of Mathematics, Trinity University, Nov 10, 2005.
- [17] *On the optimal anisotropic triangulation based on the interpolation errors*, invited talk in the international conference on “Recent advances in adaptive computation”, May 24-28, 2004, Hangzhou, China.
- [18] *Mesh metrics based on the optimal interpolation errors for anisotropic triangulation*, SIAM annual meeting: July 12-16, 2004, Portland, Oregon.
- [19] *On interpolation errors and the size, shape, and alignment of triangular elements*, Workshop on “Computational Techniques for Moving Interfaces”, Banff, Canada, August 2003.
- [20] *An r -adaptive characteristic Galerkin method for advection-diffusion problems*, SIAM 50th annual meeting, Philadelphia, July 2002.
- [21] *A preconditioning algorithm for the p -version boundary element method in three dimensions*, Texas Partial Differential Equations Meeting 2002, The University of Texas at San Antonio, Feb. 2002.
- [22] *On moving mesh methods for the numerical solution of advection dominated problems*, Interna-

tional Conference on Scientific Computation and Differential Equations, Vancouver, Canada, July 2001.

[23] *An analysis of the numerical solution based on moving meshes for advection dominated problems*, 965th American Mathematics Society meeting, Las Vegas, Nevada, April 2001.

[24] *Exact vorticity boundary conditions for Stokes equations in circular regions*, Texas Partial Differential Equations Meeting, University of Texas at Austin, Austin, Texas, May 2000.

[25] *Moving mesh method based on moving mesh PDEs*, Invited seminar talk, Center for Scientific Computing and Computational Mathematics, Stanford University, Sept. 1999

[26] *Preconditioning techniques for the hp-version finite element approximations*, Invited seminar talk, Depart. of Mathematics, University of Kansas, Lawrence, Kansas, March 1998.

[27] *Moving finite element methods based on moving mesh partial differential equations*, 45th SIAM annual meeting, Stanford University, July 1997.

[28] *An additive Schwarz method for the hp-version finite element method in three dimensions*, Conference in honor of Ivo Babuška's 70th birthday, University of Maryland at College Park, College Park, Maryland, April 1996.

[29] *Domain decomposition methods for the hp-version of the finite element method*, Computational Mechanics Colloquium, University of Manitoba, Winnipeg, Canada, Dec. 1995.

Research Funding and Awards:

[1] Principal investigator of the NSF research grant DMS-0811232: *Recovery type a-posteriori error estimation for the finite element methods on anisotropic meshes*, total budget \$121,793, from 07/01/2008 to 06/30/2012.

[2] CoPI of the joint NIH R01 research project RR022200-01A1 *UltraScan Software Maintenance and Development* (PI: Borries Demeler, University of Texas Health Science Science Center at San Antonio), from 04/15/2007 to 03/31/2011, total budget for UTSA: \$130,546.

[3] Principal investigator of the NSF research grant DMS-0209313: *Adaptive hr-mesh refinement for the numerical solution of advection-diffusion equations*, total budget \$90,252, from 07/2002 to 06/2006.

[4] CoPI of the SALSI research proposal *Novel computational approaches to hydrodynamics analysis of biological macromolecules*, funded by San Antonio Life Science Institute, total budget \$188,604, from 11/01/2004 to 10/31/2005.

[5] Faculty Research Award, The University of Texas at San Antonio, 2000.

[5] Principal investigator of the program *Domain decomposition methods for spectral approximations*, funded by the Natural Science Foundation of China, 1994-1996.

[6] First prize, the Science and Technology Progress Awards, for the work on *Spectral and pseudospectral methods for nonlinear partial differential equations*, by Ministry of Education of China, 1991.

Teaching Activities

1. Courses Taught at UTSA:

College Algebra,
Pre-calculus,
Calculus (I, II, III),
Calculus for Bioscience,
Linear Algebra,
Foundation of Mathematics,
Foundation of Analysis,
Complex Variables,
Differential Equations (undergraduate I, II, and graduate),
Numerical Analysis (undergraduate and graduate),
Real Analysis (undergraduate I, graduate I, II).

2: List of Graduate Students Mentored:

Mathew Westerhoff (GRA 2003), Sam Whorter (GRA 2004), Chenyu Gao (GRA 2009), Jermain Gonzalez (GRA 2012), Stacey Laubach (GRA 2012), Ghazal Montazeri (GRA 2012), Adam Garza (Research Internship, 2014), Majed Alotaibi (Research Internship, 2015).

3: List of MS thesis review committee served:

Duc Luu (2010), Khoa Le (2011), Minh Tuan Kha (2011).

4: Ph.D. Dissertation committee served:

Shuaipeng He (Dept. of Elec. and Computer Engrg.), 2020.

List of Department, College, University Committees Served

- University Graduate Council (2006)
- College Faculty Review Advisory Committee (2005-2007)
- College Faculty Development Leave Committee (2005-2006)
- Graduate Comprehensive Exam committee (2004-2006)
- Department Faculty Hiring committee (2004, 2014, 2016, 2019)
- Department Ph.D. Proposal committee (2013-2016)
- Department Department Scholarship Committee (2018-2019)
- Catalog Committee for Applied and Industrial Mathematics (AIM) Master's degree program (2004-2005)
- Graduate Screening and Review Committee for Applied and Industrial mathematics Master's degree program (2006-present)
- AIM graduate admission committee (2007-present)
- AIM graduate study committee (2008-present)

Professional Services

1. Served as a panelist in National Science Foundation (NSF) to evaluate proposals for an applied mathematics program, 2012.
2. Reviewed research proposals for
 - (i) National Science and Engineering Research Council (NSERC), (2006));
 - (ii) The Research Grants Council (RGC) of Hong Kong (2009, 2012, 2013);
 - (iii) Austria Science Fund (2010, 2014);
 - (iv) Research Award Program PSCREG of City University of New York (2010).
3. Served as an external reviewer for Ph.D. thesis
 - (i) *Adaptive approximation with anisotropic finite elements: theory and algorithms*, by Jean-Marie Mirebeau, J.L.Lions Laboratory of Universite Pierre et Marie Curie, 2010.
 - (ii) *$h - p$ version of the finite element method for non- homogeneous Dirichlet problems*, by Lijun Yi, Shanghai Normal University, 2010.
4. Served in the editorial board for
 - (i) International Journal of Computers and Mathematics, UK. (2010-present);
 - (ii) Missouri Journal of Mathematical Sciences (2016-present).
5. Referee for the following journals:
 - AMS Mathematics of Computation,*
 - AMS Contemporary Mathematics,*
 - Advances in Computational Mathematics,*
 - Advances in Mechanical Engineering,*
 - Abstract and Applied Analysis ,*
 - Analysis and Computations of Partial Differential Equations ,*
 - Applied Mathematics Letters,*
 - Applied Mathematics and Computation,*
 - Applied Numerical Mathematics,*
 - Calcolo,*
 - Computer Methods for Applied Mechanics and Engineering,*
 - Computer Methods in Applied mechanics,*
 - Computers and Mathematics with Applications,*
 - Communications in Computational Physics*
 - Computers and Fluids,*
 - Constructive Approximation,*
 - Electronic Journal of Differential Equations,*
 - Electronic Transactions on Numerical Analysis,*
 - Frontiers of Mathematics in China,*
 - IMA Journal of Numerical Analysis,*
 - International Journal in Computational Methods,*
 - International Journal of Computer Mathematics,*

International Journal of Numerical Methods for Fluids,
International Journal of Numerical Analysis and Mathematics,
Journal of Computational and Applied Mathematics,
Journal of Computational Mathematics and Optimization,
Journal of Computational Physics,
Journal of Difference Equations and Applications,
Journal of Scientific Computation,
Mathematical Modelling and Analysis,
Numerisch Mathematik,
Numerical Algorithms,
Numerical Mathematics: Theory, Methods, and Applications,
Numerical Methods for Partial Differential Equations,
SIAM Journal of Numerical Analysis.

4. Book review:

- (i) *Linear Algebra: Ideas and Applications*, 2nd Ed., by Richard Penney, Wiley's text book, July 2002;
- (ii) *Linear Algebra: Theory and Applications*, by Ward Cheney and David Kincaid, Addison-Wesley's text book, August 2006.
- (iii) *Fundamentals of Differential Equations* (4 chapters), by Nagle, Saff, and Snide, Addison-Wesley's text book, 2010.
- (iv) *Calculus* (3 chapters), by Taalman and Kohn, W.H. Freeman & Company, 2012.