

Chad Westphal

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Curriculum Vitae

Experience

Wabash College, Department of Mathematics and Computer Science

The *Eugene N. and Marian C. Beesley* Professor (Endowed Chair), 2023-Present

Department Chair, Mathematics and Computer Science, Spring 2016, 2019-Present

Professor of Mathematics and Computer Science, 2019-Present

Associate Professor of Mathematics and Computer Science, 2011-2019

Assistant Professor of Mathematics and Computer Science, 2007-2011

Visiting Assistant Professor of Mathematics, 2004-2007

United States Air Force Academy, Department of Mathematical Sciences (DFMS)

Distinguished Visiting Professor, Jul 2018-May 2019 (sabbatical leave)

University of Colorado, Boulder, Department of Applied Mathematics

Visiting Research Associate, Aug 2011-May 2012 (sabbatical leave)

Education

Ph.D. Applied Mathematics, University of Colorado, Boulder, 2004

M.S. Applied Mathematics, University of Tulsa, 2000

B.S. Engineering Physics *and* Mathematics, Oral Roberts University, 1998

Honors, Awards, & Funding

McLain-McTurnan-Arnold Research Fellowship, Wabash College Sabbatical Grant, 2025-2026.

The Eugene N. and Marian C. Beesley Professorship, Wabash College Endowed Faculty Chair, 2023-Present.

National Science Foundation Grant DMS-1216297, *RUI: Adaptively Weighted Finite Element Methods for PDEs and Optimal Least-Squares Metrics*, PI, 2012-2015, \$112,897.

Excellence in Teaching Award, Wabash College Chapter of Sigma Alpha Pi, The National Society of Leadership and Success, 2015.

GLCA New Directions Initiative Grant, *New Approaches in Teaching with Emerging Technology*, PI, 2013.

GLCA New Directions Initiative Grant, *Mathematical Modeling of Infectious Diseases*, PI, 2011-2012.

Research Mentor, National Science Foundation Research Experiences for Undergraduates (NSF-REU), *Wabash Summer Institute in Mathematics (WSIM)*, 2008-2010.

National Science Foundation Grant DMS-0511430, *Least-Squares Finite Element Methods for Nonlinear Partial Differential Equations*, Co-PI, 2006-2008, \$110,000.

MAA Regional Undergraduate Mathematics Conferences Grant (via NSF Grant DMS-0536991), 2008 *Illiana Undergraduate Mathematics Research Conference*, co-organized with J. Stickles.

SIAM/NSF Travel Grant, International Congress on Industrial and Applied Mathematics (ICIAM), 2007.

Short Term Visiting Research Guest, Lawrence Livermore National Laboratory, Summers 2004, '05, '06.

NSF VIGRE Graduate Fellowship, Department of Applied Mathematics, University of Colorado, 2001-2004.

SIAM Travel Grant, SIAM CS&E Conference, 2003.

Research Internship, Argonne National Laboratory, Environment, Safety and Health Division, Summer 1997.

Most Outstanding Senior, Engineering and Physics Department, ORU, 1998.

Most Outstanding Senior, Mathematics Department, ORU, 1998.

Most Outstanding Research and Design Project, Engineering and Physics Department, ORU, 1998.

Publications

A Mathematical Model for Zika Virus Disease: Intervention Methods and Control of Affected Pregnancies, (with W. Cooper, S. Stanhope, and C. Wang), *under review*.

Waterborne Disease Dynamics with a River, (with J. Leeper) *under review*.

“An Adaptive Div-Curl-Grad Least-Squares Finite Element Method for the Cahn-Hilliard Equation, preprint status.

“A Newton Div-Curl Least-Squares Finite Element Method for the Elliptic Monge-Ampère Equation,” **Comp. Meth. Appl. Math.**, 19-3, pp. 631-643, 2019.

“Soccer Penalty Kicks and the Mixed-Strategy Nash Equilibrium: An Evolutionary Approach,” (with T. Nguyễn), *under revision*.

“Adaptively Weighted Least-Squares Finite Element Methods For Partial Differential Equations with Singularities,” (with B. Hayhurst, M. Keller, C. Rai, and X. Sun), **CAMCoS**, 13-1, pp. 1-25, 2018.

“FOSLL for Nonlinear Partial Differential Equations,”* (with E. Lee and T.A. Manteuffel), **SIAM J. Sci. Comput.**, 37-5, pp. S503-S525, 2015.

“An Adaptively Weighted Galerkin Finite Element Method For Boundary Value Problems,” (with Y. Sun), **CAMCoS**, 10-1, pp. 27-41, 2015.

“A Weighted Least Squares Finite Element Method for Elliptic Problems With Degenerate and Singular Coefficients,” (with S. Bidwell and M. Hassell), **Math. Comp.**, 82, 672-688, 2013.

“Multiscale Adaptively Weighted Least Squares Finite Element Methods for Convection Dominated PDEs.” (with Y. Sun and B. Kraynik), **Involve**, 5-1, pp. 39-49, 2012.

“Ethics for Undergraduate Researchers,” (with M. Axtell), **Notices of the AMS**, 59(3), 2012.

“An Adaptive Mixed Least-Squares Finite Element Method for Viscoelastic Fluids of Oldroyd Type,” (with Z. Cai), **J. Non-Newton. Fluid. Mech.**, 159, pp. 72-80, 2009.

“A Weighted $H(\text{div})$ Least-Squares Method for Second-Order Elliptic Problems,” (with Z. Cai), **SIAM J. Numer. Anal.**, 46, pp. 1640-1651, 2008.

“Weighted-Norm First-Order System Least Squares for Problems with Three Dimensional Edge Singularities,” (with E. Lee and T.A. Manteuffel), **SIAM J. Numer. Anal.**, 46, pp. 1619-1639, 2008.

“A Least-Squares Finite-Element Method for Viscoelastic Fluids,” **Proc. Appl. Math. Mech.**, 7(1), 1025101-2, 2007.

“Teaching Time Savers: Encouraging Contact Early in the Semester,” **MAA FOCUS**, 27(6), 2007.

“Weighted-Norm First-Order System Least Squares (FOSLS) for Problems with Corner Singularities,” (with E. Lee and T.A. Manteuffel), **SIAM J. Numer. Anal.**, 44, pp. 1974-1996, 2006.

“First-Order System Least Squares for Geometrically Nonlinear Elasticity,” (with T.A. Manteuffel, S.F. McCormick and J.G. Schmidt), **SIAM J. Numer. Anal.**, 44, pp. 2057-2081, 2006.

“First-Order System Least Squares (FOSLS) for Geometrically Nonlinear Elasticity in Nonsmooth Domains,” Ph.D. Thesis, University of Colorado, 2004.

Student Research Mentoring

Summer research internships:

Jackson Leeper (Wabash), *Waterborne Disease Dynamics on Heterogenous Networks*, 2023.

Cihang Wang (Wabash), *Mathematical Models for Zika Virus Disease and Control Strategy Optimization*, 2021.

Brian Hayhurst (Wabash) and Mason Keller (Wabash), *Adaptively Weighted Least Squares Finite Element Methods for Nonlinear PDEs with Singularities*, 2015.

Chris Rai (Wabash) and Xidian Sun (Wabash), *Adaptively Weighted Least Squares Finite Element Methods for PDEs with Singularities*, 2014.

Jacob Caddick (Wabash) and Cordell Lewis (Wabash), *Improved Mathematical Models for Indoor Track Indexing*, 2014.

Ashish Baiju (Wabash) and David Gunderman (Wabash), *Adaptively Weighted Finite Element Methods and Multigrid Solvers*, 2013.

Cole Hruskovich (Wabash) and Jacob Caddick (Wabash), *Improved Mathematical Models for Indoor Track Indexing*, 2013.

Allison Cullen (U. Detroit-Mercy) and Kaitlyn Brady (Worcester), “Numerical Modeling for Capillary Equations: The Small Angle Case,” WSIM 2010.

Stephen Bidwell (Tufts) and Matthew Hassell (Binghamton U.), “A Weighted Least-Squares Finite Element Method for Elliptic Problems with Degenerate and Singular Coefficients,” WSIM 2010. Winner of Outstanding Poster distinction at the 2011 AMS/MAA Joint Mathematics Meetings.

Bridget Kraynik (College of Wooster) and Yifei Sun (Wabash), “*Multiscale Adaptively Weighted Least-Squares Finite Element Methods for Convection-Dominated Elliptic PDEs*,” WSIM 2010.

Ashley Crish (Notre Dame), Jessica Keeton (Simpson College), and Simon Rush (Dallas Baptist U.), “*Finite Element Solution of a Non-Newtonian Blood Flow Model*,” WSIM, 2009.

Myles Baker (Baylor) and Sarah Farell (Bard College), “*An Adaptively Weighted Least-Squares Finite Element Method for Convection Dominated Diffusion PDEs*,” WSIM, 2009. Winner of Outstanding Poster distinction at the 2010 AMS/MAA Joint Mathematics Meetings.

Genevieve Dupuis (Notre Dame) and Jessica Flores-Rosado (UPR-Humacao), “*Numerical Solutions for Intermediate Angles of the Laplace-Young Capillary Equations*,” WSIM, 2008.

Bryant Watkins (UMBC), Bo Xu (Columbia U.), and Dezhi Xu (Wabash), “*A Shear-Thinning Viscoelastic Model of Non-Newtonian Blood Flow*,” WSIM, 2008. Winner of Outstanding Poster distinction at the 2009 AMS/MAA Joint Mathematics Meetings.

Haris Amin (Wabash), “*Least-Squares Finite Element Models for Viscoelastic Fluids*,” Wabash College Summer Internships, 2006 and 2007.

Sam Calisch (Grinnell), “*On Weighted-Norm Least Squares for PDEs with Singularities*,” Wabash College Summer Internship, 2006.

Semester/year research projects:

Wabash Students, *Multi-Orbit Interference*, Space ISAC, 2024-2025.

Gabe Cowley and Khoi Truong, *Emergent Behavior of Pathogen Mutation in Mobility Networks*,” Wabash College, 2023.

Gabriel Cowley, “*Iterated Game Theory Models for the Dynamics of Rock-Paper-Scissors*,” Wabash College, 2020-2021.

C1C William Cooper, “*Stochastic and Deterministic Models for Zika Transmission*,” (co-advised with S. Stanhope) USAFA, 2018-2019.

C1C Cole Biedermann, “*Mathematical Models of Cyclically Competitive Species with Asymmetric Diffusion*,” USAFA, 2018-2019.

C1C Erik McMillan, “*Numerical Methods for Fully Nonlinear PDEs: Pucci’s Equation*,” USAFA, 2018-2019.

Tu Nguyễn, “*Stochastic Evolutionary Game Theory*,” Wabash College, 2017.

Mason Keller, Albert Li, Hai Nguyen, & Chris Rai, “*Modified Compartmental Models for the 2014 Ebola Outbreak in W. Africa: Why the Predictions Were Wrong*,” Wabash College, 2015.

Yifei Sun, “*Adaptive Finite Element Methods*,” Wabash College, 2013.

Zachary Mullen & Steven Caan Taylor, “*Finite Element Methods for Yield Stress Fluids*,” University of Colorado, 2012.

Jake Pettine & Nuttavuth Tamang, “*Capillary Surface Modeling with a FOSLL* Approach*,” University of Colorado, 2012.

Ben Harvill & Derrek Yager, “*Modeling Fluid Surfaces with Capillary Forces*,” Wabash College, 2010.

Kyle Prifogle, “*Collective Motion, Flocking, and Emergent Behavior*,” Wabash College, 2009.

Wesley Barnes, “*Sobolev Spaces and Trace Theorems*,” Wabash College, 2008.

Chris Schmaltz, “*Modeling Accuracy in Basketball Free Throws*,” Wabash College, 2008.

Gary Simkus, “*Frisbee Flight Simulation*,” Wabash College, 2008.

Vu Tran, “*The Black-Scholes Model via Brownian Motion and DEs*,” Wabash College, 2007.

Ryan Nuppna, “*Infectious Disease Modeling with a Modified SIR Model*,” Wabash College, 2007.

Hunter Fields, “*Modeling Cooking Techniques with PDEs*,” Wabash College, 2006.

Colin McClelland, “*An Analysis of the Three-Body Problem*,” Wabash College, 2006.

Daniel Schubert, “*Mathematics of Juggling*,” Wabash College, 2005.

Research Talks

June 2024, “*Least-Squares FEM for the Laplace-Young Capillary Equation*.” 6th Workshop on Minimum Residual & Least Squares FEM, Basque Center for Applied Mathematics, Bilbao, Spain.

June 2024, “*A Mathematical Model for Zika Virus Disease and Control of Affected Pregnancies*.” SIAM Conference on Life Sciences, Portland, OR.

Sept 2023, “*On the Dynamics and Control of Zika Virus Disease*.” 49th Annual Miami Mathematics Conference: Differential Equations and Dynamical Systems and Their Applications, Miami, OH.

Sept 2019, “*An Adaptive Newton Div-Curl Least-Squares Finite Element Method for the Cahn-Hilliard Equation*,” 4th Workshop on Minimum Residual & Least Squares FEM, Humboldt-Universität zu Berlin.

Mar 2019, “ *$\pi!$ and Fractional Derivatives, a Tale of Mathematical Generalization*,” (Keynote Address), 16th Annual Pikes Peak Regional Undergraduate Mathematics Conference, Colorado Springs.

Apr 2018, “*Soccer Penalty Kicks and the Mixed-Strategy Nash Equilibrium: An Evolutionary Approach*,” U. S. Air Force Academy, Colorado Springs.

Oct 2017, “*Least-Squares Methods for the Elliptic Monge-Ampère Equation: Recent Results*,” 3rd Workshop on Minimum Residual & Least Squares FEM, Portland, OR.

Apr 2017, “*Adaptively Weighted Finite Element Methods for PDE with Boundary Layers*,” 14th Workshop on Numerical Methods for Problems with Layer Phenomena, Galway, IE.

Aug 2015, “*Adaptively Weighted Finite Element Methods for PDE Problems with Boundary Singularities*,” 8th International Congress on Industrial and Applied Mathematics (ICIAM), Beijing.

July 2014, “*Advances in Adaptively Weighted Finite Element Methods*,” SIAM Annual Meeting, Chicago.

Mar 2013, “*Least Squares Finite Element Methods for Non-Newtonian Fluids with Application to Blood Flow*,” SIAM CS&E, Boston.

Mar 2013, “*FOSLL* For Nonlinear Partial Differential Equations*,” SIAM CS&E, Boston.

Aug 2012, “*Adaptively Weighted Finite Element Methods*,” Tufts University, Department of Mathematics.

Mar 2012, “*FOSLL* For Nonlinear Partial Differential Equations*,” 12th Copper Mountain Conference on Iterative Methods, Copper Mountain, CO.

Sept 2011, “*Weighted Norm Least Squares Finite Element Methods for Problems with Singularities*,” Computational and Applied Mathematics Colloquium, Penn State University.

July 2011, “*Weighted Norm Least Squares Finite Element Methods for PDE Problems with Singularities: An Overview*,” US National Congress on Computational Mechanics, Minneapolis, MN.

Apr. 2010, “*An Adaptive Weighted Norm Least-Squares Approach to Convection-Dominated Diffusion Problems*,” 11th Copper Mountain Conference on Iterative Methods, Copper Mountain, CO.

Jun. 2009, “*Least-Squares FEM for Problems with Boundary Singularities*,” MAFELAP 2009, The Brunel Institute of Computational Mathematics, Uxbridge, UK.

Nov. 2008, “*Least-Squares Finite Element Methods for PDEs in Nonsmooth Domains*,” SIAM Graduate Chapter Colloquium, University of Illinois at Urbana-Champaign.

July 2007, “*A Least-Squares Finite Element Method for Viscoelastic Fluid Flow*,” 6th International Congress on Industrial and Applied Mathematics (ICIAM), Zürich, CH.

Jul. 2007, “*Least-Squares Finite Element Methods for PDEs in Nonsmooth Domains*,” Institut für Angewandte Mathematik, Leibniz Universität Hannover, DE.

Jan. 2007, “*Least-Squares Finite Element Methods for PDEs in Nonsmooth Domains*,” Computational and Applied Mathematics Seminar, Purdue University.

Apr. 2006, “*A Least-Squares Finite Element Method for Viscoelastic Flow*,” 9th Copper Mountain Conference on Iterative Methods, Copper Mountain, CO.

Apr. 2005, “*Computational Modeling with Partial Differential Equations (PDEs)*,” Mathematics Department Colloquium, Rose-Hulman Institute of Technology.

May 2004, “*First-Order System Least-Squares for Problems with Boundary Singularities*,” Center for Applied Scientific Computing, Lawrence Livermore National Laboratory.

Jun. 2003, “*First-Order System Least Squares for Geometrically Nonlinear Elasticity*,” SIAM Annual Meeting, Montreal, QC.

Feb. 2003, “*First-Order System Least Squares for Geometrically Nonlinear Elasticity*,” SIAM Computational Science and Engineering Conference, San Diego.

Courses Taught

At Wabash College:

Precalculus	Linear Algebra
Calculus I	Differential Eq.
Calculus II	Partial Diff. Eq.
Discrete Math	Complex Analysis
Probability	Numerical Analysis
	Stochastic Simulation

Intro to Programming
Advanced Programming
Data Structures
Intro to Data Science
Cultures and Traditions
Enduring Questions

Elsewhere:

PDEs (USAFA)
ODEs (USAFA)
Calculus I (USAFA)
Calculus I for Engr. (CU)
Calculus III for Engr. (CU)
Numerical Analysis I, II (CU)
Physics I, II (Tulsa C. C.)

Academic Service

Department Chair, Mathematics and Computer Science, Wabash College, Spring 2016, 2019-Present.

Search Committee, Dean of the College, Wabash College, 2021-2022.

Off-Campus Study Committee, Wabash College, 2024-Present.

Pre-Engineering Committee, Wabash College, 2007-2011, 2012-2018, 2019-Present.

Admissions and Financial Aid Committee, Wabash College, 2014-2017, 2020-2023.

Athletics Committee, Wabash College, 2020-2024.

Lilly Scholarship Committee, Wabash College, 2017-2018, 2020-2024.

Trustee Committee on Admissions and Marketing, Wabash College, 2015-2020.

Graduate Fellowships Committee, Wabash College, 2012-2017, 2019-2020.

Campus Master Planning Committee, 2018-2019.

Co-Organizer, Wabash New Faculty Orientation Program, 2016-2018.

Spaces and Facilities, Subcommittee of Trustee Committee on Campus Life, Wabash College, 2017-2018.

Secondary Licensure Program / Teacher Education Committee, Wabash College, 2012-2018.

Strategy Committee (Trustee Committee), Wabash College, 2012-2014.

Search Committee, Dean of the College, Wabash College, 2013.

Graduate Admissions Committee (nonvoting), Applied Math, Colorado University, 2012.

Undergraduate Research Committee, Wabash College, 2006-2011.

General Curriculum and Distribution Review Committee, Wabash College, 2010-2011.

Integrated Marketing Committee, Wabash College, 2008-2011.

Marketing Review Committee/Web Redesign Subcommittee, Wabash College, 2009-2011.

Division I Secretary, Wabash College, 2007-2009.

Dill Grant Selection Committee, Wabash College, 2007-2008.

Howard Hughes Medical Institute (HHMI) Proposal Committee (*ad hoc*), Wabash College, 2007.

Hiring Committee Outside Faculty: Biology, Chemistry, Classics, Economics, English, French, IT Services, Political Science, Religion, Rhetoric, and Theater.

New Faculty Mentor: Spanish, Economics, Psychology, and Music departments (Wabash); Mathematics (USAFSA).

Professional Activities and Service

Journal Referee:

SIAM Journal on Numerical Analysis (SINUM)	Numerische Mathematik
SIAM Journal on Scientific Computation (SISC)	Journal of Applied Mathematics and Computing (JAMC)
SIAM Undergraduate Research Online (SIURO)	Numerical Methods for Partial Differential Equations
The College Mathematics Journal (CMJ)	Communications in Mathematical Sciences (CMS)
Rose-Hulman Mathematics Journal	Journal of Computational and Applied Mathematics
Numerical Linear Algebra with Applications	Applied Mathematics and Computation
Comp. Methods in Applied Math. (CMAM)	Computational and Applied Mathematics (COAM)

Grant Review Panelist, NSF Division of Mathematical Sciences ($\times 3$; dates withheld for confidentiality).

Reviewer, Mathematical Reviews, ongoing.

Ph.D. Thesis Committee Member, Steffen Münzenmaier, Leibnitz Universität Hanover (Germany), 2012.

MAA Poster Session Judge, Joint Mathematics Meetings, 2010.

Co-Organizer, *Illiana Undergraduate Mathematics Research Conference*, 2008.

Minisymposium Organizer, *Least-Squares Finite Element Methods*, 6th International Congress on Industrial and Applied Mathematics (ICIAM), Zürich, CH, 2007.

Co-Founder and Co-President, SIAM Graduate Student Chapter, University of Colorado, Boulder, 2003-2004.