Matthew J. Zahr

Associate Professor
Aerospace and Mechanical Engineering
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Research Interests

model reduction · finite element and discontinuous Galerkin methods · high-order discretizations · numerical methods for shocks and discontinuities · topology optimization · PDE-constrained optimization · multiphysics and multiscale problems · uncertainty quantification

Academic Positions

2025–pres **Robert W. Huether Collegiate Professor in Aerospace Engineering**, University of Notre Dame

2025–pres **Concur. Associate Professor**, Applied and Computational Mathematics and Statistics, University of Notre Dame

2025–pres **Associate Professor**, Aerospace and Mechanical Engineering, University of Notre Dame

2021–2025 **Concur. Assistant Professor**, Applied and Computational Mathematics and Statistics, University of Notre Dame

2019–2025 **Assistant Professor**, Aerospace and Mechanical Engineering, University of Notre Dame

2016–2018 **Luis W. Alvarez Postdoctoral Fellow**, Mathematics, Lawrence Berkeley National Laboratory

Education

Sep 2016 **Ph.D., Computational and Mathematical Engineering, Stanford University** *Stanford, CA*
Advisor: Charbel Farhat ○ Ph.D. minors: Mechanical Engineering, Aeronautics and Astronautics ○ Funding: Department of Energy Computational Science Graduate Fellowship ○ Dissertation: "Adaptive Model Reduction to Accelerate Optimization Problems Governed by Partial Differential Equations"

Sep 2016 **M.S., Computational and Mathematical Engineering, Stanford University** *Stanford, CA*
Advisor: Charbel Farhat

May 2011 **B.S., Civil and Environmental Engineering, University of California, Berkeley** *Berkeley, CA*
Advisor: Sanjay Govindjee ○ Minor: Mathematics

Honors & Awards

Nov 2024 **ASME Rising Star of Mechanical Engineering**, American Society of Mechanical Engineers

2023–2028 **Faculty Early Career Development (CAREER) Program**, National Science Foundation
5 year, $525k research grant

2022–2025 **Young Investigator Award**, Office of Naval Research
3 year, $510k research grant

2020–2023 **Young Investigator Award**, Air Force Office of Scientific Research
3 year, $450k research grant

Jun 2017 **Gene Golub Dissertation Award**, Stanford University *Stanford, CA*
Best thesis (Computational and Mathematical Engineering) in 2016-2017 academic year

Feb 2017 **Early Career Travel Award**
SIAM Conference on Computational Science and Engineering (February 2017)

2016–2018 **Luis W. Alvarez Postdoctoral Fellowship**, Lawrence Berkeley National Laboratory *Berkeley, CA*
2 year, independent research fellowship

2016–2018 **Sydney Fernbach Postdoctoral Fellowship**, Lawrence Livermore National Laboratory *Livermore, CA*
2 year, independent research fellowship (declined)

Apr 2015	**Robert J. Melosh Medal Finalist**, Duke University Best student paper in finite element analysis	*Durham, NC*
2013–2016	**Student Travel Award** International Meshing Roundtable (September 2016) ○ SIAM Conference on Uncertainty Quantification (April 2016) ○ World Congress on Computational Mechanics XI (July 2014) ○ International Conference on Spectral and Higher-Order Methods (June 2014) ○ SIAM Conference on Optimization (May 2014) ○ San Diego Supercomputing Summer Institute, HPC Workshop (August 2013)	
2011–2015	**Department of Energy Computational Science Graduate Fellowship** 4 years - full tuition, stipend, and research allowance	
May 2011	**University Medal Finalist**, University of California, Berkeley Campus-wide award to most distinguished graduating senior	*Berkeley, CA*
May 2011	**Civil Engineering Department Citation**, University of California, Berkeley Department-wide award to most distinguished student	*Berkeley, CA*
Aug 2010	**Best Project Award, 2010 AHPCRC Summer Institute**, Stanford University	*Stanford, CA*
Apr 2010	**Structural Engineers Association of N. California (SEAONC) Scholarship**	
May 2009	**Louise Cooper Endowment**, University of California, Berkeley Ranked 1st in CEE department	*Berkeley, CA*
Aug 2009	**Best Overall Project, 2009 Young Researchers Symposium**	

Publications

Thesis

[1] M. J. Zahr, *Adaptive Model Reduction to Accelerate Optimization Problems Governed by Partial Differential Equations*. PhD thesis, Stanford University, August 2016

Journal Articles (submitted)

[2] A. Perez Reyes and M. J. Zahr, "An implicit shock tracking method for simulation of shock-dominated flow over complex domains using mesh-based parametrizations," *Journal of Computational Physics*, in review 2025

[3] H. Dong, M. Yano, T. Huang, and M. J. Zahr, "An rp-adaptive method for accurate resolution of shock-dominated viscous flow based on implicit shock tracking," *Journal of Computational Physics*, in review 2025

[4] C. J. Naudet, B. Taylor, and M. J. Zahr, "A sharp-interface discontinuous Galerkin method for simulation of two-phase flow of real gases based on implicit shock tracking," *Journal of Computational Physics*, in review 2025

[5] A. N. Bustard, B. L. Bemis, R. A. M. Braga, M. J. Zahr, and T. J. Juliano, "Global time-resolved measurements of inlet/isolator unstart induced by mass injection," *Journal of Propulsion and Power*, in review 2025

[6] V. Zucatti and M. J. Zahr, "Model reduction of convection-dominated viscous conservation laws using implicit feature tracking and landmark image registration," *Journal of Computational Physics*, in review 2025

Journal Articles (in press)

[7] A. Thakur and M. J. Zahr, "Neural network-based Godunov corrections for approximate Riemann solvers using bi-fidelity learning," *Communications in Applied Mathematics and Computational Science*, accepted 2025

Journal Articles (published)

[8] J. M. Kaufmann and M. J. Zahr, "Symmetric, optimization-based, cross-element compatible nodal distributions for high-order finite elements," *Communications in Applied Mathematics and Computational Science*, vol. 20, pp. 119–146, April 2025

[9] J. Vandergrift and M. J. Zahr, "Preconditioned iterative solvers for constrained high-order implicit shock tracking methods," *Journal of Computational Physics*, vol. 514, p. 113234, October 2024

[10] T. Wen and M. J. Zahr, "An inexact augmented Lagrangian trust-region method to accelerate optimization problems with PDE constraints," *International Journal for Numerical Methods in Fluids*, vol. 97, pp. 621–645, April 2024

[11] H. Gao and M. J. Zahr, "Adaptive model reduction with local enrichment: empirical quadrature, error estimation, adaptivity," *International Journal of Computational Fluid Dynamics*, vol. 37, pp. 451–473, March 2024

[12] C. J. Naudet and M. J. Zahr, "A space-time high-order implicit shock tracking method for shock-dominated unsteady flows," *Journal of Computational Physics*, vol. 501, p. 112792, March 2024

[13] T. Huang, C. J. Naudet, and M. J. Zahr, "High-order implicit shock tracking boundary conditions for flows with parametrized shocks," *Journal of Computational Physics*, vol. 495, p. 112517, December 2023

[14] M. Mirhoseini and M. J. Zahr, "Accelerated solutions of convection-dominated partial differential equations using implicit feature tracking and empirical quadrature," *International Journal for Numerical Methods in Fluids*, vol. 96, pp. 102–124, September 2023

[15] V. Zucatti and M. J. Zahr, "An adaptive, training-free reduced-order model for convection-dominated problems based on hybrid snapshots," *International Journal for Numerical Methods in Fluids*, vol. 96, pp. 189–208, September 2023

[16] T. Wen and M. J. Zahr, "A globally convergent method to accelerate large-scale optimization using on-the-fly model hyperreduction: Application to shape optimization," *Journal of Computational Physics*, vol. 484, p. 112082, July 2023

[17] M. Mirhoseini and M. J. Zahr, "Model reduction of convection-dominated partial differential equations via optimization-based implicit feature tracking," *Journal of Computational Physics*, vol. 473, p. 111739, January 2023

[18] H. Gao, M. J. Zahr, and J.-X. Wang, "Physics-informed graph neural Galerkin networks: a unified framework for solving PDE-governed forward and inverse problems," *Computer Methods in Applied Mechanics and Engineering*, vol. 390, p. 114502, February 2022

[19] C. J. Naudet, J. Töger, and M. J. Zahr, "Accurate quantification of blood flow wall shear stress using simulation-based imaging: a synthetic, comparative study," *Engineering with Computers*, pp. 1–17, August 2022

[20] T. Huang and M. J. Zahr, "A robust, high-order implicit shock tracking method for simulation of complex, high-speed flows," *Journal of Computational Physics*, vol. 454, p. 110981, April 2022

[21] A. Shi, P.-O. Persson, and M. J. Zahr, "Implicit shock tracking for unsteady flows by the method of lines," *Journal of Computational Physics*, vol. 454, p. 110906, April 2022

[22] A. Schein, K. T. Carlberg, and M. J. Zahr, "Preserving general physical properties in model reduction of dynamical systems via constrained-optimization projection," *International Journal for Numerical Methods in Engineering*, vol. 122, no. 14, pp. 3368–3399, 2021

[23] M. Yano, T. Huang, and M. J. Zahr, "A globally convergent method to accelerate topology optimization using on-the-fly model reduction," *Computer Methods in Applied Mechanics and Engineering*, vol. 375, p. 113635, 2021

[24] M. J. Zahr and J. M. Powers, "High-order resolution of multidimensional compressible reactive flow using implicit shock tracking," *AIAA Journal*, vol. 59, no. 1, pp. 150–164, 2021

[25] J. Töger, M. J. Zahr, N. Aristokleous, K. Markenroth Bloch, M. Carlsson, and P.-O. Persson, "Blood flow imaging by optimal matching of computational fluid dynamics to 4D flow data," *Magnetic Resonance in Medicine*, vol. 84, no. 4, pp. 2231–2245, 2020

[26] H. Gao, J.-X. Wang, and M. J. Zahr, "Non-intrusive model reduction of large-scale, nonlinear dynamical systems using deep learning," *Physica D: Nonlinear Phenomena*, vol. 412, p. 132614, 2020

[27] D. Z. Huang, W. Pazner, P.-O. Persson, and M. J. Zahr, "High-order partitioned spectral deferred correction solvers for multiphysics problems," *Journal of Computational Physics*, vol. 412, p. 109441, 2020

[28] M. J. Zahr, A. Shi, and P.-O. Persson, "Implicit shock tracking using an optimization-based high-order discontinuous Galerkin method," *Journal of Computational Physics*, vol. 410, p. 109385, 2020

[29] M. J. Zahr, K. Carlberg, and D. P. Kouri, "An efficient, globally convergent method for optimization under uncertainty using adaptive model reduction and sparse grids," *SIAM/ASA Journal on Uncertainty Quantification*, vol. 7, no. 3, pp. 877–912, 2019

[30] M. J. Zahr and P.-O. Persson, "An optimization-based approach for high-order accurate discretization of conservation laws with discontinuous solutions," *Journal of Computational Physics*, vol. 365, pp. 105 – 134, 2018

[31] D. Z. Huang, P.-O. Persson, and M. J. Zahr, "High-order, linearly stable, partitioned solvers for general multiphysics problems based on implicit-explicit Runge-Kutta schemes," *Computer Methods in Applied Mechanics and Engineering*, vol. 346, pp. 674 – 706, 2018

[32] M. J. Zahr, P. Avery, and C. Farhat, "A multilevel projection-based model order reduction framework for nonlinear dynamic multiscale problems in structural and solid mechanics," *International Journal for Numerical Methods in Engineering*, vol. 112, no. 8, pp. 855–881, 2017

[33] M. J. Zahr, P.-O. Persson, and J. Wilkening, "A fully discrete adjoint method for optimization of flow problems on deforming domains with time-periodicity constraints," *Computers & Fluids*, vol. 139, pp. 130 – 147, 2016

[34] M. J. Zahr and P.-O. Persson, "An adjoint method for a high-order discretization of deforming domain conservation laws for optimization of flow problems," *Journal of Computational Physics*, vol. 326, pp. 516 – 543, 2016

[35] D. Amsallem, M. J. Zahr, and K. Washabaugh, "Fast local reduced basis updates for the efficient reduction of nonlinear systems with hyper-reduction," *Advances in Computational Mathematics*, pp. 1–44, 2015

[36] M. J. Zahr and C. Farhat, "Progressive construction of a parametric reduced-order model for PDE-constrained optimization," *International Journal for Numerical Methods in Engineering*, vol. 102, no. 5, pp. 1111–1135, 2015

[37] D. Amsallem, M. J. Zahr, Y. Choi, and C. Farhat, "Design optimization using hyper-reduced-order models," *Structural and Multidisciplinary Optimization*, pp. 1–22, 2014

[38] D. Amsallem, M. J. Zahr, and C. Farhat, "Nonlinear model order reduction based on local reduced-order bases," *International Journal for Numerical Methods in Engineering*, vol. 92, no. 10, pp. 891–916, 2012

Book Chapters (Invited)

[39] A. Shi, P.-O. Persson, and M. J. Zahr, "High-order implicit shock tracking (HOIST)," in *Mesh Generation and Adaptation: Cutting-Edge Techniques* (R. Sevilla, S. Perotto, and K. Morgan, eds.), pp. 233–259, Springer International Publishing, 2022

[40]M. J. Zahr and P.-O. Persson, "Energetically optimal flapping wing motions via adjoint-based optimization and high-order discretizations," in *Frontiers in PDE-Constrained Optimization*, Springer, 2018

Conference Papers (Refereed)

[41] V. Zucatti and M. J. Zahr, "Implicit feature tracking reduced-order modeling by landmark image registration," in *NATO AVT-411 Research Specialists' Meeting on Machine Learning and Artificial Intelligence for Military Vehicle Design*, (Washington, D.C.), North Atlantic Treaty Organization, 5/21/2025 – 5/23/2025

[42] H. Dong, A. Perez Reyes, and M. J. Zahr, "A p-adaptive high-order implicit shock tracking method for compressible, inviscid flows," in *AIAA Science and Technology Forum and Exposition (SciTech2025)*, (Orlando, Florida), American Institute of Aeronautics and Astronautics, AIAA Paper 2025-1568, 1/6/2025 – 1/10/2025

[43] T. Huang, M. J. Zahr, K. R. Holst, A. Baker, J. Freels, P. Batten, N. Bachchan, J. B. Maeng, T. C. Fisher, J. Park, S. Jee, and W. J. White, "High-Fidelity CFD Verification Workshop 2024 Summary: Shock-Dominated Flows," in *AIAA Aviation Forum and Exposition (Aviation 2024)*, (Las Vegas, Nevada), American Institute of Aeronautics and Astronautics, AIAA Paper 2024-3695, 7/29/2024 – 8/2/2024

[44]C. J. Naudet, B. Taylor, and M. J. Zahr, "High-order implicit shock tracking for finite-source spherical blast waves," in *AIAA Aviation Forum and Exposition (Aviation 2023)*, (San Diego, California), American Institute of Aeronautics and Astronautics, AIAA Paper 2023-3863, 6/12/2023 – 6/16/2023

[45] T. Wen and M. J. Zahr, "An augmented Lagrangian trust-region method to accelerate equality-constrained shape optimization problems using model hyperreduction," in *AIAA Science and Technology Forum and Exposition (SciTech2023)*, (National Harbor, Maryland), American Institute of Aeronautics and Astronautics, AIAA Paper 2023-1423, 1/23/2023 – 1/27/2023

[46]K. Holst, C. Kim, and M. J. Zahr, "High-Fidelity CFD Verification Workshop 2024: Shock-Dominated Flows," in *AIAA Science and Technology Forum and Exposition (SciTech2023)*, (National Harbor, Maryland), American Institute of Aeronautics and Astronautics, AIAA Paper 2023-1242, 1/23/2023 – 1/27/2023

[47] T. Huang and M. J. Zahr, "High-order implicit shock tracking boundary conditions for supersonic flow over a smoothed rectangle," in *AIAA Science and Technology Forum and Exposition (SciTech2023)*, (National Harbor, Maryland), American Institute of Aeronautics and Astronautics, AIAA Paper 2023-1977, 1/23/2023 – 1/27/2023

[48] O. Rasheed, T. Huang, and M. J. Zahr, "High-order implicit shock tracking for a supersonic biplane airfoil," in *AIAA Aviation Forum and Exposition (Aviation 2022)*, (Chicago, Illinois), American Institute of Aeronautics and Astronautics, AIAA Paper 2022-4082, 6/27/2022 – 7/1/2022

[49]T. Huang and M. J. Zahr, "High-order implicit shock tracking with targeted mesh optimization and PDE-based smoothing," in *AIAA Aviation Forum and Exposition (Aviation 2021)*, (Washington, D.C.), American Institute of Aeronautics and Astronautics, AIAA Paper 2021-2710, 6/7/2021 – 6/11/2021

[50] M. J. Zahr and P.-O. Persson, "An r-adaptive, high-order discontinuous Galerkin method for flows with attached shocks," in *AIAA Science and Technology Forum and Exposition (SciTech2020)*, (Orlando, Florida), American Institute of Aeronautics and Astronautics, AIAA Paper 2020-0537, 1/6/2020 – 1/10/2020

[51] A. Shi, P.-O. Persson, and M. J. Zahr, "An optimization-based discontinuous Galerkin approach for high-order accurate shock tracking with guaranteed mesh quality," in *AIAA Science and Technology Forum and Exposition (SciTech2019)*, (San Diego, California), American Institute of Aeronautics and Astronautics, AIAA Paper 2019-1151, 1/7/2019 – 1/11/2019

[52] M. Franco, P.-O. Persson, W. Pazner, and M. J. Zahr, "An adjoint method using fully implicit Runge-Kutta schemes for optimization of flow problems," in *AIAA Science and Technology Forum and Exposition (SciTech2019)*, (San Diego, California), American Institute of Aeronautics and Astronautics, AIAA Paper 2019-0351, 1/7/2019 – 1/11/2019

[53] D. Z. Huang, P.-O. Persson, and M. J. Zahr, "A high-order partitioned solver for general multiphysics problems and its applications in optimization," in *AIAA Science and Technology Forum and Exposition (SciTech2019)*, (San Diego, California), American Institute of Aeronautics and Astronautics, AIAA Paper 2019-1697, 1/7/2019 – 1/11/2019

[54] M. J. Zahr and P.-O. Persson, "An optimization-based discontinuous Galerkin approach for high-order accurate shock tracking," in *AIAA Science and Technology Forum and Exposition (SciTech2018)*, (Kissimmee, Florida), American Institute of Aeronautics and Astronautics, AIAA Paper 2018-0063, 1/8/2018 – 1/12/2018

[55] J. Wang, M. J. Zahr, and P.-O. Persson, "Energetically optimal flapping flight based on a fully discrete adjoint method with explicit treatment of flapping frequency," in *23rd AIAA Computational Fluid Dynamics Conference*, (Denver, Colorado), American Institute of Aeronautics and Astronautics, AIAA Paper 2017-4412, 6/5/2017 – 6/9/2017

[56] K. Washabaugh, M. J. Zahr, and C. Farhat, "On the use of discrete nonlinear reduced-order models for the prediction of steady-state flows past parametrically deformed complex geometries," in *AIAA Science and Technology Forum and Exposition (SciTech 2016)*, (San Diego, California), American Institute of Aeronautics and Astronautics, AIAA Paper 2016-1814, 1/4/2016 – 1/8/2016

[57] D. De Santis, M. J. Zahr, and C. Farhat, "Gradient-based aerodynamic shape optimization using the FIVER embedded boundary method," in *AIAA Science and Technology Forum and Exposition (SciTech 2016)*, (San Diego, California), American Institute of Aeronautics and Astronautics, AIAA Paper 2016-0807, 1/4/2016 – 1/8/2016

[58] M. J. Zahr and P.-O. Persson, "High-order, time-dependent aerodynamic optimization using a discontinuous Galerkin discretization of the Navier-Stokes equations," in *AIAA Science and Technology Forum and Exposition (SciTech 2016)*, (San Diego, California), American Institute of Aeronautics and Astronautics, AIAA Paper 2016-0064, 1/4/2016 – 1/8/2016

[59] M. J. Zahr and P.-O. Persson, "Performance tuning of Newton-GMRES methods for discontinuous Galerkin discretizations of the Navier-Stokes equations," in *21st AIAA Computational Fluid Dynamics Conference*, (San Diego, California), American Institute of Aeronautics and Astronautics, AIAA Paper 2013-2685, 6/24/2013 – 6/27/2013

[60] M. J. Zahr, D. Amsallem, and C. Farhat, "Construction of parametrically-robust CFD-based reduced-order models for PDE-constrained optimization," in *21st AIAA Computational Fluid Dynamics Conference*, (San Diego, California), American Institute of Aeronautics and Astronautics, AIAA Paper 2013-2685, 6/24/2013 – 6/27/2013

[61] K. Washabaugh, D. Amsallem, M. J. Zahr, and C. Farhat, "Nonlinear model reduction for CFD problems using local reduced-order bases," in *42nd AIAA Fluid Dynamics Conference and Exhibit, Fluid Dynamics and Co-located Conferences*, (New Orleans, Louisiana), American Institute of Aeronautics and Astronautics, AIAA Paper 2012-2686, 6/25/2012 – 6/28/2012

[62] K. Carlberg, J. Cortial, D. Amsallem, M. J. Zahr, and C. Farhat, "The GNAT nonlinear model reduction method and its application to fluid dynamics problems," in *6th AIAA Theoretical Fluid Mechanics Conference*, (Honolulu, Hawaii), American Institute of Aeronautics and Astronautics, AIAA Paper 2011-3112, 6/27/2011 – 6/30/2011

[63] D. Amsallem, M. J. Zahr, and C. Farhat, "On the robustness of residual minimization for constructing POD-based reduced-order CFD models," in *43rd AIAA Fluid Dynamics Conference and Exhibit*, (San Diego, California), American Institute of Aeronautics and Astronautics, AIAA Paper 2013-2447, 6/27/2011 – 6/30/2011

Technical Reports

[64] M. J. Zahr and S. Govindjee, "Theoretical and numerical foundations for the use of microcolumns as angular motion sensors," tech. rep., University of California, Berkeley, 2011

[65] M. J. Zahr, K. Carlberg, D. Amsallem, and C. Farhat, "Comparison of model reduction techniques on high-fidelity linear and nonlinear electrical, mechanical, and biological systems," tech. rep., University of California, Berkeley, 2010

[66] M. J. Zahr, N. Luco, and H. Ryu, "Mitigation of seismic risk pertaining to non-ductile reinforced concrete buildings using seismic risk maps," tech. rep., United States Geologic Survey (USGS), 2009

Talks

Seminar Presentations (Invited)

- M. J. Zahr, "High-order implicit shock tracking for shock-dominated flows," in *Mathematics Department Seminar, Portland State University (Host: Will Pazner)*, (Portland, Oregon), Portland State University, 3/14/2025
- M. J. Zahr, "High-order implicit shock tracking for shock-dominated flows," in *Center for Computational and Applied Mathematics Seminar, Purdue University (Host: Xiangxiong Zhang)*, (West Lafayette, Indiana), Purdue University, 10/30/2023
- M. J. Zahr, "Simulation of shock-dominated flows using high-order implicit shock tracking," in *Applied Mechanics Seminar, Indian Institute of Technology (IIT) Delhi (Host: Prateek Gupta)*, (Virtual Event; Delhi, India), IIT Delhi, 4/14/2023
- M. J. Zahr, "High-order implicit shock tracking for shock-dominated flows," in *Numerical Analysis and Scientific Computing Seminar, University of Waterloo (Host: David Del Rey Fernandez)*, (Virtual Event; Waterloo, Ontario), University of Waterloo, 2/7/2023

- M. J. Zahr, "High-order implicit shock tracking for shock-dominated flows," in *Fluid Dynamics Research Consortium (FDRC), The Pennsylvania State University (Host: David Williams)*, (State College, Pennsylvania), Penn State University, 12/8/2022
- M. J. Zahr, "High-order, optimization-based computational fluid dynamics," in *SIAM Student Chapter Lecture, University of Notre Dame*, (Notre Dame, Indiana), University of Notre Dame, 11/16/2022
- M. J. Zahr, "Simulation of shock-dominated flows using high-order implicit shock tracking," in *Eulerian Code Group, Los Alamos National Laboratory (Host: Lauren Green)*, (Virtual Event; Los Alamos, New Mexico), Los Alamos National Laboratory, 11/14/2022
- M. J. Zahr, "High-order implicit shock tracking for high-speed flows," in *Alvarez Fellow Seminar Series, Lawrence Berkeley National Laboratory (Host: Julianne Mueller)*, (Virtual Event: Berkeley, California), Lawrence Berkeley National Laboratory, 7/26/2022
- M. J. Zahr, "High-order and reduced-order methods for improved engineering analysis and design," in *Large Scale Structural Systems Early-Career Colloquium, USACM (Host: Pablo Seleson)*, (Virtual Event), United States Association for Computational Mechanics, 11/3/2021
- M. J. Zahr, "At the intersection of computational science and aerospace engineering," in *Mechanical, Aerospace & Biomedical Engineering Seminar, University of Tennessee, Knoxville (Host: Devina Sanjaya)*, (Virtual Event; Knoxville, Tennessee), University of Tennessee, Knoxville, 9/1/2021
- M. J. Zahr, "Model reduction of convection-dominated partial differential equations via optimization-based implicit feature tracking," in *Centre for Computational Science and Engineering Seminar, University of Toronto (Host: Masayuki Yano)*, (Virtual Event: Toronto, Canada), University of Toronto, 8/23/2021
- M. J. Zahr, "Model reduction of convection-dominated partial differential equations via optimization-based implicit feature tracking," in *Data-Driven Physical Simulations Seminar, Lawrence Livermore National Laboratory (Host: Youngsoo Choi)*, (Virtual Event; Livermore, California), Lawrence Livermore National Laboratory, 6/24/2021
- M. J. Zahr, "Robust high-order implicit shock tracking solver for high-speed flows," in *Computational Hypersonics Research Lab Seminar, University of Minnesota (Host: Graham Candler)*, (Virtual Event; Minneapolis, Minnesota), University of Minnesota, 5/18/2021
- M. J. Zahr, "Integrating computational physics and numerical optimization to address challenges in computational science, engineering, and medicine," in *Applied and Computational Mathematics and Statistics Seminar, University of Notre Dame (Host: Alan Lindsay)*, (Virtual Event; Notre Dame, Indiana), University of Notre Dame, 4/8/2021
- M. J. Zahr and J. M. Powers, "Accurate methods for computing high mach number reactive flow," in *Turbulence Analysis and Simulation Center Seminar (Host: Daniel Tortorelli)*, (Virtual Event; Livermore, California), Lawrence Livermore National Laboratory, 6/24/2020
- M. J. Zahr, "Integrating computational physics and numerical optimization to address challenges in computational science, engineering, and medicine," in *Data Sciences Seminar, Johns Hopkins University (Host: Fei Lu)*, (Baltimore, Maryland), Johns Hopkins University, 12/4/2019
- M. J. Zahr, "Integrated computational physics and numerical optimization," in *Center for Informatics and Computational Science Seminar, Univerity of Notre Dame (Host: Nicholas Zabaras)*, (Notre Dame, Indiana), University of Notre Dame, 3/6/2019
- M. J. Zahr, "Integrated computational physics and numerical optimization," in *Program in Applied Mathematics Colloquium, University of Arizona (Host: Matthias Morzfeld)*, (Tuscon, Arizona), University of Arizona, 9/21/2018
- M. J. Zahr, "Integrated computational physics and numerical optimization," in *Applied Mathematics Seminar, UC Berkeley (Host: Per-Olof Persson)*, (Berkeley, California), University of California, Berkeley, 9/6/2018
- M. J. Zahr, "Optimization-based computational physics and high-order methods: from optimized analysis to design and data assimilation," in *Aerospace and Ocean Engineering Seminar, Virginia Tech (Host: Kevin Wang)*, (Blacksburg, Virginia), Virginia Polytechnic Institute and State University, 4/2/2018
- M. J. Zahr, "Gradient-based optimization of flow problems using the adjoint method and high-order numerical discretizations," in *Applied, Computational, and Industrial Math Seminar Series*, (San Jose, California), San Jose State University, 5/8/2017
- M. J. Zahr and P.-O. Persson, "Optimization of CFD simulations, with MRI applications," in *TESLA Seminar (Host: Johannes Töger)*, (Lund, Sweden), Lund University, 3/31/2017
- M. J. Zahr, "Adaptive model reduction to accelerate optimization problems governed by partial differential equations," in *Farhat Research Group Seminar*, (Stanford, California), Stanford University, 1/10/2017

- M. J. Zahr, "Adaptive model reduction to accelerate optimization problems governed by partial differential equations," in *LBNL Postdoc Seminar Series*, (Berkeley, California), Lawrence Berkeley National Laboratory, 1/9/2017
- M. J. Zahr, "Efficient PDE-constrained optimization under uncertainty using adaptive model reduction and sparse grids," in *CME 500 Seminar*, (Stanford, California), Stanford University, 4/11/2016
- M. J. Zahr, "Accelerating PDE-constrained optimization problems using adaptive reduced-order models," in *University of Notre Dame Aerospace and Mechanical Engineering Seminar (Host: Gretar Tryggvason)*, (South Bend, Indiana), University of Notre Dame, 3/3/2016 – 3/4/2016
- M. J. Zahr, "Accelerating PDE-constrained optimization problems using adaptive reduced-order models," in *University of Southern California Aerospace and Mechanical Engineering Seminar (Host: Geoff Spedding)*, (Los Angeles, California), University of Southern California, 2/25/2016 – 2/26/2017
- M. J. Zahr, "Accelerating PDE-constrained optimization problems using adaptive reduced-order models," in *Luis W. Alvarez Fellowship Seminar (Host: Jonathan Carter)*, (Berkeley, California), Lawrence Berkeley National Laboratory, 2/9/2016
- M. J. Zahr, "Accelerating PDE-constrained optimization problems using adaptive reduced-order models," in *J. H. Wilkinson Fellowship Seminar (Host: Sven Leyffer)*, (Argonne, Illinois), Argonne National Laboratory, 1/15/2016
- M. J. Zahr, "Accelerating PDE-constrained optimization problems using adaptive reduced-order models," in *John von Neumann Postdoctoral Fellowship Seminar (Host: Denis Ridzal)*, (Albuquerque, New Mexico), Sandia National Laboratories, 1/11/2016
- M. J. Zahr and P.-O. Persson, "High-order methods for optimization and control of conservation laws on deforming domains," in *Dean Seminar at Sandia National Laboratories (Host: Kevin Carlberg)*, (Livermore, California), 12/14/2015
- M. J. Zahr, "Accelerating PDE-constrained optimization problems using adaptive reduced-order models," in *Sidney Fernbach Postdoctoral Fellowship Seminar (Host: Jeffrey A. F. Hittinger)*, (Livermore, California), Lawrence Livermore National Laboratory, 12/9/2015
- M. J. Zahr and P.-O. Persson, "High-order methods for optimization and control of conservation laws on deforming domains," in *Applied Mathematics Seminar at UC Berkeley (Host: Per-Olof Persson)*, (Berkeley, California), 9/30/2015
- M. J. Zahr and C. Farhat, "Accelerating PDE-constrained optimization using adaptive reduced-order models," in *Seminar at Sandia National Laboratories (Host: Drew Kouri)*, (Albuquerque, New Mexico), 7/8/2015
- M. J. Zahr, "Accelerating PDE-constrained optimization using adaptive reduced-order models: application to topology optimization," in *Robert J. Melosh Medal Competition*, (Durham, North Carolina), Duke University, 4/24/2015

Conference Semi-Plenary Lectures (Invited)

- M. J. Zahr, "High-order implicit shock tracking for shock-dominated flows," in *22nd Computational Fluids Conference (CFC2023)*, (Cannes, France), 4/25/2023 – 4/28/2023

Conference Minisymposium Keynotes (Invited)

- T. Huang and M. J. Zahr, "Simulation of shock-dominated flows using high-order implicit shock tracking," in *17th U. S. National Congress on Computational Mechanics (USNCCM17)*, (Albuquerque, New Mexico), 7/23/2023 – 7/27/2023
- T. Huang and M. J. Zahr, "High-order implicit shock tracking for compressible, viscous flows," in *15th World Congress on Computational Mechanics (WCCM-XV) and 8th Asian Pacific Congress on Computational Mechanics (APCOM-VIII)*, (Virtual Event; Yokohama, Japan), 7/31/2022 – 8/5/2022
- T. Huang and M. J. Zahr, "High-order implicit shock tracking: robust solvers and applications," in *16th U.S. National Congress on Computational Mechanics (USNCCM16)*, (Chicago, Illinois), 7/25/2021 – 7/29/2021

Conference Presentations and Other Talks (Invited)

- V. Zucatti and M. J. Zahr, "Implicit feature tracking reduced-order modeling by landmark image registration," in *NATO AVT-411 Research Specialists' Meeting on Machine Learning and Artificial Intelligence for Military Vehicle Design*, (Washington, D.C.), 5/21/2025 – 5/23/2025
- M. J. Zahr, "Implicit Shock Tracking - a PDE-constrained optimization approach to accurate resolution of high-speed viscous flows," in *2025 SIAM Conference on Computational Science and Engineering (CSE25)*, (Fort Worth, Texas), 3/3/2025 – 3/7/2025
- M. J. Zahr, "High-order implicit shock tracking for high-speed flows," in *Emerging Trends in Computational Fluid Dynamics (Jameson-Kim-Wang Symposium)*, (Stanford, California), 12/5/2024 – 12/7/2024

- M. J. Zahr, "Model reduction with implicit feature tracking to accelerate simulation of hypersonic flow," in *2024 AFOSR/ONR MURI Review*, (Washington, D.C.), Air Force Office of Scientific Research, 12/3/2024
- M. J. Zahr, "Improved blast simulations using high-order implicit shock tracking," in *AFOSR Dynamic Materials and Interaction Program Review*, (Oxon Hill, Maryland), Air Force Office of Scientific Research, 8/19/2024 – 8/23/2024
- M. J. Zahr, "Adaptive model reduction for shock-dominated flows to enable many-query computational physics," in *AFOSR Computational Mathematics Program Review*, (Hybrid Event; Washington, D.C.), Air Force Office of Scientific Research, 8/12/2024 – 8/16/2024
- M. J. Zahr, "Improved simulation of hypersonic flows using high-order implicit shock tracking," in *AFOSR/ONR/HVSI Annual High-Speed Aerodynamics Portfolio Review*, (Hybrid Event; Minneapolis, Minnesota), Office of Naval Research, 8/5/2024 – 8/9/2024
- M. J. Zahr, "Adaptive model reduction for analysis and optimization of shock-dominated flows," in *2023 AFOSR/ONR MURI Review*, (Washington, D.C.), Air Force Office of Scientific Research, 12/13/2023
- M. J. Zahr, "Improved blast simulations using high-order implicit shock tracking," in *AFOSR Dynamic Materials and Interaction Program Review*, (Hybrid Event; Alexandria, Virginia), Air Force Office of Scientific Research, 8/21/2023 – 8/25/2023
- M. J. Zahr, "Adaptive model reduction for shock-dominated flows to enable many-query computational physics," in *AFOSR Computational Mathematics Program Review*, (Hybrid Event; Washington, D.C.), Air Force Office of Scientific Research, 8/7/2023 – 8/11/2023
- M. J. Zahr, "Improved simulation of hypersonic flows using high-order implicit shock tracking," in *AFOSR/ONR/HVSI Annual High-Speed Aerodynamics Portfolio Review*, (Hybrid Event; College Park, Maryland), Office of Naval Research, 7/24/2023 – 7/28/2023
- M. J. Zahr, "Optimization-based implicit shock tracking for unsteady flows," in *SIAM Conference on Optimization*, (Seattle, Washington), 5/31/2023 – 6/3/2023
- M. J. Zahr, "Adaptive model reduction for high-speed flows," in *Computational Challenges and Emerging Tools (DDEW03) (Host: Isaac Newton Institute for Mathematical Sciences)*, (Cambridge, United Kingdom), 4/24/2023 – 4/27/2023
- M. J. Zahr, "Adaptive model reduction for shock-dominated flows," in *SIAM Conference on Computational Science and Engineering*, (Amsterdam, Netherlands), 2/27/2023 – 3/3/2023
- M. J. Zahr, "Adaptive model reduction for analysis and optimization of shock-dominated flows," in *2022 AFOSR/ONR MURI Review*, (Washington, D.C.), Air Force Office of Scientific Research, 11/30/2022
- M. J. Zahr, "Adaptive model reduction for shock-dominated flows to enable many-query computational physics," in *AFOSR Computational Mathematics Program Review*, (Hybrid Event; Washington, D.C.), Air Force Office of Scientific Research, 8/15/2022 – 8/19/2022
- M. J. Zahr, "Improved simulation of hypersonic flows using high-order implicit shock tracking," in *AFOSR/ONR/HVSI Annual High-Speed Aerodynamics Portfolio Review*, (Hybrid Event; Caltech, California), Office of Naval Research, 7/18/2022 – 7/22/2022
- M. J. Zahr, "Model reduction of convection-dominated flows using implicit tracking feature tracking," in *Reduced-Order Models at Work: Industry and Medicine (Host: Inria Bordeaux)*, (Bordeaux, France), 3/30/2022 – 4/1/2022
- M. J. Zahr, "Improved blast simulations using high-order implicit shock tracking," in *AFOSR Dynamic Materials and Interaction Kickoff*, (Virtual Event), Air Force Office of Scientific Research, 2/1/2022
- M. J. Zahr, "Adaptive model order reduction to accelerate hypersonic flow simulations," in *2021 AFOSR/ONR MURI Review*, (Washington, D.C.), Air Force Office of Scientific Research, 12/8/2021
- M. J. Zahr, "Adaptive model reduction for shock-dominated flows to enable many-query computational physics," in *AFOSR Computational Mathematics Program Review*, (Virtual Event; Washington, D.C.), Air Force Office of Scientific Research, 8/9/2021
- T. Huang, C. Naudet, and M. J. Zahr, "Robust high-order implicit shock tracking solver for complex high-speed flows," in *SIAM Conference on Computational Science and Engineering*, (Virtual Event; Fort Worth, Texas), 3/1/2021 – 3/5/2021
- A. Shi, P.-O. Persson, and M. J. Zahr, "Implicit shock tracking and the method of lines for shock-dominated, unsteady flows," in *SIAM Conference on Computational Science and Engineering*, (Virtual Event; Fort Worth, Texas), 3/1/2021 – 3/5/2021
- T. Wen and M. J. Zahr, "A globally convergent method to accelerate PDE-constrained optimization using on-the-fly model reduction," in *SIAM Conference on Computational Science and Engineering*, (Virtual Event; Fort Worth, Texas), 3/1/2021 – 3/5/2021

- M. Mirhoseini and M. J. Zahr, "Model reduction of convection-dominated flows using implicit tracking," in *SIAM Conference on Computational Science and Engineering*, (Virtual Event; Fort Worth, Texas), 3/1/2021 – 3/5/2021
- D. Z. Huang, P.-O. Persson, and M. J. Zahr, "High-order partitioned spectral deferred correction solvers for multiphysics problems," in *SIAM Conference on Computational Science and Engineering*, (Virtual Event; Fort Worth, Texas), 3/1/2021 – 3/5/2021
- M. J. Zahr, "High-resolution visualization of in vivo blood flow from low-resolution 4D flow MRI scans using computational fluid dynamics and optimization," in *SIAM Conference on Parallel Processing for Scientific Computing (PP20)*, (Seattle, Washington), 2/12/2020 – 2/15/2020
- M. J. Zahr, K. Carlberg, and D. P. Kouri, "Efficient PDE-constrained optimization under uncertainty using adaptive model reduction and sparse grids," in *SIAM Conference on Computational Science and Engineering*, (Spokane, Washington), 2/25/2019 – 3/1/2019
- M. J. Zahr and P.-O. Persson, "An optimization-based discontinuous Galerkin approach for high-order shock tracking," in *SIAM Conference on Computational Science and Engineering*, (Spokane, Washington), 2/25/2019 – 3/1/2019
- R. Baraldi, M. Morzfeld, and M. J. Zahr, "An acceleration framework for parameter estimation using implicit sampling and adaptive reduced-order models," in *SIAM Conference on Computational Science and Engineering*, (Spokane, Washington), 2/25/2019 – 3/1/2019
- M. J. Zahr, K. Carlberg, and D. P. Kouri, "Efficient PDE-constrained optimization under uncertainty using adaptive model reduction and sparse grids," in *SIAM Conference on Uncertainty Quantification*, (Garden Grove, California), 4/16/2018 – 4/19/2018
- M. J. Zahr, "Efficient PDE-constrained optimization under uncertainty using adaptive model reduction and sparse grids," in *2017 West Coast ROM Workshop*, (Berkeley, California), Lawrence Berkeley National Laboratory, 11/17/2017
- M. J. Zahr, K. Carlberg, and D. P. Kouri, "Efficient PDE-constrained optimization under uncertainty using adaptive model reduction and sparse grids," in *SIAM Conference on Computational Science and Engineering*, (Atlanta, Georgia), 2/27/2017 – 3/3/2017
- M. J. Zahr, "Efficient PDE-constrained optimization under uncertainty using adaptive model reduction and sparse grids," in *BIRS Workshop: Data-Driven Methods for ROMs and Stochastic PDEs*, (Banff, Alberta, Canada), Banff International Reseach Station, 1/30/2017 – 2/3/2017
- M. J. Zahr, K. Carlberg, and D. P. Kouri, "Efficient PDE-constrained optimization under uncertainty using adaptive model reduction and sparse grids," in *SIAM Annual Meeting*, (Boston, Massachusetts), 7/11/2016 – 7/15/2016
- M. J. Zahr, K. Carlberg, and D. P. Kouri, "Adaptive stochastic collocation for PDE-constrained optimization under uncertainty using sparse grids and model reduction," in *SIAM Conference on Uncertainty Quantification*, (Lausanne, Switzerland), Ecole Polytechnique Federale de Lausanne, 4/5/2016 – 4/8/2016
- M. J. Zahr and C. Farhat, "A nonlinear trust-region framework for PDE-constrained optimization using adaptive model reduction," in *West Coast ROM Workshop*, (Livermore, California), Sandia National Laboratories, 11/19/2015
- M. J. Zahr, "High-order, time-dependent PDE-constrained optimization using discontinuous Galerkin methods," in *Department of Energy Computational Science Graduate Fellowship Program Review*, (Washington D.C.), 7/27/2015 – 7/30/2015
- M. J. Zahr and C. Farhat, "A nonlinear trust-region framework for PDE-constrained optimization using progressively constructed reduced-order models," in *2015 SIAM Conference on Computational Science and Engineering (CSE15)*, (Salt Lake City, Utah), 3/14/2015 – 3/18/2015
- M. J. Zahr and C. Farhat, "Accelerating PDE-constrained optimization using progressively constructed reduced-order models," in *Bay Area ROM Workshop*, (Livermore, California), Sandia National Laboratories, 8/8/2014
- M. J. Zahr, K. Washabaugh, and C. Farhat, "Robust reduced-order models via fast, low-rank basis updates," in *2014 SIAM Annual Meeting*, (Chicago, Illinois), 7/7/2014 – 7/11/2014
- D. Amsallem, K. Washabaugh, M. J. Zahr, and C. Farhat, "Efficient nonlinear model reduction approach using local reduced bases and hyper-reduction," in *2013 SIAM Conference on Computational Science and Engineering (CSE13)*, (Boston, Massachusetts), 2/25/2013 – 3/1/2013
- M. J. Zahr and C. Farhat, "Efficient, parametrically robust nonlinear model reduction using local reduced-order bases," in *2013 SIAM Conference on Computational Science and Engineering (CSE13)*, (Boston, Massachusetts), 2/25/2013 – 3/1/2013

Conference Presentations and Other Talks (Contributed)

- M. J. Zahr and V. Zucatti, "Implicit feature tracking reduced-order modeling by landmark image registration," in *18th U.S. National Congress on Computational Mechanics (USNCCM18)*, (Chicago, IL), 7/20/2025 – 7/24/2025
- R. A. M. Braga and M. J. Zahr, "A hybrid shock fitting-capturing method for high-speed flows," in *18th U.S. National Congress on Computational Mechanics (USNCCM18)*, (Chicago, IL), 7/20/2025 – 7/24/2025
- H. Dong, T. Huang, M. Yano, and M. J. Zahr, "A p-adaptive implicit shock tracking method for high-speed viscous flows," in *18th U.S. National Congress on Computational Mechanics (USNCCM18)*, (Chicago, IL), 7/20/2025 – 7/24/2025
- C. J. Naudet and M. J. Zahr, "High-order implicit shock tracking for multi-material shocked flows," in *18th U.S. National Congress on Computational Mechanics (USNCCM18)*, (Chicago, IL), 7/20/2025 – 7/24/2025
- A. Perez Reyes and M. J. Zahr, "Mesh-based boundary preserving parametrization for implicit shock tracking of shock dominated flows," in *18th U.S. National Congress on Computational Mechanics (USNCCM18)*, (Chicago, IL), 7/20/2025 – 7/24/2025
- C. J. Naudet and M. J. Zahr, "High-order implicit shock tracking for multi-material shocked flows high-order implicit shock tracking for multi-material shocked flows," in *International Conference on Spectral and High Order Methods (ICOSAHOM) 2025*, (Montreal, Quebec, Canada), 7/13/2025 – 7/18/2025
- H. Dong, A. Perez Reyes, and M. J. Zahr, "A p-adaptive high-order implicit shock tracking method for compressible, inviscid flows," in *Proc. of the AIAA Science and Technology Forum and Exposition (SciTech2025)*, (Orlando, Florida), American Institute of Aeronautics and Astronautics, 1/6/2025 – 1/10/2025
- C. Naudet and M. J. Zahr, "High-order implicit shock tracking for time-dependent flows," in *Research Training Group (RTG) in Numerical Mathematics and Scientific Computing (NASC) Annual Workshop*, (Houston, Texas), 10/4/2024 – 10/5/2024
- T. Huang, M. J. Zahr, K. R. Holst, A. Baker, J. Freels, P. Batten, N. Bachchan, J. B. Maeng, T. C. Fisher, J. Park, S. Jee, and W. J. White, "High-Fidelity CFD Verification Workshop 2024 Summary: Shock-Dominated Flows," in *Proc. of the AIAA Aviation Forum and Exposition (Aviation 2024)*, (Las Vegas, Nevada), American Institute of Aeronautics and Astronautics, 7/29/2024 – 8/2/2024
- A. Thakur and M. J. Zahr, "Exploring Riemann solvers, machine learning surrogates, and shock tracking in hyperbolic PDE systems," in *16th World Congress on Computational Mechanics (WCCM-XVI) and 4th Pan American Congress on Computational Mechanicsc (PANACM-IV)*, (Vancouver, British Columbia, Canada), 7/21/2024 – 7/26/2024
- A. Perez Reyes and M. J. Zahr, "Implicit shock tracking for high-speed flows with attached shocks," in *16th World Congress on Computational Mechanics (WCCM-XVI) and 4th Pan American Congress on Computational Mechanicsc (PANACM-IV)*, (Vancouver, British Columbia, Canada), 7/21/2024 – 7/26/2024
- H. Dong and M. J. Zahr, "A p-adaptive implicit shock tracking method for high-speed viscous flows," in *16th World Congress on Computational Mechanics (WCCM-XVI) and 4th Pan American Congress on Computational Mechanicsc (PANACM-IV)*, (Vancouver, British Columbia, Canada), 7/21/2024 – 7/26/2024
- C. J. Naudet and M. J. Zahr, "High-order implicit shock tracking for time-dependent flows," in *17th U. S. National Congress on Computational Mechanics (USNCCM17)*, (Albuquerque, New Mexico), 7/23/2023 – 7/27/2023
- C. J. Naudet, B. Taylor, and M. J. Zahr, "High-order implicit shock tracking for finite-source spherical blast waves," in *Proc. of the AIAA Aviation Forum and Exposition (Aviation 2023)*, (San Diego, California), American Institute of Aeronautics and Astronautics, 6/12/2023 – 6/16/2023
- C. J. Naudet and M. J. Zahr, "High-order implicit shock tracking for unsteady flows," in *22nd Computational Fluids Conference (CFC2023)*, (Cannes, France), 4/25/2023 – 4/28/2023
- K. Holst, C. Kim, and M. J. Zahr, "High-Fidelity CFD Verification Workshop 2024: Shock-Dominated Flows," in *Proc. of the AIAA Science and Technology Forum and Exposition (SciTech2023)*, (National Harbor, Maryland), American Institute of Aeronautics and Astronautics, 1/23/2023 – 1/27/2023
- T. Wen and M. J. Zahr, "An augmented Lagrangian trust-region method to accelerate equality-constrained shape optimization problems using model hyperreduction," in *Proc. of the AIAA Science and Technology Forum and Exposition (SciTech2023)*, (National Harbor, Maryland), American Institute of Aeronautics and Astronautics, 1/23/2023 – 1/27/2023
- T. Huang and M. J. Zahr, "High-order implicit shock tracking boundary conditions for supersonic flow over a smoothed rectangle," in *Proc. of the AIAA Science and Technology Forum and Exposition (SciTech2023)*, (National Harbor, Maryland), American Institute of Aeronautics and Astronautics, 1/23/2023 – 1/27/2023

- M. Mirhoseini and M. J. Zahr, "Model reduction of convection-dominated partial differential equations via optimization-based implicit feature tracking," in *Model Reduction and Surrogate Modeling (MORE)*, (Berlin, Germany), 9/19/2022 – 9/23/2022
- V. Zucatti and M. J. Zahr, "POD-based adaptive model reduction to accelerate computational fluid dynamics," in *Model Reduction and Surrogate Modeling (MORE)*, (Berlin, Germany), 9/19/2022 – 9/23/2022
- T. Huang, C. J. Naudet, and M. J. Zahr, "High-order implicit shock tracking for flows with interfaces," in *10th International Conference on Numerical Methods for Multi-Material Fluid Flow (MultiMat 2022)*, (Zurich, Switzerland), 8/22/2022 – 8/26/2022
- E. Bursch, M. J. Zahr, and R. McClarren, "Radiation hydrodynamics modeling with high-order implicit shock tracking," in *10th International Conference on Numerical Methods for Multi-Material Fluid Flow (MultiMat 2022)*, (Zurich, Switzerland), 8/22/2022 – 8/26/2022
- C. J. Naudet and M. J. Zahr, "High-order implicit shock tracking for time-dependent flows," in *15th World Congress on Computational Mechanics (WCCM-XV) and 8th Asian Pacific Congress on Computational Mechanics (APCOM-VIII)*, (Virtual Event; Yokohama, Japan), 7/31/2022 – 8/5/2022
- M. Mirhoseini and M. J. Zahr, "Model reduction of convection-dominated partial differential equations via optimization-based implicit feature tracking," in *15th World Congress on Computational Mechanics (WCCM-XV) and 8th Asian Pacific Congress on Computational Mechanics (APCOM-VIII)*, (Virtual Event; Yokohama, Japan), 7/31/2022 – 8/5/2022
- T. Huang, C. J. Naudet, and M. J. Zahr, "High-order implicit shock tracking," in *North American High Order Methods Conference (NAHOMCon)*, (San Diego, California), 7/18/2022 – 7/19/2022
- O. Rasheed, T. Huang, and M. J. Zahr, "High-order implicit shock tracking for a supersonic biplane airfoil," in *Proc. of the AIAA Aviation Forum and Exposition (Aviation 2022)*, (Chicago, Illinois), American Institute of Aeronautics and Astronautics, 6/27/2022 – 7/1/2022
- M. J. Zahr, T. Huang, and C. J. Naudet, "High-order implicit shock tracking for high-speed flows," in *Engineering Mechanics Institute Conference 2022 (EMI 2022)*, (Baltimore, Maryland), 5/30/2022 – 6/3/2022
- M. J. Zahr, "Unsteady supersonic/hypersonic test suite," in *High Fidelity CFD Workshop 2022*, (San Diego, California), 1/8/2022 – 1/9/2022
- C. Naudet and M. J. Zahr, "Predicting wall shear stress using simulation-based imaging," in *16th U.S. National Congress on Computational Mechanics (USNCCM16)*, (Chicago, Illinois), 7/25/2021 – 7/29/2021
- A. Shi, P.-O. Persson, and M. J. Zahr, "Implicit shock tracking and the method of lines for shock-dominated, unsteady flows," in *16th U.S. National Congress on Computational Mechanics (USNCCM16)*, (Chicago, Illinois), 7/25/2021 – 7/29/2021
- M. Mirhoseini and M. J. Zahr, "Model reduction of convection-dominated partial differential equations via optimization-based implicit feature tracking," in *16th U.S. National Congress on Computational Mechanics (USNCCM16)*, (Virtual Event; Chicago, IL), 7/25/2021 – 7/29/2021
- T. Wen and M. J. Zahr, "A globally convergent method to accelerate PDE-constrained optimization using on-the-fly model hyperreduction," in *16th U.S. National Congress on Computational Mechanics (USNCCM16)*, (Chicago, Illinois), 7/25/2021 – 7/29/2021
- H. Gao and M. J. Zahr, "Parametrically robust model reduction via enrichment with locally supported basis functions," in *16th U.S. National Congress on Computational Mechanics (USNCCM16)*, (Chicago, Illinois), 7/25/2021 – 7/29/2021
- M. J. Zahr, "Implicit shock tracking using an optimization-based high-order discontinuous Galerkin method," in *International Conference on Spectral and High Order Methods (ICOSAHOM) 2020/2021*, (Virtual Event; Vienna, Austria), 7/12/2021 – 7/16/2021
- M. J. Zahr, "Model reduction of convection-dominated partial differential equations via optimization-based implicit feature tracking," in *10th International Conference on Adaptive Modeling and Simulation (ADMOS)*, (Virtual Event; Gothenburg, Sweden), 6/21/2021 – 6/23/2021
- T. Huang and M. J. Zahr, "High-order implicit shock tracking with targeted mesh optimization and PDE-based smoothing," in *Proc. of the AIAA Aviation Forum and Exposition (Aviation 2021)*, (Washington, D.C.), American Institute of Aeronautics and Astronautics, 6/7/2021 – 6/11/2021
- A. Schein, K. Calrberg, M. J. Zahr, and M. W. Gee, "An optimization-based formulation for equality and inequality constrained reduced-order modeling," in *World Congress on Computational Mechanics XIV (WCCM XIV) and European Community on Computational Methods in Applied Sciences (ECCOMAS) Congress 2020*, (Paris, France), 1/11/2021 – 1/15/2021
- M. J. Zahr and P.-O. Persson, "An r-adaptive, high-order discontinuous Galerkin method for flows with attached shocks," in *Proc. of the AIAA Science and Technology Forum and Exposition (SciTech2020)*, (Orlando, Florida), American Institute of Aeronautics and Astronautics, 1/6/2020 – 1/10/2020

- M. J. Zahr and P.-O. Persson, "An optimization-based approach for high-order accurate discretization of conservation laws with discontinuous solutions," in *15th U.S. National Congress on Computational Mechanics (USNCCM15)*, (Austin, Texas), 7/28/2019 – 8/2/2019
- P.-O. Persson, D. Z. Huang, and M. J. Zahr, "High-order partitioned solvers and fully discrete adjoints for multiphysics problems," in *15th U.S. National Congress on Computational Mechanics (USNCCM15)*, (Austin, Texas), 7/28/2019 – 8/2/2019
- M. J. Zahr, "An optimization-based approach for the reduction of conservation laws with parametrized discontinuities," in *15th U.S. National Congress on Computational Mechanics (USNCCM15)*, (Austin, Texas), 7/28/2019 – 8/2/2019
- M. J. Zahr and P.-O. Persson, "An optimization-based discontinuous Galerkin approach for high-order accurate shock tracking," in *North American High Order Methods Conference (NAHOMCon)*, (San Diego, California), 6/2/2019 – 6/5/2019
- M. J. Zahr and P.-O. Persson, "An optimization-based discontinuous Galerkin approach for high-order accurate shock tracking," in *Finite Elements in Fluids*, (Chicago, Illinois), 3/31/2019 – 4/3/2019
- M. Franco, P.-O. Persson, W. Pazner, and M. J. Zahr, "An adjoint method using fully implicit Runge-Kutta schemes for optimization of flow problems," in *AIAA Science and Technology Forum and Exposition (SciTech2019)*, (San Diego, California), 1/7/2019 – 1/11/2019
- A. Shi, P.-O. Persson, and M. J. Zahr, "An optimization-based discontinuous Galerkin approach for high-order accurate shock tracking with guaranteed mesh quality," in *Proc. of the AIAA Science and Technology Forum and Exposition (SciTech2019)*, (San Diego, California), American Institute of Aeronautics and Astronautics, 1/7/2019 – 1/11/2019
- D. Z. Huang, P.-O. Persson, and M. J. Zahr, "A high-order partitioned solver for general multiphysics problems and its applications in optimization," in *AIAA Science and Technology Forum and Exposition (SciTech2019)*, (San Diego, California), 1/7/2019 – 1/11/2019
- M. J. Zahr and P.-O. Persson, "An optimization-based discontinuous galerkin approach for high-order accurate shock tracking," in *6th European Conference on Computational Mechanics (ECCM 6) and 7th European Conference on Computational Fluid Dynamics (ECFD 7)*, (Glasgow, Scotland, United Kingdom), 6/11/2018 – 6/15/2018
- M. J. Zahr and P.-O. Persson, "An optimization-based discontinuous Galerkin approach for high-order accurate shock tracking," in *5th International Workshop on High-Order CFD Methods*, (Kissimmee, Florida), 1/8/2018 – 1/12/2018
- M. J. Zahr and P.-O. Persson, "An optimization-based discontinuous Galerkin approach for high-order accurate shock tracking," in *AIAA Science and Technology Forum and Exposition (SciTech2018)*, (Kissimmee, Florida), American Institute of Aeronautics and Astronautics, 1/8/2018 – 1/12/2018
- M. J. Zahr, "Optimization-based computational physics and high-order methods: from optimized analysis to design and data assimilation," in *LBNL CRD Postdoc Seminar Series*, (Berkeley, California), Lawrence Berkeley National Laboratory, 9/18/2017
- M. J. Zahr and P.-O. Persson, "Adjoint-based optimization of time-dependent fluid-structure systems using a high-order discontinuous Galerkin discretization," in *14th U.S. National Congress on Computational Mechanics (USNCCM14)*, (Montreal, Quebec, Canada), 7/17/2017 – 7/20/2017
- M. J. Zahr and P.-O. Persson, "Adjoint-based optimization of time-dependent fluid-structure systems using a high-order discontinuous Galerkin discretization," in *VII International Conference on Coupled Problems in Science and Engineering*, (Rhodes Island, Greece), 6/12/2017 – 6/14/2017
- J. Wang, M. J. Zahr, and P.-O. Persson, "Energetically optimal flapping flight based on a fully discrete adjoint method with explicit treatment of flapping frequency," in *23rd AIAA Computational Fluid Dynamics Conference*, (Denver, Colorado), 6/5/2017 – 6/9/2017
- M. J. Zahr, "Adjoint-based PDE-constrained optimization using globally high-order numerical discretizations," in *2017 Berkeley/Stanford Computational Mechanics Festival (CompFest)*, (Berkeley, California), University of California, Berkeley, 5/8/2017
- M. J. Zahr and P.-O. Persson, "Adjoint-based optimization of time-dependent fluid-structure systems using a high-order discontinuous Galerkin discretization," in *IACM 19th International Conference on Finite Element in Flow Problems (FEF)*, (Rome, Italy), 4/5/2017 – 4/7/2017
- M. J. Zahr and P.-O. Persson, "Adjoint-based optimization of time-dependent fluid-structure systems using a high-order discontinuous Galerkin discretization," in *European Workshop on High Order Nonlinear Numerical Methods for Evolutionary PDEs: Theory and Applications*, (Stuttgart, Germany), University of Stuttgart, 3/27/2017 – 3/31/2017

- M. J. Zahr, "Adaptive model reduction to accelerate optimization problems governed by partial differential equations," in *Thesis Defense*, (Stanford, California), Stanford University, 8/3/2016
- K. Washabaugh, M. J. Zahr, and C. Farhat, "On the use of discrete nonlinear reduced-order models for the prediction of steady-state flows past parametrically deformed complex geometries," in *AIAA Science and Technology Forum and Exposition (SciTech 2016)*, (San Diego, California), 1/4/2016 – 1/8/2016
- M. J. Zahr and P.-O. Persson, "High-order, time-dependent aerodynamic optimization using a discontinuous Galerkin discretization of the Navier-Stokes equations," in *AIAA Science and Technology Forum and Exposition (SciTech 2016)*, (San Diego, California), 1/4/2016 – 1/8/2016
- D. De Santis, M. J. Zahr, and C. Farhat, "Gradient-based aerodynamic shape optimization using the FIVER embedded boundary method," in *AIAA Science and Technology Forum and Exposition (SciTech 2016)*, (San Diego, California), 1/4/2016 – 1/8/2016
- M. J. Zahr and P.-O. Persson, "Unsteady CFD optimization using high-order discontinuous Galerkin finite element methods," in *13th U.S. National Congress on Computational Mechanics (USNCCM13)*, (San Diego, California), 7/26/2015 – 7/30/2015
- M. J. Zahr and C. Farhat, "PDE-constrained optimization using progressively constructed reduced-order models," in *World Congress on Computational Mechanics XI (WCCM XI)*, (Barcelona, Spain), 7/20/2014 – 7/25/2014
- M. J. Zahr and P.-O. Persson, "Hyperreduced models for discontinuous Galerkin finite element methods," in *International Conference on Spectral and High Order Methods (ICOSAHOM)*, (Salt Lake City, Utah), 6/23/2014 – 6/27/2014
- M. J. Zahr and C. Farhat, "Rapid nonlinear topology optimization using precomputed reduced-order models," in *17th US National Congress on Theoretical and Applied Mechanics (USNCTAM)*, (East Lansing, Michigan), 6/15/2014 – 6/20/2014
- M. J. Zahr and C. Farhat, "PDE-constrained optimization using hyper-reduced models," in *SIAM Conference on Optimization*, (San Diego, California), 5/19/2014 – 5/22/2014
- M. J. Zahr, "Rapid topology optimization using reduced-order models," in *2013 Berkeley/Stanford Computational Mechanics Festival (CompFest)*, (Berkeley, California), University of California, Berkeley, 10/19/2013
- M. J. Zahr and C. Farhat, "Rapid nonlinear topology optimization using reduced-order models," in *12th U.S. National Congress on Computational Mechanics (USNCCM12)*, (Raleigh, North Carolina), 7/22/2013 – 7/25/2013
- M. J. Zahr, D. Amsallem, and C. Farhat, "Construction of parametrically robust CFD-based reduced-order models for PDE-constrained optimization," in *43rd AIAA Fluid Dynamics Conference and Exhibit*, (San Diego, California), 6/24/2013 – 6/27/2013
- M. J. Zahr and P.-O. Persson, "Performance tuning of Newton-GMRES methods for discontinuous Galerkin discretizations of the Navier-Stokes equations," in *43rd AIAA Fluid Dynamics Conference and Exhibit*, (San Diego, California), 6/24/2013 – 6/27/2013
- D. Amsallem, M. J. Zahr, Y. Choi, and C. Farhat, "Design optimization using hyper-reduced order models," in *10th World Congress on Structural and Multidisciplinary Optimization (WCSMO10)*, (Orlando, Florida), 3/19/2013 – 3/24/2013
- M. J. Zahr and C. Farhat, "Construction of parametrically robust reduced-order models for PDE-constrained optimization," in *10th World Congress on Structural and Multidisciplinary Optimization (WCSMO10)*, (Orlando, Florida), 3/19/2013 – 3/24/2013
- D. Amsallem, M. J. Zahr, and C. Farhat, "Nonlinear model order reduction with local reduced-order bases for hyper-reduction," in *Proceedings of the 2012 European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS)*, (Vienna, Austria), 9/10/2012 – 9/14/2012
- D. Amsallem, C. Farhat, and M. J. Zahr, "Real-time CFD-based fluid-structure predictions using a database of parameterized reduced-order models," in *10th World Congress on Computational Mechanics (WCCM X)*, (Sao Paolo, Brazil), 7/8/2012 – 7/13/2012

Poster Presentations

- H. Dong, T. Huang, M. Yano, and M. J. Zahr, "A p-adaptive implicit shock tracking method for high-speed viscous flows," in *18th U.S. National Congress on Computational Mechanics (USNCCM18)*, (Chicago, IL), 7/20/2025 – 7/24/2025
- M. J. Zahr, "Improved simulation of shock-dominated flows using high-order implicit shock tracking," in *ASME 2024 - International Mechanical Engineering Congress and Exposition*, (Portland, Oregon), 11/17/2024 – 11/21/2024
- C. J. Naudet and M. J. Zahr, "High-order implicit shock tracking for time-dependent flows," in *North American High Order Methods Conference (NAHOMCon)*, (Dartmouth, New Hampshire), 6/17/2024 – 6/19/2024
- A. Perez Reyes and M. J. Zahr, "Implicit shock tracking for high-speed flows with attached shocks," in *North American High Order Methods Conference (NAHOMCon)*, (Dartmouth, New Hampshire), 6/17/2024 – 6/19/2024

- H. Dong and M. J. Zahr, "A p-adaptive implicith shock tracking method for high-speed viscous flows," in *North American High Order Methods Conference (NAHOMCon)*, (Dartmouth, New Hampshire), 6/17/2024 – 6/19/2024
- T. Huang, C. Naudet, and M. J. Zahr, "High-order implicit shock tracking for high-speed flows," in *SIAM Conference on Computational Science and Engineering*, (Virtual Event; Fort Worth, Texas), 3/1/2021 – 3/5/2021
- J. Wang and M. J. Zahr, "A topology optimization method with high order level-set based boundary tracking mesh," in *Topology Optimization Roundtable*, (Albuquerque, New Mexico), 3/10/2019 – 3/13/2019
- A. Kiran and M. J. Zahr, "An optimization-based discontinuous Galerkin approach for high-order accurate shock tracking," in *LBNL Summer Student Program Poster Session*, (Berkeley, California), 8/2/2018
- M. J. Zahr and P.-O. Persson, "Adjoint-based optimization, uncertainty quantification, and data assimilation of multiphysics systems using high-order numerical discretizations," in *DOE ASCR Applied Mathematics PI Meeting*, (Washington D.C.), 9/11/2017 – 9/12/2017
- M. J. Zahr, "Efficient PDE-constrained optimization using adaptive model reduction," in *Institute for Mathematics and its Applications: Frontiers in PDE-Constrained Optimization*, (Minneapolis, Minnesota), 6/6/2016 – 6/10/2016
- M. J. Zahr, "Efficient PDE-constrained optimization using adaptive model reduction," in *2016 Stanford Computational Mathematics and Engineering Affiliates Meeting*, (Stanford, California), 5/1/2016
- M. J. Zahr, "Efficient PDE-constrained optimization using adaptive model reduction," in *2016 Stanford Aerospace and Astronautics Affiliates Meeting*, (Stanford, California), 4/26/2016
- M. J. Zahr, P. Avery, and C. Farhat, "A hyperreduced FE^2 method for real-time multiscale simulations," in *Army High Performance Computing Research Center (AHPCRC) Review Meeting*, (Santa Cruz, California), 1/18/2016 – 1/20/2016
- M. J. Zahr and C. Farhat, "Accelerating PDE-constrained optimization using adaptive reduced-order models," in *Army High Performance Computing Research Center (AHPCRC) Review Meeting*, (Santa Cruz, California), 1/18/2016 – 1/20/2016
- M. J. Zahr and C. Farhat, "Accelerating PDE-constrained optimization using progressively-constructed reduced-order models," in *Army High Performance Computing Research Center (AHPCRC) Review Meeting*, (Santa Cruz, California), 8/10/2015 – 8/12/2016
- M. J. Zahr and P.-O. Persson, "Unsteady PDE-constrained optimization using high-order DG-FEM," in *13th U.S. National Congress on Computational Mechanics (USNCCM13)*, (San Diego, California), 7/26/2015 – 7/30/2015
- M. J. Zahr and C. Farhat, "Progressive construction of a parametric reduced-order model for PDE-constrained optimization," in *2014 DOE CSGF Annual Program Review*, (Washington D.C.), 7/14/2014 – 7/17/2014
- M. J. Zahr, "PDE-constrained optimization using progressively constructed reduced-order models," in *2014 Stanford Aerospace and Astronautics Affiliates Meeting*, (Stanford, California), 4/28/2014
- M. J. Zahr and C. Farhat, "Rapid topology optimization using reduced-order models," in *2013 DOE CSGF Annual Program Review*, (Washington D.C.), 7/25/2013 – 7/27/2013
- M. J. Zahr and C. Farhat, "Rapid structural shape optimization using progressively constructed reduced-order models," in *12th U.S. National Congress on Computational Mechanics (USNCCM12)*, (Raleigh, North Carolina), 7/22/2013 – 7/25/2013
- M. J. Zahr and C. Farhat, "Design of fluid mechanical systems using reduced-order models," in *2012 DOE CSGF Annual Program Review*, (Washington D.C.), 7/26/2012 – 7/28/2012

Grants & Funding

Active Research Grants

2023–2028 *CAREER: Nonlinear finite element manifolds for improved simulation of shock-dominated turbulent flows*, Faculty Early Career Development Program (CAREER), National Science Foundation, Principal Investigator, $524.01k, 5 years

2022–2026 *Improved simulation of external and internal hypersonic flows using high-order implicit shock tracking*, Young Investigator Program, Office of Naval Research, Principal Investigator, $510k, 4 years

2021–2025 *Improved blast simulations using high-order implicit shock tracking*, BAA-FA9550-19-S-0003 (Program: Dynamic Materials and Interactions), Air Force Office of Scientific Research, Principal Investigator, $514.42k, 4 years

2021–2026 *A robust multi-disciplinary design analysis and optimization framework for hypersonic systems grounded in model hyperreduction*, Multidisciplinary University Research Initiative, Air Force Office of Scientific Research, Co-Principal Investigator (with C. Farhat (PI), Stanford University; J. Alonso, Stanford University; G. Candler, University of Minnesota; M. Hemati, University of Minnesota; M. Heinkenschloss, Rice University), $7.5M (ND: $750k), 5 years

Completed Research Grants

2023–2024 *Research on Involution-Constrained PDEs: A Collaboration between Notre Dame Physics and AME Departments with IIT Delhi and TIFR Bangalore*, Asia Research Collaboration Grant Program, University of Notre Dame, Co-Principal Investigator, $9.75k, 1 year

2020–2024 *Adaptive, data-driven model reduction and machine learning to enable high-fidelity, many-query computational physics*, FA9550-20-1-0236, Young Investigator Program, Air Force Office of Scientific Research, Principal Investigator, $450k, 4 years

2016–2018 *Enabling Extreme-Scale Many-Query Computational Physics: An adaptive framework for optimization and uncertainty quantification of multiphysics applications*, Laboratory Directed Research and Development, Lawrence Berkeley National Laboratory, Principal Investigator, $232.5k, 2 years

Completed Education Grants

2016–2017 *Advanced MATLAB programming for scientific computing*, Development of Massively Open Online Course (MOOC), MathWorks, Principal Investigator (with N. Henderson, Stanford University), $40k, 1 year

Research Mentoring

Ph.D. Students Supervised (Formal Advisees)

Students formally (co-)advised and funded by MJZ

2025–pres **Xianyu George Pan**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: High-order implicit shock tracking for shock-dominated, unsteady flows using adaptive space-time slabs.

2024–pres **Xuehui Qian**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Implicit shock tracking for improved simulation of hypersonic flows.

2023–pres **Alexander Perez Reyes**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Improved simulation of high-speed flows over complex geometries using implicit shock tracking.

2023–pres **Akshay Thakur**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Nonlinear finite element manifolds for improved simulation of nonlinear conservatin laws. *Award*: 2025 Outstanding TA Award.

2023–pres **Huijing Dong**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: A p-adaptive high-order implicit shock tracking method for accurate resolution of viscous shocks and boundary layers.

2023–pres **Roberto Aaron Marques Braga**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: A hybrid shock capturing-tracking method for simulation of high-speed flows.

2021–pres **Victor Zucatti**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Model reduction with online basis updates for convection-dominated flows.

2020–2025 **Charles Naudet**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: High-order implicit shock tracking for shock-dominated, unsteady flows using adaptive space-time slabs. *Award*: 2024 Outstanding TA Award. First job after graduation: Research Engineer, GE Aerospace.

2019–2024 **Tianci Huang**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project 1: A globally convergent method to accelerate topology optimization using on-the-fly model reduction. Project 2: Robust full-space optimization solver development for numerical simulations with steep features. *Award*: 2023 Robert J. Melosh Medal Finalist. *Award*: 2023 Outstanding TA Award. First job after graduation: Engineer, MathWorks.

2019–2024 **Tianshu Wen**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Adaptive model reduction to accelerate optimization problems governed by partial differential equations. First job after graduation: R&D Engineer, Lorentz Solution.

2018–2023 **Marzieh Mirhoseini**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Model reduction of convection-dominated flows using implicit tracking. First job after graduation: Postdoctoral Scholar, MIT.

2018–2022 **Andrew Shi**, *Mathematics, University of California, Berkeley*. Project: Implicit shock tracking and the method of lines for shock-dominated, unsteady flows. First job after graduation: Postdoctoral Scholar, NYU Shanghai.

Ph.D. Students Supervised (Informal Advisees)

Students that work closely with MJZ (attend group meetings, weekly one-on-one meetings, first-author publications)

2019–2024 **Han Gao**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project 1: Non-intrusive nonlinear model reduction using deep neural networks. Project 2: Adaptive model reduction via enrichment with local basis functions. First job after graduation: Postdoctoral Scholar, Harvard University.

2017–2019 **Jingyi Wang**, *Mechanical Engineering, University of California, Berkeley*. Project 1: Energetically optimal flapping flight based on a fully discrete adjoint method with explicit treatment of flapping frequency. Project 2: High-order topology optimization. First job after graduation: Postdoctoral Scholar, Lawrence Livermore National Laboratory.

Masters Students (Co-)Supervised

2021–2022 **Omar Rasheed**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: High-order implicit shock tracking for a supersonic biplane airfoil.

Other Graduate Students

2022–2024 **Jakob Sebastian**, *Fluid Dynamics, Technische Universität Darmstadt*. Visiting scholar (full funding from home institution). Project: Split solvers and preconditioners for high-order implicit shock tracking.

2020–2021 **Fritiof Hegardt**, *Engineering, Lund University*. Project: Optimization-based geometry correction of blood flow CFD simulations using 4D-flow data.

2019–2021 **Alexander Schein**, *Mechanics & High Performance Computing, Technische Universität Müchen*. Project: Preserving general physical properties in model reduction of dynamical systems via constrained-optimization projection.

2018–2021 **Robert Baraldi**, *Applied Mathematics, University of Washington*. Department of Energy Computational Science Graduate Fellowship (DOE CSGF) Practicum. Project: Accelerating parameter estimation via implicit sampling and adaptive reduced-order models.

2017–2019 **Daniel Zhengyu Huang**, *Computational and Mathematical Engineering, Stanford University*. Summer Research Intern, Lawrence Berkeley National Laboratory. Project: A high-order partitioned solver for general multiphysics problems.

Smr 2018 **Aditya Kiran**, *Mathematics, University of South Carolina*. National Science Foundation Mathematical Sciences Graduate Internship (NSF-MSGI). Project: A preliminary investigation into space-time implicit shock tracking.

Aut 2018 **Anran Lu**, *Computational and Mathematical Engineering, Stanford University*. Xplore Research Program, Stanford University. Project: A preliminary investigation into optimization formulations for constrained model reduction.

Aut 2018 **Yiwen Guo**, *Computational and Mathematical Engineering, Stanford University*. Xplore Research Program, Stanford University. Project: A preliminary investigation into optimization formulations for constrained model reduction.

Smr 2018 **Michael Franco**, *Mathematics, University of California, Berkeley*. Project: Fully discrete adjoint method for fully implicit, stage-parallel Runge-Kutta schemes.

Spr 2018 **Kexin Yu**, *Computational and Mathematical Engineering, Stanford University*. Xplore Research Program, Stanford University. Project: Implementation and study of hyperreduction methods for nonlinear model reduction with pyMORTestbed.

2018 **Remmelt Ammerlaan**, *Computational and Mathematical Engineering, Stanford University*. Xplore Research Program, Stanford University. Project 1: Implementation and study of hyperreduction methods for nonlinear model reduction with pyMORTestbed. Project 2: A preliminary investigation into optimization formulations for constrained model reduction.

Spr 2016 **Gabriele Boncoraglio**, *Aeronautics and Astronautics, Stanford University*. Project: Accelerating PDE-constrained optimization with partially converged solutions and model reduction.

Aut 2015 **Christina White**, *Mechanical Engineering, Stanford University*. Project: Machine learning algorithms in model order reduction.

Undergraduate Students

2024–2025 **Timothy Welsh**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: A hybrid shock capturing-tracking method for simulation of high-speed flows. *Award*: 2025 NSF Graduate Research Fellowship Program (GRFP).

Spr 2024 **Louis Narducci**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Verification and validation of the *Talon* software.

2024–pres **Elena Saez**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Accelerating convergence of implicit shock tracking via regression-based shock prediction.

2023–2025 **Mia Simon**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Optimal approximation of discontinuous functions using implicit shock tracking.

Smr 2023 **Jeremiah Roach**, *Mechanical Engineering, Stanford University*. Project: Test cases for the 2024 High-Fidelity CFD Verification Workshop using the *Talon* software.

Smr 2023 **Peter Rossi**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Verification and validation of the *Talon* software.

Aut 2022 **Jhordan Baque**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Implicit shock tracking using non-simplex elements.

Smr 2022 **Chris Myers**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: CAD and mesh generation for hypersonic vehicles.

2022–2024 **Nicholas Stanchina**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Improved simulation of high-speed flows over complex geometries using implicit shock tracking.

2022–pres **Julian Kaufmann**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Optimal nodal distributions for simplex and prism elements. *Award*: 2024 Barry Goldwater Scholarship.

2021–2022 **Evan Bursch**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: High-order implicit shock tracking for inertial confinement nuclear fusion. *Award*: 2022 Vincent P. Slatt Fellowship for Undergraduate Research in Energy Systems and Processes. *Award*: MultiMat 2022 Travel Award.

2021–2022 **Julia Pimentel**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: An investigation into implicit shock tracking formulations and solvers.

2021–2022 **Matthew Misch**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: An investigation into implicit shock tracking formulations and solvers.

2019–2021 **Charles Naudet**, *Aerospace and Mechanical Engineering, University of Notre Dame*. Project: Accurate quantification of blood flow wall shear stress using simulation-based imaging: a synthetic, comparative study.

Smr 2019 **Tung Nguyen**, *Mathematics, Wabash College*. Project: Design optimization of cardiovascular stents.

Smr 2015 **Fredrick Earnest**, *Mechanical and Aerospace Engineering, New Mexico State University*. Undergraduate Research Intern, Army High Performance Computing Research Center, Stanford University. Project: Projection-based model order reduction for nonlinearly constrained contact.

Smr 2014 **Joseph Graff**, *Mechanical and Aerospace Engineering, New Mexico State University*. Undergraduate Research Intern, Army High Performance Computing Research Center, Stanford University. Project: Automated mesh generation and validation for CFD analysis and shape optimization.

Smr 2014 **Zach Nevills**, *Mechanical Engineering, Stanford University*. Undergraduate Research Intern, Army High Performance Computing Research Center, Stanford University. Project: Automated mesh generation and validation for CFD analysis and shape optimization.

Smr 2014 **Harry Pham**, *Mechanical Engineering, Stanford University*. Undergraduate Research Intern, Army High Performance Computing Research Center, Stanford University. Project: Implementation of an aeroelastic shape optimization driver. *Award*: 2nd Place, Best Project Award.

Masters Thesis Committee Member

2025 **Daniel Lawson**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2022 **Omar Rasheed**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2021 **Andrew Volchko**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

Candidacy Exam Committee Member

2025 **Joseph Farmer**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2025 **Jonny Davami**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2025 **Alec Jobbins**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2025 **Victor Zucatti**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2025 **Damian Agi**, *Chemical and Biomolecular Engineering, University of Notre Dame*.

2024 **Priyesh Kakka**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2024 **Molly Dougher**, *Chemical and Biomolecular Engineering, University of Notre Dame*.

2024 **Charles Naudet**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2023 **Ethan Smith**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2023 **William Bennett**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2023 **Xuemin Liu**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2023 **Tianshu Wen**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2023 **Tianci Huang**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2023 **Samuel Pasmann**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2022 **Andrew Bustard**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2022 **Jose Padilla**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2022 **Benjamin Whewell**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2022 **Han Gao**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2022 **Luning Sun**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2021 **Mohsen Darayi**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2021 **Marzieh Mirhoseini**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

2021 **Nan Feng**, *Civil and Environmental Engineering and Earth Sciences, University of Notre Dame*.
2021 **Sion Kim**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2021 **Zhuogang Peng**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2020 **Michael Vander Wal**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2020 **Navid Shervani-Tabar**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2019 **Di Zhou**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

Doctoral Committee Member

2025 **Andrew Bustard**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2025 **Charles Naudet**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2025 **Jose Padilla**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2024 **Tianshu Wen**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2024 **Xuemin Liu**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2024 **Ethan Smith**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2024 **Benjamin Whewell**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2024 **William Bennett**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2024 **Tianci Huang**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2024 **Samuel Pasmann**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2024 **Sion Kim**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2023 **Han Gao**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2023 **Luning Sun**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2023 **Marzieh Mirhoseini**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2023 **Nan Feng**, *Civil and Environmental Engineering and Earth Sciences, University of Notre Dame*.
2023 **Alexander Schein**, *Mechanics & High Performance Computing, Technische Universität Müchen*.
2023 **Zhuogang Peng**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2022 **Alessia Assonitis**, *Aerospace Engineering, Sapienza University of Rome*.
2022 **Mohsen Darayi**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2022 **Andrew Shi**, *Mathematics, University of California, Berkeley*.
2022 **Michael Vander Wal**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2021 **Di Zhou**, *Aerospace and Mechanical Engineering, University of Notre Dame*.
2020 **Navid Shervani-Tabar**, *Aerospace and Mechanical Engineering, University of Notre Dame*.

Teaching

Legend: †course designed or substantially renovated; *sole instructor of record; #co-instructor of record

University of Notre Dame

Aut 2024* †**Computational Methods (AME 30251)**, University of Notre Dame
Aut 2025* Provides students with a background in numerical techniques and modern data science to solve a variety of engineering design and analysis problems. ○ *Enrollment*: 76 (Aut 2024), 35 (Aut 2025)

Aut 2023* **Computational Methods (AME 20251)**, University of Notre Dame
Provides students with a background in numerical techniques and modern data science to solve a variety of engineering design and analysis problems. ○ *Enrollment*: 83 (Aut 2023)

Aut 2021* †**Computational Fluid Dynamics (AME 70732)**, University of Notre Dame
Aut 2023* Theory and implementation of numerical methods to solve inviscid and viscous conservation laws. Topics include: finite difference methods, finite volume methods on structured and unstructured meshes, shock capturing techniques, domain decomposition for parallel computations, visualization, and verification/validation (V&V). If time permits, more advanced topics will be covered, e.g., discontinuous Galerkin methods, shock fitting, multigrid, multiphase flows, basic fluid-structure interaction, and software design. ○ *Enrollment*: 10 (Aut 2021), 9 (Aut 2023)

Aut 2020* †**Advanced Numerical Methods (AME 60714)**, University of Notre Dame
Spr 2023* Theory and implementation of advanced numerical methods to solve and optimize linear and nonlinear partial differential equations (PDEs) with particular emphasis on hyperbolic PDEs and (compressible) computational fluid dynamics. Topcs include: hyperbolic PDE theory, discontinuous Galerkin methods, Arbitrary Lagrangian-Eulerian (ALE) formulation for PDEs on moving domains, PDE-constrained optimization, and model reduction. ○ *Enrollment*: 12 (Aut 2020), 12 (Spr 2023)

2020– †**Finite Element Methods (AME 40541/60541)**, University of Notre Dame
2024* An introduction to the fundamental concepts of linear and nonlinear finite element methods with applications to structural analysis, heat flow, fluid mechanics, and multiphysics problems. This is a combined undergraduate (AME40541) and graduate (AME60541) course (formerly AME50541). ○ *Enrollment*: 27 (Spr 2020), 29 (Spr 2021), 32 (Spr 2022), 11 (Aut 2022), 25 (Spr 2024) ○ *Course website*: http://mjzahr.github.io/teach-nd-ame40541-spr21.html

Spr 2019* †**Finite Element Methods (AME 50541)**, University of Notre Dame
An introduction to the fundamental concepts of linear and nonlinear finite element methods with applications to structural analysis, heat flow, fluid mechanics, and multiphysics problems. ○ *Enrollment*: 17 (Spr 2019) ○ *Course website*: http://mjzahr.github.io/teach-nd-ame50541-spr19.html

Stanford University

Spr 2017# **Model Reduction (CME 345)**, Stanford University
Basic mathematical theory for projection-based model reduction. Topics include: linear dynamical systems; projection-based model reduction; error analysis; proper orthogonal decomposition; balanced truncation; moment matching methods based on Krylov subspaces; nonlinear model reduction. ○ *Enrollment*: 17 (Spr 2017) ○ *Course website*: http://mjzahr.github.io/teach-stanford-cme345-spr17.html

Spr 2014* †**Advanced MATLAB for Scientific Computing (CME 292)**, Stanford University
Aut 2014* (1 unit, half term) Advanced MATLAB programming: advanced syntax, publication-quality graphics, numerical linear algebra and optimization, object-oriented programming, file manipulation and system interaction, C/MATLAB interface through MEX, MATLAB Coder, toolboxes (symbolic, parallel, PDE). ○ *Enrollment*: 11 (Spr 2014), 6 (Aut 2014), 16 (Spr 2015) ○ *Award*: Received $40k grant from MathWorks to convert course into MOOC ○ *Course website*: http://mjzahr.github.io/teach-stanford-cme292-spr15.html

Smr 2013# **Classical Solutions to Partial Differential Equations (CME 001)**, Stanford University
Refresher course intended to prepare first year ICME for upcoming coursework and qualifying exams ○ *Enrollment*: 30 (Smr 2013) ○ *Course website*: http://mjzahr.github.io/teach-stanford-cme001-smr13.html

Professional Activities

Workshop Organization

2nd High-Fidelity CFD Verification Workshop - Supersonic/hypersonic test suite, *American Institute of Aeronautics and Astronautics Science and Technology Forum and Exposition 2024 (AIAA Scitech 2024)*. Organizers: M.J. Zahr, K. Holst. January 07, 2024.

1st High-Fidelity CFD Verification Workshop - Unsteady supersonic/hypersonic test suite, *American Institute of Aeronautics and Astronautics Science and Technology Forum and Exposition 2022 (AIAA Scitech 2022)*. Organizers: T. Fisher, A. Corrigan, M.J. Zahr, C. Kim. January 09, 2022. https://turbmodels.larc.nasa.gov/highfidelitycfd_workshop2022.html.

2017 West Coast ROM Workshop, *Lawrence Berkeley National Laboratory*. Organizers: K. Carlberg, M.J. Zahr. November 17, 2017. http://math.lbl.gov/~mjzahr/wcrw2017/.

Minisymposium Organization

N. Blal, S.W. Cheung, Y. Choi, M. Yano, M.J. Zahr, "MSXXXX: Model Order Reduction: Bridging Physics and Machine Learning," 17th World Congress on Computational Mechanics and 10th European Congress on Computational Methods in Applied Sciences and Engineering (WCCM-ECCOMAS 2026) , Munich, Germany, July 19 – 24, 2026

Y. Choi, M. Yano, M.J. Zahr, "MS1002: Model order reduction for for parametrized continuum mechanics," 18th U.S. National Congress on Computational Mechanics, Chicago, Illinois, July 20 – 24, 2025

Y. Choi, M. Yano, M.J. Zahr, "MS0716: Model order reduction for for parametrized continuum mechanics," 16th World Congress on Computational Mechanics and 4th Pan American Congress on Computational Mechanics (WCCM-PANACM), Vancouver, British Columbia, Canada, July 21 – 26, 2024

Y. Choi, M. Yano, M.J. Zahr, "MS408: Model order reduction for for parametrized continuum mechanics," 17th U.S. National Congress on Computational Mechanics, Albuquerque, New Mexico, July 23 – 27, 2023

Y. Choi, M. Yano, M.J. Zahr, "MS716: Model order reduction for for parametrized continuum mechanics," 15th World Congress on

Computational Mechanics and 8th Asian Pacific Congress on Computational Mechanics (WCCM-APCOM), Yokohama, Japan, July 31 – August 5, 2022

W. Pazner, P. Persson, M.J. Zahr, "MS26: Fluid applications of high-order finite element methods," International Conference on Spectral and High Order Methods (ICOSAHOM) 2021, Vienna, Austria, July 6 – July 10, 2021

Y. Choi, M. Yano, M.J. Zahr, "MS311: Model reduction for computational physics," 16th U.S. National Congress on Computational Mechanics, Chicago, Illinois, July 25 – 29, 2021

M.J. Zahr, A. Corrigan, A. Kercher, "MS33: Advances in high-order methods for high-speed flows," SIAM Conference on Computational Science and Engineering, Fort Worth, Texas, March 1 – 5, 2021

M.J. Zahr, W. Pazner, P. Persson, "MS365: High-order discontinuous Galerkin and finite element methods for CFD," SIAM Conference on Computational Science and Engineering, Spokane, Washington, February 25 – March 1, 2019

Y. Choi, M. Yano, M.J. Zahr, "MS1001: Model order reduction for computational continuum mechanics," 15th U.S. National Congress on Computational Mechanics, Austin, Texas, July 28 – August 1, 2019

F. Chinesta, E. Cueto, C. Farhat, M.J. Zahr, "Model reduction, big data, and dynamic data-driven systems," 6th European Conference on Computational Mechanics, 7th European Conference on Computational Fluid Dynamics, Glasgow, Scotland, United Kingdom, June 11 – 15, 2018

F. Chinesta, E. Cueto, C. Farhat, M.J. Zahr, "Model reduction, big data, and dynamic data-driven systems," World Congress on Computational Mechanics XIII (WCCM XIII), New York City, New York, July 22 – 27, 2018

A. Manzoni, M.J. Zahr, "MS145: Reduced order modeling techniques in large scale and data-driven PDE problems," SIAM Conference on Computational Science and Engineering, Atlanta, Georgia, February 27 – March 3, 2017

Seminar Organization

Applied Mathematics Seminar, *Lawrence Berkeley National Laboratory, University of California, Berkeley*. Organizers: M.J. Zahr, L. Lin, P. Persson. Aut 2017, Spr 2018, Aut 2018. http://math.lbl.gov/ams.

Book Referee

Society for Industrial and Applied Mathematics (SIAM) · Springer Science & Business Media (Springer)

Journal and Book Chapter Referee

Aerospace Science and Technology (AESTE) · American Institute of Astronautics and Aeronautics Journal (AIAAJ) · Annual Reviews in Control (ARC) · Communications in Applied Mathematics and Computational Science (CAMCS) · Communications in Computational Physics (CiCP) · Computational Mechanics (CM) · Computational Science and Engineering (CSE) · Computer Methods in Applied Mechanics and Engineering (CMAME) · Computers & Fluids (CAF) · Engineering Computations (EC) · Engineering with Computers (EWCO) · Finite Elements in Analysis and Design (FEAD) · International Journal for Computational Fluid Dynamics (IJCFD) · International Journal for Numerical Methods in Engineering (IJNME) · International Journal for Numerical Methods in Fluids (IJNMF) · International Journal of Mathematics and Mathematical Sciences (IJMMS) · Journal of Aerospace Engineering (JAE) · Journal of Computational Physics (JCP) · Journal of Computational Science (JCS) · Journal of Computational and Applied Mathematics (JCAM) · Journal of IEEE TRansations on Artificial Intelligence (JIToAI) · Journal of Propulsion and Power (JPP) · Journal of Scientific Computing (JSC) · Mathematical and Computational Applications (MCA) · Optimization and Engineering (OPTE) · Proceedings of the National Academy of Sciences of the United States of America (PNAS) · SIAM Journal on Scientific Computing (SISC) · SIAM Journal on Uncertainty Quantification (JUQ) · Smart Science (SS) · SoftwareX (SOFT-X) · Springer Nature Applied Sciences (SNAS) · Institute for Mathematics and its Applications (IMA)

Professional Memberships

American Physical Society. Since 2023

American Society of Mechanical Engineers. Since 2019

American Institute of Aeronautics and Astronautics. Lifetime Membership. Since 2019

United States Association for Computational Mechanics. Since 2019

Society for Industrial and Applied Mathematics. Since 2016

Service & Outreach

University Service

Mar 2025 **ND Start Panel - *Building your Research Group***, University of Notre Dame

Participated in a panel organized by the ND College of Engineering (James Schmiedeler) to share my experiences and recommendations for best practices for building and managing a research group, including strategies to find and apply for funding, with junior faculty at ND.

Apr 2024 **Proposal Development Lunch for Junior Faculty**, University of Notre Dame
Participated in a lunch organized by the ND College of Engineering (James Schmiedeler) to share my experiences and recommendations for best practices for applying to the NSF CAREER program and AFOSR/ONR Young Investigator Programs (YIPs) with junior faculty at ND.

Nov 2022 **DoD Early Career Opportunities: Strategy Conversation**, University of Notre Dame
Served on panel to share my experience securing funding from ONRs Young Investigator Program (YIP) with Notre Dame faculty interested in pursuing similar awards.

May 2022 **Future Faculty Workshop Panelist**, University of Notre Dame
Served on panel consisting of four faculty to share my experiences starting my faculty career and offer advice.

Community Outreach

Jul 2022 – Jul 2023 **USACM Large-Scale TTA Graduate Mentoring Program**
One-on-one mentoring of graduate student (University of Iowa, 2022; Stony Brook University, 2023) at USACM conferences (WCCM, 2022; USNCCM, 2023), including: career path guidance, navigating the conferences, and general career advice.

2020–2023 **Northern Indiana Regional Science & Engineering Fair** *Notre Dame, IN*
Science fair competition in northern Indiana for grades K-12 ○ Project judge

Feb 2020 **St. Joseph Valley Mathcounts competition** *Notre Dame, IN*
Math competition in St. Joseph County for grades 6-8 ○ Assisted with organization and grading

Mar 2016 – Mar 2017 – Mar 2018 **Central Catholic High School Career Day** *Modesto, CA*
Presentation: Computational methods to solve next-generation science and engineering grand challenge problems ○ A workshop intended to demonstrate the real-world impact of CSE, convey my excitement and passion for the field, and hopefully motivate a diverse group of students to consider a CSE career ○ A question and answer session followed the workshop, including a discussion of my personal career path

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https://mjzahr.github.io/content/mjzcv.pdf