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Jesse Chan

Education

2008–2013 **Institute for Computational Engineering and Sciences (ICES)**, *The University of Texas*, Austin, TX.
- PhD in Computational Sciences, Engineering and Mathematics (CSEM).
  - Advisors: Leszek Demkowicz and Robert Moser.
  - Thesis: A Discontinuous Petrov-Galerkin Method for Convection-Diffusion Problems.
- MA in Computational Sciences, Engineering and Mathematics (CSEM).

2004–2008 **B.A. in Computational and Applied Mathematics**, *Rice University*, Houston, TX.

Professional experience

2016–present **Assistant Professor**, *Department of Computational and Applied Mathematics*, Rice University, Houston, TX.

2015–2016 **Postdoctoral Researcher**, *Department of Mathematics*, Virginia Tech, Blacksburg, VA.
- Mentor: Tim Warburton.

2013–2015 **Pfeiffer Postdoctoral Instructor**, *Department of Computational and Applied Mathematics*, Rice University, Houston, TX.
- Mentor: Tim Warburton.

Summer 2011 **Graduate Research Assistant**, *Los Alamos National Laboratory*, Los Alamos, NM, XCP-4: Methods and Algorithms.

Research Interests

High order discontinuous Galerkin (DG) methods: I work on high order numerical methods for hyperbolic PDEs governing wave propagation and fluid dynamics, including entropy stable DG methods for nonlinear conservation laws. These methods provide robustness and stability while retaining designed levels of accuracy by ensuring that numerical solutions satisfy a semi-discrete entropy inequality. I have also developed efficient low-complexity and low storage time-domain high order DG solvers for wave propagation.

High performance computing: I am interested in high performance implementations of numerical methods for PDEs, and in designing algorithms which exploit parallelism in modern many-core architectures such as graphics processing units (GPUs). I have also worked on the distributed implementation of high order adaptive finite element methods.

Discontinuous Petrov-Galerkin (DPG) methods: I have worked on high order adaptive DPG finite element methods for problems in fluid dynamics. In particular, I have investigated robust formulations for singularly perturbed convection-diffusion problems, as well as for the nonlinear equations of compressible flow.

Support and grants

CAREER: Tailored entropy stable discretizations of nonlinear conservation laws (NSF DMS-1943186). 2020-2025, $449,907, PI.

Bernstein-Bezier Techniques for High Order Time-Domain Discontinuous Galerkin Methods (NSF DMS-1719818). 2017-2020, $200k, PI.

Collaborative Research: Improved Algorithms for Multiwave Imaging in Complex Media: Theory and Computation (NSF DMS-1712639). 2017-2020, $200k, Co-PI.

Publications (Google Scholar profile)

Bold italicized authors denote supervised students or postdocs.

Submitted

1. Efficient implementation of modern entropy-based discontinuous Galerkin methods for conservation laws. Hendrik Ranocha, Michael Schlottke-Lakemper, **Jesse Chan**, Andres Rueda-Ramirez, Andrew Ross Winters, Florian Hindenlang, and Gregor J. Gassner. Link.
2. Entropy stable discontinuous Galerkin methods for the shallow water equations with subcell positivity preservation. ***Xinhui (Philip) Wu***, Nathaniel Trask, **Jesse Chan**. Link
3. Provably Stable Flux Reconstruction High-Order Methods on Curvilinear Elements. Alexander Cicchino, David C. Del Rey Fernandez, Siva Nadarajah, **Jesse Chan**, Mark H. Carpenter. Submitted to Journal of Computational Physics. Link.
4. Adaptive high-order numerical simulations of hyperbolic PDEs with Trixi.jl: A case study of Julia for scientific computing. Hendrik Ranocha, Michael Schlottke-Lakemper, Andrew Ross Winters, **Jesse Chan**, Erik Faulhaber, and Gregor J. Gassner. Submitted to JuliaCon 2021 proceedings. Link.
5. Discrete adjoint computations for relaxation Runge-Kutta methods. ***Mario J. Bencomo***, **Jesse Chan**. Submitted to JSC. Link.

Journal publications

1. Mortar-based entropy stable discontinuous Galerkin methods for non-conforming quadrilateral and hexahedral meshes. **Jesse Chan**, ***Mario J. Bencomo***, David C. Del Rey Fernandez. Journal of Scientific Computing, Volume 89, Article 51 (2021). Link.
2. Entropy stable modal discontinuous Galerkin schemes and wall boundary conditions for the compressible Navier-Stokes equations. **Jesse Chan**, ***Yimin Lin***, Tim Warburton. Journal of Computational Physics, Volume 448, 2022. Link.
3. Efficient computation of Jacobian matrices for entropy stable summation-by-parts schemes. **Jesse Chan**, ***Christina G. Taylor***. Journal of Computational Physics, Volume 448, 2022. Link.
4. High order weight-adjusted discontinuous Galerkin methods on moving curved meshes. ***Kaihang Guo***, **Jesse Chan**. Accepted to IJNME. Link.
5. A high order discontinuous Galerkin method for the symmetric form of the anisotropic viscoelastic wave equation. ***Khemraj Shukla***, **Jesse Chan**, Maarten V. de Hoop. Computers and Mathematics with Applications, Volume 99, 113-132, 2021. Link.
6. Entropy stable discontinuous Galerkin methods for nonlinear conservation laws on networks and multi-dimensional domains. ***Xinhui (Philip) Wu***, **Jesse Chan**. Journal of Scientific Computing, Volume 87, 2021. Link.
7. Entropy stable high order DG methods for the shallow water equations: curved triangular meshes and GPU acceleration. ***Xinhui (Philip) Wu***, **Jesse Chan**, Ethan J. Kubatko. Computers and Mathematics with Applications, Volume 82, 179-199, 2021. Link
8. Entropy stable reduced order modeling of nonlinear conservation laws. **Jesse Chan**. Journal of Computational Physics, Volume 423, 2020. Link
9. A weight-adjusted discontinuous Galerkin method for wave propagation in coupled elastic-acoustic media. ***Kaihang Guo***, Sebastian Acosta, **Jesse Chan**. Journal of Computational Physics, Volume 418, 2020. Link.

10. A weight-adjusted discontinuous Galerkin method for the poroelastic wave equation: penalty fluxes and micro-heterogeneities. ***Khemraj Shukla***, **Jesse Chan**, Maarten V. de Hoop, Priyank Jaiswal. Journal of Computational Physics, Volume 403, 2020. Link.
11. Bernstein-Bezier weight-adjusted discontinuous Galerkin methods for wave propagation in heterogeneous media. ***Kaihang Guo***, **Jesse Chan**. Journal of Computational Physics, Volume 400, 2020. Link
12. Efficient entropy stable Gauss collocation methods. **Jesse Chan**, David C. Del Rey Fernandez, Mark H. Carpenter. SIAM Journal on Scientific Computing, 41.5, A2938–A2966, 2019. Link
13. Skew-symmetric entropy stable discontinuous Galerkin formulations. **Jesse Chan.** Journal of Scientific Computing, Volume 81, 459–485, 2019. Link.
14. Leapfrog time-stepping for Hermite methods. Arturo Vargas, Thomas Hagstrom, **Jesse Chan**, T. Warburton. Journal of Scientific Computing, Volume 80, 289–314, 2019. Link
15. Discretely entropy stable weight-adjusted discontinuous Galerkin methods on curvilinear meshes. **Jesse Chan**, Lucas Wilcox. Journal of Computational Physics, Volume 378, 366-393, 2019. Link
16. On discretely entropy conservative and entropy stable discontinuous Galerkin methods. **Jesse Chan**. Journal of Computational Physics, Volume 362, 346-374, 2018. Link
17. Multi-patch discontinuous Galerkin isogeometric analysis for wave propagation: explicit time-stepping and efficient mass matrix inversion. **Jesse Chan**, John Evans. Computer Methods in Applied Mechanics and Engineering, Volume 333, Pages 22-54, 2018. Link
18. Weight-adjusted discontinuous Galerkin methods: matrix-valued weights and elastic wave propagation in heterogeneous media. **Jesse Chan**. International Journal for Numerical Methods in Engineering 113, 1779-1809, 2018. Link.
19. On the penalty stabilization mechanism for upwind discontinuous Galerkin formulations of first order hyperbolic systems. **Jesse Chan**, T. Warburton. Computers and Mathematics with Applications 74 (12), 3099-3110, 2017. Link
20. A GPU-accelerated nodal discontinuous Galerkin method with high-order absorbing boundary conditions and corner/edge compatibility. Axel Modave, Andreas Atle, **Jesse Chan**, T. Warburton. International Journal for Numerical Methods in Engineering 112 (11), 1659-1686, 2017. Link
21. Reduced storage nodal discontinuous Galerkin methods on semi-structured prismatic meshes. **Jesse Chan**, Russell J. Hewett, Zheng Wang, T. Warburton. Computers and Mathematics with Applications 73.5, 775-793, 2017. Link
22. Weight-adjusted discontinuous Galerkin methods: wave propagation in heterogeneous media. **Jesse Chan**, Russell J. Hewett and T. Warburton. SIAM Journal on Scientific Computing 39.6, A2935-A2961, 2017. Link
23. Weight-adjusted discontinuous Galerkin methods: curvilinear meshes. **Jesse Chan**, Russell J. Hewett and T. Warburton. SIAM Journal on Scientific Computing 39.6, A2395-A2421, 2017. Link
24. A Geometric Multigrid Preconditioning Strategy for DPG System Matrices. Nathan Roberts, **Jesse Chan**. Computers and Mathematics with Applications, 2018-2043, 2017. Link
25. GPU-accelerated Bernstein-Bezier discontinuous Galerkin methods for wave problems. **Jesse Chan** and T. Warburton. SIAM Journal on Scientific Computing 39.2, A628-A654, 2017. Link.
26. Variations on Hermite methods for wave propagation. Arturo Vargas, **Jesse Chan**, T. Hagstrom, and T. Warburton. Communications in Computational Physics 22.2: 303-337, 2017. Link
27. Foundations of the Blended Isogeometric Discontinuous Galerkin (BIDG) Method. C. Michoski, **Jesse Chan**, L. Engvall, and J.A. Evans. Computer Methods in Applied Mechanics and Engineering, Volume 305, 658-681, 2016. Link
28. GPU-accelerated discontinuous Galerkin methods on hybrid meshes. **Jesse Chan**, Z. Wang, A. Modave, J.F. Remacle, and T. Warburton. Journal of Computational Physics, Volume 318, 142-168, 2016. Link
29. A short note on a Bernstein-Bezier basis for the pyramid. **Jesse Chan** and T. Warburton.

SIAM Journal on Scientific Computing, 38(4), A2162-A2172, 2016. Link

30. Orthogonal bases for non-affine pyramidal finite elements. **Jesse Chan** and T. Warburton. SIAM Journal on Scientific Computing 38.2: A1146-A1170, 2016. Link
31. hp-finite element trace inequalities for the pyramid. **Jesse Chan** and T. Warburton. Computers and Mathematics with Applications, 69.6: 510-517, 2015. Link
32. A comparison of high order interpolation nodes for the pyramid. **Jesse Chan** and T. Warburton. SIAM Journal on Scientific Computing, 37:A2151-A2170, 2015. Link
33. A DPG method for steady viscous compressible flow. **Jesse Chan**, L. Demkowicz, and R. Moser. Computers and Fluids, 98:69-90, 2014. Link
34. A dual Petrov-Galerkin finite element method for the convection-diffusion equation. **Jesse Chan**, J. A. Evans, and W. Qiu. Computers and Mathematics with Applications, 68(11):1513-1529, 2014. Link
35. Locally conservative discontinuous Petrov-Galerkin finite elements for fluid problems. Truman Ellis, L. Demkowicz, and **Jesse Chan**. Computers and Mathematics with Applications, 68(11):1530-1549, 2014. Link
36. A robust DPG method for convection-dominated diffusion problems II: Adjoint boundary conditions and mesh-dependent test norms. **Jesse Chan**, N. Heuer, T. Bui-Thanh, and L. Demkowicz. Computers and Mathematics with Applications, 67(4):771-795, 2014. Link

Refereed conference proceedings and book chapters

1. GPU Acceleration of Hermite Methods for the Simulation of Wave Propagation. Arturo Vargas, **Jesse Chan**, Thomas Hagstrom, T. Warburton. In: Bittencourt M., Dumont N., Hesthaven J. (eds) Spectral and High Order Methods for Partial Differential Equations ICOSAHOM 2016. Lecture Notes in Computational Science and Engineering, vol 119. Springer, 2017. Link
2. Robust DPG Methods for Transient Convection-Diffusion. Truman Ellis, **Jesse Chan**, and Leszek Demkowicz. Building Bridges: Connections and Challenges in Modern Approaches to Numerical Partial Differential Equations. Springer International Publishing, 179-203, 2016. Link

Technical reports

1. Space-Time DPG: Designing a Method for Massively Parallel CFD. Truman Ellis, Leszek Demkowicz, **Jesse Chan**, and Robert Moser. ICES REPORT 14-32, 2014. Link
2. Global properties of DPG test spaces for convection-diffusion problems. **Jesse Chan**, Jay Gopalakrishnan, and Leszek Demkowicz. ICES Report 13-05, 2013. Link
3. Space-time DPG for shock problems, **Jesse Chan**, Leszek Demkowicz and Mikhail Shashkov. LA-UR 11-05511, 2011.
4. A New Discontinuous Petrov-Galerkin Method with Optimal Test Functions. Part V: Solution of 1D Burgers and Navier-Stokes Equations. **Jesse Chan**, Leszek Demkowicz, Robert Moser, and Nathan Roberts, ICES Report 10-25, 2010. Link
5. The network wave equation. **Jesse Chan**, Mark Embree. CNX report 2008. Link.

Invited presentations

2021 Efficient high order DG methods on moving curved meshes (Minisymposium talk, November 2021, SIAM TX-LA).

On the entropy projection and the robustness of high order entropy stable discontinuous Galerkin schemes for under-resolved flows (Minisymposium talk, November 2021, SIAM TX-LA).

Recent advances in high order entropy stable discontinuous Galerkin schemes (Seminar talk, Courant Numerical Analysis and Scientific Computing, November 2021, Department of Mathematics and Department of Computer Science)

Recent advances in high order entropy stable discontinuous Galerkin schemes (Seminar talk, Applied Math seminar, October 2021, Department of Mathematics, Auburn University)

Entropy stable reduced order modeling of nonlinear conservation laws (Online minisymposium talk, July 2021, USNCCM 16).

Entropy stable reduced order modeling of nonlinear conservation laws (Online minisymposium talk, March 2021, SIAM CSE 21).

Entropy stable high order discontinuous Galerkin methods for nonlinear conservation laws (Online seminar talk, February 2020, Computational Mathematics seminar, Department of Mathematics, Australian National University).

2020 Entropy stable schemes for nonlinear conservation laws: high order discontinuous Galerkin methods and reduced order modeling (Online seminar talk, December 2020, Data-driven physical simulation (DDPS) seminar, Lawrence Livermore National Labs).

Entropy stable high order discontinuous Galerkin methods for nonlinear conservation laws (Online seminar talk, November 2020, Fluids, Structures and Materials Seminar Series, Ann and H.J. Smead Aerospace Engineering Sciences, University of Colorado at Boulder).

Efficient computation of Jacobian matrices for entropy stable summation-by-parts schemes (Online minisymposium talk, October 2020, SIAM TX-LA Sectional Meeting, Houston, TX).

Stable high order methods for time-domain wave propagation in complex geometries and heterogeneous media (Seminar talk, April 2020, Electromagnetics Seminar, Department of Electrical and Computer Engineering, University of Houston, Houston, TX).

Stable high order methods for time-domain wave propagation in complex geometries and heterogeneous media (Invited plenary talk, March 2020, Rice Oil and Gas HPC Conference, Rice University, Houston, TX).

Applications of geometry and algebra: Barycentric coordinates (Invited talk, January 2020, ConocoPhilips Applied Mathematics Program AMP!, Rice University, Houston, TX).

Entropy stable schemes for nonlinear conservation laws: high order discontinuous Galerkin methods and reduced order modeling (Colloquium talk, January 2020, Department of Mathematics, University of Houston, Houston, TX).

2019 Entropy stable schemes for nonlinear conservation laws: high order discontinuous Galerkin methods and reduced order modeling (Colloquium talk, December 2019, Institute for Aerospace Studies, University of Toronto, Toronto, CN).

Entropy stable reduced order modeling for nonlinear conservation laws (Colloquium talk, September 2019, Department of Computational and Applied Mathematics, Rice University, Houston, TX).

Entropy stable schemes for nonlinear conservation laws: high order discontinuous Galerkin methods and reduced order modeling (Seminar talk, September 2019, Oak Ridge National Lab, Oak Ridge, TN).

A discretely entropy stable DG method for the shallow water equations (Minisymposium talk, August 2019, USNCCM 15, Austin, TX).

Entropy stable reduced order modeling for nonlinear conservation laws (Minisymposium talk, July 2019, ICIAM, Valencia, Spain).

Computational modeling and mathematics (June 2019, ConocoPhilips Applied Mathematics Program AMP!, Houston, TX).

Discretely entropy stable discretizations for nonlinear conservation laws: high order finite elements and reduced order modeling, (Invited talk, April 2019, GMIG project review, Houston, TX).

Entropy Stable Schemes Based on Modal Discontinuous Galerkin Formulations, (Minisymposium talk, April 2019, Finite Elements in Flow, Chicago, IL).

Entropy stable Gauss collocation DG methods (Minisymposium talk, March 2019, SIAM Conference on Computational Science and Engineering, Spokane, WA).

2018 Entropy stable schemes based on modal DG formulations (Colloquium talk, December 2018, Department of Applied Mathematics, Brown University, Providence, RI).

Discretely entropy stable discontinuous Galerkin methods (Colloquium talk, October 2018, Department of Mathematics, Rensselaer Polytechnic Institute, Troy, NY).

Bernstein-Bezier weight-adjusted discontinuous Galerkin methods for wave propagation in heterogeneous media (Minisymposium talk, October 2018, SIAM TX-LA sectional meeting, Baton Rouge, LA).

Entropy stable high order discontinuous Galerkin methods for nonlinear conservation laws (Colloquium talk, September 2018, Department of Mathematics, Purdue University, West Lafayette, Indiana).

Entropy stable discontinuous Galerkin methods for nonlinear conservation laws (Colloquium talk, August 2018, Department of Mechanical Engineering, Rice University, Houston, TX).

Energy-based methods for time-dependent acoustic and elastic wave propagation (Workshop talk, August 2018, Numerical Analysis of Coupled and Multi-Physics Problems with Dynamic Interface, BIRS Oaxaca, Mexico).

Discretely entropy stable discontinuous Galerkin methods (Minisymposium talk, July 2018, WCCM, New York, New York).

Discretely entropy stable discontinuous Galerkin methods with arbitrary bases and quadratures (Minisymposium talk, July 2018, ICOSAHOM, London, United Kingdom).

Weight-adjusted discontinuous Galerkin methods for elastic wave propagation (Minisymposium talk, July 2018, ICOSAHOM, London, United Kingdom).

Discretely entropy stable discontinuous Galerkin methods (Minisymposium talk, June 2018, ECCM-ECFD, Glasgow, United Kingdom).

Discretely stable high order methods for nonlinear conservation laws, (Seminar talk, May 2018, Department of Mathematics, Virginia Tech, Blacksburg, VA).

Discretely entropy stable high order methods for nonlinear conservation laws, (Seminar talk, May 2018, NASA Langley Research Center, Hampton, VA).

Simulating waves and fluids: accuracy, stability, and high performance computing, (Invited talk, May 2018, Ken Kennedy Institute, Houston, TX).

Discretely stable high order DG methods, (Seminar talk, April 2018, Department of Mathematics, Texas A&M, College Station, TX).

Discretely entropy stable discontinuous Galerkin methods (Minisymposium talk, January 2018, Joint Mathematics Meetings, San Diego, CA).

2017 Provably stable high order discontinuous Galerkin methods for wave propagation and fluid flow (Seminar talk, November 2017, Fluid Dynamics Research Consortium, Pennsylvania State University, University Park, PA).

Discretely entropy stable discontinuous Galerkin methods (Seminar talk, October 2017, Department of Mathematics, University of Houston, Houston, TX).

Discretely entropy stable discontinuous Galerkin methods (Symposium talk, September 2017, Texas Applied Mathematics and Engineering Symposium, Austin, TX).

Bernstein-Bezier discontinuous Galerkin methods (Minisymposium talk, June 2017, 27th Biennial Numerical Analysis Conference, Glasgow, Scotland).

Efficient time-domain discontinuous Galerkin methods for wave propagation (ICES seminar, March 2017, University of Texas at Austin, Austin, TX).

Weight-adjusted discontinuous Galerkin methods for heterogeneous media and curvilinear meshes (SIAM Conference on Computational Science and Engineering, February 2017, Atlanta, GA).

2016 Finite Element and GPU Computing Seminar: the Bernstein-Bezier Discontinuous Galerkin method (Guest lecture, October 2016, Virginia Tech, Blacksburg, VA).

Efficient time-domain DG methods for wave propagation (Seminar talk, October 2016, Department of Mathematics, Southern Methodist University, Dallas, TX).

Efficient time-domain DG methods for wave propagation, (Seminar talk, July 2016 Department of Mathematics, Texas A&M, College Station, TX).

GPU-accelerated Bernstein-Bezier DG methods (Seminar talk, April 2016, Synergistic Environments for Experimental Computing seminar, Virginia Tech, Blacksburg, VA).

Recursive structures in Bernstein-Bezier matrices (Seminar talk, March 2016, Matrix Computations seminar, Virginia Tech, Blacksburg, VA).

GPU-accelerated Bernstein-Bezier discontinuous Galerkin methods (Seminar talk, February 2016, SIAM student chapter, Virginia Tech, Blacksburg, VA).

Designing Discontinuous Galerkin methods for high order efficiency (Seminar talk, February 2016, Department of Mathematics, University of Kansas, Lawrence, KS).

Designing Discontinuous Galerkin methods for high order efficiency (Seminar talk, January 2016, Department of Computational and Applied Mathematics, Rice University, Houston, TX).

Designing Discontinuous Galerkin methods for high order efficiency (Seminar talk, January 2016, Department of Mathematics, Baylor University, Waco, TX).

2015 GPU-accelerated DG methods on hybrid meshes (Seminar talk, November 2015, Department of Mathematical Sciences, University of Delaware, Newark, Delaware).

GPU-accelerated high order DG methods on hybrid meshes (Seminar talk, November 2015, TU Wien, Vienna, Austria).

DPG for the compressible Navier-Stokes equations (Workshop talk, November 2015, Workshop on Minimum Residual and Least Squares Finite Element Methods, Delft, Netherlands).

GPU-accelerated DG Methods on Hybrid Meshes (Workshop talk, September 2015, MFO 1540, Oberwolfach, Germany).

GPU-accelerated high order DG Methods on Hybrid Meshes (Seminar talk, September 2015, Department of Mathematics, Virginia Tech, Blacksburg, VA)

High order discontinuous Galerkin methods on hybrid meshes (Minisymposium talk, July 2015, SIAM Geosciences 15, Palo Alto, CA).

High order discontinuous Galerkin methods on pyramidal elements (Minisymposium talk, April 2015, PANACM, Buenos Aires, AR).

2013 DPG methods for convection-diffusion (Workshop talk, ICES/USACM Workshop on Minimum Residual and Least Squares Finite Element Methods, Austin, TX.)

Dual Petrov-Galerkin methods: an overview of theory/applications (Seminar talk, Department of Computational and Applied Mathematics, Rice University, Houston, TX).

A higher order DPG method for compressible flow problems (Seminar talk, Department of Computational and Applied Mathematics, Rice University, Houston, TX).

DPG Methods for Transport and the Inviscid Euler Equations (SIAM CSE, Boston, MA, 2013)

2012 A Discontinuous Petrov-Galerkin method for compressible flow problems (Seminar talk, The Boeing Company, Seattle, WA.)

2011 Application of a Discontinuous Petrov-Galerkin method to compressible flow problems (Minisymposium talk, ECCOMAS, Vienna, Austria).

Contributed presentations

2019 Modal formulations of entropy stable discontinuous Galerkin methods (Minisymposium talk, June 2019, North American High Order Methods Conference, San Diego, CA).

2018 Efficient explicit solvers for multipatch discontinuous Galerkin isogeometric analysis (Minisymposium talk, June 2018, ECCM-ECFD, Glasgow, United Kingdom).

Weight-adjusted Bernstein-Bezier DG methods for wave propagation in heterogeneous media (Rice Oil and Gas HPC Conference, March 2018, Houston, TX).

Discretely entropy stable discontinuous Galerkin methods (Finite Element Rodeo, February 2018, Baton Rouge, LA).

2017 Time-domain multi-patch discontinuous Galerkin methods (Minisymposium talk, USNCCM 14, July 2017, Montreal, CA).

Weight-adjusted discontinuous Galerkin methods for acoustic and elastic wave propagation (Minisymposium talk, WAVES, May 2017, Minneapolis, MN).

Weight-adjusted discontinuous Galerkin methods for acoustic and elastic wave propagation (Rice Oil and Gas HPC Conference, March 2017, Houston, TX).

2016 GPU-accelerated DG methods at high order (Minisymposium talk, Rice Oil and Gas HPC Conference, March 2016, Rice University, Houston, TX).

GPU-accelerated Bernstein-Bezier DG methods (Minisymposium talk, ICSCA, June 2016, Toronto, Canada).

GPU-accelerated Bernstein-Bezier DG methods for wave problems (Monash Workshop on Numerical PDEs, February 2016, Monash University, Melbourne, Australia).

2015 High order discontinuous Galerkin methods on pyramidal elements (Minisymposium talk, SIAM CSE15, March 2015, Salt Lake City, UT).

2014 Dual Petrov-Galerkin methods for convection problems (Finite Element Rodeo, March 2014, Austin, TX)

2013 A higher order adaptive DPG method for compressible flow problems (Minisymposium talk, USNCCM, Raleigh, NC)

DPG: A Robust, Higher Order Adaptive Method for Convection-dominated Diffusion Problems (Minisymposium talk, FEMTEC, Las Vegas, NV)

2012 Application of a Discontinuous Petrov-Galerkin method to convection-diffusion problems (Finite Element Rodeo, Houston, TX)

2011 Application of a Discontinuous Petrov-Galerkin Method to the Euler and Navier-Stokes Equations (Minisymposium talk, USNCCM, Minneapolis, MI.)

Posters

2019 A discontinuous Galerkin method for wave propagation in coupled elastic-acoustic media (Guo, K., and Chan, J.). Poster, Rice Oil and Gas HPC conference.

2018 GPU-accelerated Bernstein-Bezier weight-adjusted DG methods for wave propagation in heterogeneous media (Guo, K., and Chan, J.). Poster, SIAM LA-TX sectional meeting.

2018 GPU-accelerated Bernstein-Bezier weight-adjusted DG methods for wave propagation in heterogeneous media (Guo, K., and Chan, J.). Poster, Rice Oil and Gas HPC conference.

2016 GPU Accelerated Discontinuous Galerkin Method on Hybrid Meshes: Applications in Seismic Imaging (Wang, Z., Chan, J. L., Modave, A., and Warburton, T.). Poster, Rice Oil and Gas HPC conference.

GPU Accelerated Hermite Methods for the Simulation of Waves (Vargas, A., Chan, J. L., and Warburton, T.). Poster, Rice Oil and Gas HPC Conference.

2015 Efficient DG Methods on Hybrid Meshes (Invited workshop poster, Polytopal Element Methods in Mathematics and Engineering, Atlanta, Georgia).

Conference and workshop participation

Workshop on Algorithms for Dimension and Complexity Reduction (ICERM, 2020), Workshop on Mathematics of Reduced Order Models (ICERM, 2020), Workshop on Scientific machine learning (ICERM, 2020), Scientific software days (University of Texas at Austin, 2017), Finite element rodeo (University of Houston, 2017), Finite element circus (University of Maryland, 2016)

Teaching experience

Numbers in parentheses are teaching evaluations (1 for "Outstanding", 5 for "Poor").

Rice University

Fall 2021 **Numerical analysis (CAAM 553)**, *Graduate course*, Rice University, Department of Computational and Applied Mathematics.

Spring 2021 **Numerical methods for PDEs (CAAM 452)**, *Graduate course*, Rice University, Department of Computational and Applied Mathematics.

Spring 2021 **Independent study (numerical analysis qualifying exams) with Caira Anderson**, *Graduate course*, Rice University, Department of Computational and Applied Mathematics.

Fall 2020 **Numerical analysis (CAAM 553)**, *Graduate course*, Rice University, Department of Computational and Applied Mathematics.

Spring 2020 **Discontinuous Galerkin methods (CAAM 542)**, *Graduate course*, Rice University, Department of Computational and Applied Mathematics.

Fall 2019 **Numerical analysis (CAAM 553)**, *Graduate course*, Rice University, Department of Computational and Applied Mathematics.

Spring 2019 **Computational Science II (CAAM 520)**, *Graduate course*, Rice University, Department of Computational and Applied Mathematics.

Fall 2018 **Numerical analysis (CAAM 553)**, *Graduate course*, Rice University, Department of Computational and Applied Mathematics, (Instructor effectiveness: 1.0, Rice Mean 1.68).

Spring 2018 **Matrix Analysis (CAAM 335)**, *Undergraduate course*, Rice University, Department of Computational and Applied Mathematics, Lead instructor of a 3 section course (Instructor effectiveness: 1.85, Rice Mean 1.66).

Spring 2018 **Topics in numerical differential equations (CAAM 652)**, *Graduate course*, Rice University, Department of Computational and Applied Mathematics, (Instructor effectiveness: 1.43, Rice Mean 1.7).

Fall 2017 **Numerical analysis (CAAM 553)**, *Graduate course*, Rice University, Department of Computational and Applied Mathematics, (Instructor effectiveness: 2.14, Rice Mean 1.73).

Spring 2017 **Foundations of finite element methods (CAAM 552)**, *Graduate course*, Rice University, Department of Computational and Applied Mathematics, (Instructor effectiveness: 1.0, Rice mean: 1.723).

Fall 2016 **Numerical analysis (CAAM 553)**, *Graduate course*, Rice University, Department of Computational and Applied Mathematics, (Instructor effectiveness: 1.43, Rice mean: 1.73).

Spring 2015 **Differential Equations in Science and Engineering (CAAM 336)**, *Undergraduate course*, Rice University, Department of Computational and Applied Mathematics, Lead instructor of a 2 section course, (Instructor effectiveness: 1.32, Rice mean: 1.78).

Fall 2014 **Differential Equations in Science and Engineering (CAAM 336)**, *Undergraduate course*, Rice University, Department of Computational and Applied Mathematics, (Instructor effectiveness: 1.35, Rice mean: 1.77).

Spring 2013 **Matrix Analysis (CAAM 335)**, *Undergraduate course*, Rice University, Department of Computational and Applied Mathematics, (Instructor effectiveness: 1.82, Rice mean: 1.75).

Fall 2013 **Teaching assistant**, *Rice University, Department of Computational and Applied Mathematics*.
- Matrix Analysis (CAAM 335), undergraduate course.
- Computational Science I (CAAM 420), graduate course.

University of Texas at Austin

Spring 2012 **Teaching Assistant**, *The University of Texas at Austin*, Institute for Computational Engineering and Sciences.
- Mathematical Models in Applied Engineering and Sciences (CAM386L), graduate course.

PhD students

2019-present **Xinhui (Philip) Wu**, *PhD student in CAAM*, Rice University.
Thesis topic: entropy stable high order DG methods for the shallow water equations.

2020-present **Christina Taylor**, *MA/PhD student in CAAM*, Rice University.

2020-present **Yimin Lin**, *PhD student in CAAM*, Rice University.

Previous PhD students

2017-2021 **Kaihang Guo**, *MA/PhD student in CAAM*, Rice University.
First position after PhD: research scientist at CGG Veritas.

Postdoctoral researchers

2019-present **Mario Bencomo**, *Pfieffer postdoctoral instructor in CAAM*, Rice University.

Undergraduate mentoring experience

Spring 2021-present **Prani Nalluri**, *undergraduate researcher*, Rice University.
Research project (CAAM 490): visualization of high order DG methods for CFD.

Fall 2020-present **Ruofeng (Charlie) Liu**, *undergraduate researcher*, Rice University.
Research projects: relaxation Runge-Kutta time-stepping methods, finite volume and high order discontinuous Galerkin methods for nonlinear conservation laws.

Summer 2020-Fall 2020 **Quan Le**, *undergraduate researcher*, Rice University.
Research project: entropy stable finite volume methods for the St. Venant equations.

Summer 2019, Spring 2020 **Jacob Engel**, *undergraduate researcher*, Rice University.
Research project: energy conservative finite volume methods for the wave equations on networks.

Summer 2018 **Matthew Schwartz**, *undergraduate researcher*, Rice University.
Research project: finite volume methods for the shallow water equations.

2017-2018 **Sanket Mehta, Meghana Pannala**, *undergraduate senior design team*, Rice University.
Research project: numerical methods for photo-acoustic tomography (PAT).

Summer 2017 **Joey Munar**, *undergraduate researcher*, Rice University.
Research project: Fekete interpolation nodes for B-spline bases.

Spring 2017 **Eva (Chen) Chen**, *undergraduate researcher*, Rice University.
Research project (CAAM 490): photo-acoustic tomography (PAT) using finite difference methods.

Other mentoring experience

Spring 2021 **Caira Anderson**, *First year graduate student in CAAM*, Rice University, Department of Computational and Applied Mathematics, Independent study (CAAM 591).
Reviewed topics related to numerical analysis in preparation for the qualifying exam.

Summer 2018 **Nigel Tan**, *MCAAM (professional MA) student*, Rice University.

Summer 2018-Fall 2019 **Khemraj Shukla**, *Visiting researcher*, PhD student in the Boone Pickens School of Geology, Oklaholma State.
Research project: energy stable discontinuous Galerkin methods for wave propagation in poroelastic media (with Maarten V. de Hoop).

2014–2016 **Zheng Wang**, *PhD student in CAAM*, Rice University.
Co-mentored (with advisor T. Warburton).

2014–2016 **Arturo Vargas**, *PhD student in CAAM*, Rice University.
Co-mentored (with advisor T. Warburton).

HPC allocations

High order entropy stable numerical methods for compressible flow. XSEDE Startup allocation. 2020-2023, 2500 service units on Comet GPU (moved to Expanse).

Software

2020-present **Principal developer of the Julia package Trixi.jl**, *Dept. of Comp. and Applied Mathematics*, Rice University, Houston, TX.

2020-present **Main developer of Julia packages NodesAndModes.jl, StartUpDG.jl**, *Dept. of Comp. and Applied Mathematics*, Rice University, Houston, TX.

2020-present **Contributor to Julia packages**, *StructArrays.jl, OrdinaryDiffEq.jl, DiffEqDocs.jl*.

Spring 2019 **Main developer of ESDG.jl,** , *Dept. of Comp. and Applied Mathematics*, Rice University, Houston, TX.
Julia implementation of energy and entropy stable high order DG methods in 1D, 2D, 3D for linear and nonlinear partial differential equations. Companion code to Spring 2020 course CAAM 542 (Discontinuous Galerkin methods).

2018 **BBWADG**, *Dept. of Comp. and Applied Mathematics*, Rice University, Houston, TX.

BBWADG, GPU-accelerated implementation of time-domain solvers for acoustic and elastic waves using Bernstein-Bezier weight-adjusted DG methods (with Kaihang Guo).

2015 **BBDG**, *Dept. of Mathematics*, Virginia Tech, Blacksburg, VA.

BBDG, a GPU-accelerated high order DG code using Bernstein-Bezier basis functions on unstructured tetrahedral meshes (with Tim Warburton).

2014–2015 **Nodes**, *Dept. of Comp. and Applied Mathematics*, Rice University, Houston, TX.

Nodes, a library of routines to compute optimized interpolation nodes for high order Lagrange finite elements (with Tim Warburton).

2010–2013 **Camellia**, *Institute for Computational Engineering and Sciences (ICES)*, The University of Texas, Austin, TX.
Contributor to Camellia, a high order adaptive MPI code developed by Nathan Roberts and built upon the Sandia Trilinos library.

University activities, service, and outreach

2021 Reviewer for the Ken Kennedy Institute graduate fellowship program
2021 Orientation week, August 2021 Engineering Orientation
2021 Commencement, May 2021: graduate marshal
2021 Rice University NSF CAREER Award Workshop panelist (May)
2021 Oil and Gas HPC Conference: abstract reviewer
2020 Reviewer for the Ken Kennedy Institute graduate fellowship program
2020 Orientation week, August 2020: academic fair (online)
2020 Rice University NSF CAREER Award Workshop panelist (March)
2020 Rice University NSF CAREER Award Workshop panelist (February)
2019 Oil and Gas HPC Conference: organizing committee
2019 Orientation week, August 2019: academic fair
2019 Commencement, May 2019: graduate marshal

2019 Undergraduate recruiting, April 2019: Owl Days reception
2018 CEVE department: faculty search committee
2018 Orientation week, August 2018: academic fair
2018 Commencement, May 2018: graduate marshal
2018 Undergraduate recruiting, April 2018: Owl Days reception
2017 Orientation week, August 2017: academic fair
2017 Commencement, May 2017: graduate marshal
2017 Convocation, May 2017: doctoral hooding
2017 Undergraduate recruiting, April 2017: Owl Days reception
2013–present Will Rice College Associate.

Departmental service

2019-2021 Undergraduate committee
2021 Colloquium co-chair.
2020 Orientation week CAAM webinar
2019 Lecturer hiring committee
2018 Data Science Initiative recruiting
2018 Graduate student recruiting
2017-2019 Graduate committee
2017 Graduate student recruiting
2017 Faculty search committee
2016-2019 Colloquium chair.
Visitors hosted Spring 2020: Chris Kees. Fall 2020: Sara Pollock. Fall 2019-Spring 2020: Karen Willcox (joint colloquium + Shell lecture between MECH and CAAM), Alexander Mamonov, Kevin Carlberg, Matthias Maier. Fall 2018-Spring 2019: Richard Carter, Ethan Kubatko, Anthony Austin, Jason Hicken, John Hawkins, David C. Del Rey Fernandez, Edmond Chow, Sigal Gottlieb. Fall 2017-Spring 2018: Mark H. Carpenter, Annalisa Quaini, Andreas Mang, Robert C. Kirby, Ming Zhao, Matthias Taus, David Fuentes, David M. Williams, Ernest Ryu. Fall 2016-Spring 2017: John Evans, Joseph Young, Maxim Olshanskii, Daniel Appelo, Sebastian Acosta

Professional service

2021 SIAM TXLA 4th annual meeting: minisymposium co-organizer
2021 USNCCM 16: minisymposium co-organizer
2019-2020 SIAM Education Committee: webpage subcommittee
2019-present Faculty mentor for Rice University student chapter of SIAM
2019 USNCCM 15: minisymposium co-organizer
2019 SIAM Computational Science and Engineering: featured minisymposium co-organizer.
2018 Proposal reviewer for Chilean National Science and Technology Commission (CONICYT)
2018 NSF proposal review panelist.
2018 World Congress on Computational Mechanics: minisymposium co-organizer.
2017 Texas Applied Math and Engr. Symposium: poster session judge.
2017 SIAM Computational Science and Engineering: minisymposium co-organizer and poster session judge.

2012–present Reviewer for: SoftwareX, SIAM Multiscale Modeling and Simulation, Numerical Algorithms, IEEE Transactions on Geoscience and Remote Sensing, Mechanics Research Communications, Communications on Applied Mathematics and Computation (CAMC), SMAI Journal of Computational Mathematics, Transactions on Magnetics - Conferences, SIAM/ASA Journal on Uncertainty Quantification, SIAM Journal on Numerical Analysis, Computational Mechanics, Journal of Computational Science, Journal of Scientific Computing, Journal of Computational Physics, Computers and Mathematics With Applications, SIAM Journal on Scientific Computing, Mathematical Modelling and Numerical Analysis, International Journal of High Performance Computing, Computer Physics Communications, Computer Methods in Applied Mechanics and Engineering, Applied Numerical Mathematics.

2006–2008 Secretary, Rice University student chapter of SIAM.

Community service and outreach

2021-present Faculty mentor for Rice University Escape Room

2019-2020 Guest speaker at ConocoPhillips Applied Mathematics Program (AMP!) for Houston-area K-12 math teachers

2018 Greater Houston Community Foundation Family Philanthropy Day volunteer

2018-2021 Greater Houston Community Foundation Scholarship reviewer

2017 Community service volunteer with St. Martin's Episcopal Church

2010–2013 Chair/co-organizer of the UT Austin ICES Forum/Babuška Seminar Series. Worked with Dr. Ivo Babuška to organize a bi-weekly seminar series aimed at exposing graduate students to a wide variety of scientific areas and applications.

2010–2012 Volunteer math coach with Austin Partners in Education.

PhD committees

2021 (Proposal) Mae Markowski, Computational and Applied Mathematics, Rice University

2021 (Proposal) Shengchao Lin, Computational and Applied Mathematics, Rice University

2021 Nidish Balaji, Mechanical Engineering, Rice University

2021 (Proposal) Lu Lin, Computational and Applied Mathematics, Rice University

2021 (Proposal) Boqian Shen, Computational and Applied Mathematics, Rice University

2021 (Proposal) Rami Masri, Computational and Applied Mathematics, Rice University

2021 Christopher Thiele, Computational and Applied Mathematics, Rice University

2020 (Proposal) Nidish Balaji, Mechanical Engineering, Rice University

2020 Yabin Zhang, Computational and Applied Mathematics, Rice University

2020 Rita Stanaityte, Mathematics, University of Houston

2020 Bryan Doyle, Computational and Applied Mathematics, Rice University

2019 (Proposal) Christopher Thiele, Computational and Applied Mathematics, Rice University

2019 Khemraj Shukla, Boone Pickens School of Geology, Oklahoma State University

2019 (Proposal) Bryan Doyle, Computational and Applied Mathematics, Rice University

2019 (Proposal): Yabin Zhang, Computational and Applied Mathematics, Rice University

2019 Kaipeng Li, Electrical and Computer Engineering, Rice University

2019 Thomas Klotz, Computational and Applied Mathematics, Rice University

2019 Peter Geldermans, Computational and Applied Mathematics, Rice University

2018 (Proposal): Thomas Klotz, Computational and Applied Mathematics, Rice University

2018 (Proposal): Kaipeng Li, Electrical and Computer Engineering, Rice University

2018 Ruichao Ye, Computational and Applied Mathematics, Rice University

2017 Wanli Cheng, Mathematics, University of Houston

MA committees

2021 Christopher Williams, Mathematical Sciences Institute, Australian National University
2021 Justin Porter, Mechanical Engineering, Rice University
2021 Alejandro Diaz, Computational and Applied Mathematics, Rice University
2020 Nathaniel Kroeger, Computational and Applied Mathematics, Rice University
2020 Lu Lin, Computational and Applied Mathematics, Rice University
2020 Boqian Shen, Computational and Applied Mathematics, Rice University
2019 Shengchao Lin, Computational and Applied Mathematics, Rice University
2019 Mae Markowski, Computational and Applied Mathematics, Rice University
2019 Rami Masri, Computational and Applied Mathematics, Rice University
2019 Connie Do, Civil and Environmental Engineering, Rice University
2018 Nick Bell, Computational and Applied Mathematics, Rice University
2018 Jonas Actor, Computational and Applied Mathematics, Rice University
2018 Christopher Thiele, Computational and Applied Mathematics, Rice University
2017 Peter Geldermans, Computational and Applied Mathematics, Rice University
2017 Jeremy Tillay, Computational and Applied Mathematics, Rice University

Qualifying examination committees

2020 Timothy Petrosius, Mechanical Engineering, Rice University
2019 Jordan Wagner, Mechanical Engineering, Rice University
2017-present CAAM Department qualifying examination committee

Awards and honors

2021 **ICERM workshop:** travel support ("Holistic Design of Time-Dependent PDE Discretizations")
2020 Selected to participate in the **NAE 26th annual US Frontiers of Engineering Symposium**
2020 **ICERM semester program workshops:** travel support ("Model and dimension reduction in uncertain and dynamic systems")
2019 **ICERM workshop:** travel support ("Scientific Machine Learning")
2015 **Oberwolfach Institute for Mathematics:** US Junior Oberwolfach Fellow.
2015 **Workshop on polytopal element methods:** travel award.
2013–2015 **Rice University:** Pfeiffer Postdoctoral Fellowship
2013 **UT Austin:** Graduate School Professional Development Travel Award
2008–2012 **UT Austin:** Computational and Applied Mathematics Fellowship
2004–2008 **Rice University.:** National Merit Scholarship, Chevron-Texaco REACH Scholarship, Louis J. Walsh Scholarship in Engineering
2007 **Rice University:** Meritorious Winner, Mathematical Competition in Modeling
Fall 2004, Spring 2006 **Rice University:** President's Honor Roll

References available upon request.