Brendan **Keith**

brendan_keith@brown.edu | brendankeith.github.io

Research Funding

2024–'28	**DOE SC ECRP**, REASON-3D: Randomized, Entropic, Adaptive, and Scalable Optimization for Non-Intrusive Data-Driven Design	*$875k*
2023	**OVPR Seed Award (Brown Internal)**, Data-Driven High-Order Accurate Fail-Safe Neural Topology Optimization for Plastic Deformation and Fracture	*$100k*
2022–'24	**LLNL LDRD**, Adaptive Sampling for Risk-Averse Design and Optimization	*$1.4m*

Appointments

Division of Applied Mathematics
Brown University — *Providence, Rhode Island*
Assistant Professor — *July 2022 – present*

Center for Applied Scientific Computing
Lawrence Livermore National Laboratory — *Livermore, California*
Postdoctoral Researcher — *Feb. 2021 – June 2022*

Institute for Computational and Experimental Research in Mathematics (ICERM)
Brown University — *Providence, Rhode Island*
Postdoctoral Fellow — *Sept. 2020 – Dec. 2020*

Chair of Numerical Mathematics
Technische Universität München — *Garching, Germany*
Postdoctoral Researcher — *Sept. 2018 – Aug. 2020*
Supervisor: Barbara Wohlmuth

Education

Oden Institute for Computational Engineering and Sciences
University of Texas at Austin — *Austin, Texas*
Ph.D. Computational Science, Engineering, & Mathematics — *2018*
Supervisor: Leszek Demkowicz
Dissertation: A saddle-point paradigm for finite element analysis and its role in the DPG methodology

Department of Mathematics and Statistics
McGill University — *Montréal, Quebec*
M.Sc. Applied Mathematics — *2013*
Supervisor: George Haller
Thesis: Lagrangian coherent structures in three-dimensional steady flows

Departments of Applied Mathematics, Pure Mathematics, and Physics
University of Waterloo — *Waterloo, Ontario*
B.Math Honours Applied Mathematics with Physics Option — *2011*
B.Math Honours Pure Mathematics — *2011*

Publications

Preprints

1. Bollapragada, R., Karamanli, C., Keith, B., Lazarov, B., Petrides, S., and Wang, J. (2023). *An Adaptive Sampling Augmented Lagrangian Method for Stochastic Optimization with Deterministic Constraints*. arXiv: 2305.01018 [math.OC].
2. Gillette, A., Keith, B., and Petrides, S. (2022). *Learning robust marking policies for adaptive mesh refinement*. arXiv: 2207.06339 [math.NA].

Scientific Journal Articles

3. Beiser, F., Keith, B., Urbainczyk, S., and Wohlmuth, B. (2023). *Adaptive sampling strategies for risk-averse stochastic optimization with constraints*. IMA J. Numer. Anal. drac083.
4. Kodakkal, A., Keith, B., Khristenko, U., Apostolatos, A., Bletzinger, K.-U., Wohlmuth, B., and Wuechner, R. (2022). *Risk-averse design of tall buildings for uncertain wind conditions*. Comput. Methods Appl. Mech. Engrg., **402**, 115371.
5. Keith, B., Khadse, A., and Field, S. E. (2021). *Learning orbital dynamics of binary black hole systems from gravitational wave measurements*. Phys. Rev. Res., **3** (4), 043101.
6. Keith, B. (2021). *A priori error analysis of high-order LL* (FOSLL*) finite element methods*. Comput. Math. Appl., **103**, 12–18.
7. Keith, B., Khristenko, U., and Wohlmuth, B. (2021). *Learning the structure of wind: A data-driven nonlocal turbulence model for the atmospheric boundary layer*. Phys. Fluids., **33**(9), 095110.
8. Keith, B., Khristenko, U., and Wohlmuth, B. (2021). *A fractional PDE model for turbulent velocity fields near solid walls*. J. Fluid Mech., **916**, A21.
9. Drzisga, D., Keith, B., and Wohlmuth, B. (2020). *The surrogate matrix methodology: Accelerating isogeometric analysis of waves*. Comput. Methods Appl. Mech. Engrg., **372**, 113322.
10. Drzisga, D., Keith, B., and Wohlmuth, B. (2020). *The surrogate matrix methodology: A reference implementation for low-cost assembly in isogeometric analysis*. MethodsX, **7**, 100813.
11. Demkowicz, L., Gopalakrishnan, J., and Keith, B. (2020). *The DPG-star method*. Comput. Math. Appl., **79**(11), 3092–3116.
12. Drzisga, D., Keith, B., and Wohlmuth, B. (2020). *The surrogate matrix methodology: Low-cost assembly for isogeometric analysis*. Comput. Methods Appl. Mech. Engrg., **361**, 112776.
13. Drzisga, D., Keith, B., and Wohlmuth, B. (2019). *The surrogate matrix methodology: a priori error estimation*. SIAM J. Sci. Comput., **41**(6), A3806–A3838.
14. Keith, B., Vaziri Astaneh, A., and Demkowicz, L. (2019). *Goal-oriented adaptive mesh refinement for discontinuous Petrov–Galerkin methods*. SIAM J. Numer. Anal., **57**(4), 1649–1676.
15. Vaziri Astaneh, A., Keith, B., and Demkowicz, L. (2019). *On perfectly matched layers for discontinuous Petrov–Galerkin methods*. Comput. Mech., **63**(6), 1131–1145.
16. Keith, B., Petrides, S., Fuentes, F., and Demkowicz, L. (2017). *Discrete least-squares finite element methods*. Comput. Methods Appl. Mech. Engrg., **327**, 226–255.
17. Keith, B., Knechtges, P., Roberts, N., Elgeti, S., Behr, M., and Demkowicz, L. (2017). *An ultraweak DPG method for viscoelastic fluids*. J. Non-Newton. Fluid Mech., **247**, 107–122.
18. Fuentes, F., Keith, B., Demkowicz, L., and Le Tallec, P. (2017). *Coupled variational formulations of linear elasticity and the DPG methodology*. J. Comput. Phys., **348**, 715–731.
19. Keith, B., Fuentes, F., and Demkowicz, L. (2016). *The DPG methodology applied to different variational formulations of linear elasticity*. Comput. Methods Appl. Mech. Engrg., **309**, 579–609.
20. Fuentes, F., Keith, B., Demkowicz, L., and Nagaraj, S. (2015). *Orientation embedded high order shape functions for the exact sequence elements of all shapes*. Comput. Math. Appl., **70**(4), 353–458.

Conference Proceedings

21. Yang, J., Mittal, K., Dzanic, T., Petrides, S., Keith, B., Petersen, B., Faissol, D., and Anderson, R. (2023). *Multi-Agent Reinforcement Learning for Adaptive Mesh Refinement*. *Proceedings of the 22nd International Conference on Autonomous Agents and Multiagent Systems (AAMAS-2023)*, 14–22.
22. Tosi, R., Nuñez, M., Keith, B., Pons-Prats, J., Wohlmuth, B., and Rossi, R. (2021). *Scalable dynamic asynchronous Monte Carlo framework applied to wind engineering problems*. *Advances in Uncertainty Quantification and Optimization Under Uncertainty with Aerospace Applications. Proceedings of the 2020 UQOP International Conference*. Ed. by Vasile, M. and Quagliarella, D. Vol. 8. Space Technology Proceedings. Springer, 55–68.

Other

23. Keith, B. (2018). *New ideas in adjoint methods for PDEs: A saddle-point paradigm for finite element analysis and its role in the DPG methodology*. PhD thesis. Austin, Texas: University of Texas at Austin.
24. Keith, B., Demkowicz, L., and Gopalakrishnan, J. (2017). *DPG* method*. ICES Report 17-25. The University of Texas at Austin.
25. Keith, B. (2014). *Lagrangian Coherent Structures in Three-dimensional Steady Flows*. Master's Thesis. Montreal, Quebec: McGill University.

26. Robison[1], B. K. (2011). *The Wave Equation and Multi-Dimensional Time*. The Waterloo Mathematics Review, **1**(1), 32–42.

Selected Conference Presentations and Invited Talks

2023	**USNCCM17,** US National Congress on Computational Mechanics	*Albuquerque, NM*
2023	**HOFEIM,** International Workshop on High-Order Finite Element and Isogeometric Methods	*Larnaca, CY*
2023	**WIAS,** Weierstrass Institute Mathematical Optimization Seminar	*Berlin, DE*
2023	**UT Austin,** Workshop in Honor of Leszek F. Demkowicz's 70th Birthday	*Austin, TX*
2023	**UT Austin,** Oden Institute Seminar	*Austin, TX*
2022	**Simula RL,** Optimization in Oslo	*Oslo, NO*
2022	**EPFL,** Mathematics in Computational Science and Engineering Seminar	*Lausanne, CH*
2022	**USACM,** Large-Scale TTA Early-Career Colloquium	*Virtual*
2022	**NC State,** Numerical Analysis Seminar	*Virtual*
2022	**ICCOPT,** International Conference on Continuous Optimization	*Bethlehem, PA*
2022	**SIAM UQ22,** SIAM Conference on Uncertainty Quantification	*Atlanta, GA*
2021	**USNCCM16,** US National Congress on Computational Mechanics	*Virtual*
2021	**SIAM OP21,** SIAM Conference on Optimization	*Virtual*
2021	**SIAM DS21,** SIAM Conference on Applications of Dynamical Systems	*Virtual*
2021	**ECOM,** East Coast Optimization Meeting	*Virtual*
2021	**SIAM CSE21,** SIAM Conference on Computational Science and Engineering	*Virtual*
2019	**IGA2019,** International Conference on Isogeometric Analysis	*München, DE*
2019	**FrontUQ19,** Workshop on Frontiers of Uncertainty Quantification in Fluid Dynamics	*Pisa, ITL*
2019	**USNCCM15,** US National Congress on Computational Mechanics	*Austin, TX*
2018	**Oberwolfach,** Workshop on Computational Engineering	*Oberwolfach, DE*

Selected Seminars and Training Programs

2020	**ICERM,** Semester Program: Advances in Computational Relativity	*Providence, RI*
2018	**ATPESC,** Argonne Training Program on Extreme-Scale Computing	*Chicago, IL*
2017	**Oberwolfach,** Seminar on Discontinuous Petrov–Galerkin Methods	*Oberwolfach, DE*
2016	**GPDE,** Winter school on geometric PDEs and their approximations	*College Station, TX*

Academic Service

Peer Review (Journals) *(Five to ten manuscripts per year)*

Computational Methods in Applied Mathematics (CMAM), Computer Methods in Applied Mechanics and Engineering (CMAME), Computers and Mathematics with Applications (CAMWA), IMA Journal of Numerical Analysis (IMAJNA), Mathematical Models and Methods in Applied Sciences (M3AS), Mathematics of Computation (Math. Comp.), Nature, SIAM Journal on Scientific Computing (SISC)

Peer Review (Funding Agencies)

Agence Nationale de la Recherche, Army Research Office (ARO), National Science Center, Poland (Panel ST8)

Conference Organization

Texas Applied Mathematics and Engineering Symposium (2017)
Workshop in Honor of Leszek F. Demkowicz's 70th Birthday (2023)
Banff International Research Station (BIRS) Workshop on Scientific Machine Learning (2023)

Membership

Society for Industrial and Applied Mathematics (SIAM)
United States Association for Computational Mechanics (USACM)

Selected Honors & Awards

2020	**Fellowship,** ICERM postdoctoral fellowship for the program "Advances in Computational Relativity"	*Providence, RI*
2018	**Finalist,** Student Poster Competition for the 13th World Congress on Computational Mechanics	*New York, NY*
2017	**Recognition of service,** SIAM Student Certificate of Recognition for 2017	*Austin, TX*
2017	**2nd Place,** Best Mathematically Oriented Poster at USNCCM14	*Montréal, QC*
2017	**Fellowship,** University of Texas at Austin University Graduate Continuing Fellowship	*Austin, TX*
2013	**Award,** University of Texas at Austin College Recruitment Fellowship Award	*Austin, TX*

[1]Personal name legally changed by the Government of Ontario to Brendan Keith on February 22, 2012.