

Brendan Keith

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Research Interests

Stochastic programming, high-order finite element methods, scientific machine learning, uncertainty quantification, non-local physics, numerical relativity, and high performance computing.

Research Grants

LDRD \$450,000/year (Leading PI), Adaptive Sampling for Risk-Averse Design and Optimization

2022, 2023, 2024

Appointments

Division of Applied Mathematics

Brown University

ASSISTANT PROFESSOR

Providence, Rhode Island

Start date: July 2022

Center for Applied Scientific Computing

Lawrence Livermore National Laboratory

POSTDOCTORAL RESEARCHER

Livermore, California

Feb. 2021 - June 2022

Institute for Computational and Experimental Research in Mathematics (ICERM)

Brown University

POSTDOCTORAL FELLOW

Providence, Rhode Island

Sept. 2020 - Dec. 2020

Chair of Numerical Mathematics

Technische Universität München

POSTDOCTORAL RESEARCHER

Supervisor: Barbara Wohlmuth

Garching, Germany

Sept. 2018 - Aug. 2020

Education

Oden Institute for Computational Engineering and Sciences

University of Texas at Austin

PH.D. COMPUTATIONAL SCIENCE, ENGINEERING, & MATHEMATICS

Supervisor: Leszek Demkowicz

Dissertation: A saddle-point paradigm for finite element analysis and its role in the DPG methodology

Austin, Texas

2018

Department of Mathematics and Statistics

McGill University

M.SC. APPLIED MATHEMATICS

Supervisor: George Haller

Thesis: Lagrangian coherent structures in three-dimensional steady flows

Montréal, Quebec

2013

Departments of Applied Mathematics, Pure Mathematics, and Physics

University of Waterloo

B.MATH HONOURS APPLIED MATHEMATICS WITH PHYSICS OPTION

B.MATH HONOURS PURE MATHEMATICS

Waterloo, Ontario

2011

2011

Teaching

UT Austin

GRADUATE TEACHING ASSISTANT

- CSE 386M, Functional Analysis in Theoretical Mechanics (graduate course)
- CSE 380, Tools and Techniques for Computational Science (graduate course)
- M 408N, Differential Calculus for Science

Austin, Texas

2014–2016

McGill University

GRADUATE TEACHING ASSISTANT

- Math 376, Honours Nonlinear Dynamics

Montréal, Québec

2012

Preprints

1. Beiser, F., Keith, B., Urbainczyk, S., and Wohlmuth, B. (2020). *Adaptive sampling strategies for risk-averse stochastic optimization with constraints*. arXiv:2012.03844 [math.OC].

Scientific Journal Articles

2. 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.
3. Keith, B. (2021). *A priori error analysis of high-order LL* (FOSLL*) finite element methods*. Comput. Math. Appl., **103**, 12–18.
4. 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.
5. Keith, B., Khristenko, U., and Wohlmuth, B. (2021). *A fractional PDE model for turbulent velocity fields near solid walls*. J. Fluid Mech., **916**, A21.
6. Drzisga, D., Keith, B., and Wohlmuth, B. (2020). *The surrogate matrix methodology: Accelerating isogeometric analysis of waves*. Comput. Methods Appl. Mech. Engrg., **372**, 113322.
7. 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.
8. Demkowicz, L., Gopalakrishnan, J., and Keith, B. (2020). *The DPG-star method*. Comput. Math. Appl., **79**(11), 3092–3116.
9. 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.
10. Drzisga, D., Keith, B., and Wohlmuth, B. (2019). *The surrogate matrix methodology: a priori error estimation*. SIAM J. Sci. Comput., **41**(6), A3806–A3838.
11. 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.
12. Vaziri Astaneh, A., Keith, B., and Demkowicz, L. (2019). *On perfectly matched layers for discontinuous Petrov–Galerkin methods*. Comput. Mech., **63**(6), 1131–1145.
13. Keith, B., Petrides, S., Fuentes, F., and Demkowicz, L. (2017). *Discrete least-squares finite element methods*. Comput. Methods Appl. Mech. Engrg., **327**, 226–255.
14. 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.
15. 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.
16. 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.
17. 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.

Other

18. 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.
19. 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.
20. Keith, B., Demkowicz, L., and Gopalakrishnan, J. (2017). *DPG* method*. ICES Report 17-25. The University of Texas at Austin.
21. Keith, B., Fuentes, F., and Demkowicz, L. (2015). *The Exact Sequence for Elements of All Shapes (ESEAS) software library*. URL: <https://github.com/libESEAS/ESEAS>.
22. Keith, B. (2014). *Lagrangian Coherent Structures in Three-dimensional Steady Flows*. Master's Thesis. Montreal, Quebec: McGill University.
23. Robison¹, B. K. (2011). *The Wave Equation and Multi-Dimensional Time*. The Waterloo Mathematics Review, **1**(1), 32–42.

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

Selected Conference Presentations and Invited Talks

Presented at over 25 scientific meetings since 2015

2021	USNCCM16 , US National Congress on Computational Mechanics	<i>Virtual</i>
2021	SIAM OP21 , SIAM Conference on Optimization	<i>Virtual</i>
2021	ALOP , Workshop on Nonlocal Models	<i>Virtual</i>
2021	SIAM DS21 , SIAM Conference on Applications of Dynamical Systems	<i>Virtual</i>
2021	ECOM , East Coast Optimization Meeting	<i>Virtual</i>
2021	SIAM CSE21 , SIAM Conference on Computational Science and Engineering	<i>Virtual</i>
2019	IGA2019 , International Conference on Isogeometric Analysis	<i>München, DE</i>
2019	FrontUQ19 , Workshop on Frontiers of Uncertainty Quantification in Fluid Dynamics	<i>Pisa, ITL</i>
2019	USNCCM15 , US National Congress on Computational Mechanics	<i>Austin, TX</i>
2018	Oberwolfach , Workshop on Computational Engineering	<i>Oberwolfach, DE</i>
2018	WCCM13 , World Congress on Computational Mechanics	<i>New York, NY</i>
2018	SIAM AN18 , SIAM Annual Meeting	<i>Portland, OR</i>
2018	ETAMM2 , Emerging Trends in Applied Mathematics and Mechanics	<i>Kraków, PL</i>
2017	USNCCM14 , US National Congress on Computational Mechanics	<i>Montréal, QC</i>
2017	ACSE , Advances in Computational Science and Engineering (in honor of the 80th birthday of Prof. J.T. Oden)	<i>Austin, TX</i>
2017	SIAM CSE17 , SIAM Conference on Computational Science and Engineering	<i>Atlanta, GA</i>
2016	MAFELAP 2016 , Mathematics of Finite Elements and Applications	<i>Uxbridge, UK</i>
2016	AMFE , Advances in Mathematics for Finite Elements (in honor of the 90th birthday of Prof. Ivo Babuška)	<i>Austin, TX</i>
2015	Oberwolfach , Workshop on Computational Engineering	<i>Oberwolfach, DE</i>
2015	USNCCM13 , US National Congress on Computational Mechanics	<i>San Diego, CA</i>

Selected Seminars and Training Programs

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

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), Mathematics of Computation (Math. Comp.), SIAM Journal on Scientific Computing (SISC)

Peer Review (Funding Agencies)

National Science Center, Poland (Panel ST8)

Conference Organization

Texas Applied Mathematics and Engineering Symposium

Student Government

Vice-President: UT Austin SIAM chapter. (01/2018 - 08/2018)

President: UT Austin SIAM chapter. (09/2015 - 12/2017)

Treasurer: UT Austin SIAM chapter. (09/2013 - 08/2015)

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”	<i>Providence, RI</i>
2018	Finalist , Student Poster Competition for the 13th World Congress on Computational Mechanics	<i>New York, NY</i>
2017	Recognition of service , SIAM Student Certificate of Recognition for 2017	<i>Austin, TX</i>
2017	2nd Place , Best Mathematically Oriented Poster at USNCCM14	<i>Montréal, QC</i>
2017	Fellowship , University of Texas at Austin University Graduate Continuing Fellowship	<i>Austin, TX</i>
2013	Award , University of Texas at Austin College Recruitment Fellowship Award	<i>Austin, TX</i>
2011	USRA , Undergraduate student research award. Supervisor: Ray McLenaghan	<i>Waterloo, ON</i>
2010	USRA , Undergraduate student research award. Supervisor: David Siegel	<i>Waterloo, ON</i>