

# Andrew Kruse Gillette

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<https://akgillette.github.io>

## Employment

### Lawrence Livermore National Laboratory

Computational Scientist, Center for Applied Scientific Computing	2019– now
Faculty Scholar, Center for Applied Scientific Computing	summer 2019

### University of Arizona

Designated Campus Colleague, Associate	2020– now
Member, Program in Applied Mathematics	2014–2020
Associate Professor ( <i>tenured, on leave</i> ), Department of Mathematics	2019–2020
Assistant Professor, Department of Mathematics	2013–2019

### University of California, San Diego

Postdoctoral Scholar in Mathematics ( <i>advisor: Michael Holst</i> )	2011–2013
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## Education

<b>University of Texas at Austin:</b> Ph.D. in Mathematics, ( <i>advisor: Chandrajit Bajaj</i> )	2011
<b>Amherst College:</b> B.A. in Mathematics, summa cum laude, ( <i>advisor: Robert Benedetto</i> )	2004

## Computing Skills and Interests

Python, pytorch, pandas, numpy, Julia, C++, Matlab, Mathematica; finite element packages (MFEM, GLVIS, Firedrake); workflows for high performance computing and machine learning.

## Research Interests

Finite element and other numerical methods for partial differential equations; meshing, computational geometry and topology; scientific and high performance computing; applications to multi-physics simulations; graphics and visualization; scientific machine learning and AI.

## Grants and Awards

<i>DOE Advanced Scientific Computing Research</i> , Lawrence Livermore National Lab, \$700,000	2022–2025
joint award with University of Arizona (Josh Levine) and Vanderbilt University (Matt Berger)	
<i>LDRD Feasibility Study</i> , 20-FS-034, Lawrence Livermore National Lab, \$150,000, single PI	2019
<i>NSF Computational Math Award</i> , DMS-1913094, Collaborative Research with Rob Kirby	2019–2022
University of Arizona share: \$132,999	Baylor University share: \$167,000
<i>Simons Collaboration Grants for Mathematicians</i> , declined due to NSF award	(2019–2024)
<i>Interdisciplinary Link Student Team Award</i> , University of Arizona, \$17,593, (co-PI: Sam Gralla)	2018
<i>NSF Computational Math Award</i> , DMS-1522289, \$224,998, single PI	2015–2018
<i>NSF Conference Award</i> , DMS-1542183, \$25,000, co-PI (PI: Chunmei Wang, Georgia Tech)	2015
<i>AMS-Simons Travel Grant</i> , \$4000, single PI	2012–2014

## Refereed Journal Publications

23. A. Gillette, B. Keith, S. Petrides, *Learning robust marking policies for adaptive mesh refinement*, Submitted; preprint: arXiv:2207.06339, 2022.
22. A. Gillette, E. Kur, *Data-driven geometric scale detection via Delaunay interpolation*, Submitted; preprint: arXiv:2203.05685, 2022.
21. J. Crum, C. Cheng, D. Ham, L. Mitchell, R. C. Kirby, J. Levine, A. Gillette, *Bringing trimmed serendipity methods to computational practice in Firedrake*, ACM Transactions on Mathematical Software, 48:1, pp. 1–19, 2022.
20. A. Gillette, K. Hu, S. Zhang, *Nonstandard finite element de Rham complexes on cubical meshes*, BIT Numerical Mathematics, 60, pp. 373–409, 2020.
19. J. Crum, J. Levine, A. Gillette, *Extending discrete exterior calculus to a fractional derivative*, Computer Aided Design, 114:9, pp. 64–72, 2019.
18. A. Gillette, T. Kloefkorn, V. Sanders, *Computational Serendipity and Tensor Product Finite Element Differential Forms*, SMAI Journal of Computational Mathematics, 5, pp. 1–21, 2019.
17. A. Gillette, T. Kloefkorn, *Trimmed serendipity finite element differential forms*, Mathematics of Computation, 88:316, pp. 583–606, 2019.
16. A. Gillette, C. Gross, K. Plackowski, *Numerical studies of serendipity and tensor product elements for eigenvalue problems*, Involve, a journal of Mathematics, 11:4, pp. 661–678, 2018.
15. A. Gillette, M. Holst, Y. Zhu, *Finite element exterior calculus for evolution problems*, ICMSEC Journal of Computational Mathematics, 35:2, pp. 187–212, 2017.
14. A. Gillette, *Serendipity and tensor product affine pyramid finite elements*, SMAI Journal of Computational Mathematics, 2, pp. 215–228, 2016.
13. A. Gillette, A. Rand, C. Bajaj, *Construction of scalar and vector finite element families on polygonal and polyhedral meshes*, Computational Methods in Applied Math, 16:4, pp. 667–683, 2016.
12. M. Floater, A. Gillette, *Nodal bases for the serendipity family of finite elements*, Foundations of Computational Mathematics, 17:4, pp. 879–893, 2016.
11. A. Gillette, A. Rand, *Interpolation error estimates for harmonic coordinates on polytopes*, ESAIM: Mathematical Modelling and Numerical Analysis, 50:3, pp. 651–676, 2016.
10. S. Christiansen, A. Gillette, *Constructions of some minimal finite element systems*, ESAIM: Mathematical Modelling and Numerical Analysis, 50:3, pp. 833–850, 2016.
9. K. Vincent, M. Gonzales, A. Gillette, C. Villongco, S. Pezzuto, J. Omens, M. Holst, A.D. McCulloch, *High-order interpolation methods for cardiac monodomain simulations*, Frontiers in Physiology, 6:217, 2015.
8. M. Floater, A. Gillette, N. Sukumar, *Gradient bounds for Wachspress coordinates on polytopes*, SIAM Journal on Numerical Analysis, 52:1, pp. 515–532, 2014.
7. P. Keken-Huskey, A. Gillette, J.A. McCammon, *Predicting the influence of long-range molecular interactions on macroscopic-scale diffusion by homogenization of the Smoluchowski equation*, Journal of Chemical Physics, 140:17, article 174106, 2014.
6. P. Keken-Huskey, T. Liao, A. Gillette, J. Hake, Y. Zhang, A. Michailova, A.D. McCulloch, J.A. McCammon, *Molecular and sub cellular-scale modeling of nucleotide diffusion in the cardiac myofilament lattice*, Biophysical Journal, 105:9, pp. 2130–2140, 2013.
5. P. Keken-Huskey, A. Gillette, J. Hake, J. McCammon, *Finite element estimation of protein-ligand association rates with post-encounter effects: Applications to calcium binding in Troponin C and SERCA*, Computational Science and Discovery, 5:1, pp. 1–20, 2012.
4. A. Rand, A. Gillette, C. Bajaj, *Quadratic serendipity finite elements on polygons using generalized barycentric coordinates*, Mathematics of Computation, 83:290, pp. 2691–2716, 2014.

3. A. Rand, A. Gillette, C. Bajaj, *Interpolation error estimates for mean value coordinates*, Advances in Computational Mathematics, 39:2, pp. 327–347, 2013.
2. A. Gillette, A. Rand, C. Bajaj, *Error estimates for generalized barycentric interpolation*, Advances in Computational Mathematics, 37:3, pp. 417–439, 2012.
1. A. Gillette, C. Bajaj, *Dual formulations of mixed finite element methods*, Computer Aided Design, 43:10, pp. 1213–1221, 2010.

### Refereed Conference Proceedings

7. A. Gillette, *Hermite and Bernstein style basis functions for cubic serendipity spaces on squares and cubes*, Proc. Approximation Theory XIV: San Antonio 2013, Springer, pp. 103–121, 2014.
6. A. Gillette, C. Bajaj, *A generalization for stable mixed finite elements*, Proc. ACM Symposium on Solid and Physical Modeling, Association for Computing Machinery, pp. 41–50., 2010.
5. C. Bajaj, A. Gillette, Q. Zhang, *Stable mesh decimation*, Proc. SIAM/ACM Joint Conf. on Geometric and Physical Modeling, Association for Computing Machinery, pp. 277–282., 2009.
4. C. Bajaj, A. Gillette, S. Goswami, B. Kwon, J. Rivera, *Complementary space for enhanced uncertainty and dynamics visualization*, chapter in ‘Topological Methods in Data Analysis and Visualization: Theory, Algorithms and Applications,’ Springer-Verlag, pp. 217–228., 2009.
3. C. Bajaj, A. Gillette, S. Goswami, *Topology based selection and curation of level sets*, chapter in ‘Topology-Based Methods in Visualization,’ Springer-Verlag, pp. 45–58, 2009.
2. C. Bajaj, A. Gillette, *Quality meshing of a forest of branching structures*, Proc. 17th International Meshing Roundtable, Springer-Verlag, pp. 433–449, 2008.
1. S. Goswami, A. Gillette, C. Bajaj, *Efficient Delaunay mesh generation from sampled scalar functions*, Proc. 16th International Meshing Roundtable, Springer-Verlag, pp. 495–511, 2007.

### Other Publications

4. A. Gillette, A. Rand, *Shape quality for generalized barycentric interpolation*, chapter in ‘Generalized Barycentric Coordinates in Computer Graphics and Computational Mechanics’, K. Hormann, N. Sukumar, editors, CRC Press, 2017.
3. A. Gillette, *Serendipity methods: Using mathematics to accelerate computation*, UA Mathematics Newsletter (for public audience), Fall 2014.
2. A. Gillette, *Stability of dual discretization methods for partial differential equations*, UT Austin Digital Repository, PhD Dissertation, 2011.
1. A. Gillette, *Notes on Discrete Exterior Calculus*, Technical Report, UT Austin, 2009.

### Recent Invited Talks

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|---|------|
| “Delaunay interpolation diagnostics for model assessment”                                   | 2021 |
| Center for Mathematics and AI Colloquium, George Mason University, DC ( <i>virtual</i> )    |      |
| “Why are mathematicians jumping on the machine learning bandwagon?”                         | 2021 |
| DOE Computational Research Leadership Council Seminar, ASU & CSU Fresno ( <i>virtual</i> )  |      |
| “Delaunay-Based Assessment of Variational Autoencoders”                                     | 2021 |
| SIAM Conference on Computational Science and Engineering, Fort Worth, TX ( <i>virtual</i> ) |      |
| “Delaunay-Guided Neural Network Design”   | 2021 |
| Colorado State Applied Math Seminar, Fort Collins, CO ( <i>virtual</i> )                    |      |
| “Basis construction techniques for serendipity-type spaces”                                 | 2019 |
| Polytopal Element Methods in Mathematics and Engineering (POEMS’19), Marseille, France      |      |
| “How to speed up your tensor product finite element code without really trying”             | 2019 |
| Special Session at AMS Sectional Meeting, Honolulu, HI                                      |      |
| “Structure Preservation in (Trimmed) Serendipity Finite Element Methods”                    | 2018 |
| Canadian Mathematical Society Winter Meeting, Vancouver, Canada                             |      |

**Recent Contributed Talks**

“Barycentric coordinates in general dimensions”	2022
CSF Workshop on Generalized Barycentric Coordinates, Ascona, Switzerland	
“Serendipity Elements: Old and New”	2018
Geometric & Image Data Sciences: Big Data Analysis, Graphics & Visualization, Austin, TX	
“Computational Finite Element Differential Forms on Quadrilateral Meshes”	2018
SIAM Annual Meeting, Portland, OR	
“What is a good linear finite element... on a generic polytope?”	2015
13th US National Congress on Computational Mechanics, San Diego, CA	
“Nodal Bases for the Serendipity Family of Finite Elements”	2014
International Conference on Spectral and High Order Methods, Salt Lake City, UT	
“Serendipity Basis Functions for Any Degree in Any Dimension”	2014
<i>Isogeometric Analysis 2014: Integrating Design and Analysis</i> , Austin, TX	

**Recent Poster Presentations**

4. A. Gillette, T. Kloefkorn, *Trimmed Serendipity Finite Elements*, SIAM Conference on Computational Science and Engineering, 2017.
3. A. Gillette, *Serendipity and tensor product pyramid finite elements*, Advances in Mathematics of Finite Elements (Ivo Babuska 90th Birthday Conference), 2016.
- 2b. A. Gillette, A. Rand, *What is a good linear finite element... on a generic polytope?*, Advanced Numerical Methods in the Mathematical Sciences (Workshop at Texas A&M), 2015.
- 2a. A. Gillette, A. Rand, *What is a good linear finite element... on a generic polytope?*, SIAM Conference on Computational Science and Engineering, 2015.
1. A. Gillette, M. Floater, *Nodal basis functions for serendipity finite elements*, ICERM Workshop: Robust Discretization and Fast Solvers for Computable Multi-Physics Models, 2014.

**Recent Workshop and Mini-symposium Co-organizer**

Advances in geometric and topological methods for data science	2022
<i>SIAM Mathematics of Data Science</i> , mini-symposium	
Geometric & Image Data Sciences: Big Data Analysis, Graphics & Visualization	2018
Co-organizer, special workshop celebrating 60th birthday of Chandrajit Bajaj	
Polytopal Discretization Methods for Partial Differential Equations	2018
<i>SIAM Annual Meeting</i> , mini-symposium	
Polygonal and Polyhedral Discretizations in Computational Mechanics	2018
<i>13th World Congress on Computational Mechanics</i> , mini-symposium	
Mathematics of Gravitational Wave Science	2018
<i>Joint Mathematics Meetings</i> , AMS Special Session	
Advances in Quadrilateral and Hexahedral Finite Elements (poster collection)	2017
<i>SIAM Computational Science and Engineering</i>	
Polytopal Element Methods in Mathematics and Engineering (special workshop)	2015
Co-organizer; 24 speakers and 54 participants, including many non-US researchers.	

**Postdoctoral advising**

*Tyler Kloefkorn*: University of Arizona Mathematics Department Postdoc, 2014–2017

**Graduate student advising, as PhD advisor**

*Justin Crum*: PhD in Applied Mathematics, University of Arizona, received May 2022

**Other graduate research advising**

<i>Brian Bell</i>	NSF Mathematical Sciences Graduate Internship (at LLNL), 2021
<i>Justin Crum</i>	LLNL Computing Scholar, 2021
	LLNL Data Science Summer Institute, 2020
<i>Craig Gross</i>	LLNL Data Science Summer Institute, 2020
<i>Nikki Plackowski</i>	PhD advisor in Applied Mathematics, 2017–2020
<i>Ken Plackowski</i>	supervised Masters in Applied Mathematics, 2017
<i>Kevin Gomez</i>	supervised 1st year PhD project, 2015
<i>Jeff Walter</i>	supervised 1st year PhD project, 2015
<i>Ammon Washburn</i>	supervised 1st year PhD project, 2015
<i>Ethan Lockhart</i>	supervised 1st year PhD project, 2014

**Undergraduate research advising**

<i>Victoria Sanders</i>	undergraduate research assistant, 2017–2019
<i>Craig Gross</i>	undergraduate research assistant, 2014–2017
<i>Michael Cullan</i>	supervised honors thesis, 2015–2016

**Professional Service**

## Reviewer

Numerical Algorithms; Mathematics of Computation; Numerische Mathematik; ICMSEC  
 Journal of Computational Mathematics; SIAM Numerical Analysis; SIAM Scientific Computing;  
 Finite Elements in Analysis and Design; SIGGRAPH; SIGGRAPH Asia; ESAIM: Mathematical  
 Modelling and Numerical Analysis; Int'l Journal for Numerical Methods in Engineering; Journal  
 of Aerospace Engineering; ACM Transactions on Mathematical Software; Computer Methods in  
 Applied Mechanics and Engineering; Computer Aided Design; Mathematische Zeitschrift; others.

Program Committee Member, Geometric Modeling and Processing 2016, 2017

Guest Editor, Computer Aided Geometric Design Special Issue: GMP2015 2015

Program Co-Chair, 9th International Conference on Geometric Modeling and Processing 2015

Panelist and “ad hoc” Grant Reviewer, National Science Foundation & Department of Energy

**Department-level Service**

Math Department Computer Committee	2017–2019
Modeling & Computation Seminar Organizer (weekly event)	2018–2019
Applied Mathematics Academic Program Review Committee	2018–2019
Applied Mathematics PhD Qualifying Exam Committee	2014–2019
Applied Mathematics Colloquium Committee	2014–2019
Applied Mathematics PhD Admissions Committee	2015–2016

**Outreach to K-12 Teachers**

Instructor, Tucson Math Teachers' Circle Session	2016–2018
Planned and led research-inspired activities for Southern Arizona teachers (annually).	
K-12 Alliance Professional Development Institute, Montebello, CA	2007, 2008
Taught week-long activity-based seminars for math teachers of grades 3-9.	

**Teaching**

Inquiry-based learning section of Linear Algebra (supported by internal grant; *spring 2019*)

*Course coordinator*

Introduction to Linear Algebra ( <i>8 sections</i> )	fall 2018, spring 2019
Exploring and Understanding Data ( <i>6 sections</i> )	spring 2018

*Course instructor*

Introduction to Linear Algebra	fall 2016, 2018–2019
Exploring and Understanding Data ( <i>new UA course</i> )	2017–2018
Principles of Analysis ( <i>graduate core course</i> )	2014–2016
Discrete Mathematics in Computer Science	spring 2014
Calculus I	fall 2013
Vector Calculus ( <i>Lecturer, UC San Diego</i> )	spring 2012
Precalculus ( <i>Instructor, UT Austin</i> )	2009–2010
Calculus ( <i>Teaching Assistant, UT Austin</i> )	2005–2007

**Membership**

Society for Industrial and Applied Mathematics  
 Budapest Semesters in Mathematics (alumnus)