

# JUSTIN KROMETIS

1311 Research Center Dr, RM 2016, Virginia Tech ◊ Blacksburg, VA 24061

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## RESEARCH INTERESTS

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Parameter Estimation, Uncertainty Quantification, Experimental Design, High-Performance Computing, Artificial Intelligence/Machine Learning (AI/ML), Reinforcement Learning

## EXPERIENCE

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### National Security Institute, Virginia Tech

December 2021 - Present

*Research Assistant Professor*

*Blacksburg, VA*

- Develop Bayesian methods to leverage information at all stages of testing to better characterize system performance
- Lead team of students developing computer vision model for maritime object detection and tracking
- Leverage Bayesian analysis and systems engineering to optimally design tests for AI/ML systems
- Train students in multi-agent reinforcement learning for swarm tracking of targets
- Develop high-performance GPU implementations for real-time radio frequency analytics

### Mathematics Department, Virginia Tech

September 2022 - Present

*Research Assistant Professor - Adjunct*

*Blacksburg, VA*

### Advanced Research Computing, Virginia Tech

August 2011 - December 2021

*Computational Scientist*

*Blacksburg, VA*

- Conduct research in Bayesian inference, parameter estimation, scientific computing, and machine learning
- Guest lecture for classes in Math, Statistics, Computational Modeling and Data Analytics, and other departments
- Support Virginia Tech faculty and grad students in conducting and optimizing research using high performance computing (HPC)
- Lead rollout of new HPC resources to users, including performance benchmarking (HPL, STREAM) and optimization
- Teach short courses on HPC and parallel programming
- Build and maintain software packages, from math, I/O, and MPI libraries to higher-level packages

### Mathematics Department, Virginia Tech

January 2011 - August 2011

*Curriculum Development Assistant*

*Blacksburg, VA*

- Assisted Dr. Lizette Zietsman with development of Math in a Computational Context, the first course in the Math department's reorganization of its curriculum for freshmen and sophomores

### IEM, Inc.

December 2005 - August 2011

*Division Projects Lead, Senior Transportation Analyst*

*Morrisville, NC*

- Florida Catastrophic Planning: Led wide-ranging effort to model impacts of catastrophic hurricane; Organized and participated in large-scale workshop for federal, state, and local officials
- Developed evacuation models for nuclear, chemical, and natural hazards, including publicly-assisted multimodal evacuation of New Orleans
- Developed software tools to automate accounting and project management tasks
- Contributed to the development of the first Statewide Travel Demand Model for North Carolina
- Led development of winning proposal for \$2.5 million contract

- Travel Demand Modeling: Developed traffic models used for transportation planning; Developed tools to automate processing of home interview surveys; Created techniques to project traffic volumes in rural areas

## EDUCATION

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### Virginia Tech

May 2018

Ph.D. in Mathematics

Dissertation: A Bayesian approach to estimating background flows from a passive scalar

Advisors: Dr. Jeff Borggaard (Virginia Tech), Dr. Nathan Glatt-Holtz (Tulane)

### Virginia Tech

May 2004

M.S. in Mathematics

Graduate Thesis: Lane Preference in a Simple Traffic Model

Advisors: Dr. Beate Schmittmann (Physics), Dr. George Hagedorn (Math)

### Virginia Tech

May 2004

B.S. in Physics, summa cum laude

### Virginia Tech

May 2002

B.S. in Mathematics, summa cum laude

## SKILLS

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Programming languages: Julia, Python, C/C++, R, Bash, VBA

Parallel Computing: NVidia GPU (CUDA, OCCA), MPI, OpenMP, Pthreads

AI/ML: PyTorch, TensorFlow, OpenAI Gym, RLlib, Flux (Julia)

Other tools: Git, MySQL/PostgreSQL, ParaView

## HONORS, AWARDS, AND FUNDING

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Honorable Mention, Barchi Prize for best presentation, Military Operations Research Society Symposium, 2023. (shared with Sieck, Victoria R. C. and Steve Thorsen)

Bayesian Approaches to PDE Inverse Problems: Theory, Algorithm Development and Applications. National Science Foundation (DMS-2108791). 2021. \$104,000.

Selected with Travel Support, Probabilistic Perspectives in Nonlinear PDEs Workshop, International Centre for Mathematical Sciences, June 2017

Selected with Travel Support, Gene Golub SIAM Summer School, Drexel University, August 2016

NYC Regional NVA Scenario-Specific Vulnerability Measures. IEM, Inc. 2013.

Small Projects Task Lead of the Year, IEM, 2007

Outstanding Senior, Virginia Tech Physics Department, 2004

Outstanding Senior, Traditional Option, Virginia Tech Mathematics, 2002

## PUBLICATIONS

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Glatt-Holtz, Nathan E, Andrew J Holbrook, Justin A Krometis, and Cecilia F Mondaini. “Parallel MCMC Algorithms: Theoretical Foundations, Algorithm Design, Case Studies.” *Transactions of Mathematics and Its Applications* 8, no. 2 (December 1, 2024): tnae004. DOI: [10.1093/imatrm/tnae004](https://doi.org/10.1093/imatrm/tnae004), arXiv preprint: [arXiv:2209.04750](https://arxiv.org/abs/2209.04750).

Risher, Kyle, Daniel Wolodkin, Justin Krometis, Victoria Sieck, Laura Freeman, Jeremy Werner, and Sandra Hobson. “Maximizing the Use of Data to Make Winning Decisions in the Face of Finite Resources.” *Naval Engineers Journal* 136, no. 1–2 (Spring 2024): 111–20.

Paskett, Taylor, Jared P Whitehead, Ron A Harris, Claire Ashcraft, Justin A Krometis, Isaac Sorensen, and Raelynn Wonnacott. “A Tale of Two Faults: Statistical Reconstruction of the 1820 Flores Sea Earthquake Using Tsunami Observations Alone.” *Geophysical Journal International*, February 2, 2024, ggae044. DOI: [10.1093/gji/ggae044](https://doi.org/10.1093/gji/ggae044), arXiv preprint: [arXiv:2305.01718](https://arxiv.org/abs/2305.01718).

Glatt-Holtz, Nathan, Justin Krometis, and Cecilia Mondaini. “On the Accept–Reject Mechanism for Metropolis–Hastings Algorithms.” *The Annals of Applied Probability* 33, no. 6B (December 2023): 5279–5333. DOI: [10.1214/23-AAP1948](https://doi.org/10.1214/23-AAP1948), arXiv preprint: [arXiv:2011.04493](https://arxiv.org/abs/2011.04493).

Snyder, William, Alex Santiago Anaya, Justin Krometis, Traian Iliescu, and Raffaella De Vita. “A Numerical Comparison of Simplified Galerkin and Machine Learning Reduced Order Models for Vaginal Deformations.” *Computers & Mathematics with Applications* 152 (December 15, 2023): 168–80. DOI: [10.1016/j.camwa.2023.10.018](https://doi.org/10.1016/j.camwa.2023.10.018).

Borggaard, Jeff, Nathan E. Glatt-Holtz, and Justin A. Krometis. “A Statistical Framework for Domain Shape Estimation in Stokes Flows.” *Inverse Problems* 39, no. 8 (June 2023): 085009. DOI: [10.1088/1361-6420/acdd8e](https://doi.org/10.1088/1361-6420/acdd8e), arXiv preprint: [arXiv:2212.03365](https://arxiv.org/abs/2212.03365).

Wach, Paul, Justin Krometis, Atharva Sonanis, Dinesh Verma, Jitesh Panchal, Laura Freeman, and Peter Beling. “Pairing Bayesian Methods and Systems Theory to Enable Test and Evaluation of Learning-Based Systems.” *INSIGHT* 25, no. 4 (2022): 65–70. DOI: [10.1002/inst.12414](https://doi.org/10.1002/inst.12414).

Daniel Sobien, Erik Higgins, Justin Krometis, Justin Kauffman, and Laura Freeman. “Improving Deep Learning for Maritime Remote Sensing through Data Augmentation and Latent Space.” *Machine Learning and Knowledge Extraction* 4, no. 3 (September 2022): 665–87. DOI: [10.3390/make4030031](https://doi.org/10.3390/make4030031).

Justin Krometis, Hayden Ringer, Jared P. Whitehead, Nathan Glatt-Holtz. Embracing Uncertainty in “Small Data” Problems: Estimating Earthquakes from Historical Anecdotes. 2021. arXiv preprint: [arXiv:2106.07797](https://arxiv.org/abs/2106.07797).

Cristina Marcillo, Leigh-Anne Krometis, Justin Krometis. Approximating Community Water System Service Areas to Explore the Demographics of SDWA Compliance in Virginia. *International Journal of Environmental Research and Public Health*. 2021. DOI: [10.3390/ijerph182413254](https://doi.org/10.3390/ijerph182413254)

Hayden Ringer, Jared P. Whitehead, Justin Krometis, Ronald A. Harris, Nathan Glatt-Holtz, Spencer Giddens, Claire Ashcraft, Garret Carver, Adam Robertson, McKay Harward, Joshua Fullwood, Kameron Lightheart, Ryan Hilton, Ashley Avery, Cody Kesler, Martha Morrise, Michael Hunter Klein. Methodological reconstruction of historical seismic events from anecdotal accounts of destructive tsunamis: a case study for the great 1852 Banda arc mega-thrust earthquake and tsunami. *Journal of Geophysical Research*. 2021. DOI: [10.1029/2020JB021107](https://doi.org/10.1029/2020JB021107), arXiv preprint: [arXiv:2009.14272](https://arxiv.org/abs/2009.14272).

Jeff Borggaard, Nathan Glatt-Holtz, and Justin Krometis. A Bayesian Approach to Estimating Background Flows from a Passive Scalar. *SIAM/ASA Journal on Uncertainty Quantification*, 2020. DOI: [10.1137/19M1267544](https://doi.org/10.1137/19M1267544), arXiv preprint: [arXiv:1808.01084](https://arxiv.org/abs/1808.01084).

Jeff Borggaard, Nathan Glatt-Holtz, and Justin Krometis. On Bayesian consistency for flows observed through a passive scalar. *Annals of Applied Probability*, 2020. DOI: [10.1214/19-aap1542](https://doi.org/10.1214/19-aap1542), arXiv preprint: [arXiv:1809.06228](https://arxiv.org/abs/1809.06228).

Jeff Borggaard, Nathan Glatt-Holtz, and Justin Krometis. GPU-accelerated particle methods for evaluation of sparse observations for inverse problems constrained by diffusion PDEs. *Journal of Computational Physics*, 2019. DOI: [10.1016/j.jcp.2019.04.034](https://doi.org/10.1016/j.jcp.2019.04.034), arXiv preprint: [arXiv:1808.10580](https://arxiv.org/abs/1808.10580).

Justin Krometis. A Bayesian Approach to Estimating Background Flows from a Passive Scalar. PhD thesis, Virginia Polytechnic Institute and State University, 2018. <http://hdl.handle.net/10919/83783>

Baccam, P., D. Willauer, J. Krometis, Y. Ma, A. Sen, M. Boechler. Mass Prophylaxis Dispensing Concerns: Traffic and Public Access to PODs. *Biosecurity and Bioterrorism*, 9(2):139-51, June 2011. DOI: [10.1089/bsp.2010.0027](https://doi.org/10.1089/bsp.2010.0027)

Ma, Yongchang, D. Willauer, J. Krometis, A. Sen, P. Baccam. Site Considerations for Points of Dispensing After Biological Terrorist Attack. *Transportation Research Record: Journal of the Transportation Research Board* 2234.1 (2011): 51-61. DOI: [10.3141/2234-06](https://doi.org/10.3141/2234-06)

Schmittmann, B., J. Krometis, R. Zia. Will jams get worse when slow cars move over? *Europhysics Letters*, Vol. 70 (3), pp. 299-305, 2005. DOI: [10.1209/epl/i2005-10006-6](https://doi.org/10.1209/epl/i2005-10006-6), arXiv preprint: [arXiv:cond-mat/0503413](https://arxiv.org/abs/cond-mat/0503413).

Justin Krometis. Lane Preference in a Simple Traffic Model. M.S. Thesis, Virginia Polytechnic Institute and State University, 2004. <http://hdl.handle.net/10919/42365>

## CONFERENCE ORGANIZATION

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Co-organizer, Special Session on Mathematical Advances in Bayesian Statistical Inversion and Markov Chain Monte Carlo Sampling Algorithms, AMS Spring Western Sectional Meeting, May 2022

Co-organizer, Uncertainty Quantification in Natural Hazards Associated with Coastal Processes, Ocean Sciences Meeting 2022, March 2022

## JOURNAL REVIEWER

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Fluids <https://www.mdpi.com/journal/fluids>

INSIGHT <https://www.incose.org/products-and-publications/periodicals#INSIGHT>

SIAM Undergraduate Research Online (SIURO) <https://www.siam.org/publications/siuro>

Systems and Control Letters <https://www.sciencedirect.com/journal/systems-and-control-letters>

## INVITED TALKS, CONFERENCE PRESENTATIONS, AND POSTERS

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Dahlgren Proving Ground 2023 Test Event, 31 October 2023.

Numerical Analysis Seminar, Math Department, Virginia Tech, 19 February 2021.

Military Operations Research Society Symposium, 13 June 2023

Defense and Aerospace Test and Analysis Workshop (DATAWorks), 26 April 2023

American Mathematical Society Spring Eastern Sectional Meeting, 1 April 2023

Biomedical Engineering Society Annual Meeting, 15 October 2022 (poster by Alex Santiago-Anaya, student)

Accurate ROMs for Industrial Applications (ARIA) Conference, 8 July 2022 (poster by Alex Santiago-Anaya, student)

ICAM Conference on Applied and Computational Mathematics, 1 June 2022

Mathematical Congress of the Americas 2021, New Developments in Mathematical Fluid Dynamics, 15 July 2021

Numerical Analysis Seminar, Math Department, Virginia Tech, 19 February 2021.

American Mathematical Society Fall Western Sectional Meeting, 25 October 2020.

Hausdorff School on MCMC: Recent developments and new connections, 15 September 2020.

Fall Fluid Mechanics Symposium, Virginia Tech, 4 November 2019.

Fluids Seminar, Math Department, Virginia Tech, 25 October 2019.

Recent Advances in Infinite Dimensional Stochastic Analysis Minisymposium, International Congress on Industrial and Applied Mathematics, 17 July 2019.

Spring Research Conference, Institute of Mathematical Statistics and the American Statistical Association, 24 May 2019.

Departmental Colloquium, Math Department, Virginia Tech, 22 February 2019.

Fluids Seminar, Math Department, Virginia Tech, 8 November 2018.

Probability and Statistics Seminar, Tulane University, 29 November 2017.

Math Harmonic Analysis and PDE Seminar, Math Department, University of Virginia, 10 October 2017.

Probabilistic Perspectives in Nonlinear PDEs Workshop, International Centre for Mathematical Sciences, June 2017 (Poster).

Math Department Seminar, Brigham Young University, 9 February 2017.

FOMICS Winter School on Uncertainty Quantification, Institute of Computational Science (ICS), University of Lugano, Switzerland, 18 December 2016 (Poster).

Math Department Seminar, Tulane University, 7 November 2016.

Gene Golub SIAM Summer School, Drexel University, August 2016 (Poster).

If the Curve Fits, Wear It: Applicability and Transferability of Disaggregate Curves for Small and Medium Sized Communities. Transportation Research Board (TRB) Tools of the Trade Conference, September 2012.

Modeling Mass Evacuation Staging Centers: A Case Study in New Orleans. National Evacuation Conference, February 2010.

Invited Speaker, Virginia Tech Physics Department Awards Ceremony, April 2009.

Modeling of the Evacuation of Carless Populations from Jefferson and Orleans Parishes in Louisiana. FEMA Mass Evacuation Transportation Planning Contraflow Workshop, January 2009.

## TEACHING AND COURSE DEVELOPMENT

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Full Semester Courses:

- Math in a Computational Context (Math 2984H), Spring/Summer 2011 (Assisted Dr. Lizette Zietsman with course development)
- Vector Geometry (MATH 1224), Fall 2003

Guest Lectures for the Following Courses:

- Computer Science Foundations for Computational Modeling and Data Analytics (CMDA 3634), October 2020, March 2020, February 2020, November 2019, October 2019, February 2019, December 2018, November 2018, October 2018, April 2018, December 2017, March 2016
- Advanced Statistical Computing (STAT 6984), April 2020, March 2020, February 2020, November 2017
- SIAM Student Seminar, February 2020
- Computing Skills for CMDA (CMDA 1984), November 2019, September 2019
- Remote Sensing Interdisciplinary Graduate Education Program (IGEP), September 2019
- Math in a Computational Context (Math 2405, formerly 2984H), October 2019, November 2014, October 2013, September 2012, October 2011
- Finite Elements and GPU Computing (MATH 5414), September 2018
- Metagenomics Workshop, Civil and Environmental Engineering, July 2018
- INFORMS Graduate Seminar, April 2018
- Programming for Geospatial Research (GEOG 4984), February 2018
- Industrial Systems Engineering Graduate Seminar (ISE 5024), October 2017
- Topics in Applied Mathematics: Finite Elements & GPU Computing (MATH 5414), September 2016
- Physics Department First Year Experience (PHYS 2326), May 2016, May 2015
- Programming and Mathematical Problem Solving (Math 3054), May 2015, April 2012
- Dynamics of Water and Societal Systems Research Experience for Undergraduates (REU), July 2013, June 2012
- Integrated Science Lab (COS 2984), September 2012, January 2012

#### Short Courses for Faculty and Graduates Students:

- Distributed-Memory Programming in MPI
- Shared-Memory Programming in OpenMP
- Linear Algebra Libraries
- Numerical Computing in Julia
- Parallel Matlab
- Parallel R
- Programming for the Intel Xeon Phi Architecture
- Introduction to Advanced Research Computing Resources and User Environment
- Introduction to High Performance Computing

## MENTORING

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Hayden Ringer, Ph.D. Student, Virginia Tech

Christian Frederiksen, Ph.D. Student, Tulane

Kyle Risher, Undergraduate, Virginia Tech

Mason Zoellner, Undergraduate, Virginia Tech

Andrew Wapperom, Undergraduate, University of California-Berkeley

Kenny Becerra, Undergraduate, UMBC

Kameron Lighthouse, M.S. Student, BYU

Alex Santiago-Anaya, Undergraduate, Virginia Tech

Hayden Ringer, M.S. Student, BYU

Spencer Giddens, Undergraduate and M.S., BYU

Garret Carver, Undergraduate, BYU

Cody Kesler, Undergraduate, BYU

Joshua Fullwood, Undergraduate, BYU

## **CERTIFICATIONS**

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Engineer-in-Training (EIT), Virginia, 2009