Honghu Liu

Contact Information

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Education

Ph.D. in Mathematics, Indiana University, 2013.
Advisor: Professor Shouhong Wang
Dissertation: On Some Dynamic Transition Problems

B.S. in Mathematics, Sichuan University, Sichuan, China, 2007.

Employment

8/2015–present	Tenure-track assistant professor, Virginia Tech.
3/2013–7/2015	Postdoctoral scholar, Department of Atmospheric & Oceanic Sciences, UCLA. Mentors: Prof. Michael Ghil and Dr. Mickaël D. Chekroun.

Research Interests

Stochastic closures for nonlinear PDEs and stochastic PDEs, stochastic parameterizations, phase transition and pattern formation, stochastic invariant manifolds and their approximations, optimal controls of nonlinear evolution equations, delay differential equations.

Grants

PI, National Science Foundation Grant: DMS-1616450, $214,483 (VT portion), 5/17/16–7/31/20, *Collaborative Research: Non-Markovian Reduction of Nonlinear Stochastic Partial Differential Equations, and Applications to Climate Dynamics.*

PI, Virginia Tech College of Science Dean's Discovery Fund, $22,265.52, 5/15/17–6/30/18, *Stochastic Nonlinear Reduced Order Modeling of the El Niño Southern Oscillation (ENSO).* Co-PI: Prof. T. Iliescu.

Teaching Experience

Fall 2020	Introduction to Multivariable Calculus, Math-2204. Two sessions.
Fall 2019	Introduction to Multivariable Calculus, Math-2204. Two sessions.
Spring 2019	Differential equations, Math-5246. Applied Mathematical Modeling, Math-4454.
Fall 2018	Introduction to Multivariable Calculus, Math-2204.
Spring 2018	Applied PDE sequence, 2nd semester, Math-5426.
Fall 2017	Applied PDE sequence, 1st semester, Math-5425.
Spring 2017	Applied PDE sequence, 2nd semester, Math-5426.
Fall 2016	Applied PDE sequence, 1st semester, Math-5425.
Spring 2016	Introduction to Multivariable Calculus, Math-2204.
Fall 2015	Introduction to multivariable Calculus, Math-2204.
Fall 2011	Basic Algebra.

Publications

Research Monographs

2. M. D. Chekroun, H. Liu, and S. Wang, *Stochastic Parameterizing Manifolds and Non-Markovian Reduced Equations: Stochastic Manifolds for Nonlinear SPDEs II*. SpringerBriefs in Mathematics, Springer, New York, xvii+129 pp., 2015.

1. M. D. Chekroun, H. Liu, and S. Wang, *Approximation of Stochastic Invariant Manifolds: Stochastic Manifolds for Nonlinear SPDEs I*. SpringerBriefs in Mathematics, Springer, New York, xv+127 pp., 2015.

Book Chapters and Conference Proceedings

3. M. D. Chekroun and H. Liu, Optimal management of harvested population at the edge of extinction. In J. Kotas, editor, *Advances in Nonlinear Biological Systems: Modeling and Optimal Control*, chapter 2, pages 35–72. American Institute of Mathematical Sciences, 2020.
2. M. D. Chekroun, A. Kröner, and H. Liu, Galerkin approximations for the optimal control of nonlinear delay differential equations. In D. Kalise, K. Kunisch, Z. Rao (Eds.), *Hamilton-Jacobi-Bellman Equations: Numerical Methods and Applications in Optimal Control*, chapter 4, pages 61–96. Berlin, Boston: De Gruyter, 2018. DOI: 10.1515/9783110543599-004
1. M. D. Chekroun and H. Liu, Post-processing finite-horizon parameterizing manifolds for optimal control of nonlinear parabolic PDEs. *the Proceedings of 55th IEEE Conference on Decision and Control*, 1411–1416, 2016. DOI: 10.1109/CDC.2016.7798464

Refereed Articles

12. M. D. Chekroun, I. Koren, and H. Liu, Efficient reduction for diagnosing Hopf bifurcation in delay differential systems: Applications to cloud-rain models. *Chaos: An Interdisciplinary Journal of Nonlinear Science*, 30, 053130, 27 pp., 2020. DOI: 10.1063/5.0004697
11. C. Mou, H. Liu, D. R. Wells, and T. Iliescu, Data-Driven Correction Reduced Order Models for the Quasi-Geostrophic Equations: A Numerical Investigation. *International Journal of Computational Fluid Dynamics*, 34, 147–159, 2020. DOI: 10.1080/10618562.2020.1723556
10. M. D. Chekroun, H. Liu, and J. C. McWilliams, Variational approach to closure of nonlinear dynamical systems: Autonomous case. *Journal of Statistical Physics*, 88 pp., accepted, 2019. DOI: 10.1007/s10955-019-02458-2
9. T. Iliescu, H. Liu, and X. Xie, Regularized Reduced Order Models for a Stochastic Burgers Equation, *International Journal of Numerical Analysis & Modeling*, 15, 594–607, 2018.
8. N. Boers, M. D. Chekroun, H. Liu, D. Kondrashov, D.-D. Rousseau, A. Svensson, M. Bigler, and M. Ghil, Inverse stochastic-dynamic models for high resolution greenland ice-core records, *Earth System Dynamics*, 8, 1171–1190, 2017. DOI: 10.5194/esd-8-1171-2017
7. M. D. Chekroun, A. Kröner, H. Liu, Galerkin approximations of nonlinear optimal control problems in Hilbert spaces. *Electronic Journal of Differential Equations*. Vol. 2017, No. 189, 1-40, 2017.
6. M. D. Chekroun, H. Liu, and J. C. McWilliams, The emergence of fast oscillations in a reduced Primitive Equation model and its implications for closure theories. *Computers and Fluids*, 151, 3–22, 2017. DOI: 10.1016/j.compfluid.2016.07.005
5. M. D. Chekroun, M. Ghil, H. Liu, and S. Wang, Low-dimensional Galerkin approximations of nonlinear delay differential equations. *Disc. Cont. Dyn. Sys. A*, 36, 4133–4177, 2016. DOI: 10.3934/dcds.2016.36.4133

4. M. D. Chekroun and H. Liu, Finite-horizon parameterizing manifolds, and applications to suboptimal control of nonlinear parabolic PDEs. *Acta Appl. Math.*, 135, 81–144, 2015.
3. H. Liu, T. Sengul, S. Wang, and P. Zhang, Dynamic transitions and pattern formations for Cahn-Hilliard model with long-range repulsive interactions. *Comm. Math. Sci.*, 13, 1289–1315, 2015. DOI: 10.4310/CMS.2015.v13.n5.a10
2. H. Liu, T. Sengul, and S. Wang, Dynamic transitions for quasilinear systems and Cahn-Hilliard equation with Onsager mobility. *J. Math. Phys.*, **53**:023518, 31 pp., 2012. DOI: 10.1063/1.3687414
1. H. Liu, Phase transitions of a phase field model. *Disc. Cont. Dyn. Sys. B*, 16, 883–894, 2011. DOI: 10.3934/dcdsb.2011.16.883

Preprints

- M. D. Chekroun, H. Liu, and S. Wang, On stochastic parameterizing manifolds: Pullback characterization and Non-Markovian reduced equations. *arXiv preprint*, 143 pp., 2014. arXiv link: `http://arxiv.org/abs/1310.3896`.
- M. D. Chekroun, H. Liu, and S. Wang, Non-Markovian reduced systems for stochastic partial differential equations: The additive noise case. *arXiv preprint*, 2014. arXiv link: `http://arxiv.org/abs/1311.3069`.

Conferences and Mini-symposia Organized

2019 Fall & 2020 Spring	Served as the coordinator of the *Fluids Seminars* that runs weekly at the Mathematics Department at Virginia Tech.
9/14/2019-9/15/2019	Special Session on *"Classical and Geophysical Fluid Dynamics: Modeling, Reduction and Simulation"* at the AMS Fall Central Sectional Meeting, University of Wisconsin-Madison, Madison, WI. (Co-organized with Nan Chen).
7/5/2018-7/9/2018	Special Session on *"Classical and Geophysical Fluid Dynamics: Modeling, Analysis and Reduction"* at the 12th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Taipei, Taiwan. (Co-organized with Mickaël Chekroun, Taylan Sengul, and Shouhong Wang).
6/26/2017-6/28/2017	Conference on *"Classical and Geophysical Fluid Dynamics: Modeling, Reduction and Simulation"*, Virginia Tech (Co-organized with Jeff Borggaard, Mickaël Chekroun, Traian Iliescu, Shouhong Wang and Lizette Zietsman).
2/27/2017-3/3/2017	Minisymposia on *"Reduced Order Models for Fluids: Achievements and Open Problems"* at 2017 SIAM Conference on Computational Science and Engineering (Co-organized with Jeff Borggaard, Traian Iliescu, and Lizette Zietsman).
7/2-3/2016	Special Session on *"Stochastic Modeling in Fluid Dynamics: Theory and Approximation"* at the 11th AIMS Conference on Dynamical Systems, Differential Equations and Applications (Co-organized with Roger Temam and Chuntian Wang).

	12/7-10/2015	Minisymposium on *"Deterministic and Stochastic Aspects of Fluid Dynamics"* at SIAM Conference on Analysis of Partial Differential Equations (Co-organized with Michele Coti Zelati, Roger Temam and Chuntian Wang).

Seminars and Invited Talks	9/2/2020	BEAM seminar talk, College of Engineering, Virginia Tech. (The seminar was delivered virtually)
	8/3-14/2020	Special session on Mathematical Modeling of the Paleoclimate - Tales for the Future Climate, SIAM Conference on Mathematics of Planet Earth. (The conference was held virtually)
	6/5-9/2020	Special session on Advances in Mathematical Physics, The 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Atlanta, GA. (The whole conference was postponed to June 2021 due to Covid-19)
	6/5-9/2020	Special session on Stochastic Modeling in Biological, Physical and Social Sciences: Theory and Applications, The 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Atlanta, GA. (The whole conference was postponed to June 2021 due to Covid-19)
	3/13-15/2020	Special session on Advances in High and Infinite Dimensional Stochastic Analysis, AMS Sectional Meeting, University of Virginia, Charlottesville, VA. (The whole conference was cancelled due to Covid-19)
	10/7-11/2019	Workshop on Nonlinear and Stochastic Methods in Climate and Geophysical Fluid Dynamics, Institut Henri Poincaré, Paris, France.
	9/14-15/2019	Special session on Classical and Geophysical Fluid Dynamics: Modeling, Reduction and Simulation, AMS Fall Central Sectional Meeting, University of Wisconsin-Madison, Madison, WI.
	6/2-5/2019	International Conference on Recent Advances in Fluid Dynamics and Nonlinear Dynamics, Sichuan University, Chengdu, China.
	2/25-3/1/2019	Minisymposia on Reduced Order Models for Fluids: Achievements and Open Problems, SIAM Conference on Computational Science and Engineering, Spokane Convention Center, Spokane, WA.
	2/13/2019	Fluids Seminar, Department of Mathematics, Virginia Tech, Blacksburg, VA.
	12/7/2018	Colloquium, Department of Mathematics, Old Dominion University, Norfolk, Virginia.
	9/29-30/2018	Special session on Recent Analytic and Numeric Results on Nonlinear Evolution Equations, AMS Fall Eastern Sectional Meeting, University of Delaware, Newark, DE.
	9/12-14/2018	International Union of Theoretical and Applied Mechanics Symposium: Stochastic approaches to understanding transitions in Fluid Flows, Cornell University, Ithaca, New York.

7/5-9/2018	Special session on Stochastic Modeling in Biology, Phase Transitions and Fluid Dynamics: Theory and Approximation, 12th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Taipei, Taiwan.
5/22-25/2017	Minisymposium on Optimization with PDEs: Theory and Numerics, 2017 SIAM Conference on Optimization, Vancouver, Canada.
12/12/2016	55th IEEE Conference on Decision and Control, Las Vegas, NV.
07/05/2016	Special Session on Nonlinearity in Climate and the Geosciences, A Special Session Honoring Peter D. Lax, 11^{th} AIMS Conference on Dynamical Systems, Differential Equations and Applications, Orlando, FL.
07/02/2016	Special Session on Stochastic Modeling in Fluid Dynamics: Theory and Approximation, 11^{th} AIMS Conference on Dynamical Systems, Differential Equations and Applications, Orlando, FL.
03/09/2016	Theoretical and Mathematical Physics Seminar, Department of Mathematics, Indiana University, Bloomington, IN.
11/11/2015	Applied Analysis Seminar, Department of Mathematics, Virginia Tech, Blacksburg, VA.
1/20/2015	Colloquium, Department of Mathematics, Virginia Tech, Blacksburg, VA.
11/21/2014	Colloquium, Department of Mathematics, Virginia Tech, Blacksburg, VA.
4/4-6/2014	Special Session on Stochastics and PDEs, AMS 2014 Western Spring Sectional Meeting, Albuquerque, NM.
10/5/2013	Special Session on Partial Differential Equations from Fluid Mechanics, AMS 2013 Fall Southeastern Sectional Meeting, Louisville, KY.
11/16/2012	CCAM Lunch Seminars, Center for Computational & Applied Mathematics, Purdue University, West Lafayette.
11/12/2012	PDE seminar, Department of Mathematics, Indiana University, Bloomington, IN.
7/1/2012	Special Session on Advances in Classical and Geophysical Fluid Dynamics, 9^{th} AIMS International Conference, Orlando, Florida.
4/1/2011	Graduate student seminar, Department of Mathematics, Indiana University, Bloomington, IN.
3/7/2011	PDE seminar, Department of Mathematics, Indiana University, Bloomington, IN.
11/5-7/2010	Special Session on Deterministic and Stochastic Partial Differential Equations, AMS 2010 Fall Central Section Meeting, Notre Dame, IN.

Advising

- Trevor Norton, Master's thesis, 2018.
- Qixuan Xing, undergraduate research, Summer 2019 and Spring 2020.
- Matthew Pinho, undergraduate research, Spring 2020, co-advised with Dr. Tia Chung.

peer review service

I am a reviewer for AMS's Mathematical Reviews. I have also served as a peer reviewer for the following journals:

- Applied Mathematics and Computation
- Applied Numerical Mathematics
- Communications in Mathematical Sciences
- Discrete and Continuous Dynamical Systems - Series B
- International Journal of Bifurcation and Chaos
- International Journal of Numerical Analysis & Modeling
- Journal of Applied Mathematics and Physics (ZAMP)
- Journal of Computational and Applied Mathematics
- Journal of Mathematical Analysis and Applications
- Modelling and Simulation in Materials Science and Engineering
- Physica D: Nonlinear Phenomena
- Proceedings of the Royal Society Proceedings A
- Research in the Mathematical Sciences
- Transactions of the Canadian Society for Mechanical Engineering

Committee Service

- Dean's Discovery Fund review panel, 2020 Spring
- Stochastic Analysis Faculty Position search committee, 2016 Fall
- Master's Thesis Committee for Yichen Li, 2020
- Master's Thesis Committee for Changhong Mou, 2018