

# Honghu Liu

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CONTACT INFORMATION	Department of Mathematics Virginia Tech Blacksburg, VA 24061-0123	Phone: 540-231-7249 E-mail: hhliu@vt.edu Homepage: <a href="http://math.vt.edu/people/hhliu/">math.vt.edu/people/hhliu/</a>
EDUCATION	<b>Ph.D. in Mathematics</b> , Indiana University, 2013. Advisor: Professor Shouhong Wang Dissertation: On Some Dynamic Transition Problems <b>B.S. in Mathematics</b> , 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. Mickaël D. Chekroun and Prof. Michael Ghil.	
RESEARCH INTERESTS	Small-scale parameterizations and low-dimensional closures for nonlinear parabolic PDEs with or without noise, 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, 5/17/16–7/31/19, <i>Collaborative Research: Non-Markovian Reduction of Nonlinear Stochastic Partial Differential Equations, and Applications to Climate Dynamics</i> . In collaboration with M. D. Chekroun (UCLA).  PI, Virginia Tech College of Science Dean’s Discovery Fund, \$22,265.52, 5/15/17–6/30/18, <i>Stochastic Nonlinear Reduced Order Modeling of the El Niño Southern Oscillation (ENSO)</i> . Co-PI: Iliescu Traian.	
TEACHING EXPERIENCE	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	<b>Research Monographs</b> <ol style="list-style-type: none"><li>2. M. D. Chekroun, H. Liu, and S. Wang, <i>Stochastic Parameterizing Manifolds and Non-Markovian Reduced Equations: Stochastic Manifolds for Nonlinear SPDEs II</i>. SpringerBriefs in Mathematics, Springer, New York, xvii+129 pp., 2015.</li><li>1. M. D. Chekroun, H. Liu, and S. Wang, <i>Approximation of Stochastic Invariant Manifolds: Stochastic Manifolds for Nonlinear SPDEs I</i>. SpringerBriefs in Mathematics, Springer, New York, xv+127 pp., 2015.</li></ol>	

## Published Articles

11. 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* (pp. 61–96). Berlin, Boston: De Gruyter, 2018.
10. 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.
9. 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(4), 1171-1190, 2017.
8. 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.
7. 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.
6. 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.
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*, Vol. **36**, pp 4133-4177, 2016.
4. M. D. Chekroun and H. Liu, [Finite-horizon parameterizing manifolds, and applications to suboptimal control of nonlinear parabolic PDEs](#). *Acta Appl. Math.*, Vol. **135**, pp 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.
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.
1. H. Liu, [Phase transitions of a phase field model](#). *Disc. Cont. Dyn. Sys. B*, **16**, pp. 883–894, 2011.

## 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>.

## Articles in preparation

- M.D. Chekroun, H. Liu, J.C. McWilliams, and S. Wang, Closures for stochastic partial differential equations driven by degenerate noise.

- CONFERENCES AND  
MINI-SYMPOSIA  
ORGANIZED
- 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), Webpage: [https://www.math.vt.edu/GFD\\_conference2017/index.html](https://www.math.vt.edu/GFD_conference2017/index.html).
- 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
- 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.
- 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<sup>th</sup> 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<sup>th</sup> 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<sup>th</sup> 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.

JOURNALS  
REFEREED

- Applied Mathematics and Computation
- Applied Numerical Mathematics
- Communications in Mathematical Sciences
- Discrete and Continuous Dynamical Systems - Series B
- International Journal of Numerical Analysis & Modeling
- 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
- Transactions of the Canadian Society for Mechanical Engineering