Dimitrios Giannakis

Professor
Department of Mathematics
Dartmouth College
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Research Interests

Data-driven, operator-theoretic methods for dynamical systems; kernel algorithms; quantum information; statistical forecasting, climate dynamics

Appointments

2021–	Jack Byrne Professor of Mathematics, *Dartmouth College*
2018–2021	Associate Professor, *Courant Institute of Mathematical Sciences, New York University*
2012–2018	Assistant Professor, *Courant Institute of Mathematical Sciences, New York University*
2009–2012	Postdoctoral Research Scientist, *Courant Institute of Mathematical Sciences, New York University* Mentor: Andrew J. Majda
2005–2009	Research Assistant, *Department of Physics, University of Chicago*

Education

2003–2009	Ph.D. Physics, *University of Chicago* Adviser: Robert Rosner
2002–2003	M.Phil. Technology Policy, *University of Cambridge*
1997–2001	BA, MSci Natural Sciences, *University of Cambridge*

Teaching Experience

2012–	*Courant Institute of Mathematical Sciences, New York University* Graduate Courses: Data Analysis Methods for High-Dimensional Time Series, Data-Driven Methods for Pattern Extraction and Prediction in Dynamical Systems, Fluid Dynamics, Methods of Applied Mathematics, Linear Algebra, Ordinary Differential Equations Undergraduate Courses: Chaos and Dynamical Systems, Introduction to Fluid Dynamics, Linear Algebra, Ordinary Differential Equations
2011–2012	*Courant Institute of Mathematical Sciences, New York University* Contributed lectures in graduate courses on Stochastic Modeling and Uncertainty Quantification
2004–2008	*Department of Physics, University of Chicago* Teaching Assistant, College Tutor

Research Supervision

Ph.D. Students	Mitchell Bushuk (2013–2015, currently Research Scientist at the Geophysical Fluid Dynamics Laboratory, Princeton, NJ), Xinyang Wang (2015–2019, currently data scientist in industry), Romeo Alexander (2014–2020, currently data scientist in industry), David Freeman (2020–), Claire Valva (2020–)
Masters Students	Xiucai Ding (2013–2014), Zhanyi Dong (2013–2014), June Qiong Wu (2017–2018), Shuang Guan (2019–2020), Shawn Kern (expected 2021)
Undergraduate Students	Eli Bingham (Duke University, 2013–2014), Varun Kambhampati (2016), Peilin Zhen (2018), Shunjia Ye (2019), Edoardo Luna (2020–), Joshua Chaz Rivera (2021–)
Postdoctoral Scientists	Subhomoy Gosh (2013–2014, currently Research Scientist at National Institute of Standards and Technology), Darin Comeau (2013–2016, currently Research Scientist at Los Alamos National Laboratory), Zhizhen Zhao (2013–2016, currently Assistant Professor of Electrical and Computing Engineering, University of Illinois at Urbana-Champaign), Eniko Székely (2013–2017, currently Research Scientist at Swiss Data Science Institute), Suddhasattwa Das (2016–2020, currently Postdoctoral Researcher at George Mason University), Andrew Davis (2020–), Huy Dinh (2020–), Ryan Vaughn (2020–)
Ph.D. Committee Member	Xiao Xiao (2015), Nan Chen (2016), Noah Brenowitz (2017), Di Qi (2017), Qiu Yang (2017), Kevin DallaSanta (2019)
Ph.D. Committee Member (external to NYU)	Allan Avila (University of California Santa Barbara, 2020), Paul Platzer (IMT Atlantique, France, 2020), Mathew Bowers (Purdue University, 2017), Natasza Marrouch (University of Connecticut, 2019)

Research Grants

2021–2026	Department of Defense, Vannevar Bush Faculty Fellowship, “Quantum Theory for Spectral Analysis, Prediction, and Control of Classical Systems”, \$2,871,740, PI role
2019–2022	National Science Foundation, grant DMS 1854383, “FRG: Collaborative Research: Non-Smooth Geometry, Spectral Theory, and Data: Learning and Representing Projections of Complex Systems”, \$536,419, PI role
2019–2024	Office of Naval Research, MURI grant N00014-19-1-2421, “Mathematics and Data Science for Improved Physical Modeling and Prediction of Arctic Sea Ice”, \$7,499,997, PI role
2018–2020	National Science Foundation, grant 1842538, “EAGER: Data-driven Koopman Operator Techniques for Chaotic and Non-Autonomous Dynamical Systems”, \$300,000, PI role
2016–2019	Office of Naval Research, YIP grant N00014-16-1-264, “Geometrical Methods for Feature Extraction and Prediction in Autonomous and Non-Autonomous Dynamical Systems: Applications to Atmosphere Ocean Science”, \$510,000, PI role
2016–2018	Defense Advanced Research Projects Agency, grant HR0011-16-C-0116, “A Data-Driven, Operator-Theoretic Framework for Space-Time Analysis of Process Dynamics”, \$97,185, co-PI role

2015–2017	National Science Foundation, grant MIL111004, "EAGER: Topological Machine Learning", $199,891, co-PI role
2015–2017	Defense Advanced Research Projects Agency, grant DARPA-BAA-14-46-FP-100, "New Strategies for Prediction and Data Assimilation for Turbulent Dynamical Systems in Climate Science", $320,000, co-PI role
2015–2018	National Science Foundation, grant DMS-1521775, "Novel Kernel Methods for Data Analysis in Dynamical Systems: Applications to Dimension Reduction and Prediction in Atmospheric and Oceanic Dynamics", $300,000, PI role
2015–2018	Ministry of Earth Sciences, India, grant MM/SERP NYU/ 2014/SSC-01/002, "A Novel Approach for Improving Rain-Gauge Data Assimilation and Extended Range Prediction of Sub-Seasonal Variability over India," $549,316, co-PI role
2014–2017	Office of Naval Research, grant N00014-14-1-0150, "Analysis of Large-Scale Datasets from Dynamical Systems through Discrete Exterior Calculus with Applications to Climate Atmosphere Ocean Science," $330,188, PI role

Awards

2021–	Vannevar Bush Faculty Fellowship
2016–2019	ONR Young Investigator Award
2006–2008	Alexander S. Onassis Scholarship (Greece)

Professional Service

Refereeing

Journals: *Advances in Space Research*, *Applied and Computational Harmonic Analysis*, *Atmospheric Chemistry and Physics*, *Chaos*, *Climate Dynamics*, *Communications in Applied Mathematics and Computational Science*, *Communications in Computational Physics*, *Communications in Nonlinear Science and Numerical Simulation*, *Dynamics of Atmospheres and Oceans*, *Geophysical Research Letters*, *International Journal of Bifurcation and Chaos*, *Journal of Climate*, *Journal of Fluid Mechanics*, *Journal of Nonlinear Science*, *Journal of Physical Oceanography*, *Journal of the Atmospheric Sciences*, *Monthly Weather Review*, *Nature*, *Nature Communications*, *New Journal of Physics*, *Nonlinearity*, *Nonlinear Dynamics*, *Nonlinear Processes in Geophysics*, *Open Mathematics*, *Physical Review E*, *Proceedings of the National Academy of Sciences*, *Proceedings of the Royal Society A*, *SIAM Journal on Applied Dynamical Systems*, *Journal of Nonlinear Science*, *Physics of Fluids*, *SIAM/ASA Journal on Uncertainty Quantification*, *Science Advances*, *Soft Computing*, *IEEE Transactions on Signal Processing*, *IEEE Transactions on Knowledge and Data Engineering*, *Weather and Forecasting*

Conference Proceedings: *NASA Conference on Intelligent Data Understanding (2011, 2012)*, *Neural Information Processing Systems (2016, 2019)*

Books and Book Chapters: *Springer Briefs in Mathematics*

Proposals: Fonds de la Recherche Scientifique (Belgium), Israel Science Foundation, National Science Foundation (USA), Swiss Science Foundation

Editorial Board: *Entropy* (Guest Editor for special issue on "Advanced Data Assimilation and Predictability Techniques"), *Foundations of Data Science*

Conferences — Special Sessions Co-Organized: "Data-driven approaches for analysis and prediction of climate dynamics", *SIAM Conference on Mathematics of Planet Earth*, held online, August 3–14, 2020; "Sea ice dynamics and predictability", *AGU Ocean Sciences Meeting*, San Diego, California, February 16–21, 2020; "Complex Dynamics from the Perspective of Geometry, Spectral Theory, and Data", *2019 SIAM Conference on Applications of Dynamical Systems*, Snowbird, Utah, May 19–23, 2019; "Koopman Operator Techniques in Dynamical Systems: Theory", *2017 SIAM Conference on Applications of Dynamical Systems*, Snowbird, Utah, May 21–25, 2017; Data-Driven Methods for Quantifying Uncertainty of Multiscale Dynamical Systems, *8th International Congress on Industrial and Applied Mathematics*, Beijing, China, August 10–15, 2015; "Data-driven methods for dynamical systems", *AMMCS-CAIMS Congress*, Waterloo, Canada, June 7–12, 2015; "Improving climate and weather prediction through data-driven statistical modeling" *10th AIMS Conference on Dynamical Systems, Differential Equations and Applications*, Madrid, Spain, July 7–11, 2014; "Stochastic-statistical modeling of climate", *9th AIMS Conference on Dynamical Systems, Differential Equations and Applications*, Orlando, Florida, July 1–5, 2012.

Software

1. Kernel algorithms for statistical modeling of dynamical systems (Matlab code). GitHub repository: https://dg227.github.io/NLSA/

Refereed Papers

1. Burov, D., D. Giannakis, K. Manohar, A. M. Stuart (2021). Kernel analog forecasting: Multiscale test problems. *SIAM Journal on Multiscale Modeling and Simulation*, 19(2), 1011–1040. doi:10.1137/20M1338289

2. Davis, A. D., D. Giannakis (2021). Graph-theoretic algorithms for Kolmogorov operators: Approximating solutions and their gradients in elliptic and parabolic problems on manifolds. arXiv:2104.15124

3. Froyland, G., D. Giannakis, B. Lintner, M. Pike, J. Slawinska (2021). Spectral analysis of climate dynamics with operator-theoretic approaches. arXiv:2104.02902

4. Giannakis, D. (2021). Quantum dynamics of the classical harmonic oscillator. *Journal of Mathematical Physics*, 62, 042701 (2021). doi:10.1063/5.000997710.1063/5.0009977

5. Gilani, F., D. Giannakis, J. Harlim (2021). Kernel-based prediction of non-Markovian time series. *Physica D*, 418, 132829. doi:10.1016/j.physd.2020.132829

6. Das, S., D. Giannakis, and J. Slawinska (2021). Reproducing kernel Hilbert space compactification of unitary evolution groups. *Applied and Computational Harmonic Analysis*, 54, 75–136. doi:10.1016/j.acha.2021.02.004

7. Giannakis, D. (2021). Delay-coordinate maps, coherence, and approximate spectra of evolution operators. *Research in the Mathematical Sciences*, 8, 8. doi:10.1007/s40687-020-00239-y

8. Giannakis, D., A. Ourmazd, J. Schumacher, J. Slawinska (2020). Quantum compiler for classical dynamical systems. arXiv:2012.06097

9. Das, S., D. Giannakis (2020). Reproducing kernel Hilbert algebras on compact abelian groups. arXiv:1912.11664

10. Berry, T., D. Giannakis, J. Harlim (2020). Bridging data science and dynamical systems theory. *Notices of the American Mathematical Society*, 67(9), 1336–1339. doi:10.1090/noti2151

11. Berry, T., and D. Giannakis (2020). Spectral exterior calculus. *Communications on Pure and Applied Mathematics*, 73, 689–770. doi:10.1002/cpa.21885

12. Das, S., D. Giannakis (2020). Koopman spectra in reproducing kernel Hilbert spaces. *Applied and Computational Harmonic Analysis*, 49, 573–607. doi:10.1016/j.acha.2020.05.008

13. Das, S., D. Giannakis, E. Szekely (2020). An information-geometric approach to feature extraction and moment reconstruction in dynamical systems. arXiv:2004.02172

14. Alexander, R., and D. Giannakis (2020). Operator-theoretic framework for forecasting nonlinear time series with kernel analog techniques. *Physica D*, 409, 132520. doi:10.1016/j.physd.2020.132520

15. Wang, X., J. Slawinska, and D. Giannakis (2020). Extended-range statistical ENSO prediction through operator-theoretic techniques for nonlinear dynamics. *Scientific Reports*, 10, 2636. doi:10.1038/s41598-020-59128-7

16. Giannakis, D., and S. Das (2020). Extraction and prediction of coherent patterns in incompressible flows through space-time Koopman analysis. *Physica D*, 402, 132211, doi:10.1016/j.physd.2019.132211

17. Marrouch, N., J. Slawinska, D. Giannakis , and H.-L. Read (2020). Data-driven Koopman operator approach for computational neuroscience. *Annals of Mathematics and Artificial Intelligence*, 88, 1155–1173. doi:10.1007/s10472-019-09666-2

18. Giannakis, D. (2019). Quantum mechanics and data assimilation. *Physical Review E*, 100, 032207. doi:10.1103/PhysRevE.100.032207

19. Giannakis, D., A. Ourmazd, J. Slawinska, and Z. Zhao (2019). Spatiotemporal pattern extraction by spectral analysis of vector-valued observables. *Journal of Nonlinear Science*, 29(5), 2385–2445. doi:10.1007/s00332-019-09548-1

20. Giannakis, D. (2019). Data-driven spectral decomposition and forecasting of ergodic dynamical systems. *Applied and Computational Harmonic Analysis*, 62(2), 338–396. doi:10.1016/j.acha.2017.09.001

21. Thiede, E., D. Giannakis, A. Dinner, and J. Weare (2019). Galerkin approximation of dynamical quantities using trajectory data. *Journal of Chemical Physics*, 150, 244111. doi:10.1063/1.5063730

22. Das, S., and D. Giannakis (2019). Delay-coordinate maps and the spectra of Koopman operators. *Journal of Statistical Physics*, 175(6), 1107–1145. doi:10.1007/s10955-019-02272-w

23. Wang, X., D. Giannakis, and J. Slawinska (2019). Antarctic circumpolar waves and their seasonality: Intrinsic traveling modes and ENSO teleconnections. *International Journal of Climatology*, 39(2), 1026–1040. doi:10.1002/joc.5860

24. Comeau, D., D. Giannakis, Z. Zhao, and A. J. Majda (2019). Predicting regional and pan-Arctic sea ice anomalies with kernel analog forecasting. *Climate Dynamics*, 52(9–10), 5507–5525. doi:10.1007/s00382-018-4459-x

25. Giannakis, D., A. Kolchinskaya, D. Krasnov, and J. Schumacher (2018). Koopman analysis of the long-term evolution in a turbulent convection cell. *Journal of Fluid Mechanics*, 847, 735–767. doi:10.1017/jfm.2018.297

26. Giannakis, D., and J. Slawinska (2018). Indo-Pacific variability on seasonal to multidecadal timescales. Part II: Multiscale atmosphere-ocean linkages. *Journal of Climate*, 31(2), 693–721. doi:10.1175/JCLI-D-17-0031.1

27. Slawinska, J., and D. Giannakis (2017). Indo-Pacific variability on seasonal to multidecadal timescales. Part I: Intrinsic SST modes in models and observations. *Journal of Climate*, 30(14), 5265–5294, doi:10.1175/JCLI-D-16-0176.1

28. Bushuk, M., and D. Giannakis (2017). The seasonality and interannual variability of Arctic sea-ice reemergence. *Journal of Climate*, 30(12), 4657–4676, doi:10.1175/JCLI-D-16-0549.1

29. Alexander, R., Z. Zhao, E. Székely, and D. Giannakis (2017). Kernel analog forecasting of tropical intraseasonal oscillations. *Journal of the Atmospheric Sciences*, 74(4), 1321–1342, doi:10.1175/JAS-D-16-0147.1

30. Sabeerali, C. T. , R. S. Ajayamohan, D. Giannakis, and A. J. Majda (2017). Extraction and prediction of indices for monsoon intraseasonal oscillations: An approach based on nonlinear Laplacian spectral analysis. *Climate Dynamics*, 49(9–10), 3031–3050. doi:10.1007/s00382-016-3491-y

31. Comeau, D., Z. Zhao, D. Giannakis, and A. J. Majda (2017). Data-driven prediction strategies for low-frequency patterns of North Pacific climate variability. *Climate Dynamics*, 48(5–6), 1855–1872, doi:10.1007/s00382-016-3177-5

32. Székely, E., D. Giannakis, and A. J. Majda (2016). Initiation and termination of intraseasonal oscillations in nonlinear Laplacian spectral analysis indices. *Mathematics of Climate and Weather Forecasting*, 2(1), 1–25, doi:10.1515/mcwf-2016-0001

33. Brenowitz, N. D., D. Giannakis, and A. J. Majda (2016). Nonlinear Laplacian spectral analysis of Rayleigh-Bénard convection. *Journal of Computational Physics*, 315, 536–553. doi:10.1016/j.jcp.2016.03.051

34. Székely, E., D. Giannakis, and A. J. Majda (2016). Extraction and predictability of coherent intraseasonal signals in infrared brightness temperature data. *Climate Dynamics*, 46(5), 1473–1502, doi:10.1007/s00382-015-2658-2

35. Zhao, Z., and D. Giannakis (2016). Analog forecasting with dynamics-adapted kernels. *Nonlinearity*, 29(9), 2888-2939, doi:10.1088/0951-7715/29/9/2888

36. Bushuk, M., and D. Giannakis (2015), Sea-ice reemergence in a model hierarchy. *Geophysical Research Letters*, 42(13), 5337–5335, doi:10.1002/2015GL063972

37. Giannakis, D. (2015). Dynamics-adapted cone kernels. *SIAM Journal on Applied Dynamical Systems*, 14(2), 556–608. doi:10.1137/140954544

38. Berry, T., D. Giannakis, and J. Harlim, (2015). Nonparametric forecasting of low-dimensional dynamical systems. *Physical Review E*, 91, 032915, doi:10.1103/PhysRevE.91.032915

39. Bushuk, M., D. Giannakis, and A. J. Majda (2015). Arctic sea ice reemergence: The role of large-scale oceanic and atmospheric variability. *Journal of Climate*, 28(14), 5477–5509, doi:10.1175/JCLI-D-14-00354.1

40. Bushuk, M., D. Giannakis, and A. J. Majda (2014). Reemergence mechanisms for North Pacific sea ice revealed through nonlinear Laplacian spectral analysis. *Journal of Climate*, 27(16), 6265–6287, doi:10.1175/JCLI-D-13-00256.1

41. Chen, N., A. J. Majda, and D. Giannakis (2014). Predicting the cloud patterns of the Madden-Julian oscillation through a low-order nonlinear stochastic model. *Geophysical Research Letters*, 41(15), 5612–56199, doi:10.1002/2014GL060876

42. Chen, N., D. Giannakis, R. Herbei, and A. J. Majda (2014). An MCMC algorithm for parameter estimation in signals with hidden intermittent instability. *SIAM/ASA Journal of Uncertainty Quantification*, 2(1), 647–699, doi:10.1137/130944977

43. Tung, W.-w., D. Giannakis, and A. J. Majda (2014). Symmetric and antisymmetric Madden-Julian oscillation signals in MJO deep convection. Part I: Basic modes in infrared brightness temperature data. *Journal of the Atmospheric Sciences*, 71, 3302–3326, doi:10.1175/JAS-D-13-0122.1

44. Giannakis, D., and A. J. Majda (2013). Nonlinear Laplacian spectral analysis: Capturing intermittent and low-frequency spatiotemporal patterns in high-dimensional data. *Statistical Analysis and Data Mining*, 6(3), 180–194. doi:10.1002/sam.11171

45. Giannakis, D., and A. J. Majda (2012). Limits of predictability in the North Pacific sector of a comprehensive climate model. *Geophysical Research Letters*, 39, L24602, doi:10.1029/2012GL054273

46. Giannakis, D., A. J. Majda, and I. Horenko (2012). Information theory, model error, and predictive skill of stochastic models for complex nonlinear systems. *Physica D*, 241, 1735–1372, doi:j.physd.2012.07.005

47. Giannakis, D., and A. J. Majda (2012). Comparing low-frequency and intermittent variability in comprehensive climate models through nonlinear Laplacian spectral analysis. *Geophysical Research Letters*, 39, L10710, doi:10.1029/2012GL051575

48. Giannakis, D., P. Schwander, and A. Ourmazd (2012). The symmetries of image formation by scattering. I. Theoretical Framework. *Optics Express*, 20(12), 12799–12826, doi:10.1364/OE.20.012799

49. Schwander, P., D. Giannakis, C. H. Yoon, and A. Ourmazd (2012). The symmetries of image formation by scattering. II. Applications. *Optics Express*, 20(12), 12827–12849, doi:10.1364/OE.20.012827

50. Giannakis, D., and A. J. Majda (2012). Quantifying the predictive skill in long-range forecasting. Part I: Coarse-grained predictions in a simple ocean model. *Journal of Climate*, 25(6), 1793–1813, doi:10.1175/2011JCLI4143.1

51. Giannakis, D., and A. J. Majda (2012). Quantifying the predictive skill in long-range forecasting. Part II: Model error in coarse-grained Markov models with application to ocean-circulation regimes. *Journal of Climate*, 25(6), 1814–1826, doi:10.1175/JCLI-D-11-00110.1

52. Giannakis, D., and A. J. Majda (2012). Nonlinear Laplacian spectral analysis for time series with intermittency and low-frequency variability. *Proceedings of the National Academy of Sciences*, 109(7), 2222–2227. doi:10.1073/pnas.1118984109

53. Giannakis, D., R. Rosner, and P. F. Fischer (2009). Large-wavelength instabilities in free-surface Hartmann flow at low magnetic Prandtl numbers. *Journal of Fluid Mechanics*, 636, 217–277, doi:10.1017/S0022112009007824

54. Giannakis, D., P. F. Fischer, and R. Rosner (2009). A spectral Galerkin method for the coupled Orr–Sommerfeld and induction equations for free-surface MHD. *Journal of Computational Physics*, 228(4), 1188–1233, doi:10.1016/j.jcp.2008.10.016

55. Giannakis, D., and W. Hu (2005). Challenges for the kinetic unified dark matter model. *Physical Review D*, 72, 063502, doi:10.1103/PhysRevD.72.063502

56. D. Giannakis, T. Jamasb, and M. G. Pollitt (2005). Benchmarking and incentive regulation of quality of service: An application to the UK electricity distribution networks. *Energy Policy*, 33, 2256, doi:10.1016/j.enpol.2004.04.021

Peer-Reviewed Conference Proceedings

1. Slawinska, J., A. Ourmazd, and D. Giannakis (2019). A quantum mechanical approach for data assimilation in climate dynamics. International Conference on Machine Learning Workshop on "Climate Change: How Can AI Help?". Long Beach, California, June 14, 2019. https://www.climatechange.ai/CameraReady/30/CameraReadySubmission/manuscript.pdf

2. Marrouch, N., J. Slawinska, H. L. Read, and D. Giannakis (2018). Data-driven spectral decomposition of ECoG signal from an auditory oddball experiment in a marmoset monkey: Implications for EEG data in humans. *IEEE Congress on Computational Intelligence*. Rio de Janeiro, Brazil, July 8, 2018. doi:10.1109/IJCNN.2018.8489475

3. Slawinska, J., A. Ourmazd, and D. Giannakis (2018). A new approach to signal processing of spatiotemporal data. *IEEE Statistical Signal Processing Workshop*. Freiburg, Germany, June 10, 2018. doi:10.1109/SSP.2018.8450704

4. Giannakis, D., J. Slawinska, A. Ourmazd, and Z. Zhao (2017). Vector-valued spectral analysis of space-time data. *NIPS Time Series Workshop 2017*. Long Beach, California, December 8, 2017

5. Székely, E., and D. Giannakis (2017). Pattern extraction in dynamical systems using information geometry: Application to tropical intraseasonal oscillations. *7th International Workshop on Climate Informatics*. Boulder, Colorado, September 20–22, 2017. doi:10.5065/D6222SH7

6. Slawinska, J., E. Székely, and D. Giannakis (2017). Data-driven Koopman analysis of tropical climate space-time variability. *Mining Big Data in Climate and Environment*, *17th SIAM International Conference on Data Mining*. Houston, Texas, April 29, 2017

7. Slawinska, J., and D. Giannakis (2016). Spatiotemporal pattern extraction with data-driven Koopman operators for convectively coupled equatorial waves. *6th International Workshop on Climate Informatics*. Boulder, Colorado, September 22–23, 2016. doi:10.5065/D6K072N6

8. Giannakis, D., J. Slawinska, and Z. Zhao (2015). Spatiotemporal feature extraction with data-driven Koopman operators. *NIPS 2015 workshop "Feature Extraction: Modern Questions and Challenges"*. Montreal, Quebec, December 11, 2015. *J. Mach. Learn. Res. Workshop and Conference Proceedings*, 44, 103–115

9. Székely, E., D. Giannakis, and A. J. Majda (2015). Nonlinear Madden-Julian oscillation indices using kernel methods. *5th International Workshop on Climate Informatics*. Boulder, Colorado, September, September 24–25, 2015

10. Székely, E., D. Giannakis, and A. J. Majda (2014). Kernel and information-theoretic methods for the extraction and predictability of organized tropical convection. *4th International Workshop on Climate Informatics*. Boulder, Colorado, September 25–26, 2014. doi:10.1007/978-3-319-17220-0

11. Giannakis, D., W.-w. Tung, and A. J. Majda (2012). Hierarchical structure of the Madden-Julian oscillation in infrared brightness temperature data revealed through nonlinear Laplacian spectral analysis. *NASA Conference on Intelligent Data Understanding (CIDU) 2012*. Boulder, Colorado, October 24–26, 2012. doi:10.1109/CIDU.2012.6382201

12. Giannakis, D., and A. J. Majda (2011). Time series reconstruction via machine learning: Revealing decadal variability and intermittency in the North Pacific sector of a coupled climate model. In *NASA Conference on Intelligent Data Understanding (CIDU 2011)*. Mountain View, California, October 19–21, 2011

Book Chapters

1. Giannakis, D., (2015). Mathematical methods for large geophysical datasets. In *Encyclopedia of Applied and Computational Mathematics*, B. Engquist, Ed., Springer. doi:10.1007/978-3-540-70529-1_575

2. Giannakis, D., and A. J. Majda (2014). Data-driven methods for dynamical systems: Quantifying predictability and extracting spatiotemporal patterns. In *Mathematical and Computational Modeling: With Applications in Engineering and the Natural and Social Sciences*, R. Melnik, Ed., Wiley. doi:10.1002/9781118853887.ch7

Conference and Workshop Talks

1. Operator-Theoretic Approaches for Coherent Feature Extraction in Complex Systems. *Workshop on Verification, Validation, and Uncertainty Quantification Across Disciplines* (held online). Institute for Mathematical and Statistical Innovation, Chicago, Illinois, May 11, 2021.

2. Quantum mechanical embeddings of classical dynamical systems. *Workshop on Koopman Methods in Classical and Classical-Quantum Mechanics* (held online). Wilhelm and Else Heraeus Foundation, Hanau, Germany, April 21, 2021.

3. Quantum mechanical approaches to data assimilation. *SIAM Conference on Computational Science and Engineering* (held online), March 5, 2021.

4. Data-driven approximation of vector fields and differential forms with the spectral exterior calculus. *SIAM Workshop on Advances in Manifold Learning and Applications, Joint Mathematics Meetings* (held online). January 9, 2021

5. Quantum compiler for classical dynamical systems. *Workshop on Mathematical Machine Learning and Applications* (held online). The Pennsylvania State University, University Park, Pennsylvania, December 15, 2020.

6. Coherent feature extraction from delay-coordinate-mapped data. *Second Symposium on Machine Learning and Dynamical Systems* (held online). Fields Institute, Toronto, Ontario, September 23, 2020.

7. A quantum mechanical approach for data assimilation in climate dynamics. *SIAM Conference on Mathematics of Planet Earth* (held online). August 14, 2020

8. Quantum mechanics for data assimilation in complex systems. *Universality: Turbulence Across Vast Scales*. Flatiron Institute, New York, New York, December 4, 2019

9. Forecasting nonlinear time series with kernel analog techniques. *Scientific Grand Challenges and New Perspectives in Applied Mathematics: Ocean, Atmosphere, and Climate Sciences: Celebration of Andrew Majda's 70th Birthday*. University of Victoria, British Columbia, July 25, 2019
10. Spectral approximation of evolution operators in reproducing kernel Hilbert space. *SIAM Conference on Applications of Dynamical Systems*. Snowbird, Utah, May 21, 2019
11. Quantum mechanics and data assimilation. *Nonlinear Dynamics and Data: Prediction, State Estimation, and Uncertainty Quantification in Complex Systems: A Conference to Celebrate the 70th Birthday of Andrew Majda*. Courant Institute of Mathematical Sciences, New York, New York, March 16, 2019
12. Reproducing kernel Hilbert space approaches for spectral analysis of dynamical systems. *Operator Theoretic Methods in Dynamic Data Analysis and Control*. Institute for Pure and Applied Mathematics, Los Angeles, California, February 15, 2019
13. Characterizing and predicting climate variability through the spectral theory of dynamical systems. *Big Data Challenges for Predictive Modeling of Complex Systems*. University of Hong Kong, Hong Kong, November 27, 2018
14. Spatiotemporal Pattern Extraction by Spectral Analysis of Vector-Valued Observables. *9th International Conference on Complex Systems*. Cambridge, Massachusetts, July 24, 2018
15. Data-Driven Approaches for Spectral Decomposition of Ergodic Dynamical Systems. *Workshop on Interplay of Multiscale Data Assimilation and Data Science with Advanced PDE Discretizations*. Erwin Schrödinger Institute, Vienna, Austria, June 27, 2018
16. Characterizing Climate Variability in Models and Observations through the Spectral Theory of Dynamical Systems. *Workshop on Atmosphere, Oceans, and Computational Infrastructure*. California Institute of Technology, Pasadena, California, May 18, 2018
17. Spatiotemporal Pattern Extraction by Spectral Analysis of Vector-Valued Observables. *SIAM Conference on Uncertainty Quantification*. Garden Grove, California, April 18, 2018
18. Vector-Valued Spectral Analysis of Pacific Climate Variability. *General Assembly of the European Geosciences Union*. Vienna, Austria, April 9, 2018
19. Extraction and Prediction of Coherent Patterns in Incompressible Flows through Space-Time Koopman Analysis. *Workshop on Mathematical Aspects of Physical Oceanography*. Erwin Schrödinger Institute, Vienna, Austria, March 7, 2018
20. Spatiotemporal Pattern Extraction by Spectral Analysis of Vector-Valued Observables. *Workshop on Geometry and Topology of Data*. Institute for Computational and Experimental Research in Mathematics (ICERM), Providence, Rhode Island, December 12, 2017
21. Extraction and Prediction of Coherent Patterns in Incompressible Flows through Space-Time Koopman Analysis. *9th European Nonlinear Dynamics Conference (ENOC 2017)*. Budapest, Hungary, June 27, 2017
22. Extraction and Prediction of Coherent Patterns in Incompressible Flows through Space-Time Koopman Analysis. *SIAM Conference on Applications of Dynamical Systems*. Snowbird, Utah, May 23, 2017
23. Extraction and Prediction of Coherent Patterns in Incompressible Flows through Space-Time Koopman Analysis. *Workshop on Data-Driven Methods for Reduced-Order Modeling and Stochastic Partial Differential Equations*. Banff International Research Station, Banff, Alberta, January 31, 2017

24. ENSO and its Modulations on Annual and Multidecadal Timescales Revealed by Nonlinear Laplacian Spectral Analysis. *AGU Fall Meeting*. San Francisco, California, December 14, 2016

25. Extraction and Prediction of Coherent Patterns in Incompressible Flows through Space-Time Koopman Analysis. *Kickoff Workshop for DARPA Project "A Data-Driven, Operator-Theoretic Framework for Space-Time Analysis of Process Dynamics"*. Santa Barbara, California, November 4, 2016

26. Extraction and Prediction of Coherent Patterns in Incompressible Flows through Space-Time Koopman Analysis. *Collective Variables in Classical Mechanics*. Institute for Pure and Applied Mathematics (IPAM), Los Angeles, California, October 27, 2016

27. Extraction and Prediction of Coherent Patterns in Incompressible Flows through Space-Time Koopman Analysis. *AMS Fall Central Sectional Meeting*. Minneapolis, Minnesota, October 29, 2016

28. Kernel Methods for Koopman Mode Analysis and Nonparametric Forecasting. *SIAM Conference on Mathematics of Planet Earth*. Philadelphia, Pennsylvania, October 1, 2016

29. Kernel Methods for Nonparametric Analog Forecasting. *Workshop on Stochastic Weather Generators*. Centre Henri Lebesgue, Vannes, France, May 19, 2016

30. Kernel Analog Forecasting of Tropical Intraseasonal Oscillations. *American Meteorological Society (AMS) Conference on Hurricanes and Tropical Meteorology*. San Juan, Puerto Rico, April 20, 2016

31. Analysis and Forecasting of Large Datasets. *Workshop of Office of Naval Research MURI Grant "Physics-Constrained Stochastic/Statistical Models for Extended-Range Environmental Prediction"*. New York University, New York, New York, January 28, 2016

32. Data-Driven Spectral Decomposition and Forecasting of Ergodic Dynamical Systems. *Workshop on Uncertainty Quantification for Multiscale Stochastic Systems and Applications*. Institute for Pure and Applied Mathematics (IPAM), Los Angeles, California, January 21, 2016

33. Data-Driven Spectral Decomposition of Ergodic Dynamical Systems. *Workshop on Sensitivity, Error and Uncertainty Quantification for Atomic, Plasma, and Material Data*. Institute for Advanced Computational Science (IACS), Stony Brook, New York, November 7, 2015

34. Data-Driven Spectral Decomposition of Ergodic Dynamical Systems. *International Conference on Scientific Computation and Differential Equations (SciCADE)*. Potsdam, Germany, September 15, 2015

35. Data-Driven Spectral Decomposition of Ergodic Dynamical Systems. *International Congress on Industrial and Applied Mathematics*. Beijing, China, August 14, 2015

36. Data-Driven Spectral Decomposition of Ergodic Dynamical Systems. *International Congress on Industrial and Applied Mathematics*. 2015 AMMCS-CAIMS Congress, Waterloo, Ontario, June 11, 2015

37. Data-Driven Methods for Nonparametric Forecasting of Dynamical Systems. *12th Annual Conference on Frontiers in Applied and Computational Mathematics (FACM '15)*, New Jersey Institute of Technology, Newark, New Jersey, June 5, 2015

38. Kernel Analog Forecasting of Intraseasonal Oscillations. *Workshop on Stochasticity and Organization of Tropical Convection*. Banff International Research Station, Banff, Alberta, April 30, 2015

39. Data-Driven Methods for Climate Science: Extracting and Predicting Spatiotemporal Patterns. *Symposium on Data Science and Applications*. New York University Shanghai, Shanghai, China, November 22, 2014

40. Extracting Spatiotemporal Patterns with Dynamics-Adapted Kernels. *10th AIMS Conference on Dynamical Systems. Differential Equations, and Applications*. Madrid, Spain, July 8, 2014

41. Extraction and Predictability of MJO Signals in Infrared Brightness Temperature Data. *4th Workshop on Understanding Climate Change through Data*. National Center for Atmospheric Research (NCAR), Boulder, Colorado, July 1, 2014

42. Extracting Spatiotemporal Patterns with Dynamics-Adapted Kernels. *Model-Data Integration in Physical Systems*. Isaac Newton Institute, Cambridge, United Kingdom, March 18, 2014

43. Extraction and Predictability of MJO Signals in Infrared Brightness Temperature Data. *Center for Prototype Climate Modeling*. New York University Abu Dhabi, Abu Dhabi, United Arab Emirates, March 6, 2014

44. Capturing Intermittent and Low-Frequency Variability in High-Dimensional Data through Nonlinear Laplacian Spectral Analysis. *2013 International Symposium on Nonlinear Theory and Applications (NOLTA)*. Santa Fe, New Mexico, September 9, 2013

45. Data-Driven Methods for Dynamical Systems: Quantifying Predictability and Extracting Spatiotemporal Patterns. *Applied Mathematics, Modeling and Computational Science (AMMCS) Conference*. Waterloo, Ontario, August 27, 2013. (Keynote lecture.)

46. Capturing Intermittent and Low-Frequency Variability in High-Dimensional Data through Nonlinear Laplacian Spectral Analysis. *CMOS/CGU/CWRA Congress*, Saskatoon. Saskatchewan, May 27, 2013

47. Capturing Intermittent and Low-Frequency Variability in High-Dimensional Data through Nonlinear Laplacian Spectral Analysis. *SIAM Conference on Applications of Dynamical Systems*. Snowbird, Utah, May 21, 2013

48. Capturing Intermittent and Low-Frequency Variability in High-Dimensional Data through Nonlinear Laplacian Spectral Analysis. *Stochastic Modeling of the Oceans and Atmosphere*, Institute for Mathematics and its Applications (IMA), Minneapolis, Minnesota, March 12, 2013

49. Capturing Intermittent and Low-Frequency Variability in High-Dimensional Data through Nonlinear Laplacian Spectral Analysis. *Adaptive Data Analysis and Sparsity*. Institute for Pure and Applied Mathematics (IPAM), Los Angeles, California, January 31, 2013

50. Capturing Intermittent and Low-Frequency Variability in High-Dimensional Data through Nonlinear Laplacian Spectral Analysis. *Joint Mathematics Meetings*. San Diego, California, January 10, 2013

51. Hierarchical Structure of the Madden-Julian Oscillation in Infrared Brightness Temperature Data Revealed through Nonlinear Laplacian Spectral Analysis. *NASA Conference on Intelligent Data Understanding (CIDU) 2012*. Boulder, Colorado, October 25, 2012

52. Quantifying Long-Range Predictability and Model Error via Data Clustering and Information Theory. *AIMS Conference on Dynamical Systems*. Orlando, Florida, July 2, 2012

53. Capturing Intermittent and Low-Frequency Variability in High-Dimensional Data through Nonlinear Laplacian Spectral Analysis. *AIMS Conference on Dynamical Systems*, Orlando, Florida, July 1, 2012

54. Diffractive Imaging through Manifold Symmetries of Scattering. *SIAM Conference on Imaging Science*. Philadelphia, Pennsylvania, May 21, 2012

55. Quantifying Long-Range Predictability and Model Error through Data Clustering and Information Theory. *SIAM Conference on Uncertainty Quantification*. Raleigh, North Carolina, April 5, 2012

56. Comparing Low-Frequency and Intermittent Variability in Comprehensive Climate Models through Nonlinear Laplacian Spectral Analysis. *Workshop on Tropical and Extratropical Interactions in Climate*. Center for Prototype Climate Modeling, New York University Abu Dhabi, Abu Dhabi, United Arab Emirates, March 22, 2012

57. Quantifying the Predictability and Model Error in Regime Forecasts through Data Clustering and Information Theory. *AGU Fall Meeting*. San Francisco, California, December 8, 2011

58. Nonlinear Laplacian Spectral Analysis for Time Series: Capturing Intermittency and Low-Frequency Variability. *International Workshop on Statistical Inverse Modeling of Complex Nonlinear Systems*. Fudan University, Shanghai, China, September 8, 2011

59. Quantifying Predictability and Model Error in Long-Range Climate Forecasting through Information Theory. *International Workshop on Statistical Inverse Modeling of Complex Nonlinear Systems*. Fudan University, Shanghai, China, September 6, 2011

60. Quantifying Predictability and Model Error in Long-Range Climate Forecasting through Information Theory. *Verification, Validation, and Uncertainty Quantification Across Disciplines*. Institute for Computing in Science (ICiS), Park City, Utah, August 9, 2011

61. Long-Range Climate Forecasts Using Data Clustering and Information Theory. *New York Workshop on Computer, Earth, and Space Sciences*. Goddard Institute for Space Studies, New York, New York, February 25, 2011

62. Structure and Dynamics from Manifold Symmetries of Image Formation. *Minisymposium on Computational Methods for Three-Dimensional Microscopy Reconstruction*. The City University of New York, November 8, 2010

63. Identifying and Predicting the Extensional and Meandering Phases of the Jet in a Double-Gyre Ocean Model. *Mathematical Theory and Modeling in Atmosphere-Ocean Science*. Oberwolfach Institute, Germany, August 12, 2010

64. Identifying and Predicting Regimes in a 1.5-Layer Ocean Model. *Data Hierarchies for Simulating and Understanding Climate*. Institute for Pure and Applied Mathematics (IPAM), Los Angeles, California, June 10, 2010

65. Inferring the Orientation of Molecules by Laplacian Eigenfunctions., *Random Shapes Reunion Conference*. Institute for Pure and Applied Mathematics (IPAM), Los Angeles, California, December 9, 2009

66. Orientation Recovery by Diffusion Maps. *Workshop on Single-Particle Diffraction and Imaging*. University of Wisconsin, Milwaukee, January 22, 2009

Seminars

1. Department of Mechanical Engineering, California Institute of Technology, January 7, 2021
2. Department of Earth System Science, University of California Irvine, April 9, 2019
3. Courant Institute of Mathematical Sciences (Atmosphere Ocean Science Colloquium), New York University, November 14, 2018
4. Center for Informatics and Computational Science, University of Notre Dame, November 7, 2018
5. Department of Mechanical Engineering, University of California Santa Barbara, October 19, 2018
6. Department of Computing and Mathematical Sciences, California Institute of Technology, October 17, 2018
7. Department of Mathematics and Computer Science, Freie Universität Berlin, July 3, 2018
8. Department of Mathematics, Paderborn University, June 29, 2018
9. Department of Mathematics, University of New South Wales, May 24, 2018
10. Department of Mathematics, Johns Hopkins University, February 21, 2018
11. Committee on Computational and Applied Mathematics, University of Chicago, February 2, 2018
12. Department of Physics, University of Wisconsin-Milwaukee, July 27–28, 2017
13. Lamont-Doherty Earth Observatory, May 5, 2017
14. Department of Mathematics, Yale University, April 23, 2017
15. Google Research, April 12, 2017
16. Department of Mathematics, George Mason University, March 24, 2017
17. Department of Mathematics, University of South Florida, March 10, 2017
18. Department of Mechanical Engineering, University of California, Santa Barbara, January 18, 2017
19. Courant Institute of Mathematical Sciences (Applied Mathematics Seminar), New York University, March 4, 2016
20. Department of Mechanical Engineering, Ilmenau University of Technology, September 17, 2015
21. Department of Mechanical Engineering, Massachusetts Institute of Technology, March 5, 2015
22. Department of Applied Physics and Applied Mathematics, Columbia University, October 13, 2014
23. Department of Mathematics, The Pennsylvania State University, October 6, 2014
24. Department of Earth, Atmospheric and Planetary Sciences, Purdue University, November 14, 2013
25. Scientific and Statistical Computing Seminar, University of Chicago, May 30, 2013
26. Pacific Northwest National Laboratory, December 6, 2012

27. Courant Institute of Mathematical Sciences (Graduate Student/ Postdoc Seminar), November 30, 2012
28. School of Marine and Atmospheric Sciences, Stony Brook University, November 14, 2012
29. Department of Applied Physics and Applied Mathematics, Columbia University, October 18, 2012
30. Department of Mathematics, North Carolina State University, March 30, 2012
31. Department of Mathematics, Princeton University, March 28, 2012
32. Department of Mathematics, University of Delaware, April 26, 2011
33. Department of Applied Mathematics, University of Colorado, Boulder, December 14, 2011
34. Courant Institute of Mathematical Sciences (Applied Mathematics Seminar), New York University, November 11, 2011
35. Courant Institute of Mathematical Sciences (Atmosphere Ocean Science Colloquium), New York University, April 13, 2011
36. Department of Physics, University of Wisconsin, Milwaukee, February 11, 2011
37. Department of Mathematics, Freie Universität Berlin, November 4, 2009
38. Department of Mechanical Engineering, University of California, Berkeley, December 1, 2008
39. Princeton Plasma Physics Laboratory, September 22, 2008