

Steven L. Brunton

Assistant Professor, Mechanical Engineering
University of Washington

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Research Interests

- Flow control, fluid transport phenomena, and turbulent mixing enhancement
- Data science for control: machine learning, uncertainty quantification, and equation-free modeling
- Model reduction, sparse sensing, and feedback control of high-dimensional dynamical systems
- Adaptive and robust control techniques for energy optimization and conversion

Affiliations

University of Washington

Seattle, WA 98195

- (Sept. 2014 – present) Assistant Professor of Mechanical Engineering,
- (Sept. 2014 – present) Data Science Fellow, eScience Institute,
- (Sept. 2014 – present) Adjunct Assistant Professor of Applied Mathematics,
- (Sept. 2012 – Sept. 2014) Acting Assistant Professor of Applied Mathematics.

Education

Princeton University

Princeton, NJ 08544

- Ph.D. in Mechanical and Aerospace Engineering, 2012
- Advisor: Clarence W. Rowley
- Thesis: Unsteady aerodynamic models for agile flight at low Reynolds numbers.

California Institute of Technology

Pasadena, CA 91125

- B.S. in Mathematics, Minor in Control and Dynamical Systems, 2006
- Advisor: Jerrold E. Marsden
- Thesis: Rank-1 saddle transport in three or more degrees of freedom scattering reactions.

Awards & Honors

- Data Science Fellow, eScience Institute [2014]
- McGraw Graduate Teaching Fellow [2010-2011]
- Best poster award SIAM Conference on Applications of Dynamical Systems [2009]
- Athena-Feron Scholarship Award for Mathematical Excellence [2007]
- Princeton MAE Second Year Graduate Fellowship [2007]
- Gordon Wu Graduate Fellowship to attend Princeton [2006-2010]

Books

2. T. Duriez, **S. L. Brunton**, and B. R. Noack, *Machine Learning Control – Taming Nonlinear Dynamics and Turbulence*, Springer 2016.
1. J. N. Kutz, **S. L. Brunton**, B. W. Brunton, and J. L. Proctor, *Dynamic Mode Decomposition: Data-Driven Modeling of Complex Systems*, SIAM 2016.

Book Chapters

4. J. N. Kutz, S. Sargsyan, and **S. L. Brunton**, “Leveraging sparsity and compressive sensing for reduced order modeling,” MoRePaS, 2016.
3. Z. Bai, **S. L. Brunton**, B. W. Brunton, J. N. Kutz, E. Kaiser, A. Spohn, and B. R. Noack, “Data-driven methods in fluid dynamics: Sparse classification from experimental data,” to appear in *Whither Turbulence and Big Data in the 21st Century* (Springer, 2016).
2. J. N. Kutz, **S. L. Brunton**, and X. Fu, “Data methods and computational tools for characterizing complex cavity dynamics,” in *Nonlinear Optical Cavity Dynamics: From Microresonators to Fiber Lasers*, P. Grelu Ed. (Wiley-VCH Verlag GmbH & Co. KGaA, 2016).
1. J. N. Kutz, X. Fu, **S. L. Brunton**, and J. Grosek, “Dynamic mode decomposition for robust PCA with applications to foreground/background subtraction in video streams and multi-resolution analysis,” in *CRC Handbook on Robust Low-Rank and Sparse Matrix Decomposition: Applications in Image and Video Processing*, T. Bouwmans Ed. (CRC Press, 2015).

Journal Publications

35. **S. L. Brunton**, B. W. Brunton, J. L. Proctor, E. Kaiser, and J. N. Kutz
Chaos as an intermittently forced linear system.
To appear in Nature Communications, 2017.
34. S. H. Rudy, **S. L. Brunton**, J. L. Proctor, and J. N. Kutz
Data-driven discovery of partial differential equations.
Science Advances, **3**:e1602614, 2017.
33. **S. L. Brunton**, J. N. Kutz, and J. L. Proctor
Data-driven discovery of governing physical laws.
SIAM News, **50**(1), 2017.
32. K. Manohar, **S. L. Brunton**, and J. N. Kutz
Environment identification in flight using sparse approximation of wing strain.
Journal of Fluids and Structures, **70**:162–180, 2017.
31. J. M. Kunert, J. L. Proctor, **S. L. Brunton**, and J. N. Kutz
Spatiotemporal feedback and network structure drive and encode *Caenorhabditis elegans* locomotion.
PLoS Computational Biology, **13**(1):e1005303, 2017.
30. N. M. Mangan, **S. L. Brunton**, J. L. Proctor, and J. N. Kutz
Inferring biological networks by sparse identification of nonlinear dynamics.
IEEE Transactions on Molecular, Biological, and Multi-Scale Communications, Special Issue on Biological Applications of Information Theory in Honor of Claude Shannon’s Centennial – Part 1, **2**(1):52–63, 2016.
29. N. B. Erichson, **S. L. Brunton**, and J. N. Kutz
Compressed Dynamic Mode Decomposition for Real-Time Object Detection.
Journal of Real-Time Image Processing, 1–14, 2016.

28. B. W. Brunton, **S. L. Brunton**, J. L. Proctor, and J. N. Kutz.
Sparse sensor placement optimization for classification.
SIAM Journal on Applied Mathematics, **76**(5):2099–2122, 2016.
27. J. L. Proctor, **S. L. Brunton**, and J. N. Kutz
Including inputs and control within equation-free architectures for complex systems. (invited review)
European Physical Journal Special Topics, **225**:2413–2434, 2016.
26. V. Parezanovic, L. Cordier, T. Duriez, A. Spohn, B. R. Noack, J.-P. Bonnet, M. Segond, M. Abel,
and **S. L. Brunton**
Frequency selection by feedback control in a turbulent shear-flow.
Journal of Fluid Mechanics, **797**:247–283, 2016.
25. **S. L. Brunton**, J. L. Proctor, and J. N. Kutz.
Discovering governing equations from data: Sparse identification of nonlinear dynamical systems.
Proceedings of the National Academy of Sciences, **113**(15):3932–3937, 2016.
24. K. Taira, A. G. Nair, and **S. L. Brunton**
Network Structure of Two-Dimensional Isotropic Turbulence.
Journal of Fluid Mechanics, **795**(R2):1–11, 2016.
23. S. Madhavan, **S. L. Brunton**, and J. J. Riley
Finite-time Lyapunov exponents for inertial particles in an unsteady fluid.
Physical Review E, **93**:033108, 2016.
22. **S. L. Brunton**, B. W. Brunton, J. L. Proctor, and J. N. Kutz.
Koopman invariant subspaces and finite linear representations of nonlinear dynamical systems for control.
PLoS ONE, **11**(2):e0150171, 2016.
21. J. N. Kutz, X. Fu, and **S. L. Brunton**.
Multi-resolution dynamic mode decomposition.
SIAM Journal of Applied Dynamical Systems, **15**(2):713–735, 2016.
20. J. L. Proctor, **S. L. Brunton**, and J. N. Kutz.
Dynamic mode decomposition with control.
SIAM Journal of Applied Dynamical Systems, **15**(1):142–161, 2016.
19. M. C. Johnson, **S. L. Brunton**, N. B. Kundtz, and J. N. Kutz.
Extremum-seeking control of the beam pattern of a reconfigurable holographic metamaterial antenna.
Journal of the Optical Society of America, A, **33**(1):59–68, 2016.
18. **S. L. Brunton**, J. L. Proctor, and J. N. Kutz.
Compressive sampling and dynamic mode decomposition.
Journal of Computational Dynamics, **2**(2):165–191, 2015.
17. J. N. Kutz and **S. L. Brunton**.
Intelligent systems for stabilizing mode-locked lasers and frequency combs: Machine learning and equation-free control paradigms for self-tuning optics.
Nanophotonics, **4**:459–471, 2015.
16. S. Sargsyan, **S. L. Brunton**, and J. N. Kutz
Nonlinear model reduction for complex systems using sparse optimal sensor locations from learned nonlinear libraries.
Physical Review E, **92**(3):033304-1–033304-13, 2015.
15. **S. L. Brunton**, and B. R. Noack
Closed-loop turbulence control: Progress and challenges.
Applied Mechanics Reviews, **67**(5):050801-1–050801-48, 2015.

14. M. C. Johnson, **S. L. Brunton**, J. N. Kutz, and N. B. Kundtz.
Sidelobe canceling for optimization of reconfigurable holographic metamaterial antenna.
IEEE Transactions on Antennas and Propagation, **63**(4):1881–1886, 2015.
13. V. Parezanovic, J. C. Larentie, J. Delville, L. Cordier, C. Fourment, A. Spohn, B. R. Noack, J.-P. Bonnet, T. Shaqarin, M. Segond, M. Abel, and **S. L. Brunton**.
Mixing layer manipulation experiment: From open-loop forcing to closed-loop machine learning turbulence control. *The Journal of Flow, Turbulence and Combustion*, **94**(1):155–173, 2015.
12. **S. L. Brunton**, J. H. Tu, I. Bright, and J. N. Kutz.
Compressive sensing and low-rank libraries for classification of bifurcation regimes in nonlinear dynamical systems. arXiv:1312.4221 [math.DS]
SIAM Journal of Applied Dynamical Systems, **13**(4):1716–1732, 2014
11. J. L. Proctor, **S. L. Brunton**, B. W. Brunton, and J. N. Kutz.
Exploiting sparsity and equation-free architectures in complex systems.
The European Physical Journal Special Topics (EPJ-ST), **223**: 2665–2684, 2014. (invited review)
10. J. H. Tu, C. W. Rowley, D. M. Luchtenburg, **S. L. Brunton**, and J. N. Kutz.
Generalizing dynamic mode decomposition to a larger class of datasets. arXiv:1312.0041 [math.NA]
Journal of Computational Dynamics, **1**(2):391–421, 2014.
9. D. M. Luchtenburg, **S. L. Brunton**, and C. W. Rowley.
Long-time uncertainty propagation using generalized polynomial chaos and flow map composition.
Journal of Computational Physics, **274**: 783–802, 2014.
8. **S. L. Brunton**, S. T. M. Dawson, and C. W. Rowley.
State-space identification of reduced-order unsteady aerodynamic models for feedback control.
Journal of Fluids and Structures, **50**:253–270, 2014.
7. **S. L. Brunton**, X. Fu, and J. N. Kutz.
Self-tuning fiber lasers.
IEEE Journal of Special Topics in Quantum Electronics, **20**(5), 2014.
6. X. Fu, **S. L. Brunton**, and J. N. Kutz.
Classification of birefringence in mode-locked fiber lasers using machine learning and sparse representation.
Optics Express, **22**(7):8585–8597, 2014.
5. **S. L. Brunton**, X. Fu, and J. N. Kutz.
Extremum-seeking control of a mode-locked laser.
IEEE Journal of Quantum Electronics, **49**(10):852–861, 2013.
4. **S. L. Brunton**, C. W. Rowley, and D. R. Williams.
Reduced-order unsteady aerodynamic models at low Reynolds numbers.
Journal of Fluid Mechanics, **724**:203–233, 2013.
3. **S. L. Brunton** and C. W. Rowley.
Empirical state-space representations for Theodorsen’s lift model.
Journal of Fluids and Structures, **38**:174–186, 2013.
2. **S. L. Brunton**, C. W. Rowley, S. R. Kulkarni, and C. Clarkson.
Maximum power point tracking for photovoltaic optimization using ripple-based extremum seeking control.
IEEE Transactions on Power Electronics, **25**(10):2531–2540, 2010.
1. **S. L. Brunton** and C. W. Rowley.
Fast computation of finite-time Lyapunov exponent fields for unsteady flows.
Chaos **20**(1), 2010.

15. K Manohar, B. W. Brunton, J. N. Kutz, and **S. L. Brunton**
Data-Driven Sparse Sensor Placement.
Invited submission to IEEE Control Systems Magazine.
14. J. C. Loiseau and **S. L. Brunton**
Constrained sparse Galerkin regression.
Under revision for Journal of Fluid Mechanics.
13. E. Kaiser, M. Morzynski, G. Daviller, J. N. Kutz, B. Brunton, and **S. L. Brunton**
Sparsity enabled cluster reduced-order modeling for control.
Submitted to Journal of Computational Physics.
12. S. D. Pendergrass, J. N. Kutz, and **S. L. Brunton**
Streaming GPU Singular Value and Dynamic Mode Decompositions.
arXiv preprint: <https://arxiv.org/abs/1612.07875>.
11. B. Strom, **S. L. Brunton**, and B. Polagye
Intracycle angular velocity control of cross-flow turbines.
Under revision for Nature Energy.
10. K. Taira, **S. L. Brunton**, S. T. M. Dawson, C. W. Rowley, T. Colonius, B. J. McKeon, O. Schmidt, S. Gordeyev, V. Theofilis, and L. S. Ukeiley
Modal Analysis of Fluid Flows: An Overview.
Submitted to AIAA Journal.
9. W. Guo, K. Manohar, **S. L. Brunton**, and A. G. Banerjee
Sparse-TDA: Sparse realization of topological data analysis for multi-way classification.
8. N. M. Mangan, J. N. Kutz, **S. L. Brunton**, and J. L. Proctor
Model selection for dynamical systems via sparse regression and information criteria.
Submitted to the Proceedings of the Royal Society A.
7. N. B. Erichson, K. Manohar, **S. L. Brunton**, and J. N. Kutz
Randomized CP Tensor Decomposition.
6. N. B. Erichson, S. Voronin, **S. L. Brunton**, and J. N. Kutz
Randomized Matrix Decompositions using R.
Submitted to Journal of Statistical Software.
5. S. Sargsyan, **S. L. Brunton**, and J. N. Kutz
Online interpolation point refinement for reduced order models using a genetic algorithm.
Under revision for SIAM Journal on Scientific Computing.
4. Y. Hu, **S. L. Brunton**, N. Cain, S. Mihalas, J. N. Kutz, and E. Shea-Brown
Feedback through graph motifs relates structure and function in complex networks.
3. M. Au-Yeung, **S. L. Brunton**, G. Bardy, and P.G. Reinhall
Toward reliably providing a 5 minute warning of an impending ICD shock.
2. J. N. Kutz, **S. L. Brunton**, and J. L. Proctor
Koopman theory for partial differential equations.
Under revision for Journal of Nonlinear Science.
1. J. L. Proctor, **S. L. Brunton**, and J. N. Kutz
Generalizing Koopman theory to allow for inputs and control.
Under revision for SIAM Journal of Dynamical Systems.

Conference Papers

19. K. Taira, A. G. Nair, and **S. L. Brunton**.
Vortex interaction analysis using complex network framework.
Annual Meeting of the Japan Society of Fluid Mechanics, Nagoya, Japan, September, 2016.
18. K. Taira, A. G. Nair, and **S. L. Brunton**.
Complex network analysis of unsteady fluid flows.
ICTAM, Montreal, Canada, August, 2016.
17. **S. L. Brunton**, J. L. Proctor, and J. N. Kutz.
Sparse Identification of Nonlinear Dynamics with Control (SINDYc).
NOLCOS, Monterey CA, August, 2016.
16. B. Strom, **S. L. Brunton**, A. Aliseda, and B. Polagye.
Comparison of acoustic Doppler and particle image velocimetry characterization of a cross-flow turbine wake.
Proceedings of the 4th Marine Energy Technology Symposium, Washington D.C., April, 2016.
15. **S. L. Brunton**, J. N. Kutz, and X. Fu.
Self-tuning fiber lasers.
SPIE Photonics West, paper 9728-61, 2016.
14. B. Strom, **S. L. Brunton**, and B. Polagye.
Consequences of preset pitch angle for cross flow turbines.
11th European Wave and Tidal Energy Conference, Nantes, France, September 5-11, 2015.
13. B. Strom, **S. L. Brunton**, and B. Polagye.
Hydrodynamic optimization of cross-flow turbines with large chord to radius ratios.
Proceedings of the 3th Marine Energy Technology Symposium, Washington D.C., April, 2015.
12. J. N. Kutz, X. Fu, and **S. L. Brunton**.
Machine learning for self-tuning optical systems.
Proceedings of the World Congress on Engineering, 1:70–73, 2015.
11. J. N. Kutz, X. Fu, and **S. L. Brunton**.
Multi-resolution analysis of dynamical systems using dynamic mode decomposition.
Proceedings of the World Congress on Engineering, 1:90–93, 2015.
10. M. C. Johnson, **S. L. Brunton**, N. B. Kundtz, and J. N. Kutz.
An Extremum-Seeking Controller for Dynamic Metamaterial Antenna Operation.
IEEE APWC, 2015.
9. J. N. Kutz, X. Fu, and **S. L. Brunton**.
Self-tuning fiber lasers: machine learning applied to optical systems.
Nonlinear Photonics, July 2014.
8. M. C. Johnson, **S. L. Brunton**, J. N. Kutz, and N. B. Kundtz.
Sidelobe canceling on a reconfigurable holographic metamaterial antenna.
IEEE APWC, 2014.
7. T. Duriez, V. Parezanovic, J.-C. Laurentie, C. Fourment, J. Delville, J.-P. Bonnet, L. Cordier, B. R. Noack, M. Segond, M. W. Abel, N. Gautier, J.-L. Aider, C. Raibaud, C. Cuvier, M. Stanislas, and **S. L. Brunton**.
Closed-loop control of experimental shear flows using machine learning (Invited).
AIAA Paper 2014-XXXX, 7th Flow Control Conference, June 2014.
6. **S. L. Brunton**, C. W. Rowley, and D. R. Williams.
Linear unsteady aerodynamic models from wind tunnel measurements.
AIAA Paper 2011-3581, 41st Fluid Dynamics Conference and Exhibit, June 2011.
5. **S. L. Brunton**, and C. W. Rowley.
Low-dimensional state-space representations for classical unsteady aerodynamic models.
AIAA Paper 2011-476, 49th AIAA Aerospace Sciences Meeting and Exhibit, Jan. 2011.
4. **S. L. Brunton**, and C. W. Rowley.

Unsteady aerodynamic models for agile flight at low Reynolds numbers.

AIAA Paper 2010-552, 48th AIAA Aerospace Sciences Meeting and Exhibit, Jan. 2010.

3. S. L. Brunton, C. W. Rowley, S. R. Kulkarni, and C. Clarkson.

Maximum power point tracking for photovoltaic optimization using extremum seeking.

34th IEEE Photovoltaic Specialist Conference, June 2009.

2. S. L. Brunton, and C. W. Rowley.

Modeling the unsteady aerodynamic forces on small-scale wings.

AIAA Paper 2009-1127, 47th AIAA Aerospace Sciences Meeting and Exhibit, Jan. 2009.

1. S. L. Brunton, C. W. Rowley, K. Taira, T. Colonius, J. Collins, and D. R. Williams.

Unsteady aerodynamic forces on small-scale wings: Experiments, simulations & models.

AIAA Paper 2008-520, 46th AIAA Aerospace Sciences Meeting and Exhibit, Jan. 2008.

Patents

2. J. N. Kutz, J. Grosek, **S. L. Brunton**, X. Fu, and S. Pendergrass “Using dynamic mode decomposition for real-time background/foreground separation in video,”

US Patent 20,160,050,343, 2016.

1. J. N. Kutz, **S. L. Brunton**, X. Fu, “Tuning multi-input complex dynamic systems using sparse representations of performance and extremum-seeking control,”

US Patent 20,160,043,526, 2016.

Mentoring/Advising

Current

Eurika Kaiser [2016-present]. Moore Sloan Data Science Postdoctoral Fellow, co-advised w/ Nathan Kutz

Bethany Lusch [2016-present]. Postdoctoral Fellow, co-advised w/ Bing Brunton and Nathan Kutz

Thomas Mohren [2016-present]. PhD student at UW, co-advised w/ Tom Daniel

Chen Gong [2016-present]. PhD student at UW, co-advised w/ Eric Seibel

Ben Erichson [2016-present]. Visiting PhD student from St. Andrews, co-advised w/ Nathan Kutz

Zhe Bai [2014-present]. PhD student at UW

Ben Strom [2014-present]. PhD student at UW, co-advised w/ Brian Polagye

Krithika Manohar [2013-present]. PhD student at UW, co-advised w/ Nathan Kutz

Seth Pendergrass [2014-present]. Undergraduate at UW.

Graduated

Michael Au-Yeung [2014-2016]. PhD student at UW, co-advised w/ Per Reinhall

David Law [2015-2016], Masters student at UW

Tadbhagya Kumar [2015-2016]. Masters student at UW, co-advised w/ Jim Riley

Sudharsan Madhavan [2012-2014]. Masters student at UW, co-advised w/ Jim Riley

Joseph Sullivan [2013]. Undergraduate at UW.

Allen Maudlin [2013]. Undergraduate at UW.

Teaching

Instructor, University of Washington

- ME520 - **Control Theory Bootcamp**, Winter 2017, 8 students
Course Evaluations: *Pending*
- ME565 - **Mechanical Engineering Analysis**, Winter 2017, 122 students
Course Evaluations: *Pending*
- ME564 - **Mechanical Engineering Analysis**, Fall 2016, 127 students
Course Evaluations: Median 4.8/5.0, Adj. Median 4.9/5.0
- ME565 - **Mechanical Engineering Analysis**, Winter 2016, 96 students
Course Evaluations: Median 4.7/5.0, Adj. Median 4.8/5.0
- ME564 - **Mechanical Engineering Analysis**, Fall 2015, 88 students
Course Evaluations: Median 4.8/5.0, Adj. Median 4.9/5.0
- ME565 - **Mechanical Engineering Analysis**, Winter 2015, 62 students
Course Evaluations: Median 4.8/5.0, Adj. Median 5.0/5.0
- ME564 - **Mechanical Engineering Analysis**, Fall 2014, 67 students
Course Evaluations: Median 4.9/5.0, Adj. Median 4.8/5.0
- AMATH301 - **Beginning Scientific Computing**, Spring 2014, 309 students
- AMATH301 - **Beginning Scientific Computing**, Winter 2014, 309 students
Course Evaluations: Median 3.86/5.0, Adj. Median 4.1/5.0
- AMATH301 - **Beginning Scientific Computing**, Fall 2013, 368 students
- AMATH301 - **Beginning Scientific Computing**, Winter 2013, 300 students
Course Evaluations: Median 3.9/5.0, Adj. Median 4.1/5.0
- AMATH500A - **Boeing Distinguished Seminar**, Fall 2012 - Fall 2013

Teaching Assistant, Princeton University

- MAE434 - **Modern Control**, Fall 2009
- MAE433 - **Automatic Control Systems**, Spring 2009, 2010
- MAE331 - **Aircraft Flight Dynamics**, Fall 2008

Teaching Assistant, California Institute of Technology

- CDS140ab - **Introduction to Dynamics**, Fall 2005, Spring 2006

Invited Talks (SLB invited)

43. **S. L. Brunton**, “Discovering Governing Equations from Data by Sparse Identification of Nonlinear Dynamics,” MIT Applied Mathematics Seminar, Cambridge MA, May 2017.
42. **S. L. Brunton**, “Discovering Governing Equations from Data by Sparse Identification of Nonlinear Dynamics,” Virginia Tech Applied Mathematics Seminar, Blacksburg VA, April 2017.
41. **S. L. Brunton**, “Discovering Governing Equations from Data by Sparse Identification of Nonlinear Dynamics,” Harvard Applied Mathematics Seminar, Cambridge MA, April 2017.
40. **S. L. Brunton**, “Discovering Governing Equations from Data by Sparse Identification of Nonlinear Dynamics,” APS March Meeting, New Orleans, LA, March 2017.
39. **S. L. Brunton**, “Discovering Governing Equations by Sparse Identification of Nonlinear Dynamics,” SIAM Conference on Computational Science and Engineering, Atlanta, GA, March 2017.
38. **S. L. Brunton**, “Data-Driven Discovery and Control of Nonlinear Dynamical Systems,” Banff BIRS Workshop, Banff, Canada, January 2017. (**Plenary**)
37. **S. L. Brunton**, “Observing and controlling the nonlinear world in a linear framework,” Neural Computation and Engineering Connection, Seattle, WA, January 2017.
36. **S. L. Brunton**, “Discovering and Controlling Nonlinear Dynamical Systems from Data,” Caltech MCE Seminar, Pasadena, CA, January 2017.
35. **S. L. Brunton**, “Data-Driven Discovery and Control of Complex Systems,” DARPA Workshop, Santa Barbara, CA, November 2016.
34. **S. L. Brunton**, “Data-Driven Modeling and Control of Nonlinear Systems,” The Future of Vibration Energy Transfer in Solids and Structures Workshop, Seattle, WA, October 2016.
33. **S. L. Brunton**, J. L. Proctor, and J. N. Kutz, “Sparse Identification of Nonlinear Dynamics with Control (SINDYc),” NOLCOS, Monterey, CA, August 2016.
32. **S. L. Brunton**, “Discovering Nonlinear Dynamical Systems from Data,” UTRC, Hartford, CT, July 2016.
31. **S. L. Brunton**, “Data-Driven Identification of Nonlinear Dynamical Systems with Control using Sparse Regression,” SIAM Annual Meeting, Boston, MA, July 2016.
30. **S. L. Brunton**, “Predictive Shimming: Advanced Automated Gap-Filling with Data Science,” Boeing Workshop, Seattle WA, June 2016.
29. **S. L. Brunton**, “A Compressed Overview of Sparsity,” AIAA Aviation Meeting, DC, June 2016.
28. **S. L. Brunton**, “Data-Driven Modeling and Control via Sparse Sensing and Machine Learning,” Laboratoire d’Hydrodynamique de l’Ecole polytechnique, Paris, France, April 2016.
27. **S. L. Brunton**, “Data-Driven Modeling and Control via Sparse Sensing and Machine Learning,” Laboratoire d’Informatique pour la Mécanique et les Sciences de l’Ingenieur, France, April 2016.
26. **S. L. Brunton**, “Discovering Nonlinear Dynamical Systems from Data,” SIAM Conference on Uncertainty Quantification, Lausanne, Switzerland, April 2016.
25. **S. L. Brunton**, “Discovering Nonlinear Dynamical Systems from Data,” Courant Institute of Mathematical Sciences, New York, NY, USA, March, 2016.
24. **S. L. Brunton**, “Extensions to DMD and Koopman Analysis: Compressed Sensing, Multi-Resolution, and Control,” United Technologies Research Corporation, Hartford, CT, USA, November, 2015.
23. **S. L. Brunton**, “Uncertainty quantification (and sensitivity!) in fluid dynamics and control,” International Congress on Industrial and Applied Mathematics, Beijing, China, August, 2015.

22. **S. L. Brunton**, B. W. Brunton, J. L. Proctor, J. N. Kutz, and B. R. Noack, “Big data solutions for active flow control,” Bifurcations in Fluid Dynamics, Paris, France, July, 2015.
21. **S. L. Brunton**, “Data-driven modeling and control of complex systems: sparse sensing and machine learning,” SIAM Conference on Control and its Applications, Paris, France, July, 2015.
20. **S. L. Brunton**, “Compressive sensing and dynamic mode decomposition,” SIAM Conference on Applications of Dynamical Systems, Snowbird, UT, May, 2015.
19. **S. L. Brunton**, J. N. Kutz, and B. R. Noack “Self-tuning complex systems and data-driven control,” Whither Turbulence and Big Data in the 21st Century, Corsica, France, April, 2015.
18. **S. L. Brunton**, “Discovering underlying nonlinear dynamics of complex systems from data,” SIAM Conference on Computational Science and Engineering, Salt Lake City, March, 2015.
17. **S. L. Brunton**, “Data-driven modeling and control towards self-tuning complex systems,” SFB 880 Flow Control Workshop, TU-Braunschweig, Germany, February, 2015.
16. **S. L. Brunton**, “Data-driven modeling and control of complex systems,” TU-Berlin, Germany, Feb., 2015.
15. **S. L. Brunton**, “Data methods for the control of complex systems: Dimensionality reduction, sparsity, and machine learning,” Berkeley Electrical Engineering Semi-Autonomous Group, August, 2014.
14. **S. L. Brunton**, D. M. Luchtenburg, C. W. Rowley, and J. N. Kutz, “Investigating long-time uncertainty in dynamical systems using flow map composition,” SIAM Conference on Uncertainty Quantification, Savannah Georgia, April 2014.
13. **S. L. Brunton**, “Data-driven control of complex systems: Dimensionality reduction, sparsity, and uncertainty quantification,” UW Mechanical Engineering Seminar, January 2014.
12. **S. L. Brunton**, “Flow map composition for non-autonomous dynamical systems,” SIAM Conference on Applications of Dynamical Systems, May 2013.
11. **S. L. Brunton**, “Reduced-order unsteady aerodynamic models for closed-loop feedback control,” PPRIME, Poitiers France, April 2013.
10. **S. L. Brunton**, “Low-dimensional coherent structures in unsteady fluids,” MIT, Physical Mathematics Seminar, April 2013.
9. **S. L. Brunton**, “Reduced order models of unsteady aerodynamic flow for control,” SIAM Conference on Computational Science and Engineering, February 2013.
8. **S. L. Brunton**, “Feedback control of a pitching airfoil based on unsteady lift models,” University of Washington, Applied Physics Laboratory, October 2012.
7. **S. L. Brunton**, “Feedback control of a pitching airfoil based on unsteady lift models,” United Technologies Research Center, September 2012.
6. **S. L. Brunton**, S. T. M. Dawson, and C. W. Rowley, “Feedback control of a pitching airfoil based on unsteady lift models,” 42nd AIAA Fluid Dynamics Conference, June 2012.
5. **S. L. Brunton**, “Unsteady aerodynamic models for agile flight at low Reynolds number,” University of Washington, Applied Math Department, October 2011.
4. **S. L. Brunton**, C. W. Rowley and D. R. Williams, “Linear unsteady aerodynamic models from wind tunnel measurements,” 41st AIAA Fluid Dynamics Conference, June 2011.
3. **S. L. Brunton** and C. W. Rowley, “Fast computation of time-varying finite time Lyapunov exponents,” SIAM Conference on Applications of Dynamical Systems, May 2011.
2. **S. L. Brunton** and C. W. Rowley, “Reduced order models for unsteady aerodynamic forces at low Reynolds numbers,” Illinois Institute of Technology, Mechanical, Materials and Aerospace Engineering, March 2011.

1. **S. L. Brunton**, “Invariant manifold transport tubes in space mission design & chemical reaction dynamics,” Princeton Program in Applied and Computational Mathematics, Dynamical Systems & Nonlinear Science Seminar, December 2006.

Invited Talks (Others invited)

9. A. G. Nair, K. Taira, and **S. L. Brunton**, “Network-Theoretic Analyses of Vortex Dynamics,” SIAM Annual Meeting, Boston, MA, July 2016.
8. B. Strom, A. Aliseda, B. Polagye, and **S. L. Brunton**, “Unsteady Separated Flow Associated with Cross-Flow Turbines,” AIAA Sci-Tech, San Diego, CA, January 2016.
7. A. L. Eberle, **S. L. Brunton**, F. E. Fish, and T. L. Daniel, “Unsteady forces form in flapping foils and depend on fluid-solid coupling in water but not in air,” SICB, West Palm Beach, FL, January 2015.
6. B. R. Noack, T. Duriez, V. Parezanovic, V. K. von Krbek, E. Kaiser, L. Cordier, J.-P. Bonnet, M. Segond, M. W. Abel, N. Gautier, J.-L. Aider, C. Raibaud, C. Cuvier, M. Stanislas, A. Debien, N. Mazellier, A. Kourta, **S. L. Brunton**, and R. K. Niven, “Closed-loop turbulence control using machine learning,” Meeting of the *GDR 2502 Flow Separation Control and GDR MOSAR*, LIMSI, Orsay, France. (**Plenary**)
5. B. R. Noack, L. Cordier, T. Duriez, V. Parezanovic, J. Delville, J.-P. Bonnet, M. Segond, M. Abel, M. Morzynski, and **S. L. Brunton**, “Closed-loop turbulence control using reduced-order modeling and machine learning,” Computational Science & Engineering (CompSE) Workshop, Aachen, Germany, 2014. (**Keynote**)
4. M. Segond, M. Abel, V. Parezanovic, T. Duriez, B. R. Noack, L. Cordier, J.-P. Bonnet, M. Morzynski, and **S. L. Brunton**, “Genetic programming for control of dynamical systems – a new generic framework,” 85th Annual Meeting of the International Association of Applied Mathematics and Mechanics, Erlangen Nürnberg, Germany, 2014.
3. M. Abel, M. Segond, T. Duriez, L. Cordier, V. Parezanovic, B. R. Noack, J.-P. Bonnet, M. Morzynski, and **S. L. Brunton**, “Turbulence control by machine learning,” 85th Annual Meeting of the International Association of Applied Mathematics and Mechanics, Erlangen Nürnberg, Germany, 2014.
2. B. R. Noack, T. Duriez, V. Parezanovic, J.-C. Laurentie, M. Schlegel, E. Kaiser, L. Cordier, A. Spohn, J.-P. Bonnet, M. Morzynski, M. Segond, M. W. Abel, and **S. L. Brunton**, “Closed-Loop Turbulence Control - A Systematic Strategy for the Nonlinearities,” SIAM Conference on Uncertainty Quantification, April 2014.
1. J. N. Kutz and **S. L. Brunton**, “Sparsity, Sensitivity and Encoding/decoding of Nonlinear Dynamics using Machine Learning Methods,” SIAM Conference on Uncertainty Quantification, April 2014.

Contributed Talks

47. K. Manohar, E. Kaiser, **S. L. Brunton**, and J. N. Kutz. “Sensor placement for multiscale phenomena,” *SIAM CSE*, Atlanta, GA, March 2017.
46. J. N. Kutz, S. Sargsyan, K. Manohar, and **S. L. Brunton**. “Online interpolation point refinement for reduced order models,” *SIAM CSE*, Atlanta, GA, March 2017.
45. A. G. Nair, K. Taira, and **S. L. Brunton**. “Data-based extraction of modal interaction networks,” *SIAM CSE*, Atlanta, GA, March 2017.
44. **S. L. Brunton**, J. L. Proctor, and J. N. Kutz. “Sparse identification of nonlinear dynamics (SINDy),” *APS DFD*, Portland, OR, November 2016.
43. Z. Bai, E. Kaiser, J. L. Proctor, J. N. Kutz, and **S. L. Brunton**. “Compressed sensing DMD with control,” *APS DFD*, Portland, OR, November 2016.
42. E. Kaiser, B. R. Noack, A. Spohn, L. N. Cattafesta, M. Morzynski, G. Caviller, B. W. Brunton, and **S. L. Brunton**. “A probabilistic approach to modeling and controlling fluid flows,” *APS DFD*, Portland, OR, November 2016.

41. A. G. Nair, M. G. Men, K. Taira, and **S. L. Brunton**. “Vortical and modal network analysis of unsteady cylinder wake,” *APS DFD*, Portland, OR, November 2016.
40. K. Manohar, E. Kaiser, **S. L. Brunton**, and J. N. Kutz. “Sensor placement in multi scale phenomena using multi-resolution dynamic mode decomposition,” *APS DFD*, Portland, OR, November 2016.
39. B. Strom, **S. L. Brunton**, and B. Polagye. “Coordinated control of cross-flow turbines,” *APS DFD*, Portland, OR, November 2016.
38. S. Rudy, **S. L. Brunton**, J. L. Proctor, and J. N. Kutz. “Data-driven discovery of partial differential equations,” *APS DFD*, Portland, OR, November 2016.
37. K. Taira, A. G. Nair, and **S. L. Brunton**. “Vortex interaction analysis using complex network framework,” *Annual Meeting of the Japan Society of Fluid Mechanics*, Nagoya, Japan, September, 2016.
36. K. Taira, A. G. Nair, and **S. L. Brunton**. “Complex network analysis of unsteady fluid flows,” *ICTAM*, Montreal, Canada, August, 2016.
35. B. Strom, **S. L. Brunton**, A. Aliseda, and B. Polagye. “Comparison of acoustic Doppler and particle image velocimetry characterization of a cross-flow turbine wake,” *Proceedings of the 4th Marine Energy Technology Symposium*, Washington D.C., April, 2016.
34. **S. L. Brunton**, M. Johnson, X. Fu, and J. N. Kutz. “Self-tuning fiber lasers and other optical systems,” *SPIE Photonics West*, San Francisco, CA, February 2016.
33. K. Taira, A. Nair, and **S. L. Brunton**. “Network structure of two-dimensional homogeneous turbulence,” *APS DFD*, Boston, November 2015.
32. B. Strom, **S. L. Brunton**, and B. Polagye. “Phase resolved angular velocity control of cross flow turbines,” *APS DFD*, Boston, November 2015.
31. K. Manohar, **S. L. Brunton**, and J. N. Kutz. “Sparse sensing of aerodynamic loads on insect wings,” *APS DFD*, Boston, November 2015.
30. Z. Bai, **S. L. Brunton**, B. W. Brunton, J. N. Kutz, E. Kaiser, A. Spohn, and B. R. Noack. “Flow classification using machine learning on sparsely sampled experimental flow visualization data,” *APS DFD*, Boston, November 2015.
29. M. C. Johnson, **S. L. Brunton**, N. B. Kundtz, and J. N. Kutz. “An Extremum-Seeking Controller for Dynamic Metamaterial Antenna Operation,” *IEEE APWC*, Torino Italy, September 2015.
28. B. Strom, **S. L. Brunton**, and B. Polagye. “Consequences of preset pitch angle for cross flow turbines,” *11th European Wave and Tidal Energy Conference*, Nantes, France, September 5-11, 2015.
27. B. Strom, **S. L. Brunton**, and B. Polagye. “Hydrodynamic optimization of cross-flow turbines with large chord to radius ratios,” *Proceedings of the 3th Marine Energy Technology Symposium*, Washington D.C., April, 2015.
26. B. Polagye, B. Strom, C. Haegele, S. Mehta, C. Bowman, and **S. L. Brunton**. “Parametric experimentation with cross-flow turbines,” *AGU Fall Meeting*, San Francisco, December 2014.
25. S. Madhavan, **S. L. Brunton**, and J. J. Riley. “Lagrangian coherent structures and the dynamics of inertial particles,” *APS DFD*, San Francisco, November 2014.
24. V. Parezanovic, L. Cordier, B. R. Noack, A. Spohn, J.-P. Bonnet, T. Duriez, M. Segond, M. W. Abel, and **S. L. Brunton**. “Closed-loop control of an experimental mixing layer using MLC,” *APS DFD*, San Francisco, November 2014.
23. T. Duriez, V. Parezanovic, K. von Krbek, L. Cordier, B. R. Noack, J.-P. Bonnet, M. Segond, M. W. Abel, N. Gautier, J.-L. Aider, C. Raibaud, C. Cuvier, M. Stanislas, A. Debien, N. Mazellier, A. Kourta, and **S. L. Brunton**. “Closed-loop control of experimental shear flows using MLC,” *APS DFD*, San Francisco, Nov. 2014.
22. B. R. Noack, L. Cordier, V. Parezanovic, K. von Krbek, M. Segond, M. W. Abel, **S. L. Brunton**, and T. Duriez. “Machine learning control (MLC) – a novel method for optimal control of complex nonlinear systems,” *APS DFD*, San Francisco, November 2014.

21. M. C. Johnson, **S. L. Brunton**, J. N. Kutz, and N. B. Kundtz. “Sidelobe canceling on a reconfigurable holographic metamaterial antenna,” *IEEE APWC*, Aruba, August 2014.
20. J. N. Kutz, X. Fu, and **S. L. Brunton**. “Self-tuning fiber lasers: machine learning applied to optical systems,” *Nonlinear Photonics*, Barcelona, Spain, July 2014.
19. **S. L. Brunton**, J. H. Tu, and J. N. Kutz, “Nonlinear dynamic estimation with sparse sensors,” APS Division of Fluid Dynamics, November 2013.
18. J. H. Tu, D. M. Luchtenburg, C. W. Rowley, **S. L. Brunton**, and J. N. Kutz, “Novel sampling strategies for dynamic mode decomposition,” APS Division of Fluid Dynamics, November 2013.
17. S. T. M. Dawson, **S. L. Brunton**, and C. W. Rowley, “Nonlinear switched models for control of unsteady forces on a rapidly pitching airfoil,” APS Division of Fluid Dynamics, November 2013.
16. B. R. Noack, T. Duriez, L. Cordier, M. Segond, M. Abel, **S. L. Brunton**, M. Morzynsky, J.-C. Larentie, V. Parezanovic, and J.-P. Bonnet, “Closed-loop turbulence control with machine learning methods” APS Division of Fluid Dynamics, November 2013.
15. C. W. Rowley, **S. L. Brunton**, D. M. Luchtenburg, and M. O. Williams, “Coherent structure identification using flow map composition and spectral interpolation,” BIRS: Uncovering Transport Barriers in Geophysical Flows, September 2013.
14. D. M. Luchtenburg, **S. L. Brunton**, and C. W. Rowley, “Uncertainty propagation using spectral methods and flow map composition,” APS Division of Fluid Dynamics, November 2012.
13. S. T. M. Dawson, **S. L. Brunton**, and C. W. Rowley, “Feedback control of a pitching and plunging airfoil via direct numerical simulation,” APS Division of Fluid Dynamics, November 2012.
12. **S. L. Brunton** and C. W. Rowley, “Unsteady aerodynamic models for separated flows past a flat plate at $Re=100$,” APS Division of Fluid Dynamics, November 2011.
11. **S. L. Brunton**, C. W. Rowley, and D. R. Williams, “Linear unsteady aerodynamic models from wind tunnel measurements,” 41st AIAA Fluid Dynamics Conference and Exhibit, June 2011.
10. **S. L. Brunton**, and C. W. Rowley. “Low-dimensional state-space representations for classical unsteady aerodynamic models,” 49th AIAA Aerospace Sciences Meeting and Exhibit, Jan. 2011.
9. **S. L. Brunton** and C. W. Rowley, “State-space representation of unsteady aerodynamic models,” APS Division of Fluid Dynamics, November 2010.
8. **S. L. Brunton**, and C. W. Rowley, “Unsteady aerodynamic models for agile flight at low Reynolds numbers,” 48th AIAA Aerospace Sciences Meeting and Exhibit, Jan. 2010.
7. **S. L. Brunton** and C. W. Rowley, “Fast computation of Lagrangian coherent structures: algorithms and error analysis,” APS Division of Fluid Dynamics, November 2009.
6. **S. L. Brunton**, C. W. Rowley, S. R. Kulkarni, and C. Clarkson, “Maximum power point tracking for photovoltaic optimization using extremum seeking,” 34th IEEE Photovoltaic Specialist Conference, June 2009.
5. **S. L. Brunton** and C. W. Rowley, “Understanding bio-flight,” Thousand Islands Meeting, April 2009.
4. **S. L. Brunton**, and C. W. Rowley, “Modeling the unsteady aerodynamic forces on small-scale wings,” 47th AIAA Aerospace Sciences Meeting and Exhibit, Jan. 2009.
3. **S. L. Brunton** and C. W. Rowley, “A model for fast computation of FTLE fields,” APS Division of Fluid Dynamics, November 2008.
2. **S. L. Brunton** and C. W. Rowley, “Modeling unsteady aerodynamic forces on small-scale wings,” Thousand Islands Meeting, April 2008.
1. **S. L. Brunton**, C. W. Rowley, K. Taira, T. Colonius, J. Collins, and D. R. Williams, “Unsteady aerodynamic forces on small-scale wings: Experiments, simulations & models,” 46th AIAA ASM, Jan. 2008.

Contributed Posters and Movies

8. **S. L. Brunton**, J. N. Kutz, X. Fu, and M. C. Johnson, “Data-driven control of complex optical systems,” Nonlinear Optics, Hawaii, August, 2015.
7. T. Duriez, K. von Krbek, L. Cordier, B. R. Noack, J.-P. Bonnet, M. Segond, M. W. Abel, N. Gautier, J.-L. Aider, C. Raibaud, C. Cuvier, M. Stanislas, and **S. L. Brunton**, “Controlling turbulent flows in closed-loop using Machine Learning Control,” XIII Reunin sobre Recientes Avances en Fsica de Fluidos y sus Aplicaciones, Tandl, Argentina, 2014.
6. B. W. Brunton, A. L. Eberle, B. H. Dickerson, **S. L. Brunton**, J. N. Kutz, and T. L. Daniel, “Sensor placement for sparse sensory decision making,” COSYNE, Salt Lake City, February 2014.
5. **S. L. Brunton**, J. L. Proctor, and J. N. Kutz, “Compressive sensing and dynamic mode decomposition (DMD),” Moore-Sloan Data Science Poster and Networking Session, UW, February 2014.
4. **S. L. Brunton**, B. W. Brunton, A. Eberle, and J. N. Kutz, “Sparse sensing in mechanosensory systems,” BMES Annual Meeting, September 2013.
3. B. W. Brunton, **S. L. Brunton**, J. L. Proctor, and J. N. Kutz, “An adaptive sparse sampling approach to sensory decision making,” BMES Annual Meeting, September 2013.
2. **S. L. Brunton**, and C. W. Rowley, “Stirring faces: mixing in a quiescent fluid,” Gallery of Fluid Motion, APS Division of Fluid Dynamics, November 2012. arXiv:1210.3747 [physics.flu-dyn]
1. **S. L. Brunton**, and C. W. Rowley, “A Comparison of Methods for Fast Computation of FTLE Fields,” SIAM Conference on Applications of Dynamical Systems, May 2009.

Organized Seminars and Symposia

SIAM CSE17 Minisymposium

Data methods for complex systems

Co-Organizer, with Joshua Proctor And J. Nathan Kutz [2017]

SIAM Uncertainty Quantification 2016 Minisymposium

Data-driven dynamical systems

Co-Organizer, with Nathan Kutz [2016]

SIAM Control and Applications 2015 Minisymposium

Machine learning methods to control complex systems

Co-Organizer, with Bernd Noack [2015]

SIAM DS15 Minisymposium

Extensions and applications of dynamic mode decomposition

Co-Organizer, with Jonathan Tu [2015]

SIAM CSE15 Minisymposium

Data methods for complex systems

Co-Organizer, with Joshua Proctor And J. Nathan Kutz [2015]

SIAM CSE13 Minisymposium

Data-driven model reduction

Co-Organizer, with Joshua Proctor And J. Nathan Kutz [2013]

Boeing Distinguished Lectures in Applied Mathematics, University of Washington

Host seminar speakers and organize visit.

Co-Host, with Joel Zylberberg. Speakers selected and invited by J. Nathan Kutz. [Fall 2012-present]

Princeton Dynamical Systems and Applied Mathematical Modeling Lunchtime Seminar

Interdisciplinary seminar for graduate students; meets weekly with biweekly lectures

Co-Founder and Organizer, with Joshua Proctor [Fall 2008, 2009]

Service

Professional societies: SIAM, APS, AIAA, IEEE

Associate Editor for ACC SIAM Section, invited by Belinda Batten, Editor. [2015-2016]

Review papers (~70): *Proc. Nat. Acad. Sci.*, *Proc. Roy. Soc. Lon. A*, *J. Fluid. Mech.*, *J. Comp. Phys.*, *AIAA J.*, *J. Aircraft*, *IEEE TPEL*, *IEEE TVCF*, *IEEE TIE*, *Chaos*, *Energies*, *AJSE*, *J. Nonlin. Sci.*, *Sys. Cont. Lett.*, *Science Advances*, *Int. J. Rob. Non. Cont. Phys. Rev. E.*, *Theor. Comp. Fluid Dyn.*

Advisory committee for data analysis of underwater video data at PNNL. [2016]

Review committees: Mary Gates Research Scholarship Application Review [Fall, 2013]

UW committees: ME Qualifying exam reform committee (chair), ME Faculty hiring committee, ME S&D committee, eScience education curriculum committee.

Event manager: New Jersey Science Olympiad [2009, 2010]

Thesis committees: Mikala Johnson, Xing Fu, Bethany Lusch, Susie Sargsyan, Yian Ma, Donsub Rim, Trevor Harrison, Wei Guo, Emma Cotter.

Session chair at conferences: APS DFD (2013, 2014), SIAM CSE (2013), SIAM DS (2013), SIAM CSE (2015), SIAM DS (2015), SIAM CT (2015), SIAM UQ (2016), APS DFD (2016), SIAM CSE (2017).

Software

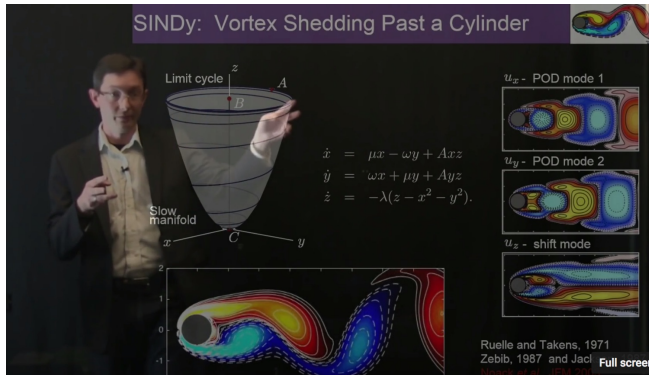
3. `eigenfish`, Developed by Seth Pendergrass, funded by DOE, 2016. [github.com/sethdp/eigenfish/]

2. `libssvd`, Developed by Seth Pendergrass, 2016. [github.com/sethdp/libssvd/]

1. `python-control`, led by Richard Murray, 2011. [sourceforge.net/projects/python-control/]

Video Outreach on YouTube

- ~ 1,000 Subscribers and ~ 65,000 views
- ~ 100 hours of educational content, including four courses, one bootcamp, and research abstracts



Mathematical Art

2. **S. L. Brunton**, “Mathematical Mountains,”
Princeton Art of Science Gallery, May 2011.
<http://crispme.com/art-of-science-2011/>
<http://butdoesitfloat.com/Mathematical-Mountains, 2011>



1. **S. L. Brunton** and C. W. Rowley, “Stirring Faces,”
Princeton Art of Science Gallery, May 2010.
<http://phys.org/news193333630.html>, May 2010.
Time Photo Essays, “Seeking Art in Science,” June 2010.
<http://arxiv.org/abs/1210.3747>
APS DFD Gallery of Fluid Motion, 2012.
(<http://www.youtube.com/watch?v=l3rtloOyh3I>)
Princeton Alumni Weekly, “Science as art,” April 2013.

