

# ADITYA G. NAIR

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## RESEARCH INTERESTS

- Computational fluid dynamics, hydrodynamic stability, flow separation control & network science.
- Data-driven model reduction & optimal feedback control of high-dimensional dynamical systems.
- Network-based inference, modeling & control of complex systems.

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## AFFILIATIONS

**University of Nevada, Reno, NV**

*starting August 2020*

Assistant Professor Aerospace Engineering (Tenure Track)

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## EDUCATION

**University of Washington, Seattle, WA**

*August 2018 - July 2020*

Post-Doctoral Research Associate

Department of Mechanical Engineering

Advisors: Dr. Steven L. Brunton & Dr. Bingni W. Brunton

**Florida State University, Tallahassee, FL**

*May 2013 - July 2018*

Ph.D. in Mechanical Engineering

GPA: 4.0

Advisor: Dr. Kunihiko Taira

Thesis: Network-theoretic analysis and control of unsteady fluid flows.

**University of Michigan, Ann Arbor, MI**

*August 2011 - April 2013*

M.S. in Mechanical Engineering

GPA: 3.82

Advisor: Dr. Eric Johnsen

**University of Mumbai, India**

*August 2007 - June 2011*

B.E. in Mechanical Engineering

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## JOURNAL PUBLICATIONS

1. **A. G. Nair**, B. Strom, B. W. Brunton & S. L. Brunton, “Phase-consistent dynamic mode decomposition from multiple overlapping spatial domains”, *Phys. Rev. Fluids* (accepted), 2020.
2. **A. G. Nair**, B. R. Noack, C. A. Yeh, E. Kaiser, S. L. Brunton & K. Taira, “Cluster-based feedback control of turbulent post-stall separated flows,” *J. Fluid Mech.* 875, 345-375, 2019.
3. P. Woerner, **A. G. Nair**, K. Taira & W. S. Oates, “Sparsification of long range force networks for molecular dynamics simulations,” *PLoS ONE* 14(4), 2019.
4. **A. G. Nair**, S. L. Brunton, & K. Taira, “Networked oscillator-based modeling and control of unsteady wake flows,” *Phys. Rev. E*, 97 (063107), 2018.
5. M. G. Meena, **A. G. Nair**, & K. Taira, “Network community-based model reduction for vortical flows,” *Phys. Rev. E*, 97 (063103), 2018.
6. K. Taira, **A. G. Nair**, & S. L. Brunton, “Network structure of two-dimensional decaying isotropic turbulence,” *J. Fluid Mech.* 795, R2, 2016.
7. **A. G. Nair** & K. Taira, “Network-theoretic approach to sparsified discrete vortex dynamics,” *J. Fluid Mech.* 768, 549-571, 2015.

## CONFERENCE PUBLICATIONS

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1. P. Woerner, **A. G. Nair**, K. Taira, & W. Oates, “Network Theoretic Approach to Atomistic Material Modeling Using Spectral Sparsification”, *In Proceedings of the ASME 2017 Conference on Smart Materials, Adaptive Structures and Intelligent Systems*, Snowbird, Utah, September 18-20, 2017.
2. **A. G. Nair**, K. Taira, & S. L. Brunton, “Oscillator network based control of unsteady fluid flows”, *20th World Congress of the International Federation of Automatic Control*, Toulouse, France, July 9-14, 2017.
3. K. Taira, **A. G. Nair**, and S. L. Brunton, “Complex Network Analysis of Unsteady Fluid Flows,” *XXIV International Congress of Theoretical and Applied Mechanics*, Montreal, August 21-26, 2016.
4. Y. Sun, **A. G. Nair**, K. Taira, L. N. Cattafesta, G. A. Bres, & L. S. Ukeiley, “Numerical Simulations of Subsonic and Transonic Open-Cavity Flows”, *44th AIAA Theoretical Fluid Mechanics Conference*, Atlanta, June 16-20, 2014.
5. E. Johnsen, L. Khieu, & **A. G. Nair**, “A Simple Method to Improve the Accuracy of Advection in Discontinuous Galerkin Methods for Navier-Stokes Simulations”, *52nd AIAA Aerospace Sciences Meeting*, National Harbor, Maryland, January 13-17, 2014.
6. E. Johnsen, S. Varadan, & **A. G. Nair**, “Recovery Discontinuous Galerkin Method for Compressible Turbulence”, *21st AIAA Computational Fluid Dynamics Conference*, San Diego, California, June 24-27, 2013.

## IN REVIEW (JOURNAL)

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1. **A. G. Nair**, K. Taira, B. W. Brunton & S. L. Brunton, “Phase-based unsteady control of vortex shedding”, arXiv preprint arXiv:2004.10561, 2020.

## IN PREPARATION (JOURNAL)

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1. **A. G. Nair**, M. Hickner, S. L. Brunton, & B. W. Brunton, “Robust aerodynamic control of aeroelastic structures”.
2. **A. G. Nair**, S. L. Brunton, & B. W. Brunton, “Active learning of network interactions”.

## CONFERENCE TALKS

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1. **A. G. Nair**, B. R. Noack, C. A. Yeh, E. Kaiser, S. L. Brunton & K. Taira, ‘Design of feedback control laws for turbulent post-stall separated flows,’ *SIAM Conference on Applications of Dynamical Systems*, Snowbird, May 19-23, 2019.
2. **A. G. Nair**, K. Taira, & S. L. Brunton, “Data-driven feedback control strategies for unsteady flows,” *SIAM Conference on Computational Science and Engineering*, Spokane, Feb. 25-Mar. 1, 2019.
3. **A. G. Nair**, B. R. Noack, C. A. Yeh, E. Kaiser, S. L. Brunton & K. Taira, “Optimal cluster-based feedback control for separated flows,” *71th Annual Meeting of the APS Division of Fluid Dynamics*, Atlanta, Nov. 18-20, 2018.
4. K. Taira, **A. G. Nair**, and C.-A. Yeh, “Modal Analysis Based Characterization, Modeling, and Control of Fluid Flows,” *JSASS 50th Fluid Dynamics Conference/36th Aerospace Numerical Simulation Symposium*, Miyazaki, Japan July 4-6, 2018.

5. **A. G. Nair**, B. R. Noack, C.-A. Yeh, E. Kaiser, S. L. Brunton, and K. Taira, “Local characterization of feedback control laws for unsteady wake flows,” *SIAM Annual Meeting*, Portland, July 9-13, 2018.
6. **A. G. Nair**, K. Taira, and S. L. Brunton, “On extracting vortical and modal networks in unsteady fluid flows,” *2nd Machine Learning Control Workshop*, Valenciennes, July 5-6, 2017.
7. **A. G. Nair**, K. Taira, & S. L. Brunton, “Data-based extraction of modal interaction networks,” *SIAM Conference on Computational Science and Engineering*, Atlanta, Feb. 27-Mar. 3, 2017.
8. M. Gopalakrishnan Meena, **A. G. Nair**, and K. Taira, “Network Representation and Analysis of Bluff Body Wake,” *SIAM Conference on Computational Science and Engineering*, Atlanta, Feb. 27-Mar. 3, 2017.
9. **A. G. Nair**, M. Gopalakrishnan Meena, and K. Taira, “Vortical and Modal Network Analysis of Unsteady Cylinder Wake,” *69th Annual Meeting of the APS Division of Fluid Dynamics*, Portland, Nov. 20-22, 2016.
10. 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, Sep. 26-28, 2016 (in Japanese).
11. **A. G. Nair**, K. Taira, & S. L. Brunton, “Network-theoretic analyses of vortex dynamics,” *SIAM Annual Meeting*, Boston, July 11-15, 2016.
12. K. Taira, **A. G. Nair**, & S. L. Brunton, “Structure and resilience of two-dimensional fluid flow networks,” *SIAM Uncertainty Quantification*, Lausanne, Switzerland, April 5-8, 2016.
13. **A. G. Nair** & K. Taira, “Network-based representation of energy transfer in unsteady separated flow,” *68th Annual Meeting of the APS Division of Fluid Dynamics*, Boston, Nov. 22-24, 2015.
14. K. Taira, **A. G. Nair**, & S. L. Brunton, “Network structure of two-dimensional homogeneous turbulence,” *68th Annual Meeting of the APS Division of Fluid Dynamics*, Boston, Nov. 22-24, 2015.
15. **A. G. Nair** & K. Taira, “Using Dynamic mode decomposition to extract dominant linear global modes from nonlinear fluid flow solvers” *SIAM Conference on Applications of Dynamical Systems*, Snowbird, May. 17-21, 2015.
16. K. Taira & **A. G. Nair**, “Sparsified-dynamics modeling of discrete point vortices with graph theory,” *67th Annual Meeting of the APS Division of Fluid Dynamics*, San Francisco, Nov. 23-25, 2014.
17. **A. G. Nair** & K. Taira, “Network-theoretic approach to model vortex interactions,” *67th Annual Meeting of the APS Division of Fluid Dynamics*, San Francisco, Nov. 23-25, 2014.
18. **A. G. Nair**, E. Johnsen, & Sreenivas Varadan, “Assessing the Recovery-based Discontinuous Galerkin Method for Turbulence Simulations.”, *65th Annual Meeting of the APS Division of Fluid Dynamics*, San Diego, 2012.

## INVITED TALKS

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1. **A. G. Nair**, S. L. Brunton, & K. Taira, “Oscillator and cluster-based control for unsteady fluid flows,” *AIAA Aviation and Aeronautics Forum and Exposition*, Reno, June 15-19, 2020 (upcoming).
2. **A. G. Nair**, “Data-driven control strategies for unsteady wake flows,” US-Japan Workshop on Data-Driven Fluid Dynamics, Kobe, Japan, Mar. 12-14, 2020 (upcoming).

3. **A. G. Nair** “Data-driven modeling and control strategies,” *Telluride Neuromorphic Cognition Engineering Workshop*, Telluride, June 30-July 19, 2019.
4. **A. G. Nair**, K. Taira, & S. L. Brunton, “Network-theoretic approaches for characterizing, modeling, and controlling fluid flows,” *AIAA Aviation and Aeronautics Forum and Exposition*, Denver, June 5-9, 2017.

## TEACHING

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### **Instructor, University of Nevada, Reno**

- ME482/682 - Aerodynamics, Fall 2020.

### **Co-instructor, University of Washington** (with S. L. Brunton)

- ME565 - Mechanical Engineering Analysis, Winter 2019.

### **Teaching Assistant, Florida State University**

- EML4930 - Numerical Methods for Engineers, (Spring 2014, Spring 2015, Spring 2016).
- EML4930/5930 - Network Analysis (Fall 2015, Fall 2017).

### **Teaching Assistant, University of Michigan**

- ME 336 - Thermodynamics II, Winter 2013.

## ORGANIZED MINISYMPOSIA AND WORKSHOPS

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1. **A. G. Nair** & T. Delbruck, “Learning to control,” *Telluride Neuromorphic Cognition Engineering Workshop*, Telluride, June 28-July 17, 2020 (upcoming).
2. T. Delbruck, A. Ames, R. Gehlhar, **A. G. Nair**, M. Cook and T. Lewis, “Controlling dynamical systems,” *Telluride Neuromorphic Cognition Engineering Workshop*, Telluride, June 30-July 19, 2019.
3. E. Kaiser & **A. G. Nair**, “Novel Perspectives on Turbulence Modeling and Control,” *SIAM Conference on Applications of Dynamical Systems*, Snowbird, May. 19-23, 2019.

## SERVICE

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**Professional societies:** SIAM, APS, AIAA.

**Review papers:** J. Fluid Mech., AIAA, IEEE, JSME, Phys. Rev. Fluids, Phys. Rev. Letters, Energies.

**Session chair:** APS-DFD (2019), SIAM DS (2019).

## FUNDING AND AWARDS

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- DoD High Performance Computing Modernization Program (5 million CPU hours), 2016-2018.
- Aero-Propulsion, Mechatronics and Energy Fellowship, 2013-2014.
- Kulpati Gold Medal, 2010-2011.
- Ratan Tata Trust Scholarship, 2009-2010.