Kiran Bhaganagar
Professor, Department of Mechanical Engineering
Associate Fellow American Institute of Aeronautics & Astronautics (AIAA)
Director for Laboratory of Turbulence, Sensing & Intelligent Systems
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a. Professional Preparation

Cornell University   Mechanical Engineering   Doctor of Philosophy, 2001

b. Appointments

2021-   Professor, Department of Mechanical Engineering, University of Texas,
           San Antonio, TX.

2021-   Director, NASA Center for Advanced Measurements in Extreme Events, University
           of Texas, San Antonio, TX

2019-todate.   Faculty, NASA Center for Advanced Measurements in Extreme Events.

2015-todate   Associate Professor, Department of Mechanical Engineering, University of
           Texas, San Antonio, TX

2009-2015   Assistant Professor, Department of Mechanical Engineering, University of
           Texas at San Antonio

2008-2009   Assistant Research Scientist, University of Michigan, Ann Arbor. MI

2004-2008   Assistant Professor, University of Maine, Orono, ME

2001-2004   Postdoctoral Research, University of California, Los Angeles, CA

Awards
- American Institute of Aeronautics and Astronautics (AIAA), Associate Fellow
- American Physics Society Women Physicist Award, April 2017
- Invited Visiting Professor, Laboratoire des Écoulements Géophysiques et Industriel, LEGI, Grenoble, France, Aug-Dec 2017
- Elected Technical Committee member of Fluid Dynamics, American Institute of Aeronautics and Astronautics (2017-)
- NSF Panel Fellow Cohort for CMMI's Game Changer Academies (CGCA) for Advancing Research Innovation, 2022

c. Products

(i)   Book

Armistead Russell, Kiran Bhaganagar, Bart Croes, Joost De Gouw, Robert Yamartino, Qi Yang,
National Academies of Sciences, Engineering, and Medicine 2019. Review of the Bureau of Ocean

Energy Management "Air Quality Modeling in the Gulf of Mexico Region" Study. Washington, DC: The National Academies Press. https://doi.org/10.17226/25600. Paperback ISBN: 978-0-309-49880-7

(ii) Editorials:

Editor, Physics of Fluids, Special Issue - A tribute to the lasting legacy of John Lumley in turbulence, February 2017.

(iii) Publications as Corresponding Author with students as co-authors

1. Tyrell Lewis and Kiran Bhaganagar, Configurable simulation strategies for testing pollutant plume source localization algorithms using autonomous multi-sensor mobile robots, International Journal of Advanced Robotic Systems, 2022

2. Kiran Bhaganagar, Prasanna Kolar, Syed-Hasib-Akhter Faruqui, Diganta Bhattacharjee, Adel Alaeddini, Kamesh Subbarao, A novel machine-learning framework with a moving platform for maritime drift calculations, Frontiers in Marine Sciences, 2022

3. Chang Chen and Kiran Bhaganagar, Fundamental framework of turbulence processes in Atmospheric Buoyant Thermal Plumes, Journal of Fluid Mechanics, 2022 – Part 1

4. Thanh Tran and Kiran Bhaganagar, PyPlume- A Python Framework for Characterization of Turbulent Plumes, Journal of Environmental Software, 2022.

5. Chang Chen and Kiran Bhaganagar, New Findings in Vorticity Dynamics of Turbulent Buoyant Plumes, Physics of Fluids, 33, 115104, 2021.

6. Jesse Slaten and Kiran Bhaganagar, Entrainment formulation for Buoyant plumes- WRF LES approach, Journal of Atmospheric Sciences, Submitted, 2021

7. Thanh Tran and Kiran Bhaganagar, The four stage development of starting Buoyant plumes, Proceedings of the ASME 2021, Fluid Engineering division Summer Meeting, FEDSM2021-65540, August 10-12 2021.

8. Daniel Brun and Kiran Bhaganagar, Use of Quadcopter UAV Multirotor for ABL Wind and Temperature Measurements, AIAA Aviation Forum 2021-2941

9. Victor Martinez and Kiran Bhaganagar, Computational Fluid Dynamic analysis of the flow around a propeller blade of multirotor unmanned aerodynamic vehicle, Proceedings of the ASME 2021, Fluid Engineering division Summer Meeting, FEDSM2021-65771, August 10-12 2021.

10. S. Bhimireddy, K Bhaganagar. Implementing a new formulation in WRF-LES for Buoyant Plume Simulations: bPlume-WRF-LES model, Monthly Weather Review, 149(7):2200-2310: 2021

11. Rajitha Meka, Adel Alaeddini and Kiran Bhaganagar, A robust deep learning framework for short-term wind power forecast of a full-scale wind farm, 221, 119759 Energy, 2021.

12. Tyrell Lewis and Kiran Bhaganagar, A Comprehensive Review of Plume Source Localization Efforts Using Unmanned Vehicles for Environmental Sensing Information Fusion, Science of the total Environment, Vol 762, 2021

13. Diganta Bhattacharjee, Kamesh Subbarao and Kiran Bhaganagar, Reachable Set Estimation for Discrete-Time Nonlinear Systems Using Ellipsoidal Set-Membership Frameworks, AIAA Scitech 2021 Forum. AIAA 2021-1459. January 2021.

14. Bhaganagar K. A physics-based mathematical model to understand the aerosol transmission risk of COVID-19. J Med Sci Res. 2020; 8(S1):3-5.

15. Kiran Bhaganagar & Sudheer Bhimireddy, Local Atmospheric Factors that enhance Air-borne Dispersion of Coronavirus - High-fidelity Numerical Simulation of COVID19 case study in Real-Time, Environmental Research, Vol 191, 110170, 2020.

16. Kiran Bhaganagar and Sudheer BhimiReddy, Numerical Investigation of starting turbulent buoyant plumes released in Neutral atmosphere. Journal of Fluid Mechanics, V900, A32, 2020.

17. Jordan Nielson, Kiran Bhaganagar, Rajitha Meka, A. Alaeddini, Using atmospheric inputs for Artificial Neural Networks to improve wind turbine power prediction, Energy,190:117263, 2020

18. Kamesh SubbaRao and Kiran Bhaganagar, Nonlinear Model Predictive Control based Cooperative Plume Tracking using Unmanned Aerial Vehicles, *AIAA Science and Technology Forum and Exposition* 2019

19. Sudheer, R. Bhimireddy & Kiran Bhaganagar, Performance Assessment of Dynamic Downscaling of WRF to Simulate Convective Conditions during Sagebrush Phase I Tracer Experiments, *Atmosphere*, 2018

20. Jordan Nielson & Kiran Bhaganagar, Capturing Day to Day Diurnal Variations of Stability in the Convective Atmospheric Boundary Layer Using Large Eddy Simulation, *The open Atmospheric Science Journal* 2018

21. Jordan Nielson & Kiran Bhaganagar, Using Field-data based Large Eddy simulation to understand role of atmospheric stability on energy production (EP) of wind turbines, *Wind Engineering*, 2018

22. Sudheer R. Bhimireddy & Kiran Bhaganagar, Short-term passive tracer plume dispersion in convective boundary layer using a high-resolution WRF-ARW model, *Atmospheric Pollution Research, 9:901-911, 2018*

23. Kiran Bhaganagar & Narasimha Rao Pillalamarri, Lock-Exchange Release density currents over 3-D regular roughness elements, *Journal of Fluid Mechanics*, 2017

24. Manjura Nayamatullah, Narasimha Rao Pillalamarri & Kiran Bhaganagar, Large-Eddy-Simulation Approach in Understanding flow structures of 2-D Turbulent Density Currents over sloping surfaces, *Fluid Dynamics Research*, 2017

25. Kiran Bhaganagar & Sudheer BhimiReddy, Assessment of the plume dispersion due to chemical attack on April 4, 2017, in Syria, *Natural Hazards*, 2017

26. Kiran Bhaganagar, Role of head of turbulence 3-D density currents in mixing during slumping regime, *Physics of Fluids*, 020703, 2017

27. Kiran Bhaganagar, Tom Gatski and Will George, Preface to special-topic: A tribute to John Lumley, *Physics of Fluids*, 020501, 2017

28. Kiran Bhaganagar et al, Editorial: Tributes to the lasting legacy of John Leask Lumley in turbulence: A perfect man in an imperfect world, *Physics of Fluids,* 020601, 2017

29. Kiran Bhaganagar and Mithu Debnath, Effect of Mean Atmospheric Forcings of Stable Atmospheric Boundary Layer on Wind Turbine Wake, *Journal of Renewable and Sustainable Energy*. 2015.

30. Kiran Bhaganagar and Mithu Debnath, Implications of stably stratified atmospheric boundary layer turbulence on near-wake structure of wind turbine, *Energies*, 2014.

31. Kiran Bhaganagar and Long Chau, Characterizing turbulent flow over 3-D idealized and irregular rough surfaces at low Reynolds number, *Applied Mathematical Modeling*, 2014.

32. Kiran Bhaganagar, Direct numerical simulation of lock-exchange density currents over rough wall in slumping phase, *Journal of Hydraulic Research*, 2014.

33. Kiran Bhaganagar and Carlos Moreno, Modeling of Stenotic coronary artery and implications of plaque morphology on blood flow, *Modelling and Simulation in Engineering*, Volume 37, Issue 7, Pages 5381–5393, 2013

34. Kiran Bhaganagar, Chetan Veeramachaneni, Carlos Moreno, Significance of plaque morphology in modifying flow characteristics in a diseased coronary artery: Numerical simulation using plaque measurements from intravascular ultrasound imaging, *Applied Mathematical Modeling*, 37(7):5381-5393, 2013

35. Kiran Bhaganagar and Richard Leighton, Three level decomposition for the analysis of turbulent flow over rough-walls, *Journal of Applied Fluid Mechanics*, 6(2):257-265,2012

36. Long Chau and Kiran Bhaganagar, Understanding turbulent flow over ripple-shaped random roughness in a channel, *Physics of Fluids* 24, 115102, 2012

37. Kiran Bhaganagar and Vejapong Juttijudata, Turbulent time-events in channel with rough walls, *Theoretical and Computational Fluid Dynamics*, December 2012, Volume 26, Issue 6, pp 583–589, 26(6): 583-589,

38. Richard Leighton and Kiran Bhaganagar Turbulence production by rough boundaries, 16th *USNCTAM* 2010:1173, June,2010.

39. K. Bhaganagar, R. Beaumont, B. Segee and B. Ozer, Using fuzzy logic for Morphological Classification of IVUS-based plaques in Coronary artery in the context of hydrodynamics, *Soft Computing*, 14: 265, 2010.

40. K. Bhaganagar Direct numerical simulation of flow in stenotic channel to understand the effect of stenotic morphology on turbulence, *Journal of Turbulence*, N41, Volume 10, 2009

41. K. Bhaganagar and T. Hsu, Direct Numerical simulations of flow over two-dimensional and three-dimensional ripples and implication to sediment transport: Steady flow, *Coastal Engineering*, Volume 56, Issue 3, March 2009, Pages 320–331

42. K. Bhaganagar, Direct numerical simulation of unsteady flow in channel with rough walls, *Physics of Fluids* 20, 101508 (2008)

43. M. Sen, K. Bhaganagar and V. Juttijudata, Application of proper orthogonal decomposition (POD) to investigate a turbulent boundary layer in a channel with rough walls, *Journal of Turbulence,* Article: N41: Vol 8, 2007

44. K. Bhaganagar, J. Kim and G. Coleman, "Effect of roughness on pressure fluctuations in a turbulent boundary layer", *Physics of Fluids*, 028103, 2007

45. K. Bhaganagar, J. Kim and G. Coleman, Effect of Roughness on wall bounded turbulence, *Flow, Turbulence and Combustion,* July 2004, Volume 72, Issue 2, pp 463–492,2004

46. K. Bhaganagar, D. Rempfer and J.L. Lumley, Direct Numerical Simulation of Spatial Transition to Turbulence using Fourth-Order Vertical Velocity Second-Order Vertical Vorticity Formulation, *Journal of Computational Fluid Dynamics*, Volume 180, Issue 1, 20 July 2002, Pages 200-228, 2002

 (iii) **Recent Invited and International Talks**
- Buoyant Turbulent Plumes: UTSA Wildland fire WRF-LES bplume model, UTSA WRF-LES-bplume model for WildFires" at the USFS NOAA Fire Weather Research MOU WG Meeting on Dec 9 2021
- "Extreme Computing and Extreme Events in the Environment" at the IXPUG Annual Conference 2021,Oct 19-21, 2021, Keynote, https://www.ixpug.org/ixpug-2021
- Overview of NASA CAMEE Research and the Artemis Mission, 2ⁿᵈ Annual Conference of Center for Advanced Measurements in Extreme Events, San Antonio, TX, August 2021
- Novel Sensing and machine learning for drift prediction of objects in the ocean subject to wind and wave forcings, UTSA Distinguished Lecture, November 2020.
- Implementation of buoyancy forcings using WRF-LES for Wildland Fire plumes, TACC Symposium, October, 2020
- Grand Vision for Wind Energy, NAWEA WindTech Amherst, MA, 2019, Machine Learning Approach towards short term forecasting of wind turbine power production.
- University di Roma tre, Rome, Italy, November 2017, Entrainment and mixing in ocean and role of lock-exchange release turbulent flows.
- University of Lorraine, Nancy, France, October 2017, Framework of density currents over roughness

- Barcelona Supercomputing Center, Barcelona, Spain, October 2017, Understanding turbulence mixing in oceanic and atmospheric flows from Simulations to UAV's
- Laboratoire des Écoulements Géophysiques (LEGI), Grenoble. France, October 2017, Understanding role of roughness effects on turbulence mixing in Turbulence buoyancy driven flows
- European Turbulence Conference (ETC16), Stockholm, Sweden, August 2017, Density currents over rough-walls: Relation between drag and mixing.
- European Geophysical Unit, Vienna, April 2017, Few thoughts on Mixing and Entrainment of Lock-Release Turbulent Dense Currents over Rough-Surfaces
- 11th International ERCOFTAC Symposium on Engineering Turbulence Modeling and Measurements, Palermo, Sicily, Italy, September 2016, Framework for Buoyancy-Driven Flows using Large Eddy Simulations.
- EGU, Vienna, April 2016, Numerical investigation of entrainment of dense currents
- Whither turbulence and big data, Cargese Institute, Corsica, April 2015, Effect of roughness on turbulence from lab-scales to atmospheric scales.
- Work Shop on Challenges in Wind Energy: Future directions & Role of Wake Effects, August 9th, Pollachi, Coimbatore, India, 2015
- Towards improved prediction of wakes of wind turbines, International Conference on Renewable Energy and Sustainable Environment, August 10-13,Pollachi, Coimbatore, India, 2015
- Towards improved prediction of wake-wake interactions of wind turbine, Iowa State University, Ames, Iowa, 04/22/2014
- Understanding density currents over rough-topography, Symposium on Fluid Dynamics, San Juan Puerto Rico, November 2013.

(iii) **Conference Presentations**

- Ishan Bhattarai and Kiran Bhaganagar, Effect of Roughness on Entrainment of Turbulent Buoyant Flows, 74th Annual Meeting of the APS Division of Fluid Dynamics, Phoenix, Arizona, November, 2021
- Chang Chen and Kiran Bhaganagar, Vortical Structures in Turbulent Buoyant Plumes, 74th Annual Meeting of the APS Division of Fluid Dynamics, Phoenix, Arizona, November, 2021
- Pratik Mitra and Kiran Bhaganagar, Direct Numerical simulations of rough wall-bounded turbulence over unsteady channel flows, 74th Annual Meeting of the APS Division of Fluid Dynamics, Phoenix, Arizona, November, 2021
- Jesse Slaten and Kiran Bhaganagar, Turbulent Entrainment in Buoyancy Driven Flows in a stratified environment using WRF-LES. 74th Annual Meeting of the APS Division of Fluid Dynamics, Phoenix, Arizona, November, 2021
- Daniel Brun and Kiran Bhaganagar, Flow calculations of Forces Buoyant Plumes using infra-red Gas visualization. 74th Annual Meeting of the APS Division of Fluid Dynamics, Phoenix, Arizona, November, 2021
- Thanh Tran and Kiran Bhaganagar, Video: Starting Turbulent Plumes – Formation and Growth. 74th Annual Meeting of the APS Division of Fluid Dynamics, Phoenix, Arizona, November, 2021
- Meka, R. K. Bhaganagar & A. Alaeddini. (2020). A Deep Learning Framework for Forecasting Power in a Full-Scale Wind Farm, 100th, American Meteorological Society Annual Meeting, Boston, MA, January 16th-19th,2020.
- S. BhimiReddy, K. Bhaganagar (2020). New Implementation of Buoyant Transport and Dispersion in Weather Research & Forecast's Large-Eddy Simulation Framework, 100th, American Meteorological Society Annual Meeting, Boston, MA, January 16th-19th,2020.

- D. Brun, S. BhimiReddy and K. Bhaganagar, Plume Chamber studies to characterize Turbulent Buoyant Plumes using multiple sensors, Bulletin of the American Physical Society, APS-DFD, Seattle, 2019
- S. BhimiReddy and K. Bhaganagar, Bulletin of the American Physical Society, APS-DFD, Seattle, 2019
- Nielson, J. & Bhaganagar, K. (2018). Using Artificial Neural Networks and the Rapid Refresh Model for Wind Energy Forecasting, 71st Annual Meeting of the APS Division of Fluid Dynamics, November 18–20, 2018; Atlanta, Georgia
- Brun, D. Bhimireddy, S. & Bhaganagar, K. (2018). Flow Calculations of Forced Buoyant Plume using Infrared Gas-Visualization, 71st Annual Meeting of the APS Division of Fluid Dynamics, November 18–20, 2018; Atlanta, Georgia
- Bhimireddy, S., Brun, D. & Bhaganagar, K. (2018). Investigation of mean scalar characteristics of vertical buoyant gas plume inside a gas chamber with multiple sensors, 71st Annual Meeting of the APS Division of Fluid Dynamics, November 18–20, 2018; Atlanta, Georgia
- Bhaganagar, K., & Reddy, S. (2016). Simulation of plume rise: Study the effect of stably stratified turbulence layer on the rise of a buoyant plume from a continuous source by observing the plume centroid (20th ed., vol. 61). 69th Annual Meeting of the APS division of Fluid Dynamics, Portland, Oregon, November 2016.
- Bhaganagar, K., & Nielson, J. (2016). Using Reconstructed POD Modes as Turbulent Inflow for LES Wind Turbine Simulations (20th ed., vol. 61). 69th Annual Meeting of the APS division of Fluid Dynamics, Portland, Oregon, November 2016.
- J. Nielson and K. Bhaganagar, Towards LES Modeling of the Diurnal Cycle from Field Data Inputs, WindFarms-2016,,Dallas, April, 2016
- J. Nielson and K. Bhaganagar,, Using LES to Understand Wake Evolution During Diurnal Cycle, 9-15-1 15th International Symposium on Measurement and Modeling of Environmental Flows, International Mechanical Engineering Congress and Exposition, November 13-19, 2015, Houston, Texas.
- K. Bhaganagar, M. Naymatullah, C. Cenedese, AGU Annual Meeting, San Francisco, 2014.
- K. Bhaganagar and F. Hussain, Vortex structures in wind turbine wake due to atmospheric stratification, 67th APS-DFD, San Francisco, 2014.
- K. Bhaganagar, Jordan Nielson and Mithu Debnath, Turbulence in wind turbine wake: Effect of atmospheric forcings, ASME Congress of Mechanical Engineering and exposition, Montreal, 2014.
- K. Bhaganagar, J. Nielson* and M. Debnath*, Turbulence in wind turbine wake, Effect of atmospheric forcings, , November 14-20, Fluid Dynamics meeting, Canyon Lake Texas, 2013
- K. Bhaganagar and R. Chowdhury, Buoyancy driven turbulent flows over irregular rough surfaces, 65th Annual Meeting of the APS Division of Fluid Dynamics November 18-20, 2012; San Diego, California
- C. Moreno and K. Bhaganagar, Patient specific flow dynamic simulations of flow in diseased coronary artery, 65th Annual Meeting of the APS Division of Fluid Dynamics November 18-20, 2012; San Diego, California
- G. Sloan, Z. Feng, K. Bhaganagar and D. Benerjee, Numerical simulation of nanoparticle simulation with experimental validation, 65th Annual Meeting of the APS Division of Fluid Dynamics November 18-20, 2012; San Diego, California
- K. Bhaganagar, Buoyancy driven flows and application to environmental flows, Collaborative Initiative for Wind Turbine Research, Lubbock, Texas, March 2012
- K. Bhaganagar, Direct numerical simulations of density currents over rough surfaces, APS-DFD, Baltimore, MD, 2011
- L. Chau and K. Bhaganagar, Direct numerical simulations of flow over ridges in the presence of waves and current, 63rd APS-DFD, Long Beach, CA, 2010
- K.Bhaganagar, R. Leighton, An Analytical framework for the study of rough-wall turbulent

boundary layer, 63rd APS-DFD, Long Beach, CA, 2010
- ❖ R. Leighton and K.Bhaganagar, Turbulence production by rough boundaries, 2010, State College, PA, June, 2010
- ❖ K. Bhaganagar, V. Juttijudata, M. Sen, Further insight into physics of rough-wall turbulent boundary layer" 61st APS-DFD, Washington, D.C., 2008

iv.   Intellectual Property and Patents

Kiran Bhaganagar, Prasanna Kolar, Sudheer Bhimireddy and Jordan Nielson, *Mobile- RTEC: Low cost mobile environmental sensing system with remote access in real-time*, Patent Filed October 2018.

Kiran Bhaganagar, Sudheer Bhimireddy, Prasanna Kolar, Victor Canseso, Danial Brun, *Experimental facility for generation, measurement and visual detection of vertical momentum and buoyancy driven plumes*. Patent Filed November 2018

d.   Synergistic Activities

1. Technical Committee of Fluid Dynamics, AIAA, member (national level)
2. Technical committee of National Academy of Science, NAS Board on Atmospheric Science and Climate
3. Organizer Aviation conference, AIAA 2018, 2019
4. Editorial Role: Editor, Special Issue, Physics of Fluids (March, 2017), Tribute to Legacy of John Lumley
5. Associate Editor: Progress in Computational Fluid Dynamics, Journal of Flow Visualization and Imaging.
6. Mentorship: So far I have trained I have mentored 16 graduate research assistants, 24 undergraduate research assistants and 11 graduate teaching assistants. Of which, 6 of them are from minority population. These students are minority students and most of them are the first in their families to be educated for higher education. I work as unofficial mentor for women undergraduate students. There are two manuscripts in preparation with undergraduate students as co-authors.
7. Workshop Organizer: Texas, Annual Fluid Dynamics (2013,2014,),
8. Administrative role: Chair, Graduate Student Committee (2013-2017), Committee member for F&A of Mechanical Engineering (2012-2017), Graduate Committee (2010-2017), Undergraduate Committee (2010-2012), Faculty development, Mentor for underrepresented women and minority in education in Women's resource center (2010-2017)
9. Federal Agency Proposal Reviewer: Reviewer and Panel member for NSF TUES proposals (2011), NSF SBIR (02/2014), NSF GRF (02/2014, 2015, 2016), NSF CBET(04/2014, 2015, 2016), Reviewer for Nuclear Energy University Programs Proposals (03/2010, 03/2011)

e.   Summary

Bhaganagar had rigorous training as a Ph.D. student under the guidance Prof John Lumley, world's leading experts on turbulence. Bhaganagar's expertise is in the area of turbulence model development for atmospheric plumes, rough-wall turbulent boundary layer, leeway drag due to the

combined interactions of wind and wave turbulence. Recently, Bhaganagar served as a principal investigator for the following: United States Coastal Guard, Integrated high-fidelity approach towards improved leeway drift prediction, NASA MIRO Center for Advanced Measurements in Extreme Environments; US Army, Novel Technology for detection and prediction of spreading of air-borne chemical agent. Bhaganagar has contributed to numerical tools, including WRF-LES to simulate 2-way feedback between the ABL and the plume, DNS of rough-wall turbulent channel flow, LES of wake effects of wind turbine, a novel technology for leeway detection due to the interaction of wind and current