SACHIT BUTAIL

Email: sachitb@gmail.com
http://sach1tb.freeshell.org

Professional preparation

Postdoctoral training, 7/2012 – 6/2014	Dynamical Systems, Robotics, Animal Behavior	New York University, Brooklyn, NY, USA
Ph.D., 2012	Aerospace Engineering	University of Maryland, College Park, MD, USA
M.Eng., 2005	Systems Engineering	Cornell University, Ithaca, NY, USA
B.E., 2000	Mechanical Engineering	Delhi College of Engineering, Delhi University, New Delhi, India

Academic Appointments

08/2016— **Assistant Professor**, Department of Mechanical Engineering, Northern Illinois University, DeKalb, IL, USA

07/2014—12/2015 **Assistant Professor,** Indraprastha Institute of Information Technology Delhi (IIIT-Delhi), New Delhi, India.

Other Appointments

03/2016—07/2016 **Visiting Scholar,** Johns Hopkins University, Baltimore, MD, USA

06/2015—08/2015 **Visiting Professor**, New York University, Brooklyn, NY, USA

08/2000—08/2004 **Systems Engineer, Analyst**, Tata Consultancy Services, Delhi, India

Publications[1]

Journal

1. S. Butail, *V. Mwaffo*, and M. Porfiri. Model-free information-theoretic approach to infer leadership in pairs of zebrafish. *Physical Review E,* **93**(4) 042411*,* 2016

2. T. Bartolini, *V. Mwaffo*, A. Showler, S. Macrì, S. Butail and M. Porfiri. Zebrafish response to 3D printed shoals of conspecifics: the effect of body size. *Bioinsipiration & Biomimetics*, **11**(2):026003, 2016

3. N. Abaid, S. Butail, M. Porfiri, M. and D. Spinello. Dynamics of animal systems *European Physical Journal (Preface to Special Topics)*, **224**:3109-3117, 2015

4. *K. Gajamannage*, S. Butail, M. Porfiri, and E. M. Bollt. Identifying manifolds underlying group motion in Vicsek agents *The European Physical Journal (Special issue: Animal Dynamics)*, **224**: 3245-3256, 2015

5. *V. Mwaffo*, R. P. Anderson, S. Butail, and M. Porfiri. A jump persistent turning walker to model zebrafish locomotion. *Journal of the Royal Society Interface*, **12**(102): 20140884, 2015.

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[1] Names underlined indicate students directly supervised; names in italics are mentees

6. T. Bartolini, *V. Mwaffo*, S. Butail, and M. Porfiri. Effect of acute ethanol administration on zebrafish tail beat motion. *Alcohol,* **49**:721–725, 2015

7. *V. Mwaffo*, S. Butail, M. diBernardo, and M. Porfiri. Measuring zebrafish turning rate. *Zebrafish*, **12**(3): 250–254, 2015

8. F. Ladu, T. Bartolini, S. Panitz, F. Chiarotti, S. Butail, S. Macrì, and M. Porfiri. Live predators, robots, and computer-animated images elicit differential avoidance responses in zebrafish. *Zebrafish* (cover page), **12**(3): 2015–214, 2015.

9. T. Bartolini, S. Butail, and M. Porfiri. Temperature influences sociality and activity of freshwater fish. *Environmental Biology of Fishes*, **98**(3): 825–832, 2015.

10. *K. D. Gajamannage*, S. Butail, M. Porfiri, and E. M. Bollt. Dimensionality Reduction of Collective Motion by Principal Manifolds. *Physica D: Nonlinear Phenomena*, **291**:62–73, 2015.

11. D. Shishika, N. C. Manoukis, S. Butail, and D. A. Paley. Male motion coordination in anopheline mating swarms. *Scientific Reports*, **4**(6318), 2014.

12. S. Butail, F. Ladu, D. Spinello, and M. Porfiri. Information flow in animal-robot interactions. *Entropy (Special issue: Information in Dynamical Systems and Complex Systems),* **16**(3): 1315–1330, 2014. One of top 10 cited papers in last two years (2014-)

13. F. Ladu, S. Butail, S. Macrì, and M. Porfiri. Sociality modulates the effects of ethanol in zebrafish. *Alcoholism, Clinical and Experimental Research*, **38**(7): 2096–2104, 2014.

14. S. Butail, *P. Salerno*, E. M. Bollt, and M. Porfiri. Classification of collective behavior: a comparison of tracking and machine learning methods to study the effect of ambient light on fish shoaling. *Behavior Research Methods*, 2014.

15. S. Butail, G. Polverino, P. Phamduy, F. Del Sette, and M. Porfiri. Influence of robotic shoal size, configuration, and activity on zebrafish behavior in a free-swimming environment. *Behavioural Brain Research*, **275**:269–280, 2014.

16. A. Chicoli, S. Butail, Y. Lun, J. Bak-Coleman, S. Coombs, and D. A. Paley. "The effects of flow on schooling *Devario aequipinnatus*: school structure, startle response and information transmission. *Journal of Fish Biology*, **84**(5): 1401–1421, 2014.

17. N. C. Manoukis, S. Butail, M. Diallo, J. M. C. Ribeiro, and D. A. Paley. Stereoscopic Video Analysis of *Anopheles gambiae* Behavior in the Field: Challenges and Opportunities. *Acta Tropica,* **132**:S80–S85, 2014.

18. S. Butail, E. M. Bollt, and M. Porfiri. Analysis and classification of collective behavior using generative modeling and nonlinear manifold learning. *Journal of Theoretical Biology*, **336**(7): 185–199, 2013.

19. S. Butail, T. Bartolini, and M. Porfiri. Collective response of zebrafish shoals to a free-swimming robotic fish. *PLoS One*, **8**(10): e76123, 2013.

20. S. Butail, N. C. Manoukis, M. Diallo, J. M. C. Ribeiro, and D. A. Paley. The Dance of Male *Anopheles gambiae* in Wild Mating Swarms. *Journal of Medical Entomology*, **50**(3): 552–559, 2013.

21. S. Butail, N. C. Manoukis, M. Diallo, J. M. C. Ribeiro, T. Lehmann, and D. A. Paley. Reconstructing the flight kinematics of swarming and mating in wild mosquitoes. *Journal of the Royal Society Interface*, **9**(75): 2624–2638, 2012.

22. S. Butail and D. A. Paley. Three-dimensional reconstruction of the fast-start swimming kinematics of densely schooling fish. *Journal of the Royal Society Interface*, **9**(66): 77–88, 2011.

Book Chapters
23. S. Butail, N. Abaid, S. Macrì, and M. Porfiri. Fish-robot interactions: robot fish in animal behavioral studies. In R. Du, Z. Li, K. Youcef-Toumi, and P Valdivia y Alvarado, editors, *Robot Fish, Bio-inspired Fishlike Underwater Robots*, chapter 12, pages 221–240. Springer, 2015.

Conference (refereed)
24. V. Sathish, S. Ramaswamy, and S. Butail. Training data selection criteria for detecting failures in industrial robots. *IFAC International Conference on Advances in Control and Optimization Of Dynamical Systems,* Tiruchirappalli, India, February 2016
25. S. Butail. Simulating the effect of a social robot on moving pedestrian crowds. *In Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 2413–2418 Hamburg, Germany, September 2015
26. V. Sathish, S. Ramaswamy, and S. Butail. A simulation based approach to detect wear in industrial robots. *In Proceedings of the IEEE International Conference on Automation Science and Engineering (CASE)*, pages 1570–1575, Gothenburg, Sweden, August 2015.
27. S. Butail, T. Bartolini, and M. Porfiri. Collective response of zebrafish to a mobile robotic fish. *In Proceedings of the ASME Dynamic Systems and Control Conference*. Invited session on "Biologically-inspired control and its applications", Palo Alto, CA, October 2013.
28. S. Butail, A. Chicoli, and D. A. Paley. Putting the fish in the fish tank: Immersive VR for animal behavior experiments. *In Proceedings of the IEEE International Conference on Robotics and Automation (ICRA),* pages 5018–5023, Minneapolis, MN, USA, 2012.
29. S. Butail, N. C. Manoukis, M. Diallo, A. S. Yaro, A. Dao, S. F. Traoré, J. M. C. Ribeiro, T. Lehmann, and D. A. Paley. 3D tracking of mating events in wild swarms of the malaria mosquito Anopheles gambiae. *In Proceedings of the IEEE Conference of Engineering in Medicine and Biology Society (EMBC)*, pages 720–723, Boston, MA, USA, January 2011.
30. S. Butail and D. A. Paley. 3D reconstruction of fish schooling kinematics from underwater video. *In Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, pages 2438–2443, Anchorage, AK, USA, May 2010.
31. S. Butail and D. A. Paley. Vision-based estimation of three-dimensional position and pose of multiple underwater vehicles. *In Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 2477–2482, St. Louis, MO, USA, 2009.
32. N. Sydney, S. Napora, S. Beal, P. Mohl, P. Nolan, S. Sherman, A. Leishman, S. Butail, and D. A. Paley. A Micro-UUV testbed for Bio-Inspired Motion Coordination. *In International Symposium Unmanned Untethered Submersible Technology*, Durham, NH, USA, 2009.
33. S. Butail and M. Peck. Non-Contacting Interfaces: A Case Study in Modular Spacecraft Design. *In Proceedings of the Conference on Systems Engineering Research*, volume 2, pages 27–34, New Jersey, NJ, USA, 2007.

Oral Abstracts

1. <u>P. Jain</u>, K. Choudhary, S. Pradhan, O. P. Singh, and S. Butail. An indoor lighting system to study mosquito-swarming behavior. In Research showcase, IIIT-Delhi, New Delhi, India, 2015. Second prize in Elevator Pitch demo competition

2. F. Ladu, T. Bartolini, S. Panitz, S. Butail, S. Macrì, and M. Porfiri. Biologically- inspired robots elicit a robust fear response in zebrafish. In Proceedings of the SPIE, Bioinspiration, Biomimetics, and Bioreplication V, pages 9429–20, San Diego, CA, USA, Mar 2015.

3. S. Butail, *P. Salerno*, E. Bollt, and M. Porfiri. Classification of collective behavior using machine learning: a comparison with visual tracking in a study on the effect of ambient light on fish shoaling. In 8th Annual Machine Learning Symposium, New York Academy of Sciences, New York, New York, USA, March 2014.

4. S. Butail, G. Polverino, P. Phamduy, F. Del Sette, and M. Porfiri. Fish-robot interactions in a free-swimming environment: Effects of speed and configuration of robots on live fish. In Proceedings of SPIE, Bioinspiration, Biomimetics, and Bioreplication, page 90550I, San Diego, CA, USA, March 2014.

5. S. Butail, F. Ladu, D. Spinello, and M. Porfiri. Inferring information flow between interacting animals and robots. In U.S. National Congress on Theoretical and Applied Mechanics, Michigan State University, June 2014.

6. *K. Gajamannage*, S. Butail, E. Bollt, and M. Porfiri. Model reduction of collective motion by principal manifolds. In U.S. National Congress on Theoretical and Applied Mechanics, Michigan State University, June 2014.

7. D. L. Shishika, N. C. Manoukis, S. Butail, and D. A. Paley. The dynamics of malarial mosquitoes in wild mating swarms. In U.S. National Congress on Theoretical and Applied Mechanics, Michigan State University, June 2014.

8. S. Butail, T. Bartolini, V. Cianca, S. Macrì, and M. Porfiri. Bioinspired robotic fish for animal behavior research. In Dynamic Systems and Control Conference Video Session, Palo Alto, CA, October 21–23 2013.

9. S. Butail, N. Abaid, E. Bollt, and M. Porfiri. Evolution of a network of multi-agent systems on low-dimensional manifolds. In SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, 2013.

10. N. C. Manoukis, S. Butail, D. L. Shishika, D. A. Paley, and J. M. C. Ribeiro. 3D video analysis of male anopheles gambiae mating behavior in the field: Challenges and opportunities. In 4th Research Co-ordination Meeting of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture on Biology of Male Mosquitoes in Relation to Genetic Control Programmes, Juazeiro, Brazil, 2013.

11. J. Coleman, S. Butail, D. A. Paley, and S. Coombs. The spatiotemporal dynamics of rheotaxis in stream-dwelling fish under different flow and sensory conditions. In International Congress of Neuroethology, University of Maryland, College Park, MD, USA, 2012.

12. A. Chicoli, Y. Lun, S. Butail, S. Coombs, and D. A. Paley. Making waves: Quantitative analysis of information transmission in schooling fish. In Society for Integrative and Comparative Biology (SICB), Charleston, SC, 2012.

13. D. A. Paley and S. Butail. Reconstruction and analysis of individual dynamics in fish schools and mosquito swarms. In SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, 2011.

14. J. Lun, A. Chicoli, S. Butail, S. Coombs, and D. A. Paley. Escape response probability of giant danios to select visual looming stimuli. In Soc. for Neuroscience Annual Meeting, 2011.

15. J. Coleman, S. Butail, D. A. Paley, and S. Coombs. The effect of group size on rheotactic performance in schooling giant danio. In International Congress on Flow Sensing in Air and Water, Bonn, Germany, 2011.

16. A. Chicoli, Y. Lun, S. Butail, S. Coombs, and D. A. Paley. Motion coordination for information transmission in schooling fish: Determining threat-detection sensitivity and response bias. In NSF Engineering Research and Innovation Conf., Atlanta, Georgia, 2011.

17. N. C. Manoukis, S. Butail, D. A. Paley, A. S. Yaro, M. Diallo, S. F. Traoré, A. Dao, J. M. C. Ribeiro, and T. Lehmann. Quantifying and analyzing dance of *Anopheles gambiae* in mating swarms. In American Society of Tropical Medicine and Hygiene Annual Meeting (*talk*), 2010.

18. N. C. Manoukis, S. Butail, D. A. Paley, A. S. Yaro, M. Diallo, S. F. Traoré, A. Dao, J. M. C. Ribeiro, and T. Lehmann. Quantifying and analyzing the mosquito dance in mating swarms. In Biology of Mosquito Vectors, Johns Hopkins Malaria Research Institute, Johns Hopkins Bloomberg School of Public Health (*talk & poster*), 2010.

19. S. Butail, D. A. Paley, and A. N. Popper. 3D reconstruction of fish schooling kinematics from underwater video. In Neuroscience and Cognitive Science FEST, University of Maryland, College Park, 2010.

20. S. Butail and D. A. Paley. Vision-based tracking of pose of multiple underwater vehicles. In Northeast Control Workshop, Carnegie Mellon University, Pittsburgh, PA, 2009.

21. S. Butail and D. A. Paley. Tracking multiple underwater vehicles: a probabilistic framework. In Graduate Research Interaction Day (GRID), University of Maryland, College Park, MD, 2009. First prize in modeling and simulation

Editorial activities
– Editor for European Physical Journal (EPJ) special issue titled "Dynamics of Animal Systems" with Nicole Abaid (Virginia Tech), Maurizio Porfiri (New York University), and Davide Spinello (University of Ottawa)

External Grants
– National Science Foundation - Sensors, Dynamics, & Control: "Causal Relationships Underlying the Collective Dynamic Behavior of Swarms" (Co-investigator and sub-awardee, $22,676, CMMI 1433670, $350k, September 2014 - August 2017, PI: Maurizio Porfiri, New York University)

Awards
– Travel Awards for International Conference on Intelligent Robots and Systems (2015), International Workshop on Complex Systems and Networks (2012), International Conference on Robotics and Automation (2012), International Conference of the IEEE Engineering in Medicine and Biology Society (2011)
– Dean's Graduate Fellowship, University of Maryland, 2007–08

Media coverage

– *Reuters, Discover magazine, Popular science, National Science Foundation, MSN news, Redorbit, Futurity, Mental floss*, "Follow that Fish! Zebrafish React Differently to Alcohol When Shoalmates are Close by". May, 2014

– *Nautilus Science Magazine*, "Animals Bow to Their Mechanical Overlords: Robots are infiltrating insect, fish, and bird communities—and seizing control". Emily Anthes, February 13, 2014

– *E@M, The Magazine of the Clark School of Engineering, University of Maryland*; "We, Robots" Spring 2011.

Teaching[2]

IIIT-Delhi

– *Modeling complex systems*: senior undergraduate and graduate level course on mathematical models of complex systems including population dynamics, disease spreading, collective motion, real-world networks, traffic flow, and social contagion. 2014 (3 students; 4.0/5.0, 5.0/5.0), 2015 (16 students; 3.81/5.0, 3.97/5.0)

– *Math III, multivariable calculus*: undergraduate level course jointly taught with two other faculty in 2014 (60 students)

– *Stochastic estimation and control*: graduate level course on linear estimation and control of dynamical systems with introduction to nonlinear estimation methods; half semester, 2015 (9 students; 3.3/5.0, 3.33/5.0)

Advising

Doctoral thesis

– Sathish, V. (2014-), IIIT-Delhi, Sponsored by ABB Group, Data-driven detection of wear-induced faults in industrial robots

Undergraduate research thesis

– Puneet Jain (2015-), IIIT-Delhi, Frequency response analysis of mosquito swarming behavior

Internships

– Naman Gupta (2015), IIIT-Delhi, Developing virtual reality display for crowd behavior test bed

– Anmol Singh (2015), IIIT-Delhi, Developing motion capture for crowd behavior test bed

– Abhishek Bhatia (2014-2015), IIIT-Delhi, Experimental evaluation and modeling of crowd evacuation

– Sidharth Raja (2015), Delhi Technological University, Identifying features of group membership in crowds for natural robot navigation

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[2] Teaching evaluation is reported in terms of two numbers: the first number is the average of questions related to the extent to which learning outcomes were achieved, and the second number is the average of questions related to the effectiveness of the instructor.

Invited Talks
- Simulating social robot interaction with moving pedestrian crowds, Department of Mechanical & Aerospace Engineering, New York University, June 26, 2015
- Measuring information flow in fish-robot interactions, Centre for Ecological Sciences, Indian Institute of Science, Bangalore, December 1, 2014
- Low-dimensional representation of collective motion in animal groups, Indraprastha Institute of Information Technology, Delhi, June 4, 2013 (e-seminar)
- Collective motion in animal groups: trajectory reconstruction and manifold learning, Department of Mathematics and Computer Science, Clarkson University, January 22, 2013
- Model-based Estimation and Characterization of Collective Motion in Animal Groups, Department of Aerospace Engineering, Indian Institute of Technology, Kanpur, November 9, 2012 (Skype)

Workshops
- Flow of information in collective animal behavior, Centre for Ecological Sciences, Indian Institute of Science, Bangalore, November 28, 2014

Professional Service
- Session co-chair, Dynamic Systems and Control Conference 2013 (Biologically-inspired control and its applications)

Reviewing Activities
- *Journals*: ASME Journal of Dynamic Systems, Automatica, Behavior Research Methods, Bioinspiration & Biomimetics, Biological Invasions, Communications in Nonlinear Science and Numerical Simulation, IEEE Transactions on Circuits and Systems I, IEEE Transactions on Control of Network Systems, IEEE Transactions on Mechatronics, International Journal of Robust and Nonlinear Control, International Journal of Computer Assisted Radiology and Surgery, Journal of the Royal Society Interface, Measurement and Control, Neural Computing and Applications, PeerJ, PLoS One, Royal Society Open Science
- *Conferences*: IEEE American Control Conference (ACC), IEEE Conference on Decision and Control (CDC), IEEE International Conference on Robotics and Automation (ICRA), IEEE/RSS International Conference on Intelligent Robots and Systems (IROS), Dynamic Systems and Control Conference (DSCC), International Federation of Automatic Control (IFAC)

Professional Societies
SIAM, IEEE Robotics and Automation, IEEE Controls Systems