

# Brian K. Taylor

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## Education

Case Western Reserve University  
Doctor of Philosophy in Mechanical Engineering  
Dissertation: *Tracking Fluid Borne Odors in Diverse and Dynamic Environments Using Multiple Sensory Mechanisms*  
Advisor: Dr. Roger D. Quinn  
Cleveland, Ohio  
Graduation: 08/17/2012  
4.0 Cumulative GPA

Case Western Reserve University  
Master of Science in Mechanical Engineering (Requirements Completed in 7/2008)  
Thesis: *Implementation and Benchmarking of a Whegs™ Robot in the USARSim Environment*  
Advisor: Dr. Roger D. Quinn  
Cleveland, Ohio  
Graduation: 01/16/2009  
4.0 Cumulative GPA

Case Western Reserve University  
Bachelor of Science in Aerospace Engineering – Magna Cum Laude  
Minor – Music  
Cleveland, Ohio  
Graduation: 05/15/2005  
3.81 Cumulative GPA

## Professional Experience

Assistant Professor of Mechanical and Aerospace Engineering  
Case Western Reserve University  
01/01/2023 – Present  
Cleveland, OH

- Performs research on bio and bioinspired navigation strategies. Particular areas of interest include animal magnetoreception, sensory processing using computational neuroscience, and leveraging biological principles in developing engineered systems.
- Supervises research and development work of undergraduates, graduates, postdoctoral researchers, postbaccalaureate researchers, and research associates
- Courses Taught:
  - Advanced Dynamics I (Graduate Level)

Assistant Professor of Biology  
The University of North Carolina at Chapel Hill  
07/01/2018 – 12/31/2022  
Chapel Hill, NC

- Performs research on bio and bioinspired navigation strategies. Particular areas of interest include animal magnetoreception, sensory processing using computational neuroscience, and leveraging biological principles in developing engineered systems.
- Supervises research and development work of undergraduates, graduates, postdoctoral researchers, postbaccalaureate researchers, and research associates
- Courses Taught:
  - Mathematical Methods for Quantitative Biology
  - Introduction to Computational Neuroscience (developed and deployed by me)

Research Mechanical Engineer  
Air Force Research Laboratory  
10/8/2012 – 06/29/2018  
Eglin Air Force Base, FL

- Performed in house research on bioinspired navigation, and GPS-degraded/denied navigation. Helped craft research tasks for external agencies such as universities and private sector companies to propose against. Performed program management duties to guide and monitor the work of external contractors towards program requirements (Oct 2012 – June 2018)
- Worked as a visiting scientist with Dr. Ken Lohmann of the University of North Carolina at Chapel Hill to advance basic research on animal magnetic reception (Feb 2016 – June 2016, August 2016 – September 2016)

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- Directed, drove, and developed research on bioinspired magnetic reception and multimodal sensing. Research thrusts include bioinspired and bio-based navigation algorithms and processing methods, and hardware testing. (Jan 2013 – June 2018)
- Supported one of the Air Force Research Laboratory's major long-range high velocity penetrator programs as a subject matter expert and program manager responsible for improving overall weapon system performance and accuracy. Worked with a team of Air Force and Industry partners to ensure that program cost, schedule and performance objectives were met. Presented the final results to government and industry partners. (Jan 2014 – Nov 2014)

## Selected Honors

- !Tanner Award for Excellence in Undergraduate Teaching from UNC Chapel Hill (2021)
- Selected to participate in Engineering Unleashed Faculty Learning Community (2020)
- Selected for the Air Force Office of Scientific Research (AFOSR) Visiting Scientist Program (2015)
- Co-Author for the CLAWAR Association Best Technical Paper Award (2011)
- One of 7 composers selected for the Greater Cleveland Flute Society's Composers Connection Concert (2011)
- Selected for the Science, Mathematics and Research for Transformation (SMART) Scholarship Program (2009-2012)
- Selected for the Department of Homeland Security (DHS) Scholarship and Fellowship Program (2006 - 2009)
- Accorded Honorable Mention in the NSF Graduate Research Fellowship Program (2006)
- Accorded Honorable Mention in the Ford Foundation Diversity Fellowship Program (2006)
- Awarded Case Western Reserve University Case Prime Fellowship (2005)
- Engineer Intern, State Board of Registration for Professional Engineers and Surveyors (2005)

## Bibliography and Products of Scholarship

- \*lead author, ^research/project leader, &student or personnel supervised
- All of my scholarly works are interdisciplinary as each one leverages various elements of biology and engineering
- Scholarship while at UNC Chapel Hill contains short descriptions of work and my role.

## Books & Chapters (show author order and include pages)

- Fleissner G., Fleissner G., and **Taylor B.K.\***, “Magnetoreception”, Encyclopedia of Animal Behavior (2<sup>nd</sup> ed) – 2019. Pgs 142-155 (<https://www.sciencedirect.com/referencework/9780128132524/encyclopedia-of-animal-behavior>)
  - Provides an overview of magnetoreception in animals. I authored a revision for the 2019 edition that focuses on computational efforts in the field, including my own.

## Refereed papers/articles

1. !Harvey, A<sup>&</sup>, **Taylor, B.K.\***^ (2022). A Real-World Implementation of Neurally-Based Magnetic Reception and Navigation. In: , *et al.* Biomimetic and Biohybrid Systems. Living Machines 2022. Lecture Notes in Computer Science, vol 13548. Springer, Cham. [https://doi.org/10.1007/978-3-031-20470-8\\_22](https://doi.org/10.1007/978-3-031-20470-8_22)
  - a. Implemented neurally based distributed sensing and processing for magnetoreception studies in a tethered robotic system.
2. !Nichols S<sup>&</sup>, Havens LT, **Taylor BK\*^**, “Sensation to navigation: a computational neuroscience approach to magnetic field navigation” *J Comp Physiol A* (2022). <https://doi.org/10.1007/s00359-021-01535-w>
  - a. Supervised an undergraduate in adapting his honors thesis work that combines computational neuroscience and agent based modeling to test a hypothesized magnetic navigation strategy.
3. !Pizzuti S<sup>&</sup>, Bernish M<sup>&</sup>, Harvey A<sup>&</sup>, Tourangeau LV<sup>&</sup>, Shriver CD<sup>&</sup>, Kehl CE<sup>&</sup>, **Taylor BK\*^** “Uncovering how animals use combinations of magnetic field properties to navigate: a computational approach.” *J Comp Physiol A* (2021). <https://doi.org/10.1007/s00359-021-01523-0>
  - a. Perspective piece on my lab's combined efforts on modeling, simulation, and robotics to study bio and bioinspired magnetoreception and navigation.

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4. 'O'Connell D.<sup>&</sup>, Kehl CE<sup>&</sup>, **Taylor BK<sup>^</sup>**, Piacenza J, Piacenza S, Faller KJ II (2021). "A computational framework for studying energetics and resource management in sea turtle migration and autonomous systems." *Journal of Theoretical Biology*: 110815. <https://doi.org/10.1016/j.jtbi.2021.110815>
  - a. Mentored and assisted first graduate student in publishing her first journal paper as a PhD student. I led this interdisciplinary work that leverages previous magnetoreception work to study the potential effects of tracking tags on the energetics of migrating sea turtle. In this effort, I also led a team of interdisciplinary researchers at 3 different institutions.
5. '**Taylor BK<sup>^</sup>**, Bernish M<sup>&</sup>, Pizzuti S<sup>&</sup>, Kehl CE<sup>&</sup>, (2021) “A bioinspired navigation strategy that uses magnetic signatures to navigate without GPS in a linearized northern Atlantic Ocean: a simulation study” –Bioinspiration and Biomimetics – <http://dx.doi.org/10.1088/1748-3190/abc7cd> (a)
  - a. Led an undergraduate, an undergraduate/research assistant, and postdoc on a paper that uses a simulation-based approach to study the hypothesis that turtles use magnetic signatures in a simplified but realistic Northern Atlantic Ocean
6. '**Taylor BK<sup>^</sup>**, Lohmann K, Lohmann CMF, Havens LT, Granger J, “Long-distance transequatorial navigation using sequential measurements of magnetic inclination angle.” *Journal of The Royal Society Interface*. 2021;18(174):20200887. (b)
  - a. Conceptualized and led the development and authorship of a study that used a computational approach as a means of testing and exploring the hypothesis that birds can use inclination angle as a means of transequatorial navigation. This study also demonstrated that the strategy could potentially be robust to magnetic field reversals.
7. 'Nichols ST<sup>&</sup>, Kehl CE<sup>&</sup>, **Taylor BK<sup>^</sup>**, Harley C., “Bioinspired Navigation Based on Distributed Sensing in the Leech”, Presented at the peer reviewed conference *Living Machines, 2020*
  - a. This peer reviewed conference paper was based on the final paper of a biology 395 student that I supervised. Under my leadership, and in collaboration with a colleague, the student used an hybrid approach that combined simplified computational neuroscience methods with an agent-based-model to successfully reproduce behavior that is observed in real leeches.
8. **Taylor BK<sup>^</sup>**, Charbonneau C<sup>&</sup>, Kehl CE<sup>&</sup>, Piacenza JR, Piacenza SE, Faller J, “Energetic Analysis of Tagged Sea Turtles Using Geomagnetic Navigation”, Presented – International Navigation Conference (2019)
  - a. Led a team of interdisciplinary researchers at 3 institutions, including a UNC undergraduate, to develop a peer-reviewed conference paper that combines my magnetoreception work with multi-objective optimization methods to study the potential effects of tracking tags on the energetics of migrating sea turtles.
9. **Taylor, B. K.<sup>^</sup>** and S. Corbin<sup>&</sup> (2019). "Bioinspired magnetoreception and navigation in nonorthogonal environments using magnetic signatures." *Bioinspiration & Biomimetics* **14**(6): 066009. - doi 10.1088/1748-3190/ab40f8
  - a. Led and supervised an undergraduate Mechanical Engineering major (University of West Florida) in publishing a parametric study that used an abstracted but tunable environment to test the hypothesis that animals use magnetic signatures to navigate.
10. Huang G, **Taylor BK** and Akopian D, "A Low-Cost Approach of Magnetic Field-Based Location Validation for Global Navigation Satellite Systems," in *IEEE Transactions on Instrumentation and Measurement*, vol. 68, no. 12, pp. 4937-4944, Dec. 2019, doi: 10.1109/TIM.2019.2901512.
  - a. Coauthor on a paper that explores using magnetic field information validation/health checking tool for Global Navigation Satellite Systems (GNSS)
11. **Taylor, B.K.<sup>^</sup>**. “Bioinspired Magnetoreception and Navigation Using Magnetic Signatures as Waypoints”, *Bioinspiration and Biomimetics*, Vol 13, no 4, 14 May 2018 (Featured Article) - <https://doi.org/10.1088/1748-3190/aabbec>
12. **Taylor, B.K.<sup>^</sup>**, “Bioinspired magnetic reception and multimodal sensing.” *Biological Cybernetics*, 2017. **111**(3): p. 287-308. <https://doi.org/10.1007/s00422-017-0720-3>

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13. **Taylor, B.K.\*^**, Johnsen, S., Lohmann, K.J., “Detection of magnetic field intensity using distributed sensing: a computational neuroscience approach”. *Bioinspiration and Biomimetics*, Vol 12, no 3, 19 May 2017 (Featured Article) - <https://doi.org/10.1088/1748-3190/aa6ccd>
14. **Taylor, B.K.\*^**, “Validating a model for detecting magnetic field intensity using dynamic neural fields” *Journal of Theoretical Biology*, Available online 10 August 2016, ISSN 0022-5193, <http://dx.doi.org/10.1016/j.jtbi.2016.08.010>.
15. **Taylor, B.K.\*^**, and G. Huang, “Bioinspired Magnetic Navigation Using Magnetic Signatures as Waypoints”, in *Biomimetic and Biohybrid Systems: 6th International Conference, Living Machines 2017, Stanford, CA, USA, July 26–28, 2017, Proceedings*, M. Mangan, et al., Editors. 2017, Springer International Publishing: Cham. p. 48-60.
16. Huang, G., **Taylor B.K.\*^**, “Engineered and bioinspired approaches to magnetic navigation”. Presented at the ION 2017 Pacific PNT Meeting, Honolulu, HI, May 2017
17. **Taylor, B.K.\***, Wu, D., Willis, M.A., Quinn, R.D. “Maintaining Odor Tracking Behavior Using an Established Tracking Direction in a Dynamic Wind Environment”. *Proceedings of the International Conference on Robotics and Automation (ICRA)* 2012.
18. Rutter, B.L., **Taylor, B.K.**, Quinn, R.D., Lewinger, W.A., Bender, J.A., Ritzmann, R.E., Blumel, M., “Descending Commands to an Insect Leg Controller Network Cause Smooth Behavioral Transitions”, *Proceedings of the International Conference on Intelligent Robots and Systems (IROS)*, 2011.
19. **Taylor, B.K.\***, Willis, M.A., Quinn, R.D. “Integrating olfaction, vision and touch to locate fluid-borne odors in diverse and dynamic environments”. 1<sup>st</sup> International Conference on Applied Bionics and Biomechanics, 2010.
20. **Taylor, B.K.\***, Balakirsky, S., Messina, E., Quinn, RD., “Analysis and Benchmarking of a Whegs™ Robot in the USARSim Environment,” *Proceedings of IROS* 2008

### Refereed unpublished oral presentations and/or abstracts

1. **Taylor BK\*^**, Harvey AJ<sup>&</sup>, Tourangeau L<sup>&</sup>, O’Connell D<sup>&</sup>, Kehl CE<sup>&</sup> “Bioinspired magnetic navigation via magnetic signatures using real-world robots”, Accepted to the 2021 Adaptive Motions in Animals and Machines (AMAM) Conference (c)
  - a. I led the development of a peer-reviewed abstract and poster that highlights our work on using mobile and tethered robots as novel research tools to study animal magnetoreception.

### Conference Presentations

- P: presented by me
- SP: presented by a student that I directly mentor or supervise
- JP: jointly presented
- <sup>!SP</sup> O’Connell DC<sup>&</sup>, Kehl CE<sup>&</sup>, Taylor, BK, Piacenza, J, Piacenza, S, Faller II, KJ, **Taylor BK**, “Simulation and analysis of the impact of different satellite tracking tags on the energetics and resource management behavior of migrating sea turtles”. Presented for the annual meeting of The Society for Integrative and Comparative Biology.
- <sup>!SP</sup> Piephoff F<sup>&</sup>, Kehl CE<sup>&</sup>, Taylor BK, Harley CM, Mota B. “Biophysical modeling of mechanosensation in the leech”. Presented for the annual meeting of The Society for Integrative and Comparative Biology.
- <sup>!</sup>Havens LT; Notar JC; **Taylor BK**; Lohmann KJ, “Bridging the gap between theory and behavior in magnetoreception”. Presented for the annual meeting of The Society for Integrative and Comparative Biology.
- <sup>!SP</sup>Piephoff F<sup>&</sup>, **Taylor BK\*^**, Kehl CE<sup>&</sup>, Harley, C, Mota B, “Computational Modeling of Mechanoreception in the Leech”. Presented at the Triangle Chapter Society for Neuroscience Meeting (April 22, 2021)

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- !Havens LT, **Taylor BK**, Lohmann KJ, “Studying a black box: investigating processing of a receptorless sense”, Presented at the Annual SICB Meeting (January 2, 2021)
- !<sup>SP</sup>Nichols S<sup>&</sup>, **Taylor BK**<sup>^</sup>, Kehl CE<sup>&</sup>, Harley, “Bioinspired Navigation based on Distributed Sensing in the Leech”, Presented for the 2020 Southeast Regional SICB Meeting (November 14, 2020)
- !<sup>SP</sup>O’Connell D<sup>&</sup>, Kehl CE<sup>&</sup>, **Taylor BK**<sup>^</sup>, “Modeling the effects of satellite tracking tags on energy use and resource management behavior in sea turtles”, Presented for the 2020 Southeast Regional SICB Meeting (November 14, 2020)
- !<sup>SP</sup>Bernish M<sup>&</sup>, Pizzuti S<sup>&</sup>, Kehl CE<sup>&</sup>, **Taylor BK**<sup>^</sup>, “Using Magnetic Signatures to Navigate the North Atlantic.”, Presented for the 2020 Southeast Regional SICB Meeting (November 14, 2020)
- !<sup>SP</sup>Harvey AJ<sup>&</sup>, Kehl CE<sup>&</sup>, **Taylor BK**<sup>^</sup>, “Caretta2: A Software Platform for Magnetoreception and Navigation Research.”, Presented for the 2020 Southeast Regional SICB Meeting (November 14, 2020)
- <sup>P</sup>**Taylor, B.K.**<sup>\*^</sup>, Kehl, C.E<sup>&</sup>. “ Bioinspired trans-equatorial navigation using sequential measurements of magnetic inclination”. Presented at the annual meeting of The Society for Integrative and Comparative Biology. Austin, Texas, 1/4/2020
- <sup>P</sup>**Taylor, B.K.**<sup>\*^</sup>, Kehl, C.E<sup>&</sup>. “ A bioinspired navigation strategy that uses magnetic signatures to navigate without GPS in the Northern Atlantic”. Presented at the annual meeting of The Society for Integrative and Comparative Biology. Austin, Texas, 1/4/2020
- <sup>JP</sup>Corbin S<sup>&</sup>., **Taylor, B.K.**<sup>\*^</sup>, " Bioinspired Magnetoreception and Navigation Using Magnetic Signatures in Nonorthogonal Environments ". Presented at the annual of The Society for Integrative and Comparative Biology. Tampa, Florida, 1/5/2019
- <sup>P</sup>**Taylor, B.K.**<sup>\*</sup>, Lohmann K.J., "Validating a model for detecting magnetic field intensity using simulated and hardware approaches". Presented at the annual of The Society for Integrative and Comparative Biology. New Orleans, Louisiana, 1/7/2017
- <sup>P</sup>**Taylor, B.K.**<sup>\*</sup>, "Validating a model for detecting magnetic field intensity using dynamic neural fields". Presented at the 4<sup>th</sup> Annual Meeting of the Air Force Research Laboratory Mathematical Modeling Institute at the University of Florida Research Engineering and Education Facility (UF-REEF), Shalimar, Florida, 7/27/2016
- <sup>P</sup>**Taylor, B.K.**<sup>\*^</sup>, Rutkowski, A.J., "Bio-inspired Magnetic Field Sensing and Processing". Presented at the 3<sup>rd</sup> Annual Meeting of the Air Force Research Laboratory Mathematical Modeling Institute at the University of Florida Research Engineering and Education Facility (UF-REEF), Shalimar, Florida, 7/30/2015
- <sup>P</sup>**Taylor, B.K.**<sup>\*^</sup>, "Bioinspired Magnetic Reception and Multimodal Sensing", Presented for the 2<sup>nd</sup> Annual Meeting of the Air Force Research Laboratory Mathematical Modeling Institute at the University of Florida Research Engineering and Education Facility (UF-REEF), Shalimar, Florida, 7/30/2014
- Chen, R., **Taylor, B.K.**, Avondet, J., Willis, M., Quinn, R., “Using a Robotic Platform to Understand Moth Flight Orientation”, *Research ShowCASE*, Cleveland OH, April 2013
- <sup>P</sup>**Taylor, B.K.**<sup>\*</sup>, Quinn, R.D., Willis, M.A., “Tracking Fluid-Borne Odors in Dynamic Environments with Animals and Robots”. Presented at the Tenth International Congress of Neuroethology (August 2012).
- <sup>P</sup>**Taylor, B.K.**<sup>\*</sup>, Willis, M.A., Quinn, R.D. “Multi-Modal Sensing Enables an Agent to Track a Fluid-Borne Odor to its Source”. *Research ShowCASE*, Cleveland, OH., April 2010
- <sup>P</sup>**Taylor, B.K.**<sup>\*</sup>, Rutter, B.L., Willis, M.A., Quinn, R.D. “Using Sensory Coupled Action Switching Modules to Track a Wind-Borne Odor”. *Research ShowCASE*, Cleveland, OH., April 2009

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- Rutter, B.L., Bender J.A., **Taylor, B.K.**, Ritzmann, R.E., Quinn, R.D. (2008) “Experiments in Locomotion with Neuromechanically Based Robotic Insect Models” Soc. Neuroci. Abstr. 198.7.
- **Taylor, B.K.** \*, Balakirsky, S., Messina, E., Quinn, R.D., “Using Biological Analysis Tools to Study the Behavior of a Whegs Robot,” Fourth International Symposium on Adaptive Motion of Animals and Machines, 2008
- **Taylor, B.K.** \*, Witushynsky, T.C., Bachmann, R.J., Quinn, R.D. “Design of a Micro Air Vehicle with Wing Folding Capabilities”. *Research ShowCASE*, Cleveland, OH., April 2010
- Rutter BL, **Taylor B.K.**, Mu L, Ritzmann RE (2007) “A Functional Kinematic Model of the Cockroach Mesothoracic Leg,” International Congress of Neuroethology, Vancouver, Canada, Abstract P0232
- Rutter, B.L., Lewinger, W., **Taylor, B.K.**, Wilson, M., Blümel, M., Ekeberg, Ö., Büschges, A., Ritzmann, R.E., Quinn, R.D. (2006) “Neurally-Based Robot Control for Neuromechanical Modeling of Insect Stepping,” Soc. Neuroci. Abstr. CD ROM 32: 449.13.
- Rutter, B.L., Mu L., **Taylor, B.K.**, Quinn, R.D., Ritzmann, R.E., (2006) A Model that Transforms Insect Electromyograms into Pneumatic Muscle Control. *Research ShowCASE*, Cleveland, OH April 6
- Mu, L., **Taylor, B.K.**, Rutter, B.L., Ritzmann, R.E. (2006) Altered joint reflexes in the cockroach may lead to directional changes in leg extension. Soc. Neuroci. Abstr. CD ROM 32: 449.11.

### Invited Talks and Lectures

- <sup>!</sup>“Bio and Bioinspired Magnetic Reception and Multimodal Sensing”. Presented for the Modeling, Computation, Nonlinearity, Randomness and Waves Seminar at The University of Arizona – Thursday, October 7, 2021
- <sup>!</sup>“Bio and Bioinspired Magnetic Reception and Multimodal Sensing”. Presented for The Department of Mechanical and Aerospace Engineering of Case Western Reserve University – Friday, September 17, 2021
- <sup>!</sup>“Bio and Bioinspired Magnetic Reception and Multimodal Sensing”. Presented as part of the Bioinspiration and Biodiversity Workshop – April 19, 2021
- <sup>!</sup>“Bio and Bioinspired Magnetic Reception and Multimodal Sensing”. Presented for The Department of Mechanical and Aerospace Engineering of North Carolina State University – March 26, 2021
- <sup>!</sup>“Bio and Bioinspired Magnetic Reception and Multimodal Sensing”. Presented for The University of Florida Whitney Laboratory – October 9, 2020
- <sup>!</sup>“Bio and Bioinspired Magnetic Reception and Multimodal Sensing”. Presented for a University of North Carolina at Chapel Hill First Year Seminar “Exploring Engineering” – September 23, 2020
- “Bio and Bioinspired Magnetic Reception and Multimodal Sensing”. Presented for a University of North Carolina at Chapel Hill First Year Seminar “Robots in Science Fiction” – January 29, 2020
- “Bio and Bioinspired Magnetic Reception and Multimodal Sensing”. Presented at Metropolitan State University – September 26, 2019
- “Using Sea Turtle Navigation as Inspiration for Novel Human Navigation Systems”, Presented at the 2019 International Sea Turtle Symposium, Charleston North Carolina, February 6, 2019

### Popular Media

- Online Article: Nature’s Compass <https://endeavors.unc.edu/natures-compass/> (author – Megan May – February 18 2021)

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## Teaching Activities

- &student or personnel has published and/or given a scholarly presentation
- !During pandemic

## Courses

<sup>!</sup>Advanced Dynamics I (EMAE 481)  
Case Western Reserve University

01/01/2023 – Present  
Cleveland, OH

- Sole instructor for course aimed at covering Newtonian mechanics, and elements of analytical mechanics
- 18 Students

<sup>!</sup>Instructor for Mathematical Modeling for Quantitative Biology (BIOL 226/L)  
University of North Carolina at Chapel Hill

08/15/2022 – 12/11/2022  
Chapel Hill, NC

- Sole instructor for course and lab aimed at introducing students to various concepts and methods in quantitative biology, particularly as they apply to medical applications. Topics included: Random Walks, Diffusion, Genetic Algorithms, Biochemical Kinetics, Computational Neuroscience, Muscle Mechanics, Robotics as applied to medicine
- Course involves mathematical application, computer programming fundamentals, development of basic computer programs that leverage mathematics to solve problems, and a semester-long coding assignment
- Teaching Innovation: Invited radiation oncologist to discuss her use of mathematics on the front lines of medicine.
- 20 Students with TA for labs

<sup>!</sup>Instructor for Introduction to Computational Neuroscience (BIOL 554)  
University of North Carolina at Chapel Hill

1/10/2022 – 5/05/2022  
Chapel Hill, NC

- Developer and sole instructor for a course aimed at introducing students to mathematical tools and techniques for modeling the various elements and phenomena that comprise the nervous system and brain.
- Course involves mathematical application, and development of computer programs that leverage mathematics to solve problems
- Teaching Innovation: Invited guest lecturer and computational neuroscience researcher to discuss their research and how the material covered is actually employed in the course of research.
- 23 students

<sup>!</sup>Instructor for Introduction to Computational Neuroscience (BIOL 554)  
University of North Carolina at Chapel Hill

1/19/2021 – 5/12/2021  
Chapel Hill, NC

- Developer and sole instructor for a course aimed at introducing students to mathematical tools and techniques for modeling the various elements and phenomena that comprise the nervous system and brain.
- Course involves mathematical application, and development of computer programs that leverage mathematics to solve problems
- Teaching Innovation: Invited guest lecturer and computational neuroscience researcher to discuss his research and how the material covered is actually employed in the course of research.
- 15 students

<sup>!</sup>Instructor for Mathematical Modeling for Quantitative Biology (BIOL 226/L)  
University of North Carolina at Chapel Hill

08/10/2020 – 11/25/2020  
Chapel Hill, NC

- Sole instructor for course and lab aimed at introducing students to various concepts and methods in quantitative biology, particularly as they apply to medical applications. Topics included: Random Walks, Diffusion, Genetic Algorithms, Biochemical Kinetics, Computational Neuroscience, Muscle Mechanics, Robotics as applied to medicine
- Course involves mathematical application, computer programming fundamentals, development of basic computer programs that leverage mathematics to solve problems, and a semester-long coding assignment
- Teaching Innovation: Invited radiation oncologist to discuss her use of mathematics on the front lines of medicine.
- 20 Students with TA for labs



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<sup>!</sup>Instructor for Introduction to Computational Neuroscience (BIOL 590) 01/09/2020 – 05/10/2020  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Developer and sole instructor for a course aimed at introducing students to mathematical tools and techniques for modeling the various elements and phenomena that comprise the nervous system and brain.
- Course involves mathematical application, and development of computer programs that leverage mathematics to solve problems
- Transitioned course to online learning due to COVID-19 pandemic
- 15 students

Instructor for Mathematical Modeling for Quantitative Biology (BIOL 226/L) 08/20/2019 – 12/12/2019  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Sole instructor for course and lab aimed at introducing students to various concepts and methods in quantitative biology, particularly as they apply to medical applications. Topics included: Random Walks, Diffusion, Genetic Algorithms, Biochemical Kinetics, Computational Neuroscience, Muscle Mechanics, Robotics as applied to medicine
- Course involves mathematical application, computer programming fundamentals, and development of basic computer programs that leverage mathematics to solve problems, and a semester-long coding assignment
- Teaching Innovation: Invited radiation oncologist to discuss her use of mathematics on the front lines of medicine. Resulted in two students from the course working for her as research interns. One did independent research, the other is using the research opportunity for honors research credit.
- 22 Students

Instructor for Mathematical Modeling for Quantitative Biology (BIOL 226/L) 01/09/2019 – 04/30/2019  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Sole instructor for course and lab aimed at introducing students to various concepts and methods in quantitative biology including: Random Walks, Diffusion, Genetic Algorithms, Biochemical Kinetics, Computational Neuroscience, Muscle Mechanics, Stochastic Simulation of Chemical Reactions.
- Course involves mathematical application, computer programming fundamentals, and development of basic computer programs that leverage mathematics to solve problems
- 30 students

### Graduate Students Supervised

<sup>!</sup>**&Faye Piephoff** 01/01/2023 – Present  
Case Western Reserve University Cleveland, OH

- Using computational neuroscience and physics-based modeling to investigate distributed sensing in the Leech

<sup>!</sup>**Andrew Giang** 01/01/2023 – Present  
Case Western Reserve University Cleveland, OH

- Interests in bird magnetoreception

<sup>!</sup>**&Delaney O’Connell (B.S. Quantitative Biology – UNC Chapel Hill)** 01/10/2021 – 5/8/2022  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Recipient of NSF GRFP award
- Adaptability of magnetoreception strategies to temporal changes
- Resource management and energetics in animal migration

### UNC Undergraduate Students Supervised

<sup>!</sup>**Quynh Ngo:** Undergraduate Major: Biology 01/10/2022 – Present  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Using agent based modeling to study applications of bioinspired navigation for navigation and exploration of other planets
- Summer 2022: BIOL 395
- Spring 2022: Biology Intern



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- !&Jacqueline Gu:** Undergraduate Major: Quantitative Biology 08/18/2021 – 05/8/2022  
University of North Carolina at Chapel Hill Chapel Hill, NC
- Used computational neuroscience to understand distributed visual sensing and processing in the Leech
  - Spring 2022: BIOL 395
  - Fall 2021: Biology Intern
- !&Sebastian Nichols:** Undergraduate Major: Quantitative Biology 08/26/2019 – 05/14/2021  
University of North Carolina at Chapel Hill Chapel Hill, NC
- Using computational neuroscience to understand distributed sensing and processing in the Leech
  - !Awarded the Robert Coker Award for excellence in research in Organismal Biology and Ecology.
  - !Awarded Highest Honors upon graduation
  - !Honors Thesis Title: Bioinspired Navigation Base on Distributed Sensing in the Leech using Dynamic Neural Fields
  - !Summer 2020: BIOL 395 – Recipient of Summer Award for Research-Intensive Courses (SARIC) for Undergraduate Research for Summer 2020
  - !& Spring 2020: BIOL 395 – Work led to submission of a peer-reviewed conference paper
  - Fall 2019: Biology Intern
- !&Susan Pizzuti:** Undergraduate Major: Quantitative Biology 05/15/2020 – 06/31/2022  
University of North Carolina at Chapel Hill Chapel Hill, NC
- Application of dynamical systems analysis to magnetic migration strategies for the north Atlantic ocean
  - Intern (Summer 2021)
  - Work Study (Fall 2020 and Spring 2021)
  - 2020 Science and Math Achievement and Resourcefulness Track (SMART) student (Summer 2020)
- !Ashley Ruhashya:** Undergraduate Major: Biology 01/17/2020 – 05/10/2020  
University of North Carolina at Chapel Hill Chapel Hill, NC
- Indirectly mentored student during her independent research that she performed under the direction and supervision of Dr. Colette Shen at UNC Hospitals for independent research credit.
- !&Delaney O’Connell:** Undergraduate Major: Quantitative Biology 01/17/2020 – 05/10/2020  
University of North Carolina at Chapel Hill Chapel Hill, NC
- Development and modification of code for studying the effects of tracking tags on turtle energetics and ecology.
  - &Work during 2020 and early 2021 led to the publication of a journal paper
- !&Andrew Harvey:** Undergraduate Major: Biology/Computer Science 05/16/2019 – 05/10/2020  
University of North Carolina at Chapel Hill Chapel Hill, NC
- !Development of software to control a magnetic navigation testing environment and tethered robot. Partially supervised through an Honors Thesis for Computer Science (A – Graduation with Highest Honors).
  - Student Employee during Summer 2019
  - Honors thesis work during Fall 2019 and !Spring 2020
- !&Maggie Bernish:** Undergraduate Major: Quantitative Biology 08/26/2019 – 05/10/2020  
University of North Carolina at Chapel Hill Chapel Hill, NC
- Application of dynamical systems analysis to magnetic migration strategies for the north Atlantic ocean
  - !& Spring 2020: BIOL 395 (A) – work during the Spring 2020 semester led to journal paper authorship
  - Fall 2019: Biology Intern
- &Casey Charbonneau:** Undergraduate Major: Quantitative Biology 05/16/2019 – 07/29/2019  
University of North Carolina at Chapel Hill Chapel Hill, NC
- Development and modification of code for studying the effects of tracking tags on turtle energetics and ecology
  - &Contributor to peer reviewed conference paper (cowrote introduction and methods)
  - Now employed at *Aerotek*

Note: Items labeled with “!” occurred during the COVID 19 pandemic

**JR Elliot:** Undergraduate Major: Biomedical Engineering 02/15/2019 – 05/12/2019  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Analyzed historic and predictive modeled magnetic field data from an animal perspective
- Now employed at *Allscripts*

**Nomi Topasna:** Undergraduate Major: Biomedical Engineering 02/01/2019 – 05/12/2019  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Developed a more advanced vehicle model of an agent that navigates using magnetic signatures
- Now employed at *Aerotek*

### Other Personnel Supervised (includes students that worked in employment capacity)

- Bold indicates direct supervision or mentorship

**<sup>!</sup>Dr. Jeffery Gill** (Ph.D. – Biology: Case Western Reserve University) 01/01/2023 – Present  
Case Western Reserve University Cleveland, OH

- Research associate assisting with research, lab management, and facility setup. Active contributor on proposals and papers.

**<sup>!</sup>Renzhi Li:** Undergraduate Major: Biology 09/01/2023 – Present  
Case Western Reserve University (01/01/2023 – Present) Cleveland, OH  
University of North Carolina at Chapel Hill (09/01/2022 – 12/31/2022) Chapel Hill, NC

- Using agent based modeling to study applications of bioinspired navigation for navigation and exploration of other planets
- University of Southern California (Electrical Engineering – Class of 2025)

**<sup>!</sup>&Dr. Catherine Kehl** (Ph.D. – Biology: Case Western Reserve University) 07/01/2019 – Present  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Will help develop modeling and simulation of animal magnetic navigation from behavioral and neural perspectives, and general laboratory assistance.

<sup>&</sup> Contributor to peer reviewed conference paper

**<sup>!</sup>&JaNya Brown:** Research Intern 06/01/2020 – 08/06/2021  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Developed preliminary generalized agent-based modeling tool for studying animal navigation
- York College of Pennsylvania Undergraduate (Forensic Chemistry – Class of 2024)

**<sup>!</sup>&Faye Piephoff:** Research Associate 05/18/2020 – 12/31/2022  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Using computational neuroscience and physics-based modeling to investigate distributed sensing in the Leech
- Hired after taking BIOL 590 with me in Spring 2020
- Hired upon graduation (UNC Class of 2020 – B.A. Biology)

**<sup>!</sup>Cassandra Shriver:** Research Associate 05/18/2020 – 05/02/2021  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Developed dynamics simulation to study the effects of tracking tags on turtle energetics and ecology
- Duke University Undergraduate (Mechanical Engineering – Class of 2021)

**<sup>!</sup>&Delaney O’Connell:** Research Associate 05/11/2020 – 01/18/2021  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Development and modification of code for studying the effects of tracking tags on turtle energetics and ecology.
- Hired upon graduation (UNC Class of 2020 – B.S. Quantitative Biology)

**<sup>!</sup>Andrew Harvey:** Research Associate 05/11/2020 – 06/30/2021  
University of North Carolina at Chapel Hill Chapel Hill, NC

Note: Items labeled with “!” occurred during the COVID 19 pandemic

- Development of software to control a magnetic navigation testing environment. Partially supervising through an Honors Thesis for Computer Science.
- Hired upon graduation (UNC Class of 2020 – B.S. Biology and Computer Science)

**!Maggie Bernish:** Research Associate 05/11/2020 – 06/30/2021  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Application of dynamical systems analysis to magnetic migration strategies for the north Atlantic ocean
- Hired upon graduation (UNC Class of 2020 – B.S. Quantitative Biology)

**!Luc Tourangeau:** Research Associate 06/03/2019 – 06/30/2021  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Mobile Robot development for magnetic navigation research

**Nomi Topasna:** Undergraduate Major: Biomedical Engineering 05/13/2019 – 07/15/2019  
University of North Carolina at Chapel Hill Chapel Hill, NC

- Tethered robot development for magnetic navigation research
- Now employed at *Aerotek*

**Sabrina Corbin:** Undergraduate Major: Mechanical Engineering 05/21/2018 – 07/27/2018  
Air Force Research Laboratory Eglin Air Force Base, FL

- Explored the effects of different environmental conditions and strategy parameters on the performance of a bioinspired magnetic navigation algorithm. Nominated for the AFRL Scholars “Outstanding Scholar” award.

**Ryan Murphey:** High School Student 09/1/2017 – 06/29/2018  
Air Force Research Laboratory Eglin Air Force Base, FL

- Mentoring a high school student through his externship to give him exposure to various engineering fields.

**Sharon Maguire:** Undergraduate Major: Mechanical Engineering 05/22/2017 – 07/28/2017  
Air Force Research Laboratory Eglin Air Force Base, FL

- Designed and began initial construction on a 10x10x10ft artificial magnetic environment for laboratory magnetic navigation experiments. Upon my recommendation, Sharon was one of the recipients of the AFRL Scholars "Outstanding Scholar" award.

**Christian Clark:** High School Student 05/22/2017 – 07/28/2017  
Air Force Research Laboratory Eglin Air Force Base, FL

- Implemented multiple biologically plausible magnetic navigation algorithms in simulation. Nominated for the AFRL Scholars “Outstanding Scholar” award.

**Gannon Woods:** High School Student 09/01/2014 – 08/14/2015  
Air Force Research Laboratory Eglin Air Force Base, FL

- Assisted a co-worker in mentoring a high school student through his externship to give him exposure to various engineering fields

**Brian Ortiz-Munoz:** Undergraduate Major – Aerospace Engineering 06/08/2015 – 8/14/2015  
Air Force Research Laboratory Eglin Air Force Base, FL

- Developed a software simulation of an artificial magnetic environment. Validated the simulation against that of a real world artificial magnetic environment. Upon my recommendation, Brian was one of three recipients of the AFRL Scholars "Outstanding Scholar" award.

**Spencer Mickus:** High School Student 06/01/2015 – 8/5/2015  
Air Force Research Laboratory Eglin Air Force Base, FL

- Took data to characterize and improve an artificial magnetic environment built for magnetic navigation testing

**Jamie Barnes:** High School Student 09/01/2014 – 08/14/2015  
Air Force Research Laboratory Eglin Air Force Base, FL

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- Assisted a co-worker in mentoring a high school student through her externship to give her exposure to various engineering fields

**Shang-Shang Chen:** High School Student  
Case Western Reserve University

04/06/2012 – 08/29/2012  
Cleveland, OH

- Developed software to allow an odor tracking robot to use moth antennae as odor sensors to aid in biological studies.

**Dora Wu:** Undergraduate Majors – Mechanical Engineering and Music (Violin Performance)  
Case Western Reserve University

05/17/2011 – 08/01/2011  
Cleveland, OH

- Took data from and assisted in repairing a 3D odor tracking robot.

## Graduate Committees

**Michael Senter: Mathematics (Advisor – Dr. Laura Miller)**  
University of North Carolina at Chapel Hill (Mathematics)

04/17/2020 – 05/10/2021  
Chapel Hill, NC

- Student successfully defended PhD thesis on 04/07/2021

**Hazel (formerly Luke) Havens: Biology (Advisor: Dr. Kenneth Lohmann)**  
University of North Carolina at Chapel Hill (Biology)

03/20/2020 – Present  
Chapel Hill, NC

- Named as committee chair

## Grants/Funding Obtained and Pending

- “Development of Biologically Inspired GPS-Free Navigation” PI for UNC Idea Grant **(\$18,733)**. Collaborators: Dr. Kenneth Lohmann (Charles Postelle Distinguished Professor), Dr. Catherine Kehl (Postdoctoral Researcher), Mr. Luke Havens (Graduate Researcher) – **Awarded – July 2020**. Funding will support animal field work, and the development of novel sensors using commercial-off-the-shelf products.
- “Magnetoreception in Marine Animals and Bio-Inspired Algorithms for Long-range, GPS-free Navigation” Co-PI with Drs. Kenneth Lohmann (UNC Chapel Hill), and Sonke Johnsen (Duke University) for AFOSR Grant FA9550-20-1-0399 **\$2,500,000 total – \$333,350 direct to Taylor Lab for postdoc support, graduate student support, and 1 month summer salary per year**. September 30 2020 – September 29 2025
- “Sparse Coding of Magnetic Fields for Location” as Co PI **(\$125,000 – All towards equipment and funding a postdoc)**. Award from the Chief Scientist Innovative Research Fund to explore neuromorphic and computational neuroscience approaches to using the magnetic field as a navigational signal
- “Bioinspired Magnetosensing and Sensory Integration” as PI **(\$17,000 – all for equipment)**. Award from the Chief Scientist Innovative Seedling Fund to construct an automated 3-axis artificial magnetic environment for biological and bioinspired magnetic navigation testing.
- Selected for the Air Force Office of Scientific Research (AFOSR) Visiting Scientist Program to collaborate with Dr. Ken Lohmann of the University of North Carolina at Chapel Hill (**~\$23,000.00 – For travel costs – Started on February 1, 2016**). The collaboration will focus on exploring magnetic and multimodal reception and navigation in animals, and the application of magnetic and multimodal reception in engineered systems.
- "Differential Geometric Trajectory Shaping for Enhanced Navigation Performance" as Co PI **(\$20,000.00 – For equipment)**. Award from the office of the Chief Scientist of the Air Force Research Laboratory Munitions Directorate for beginning research efforts, April 2014.
- "Bio-inspired Magnetosensing and Sensory Integration" as PI **(\$17,000.00 – for equipment)**. Award from the Venture Capital and Chief Scientist Fund, office of the Chief Scientist of the Air Force Research Laboratory Munitions Directorate, November 2013

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## Professional Service

### Departmental and University Engagement

- <sup>!</sup>Mechanical Engineering Controls Faculty Search Committee 01/05/2023 – Present  
Case Western Reserve University Cleveland, OH
- Assisting with identifying and recruiting a faculty member for the Department of Mechanical and Aerospace Engineering in the area of controls
- <sup>!</sup>Materials Science and Engineering Materials Manufacturing Faculty Search Committee 01/05/2023 – Present  
Case Western Reserve University Cleveland, OH
- Assisting with identifying and recruiting a faculty member for the Department of Mechanical and Aerospace Engineering in the area of materials manufacturing
- <sup>!</sup>Departmental presentation strategy 01/05/2021 – Present  
University of North Carolina at Chapel Hill Chapel Hill, NC
- Assisting with development of internal communication tools to better present and highlight the strengths and viability of particular sections within the department.
- <sup>!</sup>Spring Advisory Board Presentation 05/18/2021  
University of North Carolina at Chapel Hill Chapel Hill, NC
- Presented an overview of laboratory research and efforts to the Biology Department’s advisory board, which helps fundraise and make strategic decisions for the department
- <sup>!</sup>Chair’s Advisory Committee 03/10/2021 – 05/14/2021  
University of North Carolina at Chapel Hill Chapel Hill, NC
- Asked to serve on committee that advises the chair on departmental and strategic initiatives
- <sup>!</sup>Seminar Host 09/23/2021  
University of North Carolina at Chapel Hill Chapel Hill, NC
- Invited Dr. Auke Ijspeert to speak about his work in biorobotics
- <sup>!</sup>Seminar Host 11/17/2020  
University of North Carolina at Chapel Hill Chapel Hill, NC
- Invited and hosted Dr. Barbara Webb for the Distinguished Lecture Behavior & Biorobotics
- American Society of Mechanical Engineers (ASME) – Chair: Northwest Florida Section 09/01/2016-7/01/2018  
Northwest Florida Section Niceville, FL
- Oversee and direct the activities for the section.
  - Served as acting secretary and newsletter chair for 2014 and 2015.
- Seminar Organizer 02/26/2018  
Air Force Research Laboratory – Munition’s Directorate Eglin AFB, FL
- Hosted Dr. Lorian Schweikert, a post-doctoral fellow at Duke University. Her seminar was titled “Cryptocurrency and Fish Skin: The Power of Distributed Sensing and Processing”.
- Nature-Inspired Navigation Session Co-Chair 09/01/2016-05/04/2017  
Institute of Navigation (ION) – Pacific Position, Navigation, and Time (PNT) Conference Honolulu, Hawaii
- Soliciting and reviewing nature-inspired navigation papers to be programmed into the 2017 ION Pacific PNT conference.
- AFRL – Munitions Directorate Seminar Organizer 12/1/2016-12/2/2016  
Air Force Research Laboratory Eglin Air Force Base, FL
- Initiated, coordinated and organized a visit for Dr. Jeremy Marvel (National Institute of Standards and Technology) at the Air Force Research Laboratory’s Munition’s Directorate. The visit was a joint visit for both AFRL, and the American Society of Mechanical Engineers (ASME).

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Mechanical Engineering Departmental Seminar Organizer  
Case Western Reserve University

02/18/2011  
Cleveland, OH

- Initiated, coordinated and organized a departmental seminar, facility tour, and proposal discussion for the Department of Mechanical and Aerospace Engineering at Case Western Reserve University. The guest was Dr. Bryan Jones (Mississippi State University).

Biomimetics Session Chair  
1<sup>st</sup> International Conference on Applied Bionics and Biomechanics

10/15/2010  
Venice, Italy

- Led the session on biomimetics and ensured that the session ran smoothly amongst all of the presenters.

Member: President’s Advisory Committee on Minorities (PACM)  
Case Western Reserve University

11/01/2005 – 5/01/2010  
Cleveland, OH

- Committee aimed at moving Case Western Reserve University towards being a more diverse and inclusive environment that embraces and employs the benefits of diversity. This committee serves at the pleasure of the president. Served as the secretary for the last 2 years on the committee.

NSF ACES Distinguished Lecture Proposal Acceptance  
Case Western Reserve University

02/01/2008  
Cleveland, OH

- Solely and successfully authored and had accepted a proposal to have Elena Messina of the Intelligent Systems Division at the National Institute of Standards and Technology (NIST) speak as an NSF Academic Careers in Engineering and Science (ACES) Advancement of Women in Academic Science and Engineering Careers (ADVANCE) seminar speaker at Case Western Reserve University. The talk took place on 2/12/2009.

Member: Dean Search Committee, Case School of Engineering  
Case Western Reserve University

10/01/2006 – 12/22/2006  
Cleveland, OH

- One of 2 students on a committee formed to identify a candidate pool from which to select a dean for the Case School of Engineering at Case Western Reserve University.

## Scholarly Reviews

- Journal of Comparative Physiology A
- !Journal of Comparative Physiology A
- !IEEE Robotics and Automation Letters
- !Journal of The Royal Society Interface

03/04/2023  
07/29/2021  
01/12/2021  
12/08/2020