Brian K. Taylor

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Laboratory Address
The University of North Carolina at Chapel Hill
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Education

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

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

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

Professional Experience (positions held)

Assistant Professor of Biology — 07/01/2018 – Present
The University of North Carolina at Chapel Hill — 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.

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

- Performed in house research on bioinspired navigation, and GPS-less 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)

Selected Honors

- Selected for the Air Force Office of Scientific Research (AFOSR) Visiting Scientist Program (2015)
- Nominated for Outstanding Mentor of the Air Force Research Laboratory Scholars Program at Eglin AFB (2015)
- Co-Author for the CLAWAR Association Best Technical Paper Award (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)

Publications and Presentations

Books and Book Sections

- Fleissner G., Fleissner G., and Taylor B.K., "Magnetoreception", Encyclopedia of Animal Behavior (2nd ed) – 2019.

Peer-Reviewed Journal Papers

- Huang G., **Taylor B.K.,** Akopian D, "A low-cost approach of magnetic field-based location validation for global navigation satellite systems (GNSS) – an autonomous positioning case study" Accepted – IEEE Transactions on Instrumentation and Measurement - 2019

- **Taylor, B.K.** "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

- **Taylor, B.K.,** "Bioinspired magnetic reception and multimodal sensing." Biological Cybernetics, 2017. **111**(3): p. 287-308. https://doi.org/10.1007/s00422-017-0720-3

- **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

- **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.

Peer-Reviewed Conference Papers

- **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.

- Huang, G., **Taylor B.K.**, "Engineered and bioinspired approaches to magnetic navigation". Presented at the ION 2017 Pacific PNT Meeting, Honolulu, HI, May 2017

- **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.

- 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.

- **Taylor, B.K.**, Willis, M.A., Quinn, R.D. "Integrating olfaction, vision and touch to locate fluid-borne odors in diverse and dynamic environments". 1st International Conference on Applied Bionics and Biomechanics, 2010.

- **Taylor, B.K.**, Balakirsky, S., Messina, E., Quinn, RD., "Analysis and Benchmarking of a Whegs™ Robot in the USARSim Environment," Proceedings of IROS 2008

Other Conference Papers

- Rutkowski, A.J., **Taylor, B.K.**, Eilders, M.J., Brink, K.M., Taylor, C.N., Barnes, J., "Path Planning for Cooperative Navigation with Inter-Agent Range Measurements". Proceedings of the ION 2015 Pacific PNT Meeting, Honolulu, Hawaii, April 2015, pp. 412-422.

- **Taylor, B.K.**, Rutkowski, A.J., "Bio-inspired Magnetic Field Sensing and Processing". Proceedings of the ION 2015 Pacific PNT Meeting, Honolulu, Hawaii, April 2015, pp. 412-422.

- Rutter, B.L., **Taylor, B.K.**, Quinn, R.D., Lewinger, W.A., Bender, J.A., Ritzmann, R.E., Blumel, M., "Sensory Coupled Action Switching Modules (SCASM) for Modeling and Synthesis of Biologically Inspired Coordination", To appear in the proceedings of Climbing and Walking Robots, 2011. (Awarded CLAWAR Association Best Technical Paper Award – Highly Commended Paper)

- **Taylor, B.K.**, Balakirsky, S., Messina, E., Quinn, RD., "Modeling, Validation, and Analysis of a Whegs™ Robot in the USARSim Environment," Proceedings of SPIE, 2008.

- **Taylor, B.K.**, Rutter, B.L., Quinn, R.D., "A Biologically Inspired Sensory Driven Method for Tracking Wind-Borne Odors," Proceedings of the 2009 Performance Metrics for Intelligent Systems Workshop, September 2009.

- **Taylor, B.K.**, Balakirsky, S., Messina, E., Quinn, R., "Design and Validation of a Whegs™ Robot in USARSim," Proceedings of the 2007 Performance Metrics for Intelligent Systems Workshop, NIST Special Publication 1073, August 2007.

Conference Presentations and Posters

- Corbin S., **Taylor, B.K.**, " 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

- **Taylor, B.K.**, 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

- **Taylor, B.K.**, "Validating a model for detecting magnetic field intensity using dynamic neural fields". Presented at the 4th 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

- **Taylor, B.K.**, Rutkowski, A.J., "Bio-inspired Magnetic Field Sensing and Processing". Presented at the 3rd 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

- **Taylor, B.K.**, "Bioinspired Magnetic Reception and Multimodal Sensing", Presented for the 2nd 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

- **Taylor, B.K.**, 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).

- **Taylor, B.K.**, 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

- 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, RD., "Using Biological Analysis Tools to Study the Behavior of a Whegs Robot," Fourth International Symposium on Adaptive Motion of Animals and Machines, 2008

- 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.

- 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

- "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
- "Leveraging Animal Magnetic Reception for Robust Navigation Systems". Presented for the Director's Research Seminar at the Air Force Research Laboratory's Munitions Directorate, January 30, 2017
- "Bio and Bioinspired Magnetic Reception and Multimodal Sensing". Presented at the Department of Biology's "Lunch Bunch" seminar series at The University of North Carolina at Chapel Hill, September 9, 2016
- "Bioinspired Magnetic Reception and Multimodal Sensing". Presented to undergraduates and graduate students as a part of the Testing, Evaluation, and Control of Heterogeneous Large-scale Systems of Autonomous Vehicles (TECHLAV) center for autonomy at North Carolina A&T State University – 4/22/2016
- "Biologically Inspired Systems, and Observations from Undergrad to the Workforce". Presented to undergraduates and graduate students as a part of the Air Force Research Laboratory (AFRL) Scholars Program at Eglin Air Force Base, Florida – 7/16/2015
- "Bioinspired Magnetic Reception and Multimodal Sensing", Presented at the 2015 AFOSR Basic Research Initiative (BRI) kickoff meeting for Biomagnetic Sensation, Fort Walton Beach, Florida, 4/7/2015
- "Magnetic Reception and Multimodal Sensing for Navigation", Presented at the AFRL Position, Navigation, and Timing Baseline Review, Doolittle Institute, Fort Walton Beach, Florida, 1/20/2015
- "Bioinspired Magnetic Reception and Multimodal Sensing", Presented at the US-Singapore PNT Workshop in the Maui High Performance Computing Center, Maui, Hawaii, 6/2/2014
- "Implementation and Benchmarking of a Whegs™ Robot in the USARSim Environment" Presented at John Carroll University (JCU) – University Heights, Ohio – 4/2/2009
- "The Morphing Micro Air and Land Vehicle – Current Works on a Hybrid Land/Air Remote Sensor Platform," Presented at Ecole Polytechnique Federale de Lausanne (EPFL) – Lausanne, Switzerland – 9/23/2008

Teaching/Academic Experience

Courses

Instructor for Mathematical Modeling for Quantitative Biology (BIOL 226/L) 01/09/2019 – Present
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.

Postdoctoral Supervision

Dr. Grant Huang (Ph.D. – Electrical Engineering) 09/01/2015 – 07/01/2019
Air Force Research Laboratory/University of Florida Research & Engineering Education Facility Eglin Air Force Base, FL

- Implementation of bioinspired magnetic navigation ideas in robotic hardware, and use of magnetic navigation for GNSS navigation support

Students Supervised (primary supervision only)

JR Elliot: Undergraduate Major: Biomedical Engineering 02/15/2019 – Present
University of North Carolina at Chapel Hill Chapel Hill, FL
- Analyzing historic and predictive modeled magnetic field data from an animal perspective

Nomi Topasna: Undergraduate Major: Biomedical Engineering 02/01/2019 – Present
University of North Carolina at Chapel Hill Chapel Hill, FL
- Developing a more advanced vehicle model of an agent that navigates using magnetic signatures

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 – 05/18/2018
Air Force Research Laboratory Eglin Air Force Base, FL
- Mentored 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. Selected as a recipient 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.

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. Selected as a recipient 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

Shang-Shang Chen: High School Student 04/06/2012 – 08/29/2012
Case Western Reserve University 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) 05/17/2011 – 08/01/2011
Case Western Reserve University Cleveland, OH
- Took data from and assisted in repairing a 3D odor tracking robot.

Research Support

- "Sparse Coding of Magnetic Fields for Location" as Co PI with Dr. Kaitlin Fair **($125,000)**. Award from the AFRL Munitions Directorate 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**). Award from the AFRL Munitions Directorate 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 – 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**). 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**). Award from the Venture Capital and Chief Scientist Fund, office of the Chief Scientist of the Air Force Research Laboratory Munitions Directorate, November 2013

Professional Service

American Society of Mechanical Engineers (ASME) - Chair — 09/01/2016-06/29/2018
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).

Mechanical Engineering Departmental Seminar Organizer — 02/18/2011
Case Western Reserve University — 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 — 10/15/2010
1st International Conference on Applied Bionics and Biomechanics — Venice, Italy
- Led the session on biomimetics and ensured that the session ran smoothly amongst all of the presenters.

NSF ACES Distinguished Lecture Proposal Acceptance — 02/01/2008
Case Western Reserve University — 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: President's Advisory Committee on Minorities (PACM) — 11/01/2005 – 5/01/2010
Case Western Reserve University — 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.

Member: Dean Search Committee, Case School of Engineering 10/01/2006 – 12/22/2006
Case Western Reserve University 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.

Popular Media

- Online Article: Brian Taylor: Engineering Musician http://beachcomberdestin.com/destin/article-2117-brian-taylor-engineering-musician.html
- "Spirito Sereno" – Music CD released by Brian Taylor (2016)
- Ride of Silence – Taps Bugler
- DHS Student and Alumni Network – "Building a better airplane: DHS Fellow seeks to aid military with unique invention" – February 2007
- Clue into Cleveland – Greater Cleveland Flute Society's Just Us Concert – http://clueintocleveland.wordpress.com/2011/08/19/greater-cleveland-flute-societys-just-us-recital/

Outside Activities

Member: American Association for the Advancement of Science (AAAS)	02/02/2010 – Present
Member: American Society of Mechanical Engineers (ASME)	09/01/2013 – Present
Freelance Composer, Arranger, Trumpeter and Flugelhornist	12/24/1999 – Present
Member: Village Brass Band	08/01/2015 – 06/29/2018
Trumpeter/Flugelhornist with "The EdMo Project"	01/18/2013 – 12/01/2014
Trumpeter and Transcriber for Cleveland – based "The Good Foot" Funk and Soul Band	09/01/2011 – 04/01/2012
Arranger/Composer for the Tesla Orchestra (www.teslaorchestra.com/)	05/01/2010 – 08/29/2012
Case Western Reserve University Jazz Ensemble	09/27/2001 – 05/10/2012
"Midnight Jazz Project" Jazz Quartet	08/01/2005 – 05/01/2008
Case Western Reserve University Capoeira Club	09/27/2001 – 09/27/2007
National Society of Black Engineers – Case Chapter	09/27/2001 – 05/05/2005
Case Western Reserve University Design-Build-Fly	01/23/2004 – 05/05/2005
Case Western Reserve University Design-Build-Fly	01/12/2004 – 05/08/2004