Timothy Holder

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I. Educational Background

Institution:	Degree:	Year:	Area of Study:
➢ North Carolina State University Raleigh, NC University of North Carolina Chapel Hill, NC	Ph.D.	2022 (expected)	Biomedical Engineering (Advisor: Alper Bozkurt)
➢ Washington and Lee University Lexington, VA	B.Sc.	2016	Chemistry-Engineering

II. Professional Experience

- ❖ Jan '17 - Present: Graduate Research Assistant in the iBionics Lab at NC State University
- ❖ Aug '18 - Present: Teaching Assistant for ECE 505: Neural Interface Engineering at NC State University
- ❖ Jan '18 - Jun '18: Technology Transfer & Medical Writing Intern at The Center for Advancing Innovation
- ❖ Jun '17 - Nov '17: United Therapeutics Project Lead for the Medical Innovators Collaborative
- ❖ Aug '16 - Dec '16: Graduate Research Assistant in the Neuromechanics Lab at UNC-Chapel Hill

III. Research Experience

A. With Dr. Alper Bozkurt, et al.

→ CAI Synchronized System: Using a synchronized system of wearable devices (research and commercial), psychological instruments, and video behavioral coding, this project aims both to improve the methodological state of the practice and to realize the research field's goals of causal attribution, individualization, and benefit enhancement by quantifying the individual, interaction, and environmental data attendant to Canine Assisted Interactions.

→ Non-Contact System: In collaboration with IMEC (Belgium,) this project investigates non-contact devices and methods of acquiring continuous electrocardiographic, respiratory, and thermal physiological data from humans and canines involved in Animal Assisted Activities.

→ Canine Tail Wag System: In collaboration with Dr. David Roberts and Dr. Margaret Gruen, this project seeks to use novel non-contact and body-borne wearable devices to continuously track the movement of free-range dogs' tails in 3D space, given that the animal behavior field is highly interested in this communication modality and that dogs react poorly to on-tail wearables.

→ GEB Smart Collar Study Coordination: In collaboration with Dr. David Roberts, Guiding Eyes for the Blind, and IBM, this project develops and deploys the infrastructure to effectively and efficiently run a 1000

person citizen science study using the lab-developed smart collar device, smartphone app, and cloud database for the volunteer raisers and potential guide dogs in GEB's puppy rearing program.

→ AAI Review: This systematic literature review investigates the methods, results, and theoretical frameworks of Animal Assisted Interventions in Oncology.

→ OQN Device Review: This systematic literature review investigates the objective, quantitative, and non-invasive research tools deployed to evaluate Animal Assisted Interventions' effects on humans and animals.

→ Animal Implants Review: This systematic literature review investigates the state of the practice in design and deployment of animal implantables, injectables, and ingestibles.

→ Worm Ultrasonic Neuromodulation: Using low-intensity, low-frequency ultrasound as a non-invasive, non-traditional neuromodulation modality, this project investigates the stimulation and inhibition of *Lumbricus terrestris* peripheral nervous system for eventual translation to human prosthetic control, somatosensory feedback, and pain management.

→ Health and Environment Tracker Testing: Worked with clinical staff to design trials and collect data from research subjects testing the ASSIST Center's novel, multimodal sensor testbed (HET 1.0) for simultaneously monitoring the health and environment in asthma management contexts.

B. With Dr. Xiaogang Hu, et al.

→ Human PNS Stimulation: Using a novel armband device that provides targeted transcutaneous electrical current, we non-invasively stimulated both post-stroke and post-amputation individuals' median and ulnar nerves for closed-loop prosthetic control and somatosensory feedback.

C. With Dr. Fiona Watson, et al.

→ Frog Optic Nerve Regeneration: To eventually help visually impaired individuals recover sight, this project used Translating Ribosome Affinity Purification (TRAP) and RNA sequencing to temporally profile the genetic factors expressed by retinal ganglion cells recovering from induced optic nerve injury in transgenic, post-metamorphic African clawed frog (*Xenopus laevis*.)

→ Frog Development and Organophosphate Pesticides: Collaborating with Dr. Simon Levy, we used confocal microscopy and automatic image processing to investigate the developmental disruption of the cholinergic nervous system of embryonic *Xenopus laevis* during and after exposure to the organophosphate pesticides Chlorpyrifos and Dichlorvos.

IV. Other Experience

A. Key Skills

➢ Experimental Testbed Setup ; Large Study Design (n = 1000) ; Research Trial Management ; Scientific Data Collection & Presentation ; Literature Review ; IRB applications ; Commercial Product Development ; Electronic Device Test Engineering ; MATLAB (GUI design, signal processing, data analysis, & visualization) ; Python (data science & visualization) ; R (bioinformatics) ; Java Script (web development) ; WordPress (web development) ; SOLIDWORKS (CAD modeling & 3D printing) ; Confocal Microscopic Imaging ; Small Animal Surgery (for *Lumbricus terrestris* & *Xenopus laevis*) ; Microsoft Office ; LaTeX ; Written and Oral Communication

B. Leadership

→ During my continuing tenure in the iBionics lab, I have successfully mentored 11 undergraduate and 2 high school interns of diverse demographic and educational backgrounds, yielding multiple project completions, graduate/collegiate school acceptances, and scientific journal or conference publications.

→ During my consultancy with MEDIC, I successfully led a team of engineers and scientists in meeting the product development and testing needs of our client, United Therapeutics.

→ During my undergraduate and graduate careers, I have actively led various student organizations for the mutual benefit of members and the surrounding community.

C. Organizations

- ❖ Aug '20 - Present: Alumni Representative and Board member of the Underrepresented STEM Graduate Student Association (USGSA) at NC State University.
- ❖ Jan '20 - Present: Member of the Black Graduate Student Association at NC State University.
- ❖ Feb '19 - Present: Student member of the Institute of Electrical and Electronics Engineers (IEEE)
- ❖ Jul '18 - Present: Student member of the American Association for the Advancement of Science (AAAS)
- ❖ Aug '16 - Present: Division 1 player for the intercollegiate racquetball team at UNC-Chapel Hill
- ❖ Jan '14 - May '16: Founder and President of the Racket Sports Club at Washington and Lee University
- ❖ Sep '14 - May '16: Founder and President of the American Sign Language Club at Washington and Lee University

D. Conferences and Workshops

- ❖ Jul ' 21: International Summer School on Animal-Centered Computing (virtual)
- ❖ Jul ' 20: International Summer School on Animal-Centered Computing (St. Petersburg, Russia)
- ❖ Nov '19: Annual Biomedical Research Conference for Minority Students (Anaheim, CA)
- ❖ Nov '18: Annual Biomedical Research Conference for Minority Students (Indianapolis, IN)
- ❖ Oct '18: IEEE Biomedical Circuits and Systems Conference (Cleveland, OH)
- ❖ Jan '18: IBM "Dog Collar Jobs" Design Thinking Workshop (Washington, DC)

V. Honors and Awards

- ❖ ASSIST SLC Online Independent Learning Fellowship (May '20)
- ❖ Mid-Atlantic Collegiate Racquetball Conference Player of the Year (2019-2020)
- ❖ North Carolina Racquetball Association Sportsmanship Award (Mar '19)
- ❖ Mid-Atlantic Collegiate Racquetball Conference Player of the Year (2018-2019)
- ❖ Richard Bland Fellowship at UNC-Chapel Hill (Mar '2017)
- ❖ Dean's Doctoral Fellowship at NC State University (Mar '16)
- ❖ Howard Hughes Medical Institute Research Fellowship at Washington and Lee University (Mar '14)
- ❖ The Johnson Program Scholarship at Washington and Lee University (May '12)

VI. Publications

A. Journal Articles

3. <u>Holder TRN</u>, Roberts DL, Bozkurt A. Non-invasive Devices and Methods for Quantifying Outcomes in Animal Assisted Interactions. In Preparation.

2. <u>Holder TRN</u>, Gruen ME, Roberts DL, Somers T, Bozkurt A. A Systematic Literature Review of Animal-Assisted Interventions in Oncology (Part I): Methods and Results. Integrative Cancer Therapies. January 2020. doi:10.1177/1534735420943278

1. <u>Holder TRN</u>, Gruen ME, Roberts DL, Somers T, Bozkurt A. A Systematic Literature Review of Animal-Assisted Interventions in Oncology (Part II): Theoretical Mechanisms and Frameworks. Integrative Cancer Therapies. January 2020. doi:10.1177/1534735420943269

B. Conference Proceedings (refereed)

6. <u>Holder T</u>, Williams E, Martin D, Kligerman A, Summers E, Cleghern Z, Dieffenderfer J, Russenberger J, Roberts D, Bozkurt, A (2021). From Ideation to Deployment: A Narrative Case Study of Citizen Science Supported Wearables for Raising Guide Dogs. 8th ACM International Conference on Animal Computer Interaction. In Press.

5. Cleghern Z, Foster M, Mealin S, Williams E, <u>Holder T</u>, Bozkurt A, Roberts D (2021). A Cloud Data Collection Platform for Canine Behavioral Prediction using Objective Sensor Data. International Journal of Cloud Computing. In Press.

4. Williams E, Cleghern Z, Foster M, <u>Holder T</u>, Roberts D, Bozkurt A. (2020) A Smart Collar for Assessment of Activity Levels and Environmental Conditions for Guide Dogs. 42nd Annual International Conferences of the IEEE Engineering in Medicine and Biology Society (EMBC), Montreal, Canada.

3. Cleghern Z, Williams E, Mealin S, Foster M, <u>Holder T</u>, Bozkurt A, Roberts D. (2020) Behavioral and Environmental Analytics from Potential Guide Dogs with IoT Sensor Data Informed by Expert Insight. 7th ACM International Conference on Animal Computer Interaction. Milton Keynes, UK

2. Cleghern Z, Williams E, Mealin S, Foster M, <u>Holder T</u>, Bozkurt A, Roberts D (2019). An IoT and Analytics Platform for Characterizing Adolescent Dogs' Suitability for Guide Work, 6th ACM International Conference on Animal Computer Interaction. Haifa, Israel.

1. M. Foster, Beppler E, <u>Holder T</u>, Dieffenderfer J, Erb P, Everette K, Gruen M, Somers T, Evans T, Daniele M, Roberts D, Bozkurt A (2018). A System for Assessment of Canine-Human Interaction during Animal-Assisted Therapies. 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), pp. 4347-4350, doi: 10.1109/EMBC.2018.8513384.

C. Conference Abstracts

1. Adedeji J, <u>Holder T</u>, Sotory P, Oralkan O, Bozkurt A. (2019) Excitatory and Inhibitory Effects of Ultrasonic Neuromodulation in *Lumbricus terrestris*. Annual Biomedical Research Conference for Minority Students (ABRCMS), California, United States.