Adam Willats

Collaborative, interdisciplinary researcher focused at the intersection of neuroscience, machine-learning, and closed-loop control. Currently completing a PhD in Biomedical Engineering.

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Objective

Data scientist experienced in analysis and visualization of complex neural data. **Science communicator** driven by developing interactive and intuitive ways to demonstrate concepts to others. Successful **engineer and innovator of responsive technologies** for understanding and regulating the nervous system resulting in two patents, five publications, and development of an open-source codebase. Looking to expand the efficacy of neurostimulation therapies through design and development of closed-loop algorithms and individualized data-driven models of the nervous system. Eager to apply expertise within a **collaborative research and development team** to improve quality of life for those experiencing neurological disorders.

Experience

Graduate Research Assistant, *Georgia Institute of Technology & Emory University, SIPLAB*   2014-present
- Developed recurrent, dynamical systems models of neural responses to optogenetic stimulation
- Characterized algorithms for decoding and controlling brain states *in silico*
- Implemented real-time closed-loop control algorithms to regulate neural firing *in vivo* with <2ms compute times ○
- Contributed to writing collaborative multi-year research grant which was successfully funded for $1.6 million
- Actively participated in both neuro-engineering (Neuro@GT) and machine learning communities (ML@GT)
- Organized retreats, methods clinics, and journal clubs across two universities as a member of the Computational Neuroscience Training Leadership Committee
- Mentored one undergraduate and three graduate researchers in statistical modeling and neural stimulation technology

Undergraduate Researcher, *Purdue University, Center for implantable Devices*   Jan 2014-Jun 2014
- Developed and patented technology and signal processing algorithms for a novel approach to control intraocular pressure (IOP) to treat glaucoma
- Conducted surgeries and data analysis to verify prototype performance

Intern - R&D, *Cyberonics (now LivaNova)*   May 2013-Aug 2013
- Characterized, and tested radio frequency programming system for vagus nerve stimulator
- Streamlined analysis of oscilloscope data by developing a MATLAB GUI
- Researched security concerns associated with wireless-enabled implantable medical devices

Undergraduate Researcher, *Purdue University, e-Lab*   May 2012-Aug 2012
- Integrated computer vision systems with mobile robotics platforms as part of the Purdue Summer Undergraduate Research Fellowship (SURF) program ▶
- Programmed in C++ and Lua using Robot Operating System (ROS) and torch7 machine learning framework

Education

Ph.D. in Biomedical Engineering, *Georgia Institute of Technology & Emory University*   2014-2021
- *Thesis:* Developing, characterizing, and applying closed-loop control to understand neural circuits
- Computational Neuroscience Training Grant Fellow
- Graduate Teaching Fellow
- President's Fellowship

B.Sc. in Biomedical Engineering, *Purdue University*   2010-2014

Select Courses

Data science and scientific computing, *Institute for Data Engineering and Science (IDEaS)*, Georgia Institute of Technology   2017

Mining and modeling neuroscience data, *UC Berkeley*   2015
- This course integrated lectures from prominent researchers in computational neuroscience, with hands-on analysis of a variety of neuroscience data sets.

Machine Learning for Control Systems, *Georgia Institute of Technology*   2015

Data Skills

- **Programming languages:** *MATLAB, Python, C++, JavaScript*
- **Interactive visualization:** *MATLAB LiveScript, Jupyter Notebooks, Processing.js*
- **Probability & statistical models:** *Generalized linear models (GLM), hidden Markov models (HMM), linear dynamical systems, maximum a posteriori estimation. NumPy, SciKit-Learn*
- **Databases:** *pandas*
- **High-performance, parallel computing:** *Portable Batch System (PBS) script, parallel computation in MATLAB, python*
- **Real-time signal processing:** *RTXI, Arduino*
- **Version control:** *GitHub*

Publications

ⓘ ORCiD 🎓 Google Scholar *indicates co first-author

Reviewed Articles

K. Fallah[*], **A. Willats**[*], N. Liu, C. Rozell, "**Learning sparse codes from compressed representations with biologically plausible local wiring constraints**", *Neural Information Processing Systems (NeurIPS)*, (2020) 📄

M. Bolus, **A. Willats**, C. Rozell, G. Stanley, "**State-space optimal feedback control of optogenetically driven neural activity**", *Journal of Neural Engineering*, (2020) 📄

A. Cakmak, G. Poian, **A. Willats**, A. Haffar, R. Abdulbaki, Y. Ko, A. Shah, V. Vaccarino, D. Bliwise, C. Rozell, G. Clifford, "**An unbiased, efficient sleep–wake detection algorithm for a population with sleep disorders: change point decoder**", *Sleep*, (2020) 📄

M. Bolus, **A. Willats**, C. Whitmire, C. Rozell, G. Stanley, "**Design strategies for dynamic closed-loop optogenetic neurocontrol *in vivo***", *Journal of Neural Engineering*, (2018) 📄

E. Chow, H. Joshi, **A. Willats**, D. Thompson, K. Cotton, S. Nair, C. Warren, B. Tomayko, A. Adkins, A. Shen, M. Morris, B. Byerman, "**Commercial development of RF medical implantable devices**", *2013 IEEE MTT-S International Microwave Workshop Series on RF and Wireless Technologies for Biomedical and Healthcare Applications (IMWS-BIO)*, (2013) 📄

Conference Presentations

When are open- and closed-loop control necessary for causal inference in neural circuits? *Neuromatch.io* 📄 ▶️   2020

State-aware control of neural activity: design & analysis - *COSYNE* II-38 in 📄   2018

Closed loop optogenetic control of neural circuits: Tracking dynamic trajectories of neural activity - *COSYNE* II-42 in 📄   2016

Understanding optogenetic stimulation strategies: a study of opsin-neuron models and their spiking behaviors - *Society for Neuroscience (SfN)* 📄   2016

Patents

G. Clifford, A. Cakmak, **A. Willats**, C. Rozell, "**System for Automated Analysis of Sleep and Wake States**", *PCT/US2020/049392*, (2020) 📄

P. Irazoqui, S. John, A. Kokini, **A. Willats**, A. Chelminski, M. Matuscak, G. Simon, "**Optical Pressure Treatment through Electrical Stimulation**", *US20190001134A1*, (2020) 📄

Outreach

Lab Training Guide   2020-2021
- Initiated and developed document for helping graduate students succeed at research

Georgia Intern Fellowship for Teachers (GIFT) program, Center for Education Integrating Science, Mathematics, and Computing (CEISMC)   2018
- Mentored teacher in developing curriculum centered around digital signal processing

Kids Interested In Technology, Engineering, and Science (KITES) festival [2018 ⧉] [2016 ⧉]   2016-2018
- Built Arduino-based recording unit for real-time signal measurement and display based on Backyard Brains EMG kit
- Helped develop activity plan for 4th grade students to plot and analyze data