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. 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. **Science communicator** driven to develop interactive and intuitive ways to demonstrate concepts to others. Eager to apply expertise within a **collaborative research and development team** to improve quality of life for those experiencing neurological disorders through machine learning and neurostimulation therapies.

Experience

Graduate Research Assistant, *Georgia Institute of Technology & Emory University, SIPLAB* 2014-2021 (expected)
- Developed recurrent, dynamical systems models of neural responses to optogenetic stimulation using regression and dimensionality reduction
- Characterized algorithms for identifying graphical recurrent network models of the brain
- Implemented real-time closed-loop control algorithms to regulate neural firing *in vivo* with <2 ms compute times
- Contributed to writing a collaborative multi-year research grant which was successfully funded for $1.6 million
- Collaborated and published with peers in both neuroengineering (Neuro@GT) and machine learning communities (ML@GT)
- 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

Intern - R&D, *Cyberonics (now LivaNova)* May 2013-Aug 2013
- Characterized and tested radio frequency programming system for vagus nerve stimulator
- Researched security concerns associated with wireless-enabled implantable medical devices

Undergraduate Researcher, *Purdue University*, e-Lab May 2012-Aug 2012
- Integrated machine learning computer vision systems (C++, Lua, Torch7) with mobile robotics platforms (ROS) as part of the Purdue Summer Undergraduate Research Fellowship (SURF) program

Education

Ph.D. in Biomedical Engineering, *Georgia Institute of Technology & Emory University* 2014-2021 (expected)
- *Thesis:* Developing, characterizing, and applying closed-loop control to understand neural circuits

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

Data Skills

- **Probability & statistical models:** *NumPy, SciKit-Learn. Generalized linear models (GLM), hidden Markov models (HMM), linear dynamical systems.*
- **Techniques:** Applied experience in dimensionality reduction, classification, and regression
- **Programming languages:** *MATLAB, Python, C++, JavaScript*
- **Teaching through interactive visualization:** *MATLAB LiveScript, Jupyter Notebooks, Processing.js*
- **Databases:** *pandas*, **Version control:** *GitHub*
- **High-performance, parallel computing:** *Parallel computation in MATLAB, python.*
- **Real-time signal processing:** *RTXI, Arduino*
- **Relevant courses:** Machine Learning for Control Systems, Data Science and Scientific Computing, Mining and Modeling Neuroscience Data,

Honors

Graduate Teaching Fellow - *Georgia Institute of Technology* 2021

Computational Neuroscience Training Grant Fellow - *NIH, Emory University, Georgia Institute of Technology* 2014-2018
- This program supports cross-institute and interdisciplinary training in computational neuroscience, machine learning, and neural engineering.

- As a fellow in this program I conducted research across multiple laboratories, led journal clubs, organized retreats, and attended training at UC Berkeley.

President's Fellow - *Georgia Institute of Technology* 2015

Publications

ORCiD Google Scholar *indicates co first-author

Manuscripts In Preparation

A. Willats, M. Bolus, C. Whitmire, G. Stanley, C. Rozell, "**State-aware control of switching neural dynamics**", *(in prep.)*, (2021)

A. Willats, M. O'Shaughnessy, C. Rozell, "**Closed-loop control for causal identification of neural circuits**", *(in prep.)*, (2021)

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

A. Willats, M. O'Shaughnessy, K. Johnsen, C. Rozell, "**When are open- and closed-loop control necessary for causal inference in neural circuits?**", *Neuromatch.io*, (2020)

A. Willats, M. Bolus, C. Whitmire, G. Stanley, C. Rozell, "**State-aware control of neural activity: design & analysis**", *Cosyne Abstracts*, (2018) II-38 in

M. Bolus, **A. Willats**, C. Whitmire, C. Rozell, G. Stanley, "**Closed-loop optogenetic control of thalamocortical activity**", *Society for Neuroscience*, (2017) BB21 in

M. Bolus, **A. Willats**, C. Whitmire, Z. Costello, M. Egerstedt, C. Rozell, G. Stanley, "**Closed-loop optogenetic control of neural circuits: Tracking dynamic trajectories of neural activity**", *Cosyne Abstracts*, (2016) II-42 in

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 led development of a document for helping graduate students succeed at research

Georgia Intern Fellowship for Teachers (GIFT) program 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