

# Adam Willats

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

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## Summary & 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 (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 📄

### 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
- **Version control:** GitHub, **Databases:** pandas
- **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

## 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. Abdulkaki, 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](#) 

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

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 !\[\]\(b28649c69774b0ac4a13ee3e2c917749\_img.jpg\)](#)] [\[2016 !\[\]\(428d43b897729be204accff7c7a0fb8b\_img.jpg\)](#)]

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