Griffin W. Milsap

JHU Applied Physics Lab — (240) 592-2556 — griffin.milsap@jhuapl.edu

Fall 2022

Education

2012–2018 **Johns Hopkins University**
Ph.D in Biomedical Engineering
Research in speech-related brain-machine-interface with Dr. Nathan Crone

2008–2012 **B.Sc., Rensselaer Polytechnic University, *Cum Laude***
Electrical and Computer Systems Engineering
Overall GPA: 3.68/4.0

Professional/Research Experience

2018– **Senior Professional Neuroscientist/Biomedical Engineer**
Johns Hopkins University Applied Physics Laboratory
- Developing and characterizing state-of-the-art non-invasive neuroimaging technology
- Applying artificial intelligence and machine learning techniques to electrophysiology
- Mentoring students as part of the Engineering for Professionals distance learning program

2012–2018 **Ph.D Research in Biomedical Engineering**
Johns Hopkins University Whiting School of Engineering
- Collected/Analyzed inpatient/intraoperative electrocorticographic (ECoG) recordings
- Co-authored 10+ publications, co-authored a successful NIH R01 grant
- Coursework in neuroscience, statistics, machine learning, and instrumentation

2012–2013 BCI2000 Consultant
Pacific Development and Technology, LLC
- Providing advice and programming help with remote deployment of BCI2000 system

2008–2012 **Software and Test Engineer/Undergraduate Researcher**
Wadsworth Center, Schalk Brain Computer Interfacing (BCI) Lab
- Developed, maintained and tested the BCI2000 software, used by hundreds of labs world-wide
- Interfaced eyetracking, motionsensing, and signal acquisition hardware with BCI2000
- Implemented experimental paradigms, listed in several publications

2010–2012 **Principle Software Engineer/Partner**
Motalen Inc.
- Developed musical signal processing and procedural game engine architecture
- Designed, programmed, and tested one "shipped" game title on Android, "Wave"
- Deployed BCI2000 based system for internal BCI research and development

2010–2011 Undergraduate Researcher
Rensselaer Artificial Intelligence and Reasoning Laboratory
- Worked on audio signal-processing algorithms for a creative artifical intelligence agent in collaboration with machine learning scientists and musicians.

Professional Expertise

Research	Worked in collaborative research settings for a decade throughout undergraduate and Ph.D education under Dr. Nathan Crone (`https://cronelab.github.io`) and Dr. Gerwin Schalk (`https://schalklab.org`).
Clinical	Recorded research-quality human electrocorticography in a world-class clinical epilepsy monitoring unit, as well as intraoperatively during awake DBS surgeries while interacting directly with patients and clinicians. Familiar with surgical practices and HIPAA compliant data storage/de-identification procedures.
Computational	Extensive background writing real-time software packages to facilitate signal processing of audio and electrophysiolgy. Familiar with theory and practices for data mining and machine learning. Strong background in parallelization, realtime graphics, profiling, optimization, debugging, and net-code.
Writing	Authored articles, posters, technical communications, and patent applications. Co-authored a successful NIH R01 grant application, and familiar with IRB practices, grantsmanship, and peer-review procedures.
Engineering	Developed high performance real-time systems for neural signal processing, graphics, network-communication, and interactions with the outside-world via connected hardware and embedded systems. Strong background in software engineering, system design, computer architecture, networking, and reverse engineering.
Neuroscience	Made contributions to the state-of-the-art in cortical speech representations. Familiar with classical speech/language models, and ventral-stream image identification theories.
Machine Learning	Application and training of classical ML and modern deep neural network architectures on neural data.

Awards

2022	**Publication Award** *Johns Hopkins University Applied Physics Lab Achievement Awards* A 32-channel frequency-domain fNIRS system based on silicon photomultiplier receivers
2022	**Ignition Grant Prize for Innovation** *Johns Hopkins University Applied Physics Lab Achievement Awards* Multifaceted Intentional Natural Drone (MIND) Control
2018	**Invention of the Year** *Johns Hopkins University Applied Physics Lab Achievement Awards* Coherent, Optical System for Noninvasive, Real-Time Imaging of Neural Tissue and Other Biological Systems

Technical Expertise

C/C++	Expert
Python	Expert
Linux	Expert
Javascript	Strong Background, Full Stack
Java(Android)	Strong Background
BCI2000	Active Contributor/Developer
OpenGL	Strong Background in Realtime Graphics
Packages	Numpy, Pytorch, Scikit-Learn, Matplotlib, Qt, three.js, d3.js
Software	Jupyter, Docker, Gigantum, Unity, BCI2000, Chrome Developer Console, Visual Studio/VSCode, Node.js, LaTeX, vim, git, svn, Blender, GIMP, Photoshop, Renoise, MS Office, Wireshark
Embedded	Arduino, Raspberry Pi, BeagleBone, TI MSP430, OpenBCI
Hardware	Written Realtime Software Interfaces with: Oculus/Vive, Tobii Eyetrackers, Nintendo Wii Remote, Clinical and Research EEG amplifiers, and audio interfaces.
Matlab	Working Knowledge

Publications

Selected Articles

2021 **Milsap, Griffin** and Preston Peranich. Technical Note: A Low-Cost Research Platform for Brain-Computer-Interface Applications in Mixed Reality. In *2021 10th International IEEE/EMBS Conference on Neural Engineering (NER)*, pages 515–518, May 2021. ISSN: 1948-3554

Jeremiah J. Wathen, Michael J. Fitch, Vincent R. Pagn, **Milsap, Griffin W.**, Emil G. McDowell, Lafe Spietz, Zachary E. Markow, Jason W. Trobaugh, Edward J. Richter, Adam T. Eggebrecht, Joseph P. Culver, David W. Blodgett, and Scott M. Hendrickson. A 32-channel frequency-domain fNIRS system based on silicon photomultiplier receivers. In *Optical Techniques in Neurosurgery, Neurophotonics, and Optogenetics*, volume 11629, pages 62–79. SPIE, March 2021

Margaret C. Thompson, Brian S. Robinson, **Milsap, Griffin W.**, Jeremiah J. Wathen, Michael J. Fitch, Clara A. Scholl, and Scott M. Hendrickson. Phase component of frequency-domain functional near-infrared imaging improves decoding of motor-evoked neural activity. In *2021 10th International IEEE/EMBS Conference on Neural Engineering (NER)*, pages 365–369, May 2021. ISSN: 1948-3554

Clara A. Scholl, Jeremiah J. Wathen, Michael J. Fitch, **Milsap, Griffin W.** , Margaret C. Thompson, Marisel Villafae-Delgado, Kachi Odoemene, Adam T. Eggebrecht, Zachary E. Markow, Edward J. Richter, Jason W. Trobaugh, Joseph P. Culver, David W. Blodgett, and Scott M. Hendrickson. Evaluation of neural information content from the phase component of a 32-channel frequency-domain fNIRS system. In *Optical Techniques in Neurosurgery, Neurophotonics, and Optogenetics*, volume 11629, pages 141–148. SPIE, March 2021

2020 Anna Korzeniewska, Yujing Wang, Heather L. Benz, Matthew S. Fifer, Max Collard, **Griffin Milsap**, Mackenzie C. Cervenka, Alex Martin, Stephen J. Gotts, and Nathan E. Crone. Changes in human brain dynamics during behavioral priming and repetition suppression. *Progress in Neurobiology*, page 101788, 2020

2019 **Milsap, Griffin**, Maxwell Collard, Christopher Coogan, Qinwan Rabbani, Yujing Wang, and Nathan E. Crone. Keyword Spotting Using Human Electrocorticographic Recordings. *Frontiers in Neuroscience*, 13, 2019

Milsap, Griffin, Max Collard, Christopher Coogan, and Nathan E. Crone. BCI2000web and WebFM: Browser-Based Tools for Brain Computer Interfaces and Functional Brain Mapping. *Frontiers in Neuroscience*, 12, 2019

Qinwan Rabbani, **Milsap, Griffin** , and Nathan E. Crone. The Potential for a Speech BrainComputer Interface Using Chronic Electrocorticography. *Neurotherapeutics*, 16(1):144–165, 2019

2018 Kiyohide Usami, **Milsap, Griffin W**, Anna Korzeniewska, Maxwell J Collard, Yujing Wang, Ronald P Lesser, William S Anderson, and Nathan E Crone. Cortical Responses to Input From Distant Areas are Modulated by Local Spontaneous Alpha/Beta Oscillations. *Cerebral Cortex*, 2018

2017 Kyle Rupp, Matthew Roos, **Milsap, Griffin**, Carlos Caceres, Christopher Ratto, Mark Chevillet, Nathan E Crone, and Michael Wolmetz. Semantic attributes are encoded in human electrocorticographic signals during visual object recognition. *NeuroImage*, 148:318–329, 2017

Carlos A Caceres, Matthew J Roos, Kyle M Rupp, **Milsap, Griffin**, Nathan E Crone, Michael E Wolmetz, and Christopher R Ratto. Feature Selection Methods for Zero-Shot Learning of Neural Activity. *Frontiers in neuroinformatics*, 11:41, 2017

Ravindra Arya, J Adam Wilson, Hisako Fujiwara, Leonid Rozhkov, James L Leach, Anna W Byars, Hansel M Greiner, Jennifer Vannest, Jason Buroker, **Milsap, Griffin**, and others. Presurgical language localization with visual naming associated ECoG high-gamma modulation in pediatric drug-resistant epilepsy. *Epilepsia*, 58(4):663–673, 2017

2016 Maxwell J Collard, Matthew S Fifer, Heather L Benz, David P McMullen, Yujing Wang, **Milsap, Griffin W**, Anna Korzeniewska, and Nathan E Crone. Cortical subnetwork dynamics during human language tasks. *Neuroimage*, 135:261–272, 2016

Selected Articles: Continued

2015 Vasileios G. Kanas, Iosif Mporas, **Milsap, Griffin W.**, Kyriakos N. Sgarbas, Nathan E. Crone, and Anastasios Bezerianos. Time-Varying Parametric Modeling of ECoG for Syllable Decoding. In *Brain Informatics and Health*, number 9250 in Lecture Notes in Computer Science, pages 222–231. Springer International Publishing

Miaomiao Guo, Guizhi Xu, Lei Wang, Matthew Masters, **Milsap, Griffin**, Nitish Thakor, and Alcimar Barbosa Soares. The anterior contralateral response improves performance in a single trial auditory oddball BMI. *Biomedical Signal Processing and Control*, 22:74–84, September 2015

2014 Nitish V Thakor, Matthew S Fifer, Guy Hotson, Heather L Benz, Geoffrey I Newman, **Milsap, Griffin W**, and Nathan E Crone. Neuroprosthetic limb control with electrocorticography: approaches and challenges. In *Engineering in Medicine and Biology Society (EMBC), 2014 36th Annual International Conference of the IEEE*, pages 5212–5215. IEEE, 2014

2013 **Milsap, Griffin**, Matthew Fifer, Nathan Crone, and Nitish Thakor. Listening to the music of the brain: Live analysis of ECoG recordings using digital audio workstation software. In *2013 6th International IEEE/EMBS Conference on Neural Engineering (NER)*, pages 682–685, 2013

M.S. Fifer, **Milsap, G.W.**, E. Greenwald, D.P. McMullen, W.S. Anderson, N.V. Thakor, N.E. Crone, and R. Vinjamuri. Design and implementation of a human ECoG simulator for testing brain-machine interfaces. In *2013 6th International IEEE/EMBS Conference on Neural Engineering (NER)*, pages 1311–1314, November 2013

2011 Selmer Bringsjord, Colin Kuebler, Joshua Taylor, **Milsap, Griffin**, Sean Austin, Jonas Braasch, Pauline Oliveros, Doug Van Nort, Adam Rosenkrantz, and Kasia Hayden. Creativity and conducting: handle in the CAIRA project. In *Proceedings of the 8th ACM conference on Creativity and cognition*, pages 319–320, New York, NY, USA, 2011. ACM

Posters

2017 P. Kudela, R. Oh, **Milsap, G.**, N. E. Crone, and W. S. Anderson. A study of single-pulse cortical stimulation effects across cortical micro-domains. In *Society for Neuroscience Abstract*, page 291.03/G4, November 2017. Session: Session 291 - Signal Propagation; Session Type: Poster

Milsap, G. W., M. J. Collard, K. Rupp, M. J. Roos, C. Caceres, C. Ratto, M. Wolmetz, and N. E. Crone. Intrinsic neural spaces from human electrocorticography. In *Society for Neuroscience Abstract*, page 589.12/GG7, November 2017. Session: Session 589 - Representation of Objects and Scenes; Session Type: Poster

2014 M.J. Collard, M.S. Fifer, Y. Wang, H.L. Benz, **Milsap, G.W.**, A Korzeniewska, N.V. Thakor, and N.E. Crone. Identifying functional subnetworks in human language tasks using electrocorticography, November 2014

G. Hotson, **Milsap, G.**, D.P. McMullen, B.A. Wester, W.S. Anderson, J.W. Krakauer, N.E. Crone, and N. V. Thakor. Electrocorticographic decoding of high-level action goals following verbal instruction, November 2014

A Korzeniewska, S. Dalvin, **Milsap, G.**, A. Flinker, and N.E. Crone. The impact of lexical retrieval on high-gamma effective connectivity in human language networks, November 2014

2013 **Milsap, Griffin**, Matt Fifer, Nathan Crone, and Nitish Thakor. Listening to the Music of the Brain: Live Analysis of ECoG Recordings using Digital Audio Workstation Software, November 2013

P. Brunner, A. Gunduz, W.G. Coon, **Milsap, G.**, A. L. Ritaccio, and G. Schalk. Toward real-time identification of selective auditory attention in a cocktail party using electrocorticographic signals (ECoG) in humans, November 2013

M.S. Fifer, **Milsap, G.W.**, E. Greenwald, D.P. McMullen, W.S. Anderson, N.V. Thakor, N.E. Crone, and R. Vinjamuri. Design and implementation of a human ECoG simulator for testing brain-machine interfaces. In *2013 6th International IEEE/EMBS Conference on Neural Engineering (NER)*, pages 1311–1314, November 2013

2012 **Milsap, Griffin**, Beth Werbaneth, Colin Neville, Catherine Mickey, Justin Renga, and Mukkai Krishnamoorthy. Reroot: A novel method of using mobile devices as human computer interfaces. Third Annual Undergraduate Research Symposium, Rensselaer Polytechnic Institute, 2012

2010 **Milsap, Griffin**, Gerwin Schalk, and Lester Gerhardt. Brain computer interfacing software development. First Annual Undergraduate Research Symposium, Rensselaer Polytechnic Institute, 2010

Invited Talks and Teaching

2018- Introduction to Brain Computer Interfaces. Johns Hopkins University Whiting School of Engineering. Engineering for Professionals Program. Summer Course.

2017 **Milsap, Griffin** and Peter Brunner. National Center for Adaptive Neurotechnologies Summer Course 2017: BCI2000 Fundamentals and Interfacing, July 2017

2016 **Milsap, Griffin** and Peter Brunner. National Center for Adaptive Neurotechnologies Summer Course 2016: BCI2000 Fundamentals and Interfacing, July 2016

2013 **Milsap, Griffin**, Nancy Hanrahan, Don Yanaitis, and Law Blank. Leading Edge Initiatives in Games and Health, October 2013

Notable Open Source Contributions

ezmsg A high-performance publication-subscription framework for modular neural signal processing in Python.
https://github.com/iscoe/ezmsg/

BCI2000 A notable brain computer interface research and development software suite used by hundreds of labs worldwide
http://www.bci2000.org/BCI2000/Home.html

BCI2000Web Connector between BCI2000 and Javascript via Node.js and high performance custom websocket protocols. Allows developers to communicate to/from BCI2000 using modern web browsers.
http://www.github.com/cronelab/bci2000web/

WebFM Co-Developed realtime bed-side functional mapping software built on top of BCI2000 and BCI2000Web supporting high channel-count clinical recordings; currently deployed at three medical institutions.
http://www.github.com/cronelab/webfm/

Discography and Recordings

2017 sinap.tc (credited as Stoßen). Reprise. On Glorp Records Summer 2017 Compilation, Glorp Records, 19x Digital Audio, https://glorprecords.bandcamp.com/album/glorp-records-summer-2017-compilation, July 7 2017

sinap.tc. blackbox. On GENDER ENDER, Ambrasive Records, 32x Digital Audio, https://ambrasivemusic.bandcamp.com/album/gender-ender, May 1 2017

2016 sinap.tc. *Untitled EP*. Self Released, Cassette, http://sinaptc.bandcamp.com/, Aug 14 2016

sinap.tc. Hello. On Exciting New Developments in ADHD, Ambrasive Records, 1X CDr, https://ambrasivemusic.bandcamp.com/album/exciting-new-developments-in-adhd, May 1 2016

2012 Sin(ap).tc. Dynamic(sta).tc (demo). Self Released, 17x Digital Audio, http://sinaptc.bandcamp.com/, June 10 2012

2011 Sin(ap).tc as malloc. Bang (sub)lime (malloc remix). On BMC:Remixed by Breakmaster Cylinder, 20x Digital Audio, http://www.discogs.com/Breakmaster-Cylinder-BMCRemixed/release/3303307, December 25 2011