

Mark D. Wronkiewicz

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Academic Experience

University of Washington

Postdoctoral Fellow

Advisor: Adrian KC Lee

Seattle, WA

2017-present

Research Summary

Currently, I am developing new methodology for brain-computer interfaces (BCIs). My research is focused on finding a method of using functional connectivity – loosely, a measure of communication between brain areas – as a feature in BCIs. This builds on findings from network neuroscience and may prove useful in developing an automatic pause feature when users do not intend to use their system. I am also using deep learning to generate neural activity with rich temporal structure for use in connectivity analysis. My passion for BCI research stems from its potential to both improve rehabilitation techniques for people after neural damage (e.g., stroke, spinal cord injury, degenerative diseases, etc.) and augment human brain function.

Activities and Awards

- AI Grant for proposal to generate neural data using Generative Adversarial Networks (GANs; a deep learning framework). Top 10 proposal of 450 applicants. (2017)
- NVIDIA GPU Grant for work to apply deep learning within neural engineering (2017)

University of Washington

PhD in Neuroscience

Advisor: Adrian KC Lee

Dissertation title: Facilitating the incorporation of neuroscience methods and knowledge into brain-computer interfaces

Seattle, WA

2012-2017

Research Summary

My PhD work was focused on bringing more tools and knowledge from basic neuroscience into the neural engineering domain. In my research, I primarily made use of concepts related to linear algebra-based neuroimaging techniques, machine learning (including deep learning), time series analysis, and signal processing. I found that neuroscience improved the ability to recycle data from other subjects during BCI calibration (i.e., transfer learning) and that neuroimaging tools could improve BCI accuracy by facilitating the targeting of relevant cortical regions.

Activities and Awards

- Figure from 2016 Journal of Neural Engineering publication selected for cover art of journal's October issue (2016)
- Volunteer for Peaks of Life climbing organization focused on raising money for uncompensated health care at Seattle Children's Hospital (2015-present)
- Volunteered to help plan and teach Python and Git/Github at Allen Institute for Brain Science's Dynamic Brain Workshop (2015)
- Selected to attend 2-week Allen Institute for Brain Science's Summer Workshop on the Dynamic Brain and awarded best team project (2014)

- Served as Center for Sensorimotor and Neural Engineering Student Leadership Committee Webmaster (2013-2014) and Secretary (2014-2015)
- Volunteer for Neuroscience Community Outreach (2012-present)
- Served as Neuroscience Seminar Committee member (2012-2014) and Student Leader of the Seminar Committee (2014-2015)

Merit Scholarships and Travel Awards

- BCI Meeting NSF Student Travel Award (2016)
- Center for Sensorimotor and Neural Engineering Student Travel Awards (2013 and 2016)
- National Science Foundation Graduate Research Fellowship Program (NSF GRFP; 2012)

Washington University in St. Louis

Bachelor of Science, May 2012

Major: Biomedical Engineering, Bioelectrical Track

Minor: Electrical Engineering

St. Louis, MO

2008-2012

Activities and Awards

- Awarded best project in senior design class along with two team members (2012)
- Selected as a student member for the Center for Innovation in Neuroscience and Technology (CINT) Annual Innovation Fellowship in medical device design (2011) and returned as student leader (2012)
- Co-founded and participated in the Washington University in St. Louis Brain-Computer Interface Club (WUSTL-BCI) student group (2011-2012)
- Team semi-finalist in the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) Student Design Competition (2011)
- Inducted into the Alpha Eta Mu Beta Biomedical Engineering Honors Society (2010)
- Conducted extracurricular research on BCIs in Dr. Eric Leuthardt's laboratory, including a brain-controlled hand orthotic, BCI research with stroke patients, an EEG biofeedback program, and a brain-controlled iPhone game (2009-2012)
- Made the Dean's List (all semesters 2008-2012)

Merit Scholarships

- American Society of Czech Engineers Scholarship
- Bright Flight Academic Scholarship
- DuPage County Marines Academic Scholarship
- Missouri Boys State Scholarship

Programming Experience

Python (4 years; currently proficient)

- Develop, test, and use open-source MNE-Python package to process, analyze, and model neural signals; currently ranked 12th of 96 total contributors on Github
- Implemented the widely-used Signal Space Separation algorithm (for de-noising MEG brain signals) in the open-source MNE-Python package for my 2015 Google Summer of Code project
- Utilize open-source platforms like scikit-learn, Keras, TensorFlow, numpy, scipy, and matplotlib for dissertation research
- Participated in 2014 and 2015 Allen Brain Institute Summer Workshops on the Dynamic Brain
- Developed a personal website, built an art project using the raspberry pi, and conducted mammogram analysis using convolutional neural networks in my free time

C++ (4 years)

- Engineered features for automatic detection of skin cancer
- Designed systems to preprocess real-world images of skin cancer prior to classification
- Built multiple BCI experiments using the open-source BC12000 package

Matlab (2 years)

- Conducted BCI research and data analysis as part of dissertation work
- Modeled neural and biological systems in undergraduate and graduate classes

Objective C (2 years)

- Developed “BrainCopter” brain-controlled iOS game (3rd iOS app to use neural signals); sold in Apple app store since 2012
- Developed “DrugDB” iOS app for quickly referencing information for 2,300 medical drugs; sold in Apple app store 2010-2015
- Developed “PillDB” iOS app for identifying medical pills based on color, shape, etc.

Publications

See my website for DOIs and Github links to code

Wronkiewicz, M; Larson, E; Lee, AK. Incorporating additional modern neuroscience into non-invasive brain-computer interfaces. *BCI Handbook* In press.

Wronkiewicz, M; Larson, E; Lee, AK. Incorporating modern neuroscience findings to improve brain-computer interfaces: tracking auditory attention. *Journal of Neural Engineering* 2016.

Henriksen, S; Pang, R; **Wronkiewicz, M.** A simple generative model of the mouse mesoscale connectome. *eLife* 2016.

(Note: all authors contributed equally)

Wronkiewicz, M; Larson, E; Lee, AK. Leveraging anatomical information to improve transfer learning in brain-computer interfaces. *Journal of Neural Engineering* 2015.

Madsen, D; Payne, K; Hagerty, J; Szanto, N; **Wronkiewicz, M**; Moss, R; Stoecker, W. Automatic Pill Identification from Pillbox Images. *Proceedings of the International Conference on Computer Vision Theory and Applications - Volume 1: VISAPP 2013*.

Wronkiewicz, M; Larson, E; Lee, AK. Towards a next-generation hearing aid through brain state classification and modeling. *Engineering in Medicine and Biology Society, EMBC, 2013 Annual International Conference of the IEEE 2013*.

Holmes, CD; **Wronkiewicz, M**; Somers, T; Liu, J; Russell, E; Kim, D; Rhoades, C; Dunkley, J; Bundy, D; Galboa, E; Leuthardt, EC. IpsiHand Bravo: an improved EEG-based brain-computer interface for hand motor control rehabilitation. *Engineering in Medicine and Biology Society, EMBC, 2012 Annual International Conference of the IEEE 2012*.

Bundy, DT; **Wronkiewicz, M**; Sharma, M; Moran, DW; Corbetta, M; Leuthardt, EC. Using ipsilateral motor signals in the unaffected cerebral hemisphere as a signal platform for brain-computer interfaces in hemiplegic stroke survivors. *Journal of Neural Engineering 2012*.

Fok, S; Schwartz, R; **Wronkiewicz, M**; Holmes, C; Zhang, J; Somers, T; Bundy, D; Leuthardt, E. An EEG-based brain computer interface for rehabilitation and restoration of hand control following stroke using ipsilateral cortical physiology. *Engineering in Medicine and Biology Society, EMBC, 2011 Annual International Conference of the IEEE 2011*.

Freudenburg, Z; Ramsey, N; **Wronkiewicz, M**; Smart, W; Pless, R; Leuthardt, E. Real-time Naive Learning of Neural Correlates in ECoG Electrophysiology. *International Journal of Machine Learning and Computing 2011*.

Stoecker, WV; **Wronkiewicz, M**; Chowdhury, R; Stanley, RJ; Xu, J; Bangert, A; Shrestha, B; Calcara, DA; Rabinovitz, HS; Oliviero, M; Ahmed, F; Perry, LA; Drugge, R. Detection of granularity in dermoscopy images of malignant melanoma using color and texture features. *Computer Medical Imaging and Graphics 2010*.

Stoecker, WV; Gupta, K; Shrestha, B; **Wronkiewicz, M**; Chowdhury, R; Stanley, RJ; Xu, J; Moss, RH; Celebi, ME; Rabinovitz, HS; Oliviero, M; Malters, JM; Kolm, I. Detection of basal cell carcinoma using color and histogram measures of semitranslucent areas. *Skin Research and Technology 2009*.
(Note: Wronkiewicz was misspelled in two papers)

Conference Posters and Presentations

Wronkiewicz, M; Larson, E; Lee, AK. Incorporating neuroscience priors into brain-computer interfaces to detect attentional state. *International Brain-Computer Interface Meeting, 2016*. Asilomar, CA. 2016.

Wronkiewicz, M; Larson, E; Lee, AK. Applying source imaging to advance non-invasive brain-computer interfaces. *IEEE EMBS BRAIN Grand Challenges Conference*. Washington D.C. 2014.

Wronkiewicz, M; Larson, E; Lee, AK. Developing a region-of-interest brain-state classifier informed by multiple neuroimaging techniques. *Society for Neuroscience Annual Meeting, 2013*. San Diego, CA. 2013.

Fok, S; Schwartz, R; **Wronkiewicz, M;** Holmes, C; Zhang, J. IpsiHand: An EEG Based Brain-Computer Interface for Motor Rehabilitation. *Rehabilitation Engineering and Assistive Technology Society of North America (RESNA): Student Design Competition Finalist Presentations*. Toronto, Canada. 2011.

Fok, S; Schwartz, R; **Wronkiewicz, M;** Holmes, C; Zhang, J. IpsiHand: An EEG Based Brain-Computer Interface for Motor Rehabilitation. *Undergraduate Research Symposium Keynote Speakers at Washington University in St. Louis*. St. Louis, MO. 2011.

Teaching Experience

- Volunteer teaching assistant for Allen Institute for Brain Science’s 2-week Summer Workshop on the Dynamic Brain (2015)
- Volunteer teaching assistant for Neurobiology 450B undergraduate neural engineering journal club course (2014)
- Teaching assistant for Neurobiology 302 undergraduate laboratory course (2014)

Other Relevant Skills

- Experienced with Git and Github
- Skilled with Unix command line
- Comfortable working in Windows, Mac, and Linux environments
- Skilled with Blender 3D modeling environment
- Basic understanding of Flask Web Framework
- Basic understanding of the Latvian language