

Curriculum Vitae of Po T. Wang

Po T. Wang

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EDUCATION

Ph.D. Biomedical Engineering – September 2014

University of California, Irvine, CA

Advisor: Professor Zoran Nenadic

Thesis: Novel Data Processing Techniques for High-Performance Brain-Computer Interface

M.S. Biomedical Engineering – June 2008

University of California, Irvine, CA

B.S. Bioengineering – June 2007

Rice University, Houston, TX

PROFESSIONAL EXPERIENCE

University of California, Irvine, CA

Department of Biomedical Engineering

- Associate Specialist, July 2020 – Present
- Assistant Specialist, September 2014 – June 2020
- Lecturer, Biomedical Engineering Laboratory, April 2017 – June 2017
- Graduate Student Researcher, August 2008 – September 2014
- Teaching Assistant
 - Bio-transport Phenomena, April 2011 – June 2011
 - Biomedical Electronics Lab, January 2011 – March 2011
 - Electroencephalography Lab, April 2009 – June 2009

Rice University, Houston, TX

Department of Electrical Engineering

- Laboratory Teaching Assistant, January 2007 – June 2007

Cypress Falls High School, Houston, TX

Chemistry

- Laboratory Technician, September 2001 – July 2002

RESEARCH INTERESTS

Brain-computer interface (BCI) systems, biomedical signal processing, neuroscience, high-density electrocorticography (HD-ECoG), machine learning, classification algorithms, computer-controlled assistive devices, BCI-on-a-chip, system integration, digital signal processing (DSP), fully-implantable BCI

PROFESSIONAL MEMBERSHIPS

Member, Institute of Electrical and Electronics Engineers (IEEE), since 2009
Member, IEEE Engineering in Medicine and Biology Society (EMBS), since 2009
Founding Member, Brain Computer Interface Society, since 2016

AWARDS AND RECOGNITIONS

W. L. Moody, Jr., Scholarship in Engineering, 2006 – 2007
Helping Hand Award, Disability Support Services, Rice University, Houston, Texas, 2003 – 2004

VOLUNTEER AND OTHER EXPERIENCES

University of California, Irvine, CA

Meet The Scientists, Reeve-Irvine Research Center (2010 – 2016)

- Demonstrating the BCI-Walking Simulator in the annually-held forum. This public forum brings in the people interested in the progress of treating spinal cord injury, including those with SCI.
- Coordinators: Dr. Oswald Steward and Dr. Kelli Sharp

Outreach at UC Irvine (2009 – 2013)

- Demonstrating the P300 spelling device for community college, high school, and middle school students. These outreach events promote engineering and diversity in engineering to community college and high school students.
- Coordinator: Dr. Debra Mauzy-Melitz.

IT System Administrator and Webmaster (2008 – present)

- Developing and maintaining website, collaboration tools, data storage and backup, virtual servers, computer networking in the Center for Biomedical Signal Processing and Computing (CBMSPC), Department of Biomedical Engineering.
- Ensuring compliance with HIPAA and Institutional Review Board (IRB) policies for stored data.

Safety-On-Site Representative (2012 – present)

- Communicating and providing training of safety procedures to members of the CBMSPC.
- Developing standard operation procedures and emergency procedures
- Maintaining safety training records and safety evaluations

Webmaster (2008)

- Webmaster for *BME240 – Introduction to Clinical Medicine* in Spring Quarter, 2008.
http://bme240.eng.uci.edu/student_2008.html

Bear Creek Assistance Ministries, Houston, TX

Volunteer at Client Services (ca. 2002)

- Data entry for confidential client information, providing computing and office support, and improving operational procedures of client services

SKILLS

Computer programming/coding: MATLAB, C++, C#, Regular Expression, LaTeX, PHP, HTML

Computer applications: Excel, Word, PowerPoint, Visual Studio, LabView, Adobe PhotoShop, Adobe Premiere Pro, Adobe After Effect, Linux/Unix; BCI2000; AutoCAD, Eagle, Altium

Laboratory/clinical: EEG cap mounting and gel application, bed-side electrocorticogram (ECoG) recording, tissue culture technique, surface-mount electronic (SMD) soldering and rework, analog circuit design, microcontroller programming, Arduino

Analysis: Brain image processing of functional MRI (fMRI) data, Kalman filters, Bayesian filters, Bayesian classifiers, linear and non-linear feature extraction techniques

PUBLICATIONS

DISSERTATION

Wang PT. Novel Data Processing Techniques for High-Performance Brain-Computer Interface. Ph.D. Dissertation, University of California, Irvine, 2014.

JOURNAL PUBLICATIONS

- J1. **Wang PT**, King CE, Do AH, Nenadic Z. A durable, low-cost electrogoniometer for dynamic measurement of joint trajectories. *Med Eng Phys.* 2011;33(5):546–552.
- J2. Do AH, **Wang PT**, King CE, Abiri A, Nenadic Z. Brain-computer interface controlled functional electrical stimulation system for ankle movement. *J Neuroeng Rehabil.* 2011;8(1):49.
- J3. Wu SC, Swindlehurst AL, **Wang PT**, Nenadic Z. Projection versus prewhitening for EEG interference suppression. *IEEE T Biomed Eng.* 2012;59(5):1329– 1338.
- J4. Wu SC, Swindlehurst AL, **Wang PT**, Nenadic Z. Efficient dipole parameter estimation in EEG systems with near-ML performance. *IEEE T Biomed Eng.* 2012;59(5):1339–1348.
- J5. **Wang PT**, King CE, Chui LA, Do AH, Nenadic Z. Self-paced brain–computer interface control of ambulation in a virtual reality environment. *J Neural Eng.* 2012;9(5):056016.
- J6. King CE, **Wang PT**, Chui LA, Do AH, Nenadic Z. Operation of a brain-computer interface walking simulator for individuals with spinal cord injury. *J NeuroEng Rehabil.* 2013;10:77.
- J7. Do AH, **Wang PT**, King CE, Chun SN, Nenadic Z. Brain-computer interface controlled robotic gait orthosis. *J NeuroEng Rehabil.* 2013;10(1):111.
- J8. King CE, Dave KR, **Wang PT**, Mizuta M, Reinkensmeyer DJ, Do AH, Moromugi S, Nenadic Z. Performance assessment of a brain–computer interface driven hand orthosis. *Ann Biomed Eng.* 2014;42(10):2095–2105.
- J9. Flint RD, **Wang PT**, Wright ZA, King CE, Krucoff MO, Schuele SU, Rosenow JM, Hsu FPK, Liu CY, Lin JJ, Sazgar M, Millett DE, Shaw SJ, Nenadic Z, Do AH, Slutzky MW. Extracting kinetic information from human motor cortical signals. *NeuroImage.* 2014;101:695–703.

- J10. McCrimmon CM, King CE, **Wang PT**, Cramer SC, Nenadic Z, Do AH. Brain-controlled functional electrical stimulation therapy for gait rehabilitation after stroke: a safety study. *J NeuroEng Rehabil*. 2015;12(1):57.
- J11. King CE, **Wang PT**, McCrimmon CM, Chou CCY, Do AH, Nenadic Z. The feasibility of a brain computer interface functional electrical stimulation system for the restoration of overground walking after paraplegia. *J NeuroEng Rehabil*. 2015;12(1):80.
- J12. **Wang PT**, King CE, McCrimmon C, Lin JJ, Sazgar M, Hsu FPK, Shaw SJ, Millett DE, Chui LA, Liu CY, Do AH, Nenadic Z. Comparison of decoding resolution of standard and high-density electrocorticogram electrodes. *J Neural Eng*. 2016;13(2):026016.
- J13. **Wang PT**, Karimi-Bidhendi A, Liu CY, Nenadic Z, Heydari P, Do AH. A low-cost, fully programmable, battery powered direct cortical electrical stimulator, *J. Med. Devices*. 2016;10(3):030901.
- J14. McCrimmon CM, Fu JL, Wang M, Silva-Lopes L, **Wang PT**, Karimi-Bidhendi A, Liu CY, Heydari P, Nenadic Z, Do AH. Performance assessment of a custom, portable, and low-cost brain-computer interface platform, *IEEE T. Bio-med. Eng*. 2017;6(10):2313–2320.
- J15. **Wang PT**, McCrimmon CM, King CE, Shaw SJ, Millett DE, Gong H, Chui LA, Liu CY, Nenadic Z, Do AH. Characterization of electrocorticogram high-gamma signal in response to varying upper extremity movement velocity. *Brain Structure and Function*. 2017;222(8):3705–3748.
- J16. McCrimmon CM, **Wang PT**, Heydari P, Nguyen A, Shaw SJ, Gong H, Chui LA, Liu CY, Nenadic Z, Do AH. Electrocorticogram high-gamma encoding of human gait. *Cer. Cor*. 2017.
- J17. Karimi-Bidhendi A, Malekzadeh-Arasteh O, Lee MC, McCrimmon CM, **Wang PT**, Mahajan A, Liu CY, Nenadic Z, Do AH, Heydari P. CMOS ultra-low power brain signal acquisition front-ends: design and human testing. *IEEE T BioCAS*. 2017;11(5):1111–1122.
- J18. Lee MC, Karimi-Bidhendi A, Malekzadeh-Arasteh O, Wang PT, Nenadic Z, Do AH, Heydari P. A CMOS MedRadio transceiver with supply-modulated power saving technique for an implantable brain-machine interface system. *IEEE J Solid State Circuits*. 2019;54(6):1541–1552.
- J19. Vaidya M, Flint RD, **Wang PT**, Barry A, Li Yc, Ghassemi M, Tomic G, Yao J, Carmona C, Mugler EM, Gallick S, Driver S, Brkic N, Ripley D, Liu CY, Kamper D, Do AH, Slutzky MW. Hemicraniectomy in traumatic brain injury: a noninvasive platform to investigate high gamma activity for brain machine interfaces. *IEEE T Neural Systems and Rehabilitation Engineering*. 2019;27(7):1467–1472.
- J20. **Wang PT**, Camacho E, Wang M, Li YC, Shaw SJ, Armacost M, Gong H, Kramer D, Lee B, Andersen RA, Liu CY, Heydari P, Nenadic Z, Do AH. A benchtop

system to assess the feasibility of a fully independent and implantable brain-machine interface. *J. Neural Eng.* 2019;16:066043.

- J21. Li YC, **Wang PT**, Vaidya MP, Flint RD, Liu CY, Slutzky M, Do AH. Refinement of high-gamma EEG features from TBI patients with hemicraniectomy using an ICA informed by simulated myoelectric artifacts. *Front. Neurosci.* 2020;599010.
- J22. Li YC, **Wang PT**, Vaidya MP, Flint RD, Liu CY, Slutzky M, Do AH. Electromyogram (EMG) Removal by Adding Sources of EMG (ERASE) – A novel ICA-based algorithm for removing myoelectric artifacts from EEG. *Front. Neurosci.* 2021;14:1408.

BOOK CHAPTERS

- BC1. McCrimmon CM, **Wang PT**, Nenadic Z, Do AH. BCI-based neuroprostheses and physiotherapies for stroke motor rehabilitation. In: D. J. Reinkensmeyer and V. Dietz (eds.), *Neurorehabilitation Technology*, p. 617-627, Springer International Publishing, 2016. (This book chapter is being revised in January 2022 to include the latest advances.)

CONFERENCE PUBLICATIONS

- C1. Kuchaiev O, **Wang PT**, Nenadic Z, Pržulj N. Structure of brain functional networks. In: Engineering in Medicine and Biology Society, 2009. EMBC 2009. Annual International Conference of the IEEE. IEEE; 2009. p. 4166–4170.
- C2. **Wang PT**, King CE, Chui LA, Nenadic Z, Do A. BCI controlled walking simulator for a BCI driven FES device. Proc of RESNA Ann Conf. 2010;.
- C3. Do AH, **Wang PT**, Abiri A, King CE, Nenadic Z. Brain computer interface control of functional electrical stimulation to restore foot dorsiflexion. Neurology conference. 2011;76(9):A503.
- C4. King CE, **Wang PT**, Mizuta M, Reinkensmeyer DJ, Do AH, Moromugi S, Nenadic Z. Noninvasive brain-computer interface driven hand orthosis. In: Engineering in Medicine and Biology Society, EMBC, 2011 Annual International Conference of the IEEE. IEEE; 2011. p. 5786–5789.

- C5. Do AH, **Wang PT**, King CE, Schombs A, Cramer SC, Nenadic Z. Brain-computer interface controlled functional electrical stimulation device for foot drop due to stroke. In: Engineering in Medicine and Biology Society (EMBC), 2012 Annual International Conference of the IEEE. IEEE; 2012. p. 6414–6417.
- C6. Do AH, **Wang PT**, King CE, Schombs A, Nenadic Z, Cramer SC. Brain-computer interface controlled functional electrical stimulation as a novel approach to improving foot-drop after stroke. International Stroke Conference 2013, 44: ATP94, 2012.
- C7. **Wang PT**, King CE, Schombs A, Lin JJ, Sazgar M, Hsu FPK, Shaw SJ, Millett DE, Liu CY, Chui LA, Nenadic Z, Do AH. Electrocorticographic gamma band power encodes the velocity of upper extremity movements. Proc 5th Int'l Brain-Computer Interface Meeting. 2013;.
- C8. Do AH, **Wang PT**, King CE, Schombs A, Lin JJ, Sazgar M, Hsu FPK, Shaw SJ, Millett DE, Liu CY, Szymanska AA, Chui LA, Nenadic Z. Sensitivity and specificity of upper extremity movements decoded from electrocorticogram. In: Engineering in Medicine and Biology Society (EMBC), 2013 35th Annual International Conference of the IEEE. IEEE; 2013. p. 5618–5621.
- C9. **Wang PT**, King CE, Shaw SJ, Millett DE, Liu CY, Chui LA, Nenadic Z, Do AH. A co-registration approach for electrocorticogram electrode localization using post-implantation MRI and CT of the head. In: Neural Engineering (NER), 2013 6th International IEEE/EMBS Conference on. IEEE; 2013. p. 525–528.
- C10. **Wang PT**, Puttock EJ, King CE, Schombs A, Lin JJ, Sazgar M, Hsu FPK, Shaw SJ, Millett DE, Liu CY, Chui LA, Do AH, Nenadic Z. State and trajectory decoding of upper extremity movements from electrocorticogram. In: Neural Engineering (NER), 2013 6th International IEEE/EMBS Conference on. IEEE; 2013. p. 969–972.
- C11. **Wang PT**, King CE, Schombs A, Lin JJ, Sazgar M, Hsu FPK, Shaw SJ, Millett DE, Liu CY, Chui LA, Nenadic Z, Do AH. Electrocoicogram encoding of upper extremity movement trajectories. In: Neural Engineering (NER), 2013 6th International IEEE/EMBS Conference on. IEEE; 2013. p. 1429–1432.
- C12. King CE, McCrimmon CM, **Wang PT**, Chou CCY, Nenadic Z, Do AH. Brain-computer interface driven functional electrical stimulation system for overground walking: a case report (P3. 055). Neurology conference. 2014;82(10 Supplement):P3–055.
- C13. King CE, **Wang PT**, McCrimmon CM, Chou CCY, Do AH, Nenadic Z. Brain-computer interface driven functional electrical stimulation system for overground walking in spinal cord injury participant. In: Engineering in Medicine and Biology Society (EMBC), 2014 36th Annual International Conference of the IEEE. IEEE; 2014. p. 1238–1242.
- C14. **Wang PT**, King CE, McCrimmon CM, Shaw SJ, Millett DE, Liu CY, Chui LA, Nenadic Z, Do AH. Electrocoicogram encoding of upper extremity movement

- duration. In: Engineering in Medicine and Biology Society (EMBC), 2014 36th Annual International Conference of the IEEE. IEEE; 2014. p. 1243–1246.
- C15. McCrimmon CM, King CE, **Wang PT**, Cramer SC, Nenadic Z, Do AH. Brain-controlled functional electrical stimulation for lower-limb motor recovery in stroke survivors. In: Engineering in Medicine and Biology Society (EMBC), 2014 36th Annual International Conference of the IEEE. IEEE; 2014. p. 1247–1250.
- C16. Mahajan A, Karimi-Bidhendi A, **Wang PT**, McCrimmon CM, Liu CY, Nenadic Z, Do AH, Heydari P. A 64-channel ultra-low power bioelectric signal acquisition system for brain-computer interface. In: Biomedical Circuits and Systems Conference (BioCAS), 2015 IEEE. IEEE; 2015. p. 1–4.
- C17. McCrimmon CM, Wang M, Silva-Lopes L, **Wang PT**, Karimi-Bidhendi A, Liu CY, Heydari P, Nenadic Z, and Do AH. A portable, low-cost BCI for stroke rehabilitation. In: Proc. of the 6th International Brain-Computer Interface Meeting, pp. 95, 2016.
- C18. McCrimmon CM, Wang M, Silva-Lopes L, **Wang PT**, Karimi-Bidhendi A, Liu CY, Heydari P, Nenadic Z, and Do AH. A small, portable, and battery-powered brain-computer interface system for motor rehabilitation. In Proc. of the 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2016. p. 2776–9.
- C19. **Wang PT**, Gandasetiawan K, McCrimmon CM, Karimi-Bidhendi A, Liu CY, Heydari P, Nenadic Z, and Do AH. Feasibility of an ultra-low power digital signal processor platform as a basis for a fully implantable brain-computer interface system. In: Proc. of the 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2016. p. 4491–4.
- C20. Tran T, **Wang PT**, Lee B, Nenadic Z, Liu CY, Do AH, Kreydin E. MP38-04 Electroencephalography as a means to study brain control of urination. J. Urology. 2017;199(4)supp:e501.
- C21. Lee MC, Karimi-Bidhendi A, Malekzadeh-Arasteh O, **Wang PT**, Nenadic Z, Do AH, Heydari P. A CMOS inductorless MedRadio OOK transceiver with a 42 μ W event-driven supply-modulated RX and a 14% efficiency TX for medical implants. In: 2018 IEEE Custom Integrated Circuits Conference (CICC).
- C22. Lim J, **Wang PT**, Karimi-Bidhendi A, Arasteh OM, Shaw SJ, Armacost M, Gong H, Liu CY, Do AH, Heydari P, Nenadic Z. Characterization of stimulation artifact behavior in simultaneous electroencephalography grid stimulation and recording. In: 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society. 2018. p. 4748-4751.
- C23. **Wang PT**, McCrimmon CM, Heydari P, Do AH, Nenadic Z. Subspace-based suppression of cortical stimulation artifacts. In: 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society. 2018. p. 2426-2429.

- C24. Li YC, **Wang PT**, Vaidya MP, Liu CY, Slutzky M, Do AH. A novel algorithm for removing artifacts from EEG data. In: 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society. 2018. p. 6014-6017.
- C25. Tran T, **Wang PT**, Lee B, Liu CY, Kreydin E, Nenadic Z, Do AH. Electrographic activity of the brain during micturition. In: 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society. 2018. p. 3622-3625.
- C26. Barry A, Ghassemi M, Vaidya MP, Zheng SY, **Wang PT**, Do AH, Kamper D, Slutzky MW. Design of a haptic force feedback system for pinch. In: 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society. (One page paper).
- C27. Lim J, **Wang PT**, Pu H, Liu CY, Kellis S, Andersen RA, Heydari P, Do AH, Nenadic Z. Dipole cancellation as an artifact suppression technique in simultaneous electrocorticography stimulation and recording. In: 9th International IEEE EMBS Conference on Neural Engineering. 2019. p. 725-729.
- C28. Serrano-Amenos C, Hu F, **Wang PT**, Kellis S, Andersen RA, Liu CY, Heydari P, Do AH, Nenadic Z. Thermal analysis of a skull implant in brain-computer interfaces. In: 42nd Annual International Conference of the IEEE Engineering in Medicine and Biology Society. 2020.
- C29. Lim J, **Wang PT**, Shaw SJ, Armacost M, Gong H, Liu CY, Do AH, Heydari P, Nenadic Z. Pre-whitening and null projection as an artifact suppression method for electrocorticography stimulation in bi-directional brain computer interfaces. In: 42nd Annual International Conference of the IEEE Engineering in Medicine and Biology Society. 2020.
- C30. Sohn WJ, **Wang PT**, Kellis S, Andersen RA, Liu CY, Heydari P, Nenadic Z, Do AH. A prototype of a fully-implantable charge-balanced artificial sensory stimulator for bi-directional brain-computer-interface (BD-BCI). In: 42nd Annual International Conference of the IEEE Engineering in Medicine and Biology Society. 2020.
- C31. Malekzadeh-Arasteh O, Pu H, Danesh AR, Lim J, **Wang PT**, Liu CY, Do AH, Nenadic Z, Heydari P. A fully-integrated 1 μ W/channel dual-mode neural data acquisition system for implantable brain-machine interfaces. In: 43rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society. 2021.