Kai Miller

Curriculum Vitae
August, 2007

Positions Held

Research Assistant
Department of Physics, Neural Systems Laboratory, Harborview Hospital
University of Washington
(2000-Present)
Advisors: **Marcel denNijs, Rajesh P. N. Rao, Jeffrey G. Ojemann**

Research Assistant
Departments of Physics (1998-2000) and Immunology (1997-1998), and California Space Institute at UCSD
UC San Diego
Advisors: **David Kleinfeld, Greg Silverman, Michael Wiskerchian**

Research Assistant
Environmental Physiology Lab
NASA – Johnson Space Center
Summer 1999
Advisors: **Michael Powell and Michael Gernhardt**

Education

Currently Enrolled in **M.D. Program, Physics PhD. Program, and Neurobiology and Behavior PhD Program** at the University of Washington, 2000-Present

M.S. Physics, University of Washington, 2006

B.S. Physics and Biology, University of California, San Diego, 2000

Awards

Neurological Surgery Training Grant 2006

Poncin Award 2004- Present

Medical Scientist Training Program 2000-Present

Balfour Fellow 2000-2001

National Merit Scholar 1996-2000

University of California Regent Scholar 1996-2000

University of California, San Diego Provost's Scholar 1998

Teaching - Course Instructor

Minority Medical Education Program: Introductory Physics, University of Washington
Summer 2002, Summer 2003, Summer 2004

Teaching - Guest Lecturer

CSE 590RR: Introduction to Computational Neuroscience, University of Washington
"Poisson Statistics and Stochasticity in Neuronal Spike Timing"
Fall 2003

CSE/NEUBEH 528: Computational Neuroscience, University of Washington
"Compartmental Models for Potential Propagation"
Winter 2005

CSE 599E: Brain Computer Interfaces, University of Washington
"Using Electrocorticographic Motor Signals for Device Control"
Spring 2006

CSE490I: Neurobotics
"Translating Brain Signals"
Winter 2007

Teaching - Teaching Assistant

Physics 1B: 2nd Quarter Introductory Physics, UC San Diego
Winter 2000

Physics 428A: The Physics of Biological Vision, University of Washington
Summer 2001

CSE 590RR: Introduction to Computational Neuroscience, University of Washington
Fall 2003

Mentoring

Tim Blakeley, Graduate Student (Bioengineering) 2007, Research Topic: Electrocorticography for feedback and brain mapping

Taylor Abel, Medical Student, 2007, Research Topic: Language Studies in Electrocorticography

Nathan Evans, Post Baccalaureate student, CSE. 2005-2006 Research Topic: Brain-Computer Interfaces.

Beau Crawford, undergraduate student, CSE, 2003-2005. Research Topic: Brain-Computer Interfaces and Classifier Based EMG systems..

Brian Chang, undergraduate students, CSE, 2003-2004. Research Topic: Classifier Based EMG systems

Positions and Societies

Phi Chi Medical Fraternity,
Epsilon Kappa Chapter (Seattle)
Executive Member-at-Large of the National Welfare Board, 2007 (one of 6 elected National Positions)
Executive Member-at-Large of the National Welfare Board, 2006 (one of 6 elected National Positions)
Member of the National Welfare Board, 2005 (one of 6 elected National Positions)
Member of the National Welfare Board, 2004 (one of 6 elected National Positions)
Viceroy of the Epsilon Kappa Chapter (Seattle) 2002-2004

Sigma Chi Fraternity,
Iota Chi Chapter (San Diego)
Academic Advisor to Upsilon Upsilon Chapter (2000-2001)

University of Washington Graduate Student Senate
Senator from the Physics Department (2003-2004)

Papers

Crawford, B., Kai Miller, Pradeep Shenoy, Rajesh Rao **Real-Time Classification of Electromyographic Signals for Robotic Control** Proc. 2006 AAAI conference

Holmes, M.D., Micah Brown, Don M. Tucker, Russell P. Saneto, Kai J. Miller, Gagandeep S. Wig, Jeffrey G. Ojemann 2007 **Confirmation of dense array EEG localization of neocortical seizure onset and propagation**, Neurology (currently in submission)

Leuthardt, E.C., Miller, K.J., Anderson, N., Schalk, G., Dowling, J., Moran, D., Ojemann, J.G., 2007 **Electrocorticographic Frequency Alteration Mapping (EFAM), A Novel Clinical Technique for Mapping Motor Cortex** Neurosurgery 60: ONS-260–ONS-271, 2007 DOI: 10.1227/01.NEU.0000255413.70807.6E

Leuthardt, E.C., Miller, K.J., Schalk, G., Rao, R.P.N., Ojemann, J.G., **Electrocorticography-based brain computer interface--the Seattle experience**., IEEE Trans Neural Syst Rehabil Eng. 2006 Jun;14(2):194-8

Miller, K.J., Leuthardt, E.C., Schalk, G., Anderson, N., Rao, R.P.N., Moran, D., Ojemann, J.G., 2007. **Spectral Changes in Cortical Surface Potentials during Motor Movement**, J Neurosci, 27(9):2424–2432

Miller, K.J., Makeig, S., Hebb, A.O., Rajesh P.N. Rao, R.P.N., denNijs, M., Ojemann, J.G., 2007, **Cortical Electrode Localization from X-Rays and Simple Mapping for Electrocorticographic Research: The "Location On Cortex" (LOC) package for Matlab.** J Neurosci Meth, 162; 303–308

Miller, K.J., Schalk, G., Leuthardt, E.C., Shenoy, P., Rao, R.P.N., Ojemann, J.G. 2007 **Correlation in Paired One-Dimensional, Closed Loop, Overt, Motor Controlled BCI** Journal of Technical University of Graz, Special Issue: Brain Computer Interfaces, 2007

Miller, KJ, denNijs, Marcel, Shenoy, Pradeep, Miller, John W., Rao, Rajesh P.N., Ojemann, Jeffrey G., 2007, **Real-time functional brain mapping using**

electrocorticography, NeuroImage 37 (2007) 504–507 doi: 10.1016/j.neuroimage.2007.05.029

Miller, K.J., Rao, R.P.N., and Ojemann, J.G., 2007 **The Behavioral Split in the Gamma Band** Neural Engineering, CNE '07. 3rd International IEEE/EMBS Conference on; p 465-468; DOI: 10.1109/CNE.2007.369710

Miller, K.J.; Hebb, A.O.; Ojemann, J.G.; Rao, R.P.N; den Nijs, M, 2007, **Task-Related Principal Component Analysis: Formalism and Illustration** (IEEE EMBS, In Print)

Miller, K.J.; Shenoy, P,; den Nijs, M; Sorensen, L.B.; Rao, R.P.N.; Ojemann, J.G., 2007, **Beyond the Gamma Band: The Role of High Frequency Features in Movement** Classification, (IEEE, In Review)

Ojemann, J.G.; Leuthardt, E.C.; Miller, K.J., 2007**, Brain-Machine Interface: Restoring Neurological Function through Bioengineering**,Clin Neurosurg 54; 28 doi:0148-703/07/5401-0001

Schalk, G., K.J. Miller; N.R. Anderson; J.A. Wilson; J.G. Ojemann; D.W. Moran; J.R. Wolpaw; E.C. Leuthardt, 2007, **Two-Dimensional Movement Control Using Electrocorticographic Signals in Humans** (in submission)

Schalk, G., Leuthardt, E.C., Moran, D., Miller, K.J., Ojemann, J., Wolpaw, J.R. 2006 **Towards two-dimensional cursor control using electrocorticographic signals.** Proceedings of the 11th International Conference on Human-Computer Interaction

Schalk, G., J. Kub´anek, K.J. Miller, N. Anderson, E.C. Leuthardt, J.G. Ojemann, D. Limbrick, D. Moran, L.A. Gerhardt, J.R. Wolpaw 2007 **Decoding Two-Dimensional Movement Trajectories Using Electrocorticographic Signals in Humans,** J. Neural Eng. 4 264–275 doi:10.1088/1741-2560/4/3/012

Shenoy, P., K.J. Miller, J.G. Ojemann, R.P.N. Rao **Two class robust classification of ECoG signals during repeated motor movement** Journal of Technical University of Graz, Special Issue: Brain Computer Interfaces, 2007

Shenoy, P., Miller, K.J., Ojemann, J.G., Schalk, G., Rao, R.P.N. 2007 **Generalizable Features for Electrocorticographic BCIs** IEEE Trans Neural Syst Rehabil Eng. (in print)

Shenoy, P., Miller, K.J., Crawford, B., Rao, R.P.N. 2007 **Online Electromyographic Control of a Robotic Prosthesis** IEEE Trans Biomed Eng. (in print)

Shenoy, P.; Miller, K.J.; Ojemann, J.G.; Rao, R.P.N., 2007, **Finger Movement Classification for an Electrocorticographic BCI**, Neural Engineering, CNE '07. 3rd International IEEE/EMBS Conference on, pp192-195, doi:10.1109/CNE.2007.369644

Shon, A., Miller, K.J., Ojemann, J.G., Holmes, M.D., Rao, R.P.N. 2007 **Predicting Cortical Potentials using Simultaneous Transcranial Recordings,** (submitted)

Talks

A Finite Element Model of the Dendritic Tree To Assess Morphological Relation to Spiking Behavior – Western Medical Research Forum, February 2-5, 2005, Carmel, California

Robust Electromyographic Control of a Robotic Arm – Northwest Biomechanics Symposium, May 14-15, 2005, Seattle, Washington

The Seattle ECoG BCI Experiments – Third International Meeting of Brain-Computer Interface Technology, June 14-19, 2005, Rensselaerville, New York

Toward a Multidimensional, Robust, Brain Computer Interface – School of Engineering Industry Affiliate Meeting, November 3, 2005, Seattle, WA

Electrocorticographic Cognitive Findings: Working Memory, Attention, and Face Recognition – Helen Wills Neuroscience Center, UC Berkeley Dec. 19, 2005, Berkeley, CA; Schwartz Center for Computational Neuroscience, UCSD, Dec. 28, 2005, San Diego, CA

Electrocorticographic motor change for mapping and online feedback - Department of Radiology, UCSF, July 21, 2006, San Francisco, CA

High Frequency Electrocorticographic Changes – Helen Wills Neuroscience Center, UC Berkeley July 24, 2006, Berkeley, CA;

High-frequency Electrocorticographic Change: A Specific Marker of Cortical Activation? – Swartz Center for Computational Neuroscience, UCSD August 4, 2006, San Diego, CA

Construction of a Robust Brain Computer Interface Using Electrocorticographic Recording – MSTP Retreat, Leavenworth, WA, August 7, 2006

Feature Correlation in an Electrocorticographic BCI:Screening, 1-D and 2-D control – Third international BCI workshop, September 22-23, Graz, Austria, 2006 (Slides delivered by Pradeep Shenoy)

Electrocorticographic cortical changes during a working memory task - Society for Neuroscience Meeting, October 17, 2006, Atlanta, GA

Focal electrocorticographic activation associated with motor tasks in 20 human subjects - Society for Neuroscience Meeting, October 18, 2006, Atlanta, GA

High-Frequency Electrocorticographic Features and Their Application to BCI - Neural Information Processing Systems, Dec. 8. 2006, Whistler, BC, Canada

Frontiers in Electrical Brain Mapping - Western Student Medical Research Forum, Feb. 2, 2007, Carmel, CA

Recent Advances in Electrocorticography - Harborview Regional Epilepsy Center, Feb. 7, 2007, Seattle, WA

The Behavioral Split in the Gamma Band 3rd International IEEE EMBS Conference on Neural Engineering, May 4, 2007, Kohala Coast, Hawaii, USA

Cortical spectral changes during actual and imagined motor movement, and the augmentation of spectral change with feedback – Society for Neuroscience Meeting, November 7, 2007, San Diego, CA

Abstract Presentations (Posters)

Independent Component Analysis and Source Localization in Electrocorticography - National MSTP conference, July 9 – 11, 2004 Keystone, Colorado.

A Finite Element Model of Dendritic Structure - University of Washington MSTP retreat, August20-21,2004, Leavenworth, Washington

Real and Imagined Sources in Electrocorticography - Brain-Computer-Interface Workshop and Training Course, September 17th - 18th 2004, at the Institute for Human Computer Interfaces, Graz, Austria

Identifying and Using ECoG Signals for BCI Control Using Actual and Imagined Movements - Third International Meeting of Brain-Computer Interface Technology June 14-19, 2005, Rensselaerville, New York

Thought Controlled Cursor Movement … a Robust Brain Computer Interface - University of Washington MSTP retreat, August 19,2005, Seattle, Washington

Selective Attention Effects Associated with Very High Frequency Changes in Human Primary Visual Cortex – Society for Neuroscience Meeting, November 12 – 16, 2005 Washington, DC

Construction of an Intuitive, Complete, Hodgkin-Huxley Simulation of Action Potential Generation and Propagation - Society for Neuroscience Meeting, November 12 – 16, 2005 Washington, DC

Electrocorticographic Analysis of Motor Speech – Kai Miller, Gerwin Schalk, Adam Rouse, Dan Moran, and Jeff Ojemann, Eric C. Leuthardt – Society for Neuroscience Meeting, October 17, 2006, Atlanta, GA

Decoding two-dimensional movement trajectories from electrocorticographic signals in humans - Schalk, G., J. Kub´anek, K.J. Miller, N. Anderson, E.C. Leuthardt, J.G. Ojemann, D. Limbrick, D. Moran, L.A. Gerhardt, J.R. Wolpaw – Society for Neuroscience Meeting, October 15, 2006, Atlanta, GA

Online Electrocorticographic Control of a Brain-Computer Interface – Kai J. Miller, Gerwin Schalk, Pradeep Shenoy, Eric C. Leuthardt, Rajesh P.N. Rao, Jeffrey G. Ojemann; UW CSE, Industrial Affiliates Meeting, Seattle, WA October 30-31, 2006

Real-time Functional Mapping of Cortical Motor Areas in Humans – Kai J. Miller, Pradeep Shenoy, Rajesh P.N. Rao, Jeffrey G. Ojemann; UW CSE, Industrial Affiliates Meeting, Seattle, WA October 30-31, 2006

Separation of the Cortical Spectrum to Examine Large Scale Network Dynamics – Miller, K.J., denNijs, Rao, R.P.N., Ojemann, J.G., COSYNE, February, 2007, Salt Lake City, 2007

Real-time functional brain mapping using the chi band (76-200 Hz) in Electrocorticography – Miller, K.J., Makeig, S., Hebb, A.O., Rajesh P.N. Rao, R.P.N., denNijs, M., Ojemann, J.G.,American Association of Neurological surgeons Annual Meeting, Washington, DC; April 14-19, 2007

High Frequency Activity Correlates of Face and Object Recognition near Fusiform Face Area with ECoG – Hebb, A.O., Miller, K.J., Panagiotides, H., Ojemann, J.G.;

American Association of Neurological surgeons Annual Meeting, Washington, DC; April 14-19, 2007

Task-Related Principal Component Analysis: Formalism and Illustration – 29th IEEE EMBS Annual International Conference, August 25, 2007, Lyon, France
Decoupling the cortical power spectrum – Society for Neuroscience Annual Meeting, November 4, 2007, San Diego, CA

Demonstrations

Realtime Classification of Electromyogram for Robotic Arm Control demonstration
Beau Crawford, Kai Miller, Pradeep Shenoy, Rajesh Rao - Neural Information Processing Systems, December, 2004, Vancouver, British Columbia

Grants

Exploring the Neural Dynamics of Cognition through Human Electrocorticography
A Proposal Submitted to the National Science Foundation Cognitive Neuroscience Program; Under Program Solicitation NSF 06-557; July, 2006
Written under RPN Rao and JG Ojemann, *Grant Approved and Funded, Jan, 2007*

Occasional Reviewer for…

Cerebral Cortex
IEEE Transactions on Biomedical Engineering
IEEE Transactions on Neural Systems and Rehabilitation Engineering
Neural Information Processing Systems

Personal / Extracurricular

Tennis (NCAA team at UC San Diego 1996-2000), Surfing, Travel, Literature, Chess