

Jonathan S. Brumberg

Curriculum Vitae

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Education

- 2003–2008 Ph.D. Cognitive and Neural Systems Boston University
Thesis: “An electrophysiological investigation of human motor cortex and its application to speech restoration”
- 1998–2002 B.S. Computer and Information Sciences University of Delaware
- 1998–2002 B.A. Philosophy University of Delaware

Post-graduate research & employment

- 2010–present **Research Assistant Professor:** Department of Cognitive and Neural Systems
Faculty Member: Center of Excellence for Learning in Education, Science and Technology (CELEST)
Boston University, Boston, MA
- Co-director of Neural Prosthesis Laboratory at Boston University (www.bu.edu/npl). We focus on developing multi-modal and multi-sensory brain-machine interfaces using chronically implanted electrophysiology and non-invasive electroencephalography (EEG). The primary goal of these devices is for restoration of communication and mobility for individuals with profound speech and motor deficits (e.g. Locked-in Syndrome)
 - Supervise and mentor graduate and undergraduate research projects
 - Participate in Ph.D. dissertation committees
- March 2011–present **Adjunct Professor:** Department of Electrical and Computer Engineering
Georgia Institute of Technology, Atlanta, GA
- Student advising and participation in ECE Ph.D. dissertation committees
- 2009–present **Research Consultant:** Communication and Design Laboratory (CADLAB)
Northeastern University, Boston, MA
- Involved with acoustic analysis software development.
 - Aid research program and grant proposal development.
 - Involved in mentoring of graduate student research activities.
- 2008–2010 **Research Associate:** Department of Cognitive and Neural Systems
Boston University, Boston, MA
- Research included modeling and signal processing of extracellular neural activity and electroencephalography for use in real-time neural prostheses for speech production.
 - Development of modular software framework for neural prosthesis in conjunction with Neural Signals, Inc.
 - Development and maintenance of the Directions into Velocities of Articulators (DIVA) neurocomputational model for speech production.

- 2008–2009 **Research Scientist**
Neural Signals, Inc., Duluth, GA
- Led neural decoding research for speech prosthesis brain computer interface (BCI) project.
 - Co-directed BCI software training for implant patients.

Other research & employment

- 2003–2008 **Research Assistant:** Department of Cognitive and Neural Systems
Boston University, Boston, MA
- Dissertation work: Design and implementation of a neural prosthesis for real-time control of a speech synthesizer by a completely paralyzed human. Featured on CNN, in Brainwork by the Dana Foundation, the Boston Globe, MIT Technology Review, the New Scientist, Scientific American Mind, Nature News, Esquire Magazine, Wired, Discover Magazine and Discovery News
 - Signal processing and analysis of neurobiological signals including extracellular neural recordings and magnetoencephalography.
 - Extensive computational modeling of a neural network for simulation of speech production.
- 2002–2003 **Research Assistant:** Psychology Department
Temple University, Philadelphia, PA
- Conducted and analyzed experiments with human subjects pertaining to perception of Biological Motion and Illusory Contours.
- Summer 2002 **Research Assistant:** Psychology Department
University of Delaware, Newark, DE
- Investigated numerical representations and visual attention through ERP studies of human subjects.
- Fall 2000 **Research Assistant:** Department of Computer and Information Sciences
University of Delaware, Newark, DE
- Developed new instruction manual for Introduction to Computer and Information Sciences course.

Teaching experience

- Fall 2010 **Guest Lecturer:** Department of Health Sciences
Boston University, Boston MA
- HS361 Special lecture on speech neuroscience & brain computer interfacing for speech, communication and control
- Fall 2009 **Guest Lecturer:** Department of Cognitive and Neural Systems
Boston University, Boston MA
- CN740 Special lecture on brain machine interfacing for speech communication

- Fall 2004 **Teaching Fellow:** Department of Cognitive and Neural Systems
Boston University, Boston MA
- Lab instructor for graduate-level introduction to mathematical methods for computational simulation and signal processing.
 - Instructed students on methods for numerical solution of differential equations.
- 2000-2002 **Teaching Assistant:** Department of Computer and Information Sciences
University of Delaware, Newark, DE
- Instructed classes for undergraduate-level courses ranging from beginner to intermediate level.
 - Courses: Introduction to Computer and Information Science, General Computer Science (C programming), Introduction to Computer Science (C++ programming), Machine Organization and Assembly Language (SPARC architecture).

Advising and mentorship

- Ph.D. Students Boston University (unless noted); Georgia Institute of Technology (GT)
- Rob Law (dissertation reader), Brett Matthews (GT: committee member), Sean Lorenz (dissertation reader)
 - Misha Panko, Emily Stephen (Co-sponsored NIH F31: predoctoral fellowship), Nan Jia, Spencer Torene, Andr s Salazar-Gomez
- Undergraduates Boston University (unless noted); Massachusetts Institute of Technology (MIT)
- Student volunteer research: Dante Smith, Mike Salvato (MIT)
 - Former students: Allison Song, Caroline Pardee, Michael Zu, Conrad Nied

Publications

Refereed research papers

1. Brumberg, J. S., Wright, E. J., Andreasen, D. S., Guenther, F. H., and Kennedy, P. R. (2011). Classification of intended phoneme production from chronic intracortical microelectrode recordings in speech-motor cortex. *Frontiers in Neuroscience* 5, 65.
2. Brumberg, J. S. and Guenther, F. H. (2010). Development of speech prostheses: current status and recent advances. *Expert review of medical devices* 7(5), 667–79.
3. Brumberg, J., Nieto-Castanon, A., Kennedy, P., and Guenther, F. (2010). Brain-computer interfaces for speech communication. *Speech communication* 52(4), 367–379.
4. Denby, B., Schultz, T., Honda, K., Hueber, T., Gilbert, J., and Brumberg, J. (2010). Silent speech interfaces. *Speech Communication* 52(4), 270–287.
5. Guenther, F. H., Brumberg, J. S., Wright, E. J., Nieto-Castanon, A., Tourville, J. A., Panko, M., Law, R., Siebert, S. A., Bartels, J. L., Andreasen, D. S., Ehirim, P., Mao, H., and Kennedy, P. R. (2009). A Wireless Brain-Machine Interface for Real-Time Speech Synthesis. *PLoS ONE* 4(12), e8218.
6. Terband, H., Maassen, B., Guenther, F. H., and Brumberg, J. (2009). Computational Neural Modeling of Speech Motor Control in Childhood Apraxia of Speech (CAS). *Journal of Speech Hearing and Language Research* 52(6), 1595–1609.

Papers in conference proceedings

1. Guenther, F. H and Brumberg, J. S. (2011). Brain-machine interfaces for real-time speech synthesis. In: *Proceedings of the 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC '11)*. Boston, MA.

2. Matthews, B., Kim, J., Brumberg, J. S., and Clements, M. (June 2010). A Probabilistic Decoding Approach to a Neural Prosthesis for Speech. In: *2010 4th International Conference on Bioinformatics and Biomedical Engineering*. IEEE, pp.1–4.
3. Brumberg, J. S., Kennedy, P. R., and Guenther, F. H. (Sept. 2009). Artificial speech synthesizer control by brain-computer interface. In: *10th Annual Conference of the International Speech Communication Association (Interspeech 2009)*. Brighton, U.K.: International Speech Communication Association.

Posters & Abstracts

1. Brumberg, J. S. and Guenther, F. H. (2011). A non-invasive brain-machine interface for control of a speech synthesizer. In: *Neuroscience Meeting Planner 2011*. Program No. 816.02. Washington, DC: Society for Neuroscience.
2. Panko, M., Brincat, S., Brumberg, J., Salazar-Gomez, A., Roy, J., Overduin, S., Kennedy, P., Miller, E. K., and Guenther, F. (2011). Signal stability in chronic invasive brain-machine interfaces. In: *Neuroscience Meeting Planner 2011*. Program No. 280.13. Washington, DC: Society for Neuroscience.
3. Stephen, E. P., Brumberg, J. S., and Guenther, F. H. (2011). Distinguishing imagined movement from rest using electroencephalography. In: *Neuroscience Meeting Planner 2011*. Program No. 711.05. Washington, DC: Society for Neuroscience.
4. Brumberg, J. S., Kim, J., Matthews, B., Wright, E. J., Guenther, F. H., Clements, M., and Kennedy, P. R. (2010). Evaluation of supervised classification techniques for direct phoneme prediction by a brain-computer interface. In: *Neuroscience Meeting Planner 2010*. Program No. 86.11. San Diego, CA: Society for Neuroscience.
5. Law, R., Brumberg, J., and Guenther, F. (May 2010). Nonlinear Bayesian filters for EEG-based speech prostheses. In: *Proceedings of the Fourteenth International Conference on Cognitive and Neural Systems (ICCN)*. Boston, MA.
6. Kennedy, P., Andreasen, D., Brumberg, J., Clements, M., Guenther, F., Kim, J., Matthews, B., Ramos, C., Velliste, M., and Wright, E. (2009). Human speech cortex [2]: Tuning of single units during listening and imagined singing of tones and musical notes using feedback. In: *Neuroscience Meeting Planner 2009*. Program No. 181.11. Chicago, IL USA: Society for Neuroscience.
7. Panko, M., Brumberg, J. S., Nieto-Castanon, A., Wright, E. J., Law, R., Kennedy, P. R., and Guenther, F. H. (2009). Decoding intended speech with a brain-machine interface utilizing a Neurotrophic Electrode. In: *Berlin Brain-Computer Interface Workshop: Advances in Neurotechnology, July 8-10, 2009*.
8. Velliste, M., Brumberg, J. S., Perel, S., Fraser, G. W., Spalding, M. C., Whitford, A. S., McMorland, A. J. C., Wright, E. J., Guenther, F. H., Kennedy, P. R., and Schwartz, A. B. (2009). Modular software architecture for neural prosthetic control. In: *Neuroscience Meeting Planner 2009*. Program No. 985.1. Chicago, IL USA: Society for Neuroscience.
9. Brumberg, J., Nieto-Castanon, A., Guenther, F., Bartels, J., Wright, E., Siebert, S., Andreasen, D., and Kennedy, P. (2008). Methods for construction of a long-term human brain machine interface with the Neurotrophic Electrode. In: *Neuroscience Meeting Planner 2008*. Program No. 779.5. Washington, DC: Society for Neuroscience.
10. Guenther, F., Brumberg, J., and Nieto-Castanon, A. (2008). A brain-computer interface for real-time speech synthesis by a locked-in individual implanted with a Neurotrophic Electrode. In: *Neuroscience Meeting Planner 2008*. Program No. 712.1. Washington, DC: Society for Neuroscience.
11. Terband, H., Maassen, B., Brumberg, J. S., and Guenther, F. H. (2008). Increased levels of neural noise as the core deficit in childhood apraxia of speech (CAS). In: *Conference on Motor Speech*. Monterey, CA.
12. Brumberg, J. S., Andreasen, D. S., Bartels, J. L., Guenther, F. H., Kennedy, P. R., Siebert, S. A., Schwartz, A. B., Velliste, M., and Wright, E. J. (2007). Human speech cortex long-term recordings [5]: formant frequency analyses. In: *Neuroscience Meeting Planner 2007*. Program No. 517.17. San Diego, CA.
13. Siebert, S. A., Andreasen, D. S., Bartels, J. L., Brumberg, J. S., Guenther, F. H., Kennedy, P. R., and Wright, E. J. (2007). Human speech cortex long-term recordings [1]: spike sorting and noise reduction. In: *Neuroscience Meeting Planner 2007*. Program No. 728.14. San Diego, CA: Society for Neuroscience.
14. Terband, H., Maassen, B., and Brumberg, J. (2007). Motor speech in adults and children: computational-neurological modeling of childhood apraxia of speech (CAS). In: *American Speech-Language Associate Conference 2007*. Boston, MA.
15. Wright, E. J., Andreasen, D. S., Bartels, J. L., Brumberg, J. S., Guenther, F. H., Kennedy, P. R., Miller, L., Rebesco, J., Schwartz, A. B., Siebert, S. A., and Velliste, M. (2007). Human speech cortex long-term recordings [3]: neural net analyses. In: *Neuroscience Meeting Planner 2007*. Program No. 517.18. San Diego, CA: Society for Neuroscience.
16. Shipley, T. F., Maguire, M. J., and Brumberg, J. (Aug. 2004). Segmentation of event paths. *Journal of Vision* 4(8), 562–562.

17. Shipley, T. F., Maguire, M. J., and Brumberg, J. S. (2003). Top down effects on search for biological motion. *Abstracts of the Psychonomics Society* 8(51).

PhD thesis

1. Brumberg, J. (2008). "An electrophysiological investigation of human motor cortex and its application to speech restoration". PhD thesis. Boston, MA, p. 147.

Tech reports

1. Brumberg, J. S., Kennedy, P. R., and Guenther, F. H. (2011). *An auditory output brain-computer interface for speech communication*. Tech. rep. BCI Award 2011.
2. Shipley, T. F. and Brumberg, J. S. (2003). *Markerless motion-capture for point-light displays*. Tech. rep. Philadelphia, PA: Temple University, Temple University Vision Laboratory.

Presentations

1. "Bridging speech, neuroscience and engineering for speech rehabilitation" Department of Speech, Hearing and Language Sciences Research Colloquium Series, Boston University, Boston, MA, February 16, 2011.
2. "Brain-computer interfaces for communication." Science of Learning Centers PI Awardee Meeting, Washington, DC, October 14, 2010.
3. "Brain-computer interfaces for artificial speech synthesis." Department of Speech, Hearing and Language Sciences Research Colloquium Series, Boston University, Boston, MA, April 27, 2010.
4. "Artificial speech synthesizer control by brain-computer interface." Interspeech 2009, Brighton, UK, September 7, 2009.
5. "Real-time speech synthesis for neural prosthesis." Acoustical Society of America, Portland, OR, May 18, 2009.
6. "Speech restoration by brain computer interface." CELEST Education Curriculum Workshop, July 11, 2008. [invited]
7. "An electrophysiological investigation of human motor cortex and its application to speech restoration." Boston University, June 11, 2008. [Dissertation defense]

Academic memberships, awards and service

- 2011 BCI Award Finalist (top ten out of 64 entries)
- Awarded Conference Fellowship, 2011 ASHA/NIDCD Lessons for Success Research Conference
- Ad hoc reviewer for *Journal of Speech, Language and Hearing Research*, *Neuroscience*, *Journal of Cognitive Neuroscience*, *IEEE Transactions on Neural Systems and Rehabilitation Engineering*.
- Faculty Judge, 2010-2011 Boston University Science and Engineering Symposium
- Member, Society for Neuroscience, 2007–present
- Member, International Speech Communication Association, 2009
- Member, National Student Speech Language Hearing Association, 2007–2008
- Boston University Graduate Research Fellowship, 2003-2008
- University of Delaware Honors Program, 1998–2002

Technical skills

- Advanced knowledge of computer and web programming languages including C, C++, Matlab, Pascal, Java, Perl/CGI, Python, PHP, HTML, L^AT_EX, SQL and Microsoft .NET (C# and VB)
- Administration of Linux server clusters and Microsoft Windows Server
- Extensive experience using Microsoft Office suite and Adobe Photoshop
- Proficiency with statistical analysis software packages S/R and speech synthesis including text-to-speech (Festival), formant-based (e.g. Klatt) and articulatory-based (e.g. Maeda).