

# Satrajit S. Ghosh, Ph.D.

## CURRICULUM VITAE

Speech Communication Group	Email	satra@mit.edu
Research Laboratory of Electronics	Web	<a href="http://www.mit.edu/~satra">http://www.mit.edu/~satra</a>
Massachusetts Institute of Technology		
50 Vassar St, Room 36-587		
Cambridge, MA 02139, United States		

### Profile

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Strong background in neuroimaging, neuro-computational modeling of speech, machine learning, signal processing and software engineering.

### Professional Experience

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- 2007 - **Research Scientist**  
Speech Communication Group, Research Laboratory of Electronics  
Massachusetts Institute of Technology
- Improve analysis of structural and functional neuroimaging data. Advise students on signal processing and functional imaging and in improving their experimental designs, analysis methods, and interpretation of their results. Lead a multi-institution collaboration to create an improved platform for neuroimaging data analysis and visualization.
- 2008 - **Instructor**  
Program in Speech and Hearing Biosciences and Technology  
Harvard-MIT Division of Health Sciences and Technology  
Instructor: Speech Communication (MIT: Course 6.541/HST)  
Co-Instructor: Acoustics of Speech and Hearing (MIT: Course 6.551/HST)
- 2010 - **Standards for Datasharing: Neuroimaging Task Force Member**  
International Neuroinformatics Coordinating Facility
- Neuroscience data, particularly those in neuroinformatics related areas such as neuroimaging and electrophysiology, are associated with a rich set of descriptive information often called metadata. The goal of this task force is to develop generic standards and tools to facilitate the recording, sharing, and reporting of

neuroimaging metadata. It is expected that these efforts will greatly improve upon current practices for archiving and sharing neuroscience data.

**2004 - 2006    Postdoctoral Associate**

Speech Communication Group, Research Laboratory of Electronics  
Massachusetts Institute of Technology

Designed and executed psychophysical and functional brain imaging experiments aimed at understanding human speech perception and production. Analyzed the data using speech signal processing and statistical approaches. Wrote real-time digital signal processing code for speech processing. Synthesized artificial speech and created interactive interfaces for running experiments.

**2005 - 2010    Research Fellow**

Department of Cognitive and Neural Systems  
Boston University, Boston, MA

Consulted on the hardware and software used for collecting and analyzing data from brain imaging experiments. Advised post-docs and graduate students on their experimental designs, analysis methods, and interpretation of their results.

**1999 - 2004    Graduate Research Assistant**

Speech Lab, Department of Cognitive and Neural Systems  
Boston University, Boston, MA

**1999 - 2000    Teaching Fellow**

Department of Cognitive and Neural Systems  
Boston University, Boston, MA

Course: "Neural models of Speech and Hearing."

**1997 - 1998    Software Engineer**

Media for Learning Group, Kent Ridge Digital Labs  
(now Institute for Infocomm Research), Singapore

Worked with a team of people to create real-time, parametric sound effects and interactive music generation software. Developed visual interfaces, interactive music algorithms and software libraries for scheduling sound events and interfacing with hardware.

**1996 - 1997    Teaching Assistant**

Department of Computer Science  
National University of Singapore, Singapore

## Education

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- 2004      **Ph.D. in Cognitive and Neural Systems, Boston University**  
Thesis: "Understanding cortical and cerebellar contributions to  
speech production through modeling and functional imaging"  
Advisor: Prof. Frank Guenther
- 1997      **B.S. (Honors) in Computer Science, National University of Singapore**  
Thesis: "Sound generation using the Chua oscillator with an adaptive  
neural network model for inverse parameter mapping"  
Advisor: Prof. Lonce Wyse

## Grants

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- 2008-2010      R03 (NIBIB)      **Principal Investigator**  
"Dissemination of software for artifact detection  
and functional analysis of parcellated imaging data"

## Other professional experience

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### Review Editor

Frontiers in Neuroscience Methods

### Ad-hoc reviewer

- Grants:*      National Science Foundation, USA  
National Medical Research Council, Singapore
- Journals:*      Biological Psychiatry  
Brain and Language  
Current Biology  
Human Brain Mapping  
NeuroImage  
Journal of Neuroscience  
Journal of Speech, Language and Hearing Research

## Honors and Awards Information

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- 2000      Graduate Teaching Fellow Award, Boston University
- 1998      Presidential University Graduate Fellowship, Boston University
- 1995      Dean's List, School of Science, National University of Singapore
- 1994-97      Singapore Airlines/Neptune Orient Lines Undergraduate Scholarship
- 1994      Ranked 237th (of 100000+) in Indian Institute of Technology (IIT)  
All-India Exam
- 1993      Selected to the Indian National Mathematics Olympiad

## Invited Talks

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“Region of interest analysis of functional Magnetic Resonance Imaging data”

- Gabrieli Lab, McGovern Institute for Brain Research, MIT (July, 2007)
- New York State Psychiatric Institute, Columbia University, NY (July, 2007)
- Singapore General Hospital (November, 2007)

“Exploring speech motor control through computational modeling and neuroimaging”

- Center for Life Sciences, National University of Singapore (November, 2007)

“Nipype: Opensource platform for unified and replicable interaction with existing neuroimaging tools”

- NITRC Grantee meeting, San Francisco, CA (June, 2009)
- Brigham and Women’s Hospital (December, 2009)
- BrainMap, MGH/MIT (February, 2010)
- Scientific Python Conference in India (December, 2010)

“Using high-resolution fMRI to identify individual-specific speech motor regions”

- Surgical planning laboratory, Brigham and Women’s Hospital (February, 2010)

## Professional Memberships

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Organization for Human Brain Mapping  
Society for Neuroscience

## Software developed

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2008-	Nipype: A python framework neuroimaging analysis workflows
2004-2005	Online noise suppression for MRI patient microphone input
2002-2003	Interactive parcellation of brain MRI images
1999-2000	Carotid artery diameter estimation using ultrasound images
1997-1998	Interactive sound effects and music generation

## Provisional Patents

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2007	Online noise suppression software for Magnetic Resonance Imaging
2007	Bidirectional noise suppressing communication setup for Magnetic Resonance Imaging

## Publications

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### Papers in Refereed Journals and Book Chapters

1. Nieto-Castanon, A., **Ghosh, S.S.**, Tourville, J.A., Guenther, F.H. (2003) Region of interest based analysis of functional imaging data. *Neuroimage*. 19(4):1303-16. PMID: 12948689.
2. Max, L., Guenther, F.H., Gracco, V.L., **Ghosh, S.S.** and Wallace, M.E. (2004) Unstable or insufficiently activated internal models and feedback-biased motor control as sources of dysfluency: A theoretical model of stuttering. *Contemporary Issues in Communication Science and Disorders*. 31.
3. Guenther, F.H., Nieto-Castanon, A., Ghosh, S.S., Tourville, J.A. (2004) Representation of sound categories in auditory cortical maps. *J Speech Lang Hear Res*. 47(1):46-57. PMID: 15072527.
4. Klein, A., Mensh, B., **Ghosh, S.**, Tourville, J., Hirsch, J. (2005) Mindboggle: automated brain labeling with multiple atlases. *BMC Med Imaging*. 5:7. PMCID: PMC1283974.
5. Guenther, F.H., **Ghosh, S.S.**, Nieto-Castanon, A. and Tourville, J.A. (2006) A neural model of speech production. In: J. Harrington & M. Tabain (eds.), *Speech Production: Models, Phonetic Processes, and Techniques*. London: Psychology Press.
6. Guenther, F.H., **Ghosh, S.S.**, Tourville, J.A. (2006) Neural modeling and imaging of the cortical interactions underlying syllable production. *Brain Lang*. 96(3):280-301. PMCID: PMC1473986.
7. Balci, S.K., Sabuncu, M.R., Yoo, J., **Ghosh, S.S.**, Whitfield-Gabrieli, S., Gabrieli, J.D., Golland, P. (2008) Prediction of Successful Memory Encoding from fMRI Data. *Med Image Comput Assist Interv*. 2008(11):97-104. PMCID: PMC2855196.
8. **Ghosh, S.S.**, Tourville, J.A., Guenther, F.H. (2008) A neuroimaging study of premotor lateralization and cerebellar involvement in the production of phonemes and syllables. *J Speech Lang Hear Res*. 51(5):1183-202. PMCID: PMC2652040.
9. Klein, A., **Ghosh, S.S.**, Avants, B., Yeo, B.T., Fischl, B., Ardekani, B., Gee, J.C., Mann, J.J., Parsey, R.V. (2010) Evaluation of volume-based and surface-based brain image registration methods. *Neuroimage*. 51(1):214-20. PMCID: PMC2862732.
10. Cai, S., **Ghosh, S.S.**, Guenther, F.H., Perkell, J.S. (2010) Adaptive auditory feedback control of the production of formant trajectories in the Mandarin triphthong /iau/ and its pattern of generalization. *J Acoust Soc Am*. 128(4):2033-48. PMCID: PMC2981117.
11. **Ghosh, S.S.**, Kakunoori, S., Augustinack, J., Nieto-Castanon, A., Kovelman, I., Gaab, N., Christodoulou, J.A., Triantafyllou, C., Gabrieli, J.D., Fischl, B. (2010) Evaluating the validity of volume-based and surface-based brain image registration for developmental cognitive neuroscience studies in children 4 to 11 years of age. *Neuroimage*. 53(1):85-93. PMCID: PMC2914629.
12. **Ghosh, S.S.**, Matthies, M.L., Maas, E., Hanson, A., Tiede, M., Ménard, L., Guenther, F.H., Lane, H., Perkell, J.S. (2010) An investigation of the relation between sibilant production and somatosensory and auditory acuity. *J Acoust Soc Am*. 128(5):3079-87. PMCID: PMC3003728.
13. Hinds, O., **Ghosh, S.**, Thompson, T.W., Yoo, J.J., Whitfield-Gabrieli, S., Triantafyllou, C., Gabrieli, J.D. (2011) Computing moment-to-moment BOLD activation for real-time neurofeedback. *Neuroimage*. 54(1):361-8. PMID: 20682350.

14. Golfinopoulos, E., Tourville, J.A., Bohland, J.W., **Ghosh, S.S.**, Nieto-Castanon, A., Guenther, F.H. (2011) fMRI investigation of unexpected somatosensory feedback perturbation during speech. *Neuroimage*. 55(3):1324-38. PMCID: PMC3065208
15. Silver, A.L., Nimkin, K., Ashland, J.E., **Ghosh, S.S.**, Van der Kouwe, A.J., Brigger, M.T., Hartnick, C.J. (2011) Cine magnetic resonance imaging with simultaneous audio to evaluate pediatric velopharyngeal insufficiency. *Arch Otolaryngol Head Neck Surg*. 137(3):258-63.
16. Brunner, J., **Ghosh, S.**, Hoole, P., Matthies, M., Tiede, M., Perkell, J. (2011) The influence of auditory acuity on acoustic variability and the use of motor equivalence during adaptation to a perturbation. *J Speech Lang Hear Res*. 54(3):727-39. PMID: 20966388.

## Papers in Refereed Proceedings

1. Guenther, F.H., Nieto-Castanon, A., Tourville, J.A. and **Ghosh, S.S.** (2001) The effects of categorization training on auditory perception and cortical representations. Proceedings of the Speech Recognition as Pattern Classification (SPRAAC) Workshop, Nijmegen, The Netherlands.
2. Guenther, F.H. and **Ghosh, S.S.** (2003) A model of cortical and cerebellar function in speech. Proceedings of the XVth International Congress of Phonetic Sciences (pp. 169-173). Barcelona, Spain: 15th ICPhS Organizing Committee.
3. Guenther, F.H., **Ghosh, S.S.** and Nieto-Castanon, A. (2003) A neural model of speech production. Proceedings of the 6th International Seminar on Speech Production. Sydney, Australia
4. Tiede, M., Shattuck-Hufnagel, S., Johnson, B., **Ghosh, S.**, Matthies, M., Zandipour, M. and Perkell, J. (2007) Gestural phasing in /kt/ sequences contrasting within and cross word contexts. Proceedings of the XVIth International Congress of Phonetic Sciences. Saarbrücken, Germany: 16th ICPhS Organizing Committee.
5. Cai, S, Boucek, M, **Ghosh, S.S.**, Guenther, F.H., Perkell, J.S. (2008) A System for Online Dynamic Perturbation of Formant Trajectories and Results from Perturbations of the Mandarin Triphthong /iau/. International Seminar in Speech Production, Strassbourg, France.
6. Perkell, J.S., Lane, H., **Ghosh, S.S.**, Matthies, M.L., Tiede, M., Guenther, F., Ménard, L. (2008) Mechanisms of Vowel Production: Auditory Goals and Speaker Acuity. International Seminar in Speech Production, Strassbourg, France.
7. Perrachione, T.K., Del Tufo, S.N., **Ghosh, S.S.**, Gabrieli, J.D.E. (2011) "Phonetic variability in speech perception and the phonological deficit in dyslexia." 17th Meeting of the International Congress of Phonetic Sciences, (Hong Kong, August 2011).

## Refereed abstracts

1. **Ghosh, S.S.**, Nieto-Castanon, A., Tourville, J.A. and Guenther, F.H. (2001) ROI-based analysis of fMRI data incorporating individual differences in brain anatomy. *NeuroImage*, Vol 13, Issue 6, Supplement 1, June, Page 125.

2. **Ghosh, S.S.**, Bohland, J. and Guenther, F.H. (2003) Comparisons of brain regions involved in overt production of elementary phonetic units. *Neuroimage*, Presented at the 9th Annual Meeting of the Organization for Human Brain Mapping, New York, USA. 19(2): S57.
3. Purdon, P.L., **Ghosh, S.S.**, Brown, E.N. and Bonmassar, G. (2005) A high-fidelity headphone system for simultaneous EEG/fMRI experiments. *Proceedings of the International Society for Magnetic Resonance in Medicine Meeting*, Florida, USA.
4. Tourville, J.A., Guenther, F.H., **Ghosh, S.S.**, Reilly, K.J. and Bohland, J. (2005) Effects of acoustic and articulatory perturbation on cortical activity during speech production. Presented at the 11th Annual Meeting of the Organization for Human Brain Mapping, June 12-16, 2005, Toronto, Ontario, Canada. Available on CD-Rom in *NeuroImage*, Vol. 26, No.1.
5. **Ghosh, S.S.** and Bohland, J. (2005) A speech recording setup for fMRI with online reduction of scanner noise. Presented at the 11th Annual Meeting of the Organization for Human Brain Mapping, June 12-16, 2005, Toronto, Ontario, Canada. Available on CD-Rom in *NeuroImage*, Vol. 26, No.1.
6. Dickerson, B.C., Miller, S. and **Ghosh, S.S.** (2006) An fMRI system for studying overt free recall: Preliminary data demonstrates hippocampal activation. Presented at the 12th Annual Meeting of the Organization for Human Brain Mapping, June 11-15, 2006, Florence, Italy. *NeuroImage*, Vol. 31, Supplement 1, Page S163.
7. Robin, D.A., Guenther, F.H., Narayana, S., Jacks, A., Tourville, J., Ramage, A.E., Lancaster, J.L., Franklin, C., **Ghosh, S.**, Fox, P.T. (2008) A Transcranial Magnetic Stimulation Virtual Lesion Study of Speech. *Proceedings of the conference on Speech Motor Control*. Monterey, California, USA.
8. Perkell, J.S., **Ghosh, S.S.**, Guenther, F.H., Lane, H., Mathies, M.L., Menard, L., Tiede, M.K. (2008) Mechanisms of Vowel Production: Auditory Goals and Speaker Acuity. *Proceedings of the conference on Speech Motor Control*. Monterey, California, USA.
9. Hinds, O., Gabrieli, S., Ofen, N., Yoo, J., **Ghosh, S.**, Lala, N., Willingham, D., Triantafyllou, C., Gabrieli, J. (2008) Transitions of task-related brain activation during acquisition of a novel perceptual-motor mapping. Presented at the 14th Annual Meeting of the Organization for Human Brain Mapping, Melbourne, Australia.
10. **Ghosh, S.S.**, Hamm, M., Jahns, K., Triantafyllou, C. (2008) Using High Resolution fMRI to identify individual-specific speech motor regions. *XVth conference of the International Society for Magnetic Resonance in Medicine*, Toronto, Canada.
11. Kovelman, I., **Ghosh, S.S.**, O'Loughlin, P., Ostrovskaya, I., Perrachione, T. K., Lymberis, J., Norton E. S., Cosman, S., Wexler, K., Gabrieli J. D. E. (2009) Optional Infinitive: Evidence of How Adult Brain Processes Grammatical Errors that are Typical and Atypical of Childhood Language Acquisition. *Cognitive Neuroscience Meeting*, San Francisco, California.
12. Thompson, T.W., Hinds, O., **Ghosh, S.**, Lala, N., Triantafyllou, C., Whitfield-Gabrieli, S., Gabrieli, J. (2009). Training Selective Auditory Attention with Real-Time fMRI Feedback, *NeuroImage*, Volume 47, Supplement 1, Organization for Human Brain Mapping 2009 Annual Meeting.
13. Klein, A., **Ghosh, S.S.**, Parsey, R.V. (2009) An evaluation of volume- and surface-based nonlinear registration of human brain MRI data, *NeuroImage*, Volume 47, Supplement 1, Organization for Human Brain Mapping 2009 Annual Meeting.

14. **Ghosh, S.S.**, Whitfield-Gabrieli, S., Nieto-Castanon, A. (2009). A Python-based software package for pipelined, batch analysis of fMRI data, *NeuroImage*, Volume 47, Supplement 1, Organization for Human Brain Mapping 2009 Annual Meeting.
15. **Ghosh, S.S.**, Kovelman, I., Lymberis, J., Gabrieli, J.D. (2009) Incorporating hemodynamic response functions to improve analysis models for sparse-acquisition experiments, *NeuroImage*, Volume 47, Supplement 1, Organization for Human Brain Mapping 2009 Annual Meeting.
16. **Ghosh, S.**, Burns, C., Clark, D., Gorgolewski, K., Halchenko, Y., Madison, C., Tungaraza R., Millman J. ( 2010). Nipype: Opensource platform for unified and replicable interaction with existing neuroimaging tools. 16th Annual Meeting of the Organization for Human Brain Mapping
17. **Ghosh, S.**, Granger, B., Perez, F. (2010). Distributed Neuroimaging Analysis with Nipype and IPython. 16th Annual Meeting of the Organization for Human Brain Mapping.

### Other conferences

1. Guenther, F.H., Nieto-Castanon, A., Tourville, J.A. and **Ghosh, S.S.** (2000) The representation of prototypical and non-prototypical vowels in peri-sylvian cortical areas. *Proceedings of the Society for Neuroscience Meeting*, New Orleans, USA.
2. Tourville, J.A., Guenther, F.H., **Ghosh, S.S.** and Bohland, J.W. (2004) Effects of jaw perturbation on cortical activity during speech production. *J. Acoust. Soc. Am.* 116, 2631.
3. Perkell, J., Zandipour, M., **Ghosh, S.**, Menard, L., Lane, H., Tiede, M. and Guenther, F. (2006) Variation in vowel production. *J. Acoust. Soc. Am.* 120(5), 3293-3294.
4. Perkell, J.S., Matthies, M.L., **Ghosh, S.S.**, Maas, E., Hanson, A., Guenther, F.H., Lane, H., Ménard, L., Tiede, M. (2008) Auditory and somatosensory goals for sibilants. *J. Acoust. Soc. Am.* 123(5):3459.
5. Perrachione, T., Kovelman, I., Ostrovskaya, I., Lymberis, J., O'Loughlin, P., Norton, E., **Ghosh, S.S.**, Gabrieli, J. (2009) Temporal and prefrontal cortical contributions to phonological working memory for words and pseudowords. *Proceedings of the Society for Neuroscience Meeting*, Chicago, USA.
6. Ostrovskaya, I., **Ghosh, S.S.**, Kovelman, I., Lymberis, J., O'Loughlin, P., Perrachione, T., Norton, E., Wexler, K., Gabrieli, J. (2009) Persistent markers of developmentally typical syntax errors in adult behavior and neurophysiology. *Proceedings of the Society for Neuroscience Meeting*, Chicago, USA.
7. Waskom, M.L., Polli, F.E., **Ghosh, S.S.**, Dutra, S.J., Dillon, D.G., Holmes, A.J., Iosifesco, D.V., Fava, M., Gabrieli, J. D. E., Pizzagalli, D. A. (2010) Multivariate pattern analyses reveal morphological abnormalities in major depressive disorder. *Proceedings of the Society for Neuroscience Meeting*, San Diego, USA.
8. Thompson, T., Hinds, O., **Ghosh, S.**, Pollard, K., Triantafyllou, C., Whitfield-Gabrieli, S., Gabrieli, J.D.E. (2010) Training selective auditory attention with real-time fMRI feedback. *Proceedings of the Society for Neuroscience Meeting*, San Diego, USA.
9. Perrachione, T.K., Gabrieli, J.D.E., **Ghosh, S.S.** (2011) "Optimized design and analysis of sparse-sampling functional magnetic resonance imaging experiments of speech and hearing.", 161st Meeting of the Acoustical Society of America, (Seattle, May 2011)