

# CURRICULUM VITAE

**DATE PREPARED:** August 14, 2009

## **PART I: General Information**

**Name:** Jong-Hwan Lee

**Home Address:** 75 Wyman Street  
APT 5  
NEWTON, MA 02468 United States

**Office Address:** Department of Radiology  
Brigham and Women's Hospital  
75 Francis Street  
Boston, MA 02115 United States

**Phone:** (617) 525-3311

**Email:** jhlee@bwh.harvard.edu

**Place of Birth:** Gongju, Korea

### **Education:**

1998 B.S. (Electronic Engineering), Yonsei University, Korea  
2000 M.SC. (Electrical Engineering and Computer Science), KAIST  
2005 PH.D. (Electrical Engineering and Computer Science), KAIST

### **Postdoctoral Training:**

03/05-06/06 Postdoctoral Fellow, KAIST  
10/05-05/08 Research Fellow, Brigham and Women's Hospital, Harvard Medical School

### **Academic Appointments:**

2005-2006 Postdoctoral Fellow, Korea Advanced Institute of Science and Technology, Daejeon, Korea  
2005-2008 Postdoctoral Research Fellow in Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA  
2008- Instructor, Brigham and Women's Hospital, Harvard Medical School, Boston

### **Other Professional Positions and Major Visiting Appointments:**

2000 Visiting Scholar, University of California at San Diego, San Diego, CA

### **Hospital and Health Care Organization Clinical Service Responsibilities:**

2006- Staff of fMRI Service in MRI Division, Department of Radiology, Brigham and Women's Hospital

### **Professional Societies:**

2005- Korean Brain Society, Member  
2006- International Brain Mapping and Intra-operative Surgical Planning Symposium (IBMISPS), Member

**Editorial Boards:**

2000 Ad-Hoc Reviewer, IEEE Transaction on Speech and Audio Processing  
2001 Ad-Hoc Reviewer, Neurocomputing  
2006-2007 Ad-Hoc Reviewer, Neurocomputing  
2008 Ad-Hoc Reviewer, Neuroscience Letters

**Awards and Honors:**

1994 Yonsei Special Awards (scholarship for freshmen; exempted tuition and admission fee), Yonsei University  
1995 University Designated Scholarship (exempted part of tuition), Spring, Yonsei University  
1996 University Designated Scholarship (highest honors student; exempted part of tuition), Fall, Yonsei University  
1997 University Designated Scholarship (exempted part of tuition), Spring, Yonsei University

---

## **Part II: Research, Teaching, and Clinical Contributions**

### **A. Narrative report of Research, Teaching, and Clinical Contributions**

My longstanding research interests have been in the investigation of hidden information underlying sensory signals and development of efficient methods for accurate analysis of this information. My interest has been especially focused on speech signals. Most of my graduate work was in the field of speech signal processing using artificial neural networks (ANN) or machine learning algorithms to be applied to an automatic speech recognition (ASR) system, under the guidance of Dr. Soo-Young Lee in the Department of Bio and Brain Engineering, KAIST. Dr. Lee is the director of the 'Brain Neuroinformatics Research Program' receiving 10-year funding by the Korean government. The main research goal is to learn how the brain processes information and concurrently to develop human brain-like intelligent systems (Artificial Brain).

In this project, I was involved in the development of human-like auditory processing techniques. In order to deploy the ASR system in a real environment, the technology needs to overcome several challenging problems, including an efficient and robust coding of speech signals, additive noises, convolutional noises, and interference from other sound sources. In order to address these problems, I conducted several research projects: a novel feature extraction method [article #2], maximum a posteriori (MAP) estimation-based denoising [article #1], and blind deconvolution of room reverberations [articles #3 through #5 & #13].

My recent research has focused on the application of the ANN and machine learning algorithms to the biomedical signals, such as functional MRI and electroencephalography (EEG). I was introduced to the field of biomedical research during my post-doctoral work under the guidance of Dr. Seung-Schik Yoo in the Department of Radiology, Brigham and Women's Hospital (BWH). My work as a research fellow [Research funding] on Dr. Yoo's NIH-funded research project has drawn on my extensive experiences on the development of signal processing techniques and computer programming skills. I have been involved in the acquisition, analysis of fMRI data, development of user-friendly and comprehensive software toolboxes, and manuscript preparation for this project. I have also been engaged in a research study on hormones and brain activity in women with and without depression (P.I. Dr. Jill Goldstein in the Division of Women's Health, BWH). In Dr. Goldstein's project, I am also participating in data acquisition, analyses, and giving technical expertise regarding integration of psychophysiological data (skin conductance & heart rate) with fMRI data.

A major outcome of the project with Dr. Yoo was a recent publication of our real-time automated registration technique and concurrent monitoring method of fMRI data [article #9]. Using this technique, the feasibility of the fMRI-mediated learning and consolidation of brain activations was shown within a primary motor area [article #7 and #12] and primary auditory area [article #8] via real-time fMRI (rtfMRI) neurofeedback modality.

In another recent publication [article #10 and #11], I introduced a novel group fMRI analysis technique using an independent vector analysis (IVA) method. The IVA algorithm is more advanced than the ICA algorithm since IVA allows an additional dependent parameter for the analysis compared to ICA, and thus this parameter could be assigned to the index of a subject from group fMRI data. While keeping the advantageous non-parametric and multivariate characteristics of the ICA method, the IVA method proposed presented an additional merit of automatic grouping of similar activation patterns among the subjects, which can be beneficially utilized in the group inference of fMRI data. Moreover, the IVA method showed better accuracy on the estimation of hemodynamic responses and subsequent improvement of the statistical significance compared to other conventional methods. The developed IVA method may be particularly effective for the analyses of subject- and region-specific abnormal BOLD signals such as those due to neuroleptic medications and substance abuse.

In future research activities, I will concentrate more on pre-clinical applications based on the techniques developed. These applications include (1) the motor rehabilitation of stroke patients, (2) feasibility study on the treatment of substance abuse using rtfMRI neurofeedback, (3) real-time monitoring and analysis of dynamic contrast-enhanced breast MRI for early detection of malignant tumors (in collaboration with Dr. Eva Gombos at the Lee Bell Center for Breast Imaging, BWH), and (4) identification of cortico-striatum neural circuitries of the schizophrenic patients using the developed IVA technique (in collaboration with Dr. Cynthia Wible at the Department of Psychiatry, HMS). Based on these research collaborations, I am very interested in the development of comprehensive and user-friendly software toolboxes and dissemination of these applications to the research community.

## **B. Funding Information**

- 2005- Research Fellow, N.I.H., NIH R01 NS048242-01A03, Neurofeedback Functional MRI; As a research fellow to the project, participated in data acquisition, analyses, and manuscript preparation.
- 2007- Research Fellow, N.I.H., NIMH RO1 MH56956, Gender & Brain Abnormalities in Schizophrenia Phase III; As a research fellow, participated in data acquisition, analyses, system administration, and technical expertise regarding integration of psychophysiological data with fMRI data as well as manuscript preparation.
- 2008- Investigator, High Field MRI Clinical Research Seed Grant Program: BWH / DFCI Radiology, Dynamic Contrast-Enhanced MRI for the Detection of Breast Cancer towards Adaptive Real-Time Analysis at 3.0 T Field Strength.

## **C. Report of Other (Non-Funded) Activities**

- Co-P.I. Independent Vector Analysis for Group Inference of fMRI Data.
- P.I. Adaptive Real-Time Dynamic Contrast-Enhanced MRI for the Detection of Breast Cancer

## **D. Report of Teaching**

### **1. Local contributions**

#### **c. Local Invited Presentations**

##### **Invited Talk**

- 2007- Independent Vector Analysis (IVA): A Novel Approach for fMRI Group Study, Golby Lab, Department of Neurosurgery, Brigham and Women's Hospital

##### **Radiology research retreat**

- 2009- Dynamic Contrast-Enhanced MRI for the Detection of Breast Cancer Toward Adaptive Real-Time Analysis at 3.0T Field Strength, Brigham and Women's Hospital

##### **Seminar**

- 2006- Multi-Task fMRI-based BCI for 'Thought-Controlled Computer Keyboard', Medical Imaging Physics Group (MIPG), Department of Radiology, Brigham and Women's Hospital

- 2007- Independent Vector Analysis (IVA): A Novel Multivariate Approach for fMRI Group Study, Department of Psychiatry (Dr. Cynthia Wible's lab), Harvard Medical School
- 2007- Independent Vector Analysis for Group fMRI Processing, Medical Imaging Physics Group (MIPG), Department of Radiology, Brigham and Women's Hospital
- 2007- Brain-Computer Interface using real-time fMRI: Thought-controlled robot arm, Medical Imaging Physics Group (MIPG), Department of Radiology, Brigham and Women's Hospital
- 2008- Independent vector analysis for group fMRI data processing and real-time fMRI for brain-computer-interface, Medical Imaging Physics Group (MIPG), Department of Radiology, Brigham and Women's Hospital

**g. Advisees/Trainees**

<i>Training Duration</i>	<i>Name</i>	<i>Current Position</i>
2005-2006	Dongwoo Hahn	Researcher, Samsung, Inc., Korea
2006-	Ugochukwu Amadi	Graduate Student, Gachon Medical School, Korea
2007-	Philip Keegan	Undergraduate Student, Boston University

**2. Regional, national, or international contributions**

**a. Invited Presentations**

**International**

- 2006- Automated spatio-temporal classification of human minds for fMRI based brain computer interface., International Brain Mapping & Intraoperative Surgical Planning Society (IBMISPS), Clermont Ferrand, France [*Invited Talk*]
- 2007- Simultaneous EEG and fMRI data analysis on sleep staging, KAIST, Daejeon, Korea [*Seminar*]
- 2008- Independent Vector Analysis for Group Functional MRI Data Processing, Brain Science Research Center and Department of Bios and Brain Engineering, KAIST, Daejeon, Korea [*Seminar*]
- 2008- Brain-Computer Interface using real-time fMRI: Thought-controlled robot arm, International Society for Magnetic Resonance in Medicine 2008, Tronto, Canada [*Oral Presentation*]

## Part III: Bibliography

### Original Articles

1. Lee JH, Jung HY, Lee TW, Lee SY. Speech enhancement with MAP estimation and ICA-based speech features. *Electronics Letters*. 2000;36(17):1506-1507.
2. Lee JH, Lee TW, Jung HY, Lee SY. On the Efficient Speech Feature Extraction Based on Independent Component Analysis. *Neural Processing Letters*. 2002;15(3):235-245.
3. Lee JH, Oh SH, Lee SY. Blind dereverberation of single-channel speech signals using an ICA-based generative model. *Lecture Notes in Computer Science*. 2004;3316:1070-1075.
4. Park HM, Lee JH, Kim T, Bae UM, Kim BT, Park KY, Kim CM, Lee SY. Modeling Auditory Pathway for Intelligent Information Acquisition. *International Journal of Information Acquisition*. 2004;1(4):334-356.
5. Park HM, Lee JH, Oh SH, Lee SY. Blind deconvolution with sparse priors on the deconvolution filters. *Lecture Notes in Computer Science*. 2006;3889:658-665.
6. Lee JH, Lee TW, Jolesz FA, Yoo SS. Multivariate Analysis of fMRI Group Data using Independent Vector Analysis. *Lecture Notes in Computer Science*. 2007;4666:633-640.
7. Yoo SS, O'leary HM, Lee JH, Chen NK, Panych LP, Jolesz FA. Reproducibility of trial-based functional MRI on motor imagery. *International Journal of Neuroscience*. 2007;117(2):215-227.
8. Yoo SS, Lee JH, O'leary H, Lee V, Choo SE, Jolesz FA. Functional magnetic resonance imaging-mediated learning of increased activity in auditory areas. *NeuroReport*. 2007;18(18):1915-1920.
9. Lee JH, O'Leary HM, Park H, Jolesz FA, Yoo SS. Atlas-based Multi channel Monitoring of Functional MRI Signals in Real-time: Automated Approach. *Human Brain Mapping*. 2008;29(2):157-166.
10. Lee JH, Lee TW, Jolesz FA, Yoo SS. Independent Vector Analysis (IVA): Multivariate Approach for fMRI Group Study. *Neuroimage*. 2008;40(1):86-109.
11. Lee JH, Lee TW, Jolesz FA, Yoo SS. Independent Vector Analysis (IVA) for Group fMRI Processing of Subcortical Area. *International Journal of Imaging Systems and Technology*. 2008;18:29-41.
12. Yoo SS, Lee JH, O'Leary H, Panych LP, Ferenc FA. Neurofeedback fMRI-mediated learning and consolidation of regional brain activation during motor imagery. *International Journal of Imaging Systems and Technology*. 2008;18:69-78.
13. Lee JH, Oh SH, Lee SY. Binaural semi-blind dereverberation of noisy convoluted speech signals. *Neurocomputing*. 2008;72:636-642.
14. Lee JH, Ryu J, Jolesz FA, Cho ZH, Yoo SS. Brain-Machine Interface via real-time fMRI: Preliminary study on thought-controlled robotic arm. *Neuroscience Letters*. 2009;450(1):1-6.
15. Lee W, Debasitis JC, Lee VK, Lee JH, Fischer K, Edminster K, McDannold N, Park JK, Yoo SS. Multi-layered culture of human skin fibroblasts and keratinocytes through three-dimensional freeform fabrication. *Biomaterials*. 2009;30:1587-1595.
16. Lee W, Pinckney J, Lee V, Lee JH, Fischer K, Polio S, Park JK, Yoo SS. Three-dimensional bioprinting of rat embryonic neural cells. *Neuroreport*. 2009;20(8):798-803.
17. Lee JH, Marzelli M, Jolesz FA, Yoo SS. Automated Classification of fMRI Data Employing Trial-based Imagery Tasks. *Medical Image Analysis*. 2009;13(3):392-404.
18. Lee JH, Oh S, Jolesz FA, Park H, Yoo SS. Application of Independent Component Analysis for the Data Mining of Simultaneous EEG-fMRI: Preliminary Experience on Sleep Onset. *International Journal of Neuroscience*. 2009;119:1118-1136.

### Proceedings of Meetings

1. Lee JH, Jung HY, Lee TW, Lee SY. Speech coding and noise reduction using ICA-based speech features. In: Proceedings; Helsinki, Finland. ICA;2000. p. 417-422.
2. Lee JH, Jung HY, Lee TW, Lee SY. Speech feature extraction using independent component analysis. In: Proceedings; Istanbul, Turkey. ICASSP;2000. p. 1631-1634.
3. Jeon HB, Lee JH, Lee SY. On the Center-frequency Ordered Speech Feature Extraction Based on Independent Component Analysis. In: Proceedings; Shanghai, China. ICONIP;2001. p. 1199-1203.
4. Lee JH, Lee SY. Blind dereverberation of speech signals using independence transform matrix. In: Proceedings; Portland, Oregon, USA. IJCNN;2003. p. 1453-1457.
5. Yoo SS, O'Leary HM, Park HJ, Lee JH, Park H, Panych LP, Jolesz FA. Automated Real-Time Tracing of Functional MRI Signals from Multiple Cortical Areas. In: Proceedings; Seattle, Washington: ISMRM;2006. p. 2799.
6. Yoo SS, O'Leary HM, Lee JH, Chen NK, Panych LP, Park H, Jolesz FA. Reproducibility of Trial-Based Functional MRI on Motor Imagery. In: Proceedings; Seattle, Washington: ISMRM;2006. p. 1130.
7. Yoo SS, Lee JH, Marzelli M, Jolesz FA, Panych LP. Learning Effects of Neurofeedback-fMRI on Neural Substrates Involved in Motor Imagery. In: Proceedings; Berlin, Germany: ISMRM;2007. p. 2041.
8. Lee JH, Ryu J, Jolesz FA, Cho ZH, Yoo SS. Brain-Computer Interface using real-time fMRI: Thought-controlled robot arm. In: Proceedings; Toronto, Canada: ISMRM;2008. p. 544.
9. Lee JH, Marzelli M, Jolesz FA, Yoo SS. Independent Vector Analysis for Group fMRI Processing. In: Proceedings; Toronto, Canada: ISMRM;2008. p. 3607.
10. Yoo SS, Lee W, Lee V, Lee JH, Generation of artificial neural tissue by 3-dimensional direct freeform fabrication. In: Washington, DC. Society for Neuroscience;2008. p. accepted.
11. Lee JH, Yoo SS, Stanwell P, Gombos E. Dynamic contrast-enhanced magnetic resonance imaging for breast cancer detection and characterization toward adaptive real-time analysis. In: ;2009. p. .
12. Yoo SS, Bystritsky, Lee JH, Zhang Y, Fischer K, Lee W, McDannold N, Jolesz FA. Image-guided modulation of regional brain function mediated by focused ultrasound. In: ISMRM 2009; May; Hawaii, USA. ;2009. p. .
13. Lee JH, Kearse LA, Hughes R, Tang Y, Panych LP, Stein J, Jolesz FA, Black-Schaffer RM, Yoo SS. Neurofeedback real-time fMRI for the regulation of motor areas in chronic stroke patients. In: ISMRM 2009; ;2009. p. .
14. Lee JH, Hashimoto R, Wible CG, Yoo SS. Spectrally-coherent resting-state networks of intrinsic brain activities by employing nonnegative matrix factorization to functional MRI Data. In: ;2009. p. .
15. Lee JH, Hashimoto R, Wible CG, Yoo SS. Nonnegative Matrix Factorization Toward the Analysis of Frequency-Specific Resting-State Network from functional MRI Data . In: ;2009. p. .

## **Thesis**

1. Jong-Hwan Lee. Independent component analysis models of monaural and binaural processing for blind dereverberation under noises. Daejeon, Korea: KAIST;2005.

## **Patents**

1. Lee JH, SY Lee, SH Oh. The blind dereverberation models considering measured noises and the deriving method thereof. KR patent 10-0647826. 2006 Nov 6.

## Abstracts

1. Lee JH, O'Leary HM, Lee SY, Jolesz FA, Yoo SS. Automated spatio-temporal classification of human minds for brain-computer-interface. Society for Neuroscience (SfN). 2006.
2. Lee JH, O'Leary HM, Lee SY, Jolesz FA, Yoo SS. Automated spatio-temporal classification of human minds for fMRI-based brain computer interface. International Brain Mapping & Intraoperative Surgical Planning Society (IBMISPS). 2006.
3. Yoo SS, Lee JH, O'Leary HM, Jolesz FA. Brain-Computer Interface using functional MRI: Thought-controlled Keyboard and Mouse. International Symposium on Artificial Brain with Emotion and Learning (ISABEL). 2006.
4. Yoo SS, Marzelli M, Fischer K, Lee JH, Mulkern RV. Composite MR contrast for cell imaging using superparamagnetic iron oxide particles and gadolinium chelates. European Society for Molecular Imaging. 2007.
5. Yoo SS, Lee JH, Edminster K, Jeong B. Development of robotic platform for three dimensional neural tissue engineering using independent multi-model cell-scaffold printing. Proceedings of Society for Neuroscience (SfN). 2007.
6. Yoo SS, Mitsouras D, Fischer K, Lee JH, Mulkern RV, Rybicki FJ. Inner volume approach in cellular MRI: preliminary experience. European Society for Molecular Imaging. 2007.
7. Yoo SS, Lee JH, Edminster K, Krisztina F, Marius W. Robotic platform for three-dimensional, independent, multi modal cell-scaffold printing: 'SUV for cruising new terrain of stem cell research. Harvard Stem Cell Institute (HSCI) Retreat. 2007.