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**Riccardo Barbieri, Ph.D.**

*Assistant Professor of Anaesthesia*

April 6, 2012

Re: Dr. Zhe Chen's Candidacy

It is a pleasure to provide an assessment of Dr. Zhe Chen as a candidate for a position at Brown University in the Department of Neuroscience.

Dr. Chen obtained the Ph.D. degree in electrical and computer engineering in 2005 from McMaster University, Canada. From 2001 to 2004, he worked as a research assistant in the Adaptive Systems Laboratory (directed by Prof. Simon Haykin) at McMaster University. During the summer in 2002, he worked as a summer intern in Bell Laboratories, Lucent Technologies, Murray Hill, NJ. After his Ph.D. he joined the RIKEN Brain Science Institute in June 2005 and worked as a research scientist in the Laboratory of Advanced Brain Signal Processing (headed by Prof. Shun-ichi Amari and Prof. Andrzej Cichocki). He has received a number of scholarships and awards, including the 2002 IEEE Walter Karplus Student Summer Research Award from the Neural Networks Society. He is the leading author of the book *Correlative Learning: A Basis for Brain and Adaptive Systems* (Wiley, 2007). He served as a guest editor for the special issue "Signal Processing for Neural Spike Trains" in *Journal of Computational Intelligence in Neuroscience*, and a guest editor for the Special Topic "Engineering Approaches to Study Cardiovascular Physiology: Modeling, Estimation, and Signal Processing" in *Frontiers in Computational Physiology and Medicine*. He is a Senior Member of the IEEE, his biography was included in *Marquis Who's Who in America* and *Dictionary of International Biography*.

I first contacted Dr. Chen in November 2006 and, on the basis of his high credentials and after a few phone conversations about the projects we were undertaking in our labs, we offered him a postdoctoral position here at the Neuroscience Statistics Research Laboratory (NSRL), Massachusetts General Hospital - Harvard Medical School, directed by Prof. Emery Brown. From March, 2007 Dr. Chen has joined us as a Harvard research fellow, and he was also appointed as Research Affiliate in the Department of Brain and Cognitive Sciences at Massachusetts Institute of Technology (MIT). His main research interests include neural signal processing, machine learning, neural and cardiovascular engineering, and computational neuroscience.

During these last five years, Dr. Chen has been an incredibly productive element within our group. Since 2008, affiliated with the NSRL, he has produced a total of 25 publications (+4 under review and/or in preparation), 15 abstracts, and 25 oral talks. Under his direct responsibility, he has undertaken several projects in two main areas:

- (1) *Biomedical signal processing methods to cardiovascular signals*. As part of the R-01 project entitled "Point Process Models of Human Heart Beat Interval Dynamics", Dr. Chen has developed new point process probabilistic models and algorithms for assessing human heartbeat interval dynamics and cardiovascular control by analysis of cardiovascular

variables such as the electrocardiogram (ECG), Arterial Blood Pressure, and Respiration. The proposed signal processing techniques produce new quantitative indices that could potentially have important implications for research studies of cardiovascular and autonomic regulation and for heart rate monitoring in clinical settings. Dr. Chen has applied his improved methods to a wide range of experimental protocols, including tilt table procedures, recordings during autonomic pharmacological blockade in healthy subjects, as well as databases of subjects with congestive heart failure. A most recent investigation has successfully assessed baroreflex control of heart rate during induction of general anesthesia from a dozen of healthy subjects. His latest application is currently analyzing heartbeat data for human subjects under general anesthesia, proposing new indices based on baroreflex control of heart rate and respiratory sinus arrhythmia.

- (2) *Neural signal processing methods for neuronal data analysis* focuses on development of new statistical algorithms and tools to analyze how individual and ensembles of neurons encode information about relevant external stimuli, as well as the neural correlates related to the behavior. In collaboration with experimental neuroscientists (at both MGH/HMS and MIT), Dr. Chen has been actively involved in several research investigations. One project investigated the characterization of neuronal up-down states from the primary somatosensory cortex in behaving rats. One other ongoing project is to develop spike sorting-free Bayesian decoding algorithm for estimating rat's positions based on the spiking activity of ensemble hippocampal place cells. This project may lead to other interesting applications of brain-machine interface (BMI) or neuroprosthetic devices. Another project is aimed at developing new parametric/nonparametric statistical tools for assessing ensemble neuronal interactions, which have been used for analyzing neuronal data recordings from the cat primary motor cortex as well as the rat hippocampus. Finally, Dr. Chen has designed a new statistical model and algorithm to uncover the spatial topology represented by rat hippocampal ensemble neuronal codes, and he has also used temporal difference reinforcement learning theory to model the rat's midbrain dopamine cell activity in a reward-navigation task.

In the past three years, Dr. Chen has been frequently offering technical advices on statistical data analysis for graduate students and postdoctoral fellows within or outside the Neuroscience Statistics Research Laboratory, and he has been invited by several principal investigators to their labs to present tutorial lectures on statistical data analysis. I have observed Dr. Chen in a variety of research settings, both in the Neuroscience Research Laboratory and MIT, and have noticed how he quickly focuses onto key research issues, at the same time being responsive to critical feedback and attentive to reactions from his audience. Dr. Chen has also demonstrated valuable mentoring skills in directing several visiting graduate students and a few MIT PhD students in their research projects, some of which have led to peer-reviewed publications. He is always an active participant, offering his experience and suggesting solutions to research problems as they arise. Furthermore, I have witnessed Dr. Chen presenting our work at several conferences and have always admired his conciseness and clarity, as well as his capacity to answer questions from the public effectively and to the point.

In summary, Dr. Chen has been a valuable asset within the Neuroscience Statistical Research Group. He came to us with developed research skills and a clear agenda on the knowledge he wanted to acquire. Nevertheless, he has added significant progress in all our ongoing research projects, demonstrating the ability to think critically and take control of the wide variety and complexity of the statistical methods developed in the group. Given his scholarly accomplishments and his contribution in the NSRL I can testify to his excellent scientific knowledge, his professional skills and sense of responsibility, his outstanding capacity to interact with his collaborators, as well as his competence in conveying complex scientific and mathematical concepts clearly and effectively. For these reasons I am confident that he holds great promises as an independent researcher as well as in pursuing the academic career.

Sincerely,

A handwritten signature in dark ink, appearing to read 'Riccardo Barbieri', is shown within a light gray rectangular box.

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