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David Sheinberg, PhD
Search Committee Chair
Department of Neuroscience
Brown University Providence, RI

April 19, 2012

Dear Dr. Sheinberg,

It is a pleasure for me to write this letter of recommendation for Beth Lopour. She has applied for a faculty position at Brown. Beth was my Ph.D. Advisee, and is now a post-doctoral researcher at UCLA after filing her dissertation at Berkeley in December of 2009. At UCLA she holds a *UC President's Postdoctoral Fellowship*, which is a much sought-after award. It not only funds post-doctoral study, but also includes a fund for research and professional development, as well as a faculty hiring incentive.

Education

Beth has taken courses in controls, dynamics and neurobiology and computational neuroscience. She was a student in my class: ME 277 *Oscillations in Nonlinear Systems*. The course is a difficult one on the modern theory of dynamical systems, including perturbation methods, and explores many applications in the form of computer-based assignments. In this class, I intentionally blur the lines between homework and research as much as possible. Beth excelled in this environment. She demonstrated creativity and great tenacity in completing the many open-ended assignments.

Teaching

Beth also was a member of my research group. The group meets weekly for a seminar; the students trade off in presenting something of interest. A more senior doctoral student might present her research. A more junior student might present something interesting she is doing for a class project. I recall a time when Beth decided she wanted to give us a tutorial on control theory—as she was then the resident "expert" among my current students. She set about developing a series of very well conceived examples in matlab and simulink, which demonstrate a hierarchy of different control techniques applied to accessible examples. At the same time, she was taking my dynamical systems theory course, and talking to one of my more senior doctoral students (Mark Kramer, NSF Fellow) about his research on mesoscale mathematical models of electrical wave propagation in the human cortex.

Research

These several threads were drawn together by Beth and realized in her research project. All of this occurred in her first year. She learned enough control theory to teach Mark (and me) very effectively. I taught them both about bifurcation theory and nonlinear dynamics. We all learned a considerable amount of neuroscience from our collaborators Heidi Kirsch (UCSF Epilepsy Clinic) and Jamie Sleigh (University of Auckland). What emerged from this cultural ferment was a really wonderful piece of work, in which Mark and Beth applied several feedback control methodologies to stop nascent epileptic seizures (in a computer model of the cortex) in their tracks. This represents a significant advance over the current state of the art, wherein neuroscience researchers attempt to apply open loop Brain Electrical Stimulation (BES) to the cortex of affected rats to influence the course of seizures. We did this with careful theoretical development of the technique on a computer model that has been validated by comparison with patient data from UCSF. Other researchers just try things on an ad hoc basis. Our results were published in *Physical Review E*.

I rate this as an impressive accomplishment for a first-year graduate student. Beth was central to the collaboration because she brought the control theoretic ideas; without that we had nothing. She really has impressed me since with her ability to conceive of a problem, develop the tools and capabilities and collaborations necessary to make progress, and achieve her goal. These are all qualities of the most capable researchers. I realized then that she has a very bright future ahead of her. Since that time, Beth secured a **Graduate Research Fellowship from the National Science Foundation** to support her studies.

Beth continued with the feedback control work. She has gone on to develop a much-improved theory for what exactly leads to the electrical signal that is measured at an ECoG (electrocorticogram) electrode. She has greatly refined her computer simulations of the stochastic nonlinear mesoscale PDE model comprising 14 equations. And she has studied electrode design questions such as size and spacing to effect control. We published a paper on these matters to the *Journal of Computational Neuroscience*.

Beth also worked with me (and collaborators at UCSF and in New Zealand) to study the onset of epileptic seizures in sleeping subjects. We hypothesize that during sleep transitions, the cortex may be especially susceptible to the strongly nonlinear waves that characterize the kinds of seizures we study. In fact our mathematical model shows increased susceptibility to coherent wave-like dynamics at some sleep transitions. Beth applied a machine learning technique called LLE (locally linear embedding) to characterize clinical data from the UCSF Epilepsy Center to relate the clinical data to the mathematical model. What has emerged is a spectacular set of results that combine sleep staging of the clinical data (only in a much more refined sense) and places the sleeping patient at any point in time on the ‘sleep manifold’ in the cortical model. Hence we can have a correspondence between the two that allows for direct comparison, with subsequent study of mechanisms of seizure wave initiation, ramifications on feedback control, etc. It is clear that there is considerable value in such an innovative combination of research areas: control & dynamical systems theory, machine learning, and the neuroscience of sleep and epilepsy. We have published a paper on this in the *Journal of Computational Neuroscience*. Additionally, a research proposal to further advance this line of inquiry has been funded by the National Science Foundation; I am PI and Beth is a consultant on the project.

Summary and outlook

Beth is a very capable researcher who will take her opportunity and run with it—I am confident she will be successful in a faculty position at a major research university such as Brown. She is an excellent communicator who will function very well in the classroom, and also eventually in leadership positions in her profession. She is aware that she can be a role model for other women in subjects like engineering—or computational neuroscience; indeed, she has already shown her leadership in this area as co-president of GWE (Graduate Women in Engineering) at Berkeley.

My previous student in this area, Mark Kramer, graduated from Berkeley and went to Boston University for a post-doctoral appointment. He recently (2009) won a very prestigious Burroughs Wellcome Fund Career Award at the Scientific Interface1, for his work on "Population rhythms of epilepsy". He is now an Assistant Professor at BU. Another former student of mine, Hao Lin, has just (2009) won a PECASE award[2]. Two others (both women) hold faculty positions at USC, one of these won an NSF CAREER award in 2007 and was since granted tenure. I rate Beth as being in the same lofty category as these highly effective, very creative research students with whom it has been my privilege to work over the years.

If I can be of further assistance, please do not hesitate to contact me.

Sincerely,

Andrew J. Szeri,
Professor of Mechanical Engineering, and
Dean of the Graduate Division of UC Berkeley, and
Faculty Head of the Operational Excellence Program

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[1] These five-year awards provide $500,000 to bridge advanced postdoctoral training and the first three years of faculty service.

[2] Presidential Early Career Awards for Scientists and Engineers, the highest honor bestowed by the United States government on young professionals in the early stages of their independent research careers.

Short biography of Andrew J. Szeri:

Prof. Andrew J. Szeri received his Ph.D. in Theoretical and Applied Mechanics at Cornell University in 1988, as an Advisee of Prof. Philip Holmes. After post-doctoral appointments at Caltech and U.C. Santa Barbara with Prof. Stephen Wiggins and Prof. L. Gary Leal, he became Assistant then Associate Professor at U.C. Irvine in 1991. In 1997 Prof. Szeri joined U.C. Berkeley, and was promoted to Professor in 2003. He teaches in the areas of nonlinear dynamics and fluid mechanics. He is on the editorial boards of the Springer-Verlag *Journal of Nonlinear Science* and just completed a decade of service on the board of the *Journal of the Acoustical Society of America*. Prof. Szeri has won several research awards, including a National Science Foundation Graduate Fellowship, an Office of Naval Research Young Investigator award, and a Research Fellowship from the Alexander von Humboldt Foundation (Germany). He is a Fellow of the Acoustical Society of America. Prof. Szeri is the recipient of four teaching awards. Dr. Szeri's former research advisees have gone on to positions in academia, industry and government laboratories. In recent years, his advisees have won CAREER Awards from the National Science Foundation, a PECASE Award, and a Burroughs Wellcome Career Award at the Scientific Interface. He chaired the Graduate Council of Berkeley's Academic Senate from 2003-5, which is charged with making policy concerning graduate students. He has served since 2007 as Dean of the Graduate Division, a university-wide position with responsibility for Berkeley's 11000 graduate students, and 100+ graduate degree programs of great distinction. Since January of 2011, Prof. Szeri has served as faculty head of the Operational Excellence program at Berkeley, charged with making one-time investments of up to $75M in order to create operational improvements and efficiencies that save $75M per annum thereafter.