12/15/03

Biocomplexity Faculty Search Committee C/o Professor Rob de Ruyter van Steveninck
Biocomplexity Institute, Indiana University Swain Hall West 117
Bloomington, IN 47405-7105

Dear Professor van Steveninck:

I would like to apply for a position in the Biocomplexity Institute, with an appointment in the department of physics. I have a Ph.D. in physics. I am applying because of the focus of the institute in the fields of neuroscience, organogenesis, and biological networks. My research interests are in theoretical and computational biophysics, and in theoretical and experimental nonlinear dynamics.

In biophysics, my dissertation was on the development of retina in *Xenopus Laevis*, a South African frog. My studies were theoretical and computational. In the field of neuroscience, I am interested in nonlinear neuronal dynamics such as the diffusion of neurotransmitters/modulators, and the dynamics of phase cones that are produced by amplitude modulated patterns. I am also interested in the study of chaotic attractors in the brain, which has implications for learning and diseases, such as alcoholism and Alzheimer's.

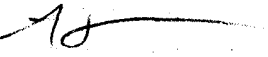
An area of nonlinear biophysics that I've recently ventured into is studies of the kidney. My ultimate goal is understand focal segmental glomerularsclerosis (FSG), a kidney disease that tends to strike African-Americans. To that end, I am working on modeling theories for the dynamics of mesoderm cells and morphogens in the pronephric kidneys of zebrafish. I intend to expand this to *Xenopus Laevis*. These studies have implications for nephron dynamics in humans. A goal is to deliberately invoke the disease in these vertebrates and so produce mutants. Because FSG involves scarring of the glomerular cells, a study of the dynamics and signaling mechanisms of the nephrons in these well and diseased creatures will lead to an understanding of the dynamics of the disease in humans. This research is by nature interdisciplinary, and of a necessity will include participation from a biologist, a nephrologist, and a chemist. I am in the process of writing a feasibility study on FSG that will be submitted to NIH in February. A further goal is kidney organogenesis, and research in this area will be greatly enhanced by studies in morphogenesis and stem cell dynamics.

In terms of chaos, I have recently completed preliminary work on a chaotic circuit that may be useful for nonlinear communications. I have also done preliminary work on chaotic vibrations in thin plates, in conjunction with a colleague at NASA, where this subject is of great interest. The goal is to control this behavior. I have undergraduate assistants in my laboratory. One of their research projects concerns the chaotic behavior of coin flips. The laboratory website lists a few of their other projects (http:// vergil.umd.edu). I have worked with undergraduate students since the inception of my research upon receipt of my Ph.D.. It is my intention to continue this practice, along with an expansion to include graduate students and postdoctoral assistants. My research includes an outreach program to interested K-12 teachers, and this will also be continued. A current outreach program includes a Physics Education Information Technology conference, which I am planning with two public high school teachers.

Teaching is a function vital to colleges and universities. Professors exist because of students. Physics is a difficult subject to convey, especially to non-physics majors. To that end, an essential part of my pedagogy is the integration of information technology along with traditional methods of teaching physics. For example, I use the web extensively to demonstrate concepts to pre-med students. Physics majors regularly use software such as Mathematica and Matlab to write programs that solve specific homework problems.

I believe my research interests, combined with my consideration for students will allow me to make a positive contribution to the program at Indiana University Bloomington. Thank you for your consideration.

Sincerely,



Crystal Cooper, Ph.D.