Biophysics of Synchronization and Chaos

This research will be conducted at College of Charleston (CofC) with faculty mentor Dr. Sorinel A. Oprisan. CofC is located in Charleston, South Carolina.

Research Description: Undergraduate students working in this computational biophysics/neuroscience lab contributed to the analysis of electrical activity of neural cells and implementation of computer models that mimic biological neural networks. The REU student can select to contribute to one of the two collaborative projects we pursue together with the Medical University of South Carolina (MUSC): 1) analysis of frontal cortex recordings from mice under different pharmacological treatments, or 2) analysis of electroencephalogram (EEG) recordings from humans. The computational lab has also research-level ECG/EEG recording capabilities for in-house designed experiments. The goal of both projects is to develop new computational tools for pattern recognition from biomedical data recordings. The first project focuses on cell- and network-level modeling with the purpose of detecting and quantifying the changes in neural activity at cell level coupled with long-term network-level modifications induced by pharmacological treatments. The second project focuses on analyzing multichannel recordings EEG with the purpose of identifying abnormal cerebral activity. Both projects are highly interdisciplinary and will expose the student to a broad range of topics from cell biology to physical principles of electricity transport, to mathematical modeling and computer simulations of biological processes.

Student Involvement, Expectations, and Deliverables: With faculty guidance both from CofC and MUSC, the students in our computational biophysics laboratory will learn (1) how to use existing computational tools, and (2) how to write computer code to perform data analysis. Students will have the opportunity to work alongside with clinicians and researchers and apply computational techniques from nonlinear dynamics & chaos, and signal & image processing with biomedical applications. The student will be responsible for all aspects of the studies conducted on the experimental data, handling clinical data, background literature review, data annotation and analysis. The student is also responsible for disseminating the research by preparing and giving an oral/poster presentation, a written report, and contributing to publishable manuscripts. The student will participate with all the other summer research students from CofC biomedical.

Peer Collaborators and Summer Activities: The REU student will live on the CofC campus, working and collaborating with 1 to 3 other undergraduates that typically work in the computational biophysics laboratory each summer. The REU student will join CofC students participating in existing summer research programs such as Summer Undergraduate Research with Faculty and HHMI Undergraduate Science Education. Combined, these programs consist of approximately 50 students and 30 faculty mentors. These summer research programs also integrate a Biomedical Research Skills seminar that meets each week (usually Friday at noon). Dr. Agnes Ayme-Southgate coordinates the seminar. The topics include basic lab safety training, responsible conduct of research, biomedical ethics, preparing a poster/talk presentation, and invited lectures from different schools in the area.