

Mathematical Modeling of Aesthetics

Eric A. Nauman

Recent work in nonlinear dynamics has proposed methods that allow one to estimate the dynamic response of complicated systems by analyzing just a few output variables. To put these methods to the test, we would like to analyze eye movements of subjects viewing works of art. Our hope is that this information will provide some insight into the process of art appreciation, otherwise known as aesthetics.

Predicting Success in Professional Sports

Eric A. Nauman

How do you relate athletic performance at the collegiate level to long-term success at the professional level? Are there factors other than peak speed and maximum bench press that predict success? – perhaps GPA? Can you even define success objectively? These are a few of the questions that we would like to address. A lot of the students' time will be spent thinking about myriad possibilities, performing large-scale statistical analyses, and then looking for new possibilities.

Computational Neuroscience

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Modeling and control of chaotic systems with applications to seizure prevention and weather control: Many physical systems exhibit an extreme sensitivity to their initial conditions often leading to chaotic behavior. In general, engineers try to avoid such systems, but it has been suggested that highly adaptive dynamic systems such as global weather patterns and the human brain benefit from such sensitivity. Furthermore, it may be possible to exploit the chaotic dynamics of these systems to produce a desired response. Ott, Grebogi, and Yorke first developed a technique for estimating the underlying dynamics of complex systems, transforming that information into a useful format, and using it to control the system's response. The goal of this project is two-fold. First, the student will develop a simulation a group of neurons in MATLAB and characterize their behavior for a given stimulus. Second, the student will implement the Ott-Grebogi-Yorke control algorithm and determine it's potential for seizure prevention.