Kempner Colloquium

Graph theory, nonlinear networks and emotional responses

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Many natural systems, including the brain, are organized as dynamic networks, with nodes interacting in a time-dependent fashion. The way in which various parts of the brain (from the micro-scale of neurons to the macro-scale of functional regions) are wired together is one of the great scientific challenges of the 21st century, currently being addressed by large-scale research collaborations, such as the *Human Connectome Project*. The aim of our own research is to understand in particular the relationship between a networks hardwired circuitry and its dynamics.

Key factors for optimal (critical) dynamics in a network of neural nodes are a combination of a well-balanced adjacency scheme together with well-tuned connection strengths between nodes. We investigate whether small perturbations in edge density or geometry can produce large effects in the systems phase space dynamics, or if phenomena like phase transitions (bifurcations) are robust to either of such changes. We finally illustrate, (using imaging results from 97 human subjects with a wide range of emotional responses) how such properties can be useful as biomarkers for different emotional profiles, or neuropsychiatric conditions.

Monday December 9, 2013
4:00 p.m.
MATH 350