CoCo Seminar Series
Spring 2014

[MS Thesis Defense]

Robustness of Complex Networks to Global Perturbations

Sam Heiserman
MS candidate, Systems Science
Binghamton University

Wednesday April 23rd, 2014
8:30-9:30am
Biotechnology Building BI 2221 (ITC Conference Room)

This thesis studies the robustness of complex dynamical networks with *non-trivial topologies* against *global perturbations*, following Robert May's seminal work on network stability, in order to find critical stability thresholds of global perturbations and to determine if their impact varies across different network topologies. Numerical analysis is used as the primary research method. Dynamical networks are randomly generated in the form of a coefficient matrix of stable linear differential equations. The networks are then inflicted with global perturbation (i.e., addition of another random matrix with varying magnitudes) and their stabilities are tested for each perturbation magnitude, to determine at what scale of global perturbation they are jarred to instability. The results show a monotonic decrease of the instability threshold over increasing link density for all network topologies. For a given link density, Erdos-Renyi random networks show highest robustness against global perturbation, closely followed by Watts-Strogatz small-world networks, and then Barabasi-Albert scale-free networks are least robust among the three topologies tested. Fully connected networks used in May's original work are found to be consistently unstable in the presence of global perturbation of any magnitude. Implications for sustainability of real-world complex networks are discussed.

Sam Heiserman is a MS candidate in Systems Science at Binghamton University. His research interests include complex systems and networks, stability and sustainability of social/ecological/economical systems.

For more information, contact Hiroki Sayama (sayama@binghamton.edu)
http://coco.binghamton.edu/