Eugene Wigner Colloquium

joint event of GRK 1558 and SFB 910

Dr. Sean Cornelius

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"Cascades, compensatory perturbations, and control in complex networks"

Genetic disease. Power grid blackouts. Ecosystem collapse. These are just a few dramatic examples of cascading failures in networks, in which perturbations to one node spread to other nodes, causing the entire system to change behavior. Intervening to mitigate these failures is of considerable interest to engineers and policymakers, but this is complicated by the fact that in networks, it is generally unclear which local modifications will produce a desired global outcome. Here, I will show how the adverse effects of perturbations in networks can be counteracted with the deliberate use of additional, compensatory perturbations. This strategy is based on exploiting the nonlinear dynamics inherent to real systems, and allows bringing a general dynamical system to a desired target state even when this state is not directly accessible due to constraints that limit the allowed interventions. Applications show that this framework permits both reprogramming a network to a desired task as well as rescuing networks from the brink of failure, which I will illustrate through the mitigation of cascading failures in a power-grid network and the identification of potential drug targets in a signaling network of human cancer.

Thursday, 16.10.14 · 16:15h · EW 202

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