Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Bimodality in Network Control TAO JIA, YANG-YU LIU, MARTON POSFAI, Center for Complex Network Research and Department of Physics, Northeastern University, JEAN-JACQUES SLOTINE, Non-linear Systems Laboratory, Massachusetts Institute of Technology, ALBERT-LASZLO BARABASI, Center for Complex Network Research and Department of Physics, Northeastern University — Controlling complex systems is a fundamental challenge of network science. Recent tools enable us to identify the minimum driver nodes, from which we can control a system. They also indicate a multiplicity of minimum driver node sets (MDS's): multiple combinations of the same number of nodes can achieve control over the system. This multiplicity allows us to classify individual nodes as critical if they are involved in all control configurations, intermittent if they occasionally act as driver nodes and redundant if they do not play any role in control. We develop computational and analytical framework analyzing nodes in each category in both model and real networks. We find that networks with identical degree distribution can be in two distinct control modes, "centralized" or "distributed", with drastic change on the role of each node in maintaining the controllability and orders of magnitude difference in the number of MDS's. In analyzing both model and real networks, we find that the two modes can be inferred directly from the network's degree distribution. Finally we show that the two control modes can be switched by small structural perturbations, leading to potential applications of control theory in real systems.

Tao Jia
Center for Complex Network Research and Department of Physics,
Northeastern University

Date submitted: 28 Nov 2012 Electronic form version 1.4