

MAR11-2010-003021

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Robustness of Interdependent Networks

SHLOMO HAVLIN, Bar-Ilan University

In interdependent networks, when nodes in one network fail, they cause dependent nodes in other networks to also fail. This may happen recursively and can lead to a cascade of failures. In fact, a failure of a very small fraction of nodes in one network may lead to the complete fragmentation of a system of many interdependent networks. We will present a framework for understanding the robustness of interacting networks subject to such cascading failures and provide a basic analytic approach that may be useful in future studies. We present exact analytical solutions for the critical fraction of nodes that upon removal will lead to a failure cascade and to a complete fragmentation of two interdependent networks in a first order transition [1]. Surprisingly, analyzing complex systems as a set of interdependent networks may alter a basic assumption that network theory has relied on: while for a single network a broader degree distribution of the network nodes results in the network being more robust to random failures, for interdependent networks, the broader the distribution is, the more vulnerable the networks become to random failure. We also show [2] that reducing the coupling between the networks leads to a change from a first order percolation phase transition to a second order percolation transition at a critical point. These findings pose a significant challenge to the future design of robust networks that need to consider the unique properties of interdependent networks.

[1] S. Buldyrev, R. Parshani, G. Paul, H.E. Stanley, S. Havlin, *Nature*, 465, 0893 (2010)

[2] R. Parshani, S. Buldyrev, S. Havlin, *PRL*, 105, 048701 (2010)