

From Single Network to Networks of Networks

Shlomo Havlin
Bar-Ilan University

Abstract:

Network science has been focused on the properties of a single isolated network that does not interact or depends on other networks. I will present several applications of networks in physiology, traffic, climate, and epidemics. In reality, many real networks, such as power grid, protein networks, transportation, and communication infrastructures interact and depend on each other. I will present a framework for studying the vulnerability of networks of interacting networks. In interdependent networks, when nodes in one network fail, they cause dependent nodes in other networks to also fail. This may lead to a cascade of failures and to a sudden fragmentation of the system. I will present analytical solutions for the critical threshold and the giant component of a network of n interdependent networks. I will show, that the general theory has many novel features that are not present in the classical network theory. I will also show that interdependent networks embedded in space are significantly more vulnerable compared to random networks.

References:

- [1] S. Buldyrev, R. Parshani, G. Paul, H.E. Stanley, S. Havlin, *Nature*, 465, 0893 (2010)
- [2] J. Gao, S. Buldyrev, H. E. Stanley, S. Havlin, *Nature Physics*, 8, 40 (2012)
- [3] A Majdandzic et al, *Nature Physics* 10 (1), 34 (2014); *Nature Comm.* 7, 10850 (2016)
- [4] Daqing Li et al, *PNAS* 112, 669 (2015)
- [5] M. Danziger et al, *Nature Physics*, 15, 178 (2019)