

# Cascading Failures and Recovery in Interacting Networks

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A framework for studying the vulnerability and the recovery of networks of interdependent networks will be presented. In interdependent networks, when nodes in one network fail, they cause dependent nodes in other networks to also fail. This is also the case when some nodes like certain locations play a role in two networks --multiplex. This may happen recursively and can lead to a cascade of failures and to a sudden fragmentation of the system.

I will present analytical solutions for the critical thresholds and the giant component of a network of  $n$  interdependent networks. I will present examples of applying our model to real financial interacting networks and show that all model parameters are experimentally accessible.

I will also show, that the general theory has many novel features that are not present in the classical network theory. When recovery of components is possible, global spontaneous recovery of the networks and hysteresis phenomena occur and the theory suggests an optimal repairing strategy for a system of systems.

I will also show that interdependent networks embedded in space are significantly more vulnerable compared to non-embedded networks. In particular, small localized attacks of zero fraction may lead to cascading failures and catastrophic consequences. Thus, analyzing real data and realistic models of network of networks is highly required to understand the system vulnerability.

## References:

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