Switching without Switches and the Fragility of Interdependency, with Applications to Failure Cascades in Finance and in Medicine

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Abstract

Recent disasters ranging from abrupt financial "flash crashes" and large-scale power outages to sudden death among the elderly dramatically exemplify the fact that the most dangerous vulnerability is hiding in the many interdependencies among different networks. In the past year, we have quantified failures in interconnected networks, and demonstrated the need to consider mutually dependent network properties in designing resilient systems. Specifically, we have uncovered new laws governing the nature of switching phenomena in coupled networks, and found that phenomena that are continuous "second order" phase transitions in isolated networks become discontinuous abrupt "first order" transitions in interdependent networks. We discuss the network basis for understanding sudden death in the elderly, and the possibility that financial ``flash crashes'' are not unlike the catastrophic first-order failure (and almost-instant recovery) incidents occurring in coupled networks [1,2].

References

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