

How Can Complex System Feedbacks Shape Cascading Failure Blackout Risk Towards Criticality?

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Abstract:

What is the risk of large blackouts such as the spectacular cascading blackout in August 2003 that cut electrical power to 50 million North Americans? Historical data show that large blackouts, although rare, occur more frequently than expected. Indeed the empirical probability distribution of blackout sizes shows a power law similar to that observed in other complex systems near criticality. Large blackouts are usually caused by a sequence of cascading failures in which dependent failures successively weaken the power network. We discuss criticality and power laws in probabilistic and power network simulation models of cascading failure. Why would a power network be designed and operated near a critical loading? We propose that economic and engineering feedbacks could slowly self-organize the power network to be operated near criticality. That is, engineered power networks may evolve towards power law probability distributions of blackout size. Different engineering policies for mitigating cascading blackouts give different feedbacks and different outcomes for a new long-term risk analysis. This research is joint work with Ben Carreras (BACV solutions, Oak Ridge TN), David Newman (University of Alaska-Fairbanks), and Hui Ren (North China Electric Power University).

About the Speaker:

Ian Dobson was educated at Cambridge and Cornell, worked as a systems analyst in British industry, and is currently professor of electrical and computer engineering at the University of Wisconsin-Madison. He has applied nonlinear dynamics and bifurcations to help explain and avoid instabilities of electric power systems. He is currently interested in cascading failure and complex systems aspects of blackout risk.
