## Predicting failure in power grids

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The stability of the power generations and supply networks, much like other large infrastructures, depends on the collective well functioning of its individual elements. In other words, a major power failure or outage has its root in preceding, apparently unrelated, failure events. In this work we ask whether it is possible to predict the susceptibility of power grid networks by monitoring these precursory signals.

The main objective of our work is to analyze the statistical trends in the power outage data and devise a risk assessment map for future outages.

Statistical regularities in the response of driven disordered system, of which a power grid is an example, are already well known (see Ref.[1] for a review). A more recent discovery is the departures from those regularities, such as the lowering of the exponent value in the Gutenberg Richter law for earthquakes magnitude size distributions, prior to large events [2]. Monitoring the amount of departures of the exponent from the regular values in the case of earthquake has led to construction of a heat map of risk for major earthquakes.

For power grids, extensive data for outages for the US and the EU countries have shown GR law like tendencies. A preliminary analysis show similar lowering of exponent values for power grid outage statistics during the time of the day when outages are more likely. Therefore, our aim is to evaluate the risk of power outages at different times and places by monitoring the changes in the outage statistics at those times and places. In contrast with earthquakes, in power grids a risk map is not only a predictive tool, but more importantly can be used for prevention of major failures by suitable mitigation strategies. This work is particularly relevant in view of the current design and large scale upgrades of the grids and its proposed integration to a super grid in the future [3]. Large outages are extreme event phenomena that have a higher chance of occurring as the system size grows. A suitable extrapolation of risk from a mathematical modeling of statistical data is, therefore, crucial.

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