Master's Thesis
"Cacading failures and blackouts in power networks"

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January 11, 2016

Electrical power systems are critical infrastructures that support our economy and social structure. Citizens common lives are supported by electricity: urban transportation systems, heating and cooling systems, computer systems, factories, communication systems, hospitals...etc. The increase of renewable energy and electricity demand could increment the probability of large blackouts in the future. Nowadays it is impossible to measure the real cost of big blackouts, however, we know that the economic impact is huge. Think about how could living without electricity for a single day be. Thus, it is necessary to prevent blackouts and improve power grids.

The study of networks tries to simplify the complexity of grids based on their parameters. Metrics tries to measure different network characteristics. Not all the metrics unfold important behavior in power grids. On the other hand, there are models that can describe power grid blackouts behavior. Usually calculation of metrics is preferred compared to simulations, however, those metrics need to be accurate in order to substitute simulations.

Particularly, with regard to power grids, blackouts are complex breaking processes that depend on several interrelated characteristics of the networks. In this work we compare different models that simplify blackouts to branch breaking processes. In our case we use the "simplified improved OPA model" in order to obtain simulated blackout results. After that, the results are compared with the information obtained in metrics. The important parameters that need to be measured by metrics are the most critical transmission lines in power grids that could unfold a blackout. Based on the results we can say that the "electrical betweenness" and "net-ability" metrics have good results seeking this critical branches. The "effective resistance" metric does not work as it is required.

In summary, we can say that it is necessary to improve metrics. Using other measured characteristics on the grids these metrics could work better and easily explain grids weakness and strengths. The nominal power flow in each line

and the probability of cutting a single transmission line could be used for this purpose. These metrics could also be used in other network areas.