Complex Networks Project Proposal

Modelling power grid network

Mateusz Iwo Dubaniowski*[[1]](#footnote-1)*

PhD Researcher

Future Resilient Systems – Singapore-ETH Centre

31 January 2016

The aim of this document is to propose the project and initially plan the work to be carried out as a part of the Complex Networks (CN) course. The project to be completed as a part of the course will incorporate the complex networks framework described throughout the course and implement Python *numpy*’s library implementation of the complex networks concepts to develop and visualize the solution.

**The problem**

Electrical grids consist of various elements such as power stations, transformation stations, substations and transmission lines. These elements of the power grid can be potentially an object of a hostile attact or critical failure due to various factors. These factors include atmospheric conditions, external power gird network influences, or systemic failures. Such failures can have significant consequences to the overall power grid of a country. An example of such failure would be a failure around Orchard Road in Singapore on the 13th of December 2015. This failure had a negative impact on the economy in the area forcing several shops to close early. Through developing simulation that navigates the most critical aspects of the network, we will be able to devise a contingency plan for such failures as well as attempt to focus on mitigating such risks.

**The Task**

We aim to develop a simulation of response of the power grid supply system to failures or downgrades in the system. This will include devising a network of electrical supply grid elements. Such network will be developed with the use of *numpy* library. We will emulate transmission lines by assigning a capacity to each transmission line. This would allow us to see how impact of a node outage propagates to other elements of the network. And, subsequently, what impact it has for the overall system.

**The Solution**

To implement the network and solve the issue we will implement the following strategy. We will use the avaialable power network of the US. We will asign a capacity to each edge of the network to represent its capacity. Subsequently, we will devise a maximum amount of electricty produced or consumed by each node. We will subsequently remove nodes from the network and decrease capacities, and see how it impacts the system. This would allow us to infer how the power grid network behaves under such conditions. Such implementation would also allow us to present understanding of the Complex Networks topic at a level required for this course.

1. iwo.dubaniowski@frs.ethz.ch [↑](#footnote-ref-1)