In this seminar, we describe the robustness assessment of power systems from a network perspective. Since the power grid is an electrical network by nature, it can be fully and accurately described by circuit laws. Based on Kirchhoff's laws and the properties of network elements, and combining with a complex network structure, we propose a model that generates power flow information given the electricity consumption and generation information. It has been widely known that large scale blackouts are results of a series of cascading failures triggered by the malfunctioning of specific critical components. Power systems can be more robust if there are fewer such critical components or the network configuration is suitably designed. The percentage of unserved nodes (PUN) caused by a failed component and the percentage of non-critical links (PNL) that will not cause severe damage are used to provide quantitative indication of a power system's robustness. We assess robustness of the IEEE 118 Bus, Northern European Grid and some synthesized networks. The influence of network structure and location of generators are explored. Simulation results show that small-world connection can significantly reduce a power system's robustness, and that with the same structure and equal percentage of generators, the system with lower generator resistance has better robustness with a given network structure. We also propose a new metric based on node-generator distance (DG) for measuring the degree of decentralization of generators in a power network which is shown to affect robustness significantly.

About the Speaker

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