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Next generation of transmission grid control centers

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RTE

Abstract:

The massive integration of generating units based on renewable energy sources (RES) with nearly zero marginal costs and mostly connected through power electronics to the grid imposes us to rethink how to protect, control and optimize power systems. The low controllability of RES generating power pushes to envision solutions based on storage devices and demand responses in order to balance the system. These evolutions are disruptive, historical design assumptions are becoming obsolete: No electrical storage, inflexible demand. There is an urgent need to rethink both economics and dynamics of power systems. Patches to adapt marginally the historical design are perhaps not a good approach even if the migration path is a critical issue. In this presentation, we focus on how to operate such a hybrid complex system (Cyber-Physical System of Systems) which more and more distributed controls. In RTE, we anticipate what could be the next generation of transmission grid control centers in this context. Our project Apogée envisions to develop the appropriate tools in order to introduce a grid navigation mode, as an analogy with airline pilots: real time grid responses under constraints will occur automatically leaving enough time for the dispatchers to anticipate future grid's behavior and constraints, hence defining a grid operation plan upfront that will minimize the risks and the cost of operation in real time. To fulfill that ambition, we need to learn about our grid's behavior under a given context in order to search and select automatically appropriate responses. Machine Learning and in particular deep learning and reinforcement learning offer new possibilities which are explored in this project. One of the key ideas is "imitation", a learning machine (e.g. a deep learning system [1]) learns to imitate the decisions of human operators

Reference:

[1] Yann LeCun, Yoshua Bengio, Geoffrey Hinton. Deep learning. Nature 521, 436–444. May 2015.