Task Force Description

Title

Application of Big Data Analytic on Transmission System Dynamic Security Assessment

Period of Time

36 months (2020, 2021 & 2022)

Contribution to the existing activities

The subcommittee brings together leaders from different disciplines and domains and meet them regularly through a wide range of communication channels to define new challenges and opportunities arising by the emerging big data in modern energy grids.

As result of the collective efforts of this group, the Subcommittee promotes activities such as panel sessions during IEEE PES conferences and support interdisciplinary collaborations like the ongoing working group on Big Data Access and the currently existing Task Forces: Big Data Webinar Series and Big Data Applications in Power Distribution Systems.

However, despite the success and interest from the international community on the activities supported by this Subcommittee, there is gap of work related to challenges arising from the extra high voltage level. As highlighted during the last Subcommittee meeting in Atlanta 2019 there is a shared interest on creating a new group developing technical and regulatory solutions for transmission systems. The present document summarize the mission and scope of the proposed TF group as well as the concrete end products/results and activities.

Mission and Scope

- Achieve transfer of knowledge between different scientific communities to solve challenging power system problems and bridge the gap between these communities.
- Evaluate how innovative algorithms could be used in the control room of power system operators to facilitate the decision making and to find stability margins in order to guarantee a secure operation.
- Enhance the value of available data in control rooms, quickly, easily and precise.
- Development of offline/online tools for parameter validation in control rooms.
- Provide a high quality report with a compilation of data mining, artificial intelligence and machine learning applications for the secure operation of transmission systems.

Technical Needs

The energy demand is continuously growing as result of a more digital and technological society. Moreover, energy transitions worldwide are pushing towards more sustainable societies demanding the maximization of carbon-free power plants integration and minimization of nuclear and carbon based energy technology. Such is the case in Europe, where up to 75% of the total demand is envisaged to be cover by renewable energy production by 2040.

These aggressive measures to fulfil the demand mostly using clean energy sources involve technical and economic challenges such as dependency on cross border exchange, the reinforcement of the existing transmission capacity and the need of flexibility by means of creating new interconnections with border countries. These however, will result in a more vulnerable transmission system, which needs to operate closer to their boundary conditions and hence is becoming more difficult to operate in real time.

Additionally, power systems are rapidly evolving towards low-inertia networks and system operators are facing new challenges associated to the dramatic increase of inverter-connected devices that, as such, do not provide any inertia to filter dynamics originated by power system disturbances. In the so-formed inverter-dominated power grids, phenomena that used to be exceptional in traditional networks, such as large frequency modulations, rapid (i.e., sub-second) large frequency variations or sudden amplitude steps, are more likely to be experienced, and have been identified and documented by systems' operators.

Consequently, utilities require higher degree of observability in the network in order to improve the decision making and situational awareness of the transmission system. Introduction of measuring devices such as syncrophasor technology have allowed system operators to monitor variables such as frequency, voltages and currents at very fast sampling rates (50 samples/sec) from remote locations in real time and at the same time have introduced the possibility to have new control variables for improving the stability of the system. However, new challenges are arising as result of the growing data available to monitor the security of the power system. Like is the case for syncrophasor data, requiring several GB of local storage per device in relatively short periods of time.

Under this context, big data analytic (data mining, artificial intelligence and machine learning) unfold new opportunities to develop sophisticated online and offline dynamic security assessment tools, particularly in bulk power systems where transmission system operators are struggling to cope with expanding data flows and computational demands.

End-Products [D] and Activities [A]

- [A1] TF physical meetings during the PES GM 2020, 2021 and 2022.
- [A2] Virtual Meetings, at least two per year (Autumn & Spring).
- [A3] International Workshop in ZHAW, Switzerland, 2020.
- [A4] Organization of one panel session in one IEEE PES Conference in 2021, such as IEEE ISGT Europe or IEEE SGSMA.
- [A5] International Workshop in Tianjin University, China, 2021.

- [D1] Report 1: "Data handling on transmission systems: A survey of needs for transmission utilities to understand they current issues related with continuous grow of data in control rooms". [end 2020]
- [D2] TF Special Issue: on international Journal, announced before the end of 2021.
- [D3] Report 2: "Compilation of data mining, artificial intelligence and machine learning applications to enhance the value of data in control rooms". [by PESGM2021]
- [D4] Report 3 (Final): "Demonstration of application of data mining, artificial intelligence and machine learning algorithms to maintain the security operation of transmission systems", IEEE Transactions, [by PESGM2022]

TF Leadership and Core Members

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