

**Research Topic for the ParisTech/CSC PhD Program**  
**(one page maximum)**

**Subfield:** Electrical engineering, applied mathematics, smart grid

**ParisTech School:** MINES-Paristech

**Title:** Big data based forecasts for the electric power system

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**Short description of possible research topics for a PhD:**

**Context:** This research is based on the following considerations: 1) Forecasts for electricity demand, production from renewables or electricity prices are used as decision making support by power system's actors. 2) These parameters are in part correlated and can be forecast with the help of the same data, for example: weather forecasts, production and consumption measurements, satellite images, traffic information, news; it is then possible to exploit these correlations in order to increase the accuracy of the forecasts. 3) Increasing the size of data sources and the complexity of the models results in an increase of the cost but also in the necessity of identifying and developing adequate numerical methods in order to face problems such as the overfitting.

**Objectives:** The scientific objectives of this research are: A) to develop forecast models for the state of the electric power system (production and consumption in all nodes or regions and prices in the different markets). Particular attention will be given to the forecast of extreme values and of rare events. B) To study the resilience of the models developed respect to the overfitting and to the presence of missing data or outliers. C) To compare the performance of the models developed with the state of the art and to evaluate the relative importance of the datasets used.

**Methodology:** The research will be organized according to the following plan: i) A preparation phase characterized by a bibliographic research, the appropriation by the student of the necessary tools and the research of the available databases. The data used will be open data (eg: data made public by regulated utilities), data available for research (eg: weather forecast and measurements) and data provided by partners of MINES-ParisTech within the framework of bilateral agreements. ii) A second phase regarding the development of the forecast models (point A). iii) A third phase for the evaluation of the models.

**Required background of the student:** Applied mathematics, informatics, machine learning

**A list of 5 (max.) representative publications of the group:**

1. Andrea Michiorri, Huu-Minh Nguyen, et al., "Forecasting for dynamic line rating", Renewable and Sustainable Energy Reviews, 2015/12/31, Vol 52, pp 1713-1730
2. Andrea Michiorri, Philip C Taylor, "Forecasting real-time ratings for electricity distribution networks using weather forecast data", Electricity Distribution-Part 1, 2009. CIRED 2009. 20th International Conference and Exhibition on
3. Arthur Bossavy, Robin Girard, Andrea Michiorri, Georges Kariniotakis, "The impact of available data history on the performance of photovoltaic generation

- forecasting models”, Electricity Distribution (CIRED 2013), 22nd International Conference and Exhibition on
4. Romain Dupin, Andrea Michiorri, Georges Kariniotakis, “Dynamic Line Rating Forecasting and Evaluation”, EWEA Technology Workshop, Wind Power Forecasting 2015