Research Internship at RTE

Graph Neural Networks for Power Systems Control

Location : La Défense, France[1]
Duration : 6 months between February 1st 2021 and October 31st 2021
Additional informations : This internship can be followed by a PhD program at the Liège University, supervised by Pr. Louis Wehenkel.
Contact : *balthazar.donon@rte-france.com*

Profile and skills sought :

- Master of Science in artificial intelligence / machine learning.
- Theoretical and experimental knowledge of AI and Deep Learning.
- Experience with Python and a Deep Learning framework (TensorFlow / PyTorch).
- General knowledge in Physics and Mathematics.
- We are looking for someone curious and attracted to scientific research.

About us

RTE is in charge of managing the high and extra-high voltage power transportation network. Providing services of general interest, RTE has to make sure that the French Power Grid works properly while remaining in security, in a market open to competition. In this context, RTE operates and maintains the French power transmission grid, which is the largest in Europe (105 000 km of transmission lines and 47 cross-border interconnections). RTE is a forward-looking company at the heart of the current energy transition. Its 8300 employees work to make RTE an innovative and efficient company in the field of electricity transmission.

As an intern, you will be part of the Research and Development department of RTE. Its main activities concern the conduct of prospective studies, the providing of power grids operation and the development of operation tools. This department is involved in many international re- search partnerships.

Internship subject

Nowadays, climate change is recognized as a major threat to our modern societies. Thus, mas- sive investments have been made in the past few decades to push toward renewable energies integration. However, unlike thermal and nuclear power, those sources of energy have the inconvenient of being intermittent and hard to predict. This profound transformation of the energy ecosystem, coupled with new market mechanisms close to real-time, creates an increas- ing uncertainty with regards to actual power flows through the transportation network. Antici- pating and preventing overflows is thus becoming more and more complicated.

RTE is in charge of ensuring that the French transmission power grid remains in security at all times and everywhere, and of preventing any power outage that could lead to a major European blackout. Such a possibility is not acceptable in any way. In order to help the people that operate in real-time the power grid (called « dispatchers »), RTE is starting to take an interest in the latest breakthrough in artificial intelligence. The long-term goal is to design an AI assistant perfectly fitted for Power Grids despite their intrinsic complexity, in order to provide dispatch- ers with real-time recommendations. Unlike most data types encountered in statistical learning (pictures, sounds, etc.), data encountered in

[1] *As a result of the current COVID-19 pandemic, this internship is likely to take place mostly through remote work.*

Power Systems is quite atypical: The graphical structure is explicit, and it obeys physical laws that are perfectly described by a thorough mathematical formalism.

Thus, a recent line of work pursued by the APOGEE team is trying to exploit this peculiarity by teaching Graph Neural Networks to solve complex optimization problems on Power Grids. The experimental success of some preliminary investigations demonstrated the viability of the approach in very simple settings (no time component, no uncertainties, continuous variables) and on artificial data.

After becoming acquainted with the main concepts and existing code, you will take part in the development of this novel approach. Depending on the internship progress and on your own personal interests, you will contribute to enhance the approach in order to include time and uncertainties, and/or improve the theoretical foundations of the approach. This line of work is an essential step towards the development of a novel AI method designed for graph-based industrial systems such as Power Systems. This internship will eventually be followed by a PhD.