Reinforcement Learning for Congestion Management

Keywords: Balancing, Reinforcement Learning (RL), Generator Dispatch, Curtailment

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Project description
The combined effect of increasing intermittent renewable generation and move of electricity markets towards shorter clearing interval poses a challenge for transmission system operators (TSOs), as the added volatility can create unforeseen situations and compromise security. Congestion management, the process of manually adjusting the way the grid operates and sometimes the market outcome in order to ensure secure operation is becoming more challenging as a result of the increased complexity.

In this project, you will investigate the feasibility of training a reinforcement learning agent to provide decision support for the system operators working in the control room. The agent will train in a simulated grid, with the goal of performing redispatch and curtailment of renewable generation in order to ensure secure operation.

As a part of the project, we will provide necessary components to get started, including several implementations of reinforcement learning agents. An important task will be to integrate these agents with Grid2Op, an RL library designed for power system operations, including converting observations (e.g. voltage measurements) into a format that the agent can work with, and conversely convert the agent output into a format that is interpretable by the environment.

Objective:
Train an agent that is able to perform efficient redispatching and curtailment to provide secure grid operation.

References:
Reflection on winners of the L2RPN competition: Marot, Antoine, et al. "Learning to run a power network challenge: a retrospective analysis." NeurIPS 2020 Competition and Demonstration Track. PMLR, 2021. Available: https://proceedings.mlr.press/v133/marot21a.html
Article where Discrete Q Network was first introduced: “Playing atari with deep reinforcement learning,” V. Mnih, K. Kavukcuoglu, D. Silver, A. Graves, I. Antonoglou, D. Wierstra, and M. Riedmiller, 2013. [Online]. Available: https://arxiv.org/abs/1312.5602
Article where Deep Deterministic Policy Gradient (DDPG) was first introduced: “Deterministic policy gradient algorithms,” D. Silver, G. Lever, N. Heess, T. Degris, D. Wierstra, and M. Riedmiller, in International conference on machine learning. Pmlr, 2014, pp. 387–395
Previous working using PPO in Grid2Op: “Safe Deep Reinforcement Learning for Power System Operation under Scheduled Unavailability” X. Weiss, S. Mohammadi, P. Khanna, M.R.Hesamzadeh, L. Nordström. IEEE Power & Energy Society General Meeting (PESGM) 2023. doi: 10.1109/PESGM52003.2023.10252619

Useful data-sets:
The time series needed for running simulations with Grid2Op are automatically generated or downloaded when instantiating a simulation for the first time – you will not need any additional data. ,