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”Explainable” neural networks to model electricity consumption in a decentralised grid

This presentation explores the application of innovative deep learning architectures to enhance electricity demand forecasting in decentralised grid systems, with a focus on the French energy market. Generalised Additive Models (GAMs), which are state of the art methods for electricity load forecasting, struggle with spatial dependencies and high-dimensional interactions inherent in modern grids. To address these gaps, we propose complementary deep learning frameworks: Graph Neural Networks (GNNs) for modeling spatial hierarchies across regions, multi-resolution Convolutional Neural Networks (CNNs) for integrating heterogeneous temporal data, and meta-learning techniques like the DRAGON framework to optimize neural architectures automatically. A case study forecasts 2022 French national electricity load at three hierarchical levels—national, regional (12 regions), and city (12 cities)—using a composite loss function (RMSE) and open datasets from RTE and Météo France. Despite their expressive power and strong performance, interpreting these models remains a challenge and a priority for electricity market stakeholders. While it is not the central focus of this work, we will outline some perspectives and general ideas that may contribute to a better understanding of these models.

Special/ Invited session

Explainability_FR

Classification

Mainly application

Keywords

Electricity demand forecasting, Graph Neural Networks, Generalised Additive Models, hybrid models, meta-learning.

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Track Classification: Explainability (by FR)