

École Nationale Supérieure d'Informatique et d'Analyse des Systèmes
Centre d'Études Doctorales en Sciences des Technologies de l'Information et de l'Ingénieur

AVIS DE SOUTENANCE DE THÈSE DE DOCTORAT

Madame Hanaa TALEI

Soutiendra publiquement sa thèse de Doctorat en Informatique

Le Mercredi 18 Janvier 2023 à 15H00 au Grand amphi à l'ENSIAS

Intitulé de la thèse

**MICROGRID DATA ANALYSIS AND ENERGY INEFFICIENCIES DETECTION USING
UNSUPERVISED LEARNING**

Devant le Jury composé de :

Président :

Pr. Hassan Berbia, PES, Université Mohammed V, Rabat

Directeur de thèse :

Pr. Mohamed Essaaidi, PES, Université Mohammed V, Rabat

Co-Directeur de thèse :

Pr. Driss Benhaddou, Full Professor, Houston University, USA

Rapporteurs :

Pr. Driss Moulay Driss El Ouadghiri, PES, Faculté des Sciences, Université Moulay Ismail, Meknès

Pr. Abdellatif Kobbane, PES, ENSIAS, Université Mohammed V, Rabat

Pr. Khalid Zinedine, PES, Faculté des Sciences, Université Mohammed V

Examineur:

Pr. Houssain Kettani, Full Professor, Al Akhawayn University, Ifrane



Abstract: The electrical grid is an old system that requires many updates, from the infrastructure to the services it provides, which is the core objective of the smart grid. Smart grid is the newer version of the electrical grid that comes with a package of advanced operations and energy measures such as the use of advanced metering in infrastructure, different power generation plants, microgrids (small scale electrical grid such as a smart house), renewable energy resources, etc. In addition to all these new features, it is important for the customer to have a closer interaction with the utility and understand the consumption rates to get involved in important decisions such as using stored energy in batteries when the electricity price is at its peak.

The goal of this thesis is to take the reader through the importance of a microgrid by presenting some of today's successful experiences and highlighting the importance of an energy management system. The latter is a computer-based tool used by energy managers to control and optimize the usage of energy by analyzing data collected from different sources, such as weather data, historical data, smart meter data, etc. To save energy, data analysis becomes a requirement; This thesis highlights all data analysis steps to follow, with an emphasis on storage and analysis requirements that depend on the characteristics of the data. To concretize the importance of data analysis, this thesis discusses the importance of machine learning in identifying energy inefficiencies to help an energy manager reconsider the energy strategy to operate a microgrid as part of energy analysis. The dataset analyzed in this thesis was provided by the Houston Advance Research Center and consists of 1-year data for a highly efficient building. The analysis conducted in this thesis consists of outlining how to use unsupervised machine learning techniques and time series analysis to understand consumption patterns and uncover time slots where energy wastage can be minimized. Finally, to identify the best clustering technique to find more energy inefficiencies, this thesis will compare the performance of three clustering algorithms that are K-Means, Gaussian Mixture Model, and Hierarchical Clustering.

Keywords: Data analysis, Energy efficiency, microGrid, unsupervised learning,

