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جامعة قسنطينة 1 – الإخوة منتوري
كلية العلوم الدقيقة

PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA
MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH
Constantine 1 University – Frères Mentouri
Faculty of Exact Sciences



ANNONCE DE SOUTENANCE



Conformément à la décision n° 22/D3C/2026 du 23 Février 2026 autorisant la soutenance d'une thèse de doctorat, le Vice-doyennat chargé de la post-graduation, de la recherche scientifique et des relations extérieures, a n n o n c e la soutenance publique d'une thèse de doctorat le :

Jeudi 16 Avril 2026 à 16 HOO

Lieu : Salle de conférences sise au Campus Chaab Errsas.

Filière : PHYSIQUE

Spécialité : Energies Renouvelables

Doctorante : **NAMOUNE Amina**

Sur le thème : « Modélisation et optimisation d'une installation solaire pour la production d'énergie ».

Devant le jury d'examen :

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A b s t r a c t

Faced with the growing global demand for energy and the urgent need to adopt clean and sustainable energy sources, photovoltaic (PV) systems have become a key player in the transition to renewable energy. However, these systems still face significant challenges, as their performance is heavily influenced by local climatic conditions and various faults that can degrade their efficiency.

This thesis explores ways to optimize and improve the performance of PV systems through advanced optimization techniques, machine learning, and deep learning, specifically tailored to the Algerian context. The primary goals are to enhance energy efficiency, improve fault detection, and extend the lifespan of solar installations.

The study begins with the optimization of the tilt angle of photovoltaic modules. By applying the Bat Algorithm alongside the Jordan model, the research demonstrates that the optimal tilt angle varies monthly, from 1° in June to 60° in December and January. A generalized mathematical relationship was developed to calculate the optimal tilt angle for different locations across Algeria, offering a practical tool for improving energy yield.

Next, the thesis focuses on detecting and classifying anomalies in photovoltaic panels. Two approaches were employed: one using machine learning models, specifically Random Forest and Gradient Boosting, to analyze I-V characteristic curve data for accurate and reliable fault diagnosis; the other applies the Swin Transformer V2 deep learning model to thermographic infrared (IR) images, achieving a validation accuracy of 96.39%, showcasing the effectiveness of the deep learning approach in identifying faults.

To facilitate the practical application of these solutions, an interactive web platform was developed. This platform automates the analysis of I-V and IR data, providing a user-friendly tool for rapid fault diagnosis and predictive maintenance of PV systems. The results of this research demonstrate the effectiveness of combining mathematical optimization, machine learning, and deep learning to improve the performance and reliability of photovoltaic systems. The findings contribute to the integration of solar energy into Algeria's national energy mix, supporting the goals of energy transition and sustainable development.