جامعة عبد المالك السعدي
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Université Abdelmalek Essaadi

N° d'ordre ………année…….

Pôle des Etudes Doctorales
Centre des Etudes Doctorales Sciences et Techniques et Sciences Médicales

AVIS DE SOUTENANCE DE THESE DE DOCTORAT

Madame CHEKER Zineb
Présentera ses travaux de recherche en vue de l'obtention du Doctorat

Formation Doctorale : Sciences Mathématiques, Physiques et Nouvelles Technologies
Discipline : Sciences et Techniques de l'Ingénieur
Spécialité : Génie biomédical et Intelligence artificielle

Le 22/11/2025 à 11H00 à la Salle de conférence de l'Ecole Nationale des Sciences Appliqués de Tétouan, UAE

Sous le thème

Amélioration de techniques d'aide à la détection et au diagnostic automatique précoce de risques pathologiques relatifs au système nerveux et cardiaque humain

Devant le jury composé de :

Nom et Prénom	Etablissement	Qualité
Pr. REKLAOUI Kamal	ENSA de Tétouan, UAE	Président
Pr. AMHOUD El Mehdi	UM6P de Ben Guerir	Rapporteur
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Pr. BAGHOURI Mostafa	ENSAM de Casablanca, UH2	Examinateur
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Structure de recherche : *École Nationale des Sciences Appliquées de Tétouan (ENSATe).*
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Résumé

The rise of artificial intelligence (AI) and advanced signal processing techniques offers new perspectives for the analysis and automatic classification of biomedical signals. Machine learning enables the modeling of complex, hidden relationships in data, allowing systems to identify patterns and distinguish pathological profiles. This has driven the growth of computer-aided diagnosis, paving the way for more precise and efficient medicine. Clinicians, however, face an increasing volume of biomedical data while specialized resources remain limited, often leading to subjective assessments, diagnostic delays, or the need for additional tests.

This thesis aims to design and evaluate AI-based pipelines for the automatic classification of two biomedical signal types: visual evoked potentials (VEP) in neuro-ophthalmology and electrocardiograms (ECG) for cardiac diagnostics. The goal is to develop robust frameworks adapted to hospital and telemedicine contexts. The approach combines 1D signal analysis using convolutional and recurrent neural networks (CNN 1D, RNN), time–frequency representations from STFT, CWT, and Wigner–Ville distributions processed by pre-trained CNN 2D models, and classical algorithms such as SVM, k-NN, decision trees, random forests, gradient boosting, and fuzzy systems.

A feature engineering strategy was also implemented to enhance signal representation, using spectral (PSD, SPSD), time–frequency (SPWVD), and temporal–statistical descriptors (Poincaré indices, entropies, fractal dimension, statistical moments, energy). This diversity captures signal non-stationarity and inter-patient variability, addressing the limits of conventional visual interpretation (e.g., P100 latency for VEP, P–QRS–T morphology for ECG). Models were evaluated through rigorous validation (k-fold and leave-one-out) and standard metrics (accuracy, F1-score, confusion matrices).

The obtained results show that time–frequency representations with deep networks and attribute-based methods with specific classifiers outperform other approaches. Conducted in a real clinical setting using both public and hospital data, this work aims to design diagnostic pipelines for prescreening and telemedicine, supporting rather than replacing clinicians to accelerate decision-making and ensure seamless integration into hospital practice.

Mots clés : Artificial intelligence; Machine learning; Deep learning; Signal processing; Biomedical signals; Visual evoked potentials (VEP); Electrocardiograms (ECG); Telemedicine; Feature engineering; Computer-aided diagnosis.