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BOOK OF ABSTRACTS

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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WEBVIP: Web Browser for the Visually Impaired People

Meriem ZEBOUDJ[(1)*], Khaled BELKADI[(2)],
[(1) (2)] SIMPA Laboratory, dept. of Computer Science, University of Science and Technology Mohamed Boudiaf (USTO-MB), Oran, Algeria
[*]meriem.zeboudj@univ-usto.dz

Abstract: However, the ease and growth of disseminating information on the Web allow the production of giant information mass. As a result, visually impaired users examine a lot of data to sort the results found, evaluate the content accessibility, and finally access the information sought. WEBVIP is a web browser for the blind and visually impaired, based on the web query reformulation by different metaheuristics, and also on the web page adaptation according to the preferences of these users.
The concept of reformulation is an iterative and interactive process between the user and search engines to achieve satisfactory results. Although this concept has been studied by many researchers, it has become one of the main concepts in the field of information retrieval and has been the subject of much work. Our proposed reformulation approach is based essentially on metaheuristics (FireFly, Bat, PSO, Pigeon and genetic algorithms), when the user requests the Web engine, the first step is to retrieve the relevant documents, and then extract the keyword. A preprocessing phase is used later, during which one removes all StopWord and TreeTagger will annotate the user terms. In the next step, the keywords are associated with FP_Growth to generate frequent itemsets. These paths are considered entries for the metaheuristic algorithms. These algorithms converge to top-k optimal paths, and the keywords present in the path are extracted will be suggested for the user afterward.
The proposed customization step is divided into three phases. The "User profile creation" phase, allows the user to modify the parameters that will be applied on all the web pages he will consult. The "data processing" phase is responsible for analyzing and transforming the content of web pages according to the preferences of each user (chosen previously). And the “Achieving Results” phase, represents the browser’s user interface and is mainly used to consult web pages, and in particular the result of customization (according to their preferences).

Extensive experiments are carried out on the test collections: Text Retrieval Conference TREC-3 (discs 1 and 2). This collection contains a set of documents, a query set, and judgments of relevance (a list of relevant documents for each query). The proposed approach based on the FireFly algorithm (FA-QR) was compared to the basic approach (Baseline-without reformulation) and Lucene as well as the different metaheuristics that are: particle swarm optimization (PSO-QR), pigeon algorithm (PA-QR), the bat algorithm (Bat-QR) and genetic algorithms (GA-QR).

To evaluate the performance of the web page transcoding approach for visually impaired people, proposed approach was compared to the WebbIE and Voxiweb based on the adaptation time of the web page (from the query to the web page display).

The results obtained show the effectiveness of our approach for both parties.With WEBVIP, developers can optimize their page to make it more accessible to everyone. The aim is to enable people with visual impairments to distinguish and read all the information on a website.

Keywords: Visually Impaired, Web Browser, Query Web Reformulation, Metaheuristics, Web Accessibility

NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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Transformer Fault detectionbased on infrared thermal images, MODWPT and K-Nearest Neighbors classifier

Boualem IKHLEF[1], Amine MAHAMI[1], Mohammed Amine Sahraoui[2], Chemseddine RAHMOUNE[1] and Djamel BENAZZOUZ[1]

1.Solid Mechanics and SystemsLaboratory (LMSS) University of BoumerdesBoumerdes- Algeria b.ikhlef@univ-boumerdes.dz,
a.mahami@univ-boumerdes.dz, ch.rahmoune@univ-boumerdes.dz, d.benazzouz@univ-boumerdes.dz
2. TelecommunicationsLaboratory (LIST) University of BoumerdesBoumerdes- Algeria ma.sahraoui@univ-boumerdes.dz

Abstract— Transformer fault detection is a critical aspect of maintaining the reliability and safety of electrical powersystems. Transformers, being key components in power grids, are subject to various types of faults that can lead toinefficiency, equipment damage, or even system-wide failures if left undetected. Faults in transformers can occurdue to a range of factors, such as insulation degradation, overheating, short circuits, or mechanical wear. The earlydetection of transformer faults enables timely intervention, preventing costly repairs, minimizing downtime, andextending the transformer's operational lifespan. In this paper we developed a technique where we used thermalimage infrared of transformer, image processing, MODWPT and K-Near Neighbors classifier to detect and classifynine fault classes at early stage. Experiments were conducted using public datasets to evaluate our method. Theresults indicate that the KNN-based model with an accuracy equal to 98% which is a very good result.
Keywords—infrared thermal images, fault detection, Transformer fault, MODWPT, KNN classifier

I. INTRODUCTION

Transformer fault detection is a crucial process in the operation and maintenance of electrical power systems, astransformers play an essential role in power distribution and transmission [1]. Transformer faults can arise due to various causes, such as insulation degradation, overheating, short circuits,mechanical defects, or moisture intrusion. Detecting these faults before they lead to serious consequences is criticalto maintaining the efficiency and longevity of the transformer. With the advancements in technology, modern methodsleveraging machine learning algorithms, sensor data, and real-time monitoring have enhanced the accuracy and speedof fault diagnosis [2].
Numerous researches on transformer fault detection using machine learning have been developed such as A.Tavakoli et al [3] have used vibration data, Balan [4] et al have used machine learning classifier such as Ada Boosterand XGB classifiers.

II. RESULTS

We have used 255 images of different defects, so we have nine classes considering healthy one. The results are shown in the fig.2

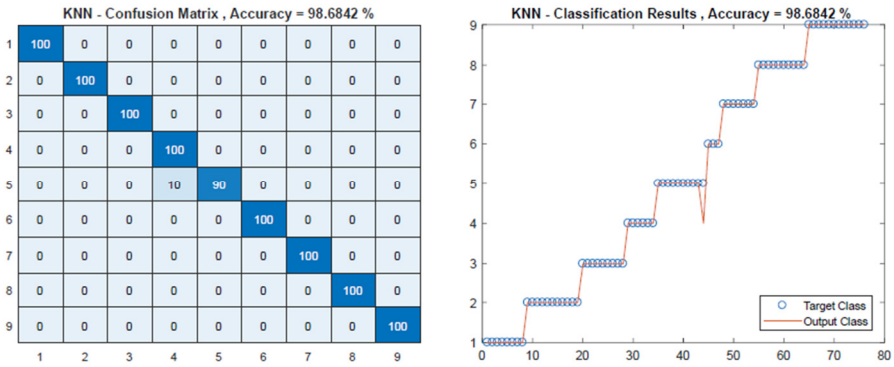

Fig.2 : Classification results

From the figures we can see that the accuracy is up to 98% it is a good result, but we do not have information about it stability, so, we studied the stability and the result is shown in the following table :

Table 01 : classification results

	KNN
Mean	96.97
Std	1.66

From the table, we can see that the mean of the accuracy of KNN is 96.97, it is good, but the standard deviation is acceptable.

III. CONCLUSION

Fault detection and diagnosis is a significant issue in both research and practice. The transformer Fault detectionis crucial for the reliability of the power system. This study reviews transformer fault detection using on thermalinfrared image and also machine learning classifier for the detection and classification into eight classes, thesimulations show that KNN classifier gives good result and also stable, so we conclude that for this application theKNN classifier is very efficiency.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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Severity Estimation of Plant Leaf Diseases based on a CNN ensemble

Mohamed Rayane Lakehal, Amine Mezenner, Naouel Arab, Hassiba Nemmour*, Youcef, Chibani
Laboratoire d'Ingénierie des Systèmes Intelligents et Communicants (LISIC),
Faculty of Electrical Engineering, University of Sciences and Technology Houari Boumediene (USTHB), Algiers, Algeria
*nemmour.hassiba@gmail.com

Abstract: The estimation of plant disease intensity is essential for various purposes, including monitoring epidemics, understanding yield loss, and evaluating treatment effects. Despite the availability of sensor technology to measure disease severity using the visible spectrum or other spectral range imaging, deep learning has emerged as a recent and advanced technique for image processing and data analysis. To enhance the severity estimation in diseased leaves, a CNN ensemble is proposed by fusing deep features extracted from outputs of fully connected layers of various CNN models. A SVM (Support Vector Machine) is utilized to achieve the classification stage. Experiments are carried out on wheat leaf images infected by the Yellow rust disease. Experiments conducted using three CNN models that are VGG16, MobileNetV2 and a customized CNN reveal that the CNN ensemble outperforms individual models.

Keywords: Convolutional Neural Networks, plant leaf disease, SVM, severity estimation

1. INTRODUCTION

Reliable and precise disease severity estimation is vital for understanding the biological aspects and has economic significance in predicting yield loss through epidemic monitoring and forecasting [1]. Pests and phyto-pathological complications pose a significant threat to global food security, driven by factors such as population growth, climate change, and industrial and economic expansion [2]. Artificial intelligence and deep learning have emerged as promising solutions for plant leaf severity estimation, in contrast to traditional determination by domain experts [3] with visual inspection of plant leaf changes, including color, texture, and morphology [4], which is an expensive and less efficient process. It is characterized by high human labor intensity, low speed, and a high misjudgment rate [5]. Plant leaf disease detection and severity classification systems, similar to many computer vision models, are typically composed of three main steps, preprocessing such as background removal, resizing and image filtering to facilitate information extraction, the feature generation and the classification. These steps aim to extract relevant information for estimating the severity level [6]. In this respect, several studies have explored color and texture features of plant leaves. For instance, in [7], the gray-level co-occurrence matrix (GLCM) was used as a textural feature descriptor with gray level images of wheat leaves. Similarly, [8] employed different color spaces, including LAB and HSV, as features for tea leaves. Furthermore, recent advances in image processing and analysis have introduced more accurate and plant leaf representative features. CNN (Convolutional neural networks) are at the forefront of this progress, as they have the ability to recognize patterns and show promising results for image classification through multiple abstraction layers [3, 7]. CNN specialize in processing data structured as multiple arrays, such as color images. The feature verification is performed by convolutional layers using the mathematical operation of convolution between the image and a kernel filter. Fully connected layers handle the classification task through backpropagation, which updates internal parameters based on computations and representations from the previous layer [8].

2. EXPERIMENTAL RESULTS

Experiments are carried out on images extracted from Yellow-Rust-19 dataset, which focuses on the severity level of Yellow Rust disease in wheat under field conditions. This dataset contains wheat

leaf images of varying sizes, totaling 15,000 samples. The samples are classified into six severity levels. Figure 2 showcases a sample from each class of the experimental set.

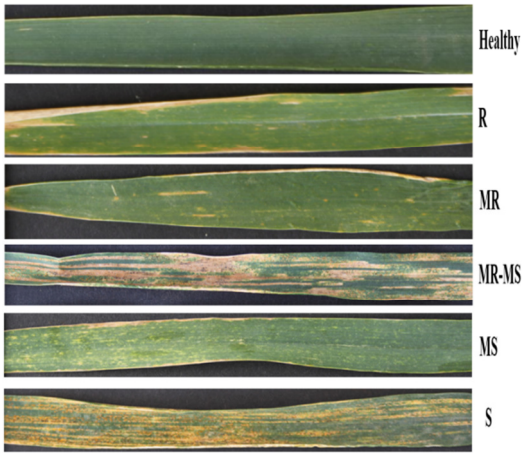

Figure.2. Images from the experimental dataset

Results in terms of overall classification accuracy are reported in Table 1. It is easy to see, that individual CNN models provide approximately the same precision. Also, the CNN ensemble provides an improvement about 1.13% over the best individual CNN.

Table.1. Severity estimation accuracy obtained for the CNN ensemble versus individual CNN

Classification system	OverallAccuracy (%)
Customized CNN	82.13
VGG16	83.13
MobileNetV2	82.92
CNN ensemble	84.26

3. CONCLUSION

In the present work, an approach for combining CNN models is introduced to improve the Yellow Rust severity estimation in wheat crops. The results showed that end-to-end CNN provide medium performance with variable accuracies among different classes. Also, the customized CNN which is a lightweight architecture provides similar performance as the VGG16 while having a small computation cost. Meanwhile, the CNN ensemble based on a deep features combination which collects 1024 features of the VGG16 and the MobileNetV2 with the 80 features of the customized CNN provided better performance.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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Compact Convolutional Vision Transformer for Tomato plant leaf disease classification

Amine Mezenner, Mohamed Rayane Lakehal, Naouel Arab, Hassiba Nemmour, Youcef, Chibani

Laboratoire d'Ingénierie des Systèmes Intelligents et Communicants (LISIC),
Faculty of Electrical Engineering, University of Sciences and Technology HouariBoumediene (USTHB), Algiers, Algeria
*nemmour.hassiba@gmail.com

Abstract: Plant disease detection is a one of the most studied subjects in precision agriculture which aims to protect and improve agricultural crops. Commonly, intelligent systems based on CNN (Convolutional Neural Networks) are employed to identify multiple plant diseases by analyzing leaf images. In this work, we propose the use of the Compact Convolutional vision Transformer for tomato disease classification. Experiments conducted on a set of 10 tomato disease categories highlight the effectiveness of the proposed system which outperforms famous CNN models including DenseNet201, and MobileNetV2by 1.73% in the overall classification accuracy.

Keywords: Convolutional Neural Networks, compact convolutional transformer,tomato disease classification.

1. INTRODUCTION

Early detection of plant leaf diseases is crucial for improving the crop production and preserving the environment from the excessive use of pesticides. Traditionally, this task was achieved by human experts, leading to lengthy processing times and high error risks. In order to cope with these limitations, researchers have explored intelligent systems based on machine learning and image processing to perform an automatic diagnose of plant leaf diseases. These systems typically involve three main stages that are preprocessing, feature generation, and classification [1]. Preprocessing encompasses various enhancement techniques like segmentation, filtering, and background elimination. Feature extraction involves utilizing color, texture, and gradient features to gather relevant information about the leaf health. Color features are often represented through histograms generated from RGB or HSB (Hue, Saturation, and Brightness) spaces. Texture information is extracted using methods like the gray level co-occurrence matrix and local binary patterns, while gradient features are commonly generated by using the histogram of oriented gradients and the scale invariant features transform [2, 3]. For the classification stage, machine learning techniques such as artificial neural networks and Support Vector Machines (SVM) were initially used. However, with the rise of deep learning, CNN (Convolutional Neural Networks) are currently the baseline systems due to their ability to handle both feature generation and classification steps [4, 5]. Recently, Vision Transformers (ViT) have emerged as new robust classification systems that can outperform CNN in various tasks. Basic ViT models are composed of several blocks of patch embedding, linear normalization, multi-head attention and fully connected layers. For plant leaf disease classification several improved ViT implementations were used. For instance, in [6] authors compared various ViT implementations such as the basic ViT and the Swin transformer. The results reported an overall classification accuracy of 95.22% on the PlantVillage tomato set by using the basic ViT. This accuracy seems to be in the same range as several CNN models and classical systems which are based on handcrafted features and SVM [3]. Therefore, in the present work we propose a novel deep learning ensemble for tomato disease classification, which is based on the fusion of deep features derived from CCT and CNN models.

2. PROPOSED SYSTEM

Presently, we propose the use of the CCT (Compact Convolutional Transformer) for tomato disease classification. The pipeline of this system is illustrated in Figure 1. This is an improved convolutional implementation of the ViT, which is a classification system composed of several processing blocks including the positional embedding, image tokenization, linear projections, transformer encoder, multi-head attention, and at the end a fully connected feed-forward networks [12]. Several improved architectures were proposed to enhance the ViT performance. Presently, we utilize the CCT (Compact Convolutional Transformer) that adds a convolutional tokenization to generate tokens with rich information. Also, it replaces the classical class token by a sequence pooling process [7].

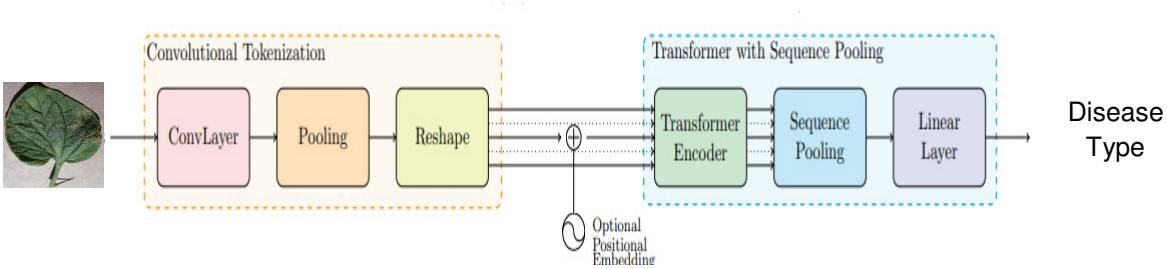

Fig. 1 Pipeline of the compact convolutional transformer for plant leaf disease classification

3. EXPERIMENTAL RESULTS

Experiments are carried out on the PlantVillage tomato dataset, comprising healthy tomato leaves and nine common tomato pathologies. The number of samples per classes varies between 373 and 3208 yielding a total of 16011 samples, from which 80% of them were used in the training stage while the remaining 20% samples were used in the validation stage.Table 1 summarizes the results obtained by the CCT along with those derived by DenseNet201 and MobileNetV2. The CCT offers the best classification score in several classes yielding a gain of 1.73% over the DenseNet201 and 2.43% over the MobileNetV2.

Table 1. Results obtained for tomato disease classification

Class	DenseNet201	MobileNetV2	CCT
Bacterial Spot	99.06	98.59	96.00
EarlyBlight	85.50	84.00	93.00
LateBlight	96.34	94.24	99.48
Leaf Mold	89.47	95.79	98.95
SeptoriaLeaf Spot	99.44	94.35	98.87
TwoSpotted Spider Mite	96.70	94.29	97.30
Target Spot	93.24	93.59	98.93
YellowLeafCurl Virus	99.69	100.0	99.84
Mosaic Virus	98.67	97.33	100.0
Healthy	96.54	98.74	100.0
Total Accuracy	**96.64**	**95.94**	**98.37**

4. CONCLUSION

In this work, we proposed the use of the CCT (Compact Convolutional Transformer) for tomato leaf disease classification. This system was evaluated in comparison with two famous CNN models that are MobileNetV2, and the DenseNet201. Experiments conducted on a public dataset composed of ten tomato disease classes, confirm the effectiveness of the CCT which outperforms CNN in 7 classes yielding a global improvement of 1.73% over the best CNN.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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LSTM-Based Sequence Prediction for Sybil Attack Detection in UAV Networks

Said NECIRI[(1)*], Noureddine CHAIB [(2)]
[(1)] Computer Science and Mathematics Laboratory (LIM), Laghouat University, Laghouat, Algeria.
[(2)] Amar Telidji University of Laghouat, Laghouat, Algeria.
s.neciri@lagh-univ.dz

Abstract: Unmanned Aerial Vehicle (UAV) networks play a crucial role in applications such as surveillance, delivery, and disaster management. However, they are vulnerable to security threats like Sybil attacks, where attackers create fake nodes to gain control. This paper proposes a novel Sybil attack detection method using a Long Short-Term Memory (LSTM) sequence prediction model. The system analyzes temporal traffic patterns, including packet transmission times, UAV identity, packet rates, transport protocols, and signal strength, to identify anomalies indicative of Sybil attacks. Simulation results show a high detection rate of 97.5% with a low false positive rate of 3.2% and an MSE of 0.0014 for normal traffic predictions. The method outperforms previous detection approaches by enabling real-time countermeasures through accurate anomaly detection.
Keywords: UAV, LSTM, Sybil Attack, Ns3 simulation, security, UAV

1. INTRODUCTION

In recent years, securing UAV networks against Sybil attacks has garnered significant attention. Traditional methods like reputation-based schemes and digital certificates [9,16] often fall short due to the dynamic nature of UAV networks and susceptibility to key compromise attacks [1,5]. Lightweight cryptography and trust management frameworks have been explored [2,7], but these may lack scalability or real-time efficiency. Machine learning, particularly deep learning, has emerged as a promising solution. Models like SVMs, Random Forests, and CNNs show potential [8,12,15] but struggle with time-series data critical for detecting sequential anomalies [11]. LSTM models, capable of learning temporal traffic patterns, offer high accuracy in anomaly detection, including Sybil attacks [14], and have proven effective against other attacks like DDoS and insider threats [4,10,13]. Integrating LSTMs with frameworks like game theory and reinforcement learning further enhances security [6]. However, few studies focus on LSTMs for Sybil attack detection in UAVs, marking a significant research gap. This paper proposes an LSTM-based sequence prediction model leveraging temporal traffic data to detect Sybil attacks in real time, validated through simulations demonstrating superior accuracy over traditional methods [3,4,14].

2. PREDICTION AND ANOMALY DETECTION

The LSTM predicts the next state X(t+1) and calculates the Mean Squared Error (MSE) between the predicted and actual values:

$$\mathrm{MSE}(t+1) = (1/n)\sum(X\_i(t+1) - \hat{}X\_i(t+1))^2 \quad (1)$$

If the MSE exceeds a threshold θ, an anomaly (Sybil attack) is flagged:

If MSE(t+1) >θ, then Sybil attack detected at time t+1

During training, the LSTM minimizes the loss function:

$$L = \sum \mathrm{MSE}(t+1) \quad (2)$$

3. EVALUATION METRICS

The system's performance is evaluated using:

Detection Rate (DR) = True Positives / (True Positives + False Negatives)

False Positive Rate (FPR) = False Positives / (False Positives + True Negatives)

Mean Squared Error (MSE) as defined above.

4. SIMULATION RESULTS

The LSTM model achieves the following results:

- Detection Rate (DR): 97.5%
- False Positive Rate (FPR): 3.2%
- Mean Squared Error (MSE): 0.0014 (for normal traffic)

5. CONCLUSION

The proposed LSTM-based approach effectively detects Sybil attacks in UAV networks by learning temporal patterns in traffic data. By continuously monitoring prediction errors, the system provides a scalable and efficient method for real-time anomaly detection.

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ComparativeStudiesofIntelligentAlgorithmsfor Enhancing Machine Learning Training in Diabetes Prediction

LakhdariLahcen[(1)*],Belagramammar[(2)]

[(1)]ElectricalengineeringdepartmentTahriMohammedBécharUniversity(TMBU),Béchar,Algeria

[(2)]ElectricalengineeringdepartmentTahriMohammedBécharUniversity(TMBU),Béchar,Algeria

[*]lakhdari.lahcen@univ-bechar.dz

Abstract: This The objective of this study is to compare the effectiveness of various intelligent algorithms in enhancing machine learning training for predicting diabetes from patient data. Early prediction of diabetes is crucial for preventing serious complications, and machine learning algorithms play an essential role in improving medical diagnostics. This research evaluates the performance of several algorithms, including Logistic Regression (LR), Random Forests (RF), Support Vector Classification (SVC), Gradient Boosting Machines (GBM), and K-Nearest Neighbors Classifier (KNN). These algorithms are compared based on multiple criteria: performance (precision, recall, F1-score, accuracy), computation time, model complexity, generalization capability, robustness, ease of implementation, and scalability. The study uses the PimaIndians Diabetes dataset, a well-known dataset containing several clinically relevant variables for diabetes prediction. The algorithms are evaluated using cross-validation methods, and regularization techniques are applied to optimize the hyperparameters.

Keywords: MachineLearning,Recall,F1-score,Accuracy

1. INTRODUCTION

Diabetesisachronicconditionthataffects millions of people worldwide, leading to severe health complications if not managed effectively. Early diagnosis and intervention are crucial for preventing the progression of the disease and minimizing its impact on patients' lives. Machine learning (ML) algorithms have shown great promise in the field of medical diagnostics, offering robust tools for early disease prediction and personalized healthcare solutions [1].

The primary objective of this study is to compare the effectiveness of various intelligent algorithms in improving machine learning training for predicting diabetes from patient data. By leveraging advanced ML techniques, we aim to enhance the accuracy and reliability of diabetes prediction models, ultimately aiding healthcare professionals in making informed decisions [2].

In this research, we evaluate the performance of several prominent machine learning algorithms, including Logistic Regression (LR), Random Forests (RF), SupportVectorClassification(SVC),Gradient Boosting Machines (GBM), and K-Nearest Neighbors Classifier (KNN). Each of these algorithmsbringsuniquestrengthsandweaknessestothetable,andacomprehensive comparison will provide insights into their suitability for diabetes prediction tasks [1].

The Pima Indians Diabetes dataset, a widely recognized dataset in the field of medical research, serves as the basis for our analysis. This dataset contains multiple clinicallyrelevantvariables,makingitanideal candidate for training and evaluating ML models for diabetes prediction. By utilizing cross-validationtechniquesandregularization methods, we aim to optimize the hyperparameters of these algorithms and ensure their robustness and generalization capability [3]

The study will focus on several key performance metrics, including precision, recall, F1-score, and accuracy. Additionally, we will consider factors such as computation time, model complexity, ease of implementation, and scalability to provide a holisticviewofeachalgorithm'sstrengthsand limitations [4,5].

This research not only contributes to the growing body of knowledge in the field of machine learning for medical diagnostics but also offers practical insights that can be appliedtoreal-worldhealthcaresettings.Byidentifying the most effective algorithms for diabetes prediction, we hope to pave theway for more accurate and efficient diagnostic tools that can improve patient outcomes and reduce the burden of diabetes on healthcare systems worldwide [5].

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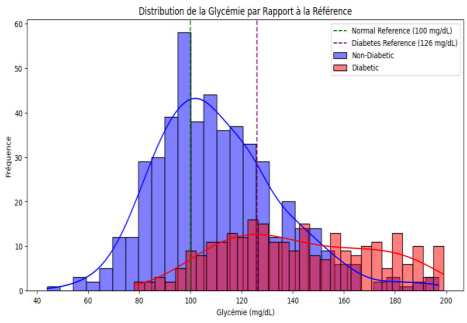

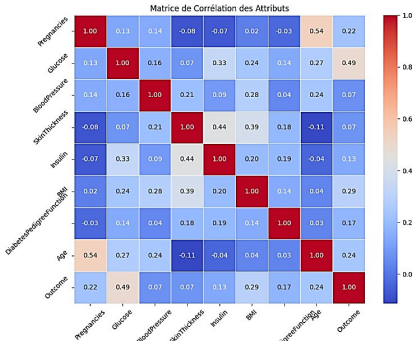

Fig.1BloodGlucoseDistributionFig.2 Attribute Correlation Matrix

TABLEI. Resultsobtainedforeachclassification algorithm tested

Algorithm	Class	Precision	Recall	F1-score	Accuracy
LogisticRegression	***0***	0.80	0.91	0.85	0.85
	1	0.91	0.80	0.86	
	Overall	0.86	0.86	0.85	
SupportVectorClassifier	***0***	0.79	0.90	0.84	0.84
	1	0.90	0.79	0.85	
	Overall	0.85	0.85	0.84	
RandomForestClassifier	***0***	0.84	0.94	0.89	0.89
	1	0.94	0.85	0.89	
	Overall	0.89	0.89	0.89	
GradientBoosting	***0***	0.86	0.97	0.91	0.91
	1	0.97	0.86	0.91	
	Overall	0.91	0.91	0.91	
K-Nearest Neighbors	***0***	0.72	0.87	0.79	0.79
	1	0.86	0.71	0.78	
	Overall	0.79	0.79	0.78	

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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Application of Machine Learning Algorithms in Predictive Maintenance

Ali CHABANE[(1)*], Fazia BOUGCHICHE[(2)], Celia BOULKENATER [(2)], Maya AGGAD[(1)] ,Smail ADJERID[(1)]
[(1)] Solid Mechanics and Systems Laboratory (LMSS),M'HamedBougara University (UMBB), Boumerdes,Algeria
[(2)] Department of industrial engineering and maintenance, National Higher School of Advanced Technologies (ENSTA), Algiers, Algeria.
[*]ali.chabane@univ-boumerdes.dz

Abstract: This paper provides a comprehensive overview of machine learning (ML) algorithms for predictive maintenance (PdM). The development of Industry 4.0 and the integrating of intelligent systems and machine learning with artificial intelligence have led to the widespread adoption of predictive maintenance approaches across various industries. However, the performance of PdM applications depends on the appropriate selection of the ML method, which can include supervised, unsupervised, or reinforcement learning algorithms. We also discuss various applications of these algorithms in predictive maintenance, such as failure prediction and detection, equipment health monitoring, and remaining useful life prediction. Additionally, we highlight the challenges and limitations of implementing machine learning in predictive maintenance.

Keywords: Machine learning, Predictive maintenance, supervised learning, unsupervised learning, Data collection.

1. INTRODUCTION

Industries across various sectors are transforming with Industry 4.0, utilizing machine learning algorithms, which have gained significant attention in recent years due to their ability to extract valuable insights from large datasets. One domain where machine learning has proven particularly useful is maintenance. Rapid technological advancements, information systems, computerized control, and communication networks (IoT) have opened up new possibilities for collecting large amounts of operational and process condition data **[1]**. This data, generated by multiple pieces of equipment, can now be used to develop an automated Fault Detection and Diagnosis (FDD) system, as shown in Figure 1. In the past, maintenance was typically performed reactively or preventively, but with the advent of machine learning, a new approach has emerged: predictive maintenance (PdM) **[2]**.

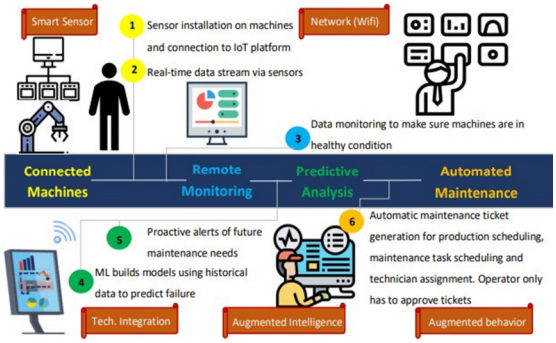

Fig. 1. PdM process using technologies (IOT platform).

This work explores the different types of maintenance and the advantages of machine learning (ML) algorithms in PdM. We then delve into the various machine learning algorithms used in predictive maintenance, including supervised, unsupervised, and reinforcement learning algorithms. Supervised learning algorithms use labeled data to train the model, while unsupervised learning algorithms are employed when no labeled data is available. Reinforcement learning

algorithms, on the other hand, rely on an agent interacting with an environment to learn how to make decisions **[3, 4]**.

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Enhancing Traceability Query in Blockchain-Based Food Supply Chains Using a Merkle B+ Tree Indexing Technique.

Ilyas Ziaya(1)*, Brahim Farou(1), Zineddine Kouahla(1)
(1) Departement of computer science. University of 8 May 1945, Guelma, Algeria
*ilyesziaya37@gmail.com

Abstract:

Blockchain technology has revolutionized data management in food supply chains by providing decentralized, secure, and transparent ledgers. However, as blockchain adoption increases, improving the efficiency of traceability queries has become a significant challenge. Traditional blockchain structures, which use linear data organization, often face performance bottlenecks as data volumes grow. The food supply chain is particularly complex, involving numerous actors across various stages from farm to table. At each stage, information about the food products is collected and stored, resulting in a large number of blocks, which complicates the traceability query process. In this work, we address the limitations of traceability queries and enhance search query performance within the blockchain by implementing an indexing technique based on the B+ Tree structure, integrated with the Merkle Tree structure. This hybrid system facilitates quick data retrieval through B+ Tree while ensuring data integrity via Merkle Tree. To implement this integration, modifications are made to the blockchain's data storage and retrieval mechanisms. This dual-layer architecture enables efficient search queries while maintaining data integrity. The performance of the Merkle B+ Tree structure is evaluated based on query time and simulations are conducted using the Hyperledger Fabric framework, which models food supply chain scenarios. Through experimental testing, we evaluate the performance of our solution in terms of query time and compare it to native blockchain methods. The results show significant improvements in query efficiency, with reduced time complexity compared to traditional approaches.

Keywords: Blockchain, Merkle B+ Tree, Indexing techniques, Traceability Query, Food Supply Chain.

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A Lightweight Intrusion Detection for Attacks in IoT Big Data Networks

ImeneBOULEGHLIMAT[(1)*], Souheila BOUDOUDA[(1)], Safia BOULEGHLIMAT[(1)]
[(1)] LIRE laboratory, Department of Software Technologies and Information Systems,University of Constantine 2-AbdelhamidMehri
[*]Corresponding author,imene.bouleghlimat@univ-constantine2.dz

Abstract: Industrial Internet of Things (IoT) security vulnerabilities create a critical challenge that needs to be addressed. Detecting intrusion from huge amounts of data in IoT Big Data networks is challenging. Deep learning models have been used to address this challenge. However, false negatives still create increased vulnerabilities. Motivated by this gap, this paper introduces a machine-learning intrusion detection model with a two-layer feature selection stage. The model evaluation results demonstrate that utilizing a two-layer feature selection improves the performance of the intrusion detection model compared to a one-layer-based feature selection found in previous works, while also enhancing processing speed and feature interpretability.

Keywords: Intrusion detection, Deep learning, Network security,TON-IoT

1. INTRODUCTION

Diverse IoT devices generate Big Data, creating challenges in storage, computation, and cybersecurity [1]. IoT networks are vulnerable to attacks, making device security a significant challenge[2].Detecting attacks amidst regular traffic is challenging due to the vast amount of data. Traditional methods that compare traffic to known attack signatures often miss new threats. In contrast, anomaly-based detection techniques using artificial intelligence, particularly machine learning and deep learning, identify unusual behavior, allowing for the detection of unfamiliar attacks that deviate from standard patterns[1]. A key drawback is the failure to detect anomalous traffic, leading to false negatives due to poor feature selection[2]. To address this issue, various approaches are suggested to improve feature selection in intrusion detection systems (IDS).The correlation-based filter method in [1] selects important features but is sensitive to noise, leading to unreliable results, and fails to address feature redundancy or correlations among multiple features.The authors in [2] used an ExtraTree classifier for feature selection during pre-processing, removing unimportant features to train various deep learning models for lightweight intrusion detection (ID) in IoT networks.However, the ExtraTree classifier does not account for non-linear correlations between features.Keshk et al. [3] proposed a model that integrates local and global explanations for feature extraction using Explainable Artificial Intelligence (XAI) to clarify both features and predictions. However, relying on XAI for feature selection can lead to high dimensionality due to improper selection of important features, increasing the risk of overfitting.In this paper, we propose a two-layer feature selection method to identify key features and introduce classifiers for lightweight ID in IoT Big Data Networks. By combining SHapley Additive exPlanations (SHAP) and autoencoders, our approach reduces dimensionality and minimizes overfitting, resulting in improved performance.

2. METHODOLOGY

A. Data Preprocessing: Data are pre-processed by handling missing values, converting strings to numbers, and applying label encoding.

B. Data Modelling: The data is split 80/20 for training and testing using sklearn's train-test-split function.

C. Feature Selection: The model is trained with important features selected through a two-layer approach. In the first layer, SHAP explains the importance of features based on the XGBoost model using the training dataset.Particularly, visualizations of SHAP values for each feature, highlighting their impact on model output, help identify the 20 most

crucial features in our case (Figure 1 and Figure 2). From the 20 identified features, the top ten are selected, and the rest are discarded.The new dataset is then split into training (80%) and testing (20%) parts.Data are normalized using the standard scaler, and the Synthetic Minority oversampling Technique (SMOTE) is applied to balance the dataset.The balanced dataset is used to train an autoencoder model for feature selection. The resulting encoded features are used in the next stage.

D. Anomality Detection Classifier: In this stage, three models are used: Random Forest (RF), Artificial Neural Network (ANN), and Long Short-Term Memory (LSTM).Each model could represent the ID model.

3. EXPERIMENTS AND RESULTS

Dataset

Network traffic data from the TONIoT network dataset [4] is used. It contains 461043 instances and 44 features.

Summary of Results

Model performance is assessed using accuracy (A1), precision (A2), recall (A3), F1-score (A4), and AUC-ROC metrics (Table 1). Our classifier outperforms those in [2] on the same dataset and reduces overfitting effectively.

4. CONCLUSION

This paper introduces a two-layer feature selection model for ID, showing that combining SHAP and autoencoder improves performance, reduces dimensionality, and optimizes storage. Future work will explore enhancements for multi-class ID classifiers.

Table 1 CLASSIFICATION PERFORMANCE RESULTS

Model	Class label	A1	A2	A3	A4	AUC Score
RF	0	1	1	1	1	0.9981
	1		1	1	1	
LSTM	0	1	1	1	1	0.9993
	1		1	1	1	
ANN	0	0.99	0.99	0.99	0.99	0.9999
	1		0.98	0.99	0.98	

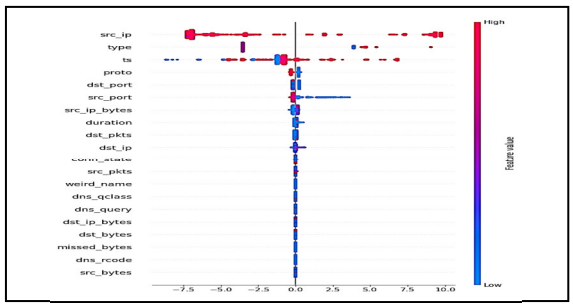

Fig. 1TON-IoT features extracted by SHAP

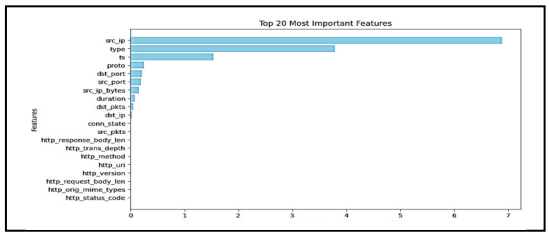

Fig. 2Top 20 features identified by SHAP

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Mind-Controlled Web Browser Navigation Based on Brain Computer Interfaces

Ahmed YassineFERDI[(1)*], AbdelkaderGHAZLI[(1)]
[(1)] Department of Mathematics and Computer Sciences,Faculty of Exact Sciences,
Tahri Mohammed University (UTMB), Bechar, Algeria
[*]ferdiahmedyacine@gmail.com

Abstract: Brain-Computer Interfaces (BCIs) are communication systems that enable direct interaction between the human brain and machines or devices without the need for physical contact, utilizing Electroencephalography(EEG) signals generated from brain activity. A BCI system typically involves two key stages: feature extraction and classification. The classification process relies on signals collected from specific EEG sensor groups. One of the main challenges in classifying motor imagery EEG signals arises from the fact that EEG data is often a mixture of meaningful signals and noise. As a result, selecting an effective classification technique is crucial in EEG-based BCIs. In this study, we applied machine learning and deep learning classifiers to categorize motor imagery in EEG data used for BCIs. We assessed the performance of several classification techniques, including Support Vector Machine, Multilayer Perceptron Neural Network, Decision Tree and Random Forest, as these are commonly employed in classification tasks. The results indicated that Random Forest outperformed the other methods, achieving the highest accuracy of 82.72%. This data was subsequently used to develop a web browser navigable via brain signals.

Keywords: BrainComputer Interfaces, Classification, Electroencephalography,Machine Learning

1. INTRODUCTION

The goal of brain-computer interfaces is to facilitate a new form of communication that enables the human brain to control machines or devices without any physical movement. Using a machine learning approach, BCIs translate electroencephalogram (EEG) data derived from brain activity into control commands [1][2].Brain-computer interfaces typically consist of five main stages. The first stage involves measuring brain activity, followed by preprocessing, feature extraction, feature classification, and control interface, which converts the classified signals into actionable data for devices such as wheelchairs or computers [1][3]. This study compares five widely used machine learning techniques: neural networks (MLP-ANN), decision trees (DT), random forests (RF), and support vector machines (SVM). The goal is to identify the most effective classifier for BCI motor images. This data will then be used to navigate a web browser, classifying it into three actions: scrolling up, scrolling down, and opening or closing tabs. The classifiers are evaluated using EEG data from hand movements obtained from the Kaggle platform.

2. METHODES AND MATERIALS

Classification

This research evaluates and contrasts five popular machine learning methods along with deep learning techniques for BCI classification, selecting neural network (MLP-ANN), decision tree (DT), random forest (RF), and support vector machine (SVM) for experimentation.

DatasetSpecifications

The BCI dataset used in this analysis consists of EEG data from hand movements, sourced from Kaggle [4].A 25-minute data collection protocol was designed, involving four participants across different sessions that addressed various scenarios during attempts to control the objects. During each session, participants were shown images depicting spontaneous motor behavior: a right arrow to represent movement to the right, a left arrow for movement to the left, and a circle indicating no movement. The only exception occurred when participants (four users) closed their eyes. In this case, participants scrolled through pages at specific intervals and could open their eyes to view the images.

Experimental Setup

The classification of EEG data from hand movements was conducted after preprocessing the dataset using Fast Fourier Transform (FFT) to extract relevant features. The processed data was organized into four comma-separated values (CSV) files, each corresponding to a different participant. These CSV files served as the input for the Python program.The classification task aimed to correctly identify values that represented right movement (0), left movement (1), or no movement (2). Once the classifiers were trained, the results were used to explore and interact with a web browser (e.g. Google Chrome). Classification was divided into three categories: the first category (right arrow) enabled upward browsing, the second category (left arrow) enabled downward browsing, and the third category (focused on a dot in the middle) opened or closed the browser depending on its current state.

3. RESULT AND DISCUSSION

The classification results for all four subjects using four different classifiers are illustrated in Figure 1.Based on these results, Random Forest emerged as a reliable and effective classifier, attaining an accuracy rate of 82.72%. Consequently, it was selected as the classifier to implement in our system for file navigation, ensuring minimal error in interpreting the user's intended brain activity whether opening or closing a file, or scrolling through its contents. Compared to the findings of Dong Ming [5], who developed a BCI system to control a computer mouse with an accuracy of 80%, our system demonstrated a superior accuracy rate of 82.72%. This highlights the advancements achieved in our work.

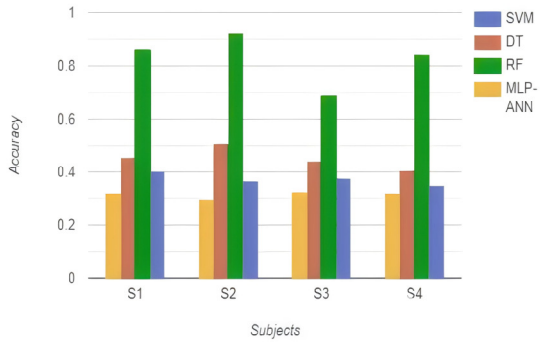

Fig. 1 Performance Comparison of four subjects.

4. CONCLUSIOON

This study aimed to classify fictitious motion EEG signals to evaluate the effectiveness of machine learning classifiers. Four classifiers were employed for data classification: SVM, MLP-ANN, Decision Tree and Random Forest. The random forest classifier performed best, achieving an accuracy of 82.72%, making it a recommended option for integration into web browser exploration. Future work will explore ways to improve this algorithm to classify EEG data more accurately beyond current capabilities.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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Design of an Expert System: A Diagnostic Support Tool.

Maya AGGAD[(1)*], Ali CHABANE[(1)], Smail ADJERID[(1)]
[(1)] Department of mechanical engineering. Solid Mechanics and System Laboratory (LMSS), Boumerdes, Algeria
[*]aggad.maya@univ-boumerdes.dz

Abstract: The unavailability of equipment due to repairs can lead to significant economic losses for companies. A rapid diagnosis can considerably reduce downtime. With this in mind, we have developed an expert system aimed at improving the diagnostic process, thereby facilitating repairs of failures in industrial equipment.In this paper, we present the various steps taken in the design and development of a MATLAB application based on expert systems theory and utilizing Failure Mode and Effects Analysis (FMEA). This solution serves as an effective tool for diagnosing and repairing failures in the industrial sector.

Keywords: Expert system, Artificial intelligence, Maintenance, Dependability, Availability

1. INTRODUCTION

Nowadays, it is crucial for companies to maintain continuous production at a pace that meets customer demands. This is only possible by investing in maintenance and paying special attention to dependability, enabling companies to reduce downtime and increase productivity.

In other words, maintaining an adequate level of availability is the goal to achieve. Indeed, the unavailability of equipment for repair in a production line reduces the company's output and leads to economic losses [1]. Reducing the mean time to repair, by providing rapid diagnostics and offering suitable solutions, is therefore essential to improve equipment availability.

However, manufacturing processes are complex, and human capabilities are limited when it comes to quickly diagnosing failures. To overcome this constraint, artificial intelligence (AI)[2] and expert systems [3][4] offer promising solutions. AI refers to the ability of machines to replicate human intelligence, while expert systems, which are a subset of AI, use specialized knowledge to solve problems in specific domains. These systems act as skill multipliers, allowing access to expert knowledge in a user-friendly way, even for operators without in-depth expertise.

In this paper, we present the development and design steps of an expert system for machine maintenance. This computer-based diagnostic tool helps industrial maintenance teams to improve their performance in terms of availability while preserving the expertise of their specialists. The application includes two interfaces:

- *Expert interface module:* designed for experts to input knowledge through appropriate forms.
- *User interface module:* an interactive tool aimed to guide the maintenance operatorsin identifying the causes of failures in a reduced timeframe.

The knowledge base is modeled using the Failure Modes and Effects Analysis (FMEA) method [5], which has proven well-suited for applying artificial intelligence in the field of maintenance.

To validate the developed application, we used a practical case involving a labeling machine.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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Leveraging Machine Learning and IoT for Soil Classification and Crop Recommendation in Algerian Agriculture

Souheila BOUDOUDA[(1)*], Mountaha BOUKALLEL[(2)],
[(1,2)]LIRE laboratory, Department of Software Technologies and Information Systems, University of Constantine 2-Abdelhamid Mehri
[*]Corresponding author, souheila.boudouda@univ-constantine2.dz

Abstract: Agriculture is a key pillar in Algeria's economic development strategy and a major source of livelihood for its population. Its success depends significantly on soil types, which are critical for predicting suitable crop varieties. This paper presents a methodology for soil classification, focusing on both nutrient composition and physical characteristics such as color and texture. By applying data mining techniques and image classification algorithms, the proposed approach aims to classify soil types more accurately. Image classification, in particular, enhances the analysis of soil texture and structure, improving the precision of classification results. Several machine learning algorithms, including K-nearest neighbor and data mining methods, are used to implement this classification framework. By utilizing these techniques, our methodology provides farmers with valuable insights into soil categorization, enabling them to make informed decisions about crop selection based on soil properties.

Keywords: Agriculture**,** Soil classification, K-nearest, nutrient composition, predictingvarieties

1. INTRODUCTION

Agriculture is crucial for the sustainability of any economy and plays a significant role in long-term economic growth. As the global population continues to grow, it becomes crucial to reassess agricultural practices to enhance both their sustainability and efficiency. Technological advancements have emerged as essential catalysts for agricultural development, ushering in a new era of innovation and transformation. [1],[2]. Digital agriculture, facilitated by information and communication technologies, furnishes farmers with vital crop and market information, thereby enhancing decision-making processes [3].

Algeria has yet to fully leverage these technologies to drive growth in the agricultural sector, as the country struggles with lack of market awareness, basic farmer to farmer communication and traditional ways to crop selection. This created a need for farmers and individuals to innovate new ways to manage farms to achieve food security.

Traditional farming methods often rely on experience and intuition, but these practices may only sometimes guarantee optimal results when it comes to soil management.Due to this, countries are producing yields much below their potential [4]. So to address this knowledge gap, numerous researcherssuch as [5], [6] have explored the potential of technology to provide accessible tools for soil classification and analysis. These tools have the potential to empower farmers in Algeria and worldwide, enabling informed decision-making about crop selection, soil health, and sustainable farming practices.

This paper proposes a technical solution to address these challenges, focusing on providing farmers with soil classification tools. The approach aims to connect farmers, optimize land use, and transform the agricultural sector by leveraging technologies such as AI, GIS, and Big Data.

2. METHODOLOGY

In order to anticipate crops more accurately, a real-time soil analysis system needs to be developed. In this research work, we use Convolutional Neural Networks (CNNs), and its chemical attributes.

The proposed system inputs soil images from the user and states the type of soil as an output. SVM and CNN architectures are used for soil image classification and evaluated accuracy of each classifier.

The basic crop recommendation is given below, Soil parameters are given as an input and the type is provided as an output.

Step 01: Crop dataset is given as an input, and the set of data imported.

Step 02: The attributes used in the set of data are transformed into a particular range, bringing the set of data into a consistent state, thus avoiding anomalies.
Step 03: Splitting the dataset into training and testing sets
Step 04: The classification algorithm(e.g,.. KNN, SVM,) is applied to the training sample.
Step 05: The trained classifier is applied to the testing samples to predict the most suitable crop for cultivation.
Step 06: The target label for new instances is found by the trained classifier so as to identify a suitable crop.
Step 07: Finally, a suitable crop for cultivation is recommended by the results.

3. EXPERIMENTS AND RESULTS

Dataset

The dataset utilized in this research was sourced from Kaggle repositories due to the lack of Algerian data.The dataset is consistent of 1244 images belonging to 4 soil classes"Alluvial Soil", "Red Soil", "Clay Soil", "BlackSoil".

Summary of Results

The outcomes results of the soil image classification experiments using CNN architecture, the images presented below show the accuracy of the model. Overall, the results exemplify the efficiency of the evaluated CNN architectures in soil classification, highlighting their potential for practical applications in agriculture, land management and environmental monitoring.

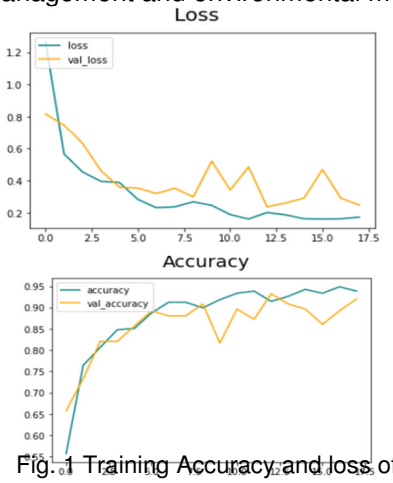

Fig. 1 Training Accuracy and loss of CNN Adam

Model accuracy is evaluated using test sets, with performance assessed through confusion matrices and classification reports. (See table1).

Table 1 Result comparison

Method	Kernel	Accuracy
K-Nearest Neighbor		99.6%
Support VesctoreMachines	Linear	100%
	RBF	100%
	Poly	100%
DecisionTrees		99.6%
RandomForests		100%

4. CONCLUSION

In conclusion, this work presents a data-driven, farmer-centric approach to address challenges faced by Algerian farmers, such as crop selection and soil management. By utilizing machine learning and IoT-based data collection, the system analyzes soil qualities and recommends crops, enabling more informed decisions. This approach can improve agricultural yields, farm management and sustainability. Predictive agriculture uses real-time and historical data to optimize production, reduce environmental impactand increase profitability. This study focuses on specific crops, but further research using IoT technology is needed to gather more data on other crops.

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Transformer Fault Classification based on Thermal Infrared Images and Artificial Intelligence Techniques

Boualem IKHLEF[1], Mohammed Amine Sahraoui[2] ,Amine MAHAMI[1], Chemseddine RAHMOUNE[1] and Djamel BENAZZOUZ[1]
1.Solid Mechanics and SystemsLaboratory (LMSS) University of BoumerdesBoumerdes- Algeria b.ikhlef@univ-boumerdes.dz,
A.MAHAMI@UNIV-BOUMERDES.DZ, CH.RAHMOUNE@UNIV-BOUMERDES.DZ, D.BENAZZOUZ@UNIV-BOUMERDES.DZ
2. TelecommunicationsLaboratory (LIST) University of BoumerdesBoumerdes- Algeria ma.sahraoui@univ-boumerdes.dz

Abstract—To preserve the optimal operation of a transformer, it is very important to detect the slightest degradation of its performance, and this in their early states. To do this, it is essential to install a diagnostic system. In this work, we used five artificial intelligence techniques to detect and classify transformer faults on the thermal infrared images, namely K-Nearest Neighbor, Naïve Bayes, Decision Tree, Random Forest and Support Vector Machine, the comparison of the simulation results shows that the best accuracy is obtained by Naïve Bayes classifier followed by Random Forest , but the stability study of these classifiers showed that Random Forest is more efficient and more reliable than the Naïve Bayes classifier, so we can conclude that Random Forest classifier is the best choice for this diagnostic problem.

Keywords—Thermal infrared images, fault detection, transformer fault

1. INTRODUCTION

Transformer fault detection is critical for the efficient operation and maintenance of electrical power systems, faults in transformers can cause major disruptions to the power supply, lead to equipment damage, and result in costly repairs. Early fault detection is essential for preventing significant failures, enhancing system reliability, and ensuring operational safety.Several studies have focused on applying machine learning to transformer fault detection. For example, A. Tavakoli et al [1] utilized vibration data, while Balan et al[2] employed classifiers such as AdaBoost and XGBoost for early fault diagnosis and accurate detection not only mitigates operational risks but also helps optimize maintenance schedules [3], prolongs transformer life, and ensures an uninterrupted power supply. The proposed method involves preprocessing thermal infrared images using image processing techniques and wavelet technique to extract features, we have used five classifier techniques which are: K-Nearest Neighbor, Naïve Bayes, Decision Tree, Random Forest and Support Vector Machine.

2. METHODOLOGY

In this work, we used image preprocessing in order to convert RGB images to signal, and then we used MODWPT to decompose the obtained signal and construct the features matrix, and at the end we applied and compare the accuracy of five classifiers which are KNN, DT, RF, SVM and CNB. The obtained result show that the naive bayes classifier gave the best accuracy, but studying the stability of classifier, we have obtained that random forest is more stable than the nave bayes.

3. RESULTS

We have used 255 images of different defects, so we have nine classes considering healthy one. The results are shown in the fig.1

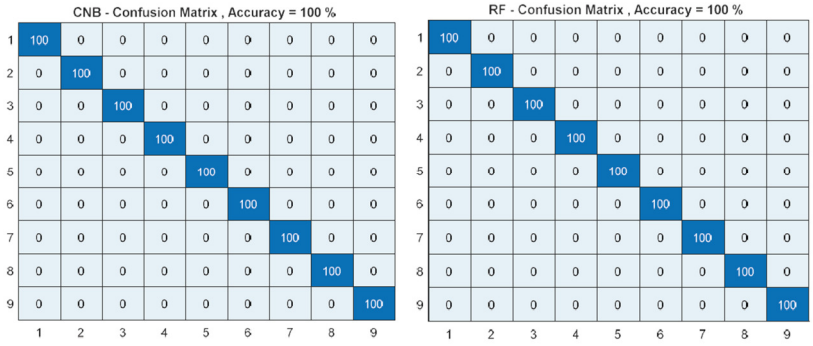

Fig.1 Confusion matrix of CNB and RF

From the figures we can see that two classifiers gave a good result, the Random Forest and Naive Bayes, in order to choose the best one, we studied the stability for all classifiers, the result is shown in the following table:

Table 1 classification results

	RF	**CNB**	**KNN**	**DT**	**SVM**
Mean	99.69	99.82	96.97	97.67	98.81
Std	0.66	0.75	1.66	1.68	1.43

From the table, we can see that the mean of the accuracy of CNB is 99.82, it is the best, but the standard deviation of Random Forest is the smallest meaning that this technique is stable than the others.

4. CONCLUSION

Fault detection and diagnosis is a significant issue in both research and practice. The transformer Fault detection is crucial for the reliability of the power system. This study reviews transformer fault detection using on thermal infrared image and also machine learning classifier for the detection and classification into eight classes, the comparison between five classifiers showed that CNB gives a best mean accuracy but standard deviation of RF is smallest, so we choose the RF because it is very stable and gives a good accuracy.

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Computationally Efficient Estimation of Heart Rate from PPG Signals

Salah Ferdi*, Fayçal Abdelliche
National Polytechnic School of Constantine, Constantine, Algeria
*E-mail : ferdi.salah1@gmail.com

Abstract: Heart rate monitoring using photoplethysmographic (PPG) signals is becoming increasingly popular due to the simplicity of device design and the low cost of wearable technology.Measuring HR from PPG signal using battery-powered wearable devices with limited resources requires computationally efficient algorithms. This paper presents a simple yet accurate heart rate estimation method based on a systolic peak detectionalgorithm that employs a fractional-order calculus-based filter. The proposed method was validated on the CapnoBase benchmark dataset, demonstrating an overall Average Absolute Error (AAE) of 1.78. These results are comparable to those achieved with state-of-the-art methods, while the proposed method offers the advantage of simpler implementation.

Keywords: heart rate, systolic peak, PPG signal.

1. INTRODUCTION

The photoplethysmographic(PPG) signal represents changes in blood volume in peripheral tissues, and is measured as the variations in the intensity of light (either reflected or transmitted) emitted by a light source (LED) and detected by a photo-detector [1]. PPG signals can be acquired at different locations of the human body including fingertips and earlobes for pulse oximetry and wrists for wearable devices such as smartwatches.PPG signals can also be acquired through camera-based photoplethysmography methods that utilize smartphone cameras or webcams.

Traditionally, the electrocardiogram (ECG) signal has been regarded as the gold standard for measuring heart rate, defined as the number of heartbeats per minute. However, in recent years, there has been increasing interest in using the PPG signal for heart rate (HR) measurement [2]. Unlike electrocardiography, which requires conductive gels, precise electrode placement, and wired connections, photoplethysmography is an optical technique that uses a simpler setup. This makes it more suitable for integration into wearable devices like smart-watches and fitness trackers, enabling continuous heart rate monitoring in everyday situations.

The core component of a heart rate estimation method based on the PPG signal is the beat detector. The more accurate the detector is the more reliable the heart rate measurements. The heart rate is often deduced from the inter peak intervals calculated as the time intervals between successive systolic peaks [3]. Previous methods developed to calculate heart rate from PPG signals have used various approaches, including time-domain peak detection [4], spectral-domain peak detection [5], and machine learning algorithms and deep learning models [6]. Although these methods have been successfully applied to heart rate measurements, they are computationally expensive and/or sensitive to noise.

Measuring HR from PPG signal using battery-powered wearable devices with limited resources requires computationally efficient peak detectors. In this work, heart rate is estimated using PPG systolic peaks, which are detected using a computationallyefficient and accurate algorithm for PPG systolic peak detection.

2. RESULTS AND COMPARISON WITH EXISTING METHODS

The proposed method achieves an overall AAE of 1.78. Many methods for heart rate estimation have been evaluated on various PPG datasets, and their performance is highly dependent on the dataset used. A recent paper [9] reports an Average Absolute Error (AAE) of 1.05 on the CapnoBase dataset. In comparison, the proposed method achieves an AAE of 1.78, while offering the advantages of simpler implementation and lower computational cost.

3. CONCLUSION

An efficient and accurate method based on a PPG systolic peak detector has been proposed for heart rate estimation. This method offers a simple yet effective solution for PPG-based heart rate estimation with low computational cost. Future research will explore the application of the proposed method for heart rate estimation during physical activity.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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BFIDS: A Blockchain-Federated Learning Framework for Robust Intrusion Detection in IoT Networks

Abid Malika[(1)*], Abdelhammid Bouazza [(2)],Abdessalam Mohammed Hadjkouider[(3)]
[(1) (3)] Dpt. of Computer Science and IT KasdiMerbah University of Ouargla, Algeria.
[(2)] Department of Computer Science, University of M'sila,M'sila, Algeria
[*]abid.malika@univ-ouargla.dz, abdlhammid.bouazza@univ-msila.dz ,abdessalam.hadjkouider@univ-ouargla.dz

Abstract: The rapid proliferation of Internet of Things (IoT) devices has enabled unprecedented data sharing, thereby significantly enhancing manufacturing efficiency. However, this heightened interconnectivity also exposes network systems to various intrusion attacks. Consequently, there is an urgent demand for an efficient intrusion detection system (IDS) capable of identifying novel attack types. Commonly trained centrally, conventional IDS approaches often lack scalability and exhibit limitations in detecting emerging threats. To address these challenges, this paper introduces BFIDS, a novel framework that integrates blockchain technology with federated learning based on a convolutional neural network (CNN). By combining the decentralized and immutable attributes of blockchain with the collaborative training paradigm of federated learning, BFIDS achieves improved detection accuracy while reducing false positives. Additionally, the framework ensures transparent, privacy-preserving data exchange, coupled with reliable model updates and validation processes. Experiments show that BFIDS finds malicious entities more accurately than other methods and does a better job overall, making it a scalable and reliable choice for real-life network security needs.

Keywords: Intrusion Detection System (IDS), Blockchain, Federated Learning, Convolutional Neural Network (CNN), Internet of Things (IoT), Cybersecurity

1. INTRODUCTION

The Internet of Things (IoT) encompasses a vast network of interconnected devices with computing capabilities. Examples include sensors and processors that gather, store, and share data across the internet [1]. These devices work together toward common goals, facilitating their application in diverse domains such as smart homes, healthcare, and industrial operations. By automating tasks among remotely managed devices, IoT technology offers substantial benefits to enterprises and individual users, notably in terms of heightened operational agility and efficiency.

The International Data Corporation (IDC) projects that robust market demand will drive IoT devices to reach 41.6 billion by 2025 [2]. However, this rapid expansion also poses considerable security challenges. IoT devices frequently handle sensitive data—personal, financial, and medical information—that makes them prime targets for cyberattacks [3]. Moreover, the dispersed nature of IoT networks, which often include nodes operating at the network edge, further complicates establishing reliable security measures [4]. Compromising a single device can jeopardize the entire system, threatening privacy and security.

Integrating digital and physical systems within IoT environments escalates the consequences of potential breaches. A notable example is the 2015 cyberattack on the Ukrainian power grid, which caused a massive blackout affecting 1.4 million people [5][6]. This event underscores the pressing need for robust security mechanisms to safeguard IoT systems against major intrusions.

IoT-based intrusion detection systems (IDS) increasingly use machine learning (ML) approaches to address these challenges. By scrutinizing data transfer patterns, ML-based IDS can detect anomalies and distinguish between benign and malicious activities [7]. ML-driven IDS are better at finding new and difficult threats, like zero-day vulnerabilities and Advanced Persistent Threats (APTs) [8], than traditional methods that rely on predefined Indicators of Compromise (IOC) [9]. This means that IoT networks are safer.

In response to these needs, this paper proposes a novel framework that leverages **blockchain** and **federated learning (FL)** to enable secure and privacy-preserving collaboration in ML-based IDS for IoT

environments. The proposed framework harnesses the collective intelligence of multiple organizations by sharing detection insights while ensuring that sensitive local data remains confidential. Specifically, FL trains machine learning models across multiple devices without transmitting raw data, and blockchain safeguards integrity, transparency, and security within the collaborative process [10]. This combined approach yields a scalable and robust solution suitable for various network security scenarios, bolstering intrusion detection capabilities while preserving data privacy.

FEDERATED LEARNING

FL is a decentralized methodology enabling multiple devices or nodes to collaboratively train a shared model without exchanging raw data. Unlike traditional centralized techniques, which typically send all local data to a central server, FL keeps data on the source devices and communicates only model parameters or gradients [11]. This framework preserves privacy and mitigates the overhead associated with large-scale data transfer, making FL particularly valuable in environments where bandwidth is limited or data sensitivity is paramount.

BLOCKCHAIN

Blockchain is a distributed ledger technology that records transactions securely, immutably, and transparently across a network of computers. Originally developed to support cryptocurrencies like Bitcoin, blockchain has since found adoption in various sectors, from finance to healthcare, enabling trusted, peer-to-peer interactions without centralized oversight [12].

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Rotor Bar Breakage Fault Diagnosis in Asynchronous Machines using Support Vector Machines (SVM)

Ahmed AMRANE[(1)*], Ali CHABANE[(1,2)], SmailADJERID[(2)]
[(1)] Department of Industrial Engineering and Maintenance, National Higher School of Advanced Technologies (ENSTA), Algiers, Algeria
[(2)] Solid Mechanics and Systems Laboratory (LMSS), M'Hamed Bougara University (UMBB), Boumerdes, Algeriadept.
[*]ahmed.amrane@ensta.edu.dz

Abstract: In industrial applications, electric motors must operate continuously to maximize uptime, making system monitoring and fault diagnosis essential to prevent costly downtime and hazardous situations. While model-based approaches have traditionally been used for diagnosing induction machines, recent years have seen a shift towards artificial intelligence (AI) methods. Among these, the Support Vector Machine (SVM) has emerged as an effective machine learning technique for classification and pattern recognition tasks.This study employs SVM to classify the operational states of asynchronous machines, specifically distinguishing between healthy conditions and three types of rotor bar breakages. Using measurable data such as current, a mono-class algorithm for accurate fault classification. Various simulations demonstrate that SVM can achieve classification effectiveness of up to 90%. Notably, training based on torque-speed characteristics yielded the most consistent results, particularly as the training dataset size increased.

Keywords: induction machine, broken rotor bars defects, support vector machine (SVM), machine learning, fault diagnosis, fault classification.

1. INTRODUCTION

In an industrial environment, preventive maintenance is essential for foreseeing and preventing defects and breakdowns before they occur. It allows for anticipating potential problems and implementing preventative measures, thus saving money on production downtime and lost productivity [1, 2]. Furthermore, by adhering to rules and quality standards, enhancing production, improving safety, and extending the lifespan of equipment, preventive maintenance plays a key role in overall operational efficiency [3, 4].

Asynchronous machines are vital in industrial settings, valued for their cost-effectiveness, reliability, and durability. Widely used in applications such as production systems, machine tools, conveyors, pumps, and fans, these machines are the most common type of motor in the industry. Key advantages include variable-speed operation, low cost, minimal maintenance requirements, and high starting torque, making them ideal for a variety of industrial applications [5, 6].

Diagnostics are a crucial aspect of industrial maintenance, enhancing equipment and process reliability and safety. Effective diagnostics boost productivity by minimizing downtime, improving operational efficiency, optimizing maintenance strategies, and enhancing product quality [5]. Choosing the appropriate diagnostic method is vital and depends on the specific system or equipment, the nature of the issues, and available resources.

Various diagnostic techniques are documented in the literature for identifying and resolving issues in industrial systems. For example, methods such as nonlinear analytical redundancy have been applied to detect faults in asynchronous machines [7].

2. DYNAMIC MODEL OF INDUCTION MACHINE

Using the databases derived from the mathematical models given, and approach is validated using binary learning with the Support Vector Machine technique.

The SVM learning visualization is seen in Figure (A), where each class's points are displayed in a variety of forms and hues. Conversely, Figure (B) displays the binary SVM algorithm's classification outcomes.

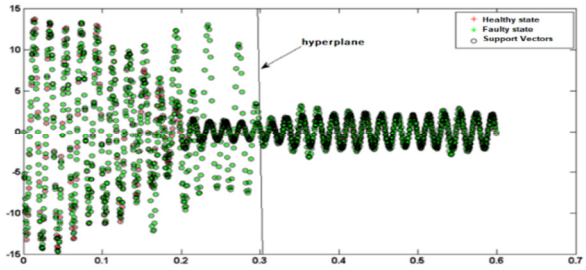

Figure A: Visualization of binary SVM classification training results.

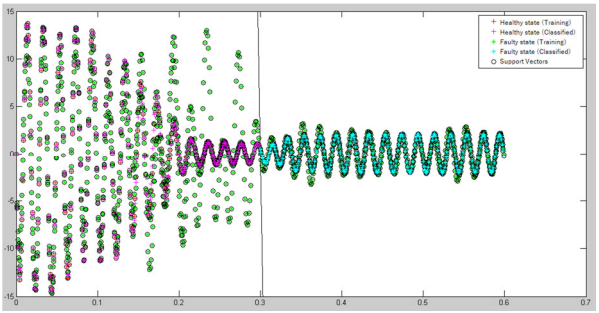

Figure B: Visualization of binary SVM classification results.

The databases used in Figures (A) and (B) were obtained from an interval of [1: 600] and were modified with a rotor resistance of Rr = 0.001 ohm. Based on figure (A) and by training, the following may be done:

- Distinguish the class hyperplane
- Classify data into two classes using

- Healthy machine [pink dots], with a high concentration of these dots in the interval [0s, 0.2s] and a decrease from 0.3s onwards.

- Faulty machine [blue dots], the distribution of green dots is along the interval [0s, 0.6s] because we injected the three databases of the machine with broken bars, which explains the concentration of these dots during the chosen time.

  Table (01) provides the results of the calculations for various parameters such as accuracy, F-score and accuracy. It highlights the performances obtained for each parameter, by presenting those obtund for the case torque Ce according to speed.

Table 01 : Performance Indices (Ce according to w)

Accuracy	Precision	Recall	F- score
0.9	0.90389	0.9	0.90194

Based on this Performance, the proposed algorithmhave an accuracy of 90%, indicating that it has managed to correctly classify most observations.

The error, on the other hand, represents the proportion of observations incorrectly classified in relation to the total number of observations. A lower error indicates a better ability of the model to correctly predict the data. The predicted curve have a lowest error, suggesting that it has managed to minimize the number of misclassified observations. The proposed method was able to classify a large number of observations accurately with a small proportion of errors. Moreover, the simulation time of 11 is also reasonable compared to other curves.

3. CONCLUSION

This study focuses on detecting rotor bar break defects in electric machines using Support Vector Machine (SVM) classification. Initially, a binary SVM model was developed to differentiate between healthy and defective states, followed by a multi-class SVM to classify various break defects (one, two, or three broken bars). Torque as a function of speed proved to be the most effective feature for assessing machine condition. The results highlighted SVM's reliability for defect identification, with database size improving accuracy but increasing simulation time. Future work could investigate additional defects and incorporate Motor Current Signature Analysis (MCSA) and vibration analysis to improve diagnostics and machine efficiency.

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Artificial palpation system with force feedback

Abou-Bakr MEGUENNI-TANI [1*], Kamila KHEMIS [2] and Youssouf BELABED [3]

[1]Electrical Engineering and Electronics Department/Faculty of Technology, University of Tlemcen, Algeria
[2]Biomedical Engineering Department/Faculty of Technology, University of Tlemcen, Algeria
[3]Mechanical Engineering Department/Faculty of Technology, University of Tlemcen, Algeria

[*]aboubakrmeguennitani@gmail.com

Abstract **–**Laparoscopic Surgery is a minimally invasive technique based on the use of surgical instruments inserted via trocars and the visualization of the explored organs on a monitor. However, the amputation of sense and the lack of tactile feedback information prevent the surgeon to recognize the shapes, the structures and the stiffness of the tissue. The objective is to recover the palpation sense artificially to allow to a human surgeon to have feedback of palpation during laparoscopic surgery. So, in this study we model a systememploying a combination of SolidWorks and Abaqus software and optimizing the laparoscopic instrument with adding an artificial palpation system with force feedback to a grasper with a linear response.

Keywords **–**haptic feedback; laparoscopic surgery; palpation; deformation; minimally invasive surgery

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Dynamic Feedback Motion Planning for Car-Like Robots Using Funnel-Graph Algorithm

DERAR Iyed [(1) *], GUERNANE Reda [(2)],
[(1) (2)] Institute of Electrical & Electronics Engineering, University of Boumerdes, Boumerdes,Algeria
[*]derariyed@gmail.com

Abstract: This study presents a funnel-based motion planning algorithm for a car-like robot, utilizing a dynamic model to capture the robot's motion.The funnel-based planner addresses the obstacle avoidance problem and dynamically updates the path to guide the robot to its goal. The proposed algorithm's performance is evaluated in a dynamic environment, and with a dynamic goal where re-planning capabilities are demonstrated. The results indicate that funnel planner provides robust navigation even in uncertain conditions.
Keywords: funnel, dynamic model, motion planning, car-like robot

1. INTRODUCTION

Motion planning algorithms are crucial for guiding robots in tasks. Traditional methods like PRM and RRT [1][2][3] create open-loop plans, while feedback motion planning, such as potential field methods [5][6][7], improves adaptability by using real-time feedback for closed-loop execution. Burridge [8] introduced funnels, where local controllers guide states through funnel-shaped regions. Building on funnel-graph generation [4]-[14], our work adapts this for dynamic environments and goals, focusing on a dynamic car-like robot model.

2. The Funnel-Graph Algorithm:

The Funnel-Graph Algorithm estimates obstacle-free areas, initializes at the goal, and iteratively samples collision-free states within the map. To minimize funnel numbers, it applies an exponential rejection condition

$$Uniform[0,1] > e^{-\frac{1}{neighbourhoodradius}} \quad (4)$$

Samples outside existing neighborhoods but intersecting at least one are added as new funnels, with edges based on intersecting centers. Dijkstra's algorithm is used to form a path when the start state and desired coverage are achieved. Figure 1 and figure 2 illustrate an experiment where a coverage criterion of 96 percent is used.

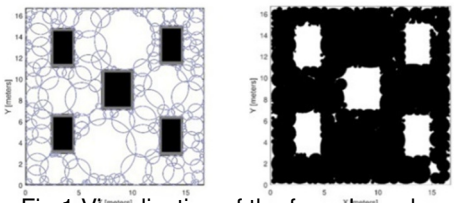

Fig.1 Visualization of the funnel-graph Algorithm(left)and Coverage estimation map(right)

3. Execution Phase:

In a dynamic environment:

Figures3 depict the scenario when the robot faces a not-anticipated road blockage the algorithm adapts to the event and adjusts the connectivity of the graph accordingly and generate new path funnels ensuring a safearrival to the goal.

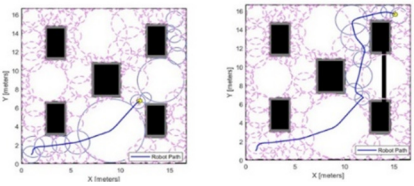

Figure 3 : Before the blockage appears (right) Adaptation after the blockage of the initial path (left).

With a dynamic goal in a dynamic environment

In this setup, the Follower robot (yellow, red trace) aims to reach and track the Leader robot (red, blue trace) in a dynamic, obstacle-filled environment. The Follower adapts its path using a graph-based structure to find the shortest, obstacle-free route. As the environment changes, the Follower continuously updates its trajectory within a predefined funnel to maintain proximity to the Leader while avoiding obstacles. This scenario tests the algorithm's ability to respond to rapid environmental changes, recalculating paths in real-time while ensuring the Follower stays close to the

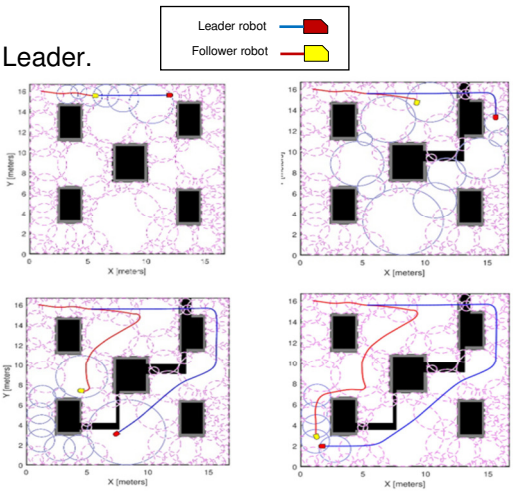

Figure 2 : Leader-Follower in a dynamic environment.

4. CONCLUSION

The paper introduces a funnel-based motion planning algorithm for car-like robots, enabling real-time path adaptation in static and dynamic environments. It employs feedback and a funnel-graph structure to handle dynamic goal scenarios and obstacle avoidance. Simulations show effectiveness in rapidly changing conditions, with potential for future extensions to multi-robot systems.

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Blood-based Biomarker Panels for Diagnosis of Alzheimer's Disease

Zakaria MOKADEM[(1)*], Mohamed DJERIOUI[(1)],Bilal ATTALLAH[(1)], Youcf BRIK[(1)]
[(1)]LASS Laboratory, Faculty of Technology, University of M'sila, University Pole, BordjBouArreridjRoad, M'sila28000, Algeria.
[*]zakaria.mokadem@univ-msila.dz

Abstract: Alzheimer's disease (AD) is characterized by the gradual degeneration of cognitive functions such as memory, thinking, and reasoning. Diagnosing AD through blood proteins is an important step that can help doctors to detect AD in its early stages. Our study aims to introduce novel blood protein panels that can serve as biomarkers for diagnosing AD. We used samples from the Alzheimer's Disease Neuro-imaging Initiative (ADNI) to examine multiple combinations of plasma proteomics. A sequential backward feature selection (SBFS) technique was used to select significant proteins, using two machine learning algorithms: extreme gradient boosting (XGBoost) and adaptive boosting (AdaBoost) classifiers. From 146 blood plasma proteins collected from 112 AD patients and 58 healthy controls (HC), we identified two panels consisting of 18 and 19 proteins, respectively. These panels show potential as diagnostic biomarkers for Alzheimer's disease based on blood analysis.

Keywords: Alzheimer's Disease, Blood biomarker, Machine Learning, Feature Selection

1. INTRODUCTION

Alzheimer's disease (AD) is a gradient degeneration of essential cognitive activities such as memory, thinking, and cognition that typically affects individuals aged 60 years and older [1]. Generally, AD is characterized by the progressive death of nerve cells, which is caused by the accumulation of extracellular amyloid-β (Aβ) plaques and interneuronal neurofibrillary (NFL) tangles composed of forms of the protein Tau [2]. Diagnosing Alzheimer's disease through blood biomarkers is considered a crucial step, as it offers accessibility, generalizability, and availability of this diagnostic technique [3,4]. Brain-derived biomarkers are typically present at relatively low concentrations in the blood, primarily due to the blood-brain barrier (BBB), which restricts the free passage of molecules between the central nervous system (CNS) and blood [5]. However, the progressive damage to the BBB in AD patients may allow some proteomics molecules to pass into the blood, thereby enabling the possibility of diagnosing patients based on plasma proteins.

Our study introduces new panels of plasma proteins that can serve as valuable diagnostic tools for diagnosing Alzheimer's disease.

2. MATERIAL AND METHODS

This study used samples collected by the Alzheimer's Disease Neuro-imaging Initiative (ADNI) to qualify multiple panels in plasma proteomics[6]. We applied a sequential backward feature selection (SBFS) technique for selecting the significant proteins, based on two machine learning (ML) algorithms: extreme gradient boosting (XGBoost) and adaptive boosting (AdBoost) classifiers. The dataset lists 170 subjects, representing baseline data on the concentration of 146 blood plasma proteins derived from a cohort of 112 Alzheimer's disease (AD) patients and 58 healthy controls (HC). The available neuropsychological assessments in ADNI, such as the mini-mental state examination (MMSE) and Clinical Dementia Rating (CDR), were used to label the clinical groups.

SBFS is a top-down search procedure that excludes features by applying the basic sequential backward selection (SBS) procedure, starting from the current feature subset, followed by a series of successive conditional inclusions of the most significant feature from the available features if an improvement can be made to the previous subsets [7]. We trained the two machine learning models with all possible combinations of the 146 proteins from the dataset. For each model, the training accuracy was recorded toselect the subsets

that achieved the best classification accuracy.

3. RESULT

The SBFS algorithm selected the group of proteins that achieved the highest accuracy. The XGBoost and AdaBoost models achieved accuracies of 93.52% and 95.88%, respectively. The selected proteins, which constitute the combination of biomarkers, are presented in Table 1. The results of the SBFS algorithm for the classification of each subset are shown in Figure 1 and Figure 2. Figure 1 illustrates the performance accuracy of the gradient boosting classifier's subsets, while Figure 2 shows the performance accuracy of the AdaBoost classifier's subsets.

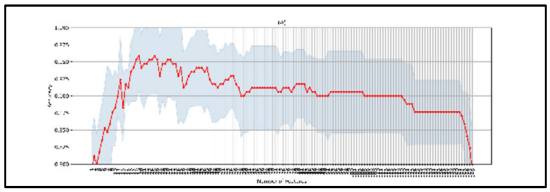

Fig. 1 Performance accuracy of subsets of the gradient boost classifier.

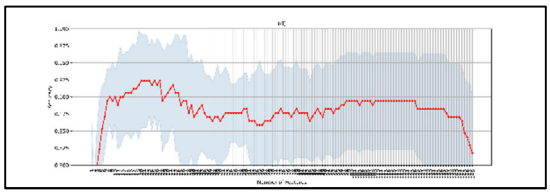

Fig. 2 Performance accuracy of subsets of the AdBoost classifier.

Table 1. The proteins selected by the SBFS technique

Machine learning	Proteins selected	Accuracy
XGBoost	A1Micro, ACE, Apo A-II, Apo A-IV,Apo B, Apo E, BMP-6, BNP, BTC, CD5L, IGM, IL-16, IL-8, MIP-1 alpha, PYY, SGOT, Sortilin, TN-C.	93.52%
AdBoost	AGRP, Apo A-II, Apo B, Apo E, BMP-6, BNP, BTC, CA-19-9, FRTN, HGF, IL-16, IFN-gamma, PPP, Proinsulin-Total, PYY, RAGE, Transferrin, TTR, VKDPS.	95.88%

Apo A-II: Apolipoprotein A-II; IL-16: Interleukin-16; PPP: Pancreatic Polypeptide; Apo A-IV: Apolipoprotein A-IV; Apo B: Apolipoprotein B; Apo E: Apolipoprotein E;MIP-1 alpha: Macrophage Inflammatory Protein-1 alpha; PYY: Peptide YY; TTR: Transthyretin; BTC: Betacellulin; TN-C: Tenascin-C; ACE: Angiotensin-onverting Enzyme; BMP-6: BoneMorphogeneticProtein 6; BNP: Brain Natriuretic Peptide; IL-8: Interleukin-8; SGOT: SerumGlutamicOxaloacetic Transaminase; AGRP: Agouti-RelatedProtein; CA-19-9: Cancer Antigen 19-9; FRTN: Ferritin; HGF: HepatocyteGrowth Factor; IFN-gamma: Interferon gamma InducedProtein 10; PPP: Pancreatic Polypeptide; RAGE: Receptor for advanced glycosylation end; VKDPS: Vitamin K-DependentProtein S.

4. CONCLUSION

In conclusion, our study identified two panels of proteins. The first panel consists of 18 proteins: A1Micro, ACE, Apo A-II, Apo A-IV, Apo B, Apo E, BMP-6, BNP, BTC, CD5L, IgM, IL-16, IL-8, MIP-1 alpha, PYY, SGOT, Sortilin, and TN-C. The second panel includes 19 proteins: AGRP, Apo A-II, Apo B, Apo E, BMP-6, BNP, BTC, CA-19-9, Ferritin, HGF, IL-16, IFN-gamma, PPP, Proinsulin-Total, PYY, RAGE, Transferrin, TTR, and VKDPS. These panels show promise as diagnostic biomarkers for Alzheimer's disease based on blood analysis.

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Evolving Smart TV for Safeguarding Children: Enhancing User Experience with IoT and Deep Learning

Farida BETTOU [(1,2)*], Abdelhamid BOUDJIT [(1)]
[(1)] Higher Normal School El KatibaAssiaDjebar (ENSC), Constantine, Algeria
[(2)] Laboratory of Applied Mathematics and Didactics, Constantine, Algeria
*bettou.farida@ensc.dz

Abstract: Smart TVs have become a central component of modern households, providing access to a wide variety of educational and entertainment content. However, ensuring child safety while using these devices is a growing concern, as children are among the most vulnerable members of society. They rely on an adult for their care, protection, and well-being. Exposure to culture and age-inappropriate content, excessive screen time, and privacy threats are significant challenges faced by parents. This research aims to investigate the potential of deep learning techniques in combination with Internet of Things (IoT) systems to address these challenges, enhancing child safety and promoting better educational outcomes. We, also, conduct an in-depth review of recent research on the application of deep learning algorithms with IoT devices in various fields. Our research focuses on developing a security system for Smart TVs consisting of two components. The first component focuses on detecting faces in images and estimating attributes such as age and gender using deep learning algorithms to identify the user. Additionally, we propose a set of rules to provide personalized recommendations and accurately predict future content trends. The second component, which is connected to the first, utilizes its results to send messages or notifications to parents through IoT, ensuring a secure and controlled environment for children. Our findings indicate that this integration has the potential to significantly improve child safety and education. As technology continues to advance, smart TVs will increasingly become central to the family home, providing a safer and more enriching media experience for children.

Keywords: Internet of Things (IoT), Deep Learning (DL), Machine Learning (ML), Artificial Intelligent (AI), Smart TV, Safeguarding Children.

1. INTRODUCTION

A smart TV is a lean-back and shared device for individuals and family members [1]. The latest smart TVs are embedded with branded operating systems [2]; furthermore, various applications have been developed for these devices, providing multiple services and functionalities, such as video-on-demand, online and offline games, live channels, movies, dramas, TV shows, Web browsing, social networking, and Content recommendations[1].

Children's use of smart TVs is becoming increasingly common, as this device provides access to a lot of entertainment and educational content that can be beneficial to them, videos, games, educational programs, and even social media applications. Some applications, also, provide educational content specifically for children that enhances their language, mathematical, and creative skills [3, 4].

The Internet of Things (IoT) connects billions of smart devices that communicate with minimal human intervention. As one of the fastest-growing fields in computing, it was projected to encompass 50 billion devices by the end of 2020. However, the interconnected nature of IoT systems and the diverse multidisciplinary components involved in their deployment have also introduced new security challenges [5].

Deep learning offers significant benefits, such as improvement of data analysis accuracy, intelligent automation of complex tasks, and accurate prediction of future trends. It also enhances AI's capabilities in understanding natural language and developing intelligent robots. These benefits make deep learning a powerful tool for enhancing performance and providing innovative solutions across various fields.

In recent years, deep learning (DL) approaches have been used from various perspectives to enhance indoor IoTapplications across several key areas, including agriculture [6], healthcare [7], and industrial cybersecurity [8], and many other areas [9,10].

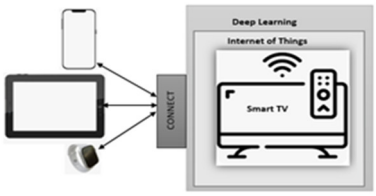

Fig. 1 Our Architecture Design

Fig. 1 illustrates our integrated system consisting of multiple smart devices connected to a smart TV through Internet of Things (IoT) and deep learning technologies. The key elements include:

•Connected Devices: These include a smartphone, a tablet, and a smartwatch, all connected to the smart TV through our communication interface (CONNECT). These devices act as interactive tools that allow the user to control the smart TV or send data to it.

•Smart TV: The smart TV communicates with the connected devices through IoT, relying on deep learning to enhance user experience, such as face recognition and personalized content recommendations.

• Internet of Things (IoT): Represents the connection between the smart devices and the Smart TV, enabling data exchange and interaction without direct user intervention, thus enhancing control and smart functionality.

• Deep Learning: Refers to the use of artificial intelligence to analyze data received from smart devices, allowing the system to offer personalized services and improve smart TV functions, such as user recognition and tailored recommendations.

Our technology represents an evolution in making devices more interactive and secure, which contributes to improving child safety in innovative and practical ways.

We utilized a dataset containing hundreds of thousands of recent YouTube videos, which were classified and organized for our system. This approach was necessary because directly accessing content through the YouTube platform can be costly and may require legal permissions. The dataset was downloadedfrom a platform dedicated to artificial intelligence. Although Unsplash, a popular website known for its vast collection of free, high-quality images, is primarily used for images contributed by photographers, the dataset itself was sourced from a different AI-focused repository. Unsplash allows for the use of images in both personal and commercial projects without requiring credit to the photographer, though it is appreciated.

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Protocol Implementation For The Battery's Data Transmission

Abdelaziz ZERMOUT[(1)], Hadjira BELAIDI[(1)*],Djillali KADDOUR[(1)], Omnia ADAIKA[(1)],Nedjwa BAHOUSSI[(1)]

[(1)] Signals and Systems Laboratory, Institute of Electrical Electronic Engineering University M'HamedBougara,Boumerdes, Algeria

* hadjira983@yahoo.fr/ ha.belaidi@univ-boumerdes.dz

Abstract: This paper examines developing and implementing a robust communication protocol designed for real-time monitoring and control of battery systems. The implemented system gathers critical data from the battery, including voltage, current, and State of Charge (SoC). This data is transmitted to a Raspberry Pi microcontroller at five-second intervals. The Raspberry Pi serves as an intermediary, forwarding the data to a dedicated webpage for visualization and analysis. Furthermore, the data is stored in an InfluxDB database, facilitating long-term storage and utilization. This database supports the generation of graphical representations, thereby enhancing the interpretation of battery performance trends and enabling informed decision-making regarding battery management strategies. The comprehensive nature of this system provides real-time insights into battery health and performance, ensuring effective monitoring and control across various applications.

Keywords: State of Charge (SoC), Li-ion Battery, InfluxDB database, communication protocol

1. INTRODUCTION

Battery Management has emerged as an essential component in ensuring the optimal performance, safety, and longevity of rechargeable battery packs across various industries and applications[1].

The core functionality of Battery Management resides in its capacity to monitor, control, and protect battery cells or packs. Utilizing a combination of sensors, microcontrollers, and advanced algorithms, it continuously assesses the battery's state, overseeing critical parameters such as voltage, current, temperature, and State of Charge (SoC)[2], [3]. This real-time monitoring empowers battery management to optimize both charging and discharging processes, mitigate the risks of overcharging and over-discharging, and maintain the battery within safe operating parameters[4].

The battery communication protocol, encompassing both wired and wireless methods [5], [6], [7], enables efficient and reliable data transmission, as well as error detection and correction.

2. BATTERY COMMUNICATION PROTOCOL

The first step in our work, after setting up the hardware illustrated in the diagram given in Fig. 1, was to program the ESP32 microcontroller to initiate battery charging. Once the battery was fully charged, Relay 1 is opened and Relay 2 is closed (for discharging) using PIN 2. The algorithm coded in the ESP32 can be summarized in the following pseudocode:

1. Read current, voltage, and temperature.
2. If the current or voltage is out of range, open the relays and stop.
3. If the temperature is high, start the fan; otherwise, stop the fan.
4. Compute mAh.
5. Send the data (various parameter variables).
6. Wait for the 5-second timer interrupt to complete, then repeat the process.

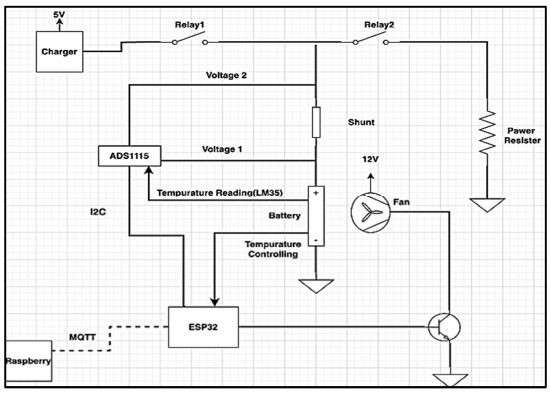
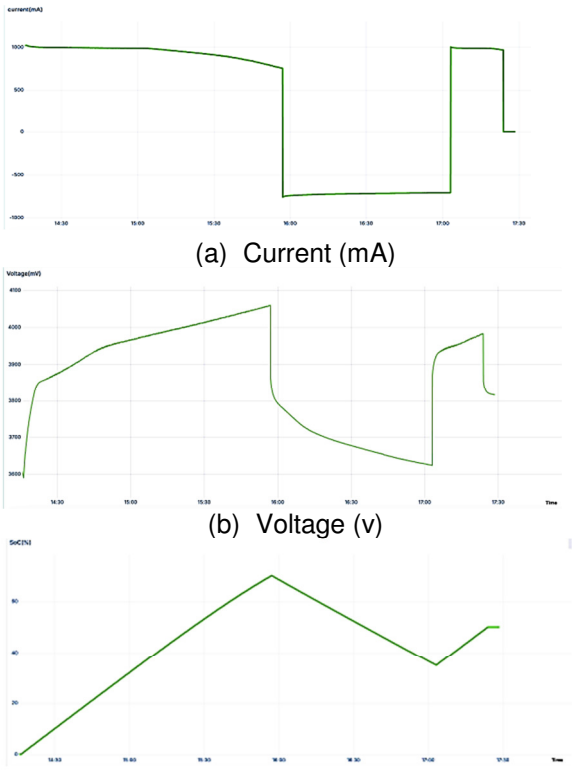


Fig. 1 Battery Management System Diagram.

A similar process was implemented for the Raspberry Pi to receive BMS data from the ESP32. Then send it to the webpage that has been created using the HTTP protocol every 5 seconds, and display it in the form of a table.To create the graphs illustrating the measured current, voltage, capacity, and State of Charge (SoC), InfluxDB was employed as the database for managing our time-series data, with Grafana serving as the visualization tool.

3. RESULTS AND DISCUSSION

To accurately determine the State of Charge (SoC) of our BMS, a controlled charging and discharging cycle was implemented. The process involves setting the charge pin to high for charging it from zero to eighty percent of its full capacity, while monitoring the battery capacity over a predetermined time, taking the initial SoC equal to zero and the maximum 2258 mAh. Using coulomb's counting equation[17], the value of SoC at each 5 seconds was calculated. The obtained results are shown in Fig. 2.



(a) Current (mA)

(b) Voltage (v)

(c) SoC (%)

Fig. 2 Battery measured variables posted on Grafana.

We established reliable communication between the devices and identified the maximum capacity of the lithium battery as 2258 mAh. We implemented controlled charge-discharge cycles to evaluate the State of Charge (SoC). The system accurately monitored current, voltage, and capacity, demonstrating consistent battery behavior consistent with typical lithium-ion characteristics.

4. CONCLUSION

Key contributions of this paper include the development of a robust BMS communication protocol, such as MQTT, the implementation of a real-time monitoring and control system, and the integration of InfluxDB for data storage and visualization through Grafana. By providing real-time insights into battery health and performance, the system facilitates the optimization of battery usage, cost reduction, and enhancement of overall system reliability. In summary, this work has effectively demonstrated the development and deployment of a comprehensive battery communication protocol, presenting a reliablesolution for the real-time monitoring and control of battery systems. This system can be improved by including other condition monitoring such as State of the Health (SoH).

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Analysis and Design of Terahertz Symmetrical Slot Antenna Based on Photonic Crystal Substrate

BENGHERBIA Ayoub[(1)*]
[(1)] Laboratory of Advanced Electronic System (LSEA), Department of Electrical Engineering, Faculty of Technology, University Yahia Fares of Medea, 26000, Algeria
[*]Corresponding author e-mail : bengherbia.ayoub@univ-medea.dz

Abstract: This study designs and analyses a photonic band gap substrate-based terahertz slot microstrip patch antenna operating in the frequency range of 0.6 to 0.7 THz. In order to meet the demands of the most recent wireless communication technology, good antenna performance at 0.65 THz is the goal of researchers and this study for this promising type of antennas. Among the exciting applications of terahertz band include but not limited to wireless communication technology, medical research, sensing, and imaging. In fact, since terahertz spectra offers unique properties including a high bandwidth and less diffraction than other wavelengths, they are used in a broad variety of applications. These different engineering applications put antennas in the focus of research community. In this work, first, a traditional patch antenna without a photonic crystal substrate. with homogeneous substrate, is designed and analyzed for its electrical characteristics. After that, a slot antenna is developed. The proposed antenna, antenna 3, is based on slot antenna and photonic crystals structure. The suggested antenna exhibits strong radiation qualities at 0.642 THz with a return loss less than -10 dB and a bandwidth of 101 GHz, according to the results. The achieved gain is 8.57 dB. The model was conducted using the commercially available, finite integration method-based CST Microwave Studio simulator.

Keywords: Photonic crystals, Slot antenna; Microstrip antenna, Gain, Terahertz.

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Study and optimization of ultra-high bit rate all optical AND/OR logic gate based on interference beams using photonics crystals waveguide

BENGHERBIA Ayoub[(1)*]
[(1)] Laboratory of Advanced Electronic System (LSEA), Department of Electrical Engineering, Faculty of Technology, University Yahia Fares of Medea, 26000, Algeria
[*]Corresponding author e-mail : bengherbia.ayoub@univ-medea.dz

Abstract: In this work, we have objective to designed a new structure of all-optical AND/OR logic gates using the interference beams technique without using input phase shifter and nonlinear material. As a main advantage, the use of curved waveguides increases the power intensity of the output and opens a wider photonic band gap (PBG). As a result, a fast response time is estimated at 74.6 fs and high bit rate equal to 13.4 Tb/s. The amount of power transmitted to the output is varied between 1.2% to 6.5% and 71% to 114% for logic level '0' and '1' respectively. In addition, the proposed all-optical OR/AND logic function can be considered for ultra-fast integrated circuits in order to ensure their application in optical telecommunication systems. To analyze this proposed gate, two different numerical methods, Plane Wave Expansion (PWE) and Finite Difference Time Domain (FDTD) are used in order to estimate the propagation modes and the output spectrum, respectively.

Keywords: photonics crystasls (PC), interference beams, all optical logic gate, nano-resonators, FDTD method.

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Power Quality in Smart Systems: IoT and Microcontroller-Based Voltage Variation Classification

KHALDI BOUCHRA FERIEL[(1)*], Dr.F.Z DEKHANDJI[(2)],Pr.A.RECIOUI[(3)]
HAMOUCHATS NESRINE[(4)*], KHELIFI IMANE[(5)*],
[(1) ,(2), (3)]Laboratory of Signals and Systems organization (LSS), university of Boumerdes, Algeria
*b.khaldi@univ-boumerdes.com
fzdekhandji@univ-boumerdes.dz
a_recioui@univ-boumerdes.dz

Abstract: Smart metering systems significantly improve energy management by delivering real-time data on power quality. This study investigates the use of microcontrollers for detecting power quality disturbances through voltage RMS variation. The microcontroller executes a classification algorithm to identify power quality issues such as sags, swells, and interruptions. In the event of abnormal conditions, classification results are sent to an IoT application and Gmail, enabling timely notifications. This integrated approach can be utilized in smart meters, enhancing their capability to monitor and manage power quality effectively.

Keywords: Power Quality, Disturbances, Classification, RMS voltage variation, Smart Meter, ESP32 Microcontroller, IoT.

1. INTRODUCTION

Smart meters are a significant advancementin energy management, replacing traditional analog meters with digital devices that provide real-time data on energy consumption. This transition improves energy efficiency, facilitates better demand management, and enhances power grid reliability [1]. By offering real-time information, utilities can prompt consumers to adjust their energy usage during peak times, leading to cost savings and decreased demand on the grid [2]. Recent studies highlight the critical role of smart meters in integrating renewable energy sources [3]. As maintaining power quality becomes essential for grid stability, there is a growing need for effective monitoring and classification of disturbances [4]. Implementing advanced technologies can significantly enhance the ability to detect and respond to these issues in real time [5].In this context, the integration of smart meters with Internet of Things (IoT) technologyfurther enhances their functionality [6].This work aims to develop a novel approach to classify power quality disturbances (PQDs) based on RMS (root mean square)voltagevariation detection within an IoT framework, enhancing smart meters' capabilities and advancing sustainable energy management.

2. EXPERIMENTAL PROCEDURE

This study investigates the development and application of a hardware-based algorithm for classifying power quality (PQ) disturbances. The objective is to enhance the real-time monitoring and management of electrical disturbances. The hardware setup consists of an ESP32 microcontroller, a potentiometer, LEDs, a buzzer, and an LCD display, all working together to create an integrated system.

The ESP32 serves as the core processing unit, interfacing with the other components while the potentiometer simulates various voltage conditions to facilitate testing. The algorithm processes the signals received from the potentiometer to identify different PQ conditions, including normal voltage, voltage sags, swells, and interruptions. Immediate feedback is provided through the LCD display, and alerts are sent via email for any detected disturbances. The initial phase of the project focused on generating signals with different RMS voltage levels, enabling the analysis of multiple PQ scenarios.

3. RESULTS AND DISCUSSION

The experimental results are summarized in Table 1. The classification outcomes were shown on the LCD, with indicators provided by LEDs and a buzzer. Alerts were sent to the IoT application and Gmail for timely notifications of power quality disturbances (PQDs). Figures 3 and 4 display the classification results, indicating that the hardware system effectively differentiates between normal voltage, voltage sags, swells, and interruptions. Overall, these findings illustrate that the developed system enhances smart metering by improving real-time power quality monitoring and supporting efficient energy management, making it a useful tool for future smart meter applications.

Table 1 Results Summary

Type of Disturbance	LCD Output	Buzzer	LED Color	IoT App
Normal Condition	NC 1.02 pu	OFF	No indicator	OK NC
Voltage Sag	Sag 0.88 pu	On	Yellow	Warning (sag)
Voltage Swell	Swell 1.5 pu	On	Red	Warning (swell)
Interruption	Interruption 0.06 pu	On	Blue	Warning (interruption)

Fig.3 Classification Results

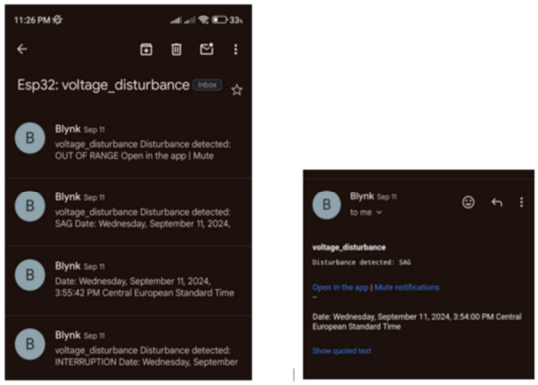

Fig. 4 Gmail Notification

4. CONCLUSION

In conclusion, this study successfully developed a hardware setup capable of monitoring power quality disturbances, which can also be adapted for use in smart meters. The system demonstrated effective detection and classification of various conditions, including normal voltage, voltage sag, swell, and interruption. The detection of RMS variations was particularly robust, ensuring accurate monitoring of power quality.Future work could explore the integration of advanced analytics to enhance classification capabilities and the incorporation of additional sensors. Expanding the IoT features could further improve the system's efficiency and enable remote access to data, facilitating better management of power quality in smart grid applications.

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Implementation Of An Assistive Hand

Hadjira BELAIDI[(1)*], ZARA Anis[(1)],Fethi DEMIM[(2)], Djillali KADDOUR[(1)], Abdelaziz ZERMOUT[(1)]
[(1)] Signals and Systems Laboratory, Institute of Electrical Electronic Engineering University M'HamedBougara,Boumerdes, Algeria
[(2)]Guidance and Navigation Laboratory, EcoleMilitairePolytechnique Bordj El Bahri, Algiers, Algeria
/ hadjira983@yahoo.fr [*] ha.belaidi@univ-boumerdes.dz

Abstract: This work focuses on developing an advanced robotic hand to assist individuals who have lost a hand. This robotic hand is designed to replicate the functionality and dexterity of a natural hand. Key features include wireless connectivity enabled by the ESP32 module, intuitive control through electromyography (EMG) sensors, and voice recognition capabilities. An accompanying Android application gathers health-related data and provides real-time notifications to healthcare providers.

Keywords: Assistive hand, ESP32, EMG sensors, voice recognition

1. INTRODUCTION

By automating repetitive or hazardous tasks, robots not only improve productivity but also reduce human error and risk[1], [2], [3].
The loss of a hand profoundly impacts an individual's daily life, encompassing both physical and emotional dimensions[4], [5]. Our work seeks to develop an advanced robotic hand that closely emulates the functionality and dexterity of a natural hand, thereby significantly enhancing the user's quality of life[6], [7], [8]. This sophisticated prosthetic device integrates cutting-edge technology, including wireless connectivity through the ESP32 module, which enables seamless communication with other devices and promotes enhanced user mobility[3], [9].
Control of the robotic hand is facilitated by electromyography (EMG) sensors, which detect muscle signals originating from the residual limb[10], [11], [12]. These signals are processed by a secondary ESP32 module, allowing for intuitive control through natural muscle movements. Additionally, voice recognition technology provides an alternative mode of operation, ensuring accessibility in diverse environments, even in the absence of Wi-Fi.
A vital component of our initiative is the creation of an Android application that serves as a comprehensive monitoring and reporting tool[13], [14]. This application aggregates health and activity metrics, including temperature, step count, distance traveled, and calories expended, thereby offering valuable insights for healthcare providers.
The paper starts by providing an in-depth analysis of the 3D printing technology of the design[15], alongside the integration of the ESP32 module for wireless communication, and the various sensors and servomotors. Then, it addresses the development of the Android application for monitoring and controlling the hand. The last section presents the work's findings and the developed application. The conclusion synthesizes our findings and reaffirms our commitment to ongoing innovation and enhancement.

2. CIRCUITS IMPLEMENTATION

Two cards were developed using ESP32 microcontrollers: the Hand Control card and the ECG Sensor card. The Hand Control card features an MPU6050 connection, Bluetooth for voice control, and Blynk integration for cloud connectivity. The ECG Sensor card is equipped with an ECG sensor that detects, processes, and interprets muscle signals; this enables the user to intuitively control the robotic hand using muscle movements.
The first ESP32 manages the robotic hand mechanism by utilizing data from the ECG sensor and communicates with the second ESP32 via the ESP-NOW protocol. It also supports voice control through Bluetooth and transmits data from the MPU6050 sensor to the Blynk platform for health monitoring. Meanwhile, the second ESP32 reads data from the ECG sensor and interacts with the first ESP32 over the same ESP-NOW protocol.

Fig. 1 The implementedapplication.

3. RESULTS AND DISCUSSION

The voice control application enables the rapid integration of voice command functionalities into our work through a Bluetooth connection with the ESP32 device. This application functions as an intelligent assistant, capable of executing commands to control various features.This capability has been implemented to provide full manual control in situations where a Wi-Fi network is not accessible (see Fig. 1).

Users can perform the following tasks by connecting their hand to the app via Bluetooth, tapping anywhere on the screen, and issuing voice commands:Open/close hand, Open/close index finger, Open/close thumb, Open/close middle finger, Open/close ring finger, Open/close pinky finger, and Numerical commands: one, two, three, four, five.

Fig. 2 Hand voice and ECG control.

The electromyography (EMG) sensor produces a voltage output that fluctuates following the intensity of muscle activity. When muscle activity is minimal, the signal remains low, approaching zero; thus, the hand will remain open. Conversely, during periods of substantial muscle activity, the signal exhibits a marked increase, as evidenced by the 4095 value and the hand will close as depicted in the last picture of Fig. 2.

4. CONCLUSION

Our work embodies a blend of technology, accessibility, and empathy. By integrating wireless communication, EMG control, and voice recognition, we have developed a versatile robotic hand. As users adapt to their new limb, our Android application serves as a companion, gathering essential data such as temperature, steps taken, and calories burned to offer insights into overall health and usage patterns. Healthcare providers receive real-time notifications, facilitating proactive intervention when necessary.

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Study and analysis of non-uniform irradiation on the solar panels

[1*]Ramadhan MASMOUDI, [2]Mohammed KADDI, [3]WASSILA Mokhtari, [4]Salheddine KABOU, [5]AhmedSAIDI

[1*] Dr, LDDI Laboratory, Faculty of Science and Technology, University of Adrar, Algeria.
[2]Messe, Faculty of Science and Technology, University of Adrar, Algeria.
[3]Dr, LDDI Laboratory, Faculty of MSMCS, University of Adrar, Adrar, Algeria.
[4]Higher Normal School of Bechar, Bechar, Algeria.
[5]Dr, LDDI Laboratory, Faculty of Science and Technology, University of Adrar, Algeria.

E-mail: ram.masmoudi@univ-adrar.edu.dz (Corresponding author)

Abstract
One of the most significant challenges that solar energy systems suffer from is the problem of unstable lighting, as well as uneven distribution of light on the surface of solar panels, which can lead to a significant decrease in the capacity production of solar panels or may result in the loss of some solar cells. This paper investigates the impact of shading on the performance of solar panels. The effects of partial shading on energy production and efficiency are explored through experimental analysis and simulation. The study reveals the significance of shading patterns and configurations on the overall output of solar photovoltaic systems. Findings underscore the importance of shading mitigation strategies and optimization algorithms to maximize energy yield and system reliability in shaded environments.

Keywords: Shading; PV; MPPT; PSC; GWO; PSO; P&O.

1. Methodology

In this paper, a series of experiments will be conducted theoretically using programming languages and software tools, and practically using equipment's to simulate real world shading scenarios. Simulations will be conducted using Proteus environments to model various shading scenarios, resulting in complex P-V curves with multiple peak points. Algorithms like Particle Swarm Optimization (PSO) will then be applied to seek the global best peaks in these curves, enabling the development of optimized solutions for solar panel energy conversion[4]. Once developed, these algorithms can be implemented on Arduino platforms for real-world testing using Proteus simulations. Practical experiments will involve deploying solar panels to exhibit shading conditions effect to assess their performance under different levels of obstruction, utilizing pyranometer to measure solar irradiance and EKO I-V analyzer to analyze I-V curves in photovoltaic systems[5]. These measurements will be used to compare the shaded performance of the solar panels against standard conditions curves, considering environmental influences such as shading or temperature. The collected data will then be compared with theoretical simulations to validate model accuracy and inform the development of strategies to mitigate shading effects.

2. Analysis

To begin the experiment, we will set up the EKO I-V analyzer to measure the power, voltage and current output of the ISO F 75 panel under normal sunlight conditions. We will record the data and analyze the I-V curve to understand the behavior of the panel. Additionally, we will measure After completing the experiment, the measured data will be saved in an Excel file and displayed graphically.

IV. Results and discussions

Modelling and simulation steps of the PV panel are made by using PROTEUS software. First,

we created models for different shading scenarios as shown in Table 1.

Table 1. Scenario of shading patterns

	PV1	PV2	PV3
Scenario 1	1000W/m^2	423W/m^2	252W/m^2
Scenario 2	730W/m²	1000W/m²	265W/m²
Scenario 3	1000W/m²	800W/m²	610W/m²

After running the simulation on Proteussoftware, we got the results shown in Fig.3

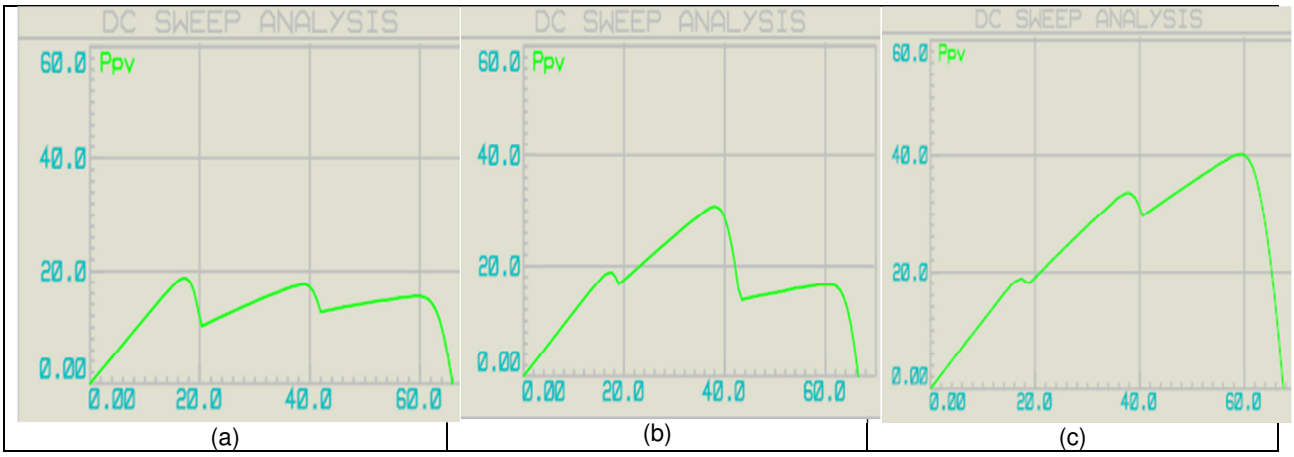

Fig. 3: simulation of shading under PROTEUS; a (scenario1);b (scenario2);c (scenario3).

3. Conclusions

This paper investigated the impact of partial shading on PV panel performance and proposed a solution using the PSO algorithm. The "right peak" emerged as the most challenging obstacle to overcome. Additionally, various parameters, such as acceleration coefficients, particle count, and iterations, significantly affect the PSO algorithm's performance. Despite these challenges, our implementation of PSO effectively mitigated shading effects and optimized panel output. This approach shows promise for maximizing solar panel efficiency under challenging conditions, advancing renewable energy technologies.

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Constrained Model Predictive Control of a TRMS with Dynamic Prediction Horizon

Khadidja SAOUDI[(1)*], Khansa BDIRINA[(1)], Kamel GUESMI[(2)]
[(1)] LAADI, FST, University of Djelfa, Djelfa, Algeria
[(2)]TICA, CReSTIC, University of Reims, Reims, France
[*]Corresponding author e-mail address: saoudi.khadidja@univ-djelfa.dz

Abstract: In this work, a Model Predictive Control (MPC) strategy is applied to a Twin Rotor Multi-Input Multi-Output (MIMO) System (TRMS) in a discrete-time framework. The control strategy is enhanced by introducing dynamic adjustment of the prediction horizon based on the system's error norm, incorporating external disturbances into the model, and enforcing control input constraints. The simulation results demonstrate the effectiveness of this approach in tracking desired reference trajectories while compensating for disturbances, ensuring robust system performance.

Keywords: Model Predictive Control, Twin Rotor MIMO System, Dynamic Prediction Horizon, Control Input Constraints, Disturbance Compensation.

1. INTRODUCTION

The Twin Rotor MIMO System (TRMS) is a benchmark in control system research, modeling helicopter dynamics with strong rotor coupling, nonlinearities, and uncertainties, posing significant control challenges [1]. Traditional methods often fail in the presence of time-varying disturbances [2]. Model Predictive Control (MPC) addresses these issues by optimizing control inputs over a prediction horizon, effectively managing coupled dynamics and constraints [3,4]. Additionally, MPC enhances performance by integrating system constraints and disturbances into its formulation, making it a robust solution for TRMS control [5].This paper presents a discrete-time MPC approach for theTRMS with dynamic prediction horizon adjustment based on state error. This feature optimizes control efficiency, while integrated disturbance compensation and input constraints enhance robustness and tracking accuracy under varying conditions.

2. SYSTEM MODELING

The mathematical model of the TRMS is represented by the following state-space form in discrete time [6]:

$$x_{k+1} = Ax_k + Bu_k + d_k$$
$$y_k = Cx_k + Du_k \qquad (1)$$

Where x_k is the system state vector at time step k, $u_k$is the control input vector, $d_k$represents external disturbances, and $y_k$denotes the system output.

3. MODEL PREDICTIVE CONTROL

MPC determines the optimal control input sequence by minimizing a quadratic cost function Jover a finite prediction horizon T_p. The cost function balances minimizing trajectory deviations and control effort. In this paper, the quadratic cost function J is defined as:

$$J = \sum_{i=0}^{T_P-1} (y_{k+i} - r_{k+i})^T Q\,(y_{k+i} - r_{k+i}) + {u_{k+i}}^T R u_{k+i} \qquad (2)$$

The cost function usesT_p as the prediction horizon, $r_k$as the reference trajectory, and weighting matrices$Q$and $R$to balance trajectory tracking and control effort, ensuring efficient system control.

The control sequence is determined by minimizing the cost function$J(u)$, applying only the first control inputu_k at each step, and re-optimizing iteratively using updated system states.

4. DYNAMIC PREDICTION HORIZON

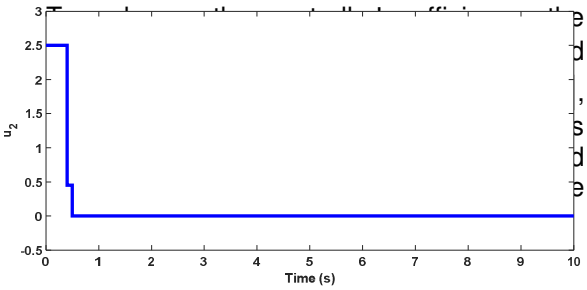

Figure 4. TRMS Control Input u2 with Disturbance and Input Constraints

$$T_p = max(1, min(T_p^{max}, round\ (E_k \times 10))) \quad (5)$$

This adaptive strategy optimizes computational efficiency by reducing the prediction horizon when fine control precision is less critical.

5. CONTROL INPUT CONSTRAINTS

The control inputs for the TRMS are constrained between -2.5 and 2.5 to reflect the physical limitations of the rotor actuators. These bounds are incorporated into the MPC optimization through inequality constraints.

6. SIMULATION RESULTS

The performance of the MPC controller with dynamic prediction horizon and disturbance compensation is evaluated through simulation over 10-time steps. The reference trajectory is set to constant angles for the rotors, $r = \left[\frac{\pi}{6}, \frac{\pi}{6}\right]$.

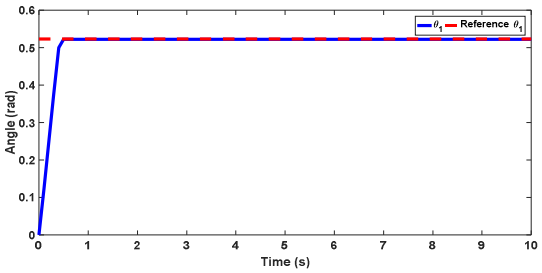

Figure 1. TRMS Angle θ_1 with Disturbance and Input Constraints

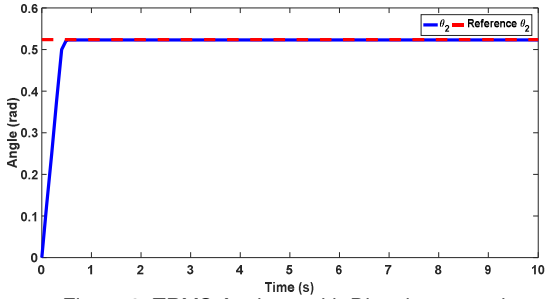

Figure 2. TRMS Angle θ_2 with Disturbance and Input Constraints

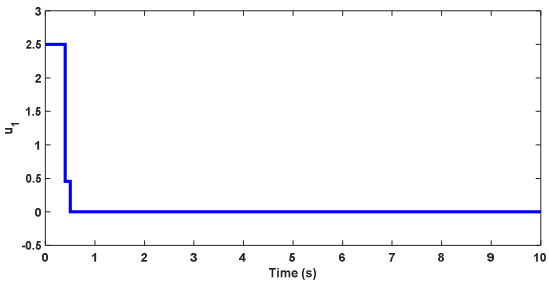

Figure 3. TRMS Control Input u1 with Disturbance and Input Constraints

The simulation demonstrates that the MPC controller with dynamic prediction horizon and disturbance compensation effectively tracks the reference angles of the rotors. It responds quickly to significant deviations, reduces computational effort as the system stabilizes, and mitigates the impact of disturbances. The control inputs stay within the set bounds of [-2.5, 2.5], ensuring optimal performance and safety.

7. CONCLUSION

This study highlights the effectiveness of MPC with a dynamically adjusted prediction horizon for controlling the TRMS. By integrating input constraints and disturbance compensation, the controller manages the system's complex dynamics, offering promising solutions for applications needing precise control amid uncertainties and physical limitations.

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Performance Comparison of Quasi-Random Sampling Methods for Brain Tumor Segmentation in MRI Images

BOUCENNA Sidahmed[(1)*], Z. CHAMA[(2)], N.TALAB[(3)], H. BELKACEM[(4)], E.B.BOURENNANE[(5)]
[(1,2,3)] ,Optronic and Photonics Laboratory,Sidi Bel Abbes, Algeria
[(4)] ,Centre for Development of Advanced Technologies, Algiers, Algeria
[(5)] ,ImViaLaboratory,Bourgogne, France
* sidahmedboucenna97@gmail.com

Abstract: Brain tumor detection and segmentation in medical imaging are crucial tasks that require high-accuracy techniques. This paper focuses on brain tumor localization through image multi-segmentation method specifically utilizing the Expectation-Maximization algorithm (EM) followed by improved region growing classification technique. Quasi-random sampling techniques such as Halton, Sobol, Hammersley, Faure, and Poisson Disk Sampling are applied to enhance the precision and speed of tumor detection in MRI images. The results of this study verify various aspects and demonstrate that the Sobol sampling method is particularly precise for defining edema and tumor areas. Sobol's ability to perform complex processes efficiently while maintaining high quality and reliability makes it exceptional. Although the sampling methods Halton, Hammersley, Faure, and Poisson Disk achieve similar levels of efficiency, the Sobol method is preferred for the segmentation of medical images. It is important to consider factors such as the alignment of the segmentation method, the inherent attributes of the dataset, real-world scenarios, and operator performance. Identifying these factors is crucial for implementing the preferred segmentation method in medical imaging.
Keywords: Brain tumor detection,MRI images,region-growing classification, quasi-random sampling,Sobol method.

1. IMAGE PREPROCESSING AND SEGMENTATION

The preprocessing phase began with loading the MRI images, followed by contrast adjustment using a sigmoid transformation to enhance visibility of brain structures. Skull stripping was applied to isolate brain tissue from non-brain elements, preparing the image for segmentation [9]. A gradient calculation, performed with the Sobel operator, was then used to identify the edges of brain tissues, facilitating the segmentation of regions of interest [10]. To generate a binary mask, we employed Kapur's entropy-based method, which maximizes global entropy to determine an optimal threshold [11]. The output was refined using Otsu's method, which optimizes inter-class variance[2]. Combining these two techniques resulted in a robust mask that accurately highlighted potential tumor regions.
Segmentation was executed using the Expectation-Maximization (EM) algorithm, which iterates between estimating probabilities and updating parameters to optimize results [3]. Following seed point selection, we employed a modified region-growing method to segment each class. Traditional region-growing methods are sensitive to seed placement and homogeneity criteria, which can prematurely halt the process. Our approach addressed these limitations by initializing segmentation with carefully chosen seed points and applying gradient-based criteria to preserve boundaries [12].

2. PERFORMANCE EVALUATION

Segmentation performance was evaluated using Dice coefficient, sensitivity, specificity, Hausdorff Distance (HD), and Average Distance (AVD) [2,13]. The Sobol sequence achieved the highest Dice coefficient and sensitivity across all datasets [4]. Hammersley excelled in boundary precision (HD), while Poisson provided a balance between accuracy and contour precision [14].

3. RESULTS

Three MRI scans depicting brain tumors were used to assess the effectiveness of the segmentation techniques. Each scan is paired with ground truth (GT) data for the tumor and edema regions (figure 01), allowing for an objective evaluation of the results. The inclusion
of GT data enhances the reliability of the segmentation methodcombined with the Halton, Hammersley, Sobol, Faure, and Poisson quasi-random sequences.

Table01: Results for Image 1.

Sequence 1	Dice (%)		Sensitivity (%)		Specificity (%)	
	R1	R2	R1	R2	R1	R2
Sobol	95.29	94.81	95.71	96.04	99.90	99.96
Hammersley	97.87	70.25	95.66	96.13	99.89	99.66
Halton	94.19	60.51	89.03	96.19	99.74	99.96
Faure	93.09	49.18	95.94	32.12	99.90	99.45
Poisson	95.87	86.78	92.07	87.23	99.81	99.88

In figure 01, the Hammersley sequence performed best, achieving a Dice Coefficient of 97.87% (table 01), indicating strong overlap with the ground truth. The Sobol sequence also showed good performance with a Dice Coefficient of 95.29% and high sensitivity, highlighting its ability to detect true positives. However, the Faure sequence had the lowest performance, with a Dice Coefficient of 93.09% and low sensitivity at 32.12%, indicating difficulties in accurate tumor detection. All sequences showed similar high specificity, but Hammersley and Sobol had better average distances (AVD) (table 02), while the Faure sequence had higher AVD values, suggesting less precise boundary delineation.

Table02: Results for Image 2.

Sequence 2	Dice (%)		Sensitivity (%)		Specificity (%)	
	R1	R2	R1	R2	R1	R2
Sobol	86.44	96.49	76.12	97.74	99.68	99.97
Hammersley	65.71	68.83	48.94	98.45	99.33	99.98
Halton	70.05	74.83	53.90	90.31	99.40	99.90
Faure	72.01	71.13	56.26	82.50	99..43	99.80
Poisson	80.36	92.67	74.47	92.70	99.66	99.90

The sobol sequence delivered the best performance, with a dice coefficient of 96.49% (table 02) and high sensitivity, demonstrating strong tumor detection and segmentation accuary. The poisson Disk sequence also perdormed well, with a Dice coefficient of 92.67% and good sensitivity. The Hammersley sequence showed decent but lower performance, with a Dice Coefficient of 68.83%. The Faure sequence haad the weakest performance, with the lowest Dice Coefficient and sensitivity. Despite these variations, specifity remained high across all sequences. The Poisson Disk sequencestood out in terms of average distance (AVD) (table 04), showing superior boundary delineation.

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Robust Trajectory Tracking of a 2-DOF HelicopterUsingPassivity-BasedSlidingMode Control

RatibaFELLAG[(1)*],MahmoudBelhocine[(1)],FethiDEMIM[(2)],MezianeHAMEL[(3)]

[(1)]RoboticsandIndustrialAutomationLaboratory,CentredeDéveloppementdes Technologies Avancées (CDTA), Algiers, Algeria
[(2)]GuidanceandNavigationLaboratory,EcoleMilitairePolytechnique(EMP),BordjElBahri, Algiers,Algeria
[(3)]LEMILaboratoryofEnergyandMechanicalEngineering,M'HamedBougaraUniversity, Boumerdès, Algeria
[*]rfellag@cdta.dz

Abstract: Thispaperpresentsapassivity-basedslidingmodecontrol(PBSMC)strategyfortrajectorytracking ofatwo-degrees-of-freedomhelicoptersystem.Theproposedapproachcombinestherobustnesspropertiesof sliding mode control with energy-shaping techniques from passivity theory to address thechallenges of cross-couplingeffectsandexternaldisturbances.Byincorporatingthesystem'snaturalenergycharacteristicsintothe sliding manifold design, we achieve improved performance while reducing control effort and chattering. The controller's effectiveness is validated through simulations using the Quanser AERO 2 model and MATLAB/Simulink.Theobtainedresultsshowrobusttrajectorytrackingwithpositionerrorsbelow1degreesin both pitch and yaw angles under disturbances.

Keywords: Sliding Mode Control, Passivity-Based Control, 2-DOF Helicopter, Robust Control, Trajectory Tracking.

1. SYSTEMDESCRIPTIONAND MODELING

TheAero2system,manufacturedbyQuanser[10] and it consists of a mounted arm on a base structure supporting dual DC motor-driven thrusters. The system model incorporates four high-precision encoders and an Inertial Measurement Unit (IMU), integrated with a data acquisition systemtoenableaccuratecontrolofpitchand yaw movements [11].

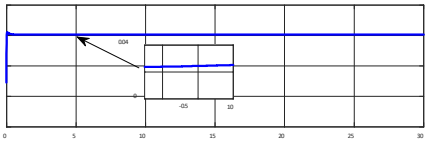
Table1.DynamicparametersoftheAero2

Symbol	Description	Value
J_p	Pitchaxisinertia	0.0232$Kg.m^2$
J_y	Yawaxis inertia	0.0238$Kg.m^2$
F_p	Pitchaxisdamping	0.0020$N.m/V$
F_y	Yawaxis damping	0.0019$N.m/V$
K_{pp}	Pitchthrustgainfromfrontrotor	0.0032N/V
K_{py}	Pitchthrustgainfromrear rotor	0.0014N/V
K_{yy}	Yawthrustgainfromrearrotor	0.0061N/V
K_{yp}	Yawthrustgainfromfrontrotor	-0.0032N/V
l_{cm}	Distancebetweenpivotandrotor	0.1674m
m_h	Helicoptermass	4.7kg
g	Gravity	9.81m/s^2

2. SIMULATIONRESULTS

To evaluate the performance of the PBSMC schemetotrajectorytrackingoftheAero2,the desired reference signals are selected as sinusoidal inputs. Two cases are considered with and without disturbance (18). Simulation results are illustrated in figures 2 to 6.

$$Disturb=0.15q^{\cdot}+0.1q+[0.1\sin(0.5t)0.1\cos(t)]^T \quad (18)$$



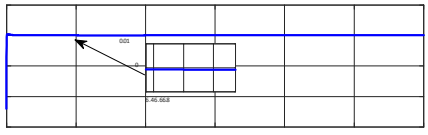


Fig.1Pitchandyawmotorvoltageswithoutdisturbance.

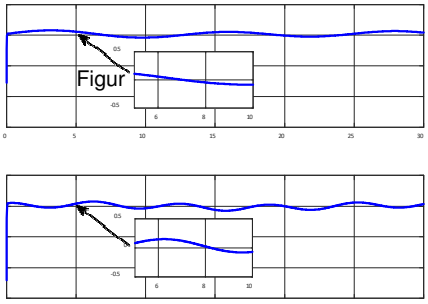


Fig.2Pitchandyawmotorvoltagesunder disturbance.

3. CONCLUSION

The depicted figures indicate robust trajectory tracking of the pitch and yaw axes of the Aero 2 using the PBSMC approach with position errors below 1 degree in both pitch and yawangles even under disturbances. Future work consists of the implementation of PBSMC on the experimental QuanserAero2platformavailableatourlaboratory for real-time assessment.

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Computation Offloading Strategy to Fog and Cloud Computing

Nour El Houda Boubaker[(1)*], Karim Zarour[(1)],Djamel Benmerzoug[(1)]
[(1)] LIRE Laboratory, Constantine 2 University, Constantine, Algeria
[*]Corresponding author e-mail address

AbstractThis paper addresses the task offloading problem in Industrial Internet of Things (IIoT) networks. It focuses on offloading decisions for industrial machines, determining whether to send computation tasks to Fog or Cloud resources. The objective is to minimize delay and energy consumption while considering the heterogeneous nature of tasks, machines, and network bandwidth. A reinforcement learning-based approach is proposed and validated through simulations.

Keywords: Offloading, Fog, Cloud, Reinforcement Learning.

1. INTRODUCTION

The rapid growth of Industrial Internet of Things (IIoT) applications demands devices with substantial computing power and energy efficiency, which compact devices often lack [1]. Computation offloading addresses this by transferring tasks to nearby powerful servers, a process requiring efficient task segmentation and offloading decisions [2]. Fog computing plays a pivotal role, with extensive studies optimizing Quality of Service (QoS) in offloading [3,10]. However, real-world networks are complex and heterogeneous, with Fog nodes differing significantly in computing power, memory, and network capacity [3-8]. These variations impact offloading performance. This paper introduces a Q-learning-based strategy to dynamically adapt offloading decisions to resource characteristics, enhancing task distribution, reducing delays, and lowering energy consumption in heterogeneous networks.

2. SYSTEM MODEL

We consider an IIoT factory environment where a stationary industrial machine generates tasks. Each task has computational requirements, including CPU usage $\boldsymbol{CPU_i}$, memory $\boldsymbol{Mem_i}$, storage $\boldsymbol{Disk_i}$, task size $\boldsymbol{TZ_i}$, and task number of instructions $\boldsymbol{NI_i}$. The IIoT network includes Fog resources and a Cloud Data Center. Nodes are characterized by the CPU frequency $\boldsymbol{CF_j}$, the computing capacity $\boldsymbol{CC_j}$, the available memory $\boldsymbol{M_j}$, the storage $\boldsymbol{D_j}$, and the computing power consumption $\boldsymbol{PC_j}$. The objective is to allocate each task to suitable Fog/Cloud resources, minimizing offloading and execution delays as well as energy consumption.

3. EXPRIMENTAL SECTION

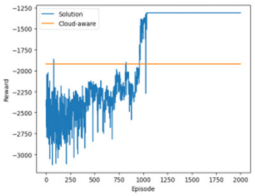
We experimented with 49 Fog machines and a Cloud, using bandwidths of [100,150] MBps for Fog and 50 MBps for Cloud connections. Our approach, compared to the Cloud-Aware benchmark, trained over 2000 episodes with α=1, γ=0.99, and an epsilon decay from 0.9 to 0.

Table 1 Exprimental Values.

Task	*CPU* *[1,3] GHZ*	*Mem* *[100,2000] MB*	*Disck* *[100,4000] MB*	*MI* *[100,18000]MI*	
Fog	CF *[1,3] GHZ*	M [100,4000]MB	*D [100,6000]MB*	*CC [100,2000]*	*CP [1,5]watt*

				MIPS	
Cloud	CF 3 GHZ	M 200000 MB	*D* *200000* *MB*	*CC* *30000* *MIPS*	*CP* *10* *watt*

Fig 2 shows the training phase, where our approach initially fluctuates but converges to a higher reward than the Cloud-aware strategy. Fig 3 highlights consistent superiority in handling varying task numbers, minimizing delay and energy consumption. While the Cloud-aware approach benefits from powerful resources, it incurs higher energy costs compared to our solution



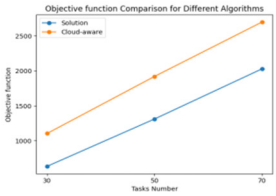


Fig 2.Training Phase.Fig 3. Rewards.

4. CONCLUSION

This paper proposes a Q-learning-based offloading approach for Fog/Cloud environments to minimize delay and energy consumption. Experiments show its effectiveness over a Cloud-Aware strategy. Future work will address dynamic factors like varying channel conditions.

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Control Strategies for Automatic Renewable Energy Integration in Smart Grid Systems

Mohammed TSEBIA[(1)*], Djamila TALAH[(2)],Hamid BENTARZI[(3)], Azeddine RATNI[(4)]
[(1,2,3)] Signals and Systems Laboratory,IGEE, UMBB, Boumerdes, Algeria
[(4)] Solid Mechanics and Systems Laboratory,FT, UMBB, Boumerdes, Algeria
*m.tsebia@univ-boumerdes.dz

AbstractThe integration of renewable energy sources into smart grid systems presents a several significant challenges. To address these challenges, it is necessary to implement control strategies for the automatic integration of renewable energy sources. This paper presents a control methodology that enables the efficient automatic integration of renewable energy into smart grids, with a particular focus on real-time monitoring and control algorithms.These strategies facilitate the balancing of energy supply and demand, ensuring grid stability, and optimal utilization of renewable energy resources.Case studies and simulations demonstrated the efficacy of this methodology in reliable power supply, reducing carbon emissions, and enhancing grid flexibility.

Keywords: Smart grid, Renewable energy, PMU, Monitoring system

1. INTRODUCTION

The integration of Renewable Energy Sources (RES) is a vital component of the transition toward a sustainable and resilient energy infrastructure [1]. To fully harness the potential of renewable energy, it is imperative to integrate these sources into the power grid [2]. However, in island areas, this integration poses significant challenges. [3]. this paper presents a control strategy for the automated integration of renewable energy into the smart grid, validated using MATLAB software. Automating renewable energy integration represents a key step in advancing a low-carbon and sustainable energy future.

2. CONCEPT OF AUTOMATIC RENEWABLE ENERGY INTEGRATION

The objective of this concept is to optimize the utilization of renewable energy sources without requiring substantial human intervention. For simulation, we use photovoltaic energy. The automation of this integration is made possible by the use of advanced technologies, control strategies, and communication systems [4], these systems facilitate the effective management of the inherent variability and fluctuating nature of renewable energy sources.

3. SIMULATION AND DISCUSSION

Case 01 : The initial case study concerns the simulation of the system in the absence of the photovoltaic energy integration system. Simulation results demonstrate that the diesel generator “Fig. 2” supplies all the power generated.

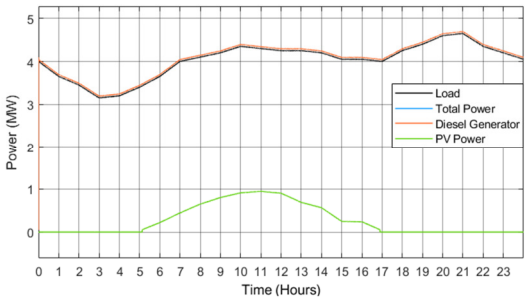

Fig. 2 The power curve for the first case

Case 02 : Figure 3 shows the power curves, which illustrate that during the integration period of the photovoltaic source; the diesel generator reduces the power produced. The threshold of power generated conditions connection and disconnection.

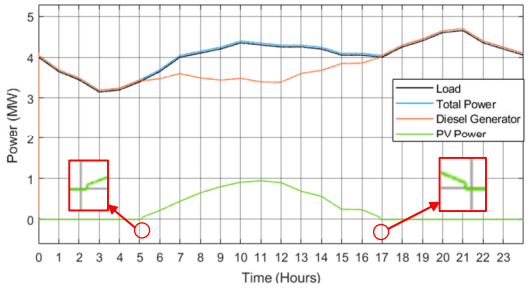

Fig. 3The power curve for the case two

Case 03

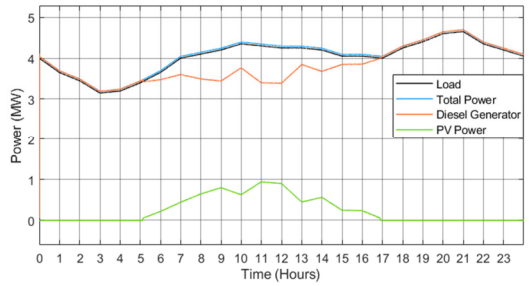

Fig. 4 The power curve for the case three

In the third simulation, we analyze the influence of passing clouds on the photovoltaic field.“Fig. 4” shows the variation in phtovoltaic power caused by the cloud's shadowand the influence on the main grid.

4. CONCLUSION

Automatic control strategies are essential for integrating renewable energy into smart grid systems, this solution optimize the use of renewable resources and improving grid reliability. The incorporation of real-time data, communication technologies, and advanced techniques enhances the efficacy of these control strategies.The results of the simulation demonstrate the significance of integrating renewable resources automatically in order to maximize resource utilization and reduce carbon dioxide emissions.Overcoming these challenges will require continued research and deployment of innovative control techniques, supported by the adoption of smart grid technologies.

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A Runge-Kutta Method for Optimizing Defect Depth in Multilayer Structures

Merwane KHEBAL[(1)*], Abdelhak ABDOU[(2)],Tarik BOUCHALA[(1)]
[(1)]LEE, FST, University ofM'sila, M'sila,Algeria
[(2)] LSTE, FST, University ofBatna2,Batna, Algeria
[*]Corresponding author e-mail address: merwane.khebal@univ-msila.dz

Abstract: This study presents an advanced optimization approach based on the Runge-Kutta algorithm to estimate the depth of internal defects in multilayer structures. The method is distinguished by its rapid and precise convergence toward optimal solutions, demonstrating its effectiveness in non-destructive testing applications. The analysis reveals high accuracy from the early iterations and a rapid reduction of errors, confirming the potential of this method to improve defect estimation in industrial environments, with superior accuracy and speed compared to traditional approaches.

Keywords : Runge-KuttaOptimization Algorithme, non-destructive testing,multilayer structures

1. INTRODUCTION

The detection and characterization of internal defects in multilayer structures are essential for ensuring quality and safety, particularly in aerospace [1]. Non-destructive testing (NDT), especially eddy current testing, is widely used for defect detection, but accurately determining defect depth remains a significant challenge [2]. Optimization algorithms, such as the Runge-Kutta method, have proven effective for solving inverse problems by iteratively refining defect parameters to minimize discrepancies between simulated and observed data [3,4].
This study focuses on applying the Runge-Kutta algorithm to estimate defect depth in multilayer structures. Its ability to handle non-linear relationships and achieve fast convergence makes it suitable for real-time industrial applications. Additionally, the algorithm demonstrates robustness against noisy or incomplete data, common in NDT environments. The findings highlight its potential to improve defect characterization, contributing to more accurate and reliable NDT methods for critical components.

2. OPTIMIZED INVERSE PROBLEMS IN DEFECT DETECTION

Multi-element eddy current non-destructive testing (NDT) is employed for defect detection in various products, including multilayer structures, tubes, and rails [5]. This approach involves developing inverse models to estimate defect depths using simulation data of defects and their impedance characteristics. The Runge-Kutta method is applied as an iterative optimization technique to minimize an objective function by refining defect depth parameters over successive iterations [6]. By leveraging intermediate slope estimations, this method achieves faster, and more precise convergence compared to traditional techniques like gradient descent.

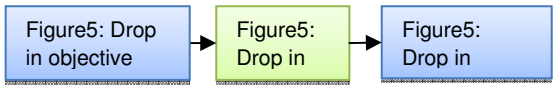


Figure5: Drop in objective function with iterations.

Runge-Kutta optimization is particularly effective for complex, non-linear systems, providing robustness and high accuracy in solving inverse problems such as defect characterization.

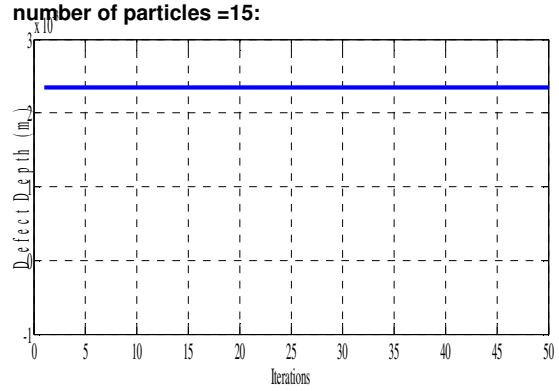
3. RESULTS AND DUSCUSION

This work uses the Runge-Kutta method with a population size of N=15, a step size control parameter α=0.5, and a decay factor β=0.8 to ensure effective and precise optimization.
Table 1 presents simulation results, showing defect depths estimated using the Runge-Kutta method. The optimal depth (d) corresponds to the best individual from the final population of the algorithm. With 100 iterations and a population of 30, the method achieves highly accurate estimates, closely matching actual values. This demonstrates the effectiveness and precision of the Runge-Kutta optimization in defect characterization.

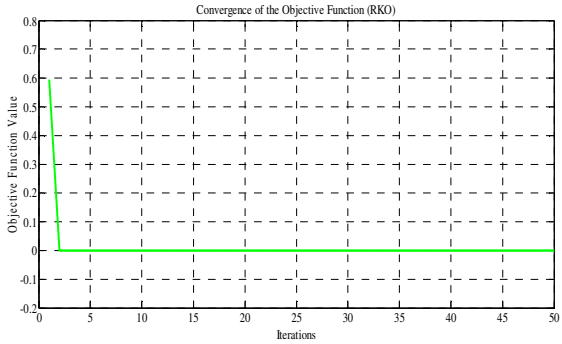
Table 1: Results obtained using the Runge-Kutta method.

Runge-Kutta			
Iterations Number	Real Value	Value Obtained	Populations Number
50	2.5	2.353	15
100	25	2.456	30

The 1st test: The number of iterations =50 and the number of particles =15:



The 2nd test: The number of iterations =100 and the number of particles =30:



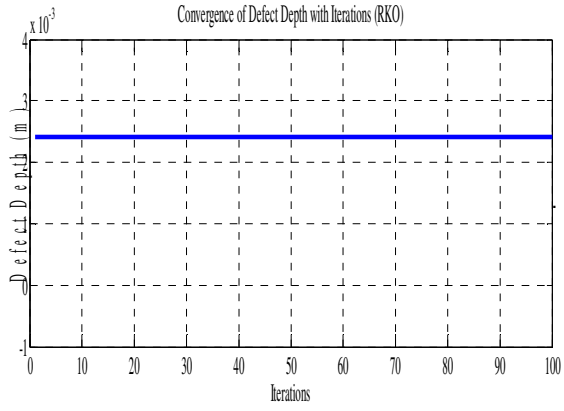


Figure5: Drop in objective function with iterations.

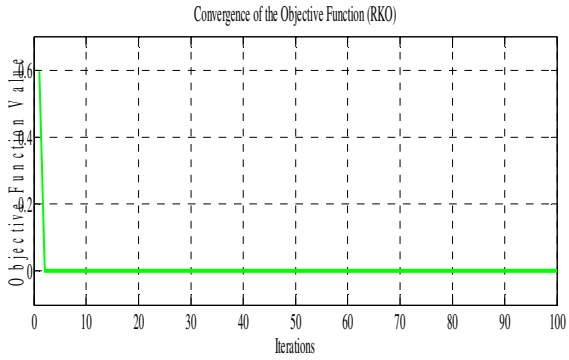


Figure 4: Evolution of the depth of the defect with

Figures (3,5) demonstrate that the depth value d converges near the optimal solution with 98.24% accuracy from the first iteration, indicating rapid and robust optimization. Figures (4,6) further highlight a significant early decrease in the objective function, with figure 6 showing a low value by the second iteration. This rapid convergence underscores the method's efficiency in minimizing error and accurately estimating defect parameters.

4. CONCLUSION

In conclusion, the results demonstrate the effectiveness of the optimization method for estimating internal defect depths, achieving approximately 98% accuracy early in the process. The rapid convergence and significant reduction in the objective function highlight the algorithm's efficiency in minimizing errors, making it highly suitable for industrial applications that demand fast and reliable non-destructive defect detection and evaluation.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
10-12 December 2024; Tamanrasset, Algeria

Nondestructive Evaluation of Material Properties through Particle Swarm Optimization

Merwane KHEBAL[(1)*], Abdelhak ABDOU[(2)] , Tarik BOUCHALA[(1)]
[(1)]LEE, FST, University of M'sila, M'sila, Algeria
[(2)] LSTE, FST, University of Batna2,Batna,Algeria

[*]Corresponding author e-mail address: merwane.khebal@univ-msila.dz

Abstract: This study uses Particle Swarm Optimization (PSO) to estimate material properties like conductivity and permeability from eddy current testing data, crucial for industrial reliability in aerospace and energy sectors. PSO effectively solves inverse problems, handling noisy or incomplete data. The results highlight PSO's role in improving the accuracy and reliability of material property estimation, advancing non-destructive testing methods.

Keywords : Particle Swarm Optimization Algorithme, non-destructive testing, multilayer structures

1. INTRODUCTION

Accurate estimation of material properties like conductivity and permeability is essential for industrial reliability, particularly in aerospace and energy sectors [1,2]. Eddy current testing, a key non-destructive method [3], faces challenges in determining these properties. This study applies Particle Swarm Optimization (PSO), known for its simplicity, robustness, and efficiency [4,5], to solve inverse problems by iteratively refining parameter estimates. PSO effectively handles noisy or incomplete data, improving the accuracy and reliability of material property estimations. The findings highlight PSO's potential to advance faster and more precise characterization techniques, enhancing industrial performance and safety.

2. RESULTS AND DUSCUSION

The PSO parameters include 30 particles, an inertia weight of 0.9, a personal acceleration coefficient of 0.15, and an overall acceleration coefficient of 1.5. Table 1 summarizes the simulation results, showing estimated conductivity and permeability values from various iterations and populations. The estimates closely match actual values after 50 iterations, demonstrating PSO's effectiveness in converging toward optimal solutions and highlighting the quality of the optimization.

Table 1: Results obtained using the PSO method.

PSO				
Number of iterations	conductivity		Permeability	
	Real value	Value obtained	Real value	Value obtained
50	$6*10^{7}$	$5.811*10^{7}$	$1.256*10^{-4}$	$1.233*10^{-4}$
100	$6*10^{7}$	$6.043*10^{7}$	$1.256*10^{-4}$	$1.243*10^{-4}$

The 2nd test: The number of iterations =50 and the number of particles =30:

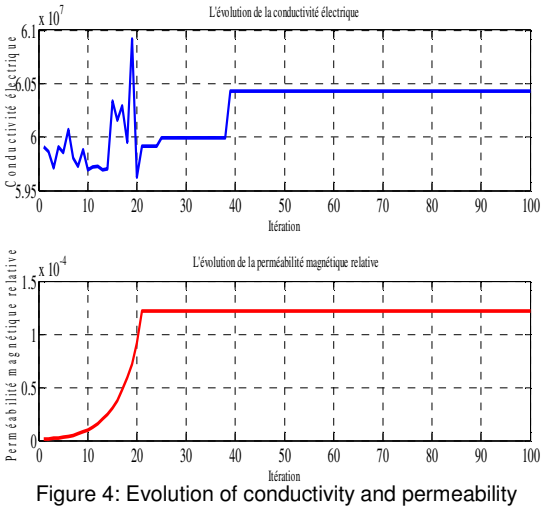

Figure 4: Evolution of conductivity and permeability

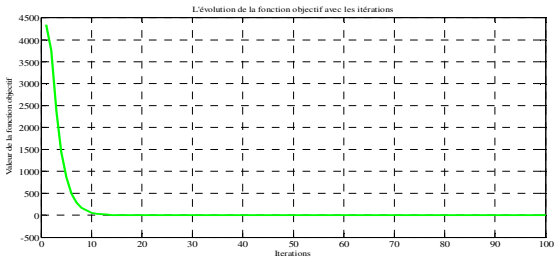

Figure 5: Drop in objective function with iterations.

According to the Figures, it can be observed that 21 iterations were sufficient for the relative magnetic permeability μr to approach the optimal solution, which is on the order of $1.243*10^{-4}$, and that 22 iterations were sufficient for the electrical conductivity σ to approach the optimal solution, which is on the order of $5.97*10^{7}$ [S/m]. It is also noted that 25 iterations were sufficient for the Particle Swarm Optimization algorithm to meet all stopping criteria. Additionally, it should be noted that the y-axis is on a logarithmic scale; the value of the objective function decreases with iterations to a very low value, which is less than 10^{-5}.

3. CONCLUSION

In conclusion, the results indicate that the optimization method used to estimate conductivity and permeability is highly effective, achieving near-optimal solutions within the first little iteration. The rapid convergence of the estimated values, along with the significant reduction in the objective function, highlights the efficiency of the PSO algorithm in minimizing discrepancies between estimated and actual material properties. This demonstrates the method's strong potential for industrial applications requiring fast and accurate estimation of material characteristics, underscoring its effectiveness in non-destructive testing for material evaluation and defect characterization.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
10-12 December 2024; Tamanrasset, Algeria

Comparative Evaluation of Swarm Intelligence-Based Multipath Routing Protocols for Video Streaming in Vehicular Ad-Hoc Networks

BENZEROGUE SARRA[(1)*], SAHRAOUI ABDELATIF[(2)], BOUNAB RAYENE[(3)]
[(1)] MISC Laboratory, University of Abdelhamid Mehri Constantine 2, Constantine, Algeria
[(2)] LAMIS Laboratory, Echahid Cheikh Larbi Tebessi University, Tebessa, Algeria
[(3)] LIRE Laboratory, University of Abdelhamid Mehri Constantine 2, Constantine, Algeria
*sarra.benzerogue@univ-constantine2.dz

Abstract: Video streaming in Vehicular Ad-Hoc Networks (VANETs) presents considerable challenges due to stringent Quality of Service (QoS) requirements, including high throughput, reliable packet delivery, low transmission delay, and stable performance, especially in emergency scenarios. These challenges are further complicated by the dynamic nature of VANETs, such as rapidly changing network topology, fluctuating vehicle densities, and environmental obstacles. This study explores the potential of Swarm Intelligence (SI) algorithms to optimize routing protocols, capitalizing on their adaptability and flexibility, which make them well-suited for the dynamic conditions of VANETs.This paper offers a detailed review of several SI-based multi-path routing protocols, including Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Artificial Bee Colony (ABC), Moth Whale Optimization Algorithm (MWOA), and the Butterfly Optimization-PSO Hybrid (BO-PSO). The performance of these protocols is evaluated using key QoS metrics—End-to-End Delay (E2ED), Throughput (Th), and Packet Delivery Ratio (PDR)—under varying vehicle densities (50 and 100 nodes).The results indicate that the ACO-based protocol outperforms others in minimizing delay, making it particularly suitable for emergency situations. In contrast, the MWOA protocol achieves higher throughput and improved packet delivery, making it more appropriate for non-safety applications. These results highlight the potential of SI algorithms in developing robust and efficient multi-path routing solutions for reliable, high-quality video streaming in dynamic vehicular environments.

Keywords: Video Streaming,Multipath, Routing Protocol, VANET, Swarm Intelligence, QoS.

NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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A TRNSYS Simulation Approach to Hybrid Energy Microgrids for Off-Grid Regions: adleas, tamanrasset, Algeria Case Study

Brahim Bacha [(1)], Rebah Nor [(1)], Nouredine Sengouga*[(2)] , Badis Bacha[(3)], Djamel Eddine Mazouzi [(2)].
[(1)] Department of Material Sciences,, University of Souk-Ahras, Souk-Ahras, Algeria.
[(2)] Department of Material Sciences, University of Biskra, Biskra, Algeria.
[(3)] Department of Electrical Engineering,, University of Biskra, Biskra, Algeria.
* Corresponding author e-mail address: n.sengouga@univ-biskra.dz

Abstract: Providing energy to isolated areas is a major global challenge. Reports indicate that 1.18 billion people worldwide lack access to electricity grids, with many of these individuals residing in remote, off-grid locations. Previous studies have demonstrated that the optimal solution to this problem lies in leveraging microgrids powered by hybrid energy systems. In this study, a microgrid comprising hybrid energy systems, photovoltaic panels, wind turbines, and diesel generators was simulated using the TRNSYS software. The simulation was based on climatic data from an isolated area near Adleas, Tamanrasset, Algeria. The results indicated stable SOC (Battery State of Charge) values in the soil throughout the entire simulation period, with an LPSP(Loss of Power Supply Probability) value of 0.17 These findings illustrate the feasibility of this approach as a viable solution to energy challenges in isolated areas.
Keywords: simulation, TRNSYS,Hybrid Energy Systems, Off-Grid Regions, Tamanrasset,Algeria

1. CASE STUDY AND DATA DESCRIPTION

The current research focuses on the installation of a hybrid energy system to deliver sustainable off-grid power to a residential home in a remote desert area of Adleas, Tamanrasset, Algeria. The building under study is a single-family dwelling with an area of approximately 120 m^2, designed to accommodate a family of five. The village is situated in a dry climate characterized by hot summers and cold winters[15]. The energy consumption of the home depends on the needs of its occupants, which vary predictablythroughout theday,Morning energy demand is driven by lighting and heating, especially during the colder monthsand household appliances such as kettles, toasters, and water heaters. In the evening, the peak load is caused by lighting and appliances used for cooking and entertainment, such as televisions and computers. Seasonal changes also affect energy use, with higher loads occurring in the summer, primarily for cooling during midday, and in the winter for heating needs.

2. TRNSYS, TRANSIENT SYSTEM SIMULATION TOOL

The model was developed in TRNSYS to simulate the energy flows of the system which is shown in Figure 2,taking into account the variability in energy produced by solar panels and wind turbines throughout the year. This simulation is crucial for understanding the performance of the hybrid system and assessing its ability to meet the energy demand of residential homes. Consequently, key performance indicators such as the State of Charge (SOC) of the battery and the Loss of Power Supply Probability (LPSP) are considered.

3. RESULTS AND DISCUSSIONS

The dynamic computer simulation of the hybrid energy system was conducted meticulously using TRNSYS software to gain detailed insights into the system's performance under the prevailing climatic conditions in Adleas, Tamanrasset, Algeria. The results demonstrate how these various components dynamically interact to meet the building's energy needs throughout the year. This simulation covers 8,736 hours with a time step of 0.25 hours. Figure 3 represents the hourly values of both temperature and wind speed throughout the year at the targeted site.

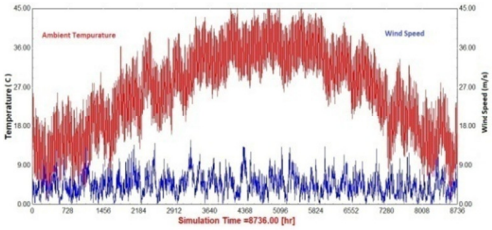

Fig. 1 Wind speed and ambient temperature

4. CONCLUDING REMARK

This paper presents a dynamic computer simulation of a hybrid energy system designed to supply a residential building in an isolated area around adleas, tamanrasset, Algeria, using TRNSYS software. The main conclusions drawn and future prospects of the work are as follows:

- The hybrid system combines solar panels, wind turbines, and a diesel generator with battery storage to provide a stable and reliable energy supply in a highly sustainable manner.
- The system reduces reliance on fossil fuels by maximizing the use of available renewable energy sources, both solar and wind. Battery storage facilitates the stability of such systems by storing excess energy and providing it during peak periods.
- The diesel generator was used minimally, resulting in reduced fuel consumption and lower environmental impact.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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A Hybrid Renewable Energy System Utilizing Intelligent Optimization Methods

Badis Bacha [(1)*],Hatem Ghodbane[(1)],Nadjiba Terki[(1)], Lamdjed Elhamel[(2)],Abir Betka[(3)],Nouredine Sengouga* ,Brahim Bacha[(5)], Soufiane Benabdi [(1)]
[(1)] Department of Electrical Engineering, Mohamed Khider University, Biskra, Algeria
[(2)] Department of English Language and Literature, Mohamed Khider University, Biskra, Algeria
[(3)] Department of Electrical Engineering, Echahid Hamma Lakhdar University, El Oued, Algeria
[(4)]Department of Material Sciences, University of Biskra, Biskra, Algeria.
[(5)]Department of Material Sciences, Souk-Ahras University, Souk-Ahras, Algeria
[*]Corresponding author e-mail address:n.sengouga@univ-biskra.dz

Abstract: The usual power sources are unable to provide this substantial demand for energy. The most efficient and practically viable power sources, in terms of both economics and ecology, are solar and wind turbine-based energy systems. A more modern idea in the field of sustainable development is the hybrid renewable energy system (HRES), which combines at least two renewable power sources, such as a solar panel or wind turbine, with other limitless sources, like fuel cells or ocean energy. This study describes the ideal hybrid power system architecture that takes into account different renewable energy generation configurations. Using the optimization approach of particle swarm optimization (PSO), one objective function of a hybrid renewable system is provided to determine the best configuration of parameters. In order to create the best hybrid system design possible, this economical factor is the levelized energy cost (LCOE). The suggested study aims to maximize the capacity of a microgrid system that provides electricity to tow families in a rural Biskra, Algerian area. The system consists of diesel generator (DG), battery storage, and photovoltaic (PV) technology. The optimal size for each part of the suggested microgrid have been determined by particle swarm optimization (PSO). Minimizing the levelized energy cost (LCOE) while preserving a high dependability index is the aim of the objective function that was established in this study. The paper's findings imply that the hybrid microgrid system under discussion might be employed to supply electricity in this region.Combining battery design, DG, and PV results in a very good levelized energy cost (LCOE) of 0.1737$/kWh.
Keywords: renewable energy, optimization, swarm intelligence.

1. CASE OF STUDY

The Biskra region was chosen as a site for this study due to the rural agricultural areas spread around the city. The Capricorn FLX weather station at the University of Mohamed KheidarBiskra provided solar radiation, and ambient temperature data used in this study.Figure 1 and 2 show the monthly average solar radiation and the temperatures, respectively, for a year (01/01/2020 to 31/12/2020).

2. OPTIMIZATION OF LCOE

The objective is to minimize LCOE of HRES which consisting of solar power units, battrey units and DG units:

$$\mathrm{Min_F(X)} = \mathrm{Min(LCOE)} \quad (1)$$

where X represents the parameters (N_{pv}, N_{bat}, and N_{DG}) of the optimization problem that needs to be optimized using the recommended PSO approach

3. RESULTS AND DISCUSSION.

Tow houses are examined in this study. PV, battery, and diesel make up the hybrid microgrid system HMGS, Details on HMGS parameters are given in Table 1.Matlab software was used to run the PSO scripts for multi-objective optimization utilizing 50 iterations, 10 population sizes, and a 4 dimension size. The lower and upper bounds for PV,battery and DG are [15 45], [1 30] and [0 4], respectively.

Table 1 displays the solution to the optimization problem based on a number of variables, such as the optimal objective values, the levelized cost of energy, the choice variables (Npv, NDG, and Nbattery), and the system energy production in kW (PV, Battery, Diesel).

Table 1 The results obtained through the optimization problem

Optimization factors/PSO Algorithm	HMGS
The best objective values	0.91233
N_{PV}	24
N_{bat}	29
N_{DG}	1
LCOE($/kWh)	0.1737
PV (kW)	2.8099e+05
Battery (kW)	5.7642e+04
Diesel (kW)	1.0245e+04

4. CONCLUSIONS

In this work optimizes a hybrid PV/ battery/diesel micro-grid system (HMGS), which combines a diesel generator, PV, and battery bank system.The issue is presented using the levelized cost of energy (LCOE) factor as the objective function. The PSO approach is used to determine the ideal system layout and optimize the size of system components, and we have obtained excellent results through this algorithm. this study lowers the cost of renewable energy resources and ensures a steady and reasonably priced energy supply makes it possible for off-grid, small-scale microgrid projects to be implemented across the nation is another benefit.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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Theoretical and Experimental Analysis of STP010D-12/KEA Photovoltaic Module

Walid CHELIA[(1)*]
[(1)] Department of Physics, University of Skikda, Laboratory of Research on Physics Chemistry of Surfaces and Interfaces, Skikda, Algeria
[*]w.chelia@univ-skikda.dz

Abstract: This work investigates theoretically and experimentally the impacts of various irradiances on the current-voltage and power-voltage characteristics of STP010D-12/KEA PV module (10W).The detailed modeling is then simulated by MATLAB program. A results showed that the varying irradiance from 310 W/m^2 to 1000 W/m^2 with taking The STC temperature, it reveals that higher irradiance gives higher current and higher power. Finally, the comparison between the theoretical and experimental results reveals considerable agreement between the theoretical and experimental results.

Keywords: PV module, Irradiance, I(V)/P(V) characteristic.

1. EXPERIMENTAL SETUP

The experimental system required various equipment's to obtain the results of I-V and P-V: 1) Solar PV module (10W), 2) Rheostat, 3) Ammeter, 4) Voltmeter, and 5) Artificial lightning source. To measure the current-voltage characteristics of a PV module at different light intensities, the distance between the light source and the PV module is varied. In addition, to a digital thermometer of the Delta OHM type "HVACR Data logger DO 2003" for measuring the temperature of the solar cell. After the execution of the electrical circuit, the distance between the light source and the PV module was fixed and then the values of the rheostat which represents the load resistance were varied, from 0 to the maximum. For each value of the resistance, the values of the voltage between the terminals of a solar module, the intensity of the current passing through the circuit and the temperature of the cell were recorded.To estimate the irradiance, we used equation (3), which gives the relationship between the irradiance and the temperature of the cell.

2. RESULTS AND DISCUSSION

In this work. The theoretical model described in this paper is validated by measured parameters of selected PV module (G=314 W/m^2). The specifications of these modules are summarized in Table 1. As can be seen in Table 1, the parameters computed by the present model fit accurately to the experimental parameters.

Table 1 THE EXPEREMNTALE AND THE THEORETICAL PARAMETERS OF STP010D-12/KEA PV MODULE.

Parameters	***Theoreticalparameters***	***Experimental parameters***	***E=|X_{Exp}-X_T|***
P_{mp}(W)	1.9	1.7	0.2
I_{mp} (A)	0.12	0.1	0.02
V_{mp}(V)	15	18	3
I_{cc}(A)	0.21	0.11	0.1
V_{co}(V)	18	19	1
η(%)	5.3	4.74	0.56
FF	0.5	0.81	0.31

For the I(V) curves, we notice the clear influence of the irradiance on the curves, there is a decrease in the value of $I_{cc}$with the decrease in the irradiation, the shape of the curves is the same for all the values of the irradiation. For the P(V) curves (Fig. 2) we notice an increase in the curves up to maximum values corresponds to the P_m (maximum power) then they undergo a decrease this is due to the value of the load resistance.

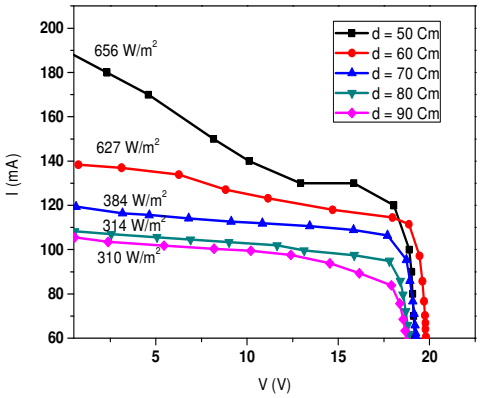

Fig. 1 *I(V)* characteristics with experimental study

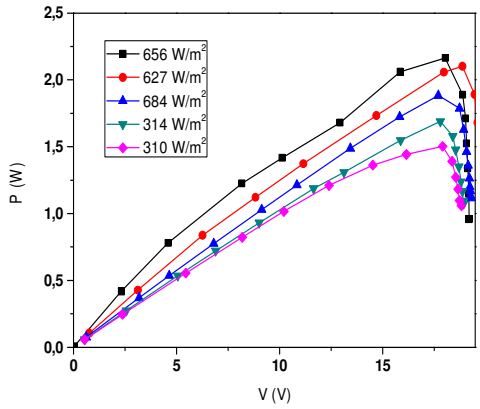

Fig. 2 *P(V)* characteristics with experimental study.

3. CONCLUSIONS

The theoretical and experimental study of a STP010D-12/KEA PV module (10W) has provided a preliminary understanding on the performance behavior of photovoltaics. The parameters of PV module are simulated by using MATLAB to investigate the effect of different irradiances. A results showed that the varying irradiance from 310 W/m^2 to 1000 W/m^2 with taking The STC temperature, it reveals that higher irradiance gives higher current and higher power. Finally, the results show noticeable agreement between the experimental and the theoretical results.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
10-12 December 2024; Tamanrasset, Algeria

A Numerical Study of Cu-Al_2O_3/Water Hybrid-Nanofluid Effect on Natural Convective Heat Transfer in a Cavity with Sinusoidal Heat Flux

Walid CHELIA[(1)*]
[(1)] Department of Physics, University of Skikda, Laboratory of Research on Physics Chemistry of Surfaces and Interfaces, Skikda, Algeria
*w.chelia@univ-skikda.dz

Abstract: The problem of natural convection in a square cavity filled with Cu–Al_2O_3/water hybrid nanofluids with sinusoidal heat flux boundary condition is investigated numerically in this work.The lattice Boltzmann method (LBM) is applied to investigate how sinusoidal heat flux boundary condition influence hybrid nanofluid. The results show that using a hybrid nanoparticles decline the strength of the hybrid nanofluid flow.In addition, the use of hybrid nanoparticles leads to increases of isotherms stretching along the horizontal surfaces.The key contribution of this study is providing an initial prediction and numerical data that future researchers can reference regarding the effects of sinusoidal BCs on hybrid nanofluid flow and heat transfer within a cavity.

Keywords: LBM, Natural convection, Hybrid nanofluid, Sinusoidal heat flux.

1. PROBLEM DESCRIPTION

The physical configuration of the present study is shown in Fig. 1. It consists of a two-dimensional cavity with length L. A constant heat flux is applied to the left hand wall while the heat flux gradient in the sine form $\partial T/\partial x = -qsin(N\pi y/L)/k_{hnf}$is imposed to right hand wall (sinusoidal heat flux boundary condition). The other walls are adiabatic. The cavity is filled with Newtonian and incompressible hybrid nanofluid, the thermophysical properties of the fluid (pure water) and nanoparticles (Cu-Al_2O_3) are presented in table 1. The density variation in the buoyancy force, which is based on the Boussinesq approximation and the viscous dissipation and Joule heating are neglected.

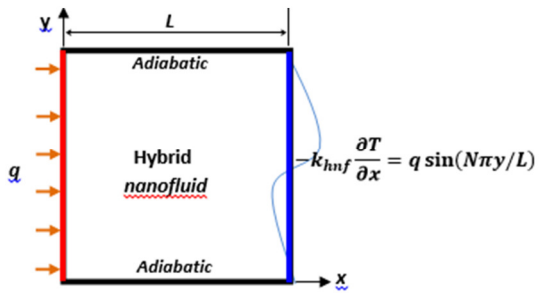


Fig. 1 Geometry and boundary conditions of the problem.

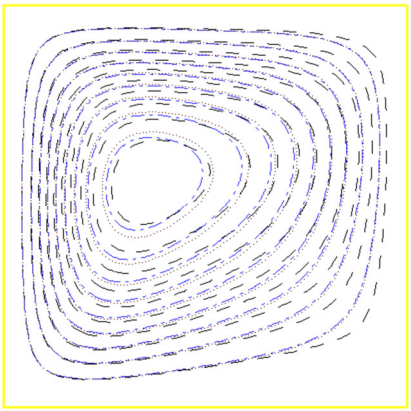
Table 1 THERMOPHYSICAL PROPERIES OF THE BASE FLUID AND THE NANO-SIZED PARTICLES[3].

Properties	***Water***	***Cu***	***Al_2O_3***
Cp (J/kg.K)	4179	385	765
ρ (kg/m^3)	997.1	8933	3970
K (W/m.K)	0.613	401	40
β×10^5 (K^{-1})	21	1.67	0.85

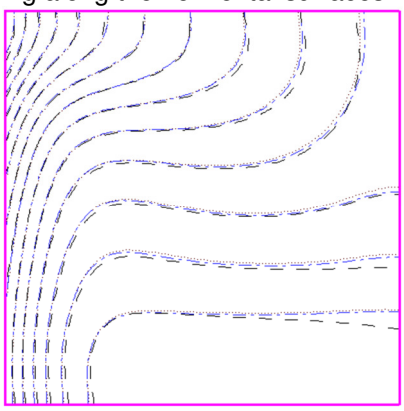
2. RESULTS AND DISCUSSION

In order to reveal the characteristics of hybrid nanofluids with effect of sinusoidal heat flux

boundary condition, the results are presented in the form of streamlines and isotherms. The Prandtl and Rayleigh numbers isfixed at 6.2 and 10^5,respectively.Additionally, the volume fraction of Cu is maintained at 0.5% while that of Al_2O_3 is changed from 0.5% to 2.5% which sums up to a total hybrid volume fraction of 1% to 3%. With a total hybrid volume fraction of 1%, 2% and 3%, and theperiodicity parameters of sinusoidal heat flux is fixed at$N$ = 2.
The effect of the presence of the Cu-Al_2O_3 hybrid nanoparticles on the streamlinesand isothermspatterns for high value of the Rayleigh number (Ra=10^5) is illustrated in Fig.3. Although the overall shape of streamlines and isotherms is the same for hybrid nanofluids, it should be mentioned that this case shows the difference between the streamlines and isotherms for various volume fractions of hybrid nanoparticles is accentuated. For the streamlines, there exist large differences in the core region and near the sinusoidal wall. Moreover, it is seen that using a hybrid nanoparticles decline the strength of the hybrid nanofluid flow. The reduction of the hybrid nanofluid velocity resulting from utilizing Cu-Al_2O_3 hybrid nanoparticles due, the increase in the dynamic viscosity. For the isotherms, relatively large differences are observed in the sinusoidal wall, where it is observed that utilizing hybrid nanoparticles displaces the isotherms. Indeed, the use of hybrid nanoparticles leads to increases of isotherms stretching along the horizontal surfaces.



Streamlines



Isotherms

3. CONCLUSIONS

In this work, the effects of sinusoidal boundary conditions (BCs) on the natural convection of Cu-Al_2O_3/water hybrid nanofluid in a square cavity are studied numerically with lattice Boltzmann Method (LBM). The results are presented at different volume fractions on streamlines and isotherms. It is found that LBM is an effective approach for simulatingsinusoidal BCs. For this case, the results show that using a hybrid nanoparticles decline the strength of the hybrid nanofluid flow.Moreover, the use of hybrid nanoparticles leads to increases of isotherms stretching along the horizontal surfaces. Finally, the obtained results can be used as a future reference for further investigation and application for the effects of sinusoidal BCs on the hybrid nanofluid flow and heat transfer in a cavity.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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A Comparative Study of PSO, Ziegler-Nichols, and Genetic Algorithm-Tuned PID and PI Controllers for DC Motor Speed Control

BOUTORA. S[(1)*], TOUIL. MdeB[(2)],
[(1)] Department of Power Engineering, University M'HamedBougara, Boumerdes, Algeria
[(2)] Department of Power Engineering, University M'HamedBougara, Boumerdes, Algeria
[*]s.boutora@univ-boumerdes.dz

Abstract: This paper presents a comparative study on tuning Proportional-Integral-Derivative (PID) and Proportional-Integral (PI) controllers for DC motor speed control. The study employs Ziegler-Nichols, Genetic Algorithm (GA), and Particle Swarm Optimization (PSO) methods to achieve optimal performance. Simulation results demonstrate that PSO provides superior control accuracy and transient response, followed by GA and Ziegler-Nichols. These findings highlight PSO's potential for industrial applications requiring precise motor control.

Keywords:PID controller, PI controller, Particle Swarm Optimization, Genetic Algorithm, Ziegler-Nichols

1. INTRODUCTION

DC motors are essential in various industrial applications due to their precise speed control capabilities. This study compares three methods for tuning PID and PI controllers: Ziegler-Nichols (ZN), Genetic Algorithm (GA), and Particle Swarm Optimization (PSO). The objective is to identify the most effective approach for achieving minimal overshoot, fast settling time, and stability in DC motor speed control. Simulation results highlight the strengths and limitations of each method, with PSO emerging as the most efficient tuning technique.

2. KEY MOTOR PARAMETERS

Parameters of the studied motor are given in table 1

Table 1 Key Motor parameters

Parameter	Value
Armature Resistance (R)	0.5 Ω
Armature Inductance (L)	0.012H
Rotor Inertia (J)	0.00471 $kg.m^2$
Viscous Friction Coefficient (B)	0.002 Nms/rad
Torque Constant (Kt)	0.5 Nm/A
Back EMF Constant (Ke)	0.5 Vs/rad

3. COMPARISON OF TUNING METHODS

The performance of the three tuning methods—Ziegler-Nichols (ZN), Genetic Algorithm (GA), and Particle Swarm Optimization (PSO)—is evaluated based on rise time, settling time, overshoot, and overall system stability. The results are summarized below in table 2.

Table 2 Results of comparison of tuning methods

Method	Ziegler-Nichols	Genetic Algorithm	PSO
RiseTime(s)	0.01	0.18	0.08
SettlingTime(s)	0.71	0.075	0.097
Overshoot(%)	4.42	5.92	0
Remarks	Simple, Less stable	Balanced performance	Most efficient and robust

4. DISCUSSION

•**Ziegler-Nichols Method**: Provides fast rise time but is prone to higher overshoot and less stability. Suitable for systems with less stringent precision requirements**.**

•**Genetic Algorithm:** Balances rise time and overshoot, offering a versatile solution for mostapplications**.**Genetic Algorithm: Balances rise time

• **Particle Swarm Optimization**: Demonstrates superior performance, achieving minimal overshoot and faster settling time, making it the most effective method for precise and dynamic control.

5. CONCLUSION

This study compares three tuning methods—Ziegler-Nichols, Genetic Algorithm, and Particle Swarm Optimization—for PID and PI controllers applied to DC motor speed control. The findings highlight the following key points:

1. **Ziegler-Nichols**: Offers a simple heuristic approach but suffers from significant overshoot and slower settling times, making it less suitable for high-precision applications.

2. **Genetic Algorithm**: Provides a balanced trade-off between rise time, overshoot, and settling time. It is versatile and adaptable to a wide range of systems.

3. **Particle Swarm Optimization**: Delivers the best results with minimal overshoot (0%) and the fastest settling time (0.097 seconds). It is the most robust method for dynamic systems requiring precise control.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
10-12 December 2024; Tamanrasset, Algeria

CerVrChain: Smart Contracts Based Certificate Degree Attestation and Verification in Algeria

Rofaida Khemaissia[(1)*], Ala Djeddai[(2)]
[(1)] Laboratory of Mathematics, Informatics and Systems (LAMIS), Echahid Cheikh Larbi Tebessi University, Tebessa,12002, Algeria
[(2)] Laboratory of Computer Science and Applied Mathematics (LCSAM), Chadli Bendjedid El-Tarf University, B.P 73, El Tarf 36000, Algeria
[*]khemaissia.rofaida@univ-tebessa.dz

Abstract: In this abstract, we give an overview of our proposal CerVrChain which is a blockchain based system for certificated degree attestation and verification in Algeria. In order to keep the security and data privacy, CerVrChainismanaged by several Algerian ministers where everyone has its responsibilities and access limitations.

Keywords: blockchain (BC),Data Integrity, Smart Contracts, Privacy, Certificate attestation and verification.

1. INTRODUCTION

The present work presentsCerVrChain a system overview about degree certification and verification in Algeria using Blockchain technology(BC). The CerVrChain proposes separate roles in order to limit possible errors and ensure better security and privacy. Thus, the ministry role is responsible for managing sensitive data about persons and certificate issuers. Other roles can interact with CerVrChain only after registration by an authorized ministry. Several works have been proposed to tackle this problem such as: [1], [2], [3] andBlockCert[1].
Section 2 gives details about CerVrChain architecture and its main components.Section 3 concludes the abstract.

2. CerVrChain Architecture and its main Functionalities

CerVrChain components and their actors are illustrated by fig1 where all required smart contracts are given. The BC smart contracts proposed by CerVrChain allow users to interact with BC network. In the next, we give detailed descriptions about CerVrChain components and their legitimate users along with their interactions.

2.1. Users Roles and Responsibilities

In this section, we give details about different important roles in CerVrChain. These separate roles ensure additional security features and gives responsibilities to every entity in the system.
Ministry of the Interior, Local Authorities and Regional Planning (MILARP:itsrole is to manageBC data about persons who are under degree preparation. Thus, every person must be registered using its national ID. This latter can be used to link every person with its certificate on BC. The MILARP is the only authority that has this role due to the sensitive data about citizens.

The minister of Higher Education and Scientific Research (MHESR): its main role is registering new certificate issuers such as universities and institutes because it is the main authority that has this right. Every certificate issuer is registered using a unique ID along with its specific information. The MHESR can manage access controls and identity management only on its certificate issuer data.

Minister of Vocational Training and Education (MVTE): has the same role as the MHESR but it cannot register certificate issuers related to higher education and scientific research.

Certificate Issuer: It is the only authority which delivers the certificate degree. Its role is attributed by the MHESR or the MVTE by providing a BC certificate. It uses this certificate and the national ID of a person to store the certificate degree on the BC.

Certificate verifier: It can be any organization which can verify a certificate degree of persons.

2.2 Blockchain Components

We are to give descriptions about CerVrChain components. Every component is considered as a blockchain smart contract which ensures the services offered by that component. All of them must interact with the Access Control to verify if the user has an access authorization to use the target components

[1] http://www.blockcerts.org/

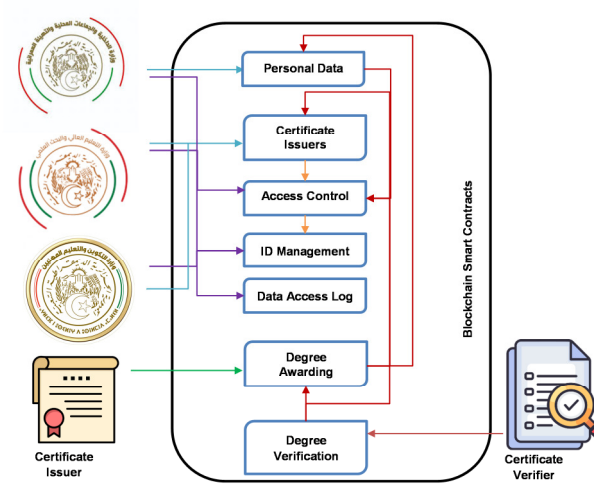

Figure 1: The Main Components of CerVrChain Architecture along with theirs Interactions

Personal data: It manages the data related to persons that have received certificate degrees from certificate issuers. This data is sensitive and therefore we proposed to be only controlled and managed by the MILARP. Every person has its unique national ID.

Certificate Issuers Data: It uses by the MHESRorMVTEto control and manage the data related to certificate issuers. The MHESR or MVTE stores every legitimate issuer using its unique ID along with its information. Therefore, every unregistered issuer is not allowed to deliver any certificate. The MHESR or MVTE stores for every issuer the authorized degrees that can be delivered.

Identity Management: It has two main tasks: the first is creating identities and registering the new users such as certificate issuers and verifiers, the second is verifying the identity validity using BC. The IDM component returns a registration certificate to every accepted demand for registration where these latter contain critical information about enrolling CerVrChain users with different roles. Only the MILARP, MVTE and MHESR can interact with IDM.

Access Control: It defines access controls to CerVrChain components where it is only used by the MILARP, MHESR and MVTE.

Access Log: It stores all operations that are performed by CerVrChain users. For the sake of performing future verification that detects inconsistencies in the history of authorization and access control components.

Degree Awarding: It is invoked by a legitimate certificate issuer in order to register new certificate degree. In this situation, the certificate issuer and the person ID must be exist with their information. This restriction ensures that every certificate must be delivered by legal issuers to legal persons. Every certificate must be stored with a unique ID that can be for example a hash that is calculated using the certificate data.

Degree Verification: A legitimate certificate verifier uses this component to check if a given certificate degree has been delivered or not to a person, it requires the intervention of Degree Awarding to complete the check using the data: Certificate hash and person ID.

3. Conclusion

In this abstract, we have presented CerVrChainwhich is a BC based certificate that ensures automatic certificate issuing and verification which limits errors and omits manual process. CerVrChainensures privacy of data related to persons or issuers or certificates using access controls. The communication between actors and CerVrChain uses TLS for a better security and privacy preserving.

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(CO2 emissions reduction and energy through innovation technologies connected with circular economy)

BitourYousra[1], Bacha Oussama[1], Korichi Mourad[1]
[1] Laboratory of Dynamic Interactions and Reactivity of Systems, KasdiMerbah University, Ouargla 30000, Algeria
Email address:
Bitour.yousra@univ-ouargla.dz (BitourYousra), bacha.oussama@gmail.com (Bacha Oussama), Mourad.korichi@gmail.com (Korichi Mourad)

Abstract: Gas flaring is a widely used procedure in many chemical systems, especially in refineries, petrochemical businesses, and oil facilities, for pressure adjustment and safety management. This process has broad ramifications: it influences human health locally, the environment regionally, and it contributes to climate change internationally(1). In actuality, one of the main causes of greenhouse gas emissions is gas flaring(2). Methane (CH_4) and carbon dioxide (CO_2) make up the majority of fugitive emissions from fuels in Algeria, according to data on greenhouse gas emissions. The production, processing, and transportation of natural gas are the primary causes of these emissions, as are venting and flaring operations. Algeria's greenhouse gas emissions were predicted to have reached 206 Mt CO_2 equivalent by 2020(3). In addition to causing environmental harm, flaring wastes a precious energy source that could be used to promote economic expansion. The majority of flared gases have a lot of fuel potential. Realizing this, the relationship between energy conversion and waste reduction has drawn interest as a viable strategy for protecting the environment and achieving carbon neutrality. This study looks at different approaches used today to recover gas emissions(4) and turn them into value-added products and renewable energy(5). In the first step, we simulated three methods of electricity generation(6). The first is electricity generation using a gas turbine(7), the second using a steam turbine(7), and the third is a combination of the first two methods (combined cycle) The results obtained by theASPENHYSYSsimulator of the three methods show that the combined cycle gives better results(Figure-1-), with an energy production of 4.47 MW/h. This electrical energy will be used to obtain renewable energy, and this is the case in our next study.

Keywords: Gas to electricity**,** Gas flare reduction, Energy recovery, Reduction CO_2, Combined cycle, gas turbine, steam turbine.

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Secure Flying Adhoc Networks(FANETs) for Smart Farming

Sihem Benfriha[(1)*],Nabila Labraoui[(2)]Sarra benadla[(3)]
[(1,2)] STIC Laboratory, Department of computer science, University of Tlemcen, Algeria
[(3)]STIC Laboratory, Department of first cycle, Higher School of Management, Algeria
[*]benfriha.sihem@univ-tlemcen.dz

Abstract: In the field of smart agriculture, drones have enabled farmers to collect and analyze data in real-time, leading to more informed decision-making, increased efficiency, and improved crop yields. However, Flying Ad hoc Networks (FANETs) are vulnerable to various security threats that can compromise the network's integrity and reliability. Consequently, in recent years, there has been a growing interest in studying trust evaluation in FANETs. Specifically, numerous studies have presented reasoning models to detect potential attacks. In this paper, we propose a fuzzy-based drone behavior evaluation model to detect malicious drones in smart farming. Compared to other models, our proposed approach demonstrates a lower error rate.

Keywords: Drone, FANET, Fuzzy Logic, Smart Farming.

1. THE PROPOSED MODEL

In this paper, we proposed using Fuzzy logic to evaluate drone behavior in smart farming named FUBA. Fuzzy logic is a computational approach that handles uncertain information byallowing for degrees of truth rather than rigid binary values.

Step 1: Fuzzification: This step generates a membership function to determine how the numerical datacorrespond to a linguistic variable, using triangular and trapezoidal functions.

Step 2: The inference engine: In this step, all the rules need to be defined in the proposed fuzzy logic model andthen explain those that reflect realistic situations.

Step 3: Defuzzification: is the pivotal stage within the fuzzy logic process, where the crispoutput is derived from the fuzzy inference engine's fuzzy output. The output is the direct trust of the drone.

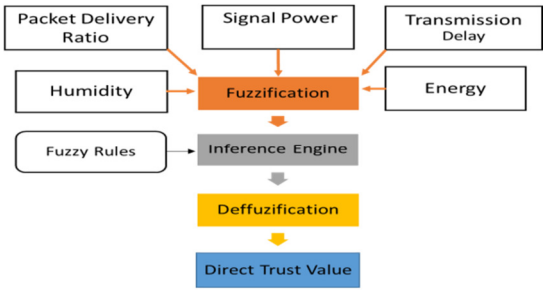

Fig. 2Fuzzy Logic for drone evaluation.

2. EXPERIMENTAL RESULTS

Figure 3 illustrates the false positive ratio for FUBA, FNDN, and UNION as afunction of drone density. The false positive is determined by computing the trusted node using the Fuzzy Logic application. It is noteworthy that at the beginning of the simulation experiments,no instances of false positives were generated. Consequently, when comparing theproposed model FUBA with FNDN and UNION, the proposed solution exhibits a lower error ratio.

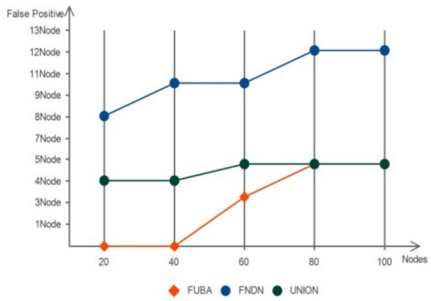

Fig. 2 False Positive rate.

3. CONCLUSION

Trust management is a crucial technique for enhancing network security, especially when combined with other protective measures to detect and prevent malicious activity within a network. In this paper, we proposed a fuzzy logic-based approach for evaluating drone behavior to detect bogus information attacks in smart farming. Our model outperforms existing models in terms of reducing false positives, providing a more reliable method for identifying malicious drones.

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Governing control system based on fuzzy logic controller in a CCGT plant

Djamila.TALAH[(1)], Mohammed. TSEBIA[(2)], Hamid.BENTARZI[(3)], Said. BELHADJ[(4)]
[(1), (2), (3)] Electrical and Electronic Institute.M'hamedBougaraUniversity, Boumerdes, Algeria
[(4)] Faculty of technology.M'hamedBougaraUniversity, Boumerdes, Algeria
[(1)] d.talah@univ-boumerdes.dz
[(2)] m.tsebia@univ-boumerdes.dz
[(3)] h.bentarzi@univ-boumerdes.dz

Abstract: The advanced technologies in the combined cycle power plants offer more effectiveness and lower environmental effects compared to the conventional systems. Fuzzy logic control is one of the frequently advanced controllers may well improve the performance of the control system in the power plant. This study focuses on the improvement of governing control system by using a fuzzy logic controller. Thus, a combined cycle gas turbine plant has been modelled and simulated on MATLAB/Simulink, and a fuzzy logic controller was implemented. The simulation results are compared with those of a conventional PID controller tuned by the Ziegler Nichols method.

Keywords: Combined cycle, Simulation, Control system, Governor, Fuzzy logic.

1. MATHEMATICAL MODELING OF THE CCGT PLANT

The thermodynamic process of the gas and steam turbine consistent on the adiabatic compression and expansion, as well as to the heat exchange in the HRSG [3, 4].

$$x = (P_{r0}\, W)^{\frac{\gamma-1}{\gamma}} \quad (1)$$

Where, γ : The ratio of specific heat,
P_r : The actual compressor ratio (for nominal airflow (W=1pu), $P_r = P_{r0}$)
The compressor discharge temperature t_d and the gas turbine exhaust temperature t_e:

$$t_d = t_i\left(1 + \frac{x-1}{\eta_c}\right) \quad (2)$$

$$t_e = t_f\left[1 - \left(1 - \frac{1}{x}\right)\eta_t\right] \quad (3)$$

Where, t_i and t_f are the ambient and inlet gas turbine temperature, respectively.
η_c and η_t are respectively, the compressor and turbine efficiency.
The mechanical output power produced by the gas turbine:

$$E_g = K_0\left[(t_f - t_e) - (t_d - t_i)\right] W \quad (4)$$

The mechanical output power produced by the steam turbine: $E_s = K_1\, t_e\, W$ (5)

In steady state and for initialization purposes, the generation output power of the plant is given by: $P = E_g + E_s$ (6)

2. THE CONTROL SYSTEM LOOPS

The control systemconsists of a speed governor control loop, fuel control loop and the temperature control loop.

A. Conventional PID Controller

The designed critical gain and critical period, for our system are: Kcr=5.5 and Pcr= 2.25.The calculated Ziegler-Nichols PID parameters are: "Kp=3.3", "Ti=1.125" and "Td=0.28125".

B. Fuzzy Logic Controller

The error and change in error of the fuzzy controller is calculated by the following formula,

$$e(k) = \omega_{ref} - \omega_r \quad (10)$$

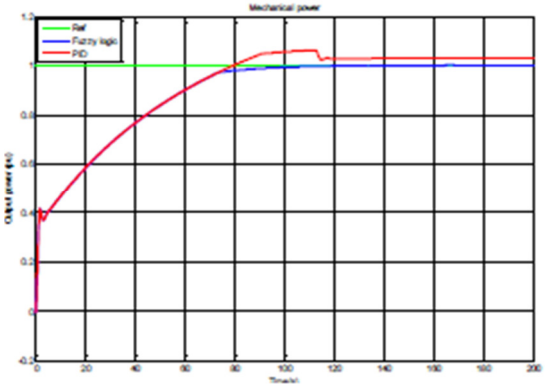
$$c_e(k) = e(k) - e(k\text{-}1) \quad (11)$$

Where, "ω_{ref}" is the reference speed and "ω_r" is the measured speed.

3. SIMULATION RESULTS AND DISCUSSION

A. Simulation results for a set point load

As illustrated in Fig. 2, the mechanical output power is represented for a PID controller and a fuzzy logic controller.



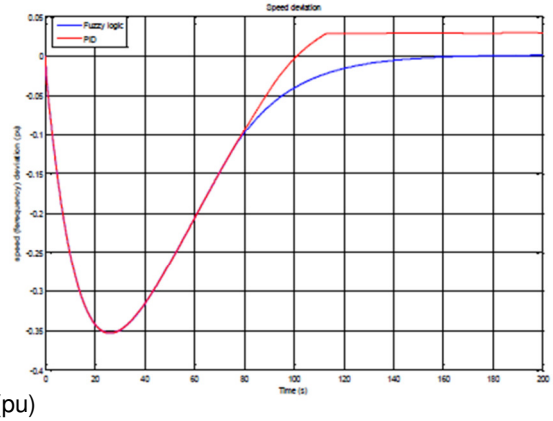


Fig. 2. Mechanical output power (pu)Fig. 3.Speed deviation (pu)

B. Simulation results for a sudden change in load

In this stage, a sudden change in power load is applied in steady state, at t=140 (s), where the load power balanced from 0.85 (pu) to 1 (pu).

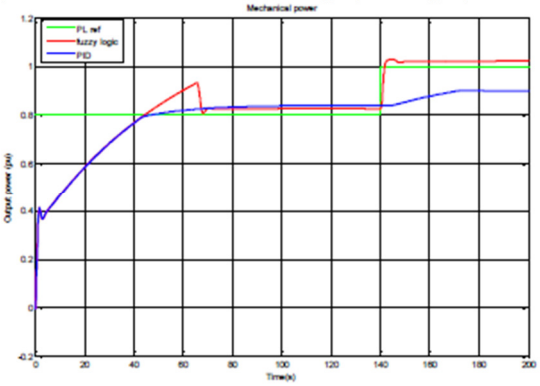


Fig. 4. Mechanical output power (pu).

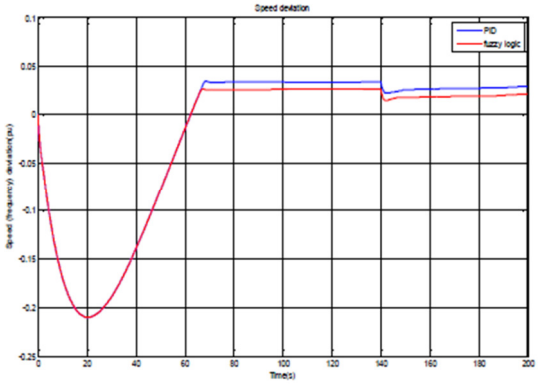


Fig.5. Speed deviation (pu), for a sudden change in load

4. CONCLUSION

In this study, a fuzzy logic controller has been implemented in the governing system in order to get better performance. The simulation results compared to the traditional PID Ziegler Nichols controller, indicate suitable dynamic responses in terms of the sensitivity to the load disturbance, fast response, reduction of settling time.

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Control Strategy of the DC-DC Converter in the Drive Train of a Fuel Cell Electric Vehicle in order to Improve its Autonomy

Said BELHADJ[(1)*], Djamila TALAH[(2)]
[(1)] Department of Electrical Systems Engineering. M. Bougara University,Boumerdes, Algeria
[(2)] Electrical and Electronic Institute. M. Bougara University, Boumerdes, Algeria
*belhadj_said_1976@yahoo.fr

Abstract : Conventional vehicles have the advantage of offering good performance and long range, but they are polluting, emit greenhouse gases, and have low energy efficiency. In this regard, interest in electric vehicles is increasing. Batteries are the primary energy storage devices in FCEVs. This document examines the control of the DC-DC bus powering the electric motor, considering the effect of parameters on vehicle performance and energy consumption. Following the tests, we determined the vehicle's various energy consumptions and ranges according to the driving cycle used (NEDC).

Keywords: Energy storage system, Fuel Cell Electric Vehicles (FCEV), DC-DC Converter, NEDC, Dynamic parameters,Control strategy.

1 MODELING OF THE VEHICLE BLOCKS

Figure 1 illustrates the model of the fuel cell electric vehicle (FCEV).

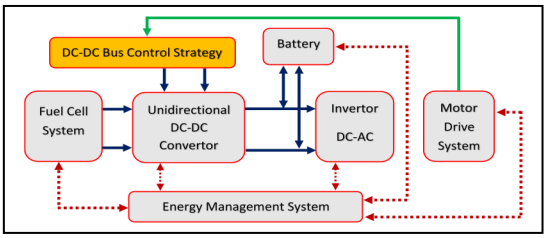


Fig. 1 Global scheme of the Fuel Cell Electric Vehicle

2 CONTROL SYSTEMS OF THE DC-DC CONVERTER

The proposed method aims to find the optimal power distribution for the battery to increase its range, in addition to the energy management system involving the fuel cell (FC). The contribution of this document lies in the control of the DC-DC bus based on the reference and instantaneous currents of the FC and a parameter denoted as Pv, which represents the vehicle's dynamic parameters.

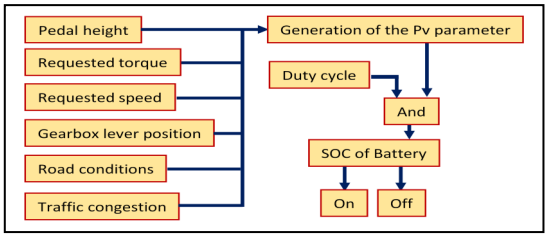


Fig. 2 Method for using the vehicle's dynamic parameters to increase battery range

3 SIMULATION RESULTS AND DISCUSSIONS

The vehicle's deceleration phase was tested during the simulation of the model with battery recharging, based on the dynamic parameters of the FCEV, using a block containing the Pv parameter in the control of the DC-DC bus block. Unnecessary battery usage was reduced to enhance range during the initial phases of acceleration at low speeds and moderate torque values. A driving cycle of the NEDC type is shown in Figure 3. Figure 4 provides a comparison between the vehicle's reference speed and measured speed. The

power demanded by the fuel cell (FC) for the vehicle is shown in Figure 5. The battery state of charge (SOC) is illustrated in Figures 6 and 7.In the three selected intervals, namely [50-60s], [120-130s], and [240-250s], the battery is not discharged, as the SOC is higher following the intervention of the Pv parameter. This results in an energy gain (in Figure 7, it appears as though the battery is recharged, but it should be interpreted as the battery not being unnecessarily discharged).

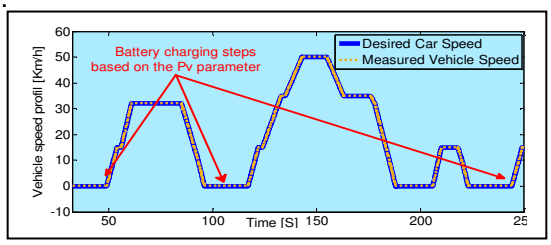
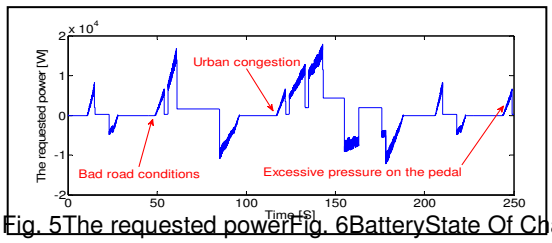


Fig. 3NEDC Driving CycleFig. 4 Comparison between the two speeds of the vehicle: reference and measured



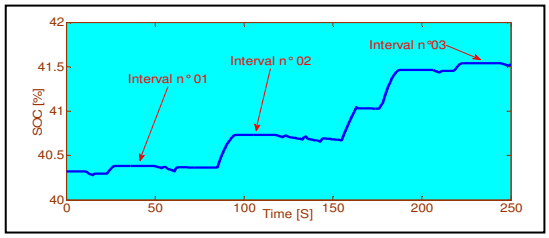


Fig. 5The requested powerFig. 6BatteryState Of Charge

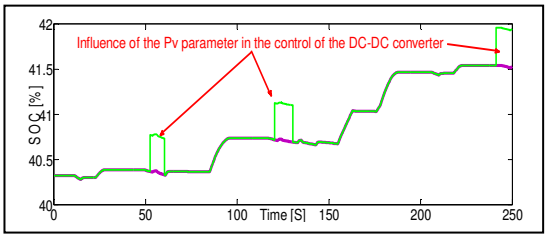


Fig. 7 The three stops of battery discharges in the ‘‘ON’’ position of the Pv parameter

5 CONCLUSION

An energy management method has been proposed as a solution for an FCEV. An additional control method at the DC-DC bus level is designed, and an improvement in range is demonstrated according to the vehicle's demand characteristics. The contribution of this method lies in disconnecting the battery's energy call to avoid unnecessary losses, with the main source ensuring the energy supply. In terms of vehicle range and battery lifespan, this control strategy will continuously contribute and assist the overall energy management system of the vehicle by adding an optimal level of energy storage, improving the supply in terms of quality and efficiency.

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Elastic Optical Networks with Machine Learning: A Comprehensive Review of Optimization Techniques

ImeneACHOURI[(1)*], MalikaBABES[(2)], YoussoufACHOURI[(3)]
[(1,2)] *Networks and Systems Laboratory*. *Badji Mokhtar Annaba University*, *Annaba*, Algeria
[(3)] *LaSTIC laboratory*. *University of Batna 2*, *Batna*, Algeria
[*]Corresponding author e-mail address {imen.achouri@univ-annaba.dz}

Abstract: This paper presents a review on optimizing Elastic Optical Networks (EONs) using Machine Learning (ML). EONs support modern data-intensive demands through adaptable spectrum allocation and efficient management. Integrating ML into EONs automates routing, spectrum assignment, and monitoring tasks, providing flexibility in handling complex traffic patterns.

Keywords: Elastic Optical Networks, Machine Learning, Spectrum Management, Network Optimization, Resilience.

1. INTRODUCTION

Increasing demands for data services like cloud storage, 5G, and streaming platforms have created a need for networks that can adapt quickly and scale effectively. Elastic Optical Networks (EONs) are suited for this purpose due to their flexible spectrum management capabilities, which allocate resources in smaller increments compared to traditional Wavelength Division Multiplexing (WDM) networks,

2. ROUTING AND SPECTRUM ALLOCATION (RSA) IN EONS

Routing and Spectrum Allocation (RSA) is crucial in EONs for determining the most efficient paths and frequency allocations for data transmission. By allocating spectrum based on variable slot sizes, EONs can reduce spectral fragmentation and improve resource utilization. RSA processes involve finding the best route and assigning an appropriate frequency range that adheres to constraints of spectral continuity and contiguity. In addition, adaptive spectrum allocation helps EONs meet diverse traffic requirements while minimizing wastage.

3. Protection Strategies in EONs

- **DedicatedProtection**:Specificresources are reserved for each data path, offering fast recovery but at a high resourcecost [1].
- **SharedProtection**:Shared backup paths are used across multiple routes, balancing resourceefficiencywith reliable data protection [2].

4. Application of Machine Learning in EONs

- **SupervisedLearning**: Uses historical data to predict future demand, allowing for preemptiveresourceadjustments [3].
- **UnsupervisedLearning**: Identifies traffic patterns, aiding in optimizedspectrumassignment by reducingpotential congestion [4].
- **Reinforcement Learning**: Learnsfrom real-time network interactions, adaptingrouting and spectrumpolicies to responddynamically to network changes [5],[6].

5. Real-Time Monitoring and Fault Detection in EONs

For EONs to maintain high performance, effective monitoring systems are essential. Real-time network monitoring focuses on tracking signal quality and traffic trends, allowing EONs to identify and address issues proactively. Monitoring systems ensure efficient resource utilization and prevent major disruptions, preserving Quality of Transmission (QoT) across a variety of traffic loads. Advanced monitoring tools, capable of identifying faults and adjusting settings on-the-fly, are integral to the robustness of EONs.

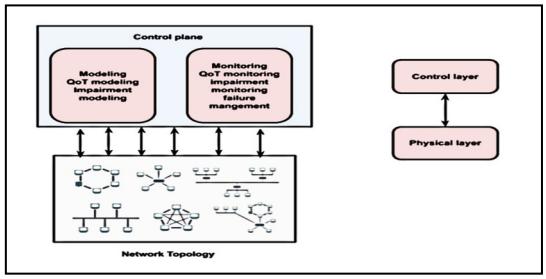

Fig. 1 Use cases of modeling and monitoring techniques in optical networks.

Figure 1 illustrates the core framework used for modeling and monitoring methodologies.

6. Advanced ML Techniques for EON Optimization

- **Quality of Service (QoS) Prediction**:Reinforcementlearningalgorithmsoptimizebandwidth allocation to meet QoS requirements by continuouslylearningfrom network behavior [4].
- **Survivability**: Deep Reinforcement Learning (DRL) approachesimprove network resilience, allowingEONs to adaptrouting in response to disruptions and maintain reliable connections [5].
- **Traffic Forecasting**: ML-based tools, such as Monte Carlo simulations and deeplearning, enhancetraffic management by accuratelypredictingdemand [6].
- **AdditionalApplications**:Other applications include real-time resource allocation and virtual network adjustments, which maximize the efficiency of EONs.

7. Discussion

Compared to traditional, staticmodels, ML-enabledEONs show advantages in scalability, adaptability, and resourceefficiency. ML models support rapidresponse to changes in traffic and network structure, a capability essential to meet the demands of high-capacity modern networks.

8. Conclusion

Machine Learning offers transformative potential for Elastic Optical Networks by enhancing flexibility, resilience, and network management efficiency. With ML-driven solutions, EONs can automate critical processes, from resource management to failure response, achieving greater adaptability and performance. Future research in ML for EONs will likely focus on developing self-managing and highly resilient networks, paving the way for the next generation of data transmission technologies.

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Lightweight Elliptical Curve Cryptography ElGamal for Secure Communication between Heterogeneous IoT Device

Maroua Ahmid[(1)*]
[(1)] LINFI Laboratory, Computer Sciences department, University of Biskra,Biskra, Algeria
*Corresponding author maroua.ahmid@univ-biskra.dz

Abstract: This research addresses critical data security and privacy concerns in the IoT perception layer by proposing a robust solution based on Elliptical Curve Cryptography ElGamal (ECC ElGamal). The system effectively ensures data integrity and confidentiality during transmission over unsecured networks. Experimental results demonstrate ECC ElGamal's superior performance, making it well-suited for resource-constrained IoT devices. The findings emphasize the crucial role of strong data protection measures in establishing secure and reliable IoT ecosystems.

Keywords: Internet of Things; security; elliptic curve cryptography; ECC ElGamal; cryptography

1. SECURITY SYSTEM

IoT security, especially data confidentiality, is hindered by resource limitations in IoT devices and the inherent vulnerabilities of wireless communication. To overcome these challenges, we propose a Lightweight Elliptic Curve Cryptography ElGamal for secure communication between diverse IoT devices. For system initialization, let an elliptic curve group $Ep\ (a,b)$, using the elliptic curve over a finite field (p) where P is a large prime, α is a primitive root of P, such that satisfy the equation (1) for $0 < x < P$, a and b determine the curve shape and satisfy the equation (2) P and α are public numbers.

$$y^2 = x^3 + a\,x + b \quad (1)$$

$$4\,a^3 + 27\,b^2 \neq 0 \quad (2)$$

In order to establish secure communications between device and gateway (D, G), device as a sender and gateway as a reserve, D creates a key pair $\{d, \beta_d\}$ as equation (3) where d is the private key and β_d is the public key of D device. The same thing for Gin equation (4).

$$\beta d = d\,\alpha \quad (3)$$

$$\beta g = g\,\alpha \quad (4)$$

When the device wants to send the information i to the gateway, the device converts the information i to a point I on the elliptic curve E by using a mapping function *map()*. Also, choose a random integer k, and keep it secret, calculate the pair point $\{Y_1, Y_2\}$. Then, mapping the pair point $\{Y_1, Y_2\}$ into the pair point $\{Y_{1m}, Y_{2m}\}$ by using the mapping function *map()* and sends them to the gateway as shown in Fig. 1.

ECC ElGamal algorithm can only encrypt and decrypt a point on the curve, not the information. Based on that we have encrypted the information characters one by one by mapping the character to a point on the curve where each character of the information represents a point in ECC ElGamal.

Then encrypt it and map it again to another point.

Fig. 1 ECC ElGamal cryptosystemdiagram.

2. EXPERIMENTAL EVALUATIONS

The proposed system was evaluated on aRaspberry Pi 3 B+ with 1GB RAM. To assess performance, ECC ElGamal was compared to ElGamal and RSA algorithms using NIST-recommended key lengths.Encryption/decryption times were measured for a 160-bit message across three security levels.Results (Figs. 2 & 3) demonstrate that ECC ElGamal consistently outperforms both RSA and ElGamal in terms of encryption/decryption speed across all security levels. ECC ElGamal offers superior security with significantly lower resource demands compared to RSA and ElGamal. This translates to faster processing and improved performance, making it ideal for resource-constrained IoT devices. ECC ElGamal emerges as a promising next-generation public-key cryptography solution for IoT applications.

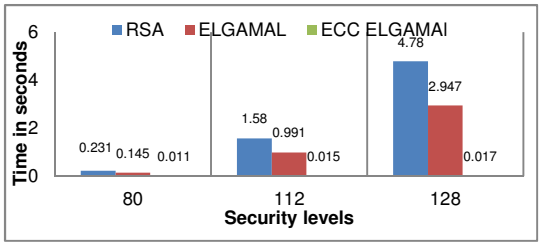

Fig.2. Comparative analysis of algorithms' encryption time.

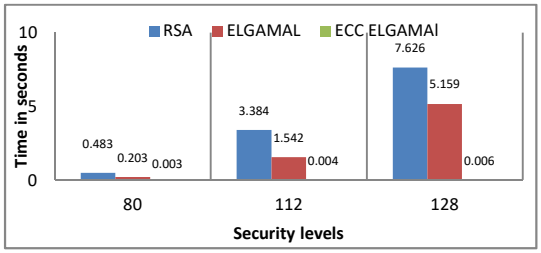

Fig.3. Comparative analysis of algorithms' decryption time.

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Optimizing Electricity Demand Forecasting through Transfer Learning and Temperature-Driven Insights

Rania FARAH[(1)*], Brahim FAROU[(2)],Zineddine KOUAHLA[(3)], Hamid SERIDI[(4)]
[(1) (2)(3)(4)]Computer Science department.Labstic Laboratory,8 May 1945 University, Guelma, Algeria
[*]farah.rania@univ-guelma.dz

Abstract: Predicting electrical load with high precision is essential for efficient energy management, particularly in regions where temperature variations impact energy consumption patterns. This research introduces a novel method that leverages transfer learning to enhance load forecasting accuracy by incorporating a temperature dataset. By adapting a pre-trained model to local temperature conditions, the approach captures the interplay between climate and load demand. Experimental results indicate that this strategy significantly improves forecast accuracy, minimizes prediction errors, and optimizes computational time. This approach offers promising applications for scenarios where resources are limited and quick, reliable predictions are needed.

Keywords: electrical load, temperature variations, transfer learning

1. THE PROPOSED APPROACH

This study introduces a forecasting approach using transfer learning to integrate temperature data into electricity load predictions, improving the model's responsiveness to local climatic effects. Consumption profiles reveal significant peaks in summer, especially in August, driven by high temperatures that increase cooling demands, as shown in Figure 1.

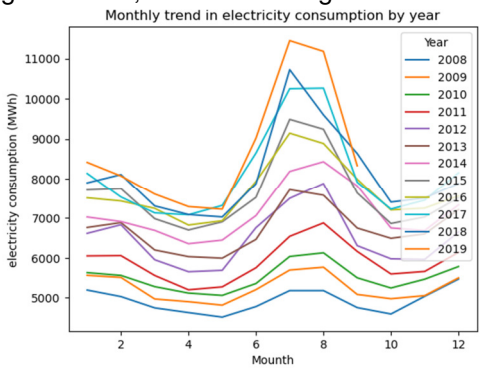

Fig 1. Consumption profiles over the years. Similarly, Figure 2 shows temperature peaks also occur at the end of summer, highlighting the strong dependency between electricity consumption and temperature fluctuations.

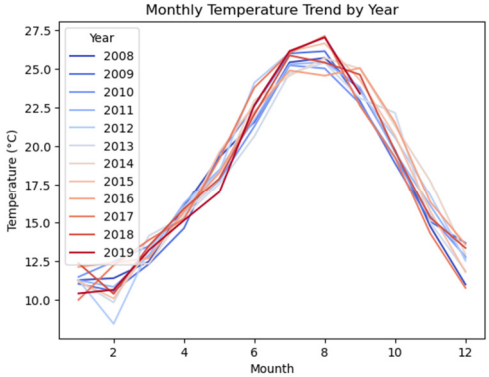

Fig 2. Profiles of the temperature during the years

This dependency highlights the importance of integrating temperature data into forecasting models to better capture seasonal demand shifts. Moreover, applying transfer learning enables the model to adapt to regional temperature patterns, making it a promising approach for improving forecast accuracy by utilizing pre-trained insights specifically adjusted to temperature-sensitive consumption behaviors.

2. RESULTS AND DISCUSSION

The application of transfer learning, using temperature data along with the previous day's consumption, led to improved prediction accuracy when integrated with an artificial neural network (ANN) model. This approach provided enhanced results within a significantly reduced training time compared to a standard ANN model. Specifically, the transfer learning-enhanced ANN reached reliable prediction accuracy within just 30 epochs, while the baseline ANN model required 200 epochs to achieve a comparable level of accuracy.

Tab 1. Table of Results

Models	Accuracy	MAPE
ANN	97%	10%
Transfer Learning	99%	1%

As we can see on the table 1 the transfer learning gave better results than a simple ANN and in less epochs. This reduction in training epochs not only accelerates the forecasting process but also optimizes computational resources, making the transfer learning approach both time- and resource-efficient. These results demonstrate the effectiveness of incorporating transfer learning with temperature variables for refining load prediction, especially in environments where rapid model retraining and deployment are necessary.

3. CONCLUSION

In this study, we presented an approach for improving electricity load forecasting by employing transfer learning combined with temperature data and previous day consumption. The findings confirm that this method significantly boosts prediction accuracy while reducing training time and computational demands. By reaching optimal accuracy with fewer epochs, the proposed model proves to be a valuable tool for energy management systems that require fast, accurate predictions in response to temperature-driven demand changes. These promising results suggest further exploration of transfer learning for other weather-related variables and highlight its potential application in real-time load forecasting across various climatic regions.

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Optimization and planning of energy systems using MESSAGE code

Rabah BENABID[(1)*]

[(1)] department of electrical engineering, CRNB, Djelfa, Algeria
[*]r.benabid@crnb.dz

Abstract: This paper presents an energy system optimization and planning procedure using message code. The problem is formulated as a mixed integer programming problem with constraints on activities and installed capacities. The objective function is the minimization of the total installation cost including the investment cost, the variable and fixed operation and maintenance costs, and the constraints violation cost. Various operation and environmental constraints are considered. The obtained results present an energy mix that satisfies the load demand as well as technical and environmental constraints.
Keywords: Energy planning, Mixed integer programming, Energy mix, MESSAGE code, Techno economic optimization.

1. LONG TERM ENERGY PLANNING PROBLEM

In this paper, the energy planning problem is solved using MESSAGE code of the IAEA [4-5]. This last, can deal with the energy planning and optimization, analysis of power plants gas emissions, fuel cycle facilities, and so on. It is based on mixed integer linear optimization with constraints [6].

$$\min \sum_{j} \sum_{t}^{T} \left[d_t^0 \Delta_t X_{jt} \times i_{jt} + d_t^C \Delta_t Y_{jt} \times O_{jt} \right] \quad (1)$$

Where, T is the number of period in the model, J and t are technology and period, respectively, d_t^0 and d_t^C are discount factors applied for operating and capital cost respectively, Δ_t is the length of period t in years, X_{jt} is the fuel consumption of technology j in period t, Y_{jt} is the capacity variables for annual new installation of technology, I_{jt} is the specific investment of technology j at period t, and O_{jt} is the operating cost of technology j in period t.
Furthermore, (2) is subject to various equality and inequality constraints [4].
Message code is based on the modelling of the energy system as an energy chain consisting various energy levels, forms and energy conversion technologies (see figure 1).

2. SIMULATION AND RESULTS

Case study

An energy test system of MESSAGE code used in this paper to explain the energy planning procedure. The energy system has two fossil power plants (oil and coal), two hydro power plants and a renewable power plant. Furthermore, various technical and environmental constraints are considered in this planning problem. The projected load demand starts from 200 MWyr and increases with a constant of 1.05 during the planning horizon from 2002 to 2030.
Due to space limitation, this extended abstract will contain only few results.Table 1, presents the energy planning results and figure 2illsutrates the power plant share in 2025.
From this table it can be concluded that the load demand is satisfied.

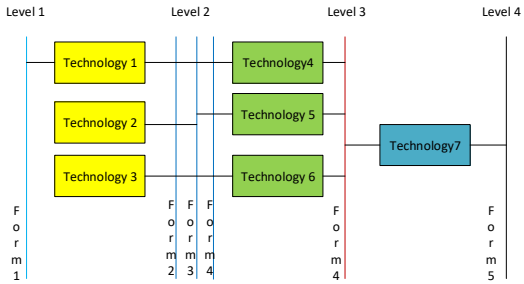

Fig. 1 Illstration of energy chain principle.

Table 1 Energy planning results (MWyr).

Years	Coal power plant	Oil power plant	Hydro1 power plant	Hydro2 power plant	Renewable power plant	Total
2002	242.22	7.78	0.00	0.00	0.00	250
2005	273.81	15.59	0.00	0.00	0.00	289.41
2010	117.25	2.35	152.00	97.76	0.00	369.36
2015	93.74	4.49	147.09	226.09	0.00	471.41
2020	169.46	26.11	159.00	238.00	9.08	601.65
2025	267.88	29.71	171.00	274.00	25.29	767.88

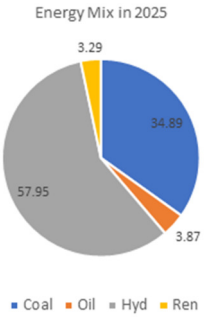

Fig. 2 Energy mix in 2025.

Also, due to the environmental constraint, the coal power plant is decommissioned in 2015 and replaced step by step by Hydro and renewable power plants (as illustrated in figure 2).

3. CONCLUSION AND FUTURE WORK

This paper presented the energy system optimization and planning using message code. The problem was formulated as a mixed integer programming problem with constraints on activities and installed capacities. Various operation and environmental constraints are considered. The obtained results present an energy mix that satisfies the load demand as well as technical and environmental constraints.For the future work, the following points will be considered: additional environmentconstraints, spinning reserve and grid flexibility aspect.

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CycleGAN-Based Image Synthesis for Improved Plant Disease Detection

Imane Bouacida[(1)*], Brahim Farou[(1)], Aissa Klai[(1)] , Hamid Seridi[(1)]
[(1)] LabStic Laboratory, University 8 Mai 1945, Guelma, Algeria
[*]bouacida.imane@univ-guelma.dz

Abstract: Deep learning has revolutionized plant disease detection, offering advanced identification methods to address a critical agricultural challenge. However, the lack of sufficient data remains a significant obstacle, as deep learning models require extensive datasets for accurate results. To overcome this challenge, we propose an artificial intelligence-based data augmentation method using CycleGAN to enhance image data for plant disease detection. This CycleGAN variant enables image-to-image translation without requiring paired examples, facilitating transformations between healthy and diseased domains and generating healthy images from diseased ones and vice versa. This approach creates a more diverse dataset, supporting reliable disease detection. Tests on the PlantVillage dataset have yielded highly promising results.

Keywords: Data Augmentation, CycleGAN, Plant disease, Deep learning, Agriculture.

1. INTRODUCTION

Plant diseases pose a significant threat to global food security by reducing agricultural productivity, disrupting food supply chains, and increasing the risk of food shortages [1, 2]. Early detection is critical, and automated plant disease detection using deep learning has shown great promise [3, 4]. However, challenges such as insufficient data hinder its effectiveness, as collecting comprehensive datasets is difficult due to the large variety of plant species and rapidly spreading diseases. Data augmentation is an effective solution to the limited data challenge, as it artificially expands the dataset by generating new data points from the existing ones [5]. Various methods for generating synthetic data have been proposed [6, 7, 8, 9, 10, 11, 12], including physical expansion, indexing robots, variational auto-encoders, and autoregressive models. However, these methods often result in poor quality, lack of diversity, and data imbalances. To address these issues, we propose using CycleGAN, an adversarial network-based data augmentation method, which enables transformations between healthy and diseased domains, generating healthy images from diseased ones and vice versa.

2. METHODS AND MATERIALS

A. Dataset:

The PlantVillage dataset [13] is an open-access resource for plant leaf disease identification, containing around 54,305 images of healthy and diseased leaves, categorized into 38 classes. The images were captured in a laboratory with a uniform background.

B. Proposed Method:Data Augmentation Using CycleGAN

Our system employs CycleGAN [14], a conditional Generative Adversarial Network (GAN) [15], to augment image data for plant disease detection. Its ability to train without paired images makes it ideal for real-world scenarios where such data is difficult to obtain. Our approach generates healthy leaf images from diseased ones and vice versa, creating a more diverse dataset for disease detection. It uses two generators and two discriminators: generator G and discriminator Dy for transforming healthy images (domain X) into unhealthy images (domain Y), and generator F and discriminator Dx for the reverse transformation. This process is illustrated in Figure 1. CycleGAN learns to extract features from healthy leaf images and uses them to generate unhealthy leaf images, vice versa. The generators aim to create realistic images, while the discriminators work to distinguish between real and generated images.

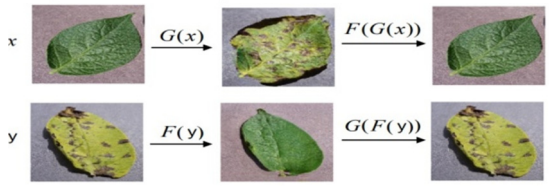

Fig. 1: CycleGan on PlantVillage dataset.

C. Experimental setup:

From the PlantVillage dataset, we selected four plant types Apple, Cherry, Corn, and Tomato and created separate datasets with both healthy and diseased samples for specific diseases: Apple (Black Rot), Corn (Northern Leaf Blight), Tomato (Leaf Mold), and Cherry (Powdery Mildew). We empirically set hyperparameters: batch size of 16, 100 epochs, learning rate of 0.0002, and Adam optimizer parameters (Beta1 = 0.5, Beta2 = 0.999). The experiments were conducted on Google Colab using a GPU.

3. RESULTS

The results, shown in Figure 2, clearly illustrate CycleGAN's ability to generate high-quality unhealthy images from healthy ones and vice versa

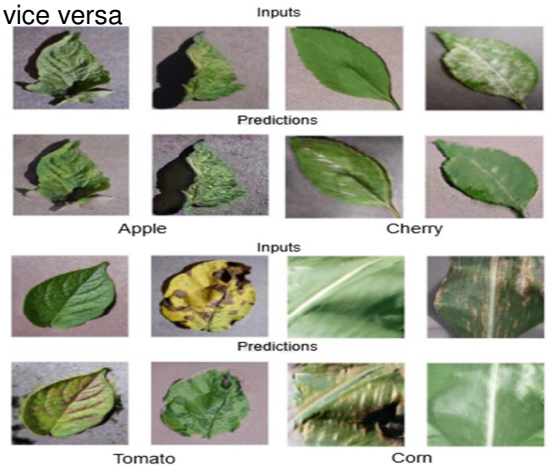

Fig. 2: Examples of the generated healthy images.

4. CONCLUSION

This work utilizes CycleGAN for artificial dataset augmentation, transforming healthy and diseased plant images to generate synthetic data. The results demonstrate successful augmentation, enhancing data diversity and improving plant disease detection. This system can help secure agriculture by improving disease detection and enhancing data diversity for training models.

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Validation of IoT Protocol Security Using AVISPA Tools in Electric Vehicle In-motion Wireless Charging

Karima MASSMI[(1)*], Khaled HAMOUID[(2)],Youssouf ACHOURI[(3)]
[(1)] LaSTIC laboratory. University of Batna 2, Batna, Algeria
[(2)]LaSTIC laboratory. University of Batna 2, Batna, Algeria
[(3)] LaSTIC laboratory. University of Batna 2, Batna, Algeria
[*]Corresponding author e-mail address{k.massmi@univ-batna2.dz}

Abstract: The rapid development of Electric Vehicle (EV) in-motion wireless charging systems requires robust security protocols to ensure safe and privacy-preserving communication between EVs and charging infrastructure. Given the mobility of EVs and the need for continuous authentication, IoT-based charging environments face unique security challenges, including threats of unauthorized access, replay attacks, and privacy breaches. This paper leverages the Automated Validation of Internet Security Protocols and Applications (AVISPA) tool to validate the security of communication protocols within an EV wireless charging scenario. By modeling an authentication protocol with AVISPA, we evaluate the protocol's resilience against common attack vectors in a high-mobility environment. Results from AVISPA simulation highlight the protocol's strengths and reveal areas needing improvement, suggesting modifications to enhance security and meet the demands of dynamic EV charging scenarios.

Keywords: IoT Security, AVISPA, Protocol Validation, Cybersecurity, Formal Verification

1. EV CHARGING SCENARIO AND AVISPA VALIDATION

Scenario Description

The chosen scenario simulates an in-motion EV charging setupwhere multiple vehicles authenticate to charging pads while maintaining secure and anonymous communication. This scenario illustrates the real-time security needs in a high-mobility context, where a secure protocol ensures that only authorized EVs access the charging infrastructure [4].

AVISPA-Based Validation

Using AVISPA, we modeled the protocol for authenticating EVs with charging pads, employing the HLPSL (High-Level Protocol Specification Language) to define the message flows and potential threat scenarios. We tested the protocol against a variety of attacks, including unauthorized access, replay attacks, and man-in-the-middle exploits [5]. The AVISPA framework provides a multi-backend approach, utilizing OFMC (On-the-Fly Model-Checker) and CL-AtSe (Constraint Logic-based Attack Searcher) to analyze protocol robustness [6],[7].

2. VALIDATION RESULTS

Based on the AVISPA simulations, the protocol was evaluated as "SAFE" under both the CL-AtSe and OFMC backends. The results indicate that the protocol successfully mitigates replay attacks and resists man-in-the-middle attacks when specific encryption and time-stamping mechanisms are applied. In the CL-AtSe backend, no reachable states were found, suggesting robust protocol security against these attack types. In the OFMC backend (Fig 2), the analysis confirmed the protocol's safety.

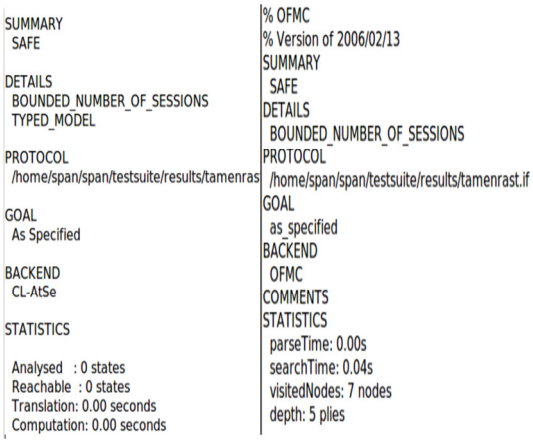

Fig. 2AVISPA Resultat.

3. CONCLUSION

This study demonstrates the utility of AVISPA for validating security protocols in high-mobility, IoT-enabled environments like EV in-motion wireless charging. By identifying protocol weaknesses and providing corrective measures, AVISPA helps ensure that in-motion charging systems remain secure, scalable, and privacy-preserving, addressing the evolving needs of modern EV infrastructure.

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Predictive Control Strategy for Three Phase Dual-Stage Grid-Connected PV

Abdellatif MAHAMMEDI[1], Abdellah KOUZOU[1], Ahmed HAFAIFA[1]
[1]Applied Automation and Industrial Diagnostics Laboratory, ZianeAchour University, Djelfa, Algeria.
mahlat7@yahoo.fr

Abstract: The photovoltaic systems linked to network have advantage to use extracted photovoltaic power in a more efficient manner. However, technical requirements on both sides must be satisfied to assure a good reliability of the photovoltaic installation and the electricity network. This study presents a control of three phase two-stage grid-connected photovoltaic (PV) system. The main objectives are: extract the maximum power point (MPP) delivered by PV arrays under irradiation variations and to inject it into the network with a high grid current quality. A modified Incremental conductance MPPT algorithm based on the direct modification of the switching signal is proposed and applied into the first stage (DC-DC Boost converter)in order to achieve high performance tracking. Furthermore, a predictive control strategy and space vector modulation SVM is applied into the second stage (Two-level inverter) in order to control the grid currents. The proposed system is discussed, verified, and compared through simulations under the MATLAB/ SIMULINK environment. The obtained results prove that the proposed control strategy provides high performance control in term of MPP tracking and grid current quality under irradiation variations.
Keywords: Grid current control, MPPT, Incremental conductance algorithm, Predictive control, Two-stage PV system.

1. SYSTEM GLOBAL CONTROL

The proposed control for the grid connected PV system as shown in Fig. 1. This technique has the following objectives:-tracking maximum power produced by PV panel; -control of DC bus with assuring a high performance of the inverter; -control of grid current quality using predictive control method.

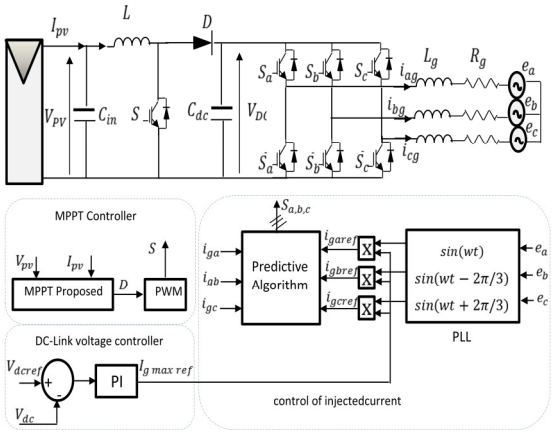

Fig.1. Global system configuration

The cost function is defined and expressed in orthogonal coordinates and measure the error between the reference and predicted currents.

2. SIMULATION RESULTS

To demonstrate the effectiveness of the proposed algorithm, it is verified by numerical simulation and compared with other algorithms. The numerical simulation is carried out in Matlab/Simulink software.

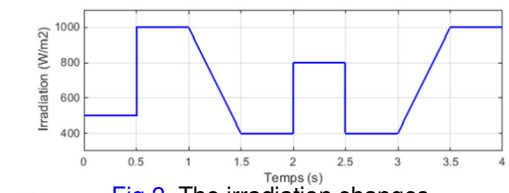

Fig.2. The irradiation changes

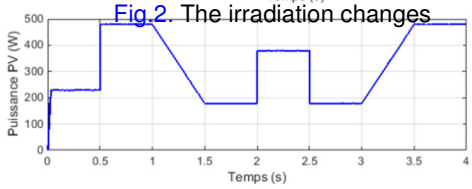

Fig.3. Performance of modified (P&O) algorithm under irradiation change

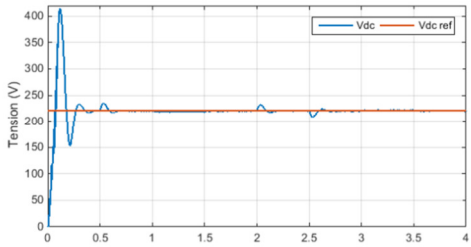

Fig.4. Evolution of the DC bus voltage controlled by a PI regulator

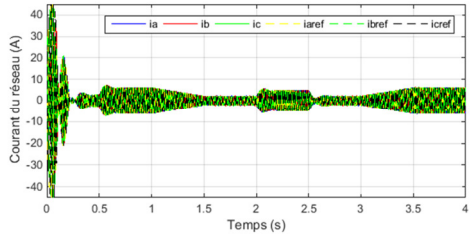

Fig.5. Evolution of grid currents controlled by the predictive algorithm

THD.

Table-2: THD under irradiation levels

Irradiation (W/m^2)	400	500	900	1000
THD (%) for predictivealgorithm	3.49	2.73	1.41	1.26
THD (%) for hysteresis command	7.66	5.96	3.01	2.62

3. CONCLUSION

In this study, a control of three phase two-stage grid-connected PV system based on predictive control strategy is presented and discussed. The simulation results show a significant enhancement by applying a modified Incremental conductance technique in terms of response time and stability around the maximum power point under irradiation changes. Moreover, the proposed control of two stages injects the PV power with high grid current quality.

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Comparative Study of Security Protocol Verification Tools: AVISPA and Scyther

Youssouf ACHOURI [(1)*], Karima MASSMI[(2)], Imene ACHOURI[(3)]
[(1)] LaSTIC laboratory. University of Batna 2, Batna, Algeria
[(2)] LaSTIC laboratory. University of Batna 2, Batna, Algeria
[(3)] Networks and Systems Laboratory. Badji Mokhtar Annaba University, Annaba, Algeria
*Corresponding author e-mail address {y.achouri@univ-batna2.dz}

Abstract: This paper presents a comprehensive comparative study between AVISPA (Automated Validation of Internet Security Protocols and Applications) and Scyther, two major tools for verifying security protocols. Based on criteria such as protocol support, usability, analysis speed, and scalability, this study aims to guide researchers in selecting the most appropriate tool for their specific needs. Our findings indicate that while AVISPA excels in detailed multi-protocol analyses, Scyther offers unique capabilities for rapid multi-session analysis with features like unbounded verification.

Keywords: AVISPA, Scyther, Protocol Verification, Comparative Analysis, Cryptographic Protocols.

1. COMPARISON CRITERIA

The comparison between AVISPA and Scyther is structured around four primary criteria: ease of use, protocol support, verification speed, and scalability [1, 2].

A. Ease of Use: Scyther stands out for its intuitive graphical interface and minimal configuration requirements, making it accessible to novice users. In contrast, AVISPA demands a more in-depth understanding of its back-end configurations, which can be challenging for new users.

B. Protocol Support: AVISPA offers extensive protocol support, ideal for complex cryptographic analyses, including multi-party protocols. Scyther, while supporting fewer protocols, enables innovative multi-protocol analysis, making it highly effective for studying composed protocols.

C. Verification Speed: Scyther is designed for rapid results, making it ideal for quick, preliminary checks on standard protocols. AVISPA, while slower, compensates with more detailed verification, which is beneficial for protocols that require a comprehensive evaluation.

D. Scalability: AVISPA's multi-backend architecture suits large-scale analyses, while Scyther's unbounded verification capability guarantees session analysis over an infinite number of protocol instances without performance loss, making it particularly valuable for repetitive verification needs in multi-session protocols.

2. RESULTS

Our evaluation of both tools on standard protocols, such as Needham-Schroeder [3] and Diffie-Hellman [5], reveals marked differences in their application:

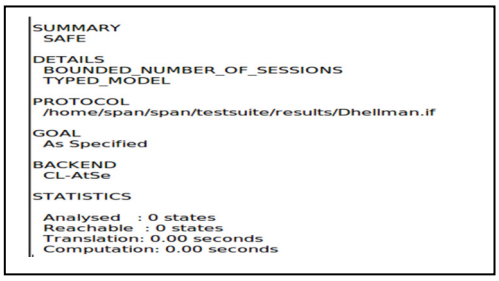
A. AVISPAdelivers thorough analyses capable of detecting complex vulnerabilities (See Fig. 1) [1].

B. SCYTHERprovides rapid insights through unique unbounded and multi-protocol analysis features (See Fig. 2) [2].

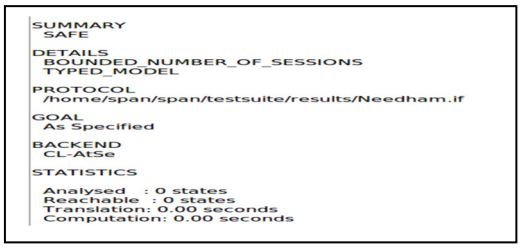
Table 1 Comparative Analysis

Tool	Protocol Support	Verification Speed	Ease of Use	Scalability
AVISPA	Broad	Moderate	Moderate	High
Scyther	Moderate	High	High	Moderate to High

These findings, summarized in Table 1, illustrate each tool's respective strengths.

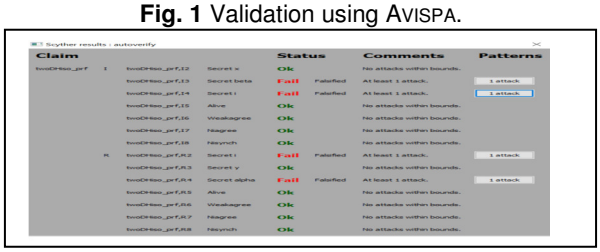


Diffie-Hellman**(a)**

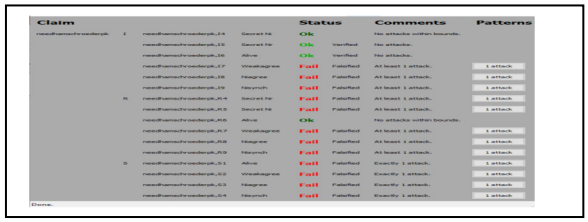


Needham-Schroeder**(b)**

Fig. 1 Validation using AVISPA.



Diffie-Hellman**(a)**



Needham-Schroeder**(b)**

Fig. 2 Validation using SCYTHER.

3. CONCLUSION

This study highlights the unique advantages of AVISPA and Scyther in the field of security protocol verification. AVISPA is particularly suitable for detailed and large-scale verification tasks, while Scyther's specialized unbounded analysis and multi-protocol capabilities make it an optimal choice for rapid, repeated analyses. This comparison serves as a practical guide for researchers seeking the most appropriate tool based on their specific verification requirements.

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Mechanisms of paraffin deposition in pipelines under laminar flow conditions

Rachid BOUCETTA[(1)*], Oussama BENHACENE[(2)],Said GROUNI[(3)] ,Mohammed ZAMOUM[(1)]
[(1)] laboratory of Hydrocarbons Physical Engineering, Universty of Boumerdes, Algeria
[(2)] Laboratory of Coatings, Materials, and Environment, Universty of Boumerdes, Algeria
[(3)] Faculty of Science and Technology University of Tamanghasset, Algeria
[*]Corresponding author r.boucetta@univ-boumerdes.dz

Abstract: A study of the flow of viscous fluids loaded with paraffin is carried out on the basis of the equations of motion, heat transfer and mass transfer. These are rewritten in dimensionless form. The new system of equations is solved numerically, using the fourth-order Runge-Kutta method, in order to prevent the problem of pipe obstruction.

Keywords: Wax deposition, Pipeline, Laminar regime, Molecular diffusion, Shear dispersion

1. INTRODUCTION

The flow of viscous fluids laden with paraffin occurs in numerous industrial settings, such as oil production wells, collection networks, oil loading and unloading pipes, and oil transport pipelines. In the oil industry, the challenge of paraffin deposits arises when the temperature of the external environment where the crude is transported falls below the paraffin crystallization temperature. These deposits can cause partial or total blockage of the pipelines, leading to a slowdown or stoppage in production. This phenomenon, which involves matter transfer, encompasses chemical, thermodynamic, and hydrodynamic aspects. Our study focuses on the hydrodynamic aspect.

Predicting the thickness of paraffin deposits [1-4] can assist the oil company in performing timely and targeted maintenance on specific sections of the pipelines. To achieve this, we modeled the flow of hot viscous fluids laden with paraffin using the fundamental equations of fluid mechanics, heat transfer, and mass transfer in a pipeline with a circular cross-section. We appropriately addressed the issue of pressure losses caused by the paraffin deposits. The resulting model is expressed in full dimensional form to be applicable to the various installations mentioned. The constitutive relations are provided in terms of various similarity parameters pertinent to this type of flow, with the Peclet number being the primary parameter. A solution algorithm based on the fourth-order Runge-Kutta method is proposed for solving the resulting system of equations.

This study focuses on the two mechanisms of paraffin deposition (molecular diffusion and shear dispersion) and aims to evaluate their impact on flow parameters. These parameters include the thickness of the paraffin deposit, the longitudinal distribution of the overall heat transfer coefficient, the longitudinal distribution of temperature, the longitudinal distribution of pressure and the variation of flow rate over time.

1. METHODOLOGY

Two regions of flow can be distinguished, the first begins at x = 0 and ends at x_d, where the product is in contact with the wall and reaches the temperature of the equilibrium point $\left(T_w|_{x_d} = T_c\right)$. In this region, the product is not yet saturated, so there is no paraffin precipitation. The other region of the flow constitutes the rest of the domain,$x_d \leq x \leq L$. In this region the product is assumed to be saturated with paraffin.

2. EQUATIONS

Momentum equation

Integrationof the momentum equation gives thedifferential pressure:

$$\Delta p = \frac{\rho Q^2}{4\pi^2 R^4} \int_0^{L^*} \frac{f}{(1-\delta^*)^5} dx^* \quad (1)$$

The following dimensionless form of the parameters is adopted: $\mathrm{L}^* = \mathrm{L}/\mathrm{R}$ long, $\mathrm{x}^* = \mathrm{x}/\mathrm{R}$, axial coordinate and $\delta^* = \delta/\mathrm{R}$ pipe wall thickness.

Temperature

From the energy balance the axial temperature distribution is

$$\theta = \frac{\mathrm{T_b} - \mathrm{T_0}}{\mathrm{T_{in}} - \mathrm{T_0}} = \exp\left[-\frac{4}{\mathrm{Pe_0} \frac{\mathrm{Q}}{\mathrm{Q_0}}} \int_0^{\mathrm{x}^*} \mathrm{U}^* \mathrm{dx}^* \right] (2)$$

Thickness paraffin deposit calculation

Expressing the radial continuity equation in terms of paraffin mass flux at liquid-deposit interface and using the Fick's law for molecular diffusion and shear dispersion, the local deposition thickness time variation takes the following form

$$\frac{\partial \delta^*}{\partial t^*} = \begin{cases} 0, & if\ 0 \leq x^* \leq x_d^* \\ \dfrac{S^* U^*}{(1-\delta^*)} \theta - \dfrac{0.0306}{(1-\delta^*)} & if\ x_d^* \leq x^* \leq L^* \end{cases} (3)$$

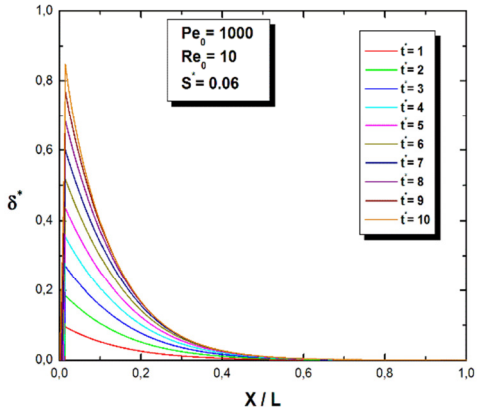

Fig. 2 Distribution of the thickness (molecular diffusion).

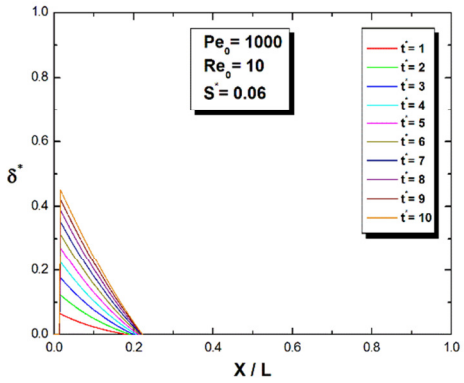

Fig. 3 Distribution of the thickness (molecular diffusion and shear dispersion).

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Silver Extraction and Recovery from broken silicon cells : Photovoltaic Modules

Sabiha ANAS BOUSSAA[a,b]✉, Messaouda AYACHI[a], Abdallah TRAD KHODJA[a], Fatima BOUDEFFAR[a], Abderrahmane NAAS[a], Samy ANAS[b], Rabia RAHMOUNE[a], Bilal MERAZKA[a], Naima ZAOURAR BOUTAREK[b]
a Research Center on Semiconductor Technology for Energetic, , 2 BD Frantz Fanon, 7 merveilles, POB 140, Algiers, Algeria
b University of Sciences and Technology Houari Boumediene USTHB, Laboratory of Materials Technologies. B.P. 2 El Alia, Bab Ezzouar, Alger, Algeria.

Abstract: Recycling helps to reduce the consumption of valuable raw materials, production costs, and environmental impacts. An important argument for the recycling of photovoltaic modules is the reduced energy consumption at the production stage through the use of existing purified material.In the present study, a new method is established to recover silver from mono crystalline silicon waste solar cell by alkaline chemical etching.Before the chemical etching, metallic contacts were extracted, without breaking.Then, 30% NaOH was used as an etching solution at temperature 80 ± 1 °C from 1 to 10 minutes. The recovered material was characterized using different characterization techniques, such as, SEM,XP.
Keywords: Recycling, end of life, photovoltaic panels, silver, recovery.

1. INTRODUCTION

Recycling helps to reduce the consumption of valuable raw materials, production costs, and environmental impacts. An important argument for the recycling of photovoltaic modules is the reduced energy consumption at the production stage using existing purified material [1].
Most of the recycling pathways are focused on recovering silicon,glass and aluminium.All stages of the silicon cell life cycle contribute to the GWP and reduction of greenhouse gas emissions by using recycled silicon material represents 42%. Recycling of solar panels can help to recover 80 percent of crystalline silicon that can beused as a new photovoltaic cell , as silicon nano powder on lithium batteries ; in supercapacitor and other applications ; more than this amount concerning other material substance such as glass and aluminium which can be re-used in several applications. The ITRPV predicts that by 2030, the total value of materials recovered from PV recycling could reach USD 450 millions. With this amount, it is possible to produce 60 million PV modules, which would represent approximately 33% of 2015 production. If Si is considered, up to 30,000 t of silicon can be recovered in 2030, the amount of silicon needed to produce around 45 million new modules. Considering current polysilicon prices and a recovery rate from commercial recycling processes of 70%, this equates to $380 million.Removing silver contacts is mainly a side effect but different methods of contacts removing were worked out [2-15]. In the present study, a new method is established to recover silver from mono crystalline silicon waste solar cell by alkaline chemical etching.

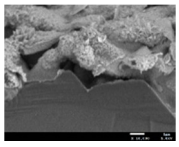
2. EXPERIMENTAL PROCEDURE

In the present work, silicon broken cells from ARCO industry photovoltaic panel were used.Before the chemical etching, metallic contacts were extracted, without breaking and the silicon cell was characterized by different characterizations techniques. 30% of NaOH was used as an etching solution at temperature 80 °C from for silver recovery.

3. RESULTS AND INTERPRETATIONS

3.1. Silicon cell characterization before purification

SEM analysis: The SEM micrographs presented in the Fig.2 and EDS analysis presented in Fig .3 show that silver is the metallic contact on the silicon broken cell.



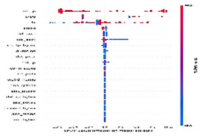


Fig. 2 SEM micrograph Fig. 3 EDS analysis

B. *Optical micrographs*

The figure.4 shows the optical micrographs of the recycled silicon from the front to the back of the cell.

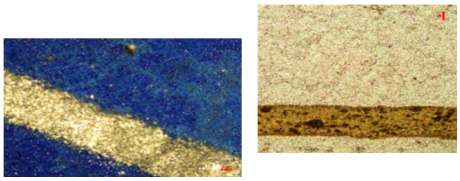


Fig. 4 Silicon micrograph before treatment (right panel/back, left panel /front)

C.XPS analysis: As it is illustrated in the XPS survey from the front of cell presented in the Fig .5,athe metallic contact is silver.From the back of the cell presented in Fig.5.b the metallic contact is silver.

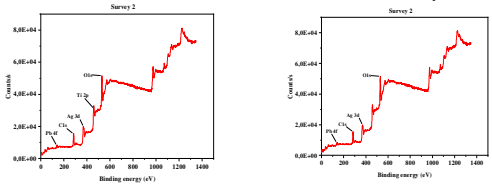


Fig. 5 XPS survey left/front front/back

3.2. Silicon cell characterization after purification

SEM analysis: The SEM micrographs presented in the Fig.6 and EDS analysis presented in Fig .7 show that silver metallic contact was completely removed from the silicon broken cell and successfully recovered.

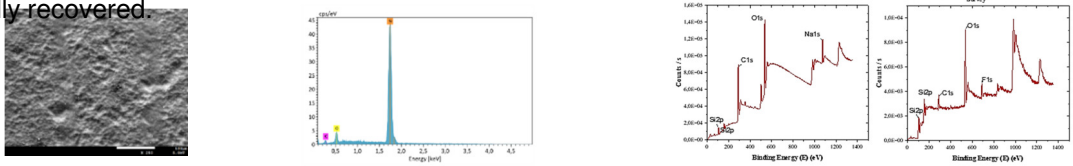


Fig. 6 SEM micrograph Fig. 7 EDS analysis of the treated cellFig. 8 XPS survey left/front- right/back

XPS analysis: As it is illustrated in the XPS survey from the front of cell presented in the Fig .8a,from the back of the cell presented in Fig.8.b the metallic contact “silver” was completely removed then recovered.

4. CONCLUSION

During this process, the anti-reflective layer was eliminated, silver was recovered using an alkaline solution of NaOH 30% for 10 minutes at 80°C, then the pure mono crystalline silicon was successfully obtained.

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NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
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Tailored POIs Recommendations: A Machine Learning Approach to Personalized Experiences

ChemlalMAROUA[(1)*], ZedadraAMINA[(1)], Kouahla MED NADJIB[(1)]
[(1)] LabSTIC Laboratory, Department of Computer Science, 8 Mai 1945 University. P.O. Box 401, Guelma, Algeria
[*]chemlal.maroua@univ-guelma.dz

Abstract: Recommender systems enhance decision-making by providing personalized suggestions. This poster presents "Tailored POIs Recommendations: A Machine Learning Approach to Personalized Experiences," a system prioritizing user preferences and locations for customized POI recommendations. It promotes healthier, refined lifestyle choices and effectively guides users through vast POIs options, improving their overall experience.

Keywords: Points of Interest (POIs), Recommendations System, Machine Learning.

1. INTRODUCTION

Recommendation systems, while promising in using user profiles for personalized POI suggestions, face challenges such as interpreting well-being from limited data and the cold start problem, as well-being factors are subjective [1]. To address these, we propose a system that integrates user profiles, including ratings and real-time location, to provide personalized recommendations aligned with user well-being [2]. The system uses advanced machine learning algorithms to evaluate and rank POI options based on relevant criteria, ensuring tailored and satisfactory suggestions.

2. PROPOSED APPROACH

We propose a personalized recommendation system that combines user profiles, historical ratings, and real-time location to offer tailored POI suggestions promoting well-being. Using advanced machine learning, the system evaluates preferences and environmental factors, dynamically ranking POI options based on personalized criteria. It adapts to user feedback, ensuring alignment with preferences and lifestyle goals.Figure 1 illustrates our proposed system.

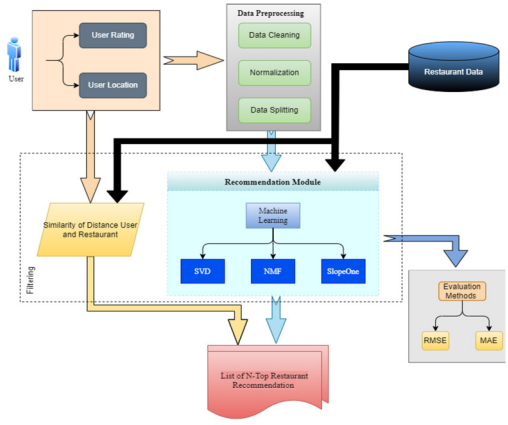

Fig. 1 Proposed Approach

3. RESULTS AND DISCUSSION

This section presents the evaluation results of the proposed system. The prediction error comparison and analysis were conducted using RMSE (Root Mean Squared Error) and MAE (Mean Absolute Error) as evaluation metrics. Table 1 summarizes the final results.

Table 1Results for 3 algorithms

Measures / **Algorithm's**	***RMSE***	***MAE***
SVD	0.7048	0.5936
NMF	0.7429	0.5838
SlopeOne	1.4150	1.2084

The SVD algorithm achieved the best performance (RMSE = 0.7048, MAE = 0.5936), forming the basis for the recommendation system is learning model.

4. CONCLUSION

We present an innovative recommendation system that uses individual profiles, including ratings and location, to prioritize POI options for personalized, well-being-focused suggestions. By optimizing the selection process, it delivers tailored recommendations that enhance user satisfaction. The system continuously refines and adapts, helping users discover dining experiences aligned with their preferences and interests.

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Fuzzy-Based Model for Automated Detection of Corrosion for Drilling

Ilhem BOUCHAREB[(1)*]
[(1)] Dept. of Electrical Engineering (EEA), Constantine, Algeria
Laboratory of Electrical Engineering Polytechnic of Constantine (LGEPC)
National polytechnical university of Constantine (ENPC),BP 75, A, Nouvelle ville RP, Constantine, Algeria
[*]ilhem.bouchareb@umc.edu.dz

Abstract: Corrosion has always been an immense problem for engineering community. Automated detectionof main failures corrosion in industrial pipes and tubes is a challenging task. Also automated detection methods play an important role in ensuring component integrity and safety in industrial through inspecting severity of failure. Recent progress in computational intelligence, sensor technology and computing performance permit the use of advanced systems to achieve this objective. This paper presents a pattern recognition approach based fuzzy logic developed for automatic detection of main failure corrosion for drilling from real dataset failure mode analysis. A fault diagnostics framework composed of a pattern recognition system, having machine learning technology as its integral part is utilized for failure detection of different failure mode and tracing path following of corrosion is illustrated. The proposed technique shows promising results to detect and classify corrosion with an accuracy of 99.45%. The specificity and sensitivity of the classifier are found to be 99.54% and 99.6% respectively.Joint Fuzzy inference system which can be used within instrument software to assess and predict corrosion behavior shows the ability of fault identification and classification within a short time. The featured data allows distinguishing between the different cases, as well as between different levels of failure.

Keywords: Corrosion, Detection, Fuzzy, Pattern recognition.

1. INTRODUCTION

Corrosion is the main threat to the petroleum industry. Its enormous impact. The values in the table may be assumed as average ones, because they vary regarding to the country and region *e.g.* in Western Europe corrosion-related failures=25%, in the Gulf of Mexico and Poland about 50%, while in India they reach 80%.Corrosion seems to be very simple, like the way in which it proceeds: it attacks everymetal thing. However, to fully understand this phenomenon a detailed study of chemical, physical and mechanical properties of material is required.The concept of intelligent device and implementation of the automated algorithm based fault detection plays an important role in industrial applications; A significant advance has been made in diagnostic by the introduction of artificial intelligence (AI)[1]-[5].

This paper presents a pattern recognition approach based fuzzy logic developed for automatic detection of main failure corrosion for drilling from real dataset failure mode analysis. A fault diagnostics framework composed of a pattern recognition system, having machine learning technology as its integral part is utilized for failure detection of different failure mode and tracing path following of corrosion is illustrated. "Explainable Artificial Intelligence in Mechanical Engineering: A Synthetic Dataset for Comprehensive Failure Mode Analysis" DOI:http://dx.doi.org/10.1109/TransAI60598.2023.00032This is the original XAI Drilling dataset optimized for XAI purposes and it can be used to evaluate explanations of suchalgorithms.The dataset comprises 20,000 data points, *i.e.*, drilling operations, stored as rows, 10 features, one binary main failure label, and 4 binary subgroup failure modes, stored in columns. The main failure rate is about 5.0 % for the whole dataset. The features that constitute this dataset are as follows: Cutting speed *v*c, Spindle speed, Feed *f*, Feed rate, Power *P*c, Cooling, Material.

Subgroup failures: Build-up edge failure, Compression chips failure, Flank wear failure, Wrong drill bit failure. Four (04) typical main fault cases have been studied via simulation based on changing

of the corrosion parameters. The detection of faults is essentially conditioned by four parameters: *the* spindle speed *n* [*1/m*], power *Pc* [*kW*], cutting speed *vc* [*m/min*] and feed rate *vf* [*mm/min*].
The Max value measurements were deeply studied carried out under different significant fault conditions: *Flank wear failure (FWF); Build-up edge failure (BEF),Compression chips failure (CCF)andWrong drill bit failure (WDF).* The fuzzy model is formed by 5 fuzzy rules describing the 4 classes and membership functions relating to 4 input parameters. The fuzzy rule base can be developed for identifying four types of corrosion failure from Tables I as follows:

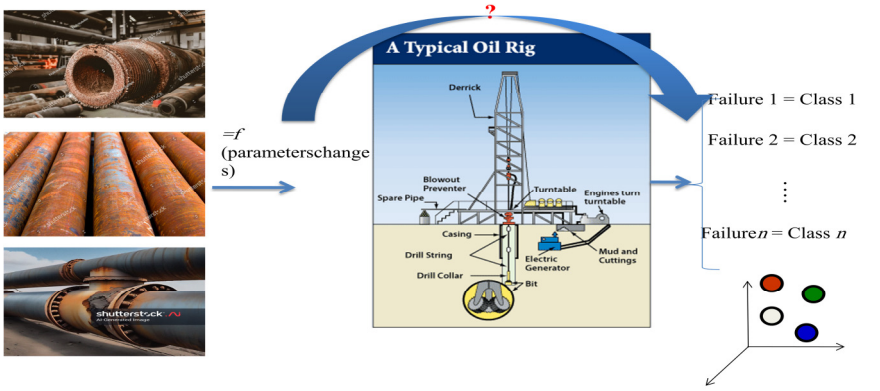

Figure 1: Influence of parameter changes on drilling performance

(r_1): If (spindle speed is *"is average")* and (power is *"average"*)and (cutting speed is *"average"*) and (feed rate is *"small"*) then (BEF fault).

(r_2): If (spindle speed is *"is large")* and (power is *"average"*)and (cuttingspeed is *"average"*) and (feed rate is*"small"*) then (CCF fault).

(r_3): If (spindle speed is *"large")* and (power is *"large"*)and (cutting speed is *"large"*) and and (feed rate is*"large"*) then (FWF fault).

(r_4): If (spindle speed is *"is large")* and (power is *"average"*)and (cutting speed is *"average"*) and and (feed rate is*"average"*) then (WDF fault).

(r_5): If (spindle speed is *"large")* and (power is *"large"*)and (cutting speed is *"large"*) and (feed rate is*"large"*) then (no fault).

The function '*evalfis'* is used to perform classification task: (evalfis ([test-sample], name of FIS system)).

Table 1 EFFECTS OF CORROSION On Drilling

Mode	Parameters			
	Spindle speed	Power	Cutting speed	Feed rate
Healthy	650	135	23	139
BEF fault	519	60	19	97
CCF fault	426	73	18	131
FWF fault	785	193	29	222
WDF fault	614	116	22	134

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Removing base wander noise and electro motion artifact from ECG signal

Anissa Khiter
Research Laboratory for Modeling, Simulation and Optimization of Real Complex Systems, ZIANE Achour University of Djelfa, AinChih, Djelfa 17000, Algeria
Corresponding author: an.khiter@gmail.com

Abstract: The electrocardiogram (ECG) is a low-frequency signal representing the electrical activity of the heart muscle. It is highly susceptible to various types of noise during recording, such as baseline wander (BW) and electrode motion (EM) artifacts. These noises overlap with the ECG signal spectrum, contaminating the original signal and complicating its analysis. Traditional filtering techniques have struggled to effectively remove noise without distorting the ECG signal. In this study, an adaptive filtering technique based on the self-correcting leaky normalized least mean square (SC-LNLMS) algorithm is proposed to address this challenge. The SC-LNLMS filter was tested using recorded ECG signals from the MIT-BIH Arrhythmia Database and noise samples from the Noise Stress Test Database (nstdb). Results demonstrate that the SC-LNLMS method effectively removes BW and EM noise, achieving a higher output signal-to-noise ratio (SNR), improved SNR, and lower mean square error (MSE) while preserving the integrity of the original ECG signal, even at low amplitudes.

Keywords: ECG signal, base wander noise, electro motion artifact, adaptive noise canceller, normalized least meant square algorithm

1. INTRODUCTION

Electrocardiogram (ECG) signals represent the electrical activity of the heart and are vital for diagnosing cardiovascular conditions. However, ECG signals are often contaminated by baseline wander (BW) noise and electrode motion (EM) artifacts, which significantly affect their quality and reliability. Traditional filtering techniques struggle to effectively remove these noises without altering the critical components of the signal, such as the P, QRS, and T waves. This study introduces the self-correcting leaky normalized least mean square (SC-LNLMS) adaptive filter, which offers an innovative approach to denoising ECG signals while preserving their integrity.

2. METHODOLOGY

The SC-LNLMS algorithm is an adaptive noise cancellation method that iteratively minimizes the difference between a desired clean ECG signal and a noisy reference signal. The process involves:

A. Dynamic Adjustment: The filter coefficients are continuously updated based on an adaptive algorithm that incorporates variable step sizes and a leakage coefficient to enhance performance.

B. Multi-Stage Filtering: The filtering process operates across multiple stages, with the output of each stage serving as the input for the next. This ensures progressive noise reduction.

C. Data Sources: The method was validated using ECG recordings from the MIT-BIH Arrhythmia Database and noise samples from the Noise Stress Test Database, with added BW and EM noise at signal-to-noise ratio (SNR) levels of 5 dB and 10 dB.

3. RESULTS

The SC-LNLMS algorithm demonstrated superior performance in removing BW and EM noise, achieving higher output SNR and lower mean square error (MSE) compared to existing techniques. Key findings include:

A. Baseline Wander Noise Removal:

At 10 dB BW noise, the SNR improved from 22.20 dB in the first stage to 27.28 dB in the last stage.At 5 dB BW noise, SNR increased from 20.12 dB to 22.15 dB across stages.Unlike traditional methods, the SC-LNLMS preserved the ST segment, a critical diagnostic feature.

B. Electrode Motion Artifact Removal:

For 10 dB EM noise, SNR *rose from 22.59dB* in the initial stage to 27.97 dB in the final stage. *For 5 dB EM noise, SNR improved* from 17.18 dB to 22.21 dB.

The method successfully separated EM noise overlapping with the P, QRS, and T waves without distorting the original signal.

4. Discussion

The SC-LNLMS method's adaptability, iterative filtering, and precise parameter tuning allowed it to outperform conventional techniques, which often fail to balance noise removal with signal preservation. The algorithm proved particularly effective in handling challenging conditions, such as significant spectral overlap between noise and signal components.

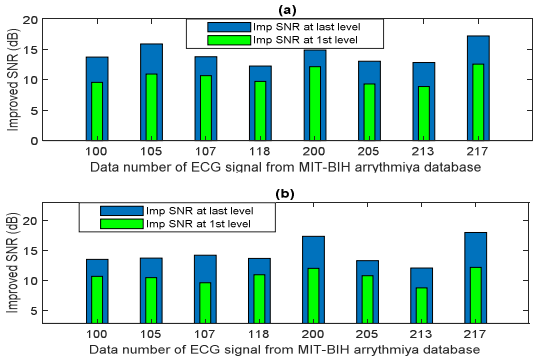

Fig. 5 SNR improvement of SC-LNLMS filtering method for BW removing, (a) SNR improvement for BW removing at 10 dB, (b) SNR improvement for BW removing at 5 dB

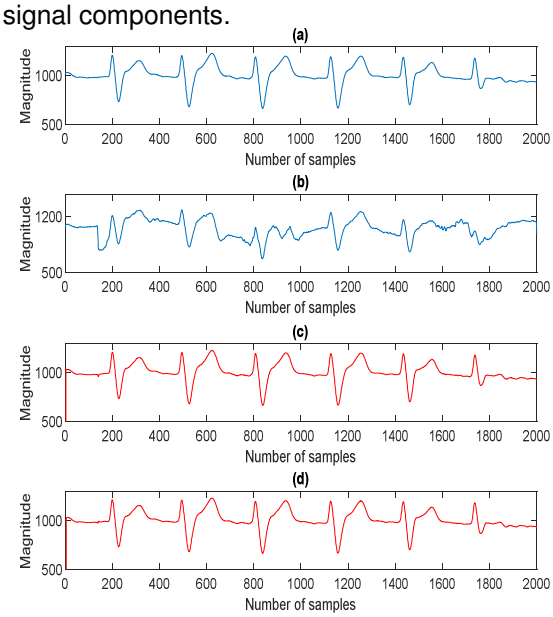

Fig.4 Outputs of ECG denoising using proposed method, (a) ECG signal (record 217 from MIT-BIH), (b) Noisy ECG signal with added EM noise at 10 dB, (c)First stage of denoised ECG signal, (d) Second stage of denoised ECG signal

5. CONCLUSION

This study highlights the SC-LNLMS algorithm as a robust solution for denoising ECG signals contaminated with baseline wander and electrode motion artifacts. Its ability to enhance signal quality without compromising diagnostic features makes it a promising tool for real-world applications in clinical and portable ECG monitoring systems. Future work may explore its integration with other noise reduction frameworks to further enhance its effectiveness.

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Achieving Secure and Efficient Vehicular Communication in IoV Networks via Federated Learning and Edge Caching

Radouane BAGHIANI (1)* , Lyamine GUEZOULI (2) , Ahmed KORICHI (1)
(1) Kasdi Merbah University, Ouargla, Algeria,
(2) HNS-RE2SD, Batna, Algeria
Baghiani.radouane@univ-ouargla.dz

Abstract: In the rapidly advancing Internet of Vehicles (IoV) ecosystem, ensuring robust security andoperational efficiency is paramount. This research combines Federated Learning (FL) with edge caching totackle these key challenges. FL enables decentralized model training, which enhances data privacy whilereducing communication load. By integrating edge caching, latency and bandwidth usage are optimizedthrough local storage of frequently accessed data at network edges. Our approach further refines resourcemanagement by employing parameter tuning, momentum techniques for faster model convergence, andparallel processing to support scalability. The results reveal that this hybrid strategy substantially improves IoVnetwork performance, promoting secure and efficient communication across vehicular systems.

Keywords:, Federated Learning (FL), Edge Caching, Data Privacy, Internet of Vehicles (IoV)

Video Encryption in Surveillance Systems Using

NATIONAL CONFERENCE ON COMPUTATIONAL ENGINEERING, ARTIFICIAL INTELLIGENCE AND SMART SYSTEMS NC²EAIS²2024
10-12 December 2024; Tamanrasset, Algeria

Chaotic Maps and Blockchain Smart Contracts Mohamed ElAmine Kheraifia

Mohamed ElAmine Kheraifia (1)*, Abdelatif Sahraoui (1), Derdour Makhlouf(2)
(1)Dept. of computer science. LAMIS Laboratory of Echahid Cheikh Larbi Tebessi University. Tebessa, Algeria
(2)Dept. of computer science. LIAOA Laboratory of University Of Oum el Bouaghi Oum El Bouagh, Algeria
* mohammedelamine.kheraifia@univ-tebessa.dz
abdelatif.sahraoui@univtebessa.dz
derdour.makhlouf@univ-oeb.dz

Abstract: Smart cities leverage technology to enhance urban living, strengthen security, and optimize resource management. Video surveillance systems are vital in these cities, offering real-time monitoring, data collection, and intelligent decision-making to support multiple facets of city operations. However, despite their numerous advantages, these systems present challenges, particularly regarding privacy, security, and ethical considerations. This paper introduces a lightweight encryption approach using blockchain and smart contracts to secure video records.

Keywords: Surveillance system, Chaotic maps, Smart contract

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A Transformative Approach to Solar Tracking Systems Using Sun Intensity Thresholds for Optimal Efficiency

Khadidja DAHLI[(1)*], Karim SELAM[(2)]
[(1)] Department of Automatic and Electrical Engineering Faculty of Technology, University of Blida 1, Blida, Algeria
[(2)] Process Control Laboratory,Polytichnical National School,Algiers, Algeria
[*] khadi.dja22977@gmail.com ; dahlikhadidja@etu.univ-blida.dz

Abstract: Solar trackers enhance energy production by continuously adjusting their position to follow the sun. However, this constant movement results in increased energy consumption, presenting a significant challenge to their overall efficiency. This study aims to address this challenge by introducing a novel approach that enables trackers to adjust their position only when a substantial change in sunlight is detected, utilizing thresholds based on light-dependent resistor (LDR) readings. Our findings indicate that sunlight intensity thresholds ranging from 50 W/m² to 150 W/m² correspond to LDR outputs of 0.2 - 0.5 V and 1 - 1.5 V, can significantly reduce energy consumption while simultaneously enhancing energy gain. This method markedly improves the efficiency of solar tracking systems, paving the way for a promising future in solar energy utilization.

Keywords: Light-Dependent Resistor (LDR), Solar energy, Solar trackers, Sunlight intensity.

1. INTRODUCTION

Solar trackers optimize the angle of photovoltaic (PV) panels to the sun's position throughout the day. By adjusting their orientation, they can increase solar energy capture and enhance energy production compared to fixed installations, improving energy yield by 25% to 45% based on geographic location and tracking technology[1][2][3][4][5] .

Numerous studies have examined methods to improve solar tracker efficiency, focusing on sun sensors like photodiodes and Light Dependent Resistors (LDRs). LDRs are favored for their simplicity and effectiveness in detecting sunlight intensity variations[6], [7] ,[8], [9], [10], [11], [12], [13]. Their integration into tracking systems can yield energy gains of up to 30% compared to fixed solar installations[14], underscoring their potential in optimizing solar energy capture.

Solar trackers, while beneficial, consume significant energy for operation, which can reduce overall efficiency [15]. This study presents a novel approach using intensity thresholds from LDR readings, enabling the tracker to adjust only with significant sunlight changes. This method minimizes unnecessary energy use and enhances energy gain, paving the way for advancements in solar tracking technology. By optimizing solar tracker parameters, we can improve performance and contribute to maximizing renewable energy utilization in an energy-conscious world.

2. RESULTS AND DISCUSSIONS

This study presents a novel sensor-based solar tracking method that adjusts the solar tracker's position only when significant changes in sunlight intensity are detected by an LDR sensor. The LDR voltage outputs, ranging from 0.0 V in darkness to 5.0 V in full sunlight (1000 W/m²), are summarized in Table 1. We evaluated the solar tracker's performance under continuous tracking versus specific thresholds of 50 W/m², 100 W/m², 150 W/m², and 200 W/m² to establish the optimal LDR threshold. By minimizing unnecessary movements, the tracker reduces energy consumption and enhances performance, effectively addressing the energy consumption challenge in sensor-based solar trackers and improving efficiency and power output.

Table 1 LDR voltage output at varying levels of sunlight intensity (W/m²)

Sunlight Intensity (Description)	Sunlight Intensity (W/m²)	LDR Voltage Output (V)
Dark	0	0.0 - 0.1
Low	50	0.2 - 0.5
Moderate	100	0.5 - 1.0
Bright	150	1.0 - 1.5
Very Bright	200	1.5 - 2.0
Full Sunlight	1000	4.5 - 5.0

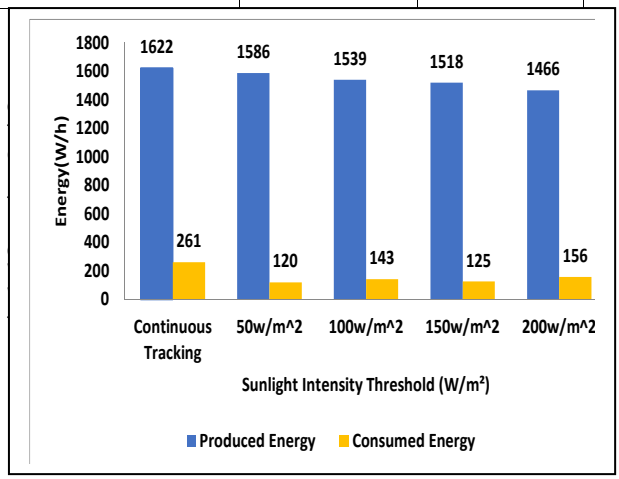

Fig. 1 Energy production and consumption at different sunlight intensity thresholds

Energy consumption

Figure 2 shows energy consumption rates at different sunlight intensity thresholds. Continuous tracking has the highest consumption at 16.08% of generated energy. In contrast, specific thresholds reduce consumption to 7.56% at 50 W/m², 9.26% at 100 W/m², 8.25% at 150 W/m², and 10.67% at 200 W/m². Thus, continuous tracking, while producing more power, consumes more energy than using LDR thresholds.

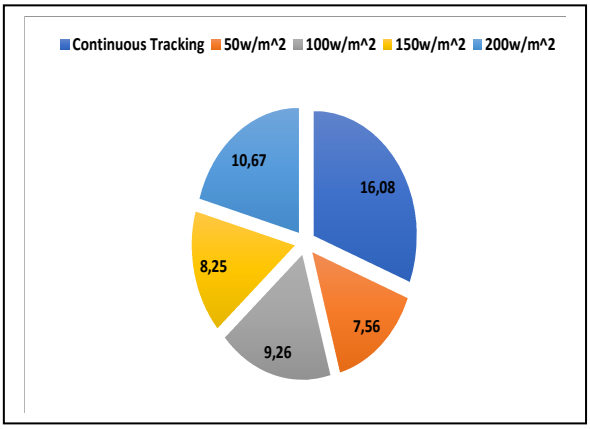

Fig. 2 Energy consumption rate at different sunlight intensity thresholds

Energy gain

Figure 3 shows energy gain at different sunlight intensity thresholds. The results indicate that energy gain is optimal when setting a threshold of 50 W/m², corresponding to an LDR reading of 0.2 - 0.5 V. Notably, energy gain does not increase beyond 150 W/m² compared to continuous tracking, where the LDR reading is approximately 1 - 1.5 V. These findings suggest that the solar tracker should only change position when the LDR readings indicate a change of 0.2 - 0.5 V (50 W/m²) for optimal performance and should not exceed a threshold of 1.5 V (150 W/m²). These findings provide a framework for optimizing solar tracker efficiency, reducing energy consumption, and enhancing system performance.

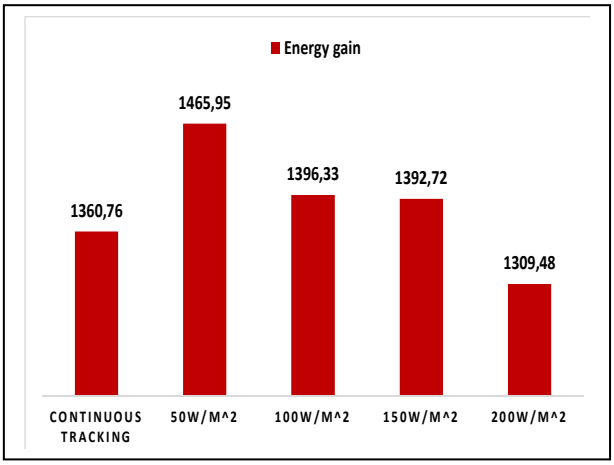

Fig. 3 Energy gain at different sunlight intensity thresholds

3. Conclusion

This study introduces a novel solar tracking strategy that optimizes efficiency by adjusting the tracker's position only when substantial changes in sunlight intensity are detected by an LDR sensor. Key advantages include:

1- Establishing sunlight intensity thresholds reduces unnecessary movement and significantly lowers energy consumption.

2- Continuous tracking offers slightly higher power but consumes more energy than tracking with specific LDR thresholds,

3- For optimal performance, the solar tracker should adjust its position when the LDR sensor reading changes by 0.2 to 0.5 V (50 W/m²).

4- The tracker must remain below 1.5 V (150 W/m²) to optimize energy gain and enhance system efficiency.

This study improves solar tracking system efficiency by addressing energy consumption challenges in sensor-based systems. Future research will focus on enhancing adaptability to different weather conditions and testing effectiveness across various geographic locations.

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Cavitation Phenomenon Through a Venturi Using Computational Fluid Dynamics: Influence of Throat Length

BENGHALIA Imane(1), ZAMOUM Mohammed(2)*, GROUNI Said(3)
(1) Laboratory of process materials and environment research, (LRME), Boumerdes, Algeria
(2) Laboratory of Hydrocarbure Physical Engineering, (LGPH), Boumerdes, Algeria
(3) Industrial Maintenance Department, University of Tamanghasset, Algeria
*Corresponding author: m.zamoum@univ-boumerdes.dz

Abstract: Hydrodynamic cavitation is a phase change damage phenomenon in several industrial applications when the local liquid pressure decreases under the vapor pressure. In this present work, our objective is to investigate the effect of different throat lengths of the venturi on the characteristics of cavitating flow. The computational fluid dynamic (CFD) was selected with a cavitation model. The mixture model for the multiphase flow and K-W SST turbulence model were adopted. The numerical results are compared to the previous experimental and numerical data. The static pressure and velocity distributions are analyzed and discussed. The obtained results fund that the throat length of the venturi has a significative influence on cavitation phenomenon, in practically on pressure and velocity flow. However, when the throat length increases leads to delay pressure recovery and results the longest distribution of the vapor in divergent part of the venturi.

Keywords: Hydrodynamic cavitation, venturi, CFD, Vapor.