3.3.2 Number of research papers per teachers in the Journals notified on UGC website during the year 2023

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Automated biomedical image classification using multi-scale dense dilated semi-supervised u-net with cnn architecture

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Abstract

Biomedical research heavily relies on automated image classification to enhance understanding of protein structure and function. This study proposes a novel approach for automating biomedical image categorization, addressing the challenges posed by intricate geometric correlations among various categorical biological patterns. The proposed model incorporates modified histogram normalization (MHN) for image pre-processing, utilizing bi-cubic interpolation and a high boost filter to enhance image resolution and contrast. For segmentation tasks, the study introduces the multi-scale dense dilated semi-supervised U-Net (MDSSU-Net), which combines a convolution block and skip connection path within an enhanced encoder-decoder framework. The semi-supervised U-Net approach allows us to train the model with limited labelled data, significantly reducing the need for extensive annotations. To classify cancer cells in textured bio-images, we employ Grey Level Co-occurrence Matrix (GLCM) and Haralick's feature extraction, which describes pixel intensity relationships within images. The task of automatic cancer classification is particularly challenging, considering the numerous histopathological images that require analysis to detect subtle abnormalities. For an accurate evaluation, we utilize performance metrics such as Dice Coefficient (DSC), Mean Intersection Over Union (MIOU), recall, precision, accuracy, sensitivity, specificity, and F1-score. The Elephant Herding Optimization (EHO) method is employed to design a unique convolutional neural network, known as C-Net, for the classification of biological images. The experimental results demonstrate the superiority of the proposed model. The MDSSU-Net segmentation framework showcases improved performance, efficiently handling diverse segmentation challenges. Moreover, the semi-supervised U-Net training approach significantly reduces the dependence on labelled data, enhancing the model's adaptability to various biomedical datasets. In cancer cell classification, the combination of GLCM and Haralick's feature extraction proves highly effective, enabling the automatic detection of cancerous cells with high accuracy. The C-Net design, utilizing EHO optimization, outperforms other network architectures, achieving superior classification results for complex biological images. This automating biomedical image classification, contributes to the broader adoption of automated image analysis in modern biological studies and diagnostic procedures.

Keywords Biomedical image · Segmentation · Classification · Haralick · Dense dilated semi-supervised U-Net · Convolutional neural network

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RESEARCH ARTICLE

CELL BIOCHEMISTRY & FUNCTION WILEY

Brain cancer classification based on multistage ensemble generative adversarial network and convolutional neural network

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Abstract

An advanced approach that capitalizes on the synergies between multimodal feature fusion and the dual-path network is presented in this manuscript. Our proposed methodology harnesses a combination of potent techniques, merging the benefits of nonlinear mapping and expansive perception. The foundation of our methodology lies in leveraging well-established pretrained models, namely EfficientNet-B7, ResNet-152, and a meticulously crafted custom convolutional neural network (CNN), to effectively extract salient features from the data. These models are combined in a two-stage ensemble approach. We employ maximum variance unfolding (MVU) to select the most relevant attributes from the extracted features. In this study, we propose a hybrid approach that integrates a generative adversarial network and Neural Autoregressive Distribution Estimation (NADE-K) with a CNN. The resulting two-stage ensemble hybrid CNN model achieves an accuracy of 99.63%. The implementation of the two-stage ensemble hybrid CNN with MVU demonstrates significant improvements in brain tumor classification.

KEYWORDS

brain tumor, convolutional neural network, dual path network, feature extraction, magnetic resonance imaging

1 | INTRODUCTION

The brain plays a vital role in our body's functioning as it is part of the central nervous system (CNS) and consists of a complex network of interconnected neurons. When brain cells experience abnormalities or malfunction, it can have an impact on nearby organs. Globally, approximately 350 000 new cases of brain tumors are detected each year, and the survival rate after 5 years is only 36%.[1] Brain tumors occur when abnormal cells start to multiply within the brain. The World Health Organization has classified brain tumors into four grades, ranging from Grade I to Grade IV, based on their severity.[2] When diagnosing a brain tumor, surgery is typically recommended by neurosurgeons. In advanced stages, alternative treatments such as chemotherapy and radiation are often suggested, as the primary objective is to inhibit or slow down the growth of cancerous tumor cells.

Early detection of brain tumors is crucial for effective treatment. Medical imaging techniques are employed to obtain images for diagnostic purposes. Magnetic resonance imaging (MRI) is a commonly utilized procedure to detect brain abnormalities. Accurately identifying and localizing tumor regions facilitates more effective treatment. However, determining the size and resolution of brain tumors in their early stages poses challenges due to limited precision. Among various imaging modalities, MRI offers the most reliable assessment of biological soft tissue structures in medical detection systems. Deep learning techniques are extensively applied in medical imaging technology.[3]

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Investigation of variable field plate length in GaN HEMT on SiC substrate for MMIC applications

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ABSTRACT

This work intends to improve the GaN HEMT device breakdown voltage, by uniformly distributing peak electric field using field plate engineering technique. A peak electric field reduction is observed by adding field plate at the gate end along with remolding the distribution of electric field linearly. The device breakdown voltage is improved by gradual decrease in electric field is observed. To analyze the OFF-state breakdown voltage, the gate field plate of various lengths is used and optimum size is calculated for GaN HEMTs. A breakdown voltage of 350 V is prominently observed in the simulation results. Moreover, the obtained results show a good substantiation with experimental data. The DC Characteristics and AC characteristics of the proposed structure exhibit an enhanced performance than the existing structures, justifying the GaN field plated HEMT as to be a promising solution for Microwave monolithic Integrated Circuit applications.

1. Introduction

As the need for high frequency and high-power devices are emerging, the next generation is stepping to a new era of capabilities, including high frequency operations and larger device breakdown voltages. GaN HEMTs has gained a lot of interest. The HEMT device has been can efficiently reduce the electric field in the channel with the field plate engineering technique leads to higher breakdown voltage. The Schottky Source/Drain contact (SSD) and Si_3N_4 Passivation technique has been contributed in enhancing the reliability of the breakdown voltage of GaN HEMTs [1]. Nevertheless, the increase in breakdown voltage is limited due to the thickness of passivation [2,3]. A novel approach has been put forward in this work by integrating these two techniques with a gate field plate engineering technique.

Gate field plate technique shows improvement on reducing electric field exponentially and also improve device breakdown voltage [4,5]. Other field-plated structures in HEMT design includes the floating multiple and the source field plate too [3,6,7]. The gate FP technology helps to smooth the EF and reduces the peak EF along the channel greatly [8–10]. In addition to the large enhancement in breakdown voltage, the FP HEMT device decreases the current collapse by inhibiting the high field trapping effect [3,11].

FP Engineering incorporates a capacitance effect by the FP, 2DEG channel, and passivation layer [26]. The passivation layer of the device should be thicker and must offer better control over the surface and channel depletion occurring in the device to obtain an effective isolation from the ambient condition. When it comes to FP HEMT structures, the capacitance effect in the channel rises as the thickness decreases. Alternately, the influence of the field plate disappears for higher thickness and lowers the breakdown voltage. Therefore, to get a high performance HEMT structure, an optimum dimension for the passivation is needed [12,13]. In GaN HEMT device gate field plate shows significant reduction in electric field leads to improvement in the device breakdown voltage besides improving the current collapse by increasing the on resistance [13,14].

In this paper, a gate field plate engineering technique is used to successfully reduce the current collapse effect at high field. Sentaurus TCAD has been used to study how the field plate affects the characteristics of AlGaN/GaN structure's breakdown voltage.

The impact ionization models used for the simulation is Shockley-Read-Hall (SRH), Field Dependent Mobility (FLDMOB) and Selberherr Tabular (SELB) models.

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Revolutionizing Fe doped back barrier AlGaN/GaN HEMTs: Unveiling the remarkable 1700V breakdown voltage milestone

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ARTICLE INFO

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ABSTRACT

This research investigates the enhanced device breakdown capabilities of silicon-based AlGaN/GaN High Electron Mobility Transistors (HEMT). By incorporating various back barrier materials, a significant improvement in peak electric field and breakdown voltage is observed. Specifically, the integration of iron (Fe) doping into the Gallium Nitride (GaN) back barrier layer, combined with different back barrier materials such as Aluminum Gallium Nitride (AlGaN) and Indium Gallium Nitride (InGaN), results in an impressive increase of up to 1700 V. This improvement is attributed to the reduction of peak electric field at the gate edge. The optimized layer configurations significantly contribute to the overall performance of silicon substrate GaN HEMT devices, making them promising candidates for high-voltage applications in electric vehicles and high-power applications.

1. Introduction

Due to the growing demand for high-power devices in the semiconductor industry, GaN-based high electron mobility transistors (HEMTs) have emerged as a suitable option [1]. GaN material is chosen for its superior mobility properties and wide bandgap. In the pursuit of improved switching applications in cutting-edge technologies, various transistors have been employed. Among these transistors, the high electron mobility transistor stands out due to its capabilities in high power, high-frequency operation, and effective temperature handling [2,3,4] (see Table 1).

GaN devices are known for their high-power performance, primarily due to their high breakdown voltages (Vbr) [6,7]. The utilization of an undoped GaN layer as a buffer layer has been demonstrated to enhance the off-state breakdown voltage in power switching and microwave applications. However, the structural quality of the undoped GaN buffer layer tends to be poor due to its low growth temperature, which can lead to a degradation of device reliability [8–10,7,11,12].

The introduction of Fe-doping induces acceptor-like traps that electrically compensate for the residual background donor impurities in the buffer region, resulting in a highly resistive GaN buffer layer [13–15]. Further improvements in Vbr can be achieved by incorporating a back barrier layer [16]. This back barrier layer, for achieving higher Vbr, can be composed of materials such as GaN, AlGaN, and InGaN [17,18]. The back barrier layer constitutes a second heterostructure within the same device, providing enhanced electron confinement, which, in turn, leads to reduced sub-threshold leakage currents and improved breakdown voltages [19,20,21,22–26].

The simulation work was conducted using Silvaco TCAD simulation software. This research is centered on optimizing Silicon Substrate Gallium Nitride High Electron Mobility Transistor (GaN HEMT) devices with the goal of enhancing their breakdown voltage. The study delves into several approaches, including the incorporation of undoped GaN layers, Fe-doped GaN layers, Fe-doped GaN layers with AlGaN back barriers, and Fe-doped GaN layers with InGaN back barriers. Through systematic adjustments to layer thickness, the objective is to improve the device's breakdown voltage.

This research not only yields valuable insights into the design and production of advanced GaN HEMT devices but also paves the way for achieving superior breakdown voltage characteristics, which are crucial for power electronics and related applications.

1.1. Device description

The unintentionally doped GaN HEMT device structure is illustrated in Fig. 1(a). While SiC is commonly used as a substrate in GaN HEMT

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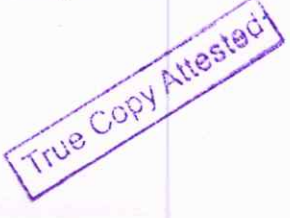

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Design and analysis of multiple input single output converter for hybrid renewable energy system with energy storage capability

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ABSTRACT

This paper proposes the design and analysis of a multiple-input-single-output (MISO) DC-DC converter suitable for a hybrid renewable energy system with energy storage capability. The converter design and control strategy validated in this research can be used to regulate the output dc voltage obtained from multiple-source renewable energy systems. The design is realized using a non-isolated double boost converter as it can handle bidirectional power flow at the storage port and has other advantages like compact structure, reduced number of components, and double boosting capability. The converter can also work without transformers, enabling the input renewable energy sources to operate individually. An inverted decoupler control strategy is adopted in the design of this novel converter. Mathematical models were developed to obtain the decoupler matrix, and the proposed control strategy is utilized to analyze the output. Simulations were performed on MISO converters with load and reference variations and is validated with the prototype. The current ripple percentage at the dual source side is found to be reduced by 2.6%. Also, the rise time, settling time, and percent overshoot of the output voltage were reduced by 0.03 s, 45 ms, and 3.6%, respectively. The performance of the proposed MISO converter is validated on a 50 W hardware prototype. The results validate the MISO converter's superior dynamic performance, output voltage regulation and reduced dual source ripple current, all of which are in agreement to the results of the simulation. A comprehensive comparison with the traditional controller is also conducted to further illustrate the advantages of the proposed inverted decoupler. The inverted decoupler validated in this work can be effectively used in hybrid renewable energy systems with energy storage capability, as it is found to be immune to the disturbances from the source end.

1. Introduction

As global energy demand continues to rise, harnessing energy from renewable energy sources has become the top priority of policymakers. Inducting renewable energy-based power projects is highly pertinent in the present scenario as the global temperature is on a rising curve. Global warming is causing detrimental effects on the climate all over the world, resulting in heat waves, forest fires, and floods, to name a few. According to the Paris Accords, world countries are obligated to keep the global rise in temperature below 2°C [1]. In the Conference of Parties (COP) 26th event held in Glasgow, countries once again affirmed their commitment towards the Paris Accords and vowed to cut carbon emissions in a phased manner so as to achieve carbon neutrality by 2050.The energy consumption of any country increases in proportion to its population growth and economy [2].The main challenge for world countries is diversifying their national grids by inducting power from distributed generation systems rather than relying heavily on conventional and centralized generation systems. Therefore, it is important to increase the dependence on hybrid renewable energy systems that extract energy from two or more renewable energy sources. Hybrid renewable energy systems can ensure feeding firm power into the grid while also assisting in meeting the additional energy demands arising from various sectors such as transportation, electric grid, and industrial manufacturing more reliably and sustainably [3]. However, hybrid renewable energy plants need proper energy management to maintain the power

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IOT based adjustment mechanism for direct reference model adaptive IMC to support voltage sag in DFIG wind farm

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ABSTRACT

Sustainable energy sources are valuable energy sources.Renewable energy production boosts the economic status of a country. Wind energy is one of the most abundant renewable energy sources, and as a result, the technology to harvest energy from the wind is growing rapidly around the world. As load centers are far away from renewable energy sources, electricity must be transferred over long distances. The most common problems with power fluctuations are caused by long-range voltage sag riding (VSRT). DFIG (Doubly Fed Induction Generator) is very popular in wind energy conversion systems due to its variable speed, high energy collection, efficiency, excellent design and unique control of phase side converters and rotor side converters. Wind speed monitoring is done with the help of Internet of Things (IOT). This paper described the use of training networks in developing adjustment algorithms for direct reference model adaptive IMC for DFIG wind farms. Here, a novel training-based neural network MIT (NNMIT) adjustment mechanism using neural network method is developed and implemented in direct reference model adaptive IMC to improve the performance of the controller during voltage sag. Direct and quadrature axis rotor current controllers are developed and the resulting DFIG is balanced with the FuzzyMIT correction mechanism in the sag ride through the conditions in the wind farm. Improvements across the voltage sag are identified and presented using NNMIT. The proposed NNMIT attain 0.15% torque ripple and 1 ms response time better than the existing FuzzyMIT method. The proposed method preserves high accuracy ranges of 97.88% than the existing method. This approach gives better performance than other control design methods which assume that the flux in the stator is constant in amplitude.

1. Introduction

Wind energy is an easily accessible renewable energy source. Wind energy conversion is a burgeoning industry. When compared to typical power plants, the operational costs for converting renewable energy into electricity are low, and the value of fuel savings is considerable. Furthermore, wind energy extraction is less costly than solar energy systems in large wind farms. The wind energy plant is comprised of the rotor, main bearing, main shaft, gearbox, and generator. The wind energy plant converts the low-speed, high-torque rotation of the turbine's rotor (blades and hub assembly) into electrical energy.

Remote area electrification is a key barrier to the growth of Indian wind energy. Many studies are still being carried out to improve wind energy generation. Wind energy commercialization is largely based on technology improvement and the ability to make it commercially viable. It should be noted that wind turbines cannot function in all wind conditions. As a result, a feasibility study of the precise place where the wind turbine will be erected is required. The capacity of a wind turbine to generate electricity varies depending on the wind speed at a given place.

Induction machines are mass-produced and have a proven track record of producing consistent results in a wide range of industrial applications. However, they are rarely employed as generators outside of the renewable energy sector. The use of induction devices as generators has one drawback. They typically fail because they rely on the grid to excite the field, which decreases the grid's strength. Unfortunately, the

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Energy efficient dual axis solar tracking system using IOT☆

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ARTICLE INFO

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Solar panel
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ABSTRACT

With the increasing demand for energy, traditional sources are becoming scarce and the need to transition to non-traditional sources of energy is urgent. Solar energy is an inexhaustible form of energy that can be easily tapped from different parts of the world and converted to electrical energy by using devices such as solar panels. However, the output power of these photovoltaic (PV) panels is not constant as the sun moves from east to west and its angle of incidence varies with the season and time of the day. To maximize energy output from the solar panel, a dual-axis solar tracker (DAST) is necessary to rotate the panel about its horizontal and vertical axes. This system will ensure efficient tracking of the sun and optimal energy output from the solar panel. The proposed system will respond within the 0.2 s to store the data in database. The whole 24 h data of solar panel is utilized in the preferred system to analyse the data to validate the robustness of the system. The proposed system uses a microcontroller to adjust the position of the solar panel based on the movement of the sun, while the performance of the tracker is monitored through the use of Internet of Things (IoT) connected via Wi-Fi.

1. Introduction

Today, human civilization is on the cusp of a transformation in terms of the way in which it generates energy to satisfy its needs. This phenomenon is driven by the detrimental effects of global warming on the environment. It is noteworthy that fossil carbon dioxide emissions are returning to their formal levels after a slight slump in 2020. Global carbon dioxide emissions owing to energy consumption, increased by 6% in 2021 reaching 36.3 billion tones as we started to rely on coal to support our demands after the Covid-19 crisis, according to a new International Energy Agency (IEA) analysis. The harmful effects of a combination of multiple stresses on the growth cycle of plants, different soils, their characteristics, and a variety of microbes should be seen as a warning that we need to revamp our response to climate change for our own well-being (see Table 1).

The United Nations General Assembly (UN-GA) came up with "Agenda 2030" in 2015, of which the salient part was the Sustainable Development Goals (SDGs) designed for a sustainable future for all. Fig. 1 shows the breakdown of renewable power generation capacity additions predicted for years extending up to 2050. One of the key goals is to avoid fossil fuels and rely on low-carbon technologies, since two-thirds of all greenhouse gases (GHGs) are emitted from power generation through polluting methods. This implies that an increase in the field of Renewable Energy (RE), in terms of innovation is imperative. RE-based installations are becoming increasingly competitive as a choice for consumers owing to their rapidly falling costs. One-fourth of all electricity generation in 2017 was from renewable energy sources.

While this can include metrics such as per capita income, it also takes into account India's and its states' progress in meeting the SDGs' objectives. India, as a geographical entity, has access to immense natural resources, which may provide high returns both economically and environmentally. Notably, there has been a considerable and impressive increase in renewable energy generation. India's total RE capacity is nearing 90 GW by 2020. Fig. 2 shows the statistical data of solar electricity generation and year-over-year growth. In certain areas, wind and solar generation units are installed on agricultural lands, which can be advantageous. The tendency to merge agriculture and RE generation on the same plot of land can encourage more people to adopt RE. The

☆ The author certifies that this material or similar material has not been and will not be submitted to or published in any other publication before its appearance in the ***Measurement: Sensors***.

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Sustainable regeneration of transformer oil through composite adsorbent of chitosan and sepiolite: a biorefinery approach

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ABSTRACT

This study introduces an innovative biorefinery approach for sustainably regenerating transformer oil utilizing a composite adsorbent comprised of Chitosan (CS) and Sepiolite (SL). Surface modification analyses, employing BET, SEM, and FTIR techniques, unveiled enhanced adsorption capabilities attributed to pores and folds on the CS-SL composite surface, coupled with uniform SL distribution within the CS substrate. Through systematic evaluations based on color index and transmittance assessments across multiple samples, optimal regeneration was achieved with a 5% volume fraction of the composite absorbent, closely replicating fresh oil properties. Significant improvements were observed in acidity (−62.50%), moisture content (−44.44%), and viscosity (−27.93%), with slight changes in density and a notable rise in flash point (+31.82°C). Electrical properties showed enhancement, with breakdown voltage (+80.00%) and resistivity (+54.93%) increasing, while dissipation factor (−98.00%) and permittivity (−44.74%) decreased, indicating improved energy efficiency. Gas chromatography-mass spectrometry confirmed the removal of oxidation by-products. This study underscores the potential of CS-SL as a sustainable adsorbent for transformer oil regeneration, thereby making significant strides toward environmental sustainability within the framework of Sustainable Development Goals (SDGs) and the principles of biorefinery practices.

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KEYWORDS
Biorefinery; composite adsorbent; chitosan; sepiolite; transformer oil regeneration

Introduction

With scope for sustainable development and growth, a delicate balance must be established between reducing environmental risks – especially those related to impregnated paper and insulating oil – and putting cost-effective measures in place to lengthen the life of insulation and lessen its environmental impact. Insulating material aging properties and transformer insulation system design are closely related to transformer dependability (Raj and Murugesan 2022). The mechanical support and electrical insulation that cellulose paper and pressboard provide to transformers is essential. According to (Raymon and Karthik 2015), transformer oil has two functions in transformers and other electrical devices: it acts as a coolant and as an insulation.

Transformer oil, which is mainly composed of petroleum mineral oil, is an essential part of transformers since it not only provides insulation but also acts as an interface for information on the condition of the transformer (Wan et al. 2013). To guarantee that transformers continue to operate normally, effective transformer oil maintenance is necessary (Godinho et al. 2014; Rafiq et al. 2015). Transformer oil is consumed more than 1600 million liters worldwide each year (Al-Zahrani and

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Bi-LSTM and partial mutual information selection-based forecasting groundwater salinization levels

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ABSTRACT

Fresh-saline groundwater is distributed in a highly heterogeneous way throughout the world. Groundwater salinization is a serious environmental issue that harms ecosystems and public health in coastal regions worldwide. Because of the complexities of groundwater salinization processes and the variables that influence them, it is challenging to predict groundwater salinity concentrations precisely. It compares cutting-edge machine learning (ML) algorithms for predicting groundwater salinity and identifying contributing factors. It employs bi-directional long short-term memory (BiLSTM) to indicate groundwater salinity. The input variable selection problem has attracted attention in the time series modeling community because it has been shown that information-theoretic input variable selection algorithms provide a more accurate representation of the modeled process than linear alternatives. To generate sample combinations for training multiple BiLSTM models, PMIS-selected predictors are used, and the predicted values from various BiLSTM models are also used to calculate the degree of prediction uncertainty for groundwater levels. The findings give policymakers insights for recommending groundwater salinity remediation and management strategies in the context of excessive groundwater exploitation in coastal lowland regions. To ensure sustainable groundwater management in coastal areas, it is essential to recognize the significant impact of human-caused factors on groundwater salinization.

Key words: bi-directional long short-term memory (BiLSTM), fresh-saline groundwater, groundwater, machine learning (ML), partial correlation input selection (PCIS), partial mutual information (PMI)

HIGHLIGHTS

- The purpose of this research is to compare cutting-edge machine learning (ML) algorithms for predicting groundwater salinity and identifying significant factors.
- The salinity of groundwater is indicated using bi-directional long short-term memory (BiLSTM) in this study.
- Diverse sample combinations for training multiple bi-directional long short-term memory (BiLSTM) models were generated using PMIS-selected predictors.

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Design of robust multi-loop PI controller for improved disturbance rejection with constraint on minimum singular value

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Disturbance rejection performance optimization with constraints on robustness for a multivariable process is commonly encountered in industrial control applications. This paper presents the tuning of a multi-loop Proportional Integral (PI) controller method to enhance the performance of load disturbance rejection using evolutionary optimization. The proposed design methodology is formulated to minimize the load disturbance rejection response and the input control energy under the constraints of robust stability. The minimum singular value of multiplicative uncertainty is considered a multi-loop system robust stability indicator. Optimization is performed to achieve the same, or higher level than the most-explored Direct Synthesis (DS) based multi-loop PI controller, which is derived from a conventional criterion. Simulation analysis clearly proved that the proposed multi-loop PI controller tuning method gives better disturbance rejection, and either, the same or a higher level of robust stability when compared to the DS-based multi-loop PI controller.

Key words: multi-loop PI controller, multivariable system, decentralized control, disturbance rejection, robust stability

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Article

Enhanced Power Factor Correction and Torque Ripple Mitigation for DC–DC Converter Based BLDC Drive

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Abstract: A novel approach to the design of power factor correction (PFC) and torque ripple minimization in a brushless direct current (BLDC) motor drive with a new pulse width modulation (PWM) technique is demonstrated. The drive was designed to have a better power factor (PF) and less torque ripple. On the other hand, the modified Zeta converter is used to enhance the power factor of the proposed system. The modified Zeta converter is operated in discontinuous inductor current mode (DICM) by using a voltage follower technique, which only needs a voltage sensor for power factor correction (PFC) operation and DC-link voltage control. The output voltage of the VSI is determined by switching patterns generated by the PWM-ON-PWM switching strategy, and it reduces the torque ripples. The proposed drive is developed and simulated in a MATLAB/Simulink environment. The power factor of 0.9999 is produced by the PFC modified zeta converter topology and the PWM-ON-PWM scheme reduce the torque ripple in the commutation region by 34.2% as compared with the PWM-ON scheme. This demonstrates the effectiveness of the suggested control method.

Keywords: power factor correction; torque ripples; BLDC; PWM-ON-PWM; zeta converter

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1. Introduction

The BLDC motor's excellent efficiency, high energy density, high torque/inertia ratio, low maintenance requirements, and broad range of speed control make it the perfect motor for low and medium power applications [1] The motor is a three-phase synchronous motor with permanent magnets on the rotor and three phase windings on the stator. There are no mechanical brushes or commutator assemblies, so it is sometimes called an electronically commutated motor. In BLDC motors, the rotor position is sensed by using hall effect sensors to provide electronic commutation [2,3]. Good power quality converters are required to achieve the unity power factor at AC mains with minimum current distortion [4,5]. In a conventional diode bridge rectifier (DBR) and high-value DC-link capacitor-provided BLDC motor driving system, a sizeable amount of harmonic current is pulled from the AC mains. Due to the integration of these elements, the supply current is severely distorted, resulting in a low PF at the AC mains and a current waveform with distinct peaks [6]. To power the BLDC motor drive, numerous single-phase power factor correction (PFC) converters have been described in the literature. A commonly employed approach involves the utilization of two-stage PFC converters, which employ two distinct converters for power factor correction and control of the DC-link voltage [7]. According to the type of application and the voltage level necessary for that specific application, a boost converter is typically employed as the first stage for PFC, followed by a second stage [8]. Two-stage power factor correction converters require larger numbers of MOSFET switches than single-stage power factor correction converters, which produce higher losses. Additionally, the

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Full Length Article

Investigations on a novel fuel water hyacinth biodiesel and Hydrogen-Powered engine in Dual-Fuel Model: Optimization with I-optimal design and desirability

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ABSTRACT

Hydrogen is one of the most promising green fuels. The present study explores the potential of novel water hyacinth biodiesel as pilot fuel as well as investigates the influence of the injection pressure of pilot fuel on the performance of hydrogen running a dual-fuel diesel engine. For experimentation, a 4.8 kW research test engine was considered. Three fuel injection pressure (FIP) of the pilot fuel, namely 220 bar, 240 bar, and 260 bar were considered at a ratio of compression as 17.5 and standard injection timing of 23° before Top Dead Centre (bTDC) for different loading conditions were considered. The peak brake thermal efficiency (BTE) under dual fuel mode (DFM) was observed as 26.77%, 28.11%, and 27.21% for FIP of the pilot fuel of 220 bar, 240 bar, and 260 bar, respectively in comparison to 25.11% for biodiesel mode at 100% load. The maximum drop in carbon monoxide (CO) and hydrocarbon (HC) emissions was found to be 15.48%, and 35.7%, respectively for the FIP of the pilot fuel of 240 bar under DFM in comparison to biodiesel mode. The fall in Oxides of Nitrogen (NO_X) emission under DFM was found to be 23.66% for the FIP of the pilot fuel of 220 bar under DFM compared to biodiesel mode. Based on the performance and emission analysis, the optimum FIP of the pilot fuel is found to be 240 bar. For the same FIP, the maximum liquid fuel replacement of 85% was obtained. The experimental study's data were evaluated using analysis of variance (ANOVA) to create models in the form of mathematical expressions for each outcome. The desirability approach was employed to optimize the operating settings for maximum performance while emitting the least amount of emission. According to the desirability-based optimization research, ideal operating conditions were 83.61% engine load and 242 bar FIP, resulting in engine performance of 26.5% of BTE, 80.47% of LFR, and 51.82 bar peak cylinder pressure. The emission levels were 191.19 ppm of NO_X, 106.41 ppm of HC, and 130.95 ppm of CO at this setting. A model validation test found that the model-predicted values were within 6% of the observed values.

1. Introduction

Environmental damage instigated by human-induced activities in search of energy for making life easier is one of the most serious challenges to humanity. Limiting global warming to 1.5 °C would necessitate an almost 45% reduction in human-induced carbon dioxide emissions from the emission level of 2010 by 2030 [1]. The ultimate target is to achieve net zero emissions by around 2050, inferring that any residual emissions would have to be balanced by removing carbon dioxide (CO_2) from the atmosphere. The net-zero goal would need "swift and extensive" structural transformations on an unparalleled scale [2].

At the moment, fossil fuels hold a significant share of the world's energy supply. Obtaining energy from all of these non-renewable fuels affects the environment and leads to global warming, environmental catastrophes such as acid rain, thick smog, changed weather patterns, and many other troubleshooters [3]. These carbon-based emissions not only pollute the environment but also impair the lives of human health conditions. There is a wide variety of fuel consumption that has been

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Influence of nano hexagonal boron nitride on the wear properties of aluminium alloy

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ABSTRACT

Spark plasma sintered, AA7050 reinforced with nano hexagonal boron nitride (n-h-BN) particles followed by characterisation research was carried out to determine the impact of h-BN in the aluminium matrix. With the aid of field-emission scanning electron microscopy , the uniform dispersion of hexagonal boron nitride was examined, and the impact of altering h-BN concentration on the mechanical and tribological properties was studied. In order to achieve individual dispersion of h-BN particles at low milling time without causing any structural damage, pre-mixing of powders prior to high-energy ball milling proved beneficial. Using the X-ray diffraction method, structural and phase analysis was performed on the powders as well as sintered samples. Pin-on disc apparatus is used for testing the weight loss of the composites. SEM was used to examine the worn surfaces of the substrate. According to the wear analysis, adding reinforcement with 0.5 wt% h-BN resulted in a 65% reduction in wear rate and a 33% increase in hardness. It has been found that h-BN tends to aggregate in composite powder above 0.5 wt%, reducing its physical and mechanical qualities.

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KEYWORDS
Nanocomposites; powder metallurgy; spark plasma sintering; hexagonal boron nitride; aluminium alloy; metal matrix composites; nano powders

1. Introduction

Metal matrix composites (MMCs) reinforced with ceramic particles are frequently used in automotive, aerospace, defence, biomedical and other industries. MMCs possess distinct characteristics from monolithic alloys, such as higher specific strength and modulus, higher thermal stability, higher wear resistance, lower density, higher stiffness and greater mechanical and electrical properties, among others [1]. Due to the recent developments in the automotive industries, the conventional materials are replaced with advanced materials in demand of fuel-efficient vehicles [2]. Aluminium (Al) and magnesium (Mg) alloys which having light weight are modified in connection with the need of the industries. Due to their production limitations, low ductility, low heat conductivity, etc., magnesium-based metal matrices are rarely employed even though both alloys

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ORIGINAL ARTICLE

Predicting the wear performance of graphene and silicon nitride reinforced aluminium hybrid nanocomposites using artificial intelligence approach

Praveen Raj[1,2] · P. L. Biju[1] · B. Deepanraj[1] · N. Senthilkumar[3]

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Abstract
Hybrid nanocomposites of aluminium (NHAMMCs) made from AA5052 are fabricated via stir casting route by reinforcing 12 wt% Si_3N_4 and 0.5 wt% of graphene for usage in aeronautical and automotive applications due to the lower density and higher strength to weight proportion. The wear characteristics of the NHAMMCs are evaluated for different axial load, rotational speed, sliding distance and sliding time based on Box-Behnken design (BBD) of response surface methodology (RSM). Orowan strengthening mechanism is identified from optical image which improves the strength of the composite. Outcomes show that with higher axial load and rotational speed, there is substantial increase in wear loss whereas with increased sliding distance and sliding time there is no considerable increase in wear loss due to the lubricating nature of the reinforced graphene particles since it has higher surface area to volume ratio. Besides, artificial intelligence approach of neuro-fuzzy (ANFIS) model is developed to predict the output responses and the results are compared with the regression model predictions. Prediction from ANFIS outplays the regression model prediction.

Keywords AA5052 silicon nitride · Graphene · Stir casting · Pin-on-disc · ANFIS · Artificial intelligence

1 Introduction

Surface interactions, particularly the exclusion and distortion of material from a surface due to the action of the contacting item through motion, constitute the phenomenon of wear [1, 2]. Similarly, to friction, the wear characteristic of materials is a very complex process that is influenced by numerous mechanisms. A material can be strong and wear-resistant but not extremely hard, and a hard material can be tough but not especially wear-resistant. The material composition, design, contact area, applied stress, environment, degree of movement, lubrication, environment, and material qualities (hardness, surface finish, and microstructure) are the key determinants of wear and galling [3]. Surface-fatigue, adhesive, abrasive, and corrosive wear are the four fundamental forms of wear. The most frequent type of wear in materials is called abrasive wear, and it happens when a rugged surface slides along a smooth one. Wear is defined as the deterioration of a solid substrate as a result of the frictional forces between that substrate and another substance in contact. Asperities out from harder surface are avoided by a plastic flow of the smoother texture, as the asperities from the harder surface press into it. By combining the actions of micro-ploughing, micro-cracking, and micro-cutting, the harder surface eliminates the softer substance when a tangential force is applied [4].

There are numerous strategies to avoid wear. The two most popular methods are modifying the characteristics of the material or using wear-resistant materials, e.g., by providing self-lubricating properties, surface treatment, coating, heat treatment and surface hardening. Separating the surfaces from one another can help reduce wear by using oil and grease [5]. At some point, it will be necessary to replace the worn-out parts, which will raise the cost and duration of operation. Currently, hybrid composites are typically chosen

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ORIGINAL PAPER

Optimizing the machining conditions in turning hybrid aluminium nanocomposites adopting teaching–learning based optimization and MOORA technique

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Abstract
In this study, hybrid nanocomposites of aluminium (NHAMMCs) made from AA5052 are fabricated via stir casting route by reinforcing 12 wt% Si_3N_4 and 0.5 wt% of graphene to study its machining characteristics through traditional turning process. The machining factors taken for the consideration in this work are rate of feed, machining speed and machining depth and nose radius. A mixed level Latin square orthogonal array (L_{18} 2^1, 3^7) is considered for designing the experimental array. Multi-Objective optimization based on ratio analysis (MOORA) method is adopted for optimizing tool wear, surface roughness, and resultant cutting force. A population-based meta-heuristic optimization procedure; teaching–learning based optimization (TLBO) is also implemented to optimize the outputs. Observation presents that all the considered input factors have a significant influence on the measured outputs. The performance of TLBO algorithm outplays the MOORA method as observed for the results of validation experiment.

Keywords Hybrid nanocomposite · Turning · Dry machining · Nose radius · TLBO · MOORA

1 Introduction

Generally, the monotonic strength and stiffness of metal matrix composites (MMCs) is much higher than unreinforced alloys. Because the reinforcing phase is usually considerably stronger than the matrix, it must initially bear a disproportionate amount of the stress [1]. As a result, micro-plasticity occurs at fairly low values of strain and stress, higher strain leads to higher micro-plasticity magnitude, therefore, the plasticity occurs in a global sense throughout the matrix. Compared with the unreinforced matrix, the rate of work hardening of MMCs is increased as a result of the integration of reinforcement [2, 3]. Near net-shape fabrication is common for MMC parts, but standard machining techniques like drilling, milling and turning are required for the precision and complexity of the final product. On the other hand, the diverse character of MMCs makes them challenging-to-cut materials [4, 5]. Abrasive particulates with tool-like toughness can cause significant tool wear and a deteriorating machined surface finish. As a result, the challenges of machining have prevented its use in more widespread contexts [6].

As a effect of the relative motion among the tool and the workpiece, the material is sheared along the shear plain, forming a chip. During machining MMC, the material is removed as a chip undergoing plastic and elastic deformation, with the strengthened particles inside this thin layer potentially being driven into the softer matrix phase are crushed by the compressive stress created among the tool and thin layer [7]. Particles are more likely to be sheared by the insert at greater strain rates because the matrix material is more resistant to deformation. Matrix deformation and particle expulsion or insertion are both simplified at low strain and velocity [8, 9]. The sheared particle results in improved surface quality, but uncertain outcomes for the particle that was pulled out, on one hand, in surface-to-surface contact applications, these voids are covered with oil to minimise friction, but the drawn particle is a major cause of wear, resulting in three-body abrasion [10].

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ORIGINAL PAPER

Experimental and finite element analysis of thermal stress on thermal spray coated AISI 304 stainless steel specimen using low cost solid lubricant

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Abstract
The scope of this work is to investigate the thermal stress on the CaF_2 coated AISI 304 stainless steel substrate using both finite element analysis and experimental method. The influence of temperature and coating thickness on the thermal stress was investigated by conducting the test at different temperatures ranging from 100 °C to 1000 °C and by varying the coating thickness at 250, 350 and 450 µm. Stoney's equation was then used to investigate the thermal stress analytically and the finite element analysis results were then compared with the analytical results. From the experimental results it was found that the specimen coated with 450 µm coating thickness has better resistance to thermal stress compared to other samples taken for investigation. The experimental results were then validated to confirm the effectiveness of the coating thickness by conducting a confirmation test using thermal shock test to validate the results experimentally. The samples after the thermal shock test were examined using SEM, revealing numerous cracks, voids and peel off of the coating as the major reason for higher thermal stress on samples coated with 250 and 350 µm.

Keywords Thermal shock resistance test · Thermal stress · Finite element method · Coating thickness

1 Introduction

Liquid lubricants are the substances which are applied to reduce the friction and wear of the contacting parts in machineries and sliding mechanisms. They play a vital role in increasing the life of the machine. However, when exposed to high temperature, high pressure and vacuum, the liquid lubricants become ineffective [1, 2]. Most of the countries are not promoting the use of liquid lubricants owing to the environmental and health issues caused by it. It also affects the physical and chemical properties of the soil. The lubricating oil which is simply poured out to the environment in the form of oil mist and micro drops causes serious risk to the environment [3].The usage of solid lubricants is the best solution to the above mentioned problems.

In extreme environmental conditions like high or low temperature and high or low pressure, solid lubricants are preferable than liquid lubricants. It is also utilized in applications where liquid lubricants and oils cannot be used. The widely used solid lubricants are MoS_2, B_4C, CaF_2 and graphite. Among these, a fluoride based solid lubricant, calcium fluoride is the most effective one and mostly used with various ceramics and metals. The wide acceptance of calcium fluoride is due to its excellent lubrication properties at elevated temperature [4, 5]. In this work, the calcium fluoride synthesized from discarded eggshells was applied on the stainless-steel substrate by using plasma thermal spray coating.

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Modelling and experimental analysis of exit burr height and studies on size effect during micro endmilling on Inconel 718

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Inconel 718

ABSTRACT

Micro endmilling is considered as a preferred precision micromachining technique to produce complex 3D micro features due to the high material removal rate (MRR) and flexibility. In micromachining, feed/tooth is comparable to tool edge radius and material grain size. The scaling issues, material microstructure, flow stress and cutting temperature has a significant influence on the cutting mechanism and machined surface quality. This work proposes a mathematical model to predict the exit burr height during micro end milling by considering size effect, material microstructure, oblique cutting principle, cutting temperature, chip formation and flow stress. The model is based on the continuity principle and burr formation geometry. The proposed exit burr height model was validated by conducting micro endmilling experiments on Inconel 718. It was found that the exit burr height model based on the Johnson–Mehl–Avrami–Kolmogorov (JMAK) grain evolution model gives a good matching with experimental results and the proposed model could predict the exit burr height with a maximum percentage error of 6.4%. Size effect in exit burr height was observed. The exit burr height was observed to be higher at feed/tooth (f/t) much below cutting edge radius due to high ploughing on the workpiece material. The exit burr height at f/t above edge radius increases with f/t similar to conventional milling. The minimum exit burr height was observed in the ploughing to shearing transition region. The proposed model can be utilized for the optimization of machining parameters to control and minimize the exit burr size.

Introduction

Micromachining has a significant role in emerging industries like aerospace, electronics, optics, biomedical, Micro-electromechanical systems (MEMS), and communication where the demand for micro component/features are huge [1,2]. Micro milling is considered as a favourable micromachining process capable to fabricate complex three-dimensional micro parts with high accuracy and precision [3]. The minimum uncut chip thickness (MUCT), size effect, ploughing effect, and chip formation are the main differences between micromachining and macro machining. MUCT is the smallest value of undeformed chip thickness above which the chip formation begins [4,5]. For micro milling operation, feed per tooth (f/t) less than MUCT, ploughing mechanism is dominant and as a result, no chip may form [6,7]. Where f/t is the ratio of feed rate (f) to the product of spindle speed (N) and the number of flutes (Z). It can be expressed as f/t = f/(NZ). Size effect region is the zone where f/t is below tool edge radius. Inside the size effect zone, the ploughing force might be significant [8]. For f/t beyond edge radius, shearing becomes prevalent in the cutting process. Hence, there might be considerable variation in the machined surface quality during micro endmilling compared to conventional milling. It was reported that the edge radius and f/t have a great role in micro end milling machining performance [9,10]. Oliveira et al [11]. experimentally determined that MUCT for micro milling is varied from 0.25 to 0.33 times the cutting edge radius regardless of tool-workpiece material, and machining parameters. Several works were reported on machining performance during micro milling of easy to cut materials. However, limited research has analyzed the surface characteristics of micro endmilled superalloys such as Inconel 718. Micro milling is associated with many issues like size effect, significant tool wear, tool deflection, and edge breakage. These issues become severe when machining of difficult to cut materials like Inconel 718 [12,13]. The presence of hard spots may lead to high force fluctuation, poor

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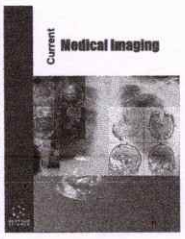

RESEARCH ARTICLE

GastroNet: A Custom Deep Learning Approach for Classification of Anomalies in Gastrointestinal Endoscopy Images

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Abstract:

Introduction:

Among all cancer forms, gastrointestinal (GI) cancer is the most serious condition that spreads quickly and requires early detection. GI disorders claim the lives of up to nearly two million people worldwide. To lower the mortality rate from GI cancer, early detection is essential.

Methods:

For the identification of GI illnesses, such as polyps, stomach ulcers, and bleeding, endoscopy is the gold standard in the medical imaging industry. The numerous images produced by endoscopy require an enormous amount of time for the specialist to diagnose the disease. It makes manual diagnosis difficult and has sparked research on automatic computer-based approaches to diagnose all the generated images quickly and accurately. AI-based algorithms have already been used in endoscopy images with promising outcomes and have enhanced disease identification and classification with precision. However, there are still a lot of issues to be solved, including figuring out potential biases in algorithms and improving interpretability and generalizability.

Results:

The proposed GastroNet model creates a system for classifying digestive problems for the Kvasir Version 1 dataset. The framework consists of different CNN layers with multiple filters, and average max-pooling is used to extract image features. The optimization of network parameters is done using the Stochastic Gradient Descent (SGD) algorithm.

Conclusion:

Finally, the robustness of the proposed model is compared with other state-of-the-art models like VGG 19, ResNet 50, Inception, and Xception in terms of evaluation metrics.

Keywords: Gastrointestinal disorder, Classification of anomalies, Convolution neural network, Custom model, Performance metrics, Robustness.

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1. INTRODUCTION

Gastric disease is a significant health issue and is among the top two causes of cancer-related fatalities [1]. The International Agency for Research on Cancer [2] of the World Health Organization (WHO) estimates that GI cancer accounts for roughly 3.5 million recent cases worldwide each year. Typically, the combined mortality rate for these cancer forms is around 63%, with 2.2 million fatalities per year [3]. Although endoscopy is currently the gold-standard method for inspecting the GI tract, the accuracy of the diagnosis is purely dependent on the skill of the doctor [3]. It is reported that polyps, one of the GI diseases, can be detected by only 27% of the experts [4]. Artificial intelligence-based research helps in assisting people in recognizing diseases that cannot be seen and would be useful for diagnosing GI disease with high accuracy [5]. AI-based algorithms have already been used in endoscopy images with

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back

Performance analysis of groundwater quality index models for predicting water district in Tamil Nadu using regression techniques

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< Previous Next >

Abstract

The widespread utilization of groundwater in various sectors, including households for drinking purposes and the agricultural and industrial domains, has elevated its status as an indispensable and crucial natural resource. Groundwater has seen significant changes in both quantity and quality factors. Water Quality Index (WQI), which is dependent on a number of factors, is still a crucial gauge of water quality (WQ) and a key component of efficient water management. If there is an automated method for forecasting WQ, the administration will benefit. The main goal of this project is to develop a machine learning (ML) model to forecast the quality of groundwater in several areas of Tamil Nadu (TN), India. The available dataset encompasses comprehensive data groundwater attributes, encompassing parameters such as pH, electrical conductivity (EC), total hardness (TH), calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), bicarbonate (HCO^{3-}), nitrate (NO^{3-}), sulfate (SO_4^{2-}), and chloride (Cl^{-}). In this study, various ML regression algorithms such as linear, least angle, random forest and support vector regressor models and their comparison with the ensemble model (EM) were depicted to predict WQI, and the results were evaluated using performance metrics. It is found that the EM has a lower RMSE in the order of 2.4×10^{-6}. Further, the predicted WQI values are used to classify the districts of TN.

Keywords: Groundwater water quality ▪ water quality index ▪ prediction ▪ regression models ▪ classification

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RESEARCH ARTICLE

Tikhonov Regularization and Perturbation-Level Tuning for the CNM in Pharmacokinetics

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ABSTRACT In pharmacokinetics, the clinical information collected from the patient is often much less than the complexity of the patient's internal operations, hence the undetermined inverse problem has emerged as a challenge to solve it and find multiple possible point sets for considering the many possible implications of drug kinetics in the patient's body. This paper suggests two enhanced schemes for the early cluster Newton method (CNM) to concomitantly explore a great solutions number for the inverse parameter determination in pharmacokinetics. The first scheme is the application of Tikhonov regularization to deal with the overdetermined system for hyperplane fitting in the CNM, and the second is an effective iterative strategy by tuning perturbation-level for the CNM. As a result of Tikhonov's filtering operation, lower order singular values than the regularization parameter, that are to blame for the instability of the matrix equation, are efficiently eliminated. With perturbation-level tuning, following every iteration, as the point cluster (PoC) gets near the solution manifold (SoM), it is essential to lessen the level of perturbation in the patient's clinical measurement data and this is suited for a numerical stabilization. Numerical simulation scenarios of two schemes have revealed that these suggested schemes can lower the iterations number and computed time, and PoC move more steadily towards the solutions manifold.

INDEX TERMS Tikhonov regularization, physiologically based pharmacokinetics, pharmacokinetics, cluster Newton method, inverse problem.

I. INTRODUCTION

In pharmacokinetics, we frequently encounter the problem of underdetermined inverse, that is, the variables number is greater than the equations number. This is because the collected data frequently do not give the complex mechanism explanation in the human body. Thanks to mathematical modeling, we would simulate complex activities and gain precious insight into in vivo pharmacokinetics. In [1] and [2], the authors proposed to apply the CNM in order to concomitantly seek many solutions for an undetermined inverse problem. Because the proposed CNM uses a least squares approach to collectively fit the Jacobian, it is more effective than algorithms that calculate many solutions one at a time. The CNM works by concurrently computing a cluster of solutions. It is proven that, the CNM is trustworthy, powerful, and efficient than the Levenberg-Marquardt method. In order to identify solutions family that best fits the additional requirements, in [3], the authors suggest a novel algorithm based on the Beta distribution's two parameters. As a result, it is possible to have considerably more control over the range of possible solutions when using the CNM. Additionally, the authors add

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