# 9th International Electrical Engineering Conference

## Friday 7th & Saturday 8th, June 2024

## Organized by:

## Institution of Engineers Pakistan & NED University of Engineering & Technology.

The Department of Electrical Engineering, NEDUET Karachi and IEP Karachi Centre organised International Electrical Engineering Conference (IEEC) 2024, themed **"Illuminating Pathways: Navigating Pakistan's Energy Challenges and Opportunities" – Rappel-Up 2024**. This conference serves as a crucial platform for addressing the pressing issues facing Pakistan's energy sector and exploring innovative solutions to shape a sustainable future.

- ✓ **Generation vs. Transmission: Bridging the Gap**
- ✓ **Escalating Energy Costs: Unravelling the Complexities**
- ✓ **Optimizing Renewable Energy Potential**
- ✓ **Manufacturing and Import Status of Electrical Engineering Infrastructure**
- ✓ **Harvesting Coal Reserves in a Sustainable Manner**

Following papers were presented in 9th International Electrical Engineering Conference 2024:

**Paper ID: IEEC-2024-03**

# Modelling and detecting the Demagnetization Fault in The Permanent Magnet Synchronous Machine Using the Current Signature Analysis

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Several kinds of faults can occur in permanent magnet synchronous machine (PMSM) system bearing faults, electrically short/open fault, eccentricity fault and demagnetization fault. Demagnetization fault means that strengths of permanent magnets (PM) in PMSM decrease, and it causes low output torque which is undesirable to EV. The fault is caused by physical damage, high temperature stress, inverse magnetic field and aging. Motor current signature analysis (MCSA) is a conventional motor fault detection method based on extraction of signal features from stator current. a simulation model of the PMSM under partial demagnetization and uniform demagnetization fault were established, and different degrees demagnetization fault was simulated. The harmonic analyses using Fast Fourier Transform (FFT) show that the fault diagnosis method based on the harmonic wave analysis is only suitable for partial demagnetization fault of the PMSM, and not apply to uniform demagnetization fault of the PMSM.

**Paper ID: IEEC-2024-07**

# An investigation and comparison of compensation topologies in inductive wireless charging for electric vehicles with zero voltage switching

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Inductive wireless charging (IWC) becomes more prominent in Electric vehicles (EV's) industry. Moreover, resonance has gained prominence recently as a way of effectively wireless delivering of power to a load across a wide air gap. However, the resonance, and a hard switching of full-bridge inverters is a major research problem need to be addressed. In this paper, a comparative analysis of five resonance compensation topologies is proposed for IWC for EVs industry. Firstly, we investigate the output characteristics of series-series (SS), series-parallel (SP), parallel-series (PS), parallel-parallel (PP), and Inductive capacitive coupling (LCC). Secondly, to avoid hard switching of the inverters the zero-volt switching (ZVS) is also implemented in all tested case studies. Extensive simulations were carried out on PSIM software to validate the theoretical results in addition Opel-Rt has been engaged for the Hard-ware in loop (HIL) testing of our work. Results indicate that proposed work present an efficient comprehensive analysis of compensation topologies with zero-volt switching feature.

**Paper ID: IEEC-2024-08**

# Comparative Analysis of Design Comparative Analysis of Design Parameters for Modern Radio Frequency CMOS Power Amplifier Architecture Trends

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This research presents a comparative analysis of design parameters in modern power amplifiers (PAs) architecture trends, predominantly for the power efficiency and consumption existing in various CMOS nano-meter technologies. The design parameters include the signal gain, linearity, output power, and output power back-off crest factor. Along with CAD simulation tools and design parameters' findings, it becomes more important for designers as technology scales down to comprehend how transistor scaling
affects circuit performance. The process-voltage-temperature (PVT) outputs from the layout design are used to assess the performance of proposed architecture on process variation conditions. Modern shortand long-range communication technologies, including BLE and WLAN, need for reliable RF PA designs with top-notch efficiency, linearity and bandwidth. The resultant parameters are compared using a table, and various parameters of various designs are visually shown for comparison. These comparative findings will provide any designer practical information to choose the best CMOS PA design for the specific application. The most important RF CMOS PA integrated implementations are addressed in the conclusion section.

**Paper ID: IEEC-2023-8**

# STM32 based Sinusoidal Ripple Current (SRC) Battery Charger for Electric Vehicles (EVs)

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A The depleting fossil fuel reserves and hazardous effect of greenhouse gases are forcing the world towards Electric Vehicle Transportation, which is the environmentally sustainable and cost-effective alternative. But many challenges need to be encountered for its vast adoption. One of the key challenges is EV charging, which should be fast, cost effective and safe. In this paper an STM32 controller base charge controller is presented which converts 100V-270V alternating current supply to a 48V direct current. This charger consists of voltage, current and temperature feedback to control the supplied voltage and current of the battery and prevent it from over temperature. The controller can be embedded with different charging methods CC-CV, multistage CC-CV, pulsating charging, etc. but in this paper sinusoidal ripple charging (SRC) technique is focused. The firmware first takes input the battey rated voltage, charging current, charging method and amount of energy at every new battery connection then starts charging. All these charging techniques are then compared and their effects on the battery are studied.

**Paper ID: IEEC-2024-9**

# Analysis of Earthing System on one of the New Substations at NED University, Main Campus as per IEEE Std. 80-2000 and Finite Element Method and AI Automation

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This paper aims to present a detailed analysis of earthing system for one of the new substations at NEDUET, Main Campus as per IEEE Std. 80-2000 and Finite Element Method using ETAP. Earthing system is designed to establish the safe limits of potential differences that can exist in a substation. The results were derived from different proposed designs that were Square Grid A=50ftx50ft, Rectangular Grid A=70ftx40ft , L-shaped Grid A=2500ft and Triangular Grid A=2500ft . FEM method was applied on the Design 2.3 as recommended by IEEE method and comparisons were made. As FEM does finite element wise calculations while Sverak equations were used in IEEE method, it gives more accurate values of Rg. Using same configuration, FEM needed minimum 8 rods of 10ft and 0.75in diameter to meet the voltage criteria. However, in doing so Vstep, Rg and GPR are comparatively high than IEEE. Hence to lower the GPR and Rg. We would need to use more number of conductors and rods and increase their dimensions to achieve the same voltage limits, hence FEM would cost more than IEEE at the expense of better accuracy.A part of AI automation has been added to intelligently make decisions on the best suitable design for given grid statistics.

**Paper ID: IEEC-2024-14**

# Enhancing Three-Phase Induction Motor Performance with 3 Soft Ramp Control

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Three-phase induction motors experience high inrush currents during start-up, exceeding their rated capacity and potentially damaging stator windings. This paper explores the implementation of soft ramp control to address this challenge. Soft starters progressively increase the voltage applied to the motor, mitigating the current surge and associated electromagnetic torque. This reduces stress on the motor, shaft, and connected equipment whilst preventing disruptions in the power supply network. In the case of the soft starts scheme, the performance of the induction motor as well as the characteristics of the load torque is outclassed as compared to contemporary methods.

**Paper ID: IEEC-2024-15**

# Data-driven approach for power flow direction estimation in presence of Renewable Energy

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Understanding power flow directions within electrical grids is paramount for ensuring grid stability, efficiency, and optimal resource utilization. This paper proposes a data-driven methodology for estimating power flow directions within a power grid using Deep Neural Networks (DNNs). The DNN model is trained on a comprehensive dataset derived from power flow simulations conducted on the IEEE 14-bus system, incorporating real-time load profile data and solar generation data. The model leverages the system's active and reactive power injections as input to accurately forecast power flow directions across each transmission line. Notably, Gaussian noise is introduced into the dataset to enhance its robustness and address potential measurement errors. This approach has the potential to improve grid monitoring and control capabilities, particularly in scenarios where real-time data acquisition might be compromised.

**Paper ID: IEEC-2024-16**

# Energy crises and Environmental Impacts on Economic in Developing Countries

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The prevalent energy crises in developing nations have a profound impact on their economic advancement and environmental endurance. This study delves into the intricate connection between energy deficiencies, environmental deterioration, and economic performance across various developing countries. An examination is conducted on the direct effects of energy shortages on industrial output, household energy accessibility, and broader economic parameters like GDP growth rates and employment statistics. Furthermore, an investigation is carried out on how these energy deficits force a dependence on inefficient and environmentally damaging energy resources, thereby worsening the ecological footprint of these countries. Employing a combination of quantitative data analysis and qualitative case studies, our study underscores the cyclic nature of energy inefficiencies and environmental consequences, unveiling a trend where short-term energy solutions result in enduring environmental predicaments. Various governmental policies and global approaches aimed at tackling these challenges are explored, with an emphasis on the incorporation of renewable energy sources as a sustainable strategy to address both economic and environmental issues. The study concludes by proposing a set of specific strategies for policymakers, stakeholders,and international entities to boost energy effectiveness, advocate for environmental endurance, and propel economic progress in developing nations.

**Paper ID: IEEC-2024-19**

# Enhancing Cyber-Physical Security of Electric Vehicle Charging Stations: A Data Mining Approach for Real-Time Detection of Cyber Attacks

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This research paper delves into the critical realm of cybersecurity concerning Electric Vehicle Charging Stations (EVCS), focusing on the detection and mitigation of cyber-attacks targeting these infrastructures. Leveraging an EVCS-based microgrid model, our study employs data mining techniques to analyze and validate real-time data within the OPAL-RT environment. A comprehensive dataset, spanning physical system faults and various cyber-attacks such as Denial-of-Service (DoS), Spoofing, Replay, and Data Manipulation, is generated for experimentation. Through the utilization of machine learning algorithms, specifically trained models, we predict potential cyber-attacks in real-time, enhancing the security posture of EVCS. Comparative analysis with existing literature underscores the efficacy of our proposed methodology, thereby reinforcing the cyber-physical security of EVCS infrastructure. This research contributes to the advancement of cybersecurity measures in the context of electric vehicle charging infrastructure, addressing the growing concerns of cyber threats in the transportation sector.

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| **Paper ID: IEEC-2024-21** | |

# Lights Handling and Optimizing Airport Runway Illuminations

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Effective lighting management on airport runways is vital for safe aircraft operations, especially in low-visibility situations. Runway lighting systems, including edge lights, threshold lights, and approach lighting, play crucial roles in guiding pilots during takeoff, landing, and taxiing. These systems enhance visibility and aid navigation, ensuring precise aircraft positioning. Proper maintenance and compliance with international standards are essential to guarantee optimal performance and safety for air traffic. With accurate lighting management, airports can mitigate risks and maintain operational efficiency even in challenging weather conditions, ultimately prioritizing the safety of passengers and crew. An intricate network of lights guides aircraft on and around airport runways, ensuring safe operation in low-visibility conditions. Runway edge lights, typically white, mark the perimeter, while red and green lights at the ends designate the stop zone and landing threshold respectively. Centerline lights provide additional guidance, and their color changes towards the end of the runway to warn pilots. Approach lighting systems further assist pilots in aligning with the runway for landing. The intensity of many lights can be adjusted to accommodate varying weather conditions. This comprehensive lighting system is crucial for safe air traffic flow, especially during nighttime and low-visibility situations

**Paper ID: IEEC-2024-22**

# Comparison of Neural-Network Prognosis Algorithm (NNPA) and Long Short Term Memory (LSTM) for Prediction of Active Line Losses

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The research, addresses the significant issue of power losses in electrical transmission lines. The paper provides a comprehensive understanding of technical losses, which are a major concern for the National Transmission and Dispatch Company (NTDC) and the Ministry of Energy 13(MOE). The research introduces a Neural Network Prognosis Algorithm (NNPA) trained on a dataset generated using the standard IEEE14 bus system and a load profile for each hour spanning five years. Newton Raphson based load flow analysis was used to calculate the active line losses in each line. The dataset incorporates Gaussian noise to simulate real-world instrumentation inaccuracies and errors. The NNPA model is compared with a Long Short Term Memory (LSTM) model trained on the same dataset. The results demonstrate that the NNPA model outperforms the LSTM model in terms of robustness and accuracy in predicting line losses. Despite the challenges posed by the presence of randomized data and noise, the NNPA model shows promising indicators of its effectiveness and validation. The research concludes that the proposed algorithm exhibits excellent convergence towards actual values in validation, reinforcing its potential for practical applications.

**Paper ID: IEEC-2024-23**

# Electromagnetic Interference (EMI) in Industrial Environments: Impacts and Strategies for Mitigation

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Despite the ongoing advancements in electronics, Electromagnetic interference is a problem that limits the ability to deliver high-accuracy results in industrial environments. EMI can interfere with everyday functioning and, in certain cases, can have disastrous consequences. It is crucial to employ proper grounding, shielding, filtering techniques, and careful component selection to reduce EMI's impact. However, the complete elimination of EMI is challenging, making it necessary to understand EMI measurement techniques to manage interference effectively. This paper investigates methods to integrate preventive measures, thorough testing, and regulatory adherence to ensure operational reliability and safety.

**Paper ID: IEEC-2024-24**

# Over-Voltage Protection Circuit for Tripping & Switching of 220V appliances using Relay Module

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The project presents an "Over Voltage Protection Circuit for Tripping & Switching of 220V Appliances Using Relay Module." It aims to safeguard appliances from potential damage due to overvoltage conditions by automatically disconnecting them from the power source. The circuit utilizes a combination of electronic components including transistors, capacitors, resistors, LEDs, diodes, and a relay module. Through the integration of these elements, the circuit detects overvoltage situations, triggers the relay to disconnect the appliance, and indicates the status through LEDs. The adjustable potentiometer allows for customization of the overvoltage threshold, enhancing flexibility and adaptability to varying electrical environments

**Paper ID: IEEC-2024-25**

# Energy Paradox in Pakistan: Sustainable Strategies in Resource-Limited Settings

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Pakistan is confronted with a significant energy paradox, as it seeks to extend access to dependable and cost-effective energy while simultaneously shifting towards sustainable energy sources. This document delves into the energy challenges that Pakistan encounters within the frame work of economic limitations, energy inefficiency, and environmental considerations. Despite the presence of abundant renewable resources such as solar and wind, the energy infrastructure and market dynamics of the nation impede widespread adoption. The research at hand scrutinizes existing energy policies, deficiencies in infrastructure, and financial mechanisms that influence the energy landscape of Pakistan. Through a combination of qualitative and quantitative research approaches, we pinpoint primary obstacles to the development of sustainable energy and put forth strategic recommendations customized for settings with limited resources. These recommendations encompass the enhancement of policy frameworks, intensified investment in renewable technologies, and the promotion of decentralized energy solutions to guarantee fair energy access. The outcomes of this study are intended to enrich the dialogue on sustainable development in emerging economies grappling with similar constraints, while also offering a blueprint for Pakistan to surmount its energy paradox.

| Paper ID: IEEC-2024-40 | |
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# Predicting the Stability of Perovskites using new tolerance Factor

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In recent years, the perovskite solar cells have gained much attention because of their ever-increasing power conversion efficiency (PCE), simple solution fabrication process, flyable, light-weight wearable and deployable for ultra-lightweight space and low-cost materials constituents etc. Over the past few years, the efficiency of perovskite solar cells has surpassed 25% due to high-quality perovskite-film accomplished through low-temperature synthesis techniques along with developing suitable interface and electrode-materials. Besides, the stability of perovskite solar cells has attracted much well-deserved attention. In this article we have focused on recent progress of the perovskite solar cells regarding their crystallinity, morphology and synthesis techniques. Also, demonstrated different layers such as electron transport-layers (ETLs), hole transport-layers (HTLs) and buffer-layers utilized in perovskite solar-cells, considering their band gap, carrier mobility, transmittance etc. Outlook of various tin (Sn), carbon and polymer-based perovskite solar cells and their potential of commercialization feasibility has also been discussed.