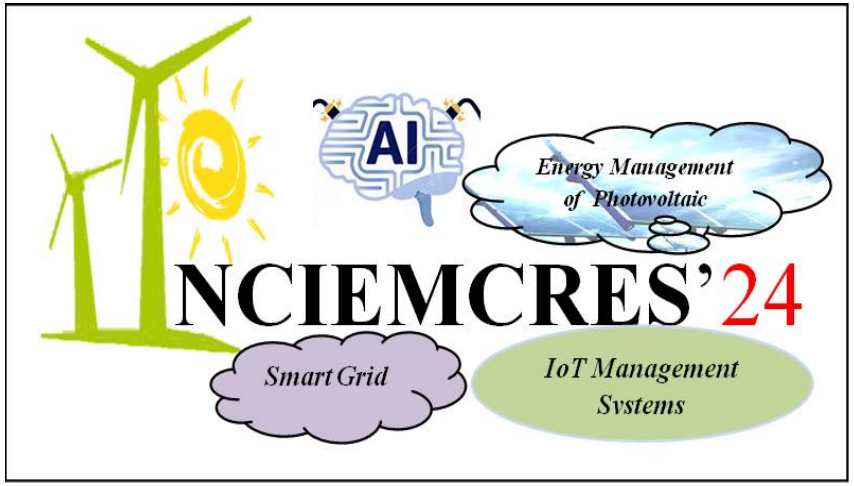
Université Abderahmane Mira de Bejaia-Algérie

Laboratoire TAMAYOUZ de Technologie Industrielle et de l'Information(L.T.2.I)

Book abstracts

National Conference on Intelligent Energy Management and Control of Renewable Energy Systems (NCIEMCRES'24)

Béjaia, October 30th -31st 2024


AI
Energy Management
of Photovoltaic
NCIEMCRES'24
Smart Grid
IoT Management
Systems

1.KEYNOTES SPEAKING

Keynote 1:

La transition énergétique : une alternative ou une fatalité?

Presented by**: Pr Seddik BACHA**

Résumé de la présentation

L’accélaration de l’intégration des système de production électriques à base de renouvelable est un fait indéniable dont la puissance installée , voire la production, dépasse les systèmes conventionnels dans beaucoup de pays. Toutefois nombe de problèmes sont apparus au fil du temps, ces derniers se trouvent accentués par l’émergence du véhicule électrique et ont porté le système électrique à ses limites structurelles et opérationnelles.

Entre autres problèmes, les plans de tension, de fréquence et de protection sont en constante révision afin de faire face à cette large intégration. Il s’agit des moyens physiques et algorithmiques qui contribuent à la maîtrise en temps réel des flux d’énergie dans les réseaux.Nous parlerons ici de flexibilisation du réseau électrique. Ces moyens de flexibilisation peuvent se décliner en :

- Ressources physiques à même d’absorber ou de fournir de l’énergie de manière contrôlée
- Une opration adaptée selon différentes échelles de temps
- Des modèles économiques adaptés ainsi que les opératuers y inhérents

La conférenceaura pour finalité de décrire ce nouveau éco-système de la flexibilité, de sa mise en œuvre et défis de sa mise en place.

Keynote 2:

Défis, Opportunités, Économies d'Énergie, et Technologies avancées associées aux Énergies Renouvelables

Présenté par: Pr REKIOUA née ZIANI Djamila

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Abstract:

Cette présentation porte ur l'évolution des ER, pour enchainer sur les défis, opportunités et économies d'énergie, puis je vais présenter les différents Technologies avancées utilisées dans le domaine des énergies renouvelables dans l'enseignement et la recherche scientifique. En effet, les ajouts de capacités renouvelables mondiales devraient faire un bond spectaculaire de 107 gigawatts pour atteindre plus de 440 gigawatts en 2023. Il s'agit de la plus forte augmentation absolue jamais enregistrée, et elle est facilitée par l'amélioration du soutien politique, les préoccupations en matière de sécurité énergétique et les prix compétitifs du solaire, de l'éolien et du stockage de l'énergie. Il existe différents facteurs qui ont contribué à promouvoir l'émergence et l'adoption croissante des énergies renouvelables dans le paysage énergétique mondial. Nous allons citer les deux plus importants: le développement de la population (dont le besoin augmente) et la préoccupation environnementale. Un accent est mis sur les systèmes de stockages utilisés et particulièrement sur l'hydrogène, son codage, la production, le stockage, le transport et ses applications terminales. Les principaux défis auxquels sont confrontées les énergies renouvelables, ainsi que les opportunités qu'elles offrent en termes de développement durable, de réduction des émissions de gaz à effet de serre et de création d'emplois verts seront présentés, ainsi que les différentes technologies avancées utilisées dans le domaine des énergies renouvelables dans l'enseignement et la recherche scientifique

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Keynote 2:

Contrôle de la mise en parallèle des convertisseurs MLI pour l'intégration des systèmes d'énergie renouvelable

Presented by: **Prof. Ali CHEBAHI**

Abstract: Dans les systèmes triphasés autonomes déséquilibrés, où la circulation du courant homopolaire (séquence zéro) est nécessaire, les onduleurs à quatre bras fournissent une connexion neutre pour les charges monophasées ou autres charges déséquilibrées typiquement utilisées dans les systèmes de distribution triphasés. De plus, le contrôle de l'amplitude et de la phase de la tension et/ou du courant de séquence zéro est également réalisé à l'aide des onduleurs à quatre bras. En raison de ces avantages, les onduleurs à quatre bras sont largement utilisés dans de nombreuses applications d'alimentation autonome basées sur les ressources d'énergie renouvelable, notamment les systèmes d'alimentation autonomes (Stand-alone power-supply systems : SPSS), les configurations parallèles et les micro-réseaux isolés à quatre fils.

Voici les défis auxquels sont confrontés les SPSS basés sur des onduleurs à quatre bras, les configurations d'onduleurs à quatre bras parallèles et les micro-réseaux isolés à quatre fils basés sur des onduleurs à quatre bras :

(1) Déséquilibre et perturbations de la tension de charge, (2) Grandes erreurs statiques sous des charges monophasées et triphasées déséquilibrées, (3) Réponses dynamiques lors de la variation de la charge ou de la tension de référence de charge, (4) Grand courant de circulation pour les configurations d'onduleurs à quatre bras parallèles qui circule entre les bras de chaque phase de ces onduleurs lorsque les onduleurs fonctionnent avec un partage de courant déséquilibré ou des paramètres de filtre de sortie déséquilibrés, (5) Partage de puissance, gestion du courant homopolaire et du courant de circulation pour les micro-réseaux isolés à quatre fils lorsque les onduleurs fonctionnent avec des paramètres des files déséquilibrés, (6) Analyse et contrôle de la qualité de l'énergie pour les trois systèmes, (7) Complexité et charge de calcul pour les trois systèmes, (8) Nombre élevé de capteurs nécessaires pour les trois systèmes**.**

Les travaux futurs et les solutions pour chaque configuration seront détaillés dans chaque partie de cette présentation.

Keynote 4:

Grid-Forming Power Inverters Control and Applications

Presented by: **Pr SOUFI Youcef**

Abstract:

In recent years, the world energy transition shifts towards greater adoption of more renewable and sustainable future energy, there has been a significant increase in investments in renewable power generation technologies. Electric power systems are increasingly being augmented with the growing demand for renewable energy technologies, mainly wind and solar, inverter-based resources are becoming an inevitable part of AC power systems. Due to the intermittent nature of these sources, IBRs often tend to extract the maximum available power at any time and feed the extracted power into the grid. While having a growing share of inverter-based resources, conventional synchronous generator-based voltageand frequency control mechanisms are still prevalent in the power industry. Therefore, inverter-based resources are experiencing a growing demand for mimicking the behaviour of synchronous generators, which is not possible with conventional grid following inverters. As the present-day inverter-based resources control may not be sufficient to ensure grid stability in a future inverter dominated power system, grid-forming inverter control technology has been considered as a potential solution. The concept of grid-forming inverters is currently emerging, which is drawing increased attention from academia and the industry. These inverters play a crucial role in stabilizing the grid and facilitating the smooth integration of intermittent renewable energy into the existing power infrastructure. In region with underdeveloped or weak grids, grid forming inverters can provide an effective solution to maintain grid stability and improve power quality. The application of inverter-based resources to electrical and renewable energy power systems has been an active area of research, has grown predominantly in recent years and has been applied to various areas of power systems where the rapid development and advancement of grid forming inverters can provide powerful tools in many aspects of the power system, including power system planning and design, coordinated control, simulation. The presentation initially deals with the need for this technology due to the substantial annual integration of inverter-based renewable energy resources and the key differences between the traditional grid-following and the emerging grid-forming inverters technologies. Also, this presentation addresses critical issues on the introduction grid grid-forming inverters technologyin power system where the main objective of this presentation is to provide a contemporary look at the current state of the art on the application of grid-forming inverters in renewable power systems. as well as to provide a better understanding of the technologies, potential advantages and research challenges of this approach and provoke interest among the research community to further explore this promising research area

Keynote 5

Energy Efficiency and Energy Savings as key drivers for climate change mitigation

Presented by **Dr. Amel Ferial BOUDJABI**

Abstract:

The world commitments are the foundations for sustained efforts to address climate change mitigation. The purpose is to challenge states, regions, cities, companies, investors and citizens to step up actions in: Energy transition, climate finance and Carbon market, Industry transition, local actions and cities and resilience. In fact, the main challenges of climate change require a global response. All the world reports outline a strategy focused on what to do to capture the economic, social and environmental benefits of enhanced energy efficiency. The last IEA's global analysis of energy efficiency and energy savings has identified the key actions that can deliver the most positive impact, this includes improving the energy efficiency of buildings and industry.It also highlights the importance of other sectors as transport where energy efficiency is becoming increasingly important. Achieving these goals requires urgent actingonthe four climate pillars as defined by the IEA. To meetthe 1,5°C and the net zero carbon emissionstargets by 2050, it is time to accelerate the scenario of decarbonation, energy mix and energy efficiency improvement by tripling the implementation of renewable energy plants beyond 2030, increasing the part of electrical vehicles to 60% , encouraging the renewable energy installations and doubling the gain of energy efficiency to at least 4%. As an example, there is not a credible scenario for the climate change mitigation without a radical change in the building sector which is responsible of more than 40% of the final energy worldwide, while in Algeria, it has reached 47% . Energy savings and sufficiency implies a drastic evolution of individuals and society,indeed , with the important growth of energy prices and economic crisis it has never been more important to use energy more wisely with simple changes in behaviour and habits to consume less for the different energy uses : heating, cooling, cooking and hot water. Investing in more efficient products and equipment can also save energy, contribute to reduce energy bills and environmental footprint as well as other energy efficiency enhancements as insulating materials, bioclimatic and energy recovery or coupling systems, new technologies and smart or AI solutions. Otherwise, the main condition to ensure evolving energy consumption and saving model remains to set up relevant policies and to attract a massive investment to support Energy efficiency and renewable projects.

Keynote 6

Adaptive control for three-phase grid-connected photovoltaic systems

Presented by **Pr. LABIOD Salim**

Abstract:

Solar energy, considered as an abundant and clean renewable resource, has found a wide range of applications. With the increasing integration of photovoltaic (PV) systems into the energy grid, there is a growing demand for reliable and efficient grid-connected PV systems that leverage advancements in power electronics and control technology. As a result, single-stage grid-connected PV systems have garnered significant interest, particularly in low-voltage applications. However, these systems exhibit nonlinear behavior with uncertain parameters due to the inherent characteristics of PV cells and the nonlinear switching functions of inverters. If left unaddressed, the nonlinearity and the uncertainty can adversely affect system performance. In this presentation, we introduce two adaptive control designs to tackle these challenges: a model-free controller and an L1 adaptive controller. These controllers aim to optimize maximum power tracking under varying atmospheric conditions and manage reactive power without the need for additional power converters. Analysis and simulation results demonstrate the effectiveness of these adaptive control schemes, highlighting their potential to enhance PV system performance.

Keynote 7:

Grid-Connected Photovoltaic Systems
An overview of recent research and emerging PV converter technology

Presented by **Pr KRIM Fateh**

Abstract: In the last five years the photovoltaic (PV) energy has grown with an average annual rate of 60%, surpassing one third of the cumulative wind energy installed capacity, is quickly becoming an important part of the energy mix in some regions and power systems. This growth has also lead to the evolution of classic PV power converters from single–phase grid-tied inverters to more complex topologies to increase efficiency, power extraction from the PV modules, and reliability without impacting the cost. This talk presents an overview of the existing PV energy conversion systems, addressing the system configuration of different PV plants and the PV converter topologies that have found practical applications for grid-connected systems. In addition, the recent research and emerging PV converter technology are discussed, highlighting their advantages comparatively to the present technology.

Keynote 8:

Fractional order adaptive control applied in Renewable Energy systems: Promising results and future prospects’

Presented by: **Prof. Samir LADACI**

Abstract:

There is more and more demand of energy in the world with its growing population and developing industry. This fact has considerably increased interest in renewable energy sources for power generation. However, this new kind of energy, unlike fossil one, is generally instable or less regular, as the steady and continuous power output is not available. For example, in solar energy, we have to deal with a varying irradiation over the day. This is a real drawback of this option, because it disturbs the electrical output of the system. In Wind energy also, the wind is a varying phenomena making it difficult to maintain a stable frequency and output voltage for the electrical output. All these problems, express a real need for powerful control solutions, in order to improve the dynamics and performance of the generated energy. Recently, many researchers have proposed fractional order controllers to deals with these fluctuations and uncertainties, as they proved to be more efficient than classical control tools. Fractional order systems, have the ability to modelize more accurately dynamic systems with memory or subject for disturbances and noses. Besides, the fractional order controllers are able to improve the performance of the controlled energy system, while rejecting disturbances and guaranteeing a robust behavior. In this talk, I will focus on fractional adaptive control as an interesting and efficient solution for such problems. I will present two kinds of adaptive control: fractional extremal control, and fractional Model Reference adaptive control to deal with three renewable energy problems:

- Maximum Power Point Tracking Technique for Efficient Photovoltaic based integration of fractional order,
- Fractional-order model reference adaptive control of a multi-source renewable energy system with coupled DC/DC converters power compensation, and
- Fractional-order model reference adaptive control applied to a wind energy system.

These control techniques have been developed by our research team, and works are ongoing towards more proper energy with good quality.

Some future development and perspectives will be presented and discussed to demonstrate the importance and necessity of fractional order control solutions in this field.

2.Abstracts of papers

1. Energy Management of Photovoltaic Systems with Storage

Efficient demand side management for stand-alone DC microgrid using load priority concept

Oualid Djoudi*[1] , Sofia Lalouni Belaid[1] , and Salah Tamalouzt[1]

[1]Laboratoire de Technologie Industrielle et de l'Information (LTII) – Algeria

Abstract

This paper introduces a fuzzy demand-side management (F-DSM) combined with an energy management system to efficiently control power flow in stand-alone DC microgrid based on wind turbines, photovoltaic panels and a battery storage system. The purpose of the proposed F-DSM is to ensure the continuous supply of critical loads during the period of peak consumption. Considering that three types of loads are linked to the DC bus (critical load, priority load and non-essential load), two fuzzy logic controllers are used. Using time of day and battery state of charge as inputs to efficiently connect and disconnect priority and non-essential loads to prevent power interruption of the critical load, when efficiently scheduling the available power at the output of distributed generators. The effectiveness of the proposed control scheme for the stand-alone DC microgrid is evaluated using MATLAB/Simulink. The obtained results show good energy scheduling in the microgrid. A continuous feeding of the critical load is achieved despite the period of peak consumption.

Keywords: Stand, alone DC microgrid, Fuzzy demand side management, Battery storage system, Battery state of charge.

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Fuzzy Logic-Based Smart Solar Systems with Hybrid Energy Storage

Mokrani Zahra*[1], Rekioua Djamila[1], Faika Zaouche , Chafiaa Serir[2], Toufik Rekioua[1], Nabil Mezzai[3], Mourad Zebboudj , and Talit Belhoul

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Abstract

Photovoltaic (PV) systems have become a crucial element in the shift toward renewable energy, converting sunlight into electricity. However, their performance is significantly influenced by external factors such as weather conditions and varying solar radiation, making it difficult to consistently operate at peak efficiency. To address these challenges, maximum power point tracking (MPPT) techniques are employed, which ensure the PV system continuously extracts the highest possible power output. Among these techniques, fuzzy logic-based MPPT has gained prominence due to its ability to handle uncertainties and imprecise data, making it highly effective in real-world environments.

In addition to power maximization, energy storage plays a vital role in stabilizing PV systems. Hybrid energy storage systems (HESS), which combine batteries and supercapacitors, provide a balanced solution to manage energy fluctuations. Batteries offer long-term energy storage, while supercapacitors excel in rapid charge-discharge cycles, addressing short-term power variations. When fuzzy logic is integrated with hybrid storage, it optimizes both power maximization from the PV system and energy management between storage components.

In this paper, the hybrid approach, using fuzzy logic for MPPT alongside a battery-supercapacitor system, enhances overall efficiency and system lifespan, making photovoltaic systems more adaptive, reliable, and efficient in harnessing renewable solar energy. It represents a significant innovation in maximizing the potential of solar power technologies.

Keywords: PV system, Fuzzy logic, Hybrid storage

*Speaker

Study of shading faults in a photovoltaic panel.

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Abstract

This paper deals with the output characteristics of a photovoltaic panel (power variation) in its normal state and then subjected to different defects.
One part is devoted to the modelling of a photovoltaic cell (simplified model of the one-diode model), the parameters as well as the characterisation program has been established under Labview. The influence of shading defect on the power in a photovoltaic panel was studied in the last part by two methods (LabVIEW software and Matlab simulink).
A comparison between the two states (healthy and faulty state) was made to show the behaviour of a photovoltaic panel.

Keywords: Photovoltaic panel model, LabVIEW Software, Data acquisition and influence of mismatch defect and shading.

*Speaker

Overview on Energy Storage Systems for Renewable energy systems

Djamila Rekioua*[1] Zahra Mokrani, Khodir Kakouche, Adel Oubelaid, Saloua Blaid, Toufik Rekioua

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Abstract

The study explores energy storage systems (ESS) tailored for renewable energy systems, addressing the rising demand for low-carbon transportation solutions. ESS has gained significant attention as a crucial element in renewable energy integration. The selection of a suitable technology primarily depends on the system's specific requirements, cost, and performance metrics. ESS technologies for renewable sources are typically categorized by the type of technology they employ. Common types include electrochemical storage (such as batteries, hydrogen fuel cells, and flow batteries), mechanical storage (such as pumped hydroelectric energy storage (PHES), gravity energy storage (GES), compressed air energy storage (CAES), and flywheel energy storage), and electrical storage (including supercapacitor energy storage (SES), superconducting magnetic energy storage (SMES), and thermal energy storage (TES)).
Additionally, hybrid or multi-storage systems that combine different storage technologies, such as pairing batteries with PHES or using a combination of supercapacitors and thermal storage, offer enhanced flexibility. These various storage methods enable the capture and controlled release of surplus energy from renewable sources, ensuring a stable and reliable energy supply. Choosing the most suitable storage technology for specific applications like photovoltaic or wind systems depends on several factors. The system should be thoroughly evaluated by considering energy and power demands, efficiency, cost-effectiveness, scalability, and durability.

Keywords: Storage, Wind Turbine, Photovoltaic, Energy Storage, Multi energy storage

*Speaker

An MPPT algorithm for Photovoltaic Power System based on Particle Swarm Optimization Technique.

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Abstract

The implementation of maximum power point tracking (MPPT) techniques is broadly investigated and employed in Photovoltaic installations to optimize the PV power transmission. These optimization techniques are vital to the operation of PV systems, with various converter models, such as boost, buck-boost and Cuk converters, serving as essential components. As a critical intermediary between the PV panel and the load, the development and application of MPPT circuits are key to optimizing energy transfer. In this study, a boost converter is selected, and control algorithm for the MPPT controller is introduced. The MPPT is based on Particle Swarm Optimization technique (PSO), This method is also compared with an existing popular MPPT algorithm (P&O) to confirm its superior performance through MATLAB simulation.

Keywords: Renewable Energy Source, Photovoltaic (PV), Maximum power point tracking (MPPT), Perturbation and Observation method (P&O), Particle Swarm Optimization.

*Speaker

Survey On Mppt Control Algorithm For Photovoltaic Systems

Syphax Ihammouchen*[1], Ali Chebabhi[2], Djamel Ziane[3], Toufik Rekioua[4], Mourad Zebboudj[5], Zahra Mokrani[5], Chafiaa Serir[1], and Talit Belhoul[6]

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Abstract

This paper presents a comparative survey of four techniques meant to track the maximum power point of photovoltaic systems: the P&O (Perturbation and Observation) method, InC (Incremental Conductance) method, a tracking technique based on backstepping, and a method based on backstepping with integral action. Nevertheless, in steady-state operation, the operating point for the first two approaches (P&O and INC) oscillates around the point of maximum power, resulting in a loss of available energy from the output panel. The simulation results show that the backstepping with integral action method is a viable and promising solution for faster and more stable maximum power tracking than the other methods investigated.

Keywords: Photovoltaic, Mppt, Perturb and Observe, Incremental conductance, Backstepping, Integral, backstepping

*Speaker

ID :07

Development of an Energy Management System for a Standalone Hybrid Solar-Wind-Battery-Diesel Power System

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Abstract

This research presents the development of a power management algorithm tailored for a hybrid energy system that integrates renewable sources (solar and wind), battery storage, and a diesel generator to provide a reliable and stable power supply to remote or off-grid locations. The primary goal is to maximize the use of renewable energy, minimize reliance on the diesel generator, and prolong battery life while ensuring the site's energy demands are consistently met. An MPPT (Maximum Power Point Tracking) algorithm is employed to ensure that the solar panels and wind turbines operate at their maximum efficiency, extracting the most energy possible from renewable sources. Alongside the MPPT, the energy management system oversees the interactions between the various energy components, regulating energy flow in a balanced manner. The system ensures smooth coordination between renewable sources, batteries, and diesel generators, optimizing battery charge and discharge cycles, and reducing diesel use to situations of absolute necessity. Simulations conducted using MATLAB/SIMULINK demonstrate the system's effectiveness, showing that it maintains a continuous power supply even with fluctuating weather conditions. The system optimizes the energy distribution, reduces dependency on the diesel generator, and ensures more efficient energy management. These improvements contribute to enhanced system reliability and lower operational costs, making the hybrid energy system a more sustainable and effective solution for isolated sites.

Keywords: Renewable Resources, Hybrid System, Manegement Algorithm, MPPT.

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ID :08

Design of a control strategy for Photovoltaic generator

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Abstract

This paper presents the design of a control strategy for Hybrid Photovoltaic – Battery Generator for Onboard Automotive Application. The proposed strategy is based on maximum power point tracking (MPPT) controller using adaptive fuzzy logic approach combined with an energy management supervisor in order to ensure system efficiency un der variation of operating conditions: load requirements, meteorological conditions . The developed adaptive MPPT leads to multi-stage fuzzy logic controller according to frequency decomposition approach allowing a good performance with fast time response, zero overshoot and stable/robust operation.
Simulation results are presented to check the theoretical analysis, ensure that the system well operates under difference operating conditions and demonstrate the performance of the proposed control strategy.

Keywords: photovoltaique generator, maximum power point tracking, fuzzy control

*Speaker

Energy management of a Sustainable Hybrid Photovoltaic-Wind Water Pumping System for Rural and Agricultural Applications

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Abstract

Renewable energy sources offer a sustainable and environmentally friendly solution to meet the growing global energy demand. This paper investigates the design and performance of a hybrid photovoltaic (PV) and wind-powered water pumping system, aimed at improving water accessibility and reliability in rural and agricultural regions. By integrating solar and wind energy, the system maximizes energy harnessing across diverse environmental conditions, addressing the intermittency challenges typically faced by individual energy sources. A comprehensive simulation is carried out to evaluate the system's energy efficiency, water output, and operational reliability. The hybrid configuration enhances system stability by ensuring continuous water pumping even during periods of low solar irradiance or weak wind speeds. Additionally, the study examines the incorporation of energy storage solutions and advanced control strategies to further optimize energy management. Results indicate that the PV-wind hybrid system offers a highly promising, sustainable solution for agricultural irrigation and potable water supply, with minimal environmental impact and improved resilience in off-grid applications.

Keywords: Photovoltaic Energy, Wind Energy, Hybrid System, Sizing, Pumping System, MPPT.

*Speaker

Battery charging to constant voltage steps through a photovoltaic source installed on the roof of a house

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Abstract

The development of storage systems plays an important role in promoting renewable energy, these sources suffer from a major problem which lies in their intermittency. In this sense, a renewable source must be equipped with a reliable storage system, which can overcome all the constraints related to both the source itself, the load and the installation environment. The purpose of this article is to study and analyze the performance of a new battery charging method through some photovoltaic generators (installed on the roof of a house) we'll call battery charging constant voltage steps and compared with Constant Current and Constant Voltage (CC/CV) Charging Method, commonly used. Both tests are performed in the first one considers that the PV source is constant and the second one takes an average day southern Algeria. The optimization of the maximum power point is made using a stochastic method called "Particle Swarm Optimization (PSO)"

Keywords: PV generator, lithium, ion batteries, charging, constant voltage, constant current, PSO.

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Green Energy Water Pumping System with Battery Storage

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Abstract

This study presents a comprehensive investigation into a hybrid photovoltaic-wind turbine system integrated with battery storage for water pumping applications. A systematic design methodology was applied to determine the optimal sizing of the photovoltaic and wind turbine components based on the specific requirements of the target location. Field measurements of irradiance, temperature, and wind speed in Bejaia, Algeria, were employed to simulate the system's performance under varying operational scenarios. Experimental validation was conducted to assess the system's efficiency and flow rate capabilities across a range of total dynamic heads (TDH). Comparative analysis between simulated and experimental results demonstrated the feasibility and effectiveness of the proposed hybrid system for small-scale water pumping applications in the region.

Keywords: photovoltaic panels, water pumping, wind turbine, storage.

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Enhancement Energy Management for Electrified Vehicles with Hybrid Energy Storage

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Abstract

Hybrid electric vehicles (HEVs) have arisen as a significant technological innovation in the automobile industry, playing a novel and ecologically beneficial kind of transportation that is gaining popularity around the world. They are powered by electrical generators and provide a clean and sustainable alternative to traditional vehicles that use fossil fuels. Furthermore, HEVs, as symbols of the shift to more sustainable mobility, play an important role in mitigating climate change and safeguarding our planet for future generations. The DTC enables precise and responsive control of the motors by directly adjusting the torque produced, without the need for complex transmission systems. The incorporation of control mechanisms in HEV cars is critical for improving overall performance, efficiency, and safety. Sliding mode control (SMC) holds significant importance when applied to direct torque control (DTC) in electric vehicles. By implementing the SMC technique, the DTC system can enhance its ability to manage torque production of the electric motor, leading to improved performance and increased robustness. The control and energy management of a fuel cell-supercapacitor electric vehicle are the subject of this research. The energy management system employed in this study aims to harness the rapid charging and discharging capabilities of supercapacitors in order to mitigate the strain placed on fuel cells due to sudden power requirements. The HEV is controlled by a sliding mode controller with direct torque control. The simulation findings validate the efficacy of the provided energy management and sliding mode control solutions based on direct control.

Keywords: Hybrid Electric Vehicles, Fuel Cell, Supercapacitor, Direct Torque Control, Sliding mode

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Association of a photovoltaic system with fuel cell modules, combined with a hybrid energy storage system for naval applications

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Abstract

In this paper, a more reliable architecture combined a photovoltaic (PV) system with fuel cell modules associated with hybrid energy storage system for small marine applications is presented. The photovoltaic (PV) system with fuel cell modules are defined as the main hybrid power source; They are associated with the DC microgrid through DC-DC boost converters. On the other hand, the hybrid energy storage system is used as much as a source of fast bi-directional auxiliary power supply. This one consists of a combination of two energy sources; which are battery banks and supercapacitors, each of them is connected to the DC microgrid via a bi-directional DC-DC converter. This combination of energy production sources with the hybrid energy storage system is sized to enable high efficiency operation and minimal weight. In order to keep the DC microgrid voltage constant, to ensure uninterrupted electrical power supply to the boat system and to improve the performance and operation of the proposed system, an energy management algorithm for the entire system is developed. Finally, the simulation tests are presented under Matlab / Simulink and discussed, the effectiveness of the proposed system with its control is confirmed.

Keywords: Hybrid DC Microgrid System, Hybrid Energy Storage System, Battery Banks System, Supercapacitors, Energy Management

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Design of a Proportional Resonant Controller for PV Single-Stage Grid –Tied Inverter

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Abstract

This contribution introduces a current control strategy for a single-phase grid-connected DC/AC inverter utilized in photovoltaic (PV) power conditioning systems. It incorporates a maximum power point tracking (MPPT) algorithm to ensure optimal power extraction, followed by a proportionalintegral (PI) controller to generate the reference current. Additionally, a proportional-resonant (PR) controller is employed to provide an infinite gain at the fundamental frequency, achieving zero steadystate error. The theoretical analysis of the PR controller is discussed and validated through simulations conducted in MATLAB/SIMULINK. The phase-locked loop (PLL) is used for synchronization, enabling accurate phase detection of the grid voltage for effective power injection. An LCL filter is also implemented between the inverter and the grid. Simulation results confirm the effectiveness of the proposed control scheme.

Keywords: PV, MPPT, Controller PR, LCL filter, Lyapunov stability, PLL, Grid, PFC

*Speaker

2. IoT Management Systems For Grid-Connected PV systems

ID :15

Addressing Power Oscillations in PV Systems Under Varying Weather Conditions with an Enhanced P&O MPPT Method

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Abstract

This Study presents an Optimized Perturb and Observe (OP&O) technique designed to enhance the performance of photovoltaic (PV) systems under varying weather conditions. Conventional MPPT methods, such as the standard Perturb and Observe (P&O), often face limitations like power oscillations and reduced tracking accuracy, especially under rapidly changing irradiance levels. The proposed OP&O method optimizes the duty cycle to address these challenges, improving both tracking speed and stability. Simulation results show that the OP&O achieves a high efficiency of 99.98% under such challenging conditions, with a rapid tracking time of 0.02 seconds. Furthermore, the technique demonstrates excellent adaptability in dynamic conditions, reducing oscillations and maintaining accuracy even in mobile PV systems experiencing rapid irradiance fluctuations. These findings highlight the OP&O's potential for improving PV system performance in real-world applications.

Keywords: Photovoltaic systems, Maximum Power Point Tracking, Reducing Oscillations, Power Quality, P&O Algorithm.

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Study and sizing of a photovoltaic power plant with a capacity of 80 MWp

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Abstract

This paper presents a study and sizing for the construction of a photovoltaic power plant with a power of 80 MWp. The implementation of this solution requires a detailed sizing study, and an adequate control of the power plant including all the systems that are installed in it. In this project, a study spotlights a possibility to produce the required energy, fulfil the required specifications which ensures good energy management using SCADA control and at the same time minimize the constraints encountered in conventional electrical energy production systems. The electrical and climatic data and parameters of the region were used to build a control system in order to test and validate the models of the wide variety of equipment.
The approach taken aims to adopt the models that suits the specificity of the power plant.

Keywords: SCADA control, Solar project 2GWp, climatic data, energy management

*Speaker

A Novel Discrete Space Vector Modulation Direct Torque Control Method Applied to Five-Phase Induction Motor for Electric Vehicle Systems

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Abstract

The purpose of this paper is to study the combination of a new discrete space vector modulation with the direct torque control method (SVM-DTC) applied to a five-phase induction motor (FPIM) used in an electric vehicle (EV). The work relies on finding how to remove the alternating current sensors from an FPIM's DTC-SVM. This is accomplished by reconstructing the phase currents using a simple DC current sensor placed at the voltage inverter's (VI) input and modifying the classical DTC-SVM control technique by applying in the switching period Ts, only four non-zero voltage vectors, each vector allows for the measurement of one of the motor's five currents during its application, and developing a new ten active vectors commutation for the reconstruction of the stator currents necessary for estimating the absolute value of the stator flux and the electromagnetic torque of the motor. The results of the simulation of the dynamic behavior obtained make it possible to validate the proposed control approach.

Keywords: Space Vector Modulation Direct Torque Control, Five, Phase Induction Motor, Eelectric Vehicle, Alternating Current Sensor, Direct Current Sensor, Voltage Inverter.

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3. Smart Grid in Isolated Power Systems

Impact of Rotor Faults of Induction Generators on the Performance and Grid Stability in Wind Energy Conversion Systems

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Abstract

This work presents an in-depth study of the impact of rotor faults in an induction generator on the performance of a wind turbine system connected to the power grid. Rotor faults, such as broken bars, constitute a substantial portion of failures in induction machines. These defects can cause serious malfunctions, diminishing the efficiency of wind energy conversion and ultimately compromising the stability of the power grid.

Traditional modeling techniques, such as the Park reference frame, do not adequately capture the dynamics of these faults. Therefore, a Multi-Coupled Circuit Approach (MCCA) is employed to incorporate the rotor fault information into the machine model, enabling more accurate simulation of the generator's faulty behavior. Simulation results vividly demonstrate the detrimental effects of rotor bar breaks on generator performance, and by extension, on grid stability and power quality.

The study of generator faults is essential for wind energy systems connected to the grid, as these systems must ensure reliable, stable, and continuous power generation. If faults go undetected or are poorly managed, they can lead to service disruptions, financial losses, and a decline in the quality of the energy fed into the grid, with potentially serious repercussions for the entire electrical system. A comprehensive understanding and precise modeling of these faults not only enhances predictive maintenance strategies for wind turbines but also facilitates their seamless integration into modern power networks.

Keywords: Wind Conversion System, Induction Generator, Multi, Coupled Circuit Approach

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Advanced Restoration Control for Three-Phase Islanded Microgrids

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Abstract

In recent years, microgrids (MGs) have emerged as key solutions for integrating Distributed Generation (DG) sources, energy storage systems, and controllable loads within low- and medium-voltage networks. These systems primarily rely on renewable energy sources (RESs), such as wind and photovoltaics (PVs), and are designed to operate in both grid-connected and islanded modes. Typically, these MGs are managed using a hierarchical control structure with primary, secondary, and tertiary control levels. The primary control level is tasked with power-sharing among parallel-connected converters while maintaining the power stage's voltage and frequency within desired references. However, during this stage, deviations in key parameters like frequency and amplitude may occur. The secondary control is responsible for correcting these deviations and ensuring proper synchronization with the main grid.
To address this issue, advanced control schemes, such as the SOGI-FLL and its enhanced version ESOGI-FLL, have been proposed due to their effectiveness in rejecting DC offsets and simplicity in implementation. Despite these advancements, there remains a gap in the literature regarding comprehensive tuning methods for the secondary controller's parameters, particularly the PI controllers, which are critical to restoring system stability.
This paper presents a detailed investigation into a secondary control strategy based on the DESOGI-FLL, aimed at enhancing DC offset rejection and improving overall performance in MG applications. By addressing the challenges in parameter tuning and control design, the proposed scheme offers a more robust approach to maintaining system stability.

Keywords: Three, Phase Microgrid, Secondary Control, Restoration, design.

*Speaker

Detection of rotor bar fractures in a self-excited induction generator

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Abstract

Energy production is a major challenge for future generations, who will have to find sustainable solutions to meet the growing needs of the world's population. Promising solutions include the development of renewable energies such as wind power. A wind energy converter consists of several components: a wind turbine, a gearbox, a generator and a load. The generator converts mechanical energy into electrical energy. It is considered one of the key components of the wind power system. However, the generator can experience various electrical or mechanical failures during operation, resulting in production stoppages and the need for maintenance. Regular monitoring of the generator's condition is therefore essential to ensure the durability and efficiency of the wind energy system. In this study, we have focused on detecting rotor bar fracture faults in induction generators. The proposed method is based on signal processing, particularly spectral analysis of the stator current using the Fast Fourier Transform (FFT). This method of early fault detection avoids costly breakdowns and ensures the optimum operation of the electrical generator. Regular monitoring ensures the generator's long-term durability and efficiency.

Keywords: failure, induction generator, detection, selfexcitation, FEM.

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Integration of Renewable Energy Sources in Smart Microgrid for Isolated Areas

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Abstract

This This paper presents a high-performance method for controlling the flow of energy in a smart microgrid (SMG), designed to supply a load in a remote area, far from the power grid. The microgrid consists of a hybrid system combining renewable energy sources, including photovoltaic and wind power, and a battery storage system. The energy management system uses artificial intelligence (AI) techniques, in particular a fuzzy logic controller (FLC). This intelligent system optimizes the management of energy flows within the microgrid, enabling efficient energy extraction despite weather variations, while ensuring adequate energy distribution to meet demand. One of the main advantages of this approach is the precise control of the battery's state of charge (SOC). In contrast to traditional systems, which are limited to two SOC levels (SOCmin-SOCmax), this method divides the SOC into five distinct levels. This enables finer management of energy storage, reducing losses and extending battery life. What's more, this advanced SOC control enables better management of the variability of renewable energy sources, guaranteeing a stable, reliable power supply in areas far from the power grid, regardless of weather conditions. What's more, the system adjusts energy production in real time, balancing supply and demand, which is crucial for maintaining stability in off-grid applications. This method represents a significant advance over conventional energy management strategies, particularly in remote areas where access to the power grid is limited.

Keywords: Smart Microgrid, Photovoltaic, Wind, Artificial Intelligence, Battery.

*Speaker

ID :22

Analysis and Reduction of Multipeak Effects in Photovoltaic Systems Under Environmental Stresses and Electrical Faults

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Abstract

Photovoltaic (PV) systems play a vital role in the shift toward renewable energy but are highly sensitive to environmental conditions and electrical faults. This study explores the occurrence of multipeak phenomena in the power-voltage (P-V) characteristics of PV systems, particularly under line-to-line (LL) faults, line-to-ground (LG) faults, and partial shading conditions (PSC). LG faults are identified as the most severe, causing up to a 50% drop in power output, whereas PSC and LL faults lead to power losses of 32% and 30%, respectively. To mitigate these effects, the Particle Swarm Optimization (PSO) algorithm is applied for Maximum Power Point Tracking (MPPT), showing high precision and fast response times. The implementation of PSO significantly improves PV system efficiency, even in fault-prone or environmentally challenging scenarios.

Keywords: Photovoltaic systems, multipeak phenomena power versus voltage characteristics, line to line faults, line to ground faults, partial shading conditions, Maximum Power Point Tracking, Particle Swarm Optimization

*Speaker

4. Artificial Intelligence Based Renewable Energy Systems

Melanoma Identification Using Convolutional Neural Networks”

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Abstract

Melanoma is considered the most aggressive form of skin cancer and one of the fastest-growing malignancies worldwide. Despite advances in computer-aided diagnostic systems, early detection remains a significant challenge. This study aims to develop a convolutional neural network (CNN) for the early detection of melanoma. By leveraging dermoscopic images from the HAM10K dataset and employing augmentation techniques to address class imbalances, we created a customized CNN architecture specifically designed to capture key features essential for melanoma classification. Additionally, we trained the same dataset using existing CNN architectures such as VGG16 and ResNet18, conducting a comparative analysis. The performance evaluation of our approach revealed promising results. Our custom CNN achieved an accuracy of approximately 93.45%, with precision, recall, and F1 score values of 89.20%, 98.87%, and 93.79%, respectively. The comparative analysis demonstrated that our CNN outperforms VGG16 and ResNet18 in terms of accuracy and sensitivity, providing a robust solution for melanoma classification.

Keywords: Melanoma, skin cancer, convolutional neural network, ResNet18, VGG16, computer, aided diagnosis.

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Convolutional Neural Networks Approach for Skin Lesion Segmentation

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Abstract

Melanoma is one of the most dangerous types of skin cancer if not detected early. The segmentation of skin lesions in dermoscopic images is a crucial task for the implementation of computer-aided diagnosis (CAD) systems. The visual complexity of these lesions, influenced by factors such as skin color variations, artifacts, and low contrast, makes their diagnosis challenging. Over the past decade, the use of deep learning methods, including Convolutional Neural Networks (CNN), has emerged as a promising approach to diagnosing skin lesions and achieving cutting-edge results in various areas of medical imaging . In this paper, we propose a reliable and efficient Convolutional Neural Networks based method for automatic melanoma segmentation. The obtained results will be tested and validated on the PH^2 dermoscopic image database. The goal is to reach a performance threshold with a Dice Coefficient of approximately 93.35%. Notably, the accuracy, sensitivity, specificity, and Jaccard index score targets are set at 96.19%, 95.42%, 96.42%, and 87.61%, respectively.

Keywords: Melanoma, Segmentation, PH^2 database, Convolutional Neural Networks.

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Comparative Analysis of Control Strategies for an Electric Vehicle

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Abstract

With the increasing emphasis on sustainable transportation, efficient current control in an electric vehicle (EV) is essential for optimal powertrain performance and safety, particularly in systems using a permanent magnet synchronous motor (PMSM). This article presents a comprehensive mathematical model of an electric vehicle based on the Newton-Euler formulation. A comparative analysis of two control strategies, passivity-based current control (PBCC) and field-oriented control (FOC), is conducted. PBCC, grounded in passivity principles, is evaluated against FOC in terms of torque dynamics, energy efficiency, and overall performance in PMSM control. The results demonstrate the advantages of PBCC over FOC, highlighting its potential to improve torque regulation and system efficiency. Additionally, the proposed PBCC shows enhanced robustness against system uncertainties and disturbances, which is critical for real-world driving conditions. Simulation results further validate the superior energy-saving potential of PBCC, making it a viable alternative for future EV applications. This work provides insights into how modern control techniques can be leveraged to optimize EV performance and extend battery life.

Keywords: Electric Vehicle (EV), Passivity Based Current Controller (PBCC), Permanent Magnet Synchronous Motor (PMSM), Field Oriented Control (FOC)

*Speaker

Autonomous UAV Navigation for Efficient Inspection of Green Energy Systems

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Abstract

Efficient control is critical for Autonomous Unmanned Aerial Vehicle (UAV) Navigation, especially in complex and dynamic environments like those found in green energy systems. This research investigates the use of a Collective Behavior-Inspired Swarm Algorithm to improve the control of an UAV during the inspection of solar and wind power installations. By addressing the limitations of traditional Proportional-Integral-Derivative (PID) controllers, particularly in parameter tuning for optimal performance, the swarm algorithm is used to fine-tune the PID parameters, leading to enhanced stability and responsiveness. Results demonstrate that the optimized control system significantly improves the UAV's ability to maintain stable flight and precise navigation, even when exposed to external disturbances. This study underscores the potential of collective behavior-inspired algorithms to enhance the efficiency and reliability of UAV inspections in renewable energy applications.

Keywords: Autonomous UAV Navigation, Green Energy Systems Inspection, Collective Behavior, Inspired Swarm Algorithm, PID Controller, Attitude and altitude Stabilization

*Speaker

Demagnetization Fault Detection in PMSGs through Line Current Spectrum Analysis

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Abstract

The sturdy rotor architecture of permanent magnet synchronous machines (PMSM) makes them lightweight, dependable, and efficient, which is particularly beneficial in renewable energy applications like wind turbines. Nevertheless, a number of operating limitations may have an impact on PMSMs, potentially resulting in malfunctions that, if missed, could cause the machine to gradually deteriorate. Permanent magnets made of neodymium, iron, and boron (NdFeB) have a high energy density and are commonly employed in PMSMs. However, due to their sensitivity to temperature and other working conditions, their magnetization gradually becomes irreversibly demagnetized. This paper presents a 2D finite element method (FEM) approach for demagnetization characterization, followed by a defect detection analysis of the machine current signature using the Hilbert transform. Simulations using a mathematical model of a PMSM are used to verify the efficacy of this approach.

Keywords: Permanent Magnet Synchronous Generator, Wind Turbine, Demagnetization, Fault Detection, Finite Element Analysis.

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A Hybrid CNN-Based Approach for Accurate Melanoma Classification

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Abstract

Melanoma is recognized as one of the most aggressive forms of skin cancer, constituting one of the most common rapidly growing malignant tumors worldwide. Although numerous proposals for computer-aided diagnostic systems have been put forward for melanoma, early detection of this skin lesion remains a major challenge. In this article, we present an innovative approach to melanoma classification based on deep learning techniques. Our research aims to develop a computer-aided diagnostic system capable of discriminating between melanocytic skin lesions and non-melanocytic skin lesions in dermoscopic images.
The proposed deep learning model is a hybrid architecture that combines features from the original image extracted by two pretrained architecture models: EfficientNet and DenseNet. This combination of two CNN branches leverages information provided by these two pretrained architectures, thus obtaining a more detailed and discriminative representation of dermoscopic images.
We evaluate the performance of our model using the Human Against Machine (HAM10000) dataset. Due to the imbalance between the two classes, melanoma and non-melanoma, we apply melanoma-specific data augmentation. The model achieves a test accuracy of 94.61

Keywords: EfficientNet, DenseNet, Convolutional Neural Network (CNN), Deep Learnig.

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Transfer Learning for Medical Image Detection Using Deep Learning

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Abstract

Segmentation of skin lesions is a crucial step in computer-assisted melanoma diagnosis. Automatically recognizing skin lesions in dermoscopy images is challenging due to artifacts, as well as the wide variety of textures, colors, and shapes, often with unclear or ambiguous boundaries. In this research, we propose a technique for segmenting two-dimensional medical images based on convolutional neural networks. The encoder utilizes a pre-trained ResNet-50 model, while the decoder is based on the U-Net architecture. We present an efficient strategy for transferring the performance of a two-dimensional classification network trained on natural images to medical image segmentation. This strategy relies on weights derived from noisy student training, rather than the conventional ImageNet training method. obtained results will be tested and validated using the ISIC 2018 Database of dermoscopic images. Our goal is to achieve a Dice Coefficient of approximately 87.98%. Additionally, we aim for accuracy, sensitivity, specificity, and Jaccard index scores of 93.34%, 88.47%, 95.32%, and 78.78%, respectively.

Keywords: Medical image detection, transfer learning, ResNet 50, convolutional neural networks.

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Five-Phase Multilevel Inverter for EV

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Abstract

In the ever-evolving fields of electric traction and power electronics, this research introduces a new five-phase seven-level inverter topology designed to enhance reliability. The proposed five-phase inverter is distinguished by its exceptional ability to generate a seven-level output voltage while reducing the number of switches, utilizing just six IGBTs per phase. This efficient structure minimizes switching losses, reduces size, and lowers installation costs, making it ideal for applications that require improved energy quality and compact design. The impact of this topology extends beyond electric traction, benefiting industries striving for enhanced system performance and greater reliability. The performance of the proposed seven-level inverter, with its reduced number of switches, is used to drive a PMSM in an EV, regulated by field-oriented control in various situations. The results are validated using MATLAB/SIMULINK, highlighting the topology's potential to enhance high-performance power electronics applications. Consequently, this research contributes to the evolution of inverter technology, addressing the growing demand for precise motor control solutions across diverse industries and improving the exploitation of renewable energy.

Keywords: seven level inverter, pulse width modulation PWM, five phase PMSM, EV drive, field, oriented control

*Speaker

A Comparative Study of Model Predictive Control Algorithms for Enhanced Maximum Power Point Tracking in Solar PV Systems

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Abstract

Renewable energy sources are increasingly important in addressing growing energy demands and reducing CO2 emissions. Among these, solar power stands out for its accessibility and simplicity , making it an advantageous solution. However, the effectiveness of solar energy systems can be impacted by fluctuating irradiance levels and ambient temperatures, leading to variations in optimal performance. Therefore, it is crucial to implement effective control methods to enhance output power and maximize efficiency. In this paper, we present a comparative analysis of maximum power point tracking (MPPT) systems based on model predictive control algorithms. These methods are classified as advanced control techniques that exploit the future behavior of photovoltaic systems. The first approach, adaptive generalized predictive control is developed within a comprehensive system that includes a least squares recursive algorithm-based identifier, the predictive controller, the PV module, and the RST polynomials. The second approach, predictive functional control, involves using a discretized model of the system. The main objective is to design predictive control algorithms for photovoltaic generators, allowing them to follow a desired trajectory and maximize power generation. The performance of the photovoltaic systems is investigated through the implementation of the proposed control systems. The simulation results demonstrate the high tracking efficiency of these algorithms, considering external temperature change and potential perturbations

Keywords: Photovoltaic system, Maximum power tracking, Predictive Functional Control, Adaptive Genralized Predictive Control

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Application of Fuzzy Logic Controllers for Enhancing the Performance and Stability of DFIG in Wind Energy Conversion Systems

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Abstract

This paper presents a comprehensive study on the application of Fuzzy Logic Controllers (FLCs) to Doubly-Fed Induction Generators (DFIGs) in Wind Energy Conversion systems (WECS). DFIGs are widely used in modern wind turbines due to their ability to operate efficiently over a range of wind speeds and their grid-friendly features, such as reactive power control and reduced mechanical stress. However, the nonlinear and dynamic behavior of DFIGs under varying wind conditions introduces significant control challenges, particularly in terms of maintaining system stability and optimizing power generation.
One of the key issues in DFIG-based WECS is the parametric variation caused by fluctuations in wind speed and grid conditions. These variations affect the electrical and mechanical parameters of the generator, leading to performance degradation and potential instability. Traditional linear control methods often struggle to cope with these changing dynamics, making advanced control strategies necessary.

In this study, nonlinear control technique, including fuzzy logic controllers (FLCs),is explored as a means of addressing the complex, nonlinear behavior of DFIGs. FLCs, known for their robustness in handling uncertainties and imprecise inputs, offer significant advantages in managing the parametric variations in wind turbines. Unlike conventional controllers, FLCs do not require an exact mathematical model of the system, making them highly effective in environments with unpredictable wind conditions and grid disturbances.
The implementation of FLCs in this context allows for adaptive and flexible control of the DFIG, improving its response to varying wind speeds and grid demands. Simulation results demonstrate that FLCs can enhance system performance by providing smooth power output, improving the quality of energy injected into the grid, and mitigating the adverse effects of parameter changes caused by fluctuating wind conditions. Additionally, the integration of nonlinear control strategies ensures better fault tolerance, reducing the impact of rotor faults and other operational anomalies.

Keywords: Fuzzy Logic Controller (FLC), Doubly Fed Induction Generator (DFIG), Wind Conversion System (WCS)

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Adaptive Metaheuristic APSO-Based MPPT Algorithm for Solar PV Systems Under Different Scenarios

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Abstract

The search for the global maximum power point GMPP is essential to retrieve the maximum power from the photovoltaic (PV) panels. Mainly under partial shading conditions since the photovoltaic (PV) systems are subjected to several local maximum points. In the literature, we find several algorithms which aim to attain the MPP, the classical MPPT methods, designed mainly for a uniform solar radiation such as perturb and observe P&O algorithm, and the metaheuristic MPPT methods, designed to improve the efficiency of the PV system such as particle swarm optimization PSO, or the adaptive MPPT methods such as APSO which combines between both algorithms for better performance. the three techniques were carried out under uniform radiation and partial shading condition comparing them on the following three points: tracking speed, accuracy and performance. Under uniform radiation, the three techniques have reached the MPP and performed well with different accuracy and tracking speed. Under partial shading, The P&O algorithm demonstrates inefficiency in accurately tracking the global maximum power point (GMPP). causing a drastic decrease in the tracking performance estimated in this study at only 65.11% of the PV system. Contrary to the PSO and APSO algorithms which succeeded in tracking the global maximum power with a tracking performance estimated at 98.02%. This paper introduces a simulation study of MPPT under uniform radiation and partial shading conditions using P&O, PSO and APSO methods. The methods are applied on a DC-DC boost converter and the study is achieved via the package software MATLAB/SIMULINK.

Keywords: Global maximum power point GMPP, photovoltaic (PV) panels, partial shading conditions, MPPT methods, P&O algorithm, PSO algorithm, APSO algorithm, duty cycle, DC, DC converter.

*Speaker

AG/FPID Controller to improve the Performances of Aircraft pitch angle System

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Abstract

Fractional calculus, which deals with derivatives and integrals of non-integer order, has seen a resurgence of interest in recent years. It has found applications in various fields such as control theory, signal processing, physics, and engineering. The use of fractional calculus in control theory has led to the development of new control algorithms and methods that offer advantages in dealing with complex and non-linear systems. The current research work presents the use the fractional adaptive PID controller approach optimized by genetic algorithm to improve the performances (rise time, setting time , overshoot and mean absolute error) for Aircraft by introducing fractional order integrator and differentiator in the classical feedback adaptive PID controller. To validate the arguments, effectiveness and performances analysis of the proposed fractional order adaptive PID controller optimized by genetic algorithm have been studied in comparison to the classical adaptive PID controller. Numerical simulation and analysis are presented to verify the best controller. The Fractional order adaptive PID gives the best results in terms of settling time, rise time, overshoot and mean absolute error. This approach can also be generalized to others fractional and integer systems in order to improve their performances and noise rejection.

Keywords: Artificial Intelligence, optimisation, FPID, AG

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Power Quality Improvement in Grid-Connected PV Systems Using a Four-Leg SAPF under Balanced and Unbalanced Conditions.

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Abstract

This study employs a three-phase, two-level inverter with four legs that acts as an active power filter connected in parallel with the perturbing load to analyze power quality and improve it in three-phase, four-wire photovoltaic grid-connected inverters. This study evaluates the effectiveness of the synchronous reference method (SRF), which is based on hysteresis modulation and generates harmonic currents during hysteresis regeneration, with low pass and high pass filters inside the control by the park transform. To enhance the power quality of four-wire grid-connected photovoltaic systems, a three-phase, four-leg, two-level shunt active power filter (SAPF) is utilized. On the other hand, a non-linear load is designed. The performance analysis of two methods, developed using MATLAB/Simulink's SimPowerSystems, is evaluated based on two key criteria: responsive duration and total harmonic distortion (THD) percentage. The study investigates these criteria under both balanced and unbalanced load conditions, with and without variations. The findings indicate that the SRF theory is considerably more dynamic and accurate when high pass filters are used instead of the low pass filters used in the system under study. This suggests that selecting the appropriate pass filters for the SRF control is important to achieving higher power quality outcomes, simulation results in MATLAB Simulink show how well our high pass filter selection improves the system's power quality.

Keywords: Shunt Active Power Filter (SAPF), Total harmonic distortion, non linear load.synchrounous reference frame (SRF)

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Face Detection and recognition system using Deep Learning model

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Abstract

Biometric detection systems, particularly facial recognition technologies, are increasingly used across various sectors due to their effectiveness in authentication and user convenience. These systems involve three main phases: face detection, image processing, and face recognition, using unique physical or behavioral traits for identification. Traditional methods often face challenges in real-world conditions with variations in lighting, pose, and expression. This paper presents a robust face detection and recognition framework that uses the Viola-Jones algorithm for initial detection, followed by a model of deep learning for feature extraction and recognition. Our approach aims to enhance accuracy in recognizing faces from the Face96 database, addressing the complexities introduced by diverse facial variations and environmental conditions. The work contributes to improving facial recognition systems' performance in challenging scenarios. Experimental results show that our proposed system outperformms the recognition face methods.

Keywords: face detection, Viola, Jones algorithm, images processing, deep learning

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Real-Time Implementation of MPPT Control for Boost Power Converter with dSPACE 1104 HardwareTimes

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Abstract

This article explores the role of Maximum Power Point Tracking (MPPT) in optimizing the performance of solar panel systems. It introduces a solution that integrates MPPT algorithms, Through comparisons between Fuzzy logic controller (FLC) and the classical Perturbation and Observation (P&O) algorithm, conducted via detailed simulations and practical experiments, the article highlights the superior performance of FLC across diverse environmental conditions. Furthermore, the practical implementation of these two MPPT methods, throw DSPACE 1104 platform for real-time control, shows their effectiveness in maintaining stable power output, even under weather conditions fluctuating. The obtained results are interesting in PV systems which need rapidity and accuracy

Keywords: Photovoltaic, MPPT, Boost, Control, Real, Time.

*Speaker

Enhancing Wind Energy Conversion Systems via Novel Fuzzy Logic-Based Direct Power Control

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Abstract

This study introduces a new control method for Wind Energy Conversion Systems (WECS) using Doubly-Fed Induction Generators (DFIG): Fuzzy Logic Controller based Direct Power Control (FLC-DPC). This approach aims to overcome the limitations of conventional Direct Power Control (C-DPC) by replacing its switching table and hysteresis regulators. Simulation results demonstrate significant improvements over C-DPC. The new method reduces variations in active and reactive power, lowers Total Harmonic Distortion (THD) in injected currents, and improves overall power quality. By addressing the shortcomings of C-DPC, FLC-DPC offers a more reliable and efficient control approach for wind energy conversion systems.

Keywords: Fuzzy Logic Control, DPC, DFIG, Wind power conversion system, Renewable energy.

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Enhanced DTC for DFIG Wind Turbines Using Fuzzy Logic Control

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Abstract

This paper presents a fuzzy logic 12-sector enhanced direct torque control (FH12-DTC) strategy for doubly-fed induction generator (DFIG) wind turbines. The proposed FH12-DTC method improves on C-DTC by incorporating fuzzy logic in a 12-sector design, reducing torque and flux ripples and enhancing performance. Simulations in MATLAB/Simulink show that FH12-DTC significantly outperforms C-DTC, delivering smoother torque and flux control. This approach highlights how fuzzy control can address the limitations of conventional DTC, offering a more efficient solution for DFIG wind turbines.

Keywords: Wind turbine, DTC, DFIG, Hysteresis, Fuzzy logic control.

*Speaker

Improving DFIG Performance Using Neural Network Control in Wind Energy Systems

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Abstract

This paper introduces a Neural Network-based Direct Power Control (NN-DPC) strategy for Doubly-Fed Induction Generators (DFIG) in Wind Energy Conversion Systems. NN-DPC replaces conventional DPC components with three neural networks, handling active and reactive power control and optimizing rotor voltage selection. Simulations show that NN-DPC improves power quality and reduces power ripples and total harmonic distortion (THD) compared to conventional methods. This approach provides a more efficient and reliable control strategy for DFIG-based wind turbines.

Keywords: Renewable energy, Wind power conversion system, DFIG, DPC, Neural networks.

*Speaker

Energy Management Based-Artificial Neural Network for Multi-sources Renewable Systems.

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Abstract

This research introduces an intelligent energy management system (EMS) designed for an optimized hybrid energy configuration, specifically tailored to meet the energy demands of isolated regions in Algeria. The hybrid system integrates three main renewable energy sources: photovoltaic (PV) panels, wind turbines, and a battery storage unit. These sources work in synergy to ensure a continuous and reliable power supply to meet the dynamic energy demands of the load. The system's architecture is based on a direct current (DC) bus, where the different energy sources are connected through DC/AC converters to facilitate efficient energy distribution and conversion. At the heart of this management system is the implementation of an Artificial Neural Network (ANN) algorithm. The ANN is trained using extensive historical data sets, including climate data such as solar radiation, wind speeds, and temperature, as well as load demand profiles over a one-year period. This allows the system to predict future energy production and consumption trends, optimizing the balance between supply and demand. By learning from seasonal and daily variations in weather conditions, the ANN continuously adjusts energy flow to maintain system stability and maximize efficiency.

The findings demonstrate that the proposed EMS significantly enhances the overall system performance by efficiently managing energy production, storage, and consumption. The intelligent control system not only reduces energy losses but also minimizes reliance on backup systems, leading to cost savings and improved sustainability. The study underscores the importance of diversifying energy sources in hybrid systems and highlights the role of accurate component sizing in ensuring long-term energy security and efficiency.

Keywords: Hybrid renewable energy systems, Photovoltaic, Wind turbine, Battery storage, Energy management system, Artificial Neural Network (ANN), Renewable energy integration.

*Speaker

AI-Driven Prediction of Withstand Voltage in Dielectric Gaps under Non-Uniform Fields in High -Voltage Networks

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Abstract

Understanding the optimal operating conditions of insulating barriers is crucial for their application in industrial settings. Therefore, both numerical and experimental studies of field distribution phenomena and the development of electrical discharges are essential. The main objective of this paper is to analyze the behavior of two configurations, rod-rod and rod-plane, with and without insulating barriers, under the influence of a non-uniform electric field.
Several electro-geometric parameters were considered, such as the severity of site pollution, the distribution of the electric field, the width, position, and number of insulating barriers, the variation in electrode configurations, the type of insulating material used as a barrier, and the inter-electrode distance.

Based on the results obtained from the numerical simulation of the rod-plane model with a barrier, we will apply fuzzy logic techniques to predict the withstand voltage of the configurations used in the numerical model and to estimate the performance of the air gap.

To validate this model, an experimental setup was developed, allowing us to observe the progression of electrical discharges within the specified system.
A comparison between the numerical and experimental results was conducted. The use of fuzzy logic in this study demonstrated strong performance in analyzing the various stages of discharge. A perfect correlation was established between the experimental and numerical studies. Enhanced system performance was achieved through the use of clean, tubular barriers of significant length.

Keywords: insulating barriers, electric field, pollution, electric discharge, fuzzy logic, withstand voltage.

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Intelligent energy management of microgrid system combined with hybrid energy storage system

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Abstract

This paper presents a modeling, control and simulation of a microgrid system associated with a hybrid energy storage system. The microgrid is composed of a WT-DFIG combined with a photovoltaic system, the latter is connected to the DC microgrid, which is itself created between the two converters linking the rotor of the DFIG and the AC grid. The rotor power supply of the wind generator is provided via a three-level inverter. This converter is controlled by a flexible algorithm based on the DTC technique combined with the fuzzy logic technique, called direct reactive power control. The microgrid operates as a hybrid system with two energy storage devices, the first is chemical using a battery bank (BB) and the second is an electrical device represented by a supercapacitor (SC). To better exploit the benefits of this topology, we are led to integrate artificial intelligence techniques based on fuzzy logic, to optimize the operation of the overall system. Thus, intelligent energy management (IEM) is used. The main objective of this contribution is to improve the performance and operation of the proposed system. Indeed, the proposed intelligent energy management is oriented towards the control of active and reactive powers brought into play by the microgrid, as well as the local compensation of reactive energy. This algorithm must also ensure continuity of service, and smoothing of the power at the system output to the AC network. The simulation results presented and analyzed below are carried out using Matlab/Simulink.

Keywords: Hybrid Micro, Grid System, Hybrid Energy Storage System, Intelligent Energy Management System, Fuzzy Logic Control Technique.

*Speaker

Proposed Energy Management Strategy for Fuel Cell Electric Vehicles

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Abstract

In recent years, there has been a growing interest in electrified automotive engineering, driven by the need for cleaner, more efficient transportation solutions. This paper introduces a fuzzy energy management strategy designed for fuel cell electric vehicles. The proposed strategy not only offers multiple driving modes but also ensures the delivery of the appropriate type and quantity of power based on the vehicle's demands. Moreover, it considers the slow transient dynamics of fuel cells, enhancing system responsiveness. Numerical simulations conducted in MATLAB/Simulink demonstrate the effectiveness of the proposed control strategy in optimizing vehicle performance.

Keywords: Hybrid Electric Vehicle, Fuzzy logic control, Fuel Cell, Energy Management Strategy

*Speaker

Control of PMSM for Hybrid Electric Vehicles in the Context of Renewable Energy Systems

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Abstract

This paper presents an intelligent approach to the design and control of a Permanent Magnet Synchronous Machine (PMSM) for hybrid electric vehicle propulsion within the context of renewable energy systems. The study is structured as follows: Intelligent modeling and simulation of the self-regulated PMSM, including integration with renewable energy sources. Development and simulation of an advanced direct torque control (DTC) strategy applied to the PMSM for optimized energy management. Application of the control strategy to hybrid electric vehicles, focusing on energy efficiency in renewable energy environments. The study investigates various transient operating modes, including no-load startup, the application of load torque, speed reversal, and command changes, all within the scope of intelligent energy management. Simulation results show that the proposed control technique delivers high performance, both dynamically and statically, while enhancing energy efficiency in renewable systems.

Keywords: hybrid vehicle, permanent magnet synchronous machine, direct torque control

*Speaker

Intelligent Control Strategy for High-Performance Electric Vehicle PMSMs

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Abstract

In recent years, battery electric vehicles (BEVs) have gained significant attention due to their potential to reduce greenhouse gas emissions and dependence on fossil fuels. However, improving the performance and efficiency of electric vehicle traction systems remains a critical challenge. This article presents an intelligent direct torque control technique based on fuzzy logic. This technique replaces the switching table and hysteresis comparators used in conventional direct torque control (CDTC) with a fuzzy logic controller (FLC). The proposed method is applied to a permanent magnet synchronous motor (PMSM) integrated into an electric vehicle (EV) powered by a Li-ion battery through a DC/DC buck-boost converter. Furthermore, a fuzzy controller replaces the proportional-integral speed controller, addressing the difficulty of its tuning and improving dynamic speed response. To assess the effectiveness of the proposed fuzzy direct torque control technique (FDTC), a customized driving cycle is employed. Simulation results are compared to those obtained with the conventional direct torque control method. These results demonstrate that FDTC significantly reduces torque and flux ripples, as well as the total harmonic distortion (THD) of PMSM current, there by substantially enhancing the performance of the electric vehicle.

Keywords: electric vehicle, permanent magnet synchronous motor, fuzzy logic control, torque and flux ripples, li, ion battery

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End effects impact on characteristics and performance of a Single-Sided linear induction motor

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Abstract

This paper investigates the impact of end effects on the characteristics and performance of a Single-Sided Linear Induction Motor (LIM) for design purposes. The use of LIMs in maglev trains, in contrast to traditional rail systems, often leads to reduced pollution and offers environmental benefits. LIMs, an essential element of maglev technology, enable the levitation and propulsion of trains through electromagnetic principles. Designing an efficient LIM is a complex task, requiring the optimization of various physical and geometric parameters. In this context, electromagnetic modeling is essential, it facilitates the development of equations that predict motor behavior. A 2D mathematical model using the magnetic vector potential A is employed. The model is implemented using the finite element method (FEM) on the open-source platform Gmsh-GetDP, coupled with a circuit model to account for constant voltage supply operation. This study, both numerical and analytical, aims to highlight the influence of end effects on various parameters affecting the LIM's characteristics and performance. Additionally, a parametric study is conducted to optimize the machine's operation for a given set of specifications. Improving performance is achieved by minimizing end effects and reducing the influence of higher-order harmonics. Overall, choosing these parameters is crucial to achieving the desired performances of the machine. Proper consideration of this parameter can help design LIMs that meet specific requirements for various applications. Therefore, engineers and researchers should carefully evaluate different parameters of construction LIM and their impact on machine performance to optimize the design and maximize efficiency.

Keywords: linear induction motor, end effects, numerical and analytical models, maglev

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A Systematic Investigation of Metaheuristic-Based Maximum Power Point Tracking for Photovoltaic Systems under partial shading condition

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Abstract

As a consequence of creating several high points in the power-voltage trajectory, partial shadowing condition (PSC) has a significant impact on efficiency in photovoltaic (PV) systems, leading to subpar power extraction. In such cases, traditional maximum power point tracking (MPPT) methods, such as perturb and observe (P&O), often misidentify the global maximum. Particle swarm optimization (PSO), adaptive PSO (APSO), and grey wolf optimization (GWO) are a few examples of the improved metaheuristic algorithms that have been developed to address these difficulties. These algorithms have enhanced capabilities in determining the global maximum. This study provides a comprehensive analysis of these enhanced metaheuristic methods for optimizing MPPT efficiency in PV systems affected by PS, which necessitates a big database. Extensive simulations show that the proposed methods outperform current methods in terms of tracking accuracy and overall system efficiency. In complex shading situations, the results highlight the clear benefits of metaheuristic techniques to boosting energy output and improving the longevity of PV systems.

Keywords: PV system, partial shading, maximum power point tracking, particle swarm optimization, grey wolf optimization, adaptive particle swarm optimization.

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Advanced MPPT Control in PV Systems Through ANFIS Method for Handling Non-Uniform Solar Irradiation

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Abstract

The use of photovoltaic (PV) systems and other renewable energy sources (RES) is crucial for achieving sustainable energy development. Using maximum power point tracking (MPPT) techniques is critical for PV systems to operate at their MPP irrespective of external conditions, which is essential for maximizing efficiency. The maximum power point tracking (MPPT) controller for a freestanding photovoltaic (PV) system was developed and deployed in this article. The controller is called an ANFIS. Here we compare the proposed ANFIS controller to a popular MPPT technique, the conventional perturb and observe (P&O) approach. The ANFIS controller dynamically adjusts to changes in temperature and solar irradiation, making it the most efficient system controller in terms of convergence speed, accuracy, and overall performance. The ANFIS controller outperforms the P&O method in standalone PV systems, according to both theoretical and practical evaluations. This work adds to the existing literature on PV system optimized operations, bringing us closer to more efficient and reliable RES.

Keywords: renewable energy sources, maximum power point tracking, adaptive neuron fuzzy inference system, perturb and observe, Standalone photovoltaic (PV) system.

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Improvement of Grid-Connected PV System Performance with a Hybrid ANNs-FLC

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Abstract

Recent advances in this field have enabled the creation of cutting-edge three-phase grid-tied photovoltaic (PV) systems that use ANNs and fuzzy logic controllers to execute a smart maximum power point tracking (MPPT) algorithm. difficulties like climate-induced mismatching difficulties, which may have a large effect on PV array performance, are the motivation for the recommended hybrid MPPT technique. By adapting to varying levels of solar radiation, Hybrid ANNs-FLC technology more precisely and efficiently determines the maximum power point (MPP) than the conventional Incremental Conductance (IC) MPPT method. The correct operation of grid-tied inverters depends on determining the optimal DC bus voltage reference, which is accomplished using both MPPT approaches. Optimal power generation, grid regulation of active power, and reactive power reduction are all possible with the proposed MPPT approach. Extensive simulations conducted using MATLAB/Simulink software thoroughly evaluate the system's effectiveness, dependability, and feasibility, revealing its potential for efficient energy transformation and strong grid integration in actual applications.

Keywords: PV systems, maximum power point tracking, artificial neural networks, fuzzy logic controller, incremental conductance, grid, tied photovoltaic (PV) systems.

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Optimized MPPT for PV Systems with Flower Pollination Algorithm under Partial and Dynamic Shading Conditions

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Abstract

Solar energy is one of the most extensively utilized renewable energy sources. However, achieving optimal solar energy capture in photovoltaic (PV) systems poses a significant challenge due to varying weather conditions. This challenge becomes even more critical for PV systems seeking to optimize power output through Maximum Power Point Tracking (MPPT), especially under partial shading conditions (PSCs). PSCs cause multiple peaks to appear on the P-V curve of PV arrays, known as Local Maximum Power Points (LMPPs), with one Global Maximum Power Point (GMPP). To ensure maximum energy capture and avoid being trapped at local peaks, advanced MPPT algorithms are required. This paper presents a novel MPPT approach based on the Flower Pollination Algorithm (FAP), designed specifically for partial shading conditions. The proposed MPPT method was tested under non-uniform conditions, and a comparative analysis with the conventional PSO algorithm was carried out. The simulation results, performed using Matlab/Simulink, highlight the superior efficiency and precision of the FAP algorithm in tracking the GMPP, even in the presence of partial shading conditions (PSCs) and dynamic shaiding conditions (DSCs).

Keywords: Flower Pollination Algorithm (FAP), MPPT, PSCs, DSCs, GMPP, LMPPs, PV System.

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Evaluating Fault Detection in Photovoltaic Systems: A Study of ANN, KNN, SVM, DT, and DF

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Abstract

A comparative study is presented in this paper, focusing on various machine learning algorithms for fault detection and diagnosis in photovoltaic (PV) systems. The performance of Artificial Neural Networks (ANN), K-Nearest Neighbors (KNN), Support Vector Machines (SVM), Decision Trees (DT), and Decision Forests (DF) is evaluated using a dataset consisting of seven classes, which includes a healthy state and five distinct faults: short circuits of three modules, ten modules, string disconnection, and strings with 25%, 50%, and 75% partial shading. The dataset is characterized by two critical features: the maximum power current (Impp) and the maximum power voltage (Vmpp). Four performance metrics-accuracy, precision, recall, and F1-score-are employed to assess the effectiveness of each algorithm. The results highlight the strengths and weaknesses of each approach, providing valuable insights for the selection of appropriate algorithms in the field of PV system diagnostics.

Keywords: Fault detection and diagnosis, Photovoltaic systems, Machine learning, Comparative study, Fault classification

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Parameter Extraction of Photovoltaic Cells Using One to One Based Optimizer

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Abstract

This paper presents a study on the extraction of parameters from photovoltaic (PV) cells using a metaheuristic algorithm known as One to One Based Optimizer (OOBO). The single diode model is employed to extract five critical parameters that define the performance of the PV cell. The algorithm demonstrates low error rates, indicating high accuracy in parameter extraction. Two distinct methods are utilized to evaluate the performance of OOBO. The first method involves comparing the estimated I-V and P-V characteristics, derived from the five extracted parameters, with their measured counterparts. The second method compares the estimated current, voltage, and power at the maximum power point (MPP) with the measured values at the MPP. Both comparison methods highlight the accuracy of the OOBO algorithm, confirming its effectiveness in parameter extraction for PV cells.

Keywords: Photovoltaic cells, One to One Based Optimizer, Parameter extraction, Single diode model, Metaheuristic algorithm, Optimization.

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Lyrebird Optimization Algorithm: A Precise Approach for Photovoltaic Cell Parameter Extraction

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Abstract

This study explores the application of the Lyrebird Optimization Algorithm (LOA) for extracting parameters from photovoltaic (PV) cells. Using a single diode model, the LOA extracts five crucial parameters that define PV cell performance. The algorithm's effectiveness is evaluated through two methods: comparing estimated I-V and P-V characteristics with measured data, and comparing estimated current, voltage, and power at the maximum power point (MPP) with measured values. Both evaluation methods confirm the LOA's high accuracy in parameter extraction, demonstrating low error rates. This research highlights the potential of the LOA as an efficient metaheuristic algorithm for optimizing PV cell performance through accurate parameter extraction.

Keywords: Lyrebird Optimization Algorithm (LOA), Photovoltaic (PV) cells, Parameter extraction, Single diode model, IV and PV characteristics, Optimization.

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Enhancing the Performance of Grid-Connected Photovoltaic Systems: A Solution Provided by Series Z-Source Inverter Controlled by SVM Technique

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Abstract

This paper presents a photovoltaic (PV) system connected to the grid through a series Z-source inverter, a variant of the Z-source inverter, proposed to boost the output voltage inverter, without the need for separate DC-DC-AC conversion stages. Control strategy of the series Z-source inverter is based on a slight modification of space vector modulation (SVM) technique that incorporates shoot-through states in the control of the inverter stage. Additionally, maximum power point tracking (MPPT) with voltage oriented control (VOC) techniques are used to maximize the extracted power from the PV and to improve the quality of injected power into the grid respectively. Simulations results illustrate the effectiveness of this approach under varying environmental conditions. The proposed system offers a promising solution for integrating renewable energy sources into the grid, ensuring both performance and reliability.

Keywords: Z source inverter, Space Vector Modulation, MPPT, Photovoltaic system

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Performance Analysis of Five-Phase AC/DC Converters for Renewable Energy Applications Based on Space Vector Modulation

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Abstract

Multiphase systems have become an attractive solution for high power applications due to their ability to increase energy efficiency and enhance reliability. This is thanks to advances in power electronics, which have greatly contributed to the more efficient integration of these types of systems, making them feasible and high-performing, particularly through the use of multiphase converters and their appropriate modulation strategy. This paper aims to study a five-phase AC/DC converter controlled by the Space Vector Modulation (SVM) technique, dedicated to applications in the field of renewable energy. Following a mathematical analysis, the global system is simulated in the Matlab environment. The proposed space vector modulation demonstrates that a suitable use of both large and small current vectors improves the input current waveforms of the five-phase AC/DC converter.

Keywords: power converter, AC/DC converter, space vector modulation, multiphase system

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Comparing the Effectiveness of Classical P&O and GWO-based -MPPTs Algorithms for PV Systems under partial shading conditions.

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Abstract

Solar power generation is a highly advantageous alternative to conventional energy sources owing to its extensive availability and ecological sustainability. Despite its availability and sustainability, solar power generation encounters several challenges. One of the key difficulties faced by photovoltaic (PV) systems is maximizing power extraction from the PV array, especially during instances of partial shading conditions (PSCs). This is where Maximum Power Point Tracking (MPPT) approaches come into play to address this challenge. This paper aims to conduct a comparative analysis of classical perturb & observe (P&O) and Grey Wolf Optimizer (GWO)-based MPPT based on crucial factors such as convergence speed, robustness in dynamic environments, and tracking efficacy. The comparative results are verified via MATLAB/SIMULINK software. The simulation results demonstrate that the GWO algorithm offers superior tracking performance and adaptability to reach the global maximum power point (GMPP) compared to the traditional P&O method, particularly in fluctuating weather conditions. The comparison of classical and optimization-based approaches shows that GWO has less steady-state oscillation in MPP compared to the P&O method

Keywords: MPPT, PV generator, P&O, GWO, BOOST converter, PSC.

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Comparison between MPPTs for PV system using Sliding mode control and Grey wolf optimization

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Abstract

Photovoltaic systems are among the most prominent sustainable solutions for the generation of electrical power. however, their efficacy is significantly impacted by the intermittent nature of the energy they generate. This intermittent energy is a consequence of nonlinear changes that arise from fluctuations in solar irradiance. Consequently, an efficient algorithm must be used to track the Maximum Power Point (MPP) under a variety of irradiance conditions. This paper provides a comparison of the Sliding Mode Control (SMC) algorithm and the Grey Wolf Optimization (GWO) algorithm in terms of tracking efficiency and stabilization time in three distinct scenarios (uniform solar radiation, partial shading, and dynamic shading). Additionally, it provides a study of photovoltaic systems. MATLAB/SIMULINK simulation results indicate that the SMC algorithm functions effectively under circumstances of uniform solar irradiation. Nevertheless, complications occur when confronted with more intricate situations, such as dynamic shading or partial shading. In these scenarios, the results reveal the superiority of the GWO algorithm in tracking the MPP. This superiority is demonstrated by the GWO algorithm's high adaptability to sudden changes in irradiance conditions, allowing it to respond faster and more accurately compared to the SMC algorithm in these varying conditions.

Keywords: Photovoltaic system, Sliding mode control, Grey wolf optimization, Maximum power point, Partial shading, Dynamic shading.

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ID 59

Integrating AI for Sustainable Energy Solutions in Architectural Design

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Abstract:

In order to increase building sustainability and energy efficiency, artificial intelligence (AI) integration with renewable energy systems is starting to take off in the architectural community. Because AI technologies improve prediction accuracy for energy generation, they are being used more and more to enhance the performance of renewable energy sources, such wind and solar power. Artificial intelligence (AI)-powered models anticipate energy production by analyzing past data and environmental variables. This enables systems to dynamically adapt to changing conditions.

AI also helps energy storage devices operate more efficiently by managing battery charge and discharge cycles better. In order to ensure effective energy storage and lower energy losses in architectural applications, AI algorithms forecast energy demand and consumption. This is especially useful in microgrids and smart buildings, where artificial intelligence (AI) systems manage and balance energy storage, supply, and demand in real-time.

AI-driven technologies like Cove.Tool, EnergyPlus, and machine learning frameworks like TensorFlow are used in architectural design to model and optimize energy systems. With the aid of these technologies, engineers and architects can create structures that are more energy-efficient overall and make the most use of renewable energy sources. The implementation of AI in renewable energy systems thus presents considerable prospects to enhance the sustainability of the built environment, harmonizing with global initiatives toward energy transition and the reduction of carbon emissions.

This academic study adds to the current conversation on how artificial intelligence (AI) may advance renewable energy systems in architecture by highlighting how AI can spur innovation in sustainable building design.

ID 60

Remote monitoring and control of the different parameters of the photovoltaic installation

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Abstract— Photovoltaic installations continue to increase in the world, however, they need to be monitored to verify their proper functioning, detect possible failures or for better energy management. This is the purpose of the supervision or monitoring operation This work involves designing and implementing a real-time remote monitoring system for meteorological and electrical parameters of a photovoltaic station using a Raspberry Pi board. The supervision and monitoring of our system involve measuring temperature, illumination, and electrical quantities using voltage and current sensors. Subsequently, displaying the results on the Ubidots interface allows for tracking and monitoring the variation of these parameters and reacting in case of danger. Practical tests conducted on the developed system have demonstrated the reliability of the data acquisition system and its capability to be used for PV system monitoring

Keywords: Monitoring, Photovoltaic installations, Raspberry Pi, Iot, supervision, data acquisition.

ID 61

Modeling and simulation of photovoltaic systems using maximum power point tracking techniques

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Abstract— solar energy, harnessed from the sun's rays, is a sustainable and abundant energy source that contributes to the transition to renewable energy and reduces reliance on fossil fuels. It is used in various technologies, including photovoltaic (PV) systems. Maximum Power Point Tracking (MPPT) is a technology in photovoltaic systems that optimizes power extraction from solar panels, It works by understanding the IV curve, where the maximum power output is located, and tracking the MPP using algorithms that continuously measure voltage and current, It uses algorithms like Perturb and Observe, Incremental Conductance, Constant Voltage, Particle Swarm Optimization, and Fuzzy Logic Control. Despite challenges, MPPT remains crucial in modern solar energy systems. Benefits of MPPT include increased efficiency, better performance in fluctuating conditions, and improved ROI. The study compares the Perturb and Observe (P&O), Incremental Conductance (INC), and Particle Swarm Optimization (PSO) methods for Maximum Power Point Tracking (MPPT) in photovoltaic systems. P&O adjusts the operating point by perturbing voltage and observing power changes, offering simplicity and minimal computational resources. INC uses incremental changes in voltage and current for more accurate MPP, but requires more computations. PSO, a heuristic optimization algorithm, mimics bird social behavior and can handle complex optimization problems but requires careful parameter tuning. The system includes a photovoltaic panel (PV) and a DC-DC converter, which serves as the adjustment stage. Modeling and simulation of PV system was developed using MATLAB/Simulink.

Keywords: Maximum power point tracking, DC-DC boost transformer, Perturb and Observe (P&O), Incremental Conductance (INC), Particle Swarm Optimization (PSO).

ID 62

CONTROL OF A GRID-CONNECTED PHOTOVOLTAIC SYSTEM USING ARTIFICIAL NEURAL NETWORK

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Abstract—This paper investigates the use of Artificial Neural Networks (ANN) for Maximum Power Point Tracking (MPPT) control in grid-connected photovoltaic (PV) systems. MPPT is critical for optimizing the energy yield of solar panels, which are subject to fluctuations due to environmental factors such as sunlight intensity and temperature. Traditional MPPT techniques, while effective, often exhibit limitations in dynamic conditions, leading to inefficiencies in power extraction. The proposed ANN-based MPPT control framework advantages historical and real-time data-including voltage, current, temperature, and solar irradiance to accurately predict the maximum power point. By training the neural network on extensive datasets, the system demonstrates enhanced adaptability to changing conditions, thus improving the speed and accuracy of power tracking. Simulation results indicate that the ANN-based approach significantly outperforms conventional MPPT methods, achieving higher energy conversion efficiencies and more stable performance in grid-connected scenarios. This study underscores the potential of integrating machine-learning techniques into MPPT strategies for PV systems, highlighting their ability to optimize energy output and enhance the reliability of renewable energy sources in grid applications. The findings contribute to the ongoing development of intelligent solar energy systems that can effectively support grid stability and sustainability.

Keywords: Maximum power point tracking, Artificial neural network control, ANN-based MPPT control, DC-DC boost transformer, PV grid-connected, DC-AC inverter.

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Adaptive Metaheuristic APSO-Based MPPT Algorithm for Solar PV Systems Under Different Scenarios

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***Abstract*—**The search for the global maximum power point GMPP is essential to retrieve the maximum power from the photovoltaic (PV) panels. Mainly under partial shading conditions since the photovoltaic (PV) systems are subjected to several local maximum points. In the literature, we find several algorithms which aim to attain the MPP, the classical MPPT methods, designed mainly for a uniform solar radiation such as perturb and observe P&O algorithm, and the metaheuristic MPPT methods, designed to improve the efficiency of the PV system such as particle swarm optimization PSO, or the adaptive MPPT methods such as APSO which combines between both algorithms for better performance. the three techniques were carried out under uniform radiation and partial shading condition comparing them on the following three points: tracking speed, accuracy and performance. Under uniform radiation, the three techniques have reached the MPP and performed well with different accuracy and tracking speed. Under partial shading, The P&O algorithm demonstrates inefficiency in accurately tracking the global maximum power point (GMPP). causing a drastic decrease in the tracking performance estimated in this study at only 65.11% of the PV system. Contrary to the PSO and APSO algorithms which succeeded in tracking the global maximum power with a tracking performance estimated at 98.02%. This paper introduces a simulation study of MPPT under uniform radiation and partial shading conditions using P&O, PSO and APSO methods. The methods are applied on a DC-DC boost converter and the study is achieved via the package software MATLAB/SIMULINK.

Keywords—Global maximum power point GMPP, photovoltaic (PV) panels, partial shading conditions, MPPT methods, P&O algorithm, PSO algorithm, APSO algorithm, duty cycle, DC-DC converter.

ID 64

Power sharing improvement in an islanded microgrid using inverse droop control strategy based on virtual complex impedance.

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***Abstract*— This paper proposes a virtual complex impedance-based inverse droop control strategy (VCI-IDCS) to enhance the performance of voltage source inverter (VSI)-based distributed generation (DG) units in an islanded microgrid (IMG) with mismatched line impedances. The method aims to improve power sharing, energy management, decoupling, and oscillation reduction while eliminating circulating currents using a decentralized approach. While the traditional droop control method (TDCM) performs well in ideal IMGs, its effectiveness diminishes under line impedance mismatches. Our proposed VCI-DCM addresses these challenges for three VSI-based DG units in an IMG. MATLAB/Simulink simulations validate the performance of the VCI-DCS. Results demonstrate significant improvements in IMG control, including equal active and reactive power sharing with minimal oscillations, elimination of reactive power errors among DG units, mitigation of circulating currents. These outcomes showcase the proposed method's ability to enhance overall IMG performance under line impedance mismatches.**

Keywords: **Islanded microgrid (IMG), Inverse droop control strategy (IDCS), Virtual complex impedance (VCI), Power sharing.**

Use of the cos-sin wave and DC bus voltage parameters of the photovoltaic system for power supply and regulation of the parallel active power filter.

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Abstract— **The quality of energy is directly affected by the distortion of one or more factors such as electric currents, voltages, powers and frequencies, these deviations cause malfunctions and even in certain cases the destruction of electrical equipment.**

Keywords: **shunt active power filter (SAPF), total harmonic distortion (THD), power quality, photovoltaic energy generator. c**

Optimized DTC Control Using Fuzzy Logic for a SEIG Supplying an Autonomous Load

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***Abstract*—This study aims to enhance the accuracy of direct torque control (DTC) applied to regulate the terminal voltage of a self-excited induction generator (SEIG)-based wind power system that supplies an autonomous load. A fuzzy logic controller is proposed to improve the performance of both conventional DTC, thereby reducing torque and flux ripples in the SEIG. Two control strategies are implemented: The first one: The flux is maintained at a constant level, while in the second: The flux varies with the wind speed. The proposed control strategy seeks to maintain a consistent DC bus voltage despite variations in load and wind speed. By adjusting the torque based on the wind speed, the system can be effectively regulated. Additionally, the study accounts for the impact of magnetic saturation in the materials, and the dynamic model is analyzed in the (α β) reference frame using the concordia transformation. The proposed system's effectiveness is validated through simulation tests conducted in MATLAB/Simulink.**

Keywords: **Induction Generator, Saturation, Autonomous, DTC control, Fuzzy Logic.**

Neural Network based MPPT controller for standalone PV system conversion

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***Abstract*— This paper presents an MPPT controller based on a Neural Network technique (NN) for maximum energy harvesting from a standalone PhotoVoltaic (PV) system under varying conditions. This approach uses Equilibrium Optimizer (EO) algorithm to tune the NN parameters in order to overcome the usual weaknesses of conventional MPPT techniques and avoid the difficulties associated with the use of classical learning algorithms. The aim of this combination (NN-EO) is to achieve high accuracy and efficiency in Maximum Power Point tracking (MPPT). This work is motivated by the learning potential of the neural networks and their ability to generalize acquired knowledge. The proposal is compared with conventional technique in the literature, and the obtained results prove its effectiveness and promising potential. The work is developed with MatLab/Simulink environment.**

***Keywords:* MPPT Control; smart grid; Neural Network; Automatic learning; Optimization, EO Algorithm; Accuracy- Complexity Trade-off.**

MLP Neural Network based Multiobjective Tuning for MPPT Control of standalone PV System

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***Abstract*— This paper presents a multiobjective strategy to tune a Neural Network (NN) for a Maximum Power Point Tracking (MPPT) for a standalone PhotoVoltaic (PV) system operating under dynamic conditions. This approach is motivated by the learning capabilities of NN and their strong generalization properties. By employing multiobjective algorithm, the proposal effectively addresses multiple conflicting objectives, optimizing both of energy yield of the PV conversion system and the computational complexity of the control unit. The approach is developed with MatLab/Simulink environment and the obtained results in addition to the comparative study with adjusted P&O technique demonstrate the effectiveness and significant potential of the proposal for improving PV system performance.**

***Keywords:* MPPT Control, smart grid, Neural Network, Automatic learning, Multiobjective Optimization.**

ID 69

Real-time Simulation Of Optimal Differential Flatness Based Energy Management Strategy For Electric Vehicle Applications.

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***Abstract*— The proposal combines optimal energy management for electric vehicles via slap swarm optimization and differential flatness control. A battery-supercapacitor power system isutilized. A synchronous reluctance motor (SynRM) drive gets power from DC-DC bidirectional converters that connect each source in parallel to the DC bus. The suggested EMS basic forces utilize a combination of the complementing properties of two methodologies: the Slap Swarm Optimization Algorithm and Differential Flatness (DF). The Slap Swarm optimization algorithm employs a rapid optimization process to adapt the DF gains in real-time, hence enhancing system performance. DF employs predetermined trajectories that adhere to the system's physical properties, serving as an effective mechanism to ensure the dynamic restrictions of the sources while achieving the necessary robust control characteristics. A lot of hardware-in- the-loop (HIL) real-time simulations of the electric vehicle were run using the OPAL-RT OP4510 simulator to test the proposed EMS's viability and performance. The main goal of the suggestedEMS is to keep the DC-bus stable by reducing the DC-bus voltage changes ($\Delta v = 5$ V) and voltage overshoots to 15 V (3.2%), while still meeting the SynRM motor's power needs. Moreover, the technique reduces induced harmonics from the drive (10.49%), decreasing the battery current ripple by 17.15A and thus improving the battery's lifespan.**

***Keywords:* Energy Management Strategy, online optimization, real time simulatio**