Titles & Abstract

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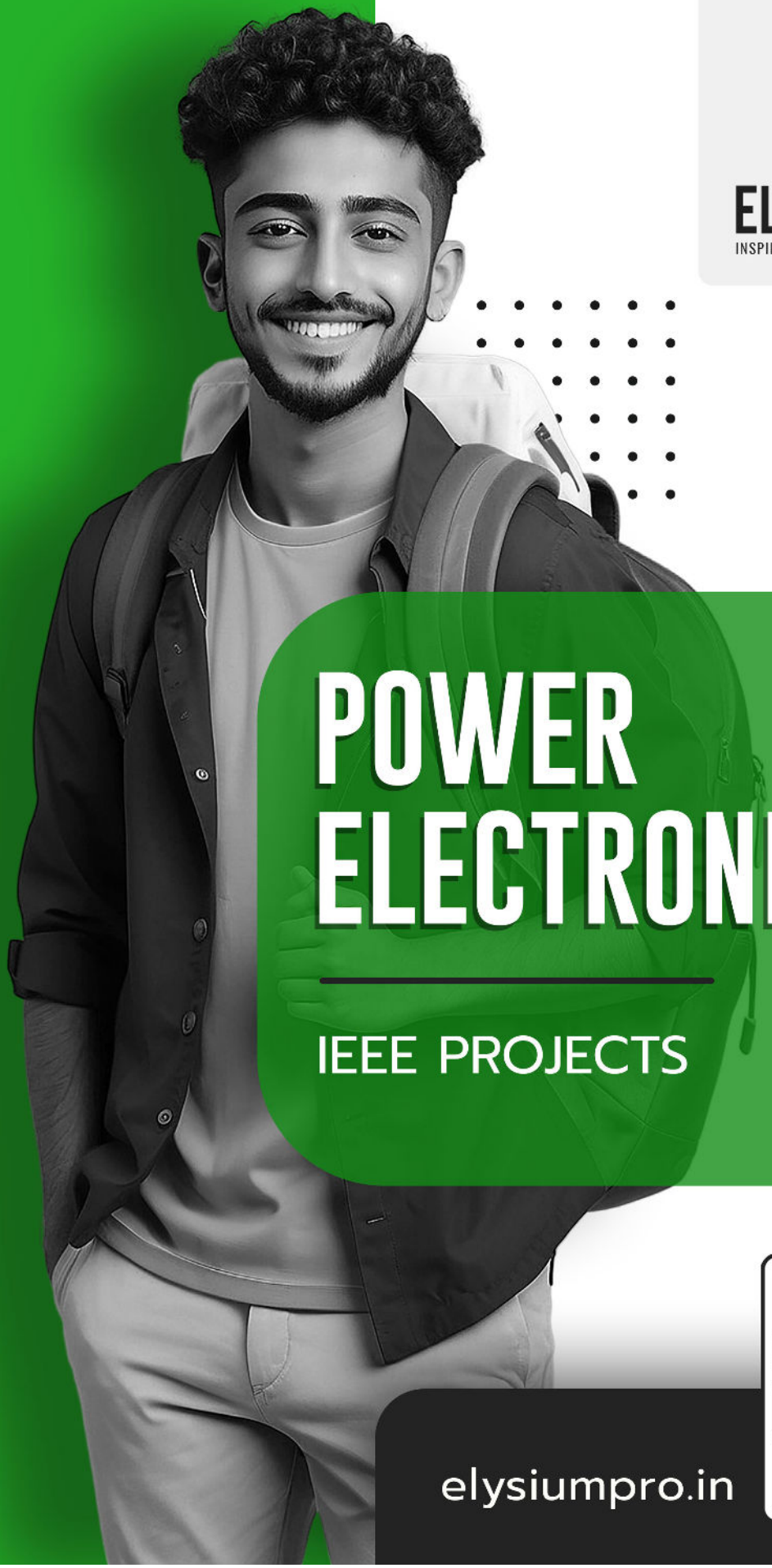

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EPRO-PE-001

Data-Driven Low-Complexity Detection in Grant-Free NOMA for IoT

This article proposes a low-complexity data-driven multiuser detector for grant-free nonorthogonal multiple access (GF-NOMA), which has gained significant interest in Internet of Things (IoT). IoT traffic is predominantly sporadic, where devices become active whenever they have data to transmit. The conventional grant-access procedure for requesting a transmission slot every time results in significant signaling overhead and latency. In power domain GF-NOMA, multiple devices can be preallocated the same channel resource, but different power levels. Whenever a device has data, it starts transmission directly using the allocated power level without any grant request. While this significantly reduces the signaling overhead, the access point has to perform the complex task of identifying the active devices and decoding their data. Conventional receivers for power domain NOMA fail in such GF scenarios and the typical solution is to limit transmissions to be packet-synchronized and add carefully chosen pilots in every packet to facilitate activity detection. However, in fairly static IoT networks with low-complexity devices and small packet sizes, this represents a significant overhead and reduces efficiency. In this work we solve the GF-NOMA detection problem without these constraints,

EPRO-PE-002

Asymmetric SVPWM and Error Suppression Method for Current Reconstruction of T-type Three-Level Inverter

Accurate monitoring and control of T-type three-level inverters (TThLIs) depend on precise phase current measurements. However, traditional methods like Space Vector Pulse Width Modulation (SVPWM) can create blind spots in current data (called unobservable areas, UAs) and inaccuracies due to zero-point drift (ZPD). To address these issues, we've developed a new method called Asymmetric SVPWM and Error Suppression (APES). APES works in two steps:Asymmetric SVPWM: It adjusts the pulse signals to ensure sufficient time for accurate current measurements, eliminating UAs. Error Suppression: It uses a dynamic technique to identify and correct ZPD errors in current readings

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EPRO-PE-003

An Energy Based Model of Four Switch BuckBoost Converter

The four-switch buck–boost (FSBB) topology is widely used alongside isolated converters to enhance voltage range capabilities. In these applications, independent control of the duty-cycles of the FSBB's two legs and phase shifting are employed to shape the inductor current ripple, enabling zero voltage switching. This presentation introduces a novel nonlinear average model and its corresponding linearized small-signal model for the FSBB, accounting for the dynamics of phase shift and duty-cycles. The inductor energy-based approach accurately describes these dynamics. The proposed models demonstrate excellent alignment with simulation results and are validated through experimental measurements.

EPRO-PE-004

A Review of Broadband Frequency Techniques for Insulation Monitoring and Diagnosis in Rotating Electrical Machines

Rotating electrical machines greatly suffer from insulation degradation and failure. The adoption of wide bandgap semiconductors in Variable-Frequency Drives (VFDs) hinder the utilization of traditional techniques such as on-line Partial
Discharges (PD) to monitor and diagnose the insulation status and failure. Alternative techniques exploiting the broadband frequency behaviour of machine windings, and the increased high-frequency content of VFD excitation arise as a valid alternative. The present work provides a comprehensive analysis and review of cutting-edge broadband frequency techniques aimed to diagnose winding insulation degradation and faults. First, the broadband nature of machine windings is illustrated by explaining the per-turn equivalent circuit and the physical interpretation of its parameters. Then, the different insulation monitoring and diagnosis methods are thoroughly reviewed.

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EPRO-PE-005

Optimized 9-Level Switched-Capacitor Inverter for Grid-Connected Photovoltaic System

According to experimental data, the suggested inverter may generate cleaner electricity, as evidenced by its ability to attain a THD of 13.58% in its output voltage. A single-stage, three-phase grid-connected photovoltaic (PV) system serves as validation for the topology's practical use, demonstrating its potential for use in renewable energy applications. MATLAB/Simulink simulations are used to show the dynamic performance and stability of the system under different operating situations. For the conversion of the DC to AC use the main component is the inverter. For the more power efficient use the nine-level inverters. By the use of the multilevel inverters get the rid of more THD in the circuit. Our main objective is to attain the THD rate as 13.58% but our designed model get the THD rate is 14.76% almost our target is achieved with the power of 157.6 watts. This project main motive is to convert the DC to AC signal for that use the solar PV as input with the solar irradiance and time and use boost converter and DC-DC converter with the controller for regulating the voltages. For the conversion use inverter in this place replace the nine lever inverters is connected for getting the pulsating sine wave. For the output calculation use the Grid to read up the voltages and current from the circuits.

EPRO-PE-006

Virtual Synchronous Machine Control for Asynchronous Grid Connections

The reduced amount of large synchronous generators results in the need for fast, flexible, and intelligent power distribution devices to enhance the inertia in the modern power system.

This Project proposes a new approach to control an asynchronous low voltage grid connection, employing a virtual synchronous machine with frequency-based power control.

The grid-forming converter, receiving the primary side frequency measurement, varies the fed grid frequency on the secondary side artificially, to interact with frequency-dependent resources.

This enables the adjustment of the consumed or generated power in the fed grid without the need for additional communication infrastructure, and thus supports the frequency control of the mains.

The performance of the proposed frequency control has been validated through simulation.

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EPRO-PE-007

Reconfiguration of Bipolar HVDC System for Continuous Transmission Under DC Line Fault

The bipolar high voltage DC transmission (HVDC) system that connects offshore wind power plants (WPPs) is redesigned using the approach suggested in this article. Even in the event of a dc defect at one of the two poles, conventional bipolar HVDC systems can still transmit half of the rated power. However, because WPPs are unable to sustain operations on their own, the shutdown of half of the total WPPs is unavoidable. The WPPs take a while to restart after they are turned off. Over time, there is a decline in power transmission, which has an adverse effect on the onshore ac system.

By disconnecting switches, the suggested reconfiguration method shifts the converters and WPPs from the defective pole to the healthy pole, instantly eliminating the dc fault. Additionally, the reconfiguration is based on the fault ride-through (FRT) capabilities of the WPPs as defined by the current grid code, the reconfiguration is developed.

Consequently, even in the event of a dc line failure, the reconfiguration enables the uninterrupted operation of all WPPs. As a result, the suggested approach may increase supply reliability. Electromagnetic transient (EMT) simulations are used to validate the validity of the suggested approach.

EPRO-PE-008

30 kW Bidirectional Inductive Power Transfer Charger With Intermediate Coil for EV Applications

Inductive Power Transfer (IPT) technology has emerged as a promising approach for EV charging, offering benefits such as wireless operation, improved safety, and ease of use.

In this paper, we present the design and development of a 30 kW bidirectional IPT charger with an intermediate coil for EV applications.

The proposed system consists of a primary coil located at the charging station, an intermediate coil, and a secondary coil mounted on the EV.

The intermediate coil serves as a coupling element, improving the power transfer efficiency and flexibility of the system.

The bidirectional nature of the charger allows for both charging the EV battery from the grid and discharging the EV battery to the grid, enabling vehicle-to-grid (V2G) functionality.

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EPRO-PE-009

Novel Hermite Interpolation-Based MPPT Technique for Photovoltaic Systems Under Partial Shading Conditions

Solar energy is a sustainable and highly promising renewable energy source. The commonly employed Perturbation and Observation (P&O) and Incremental Conductance (INC) methods exhibit advantages such as ease of implementation. However, achieving maximum power through Maximum Power Point Tracking (MPPT) proves challenging under partial shading conditions (PSCs). This paper proposes a novel MPPT based on segmented cubic Hermite interpolation (HPO) to efficiently track the maximum power under all weather conditions. The proposed MPPT is applied to a photovoltaic system comprised of a photovoltaic array and a boost chopper. The feasibility and effectiveness of the proposed HPO algorithm are validated through a comparison with INC and Particle Swarm Optimization (PSO) methods. A solar photovoltaic system based on the Hermite interpolation Maximum Power Point Tracking (HPO-MPPT) algorithm was constructed using MATLAB/SIMULINK software. After testing the system in four distinct illumination scenarios, the average tracking efficiency and speed were found to be 99.84% and 0.28 seconds, respectively. Notably, under PSCs, the suggested approach produced the fastest tracking speed of 0.23 s and the highest tracking efficiency of 99.99%.

EPRO-PE-010

Over 98% Efficiency SiC-MOSFET based Four-Phase Interleaved Bidirectional DC-DC Converter Featuring Wide-Range Voltage Ratio

This article proposes a new floating four-phase interleaved chargepump bidirectional dc-dc converter (F4P-ICPBDC) with a broad Buck/Boost voltage ratio. Low-voltage side capacitor and inductors are protected from current ripple by the interleaved structure, and the high Buck/Boost voltage conversion ratio is enabled by the floating configuration. A reasonably priced asymmetric duty limit control technique is used to guarantee a balanced average inductor current over the whole duty cycle range. Furthermore, bidirectional synchronous rectification functions are executed without any extra hardware requirements, which raises the converter's overall efficiency. Additionally, illustrations of the converter's complete operating principles, device stresses, current ripple characteristics, and parameter design guidelines are provided.

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EPRO-PE-011

High-efficiency Modulation Scheme for Three-Level Buck Four-Leg Current-Source Inverter

The disadvantages of the four-leg current source inverter (4L-CSI) are bulkiness and low efficiency. Its advantages include zero-sequence current management, voltage boosting, and output short-circuit protection. A straightforward and highly efficient modulation approach along with a three-level buck 4L-CSI (3L-Buck-4L-CSI) topology are suggested as solutions to these shortcomings. The multilayer properties of 3L-Buck-4L-CSI allow for a significant reduction in the DC inductor's volume and a quick response in the DC-link current. The suggested modulation method is an algebraic modulation scheme, meaning that the duty cycles can be easily and directly produced by solving algebraic equations. Furthermore, as compared to traditional modulation systems, it lowers the DC-link current and switching times, which significantly raises the converter's efficiency. The outcomes of the experiment confirm that the suggested modulation scheme and topology are successful.

EPRO-PE-012

General and Unifed Model of the Power Flow Problem in Multiterminal AC/DC Networks

This paper proposes a generic and unifed model of the power ?ow (PF) problem for multiterminal hybrid AC/DC networks. The proposed model is an extension of the standard AC-PF. The DC network is treated as an AC one and, in addition to the Slack, PV and PQ nodes, four new node types are introduced to model the DC buses and the buses connecting the AC/DC interfacing converters (IC). The unifed model is solved using the Newton-Raphson method. The extended PF equations can be used in the presence of multiple ICs operating under different control modes. Compared to other recent works, the proposed method allows multiple ICs to regulate the DC voltage simultaneously. This corresponds to more realistic operational conditions that ensure redundancy and allow for more ?exible control of the hybrid grid.

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EPRO-PE-013

A Wireless Self-Powered I-V Curve Tracer for On-Line Characterization of Individual PV Panels

The current-voltage (I-V) characteristic of a photovoltaic (PV) generator is primarily responsible for describing its behaviour under particular temperature and irradiation conditions. As a result, the I-V curve tracing must be regarded as the most precise and useful diagnostic technique for correctly identifying PV panel defects. An innovative I-V curve tracer for individual PV panels is provided in this research.

It guarantees the ensuing benefits. 1) An improved I-V curve measurement as a result of a creative tracing technique. 2) In-situ characterization due to an appropriate disconnection circuit during regular operation. 3) Complete portability made possible by a Bluetooth connection and a Li-ion battery power source. The suggested instrument has been created and constructed. The final prototype has been employed to assess a PV panel's I-V curve.

EPRO-PE-014

Advancing Electric Vehicle Charging Ecosystems with Intelligent Control of DC Microgrid Stability

This project presents the improvement of voltage stability and control in DC microgrids to enhance voltage stability. A Simulink model is developed to represent a microgrid, solar panel, Wind turbine generator, fuel cell and Battery incorporating an DC-DC converter, hybrid Firefly Algorithm-Particle Swarm Optimization (FA-PSO) approach is used to tune Fuzzy Controller to achieve faster convergence, voltage regulation in EV The simulation aims to provide the improvement of voltage stability and control in DC microgrid.batteries.

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EPRO-PE-015

A Soft-switched Multi-port Converter for PV/Supercapacitors Hybrid Systems enabling

Supercapacitors (SC) have superior performance for frequency response services in grid-tied photovoltaic (PV) systems owing to high power density.
However, their variable voltage makes PV/SC hybridization quite challenging.
The current body of literature lacks solutions that offer either a substantial stepup gain for the SC ports when controlled as a voltage source or a significant capability for high current discharging
when controlled as a current source.
To tackle this concern, this paper proposes a new compact multi-port dc/dc converter that integrates SC at the PV side by modifying the standard boost converter with
three additional switches (two switches are soft switched and one is hard switched with low voltage) and three diodes.
This topology allows SC operation at almost their entire voltage range, while a decoupling control method ensures separate regulation of the PV array and SC.
The complete control scheme leverages both the SC and PV array for frequency response and comprises voltage recovery and protection for the SC.

EPRO-PE-016

Impact of DC-Link Voltage Control on Torsional Vibrations in Grid-Forming PMSG Wind Turbines

Supercapacitors (SC) have superior performance for frequency response services in grid-tied photovoltaic (PV) systems owing to high power density.
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EPRO-PE-017

Multi-scale Fusion Model Based on Gated Recurrent Unit for Enhancing Prediction Accuracy of State-of-charge in Battery Energy

Accurate prediction of the state-of-charge (SOC) of battery energy storage system (BESS) is critical for its safety and lifespan in electric vehicles. To overcome the imbalance of existing methods between multi-scale feature fusion and global feature extraction, this paper introduces a novel multi-scale fusion (MSF) model based on gated recurrent unit (GRU), which is specifically designed for complex multi-step SOC prediction in practical BESSs. Pearson correlation analysis is first em- ployed to identify SOC-related parameters. These parameters are then input into a multi-layer GRU for point-wise feature ex- traction. Concurrently, the parameters undergo patching before entering a dual-stage multi-layer GRU, thus enabling the model to capture nuanced information across varying time intervals. Ultimately, by means of adaptive weight fusion and a fully connected network, multi-step SOC predictions are rendered. Following extensive validation over multiple days, it is illustrated that the proposed model achieves an absolute error of less than 1.5% in real-time SOC prediction.

EPRO-PE-018

An_Energy-Based_Model_of_Four-Switch_BuckBoost_Converter

The four-switch buck–boost (FSBB) topology is widely used alongside isolated converters to enhance voltage range capabilities. In these applications, independent control of the duty-cycles of the FSBB's two legs and phase shifting are employed to shape the inductor current ripple, enabling zero voltage switching. This presentation introduces a novel nonlinear average model and its corresponding linearized small-signal model for the FSBB, accounting for the dynamics of phase shift and duty-cycles. The inductor energy-based approach accurately describes these dynamics. The proposed models demonstrate excellent alignment with simulation results and are validated through experimental measurements.

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EPRO-PE-019

Centralised Multimode Power Oscillation Damping Controller for Photovoltaic Plants With Communication Delay Compensation

Low-frequency oscillations are an inherent phenomena in transmission networks and renewable energy plants should be configured to damp them. Commonly, a centralised controller is used in PV plants to coordinate PV generators via communication channels. However, the communication systems of PV plants introduce delays of a stochastic nature that degrade the performance of centralised control algorithms. Therefore, controllers for oscillation damping may not operate correctly unless the communication channel characteristics are not considered and compensated. In this article, a centralised controller is proposed for the oscillation damping that uses a PV plant with all the realistic effects of communication channels taken into consideration. The communication channels are modelled based on measurements taken in a laboratory environment, considering its stochastic nature. The controller is designed to damp several modes of oscillation by using the open-loop phase shift compensation. Theoretical developments were validated in a laboratory using four converters acting as two PV inverters, a battery and a STATCOM. highlighting the importance of their accurate modelling and consideration during the controller design stage

EPRO-PE-020

Decentralized_Dynamic_Power_Sharing_Control_for_Frequency_Regulation_Using_Hybrid_Hydrogen_Electrolyzer_Systems

Hydrogen electrolyzers are promising tools for frequency regulation of future power systems with high penetration of renewable energies and low inertia. This is due to both the increasing demand for hydrogen and their flexibility as controllable load. The two main electrolyzer technologies are Alkaline Electrolyzers (AELs) and Proton Exchange Membrane Electrolyzers (PEMELs). However, they have trade-offs: dynamic response speed for AELs, and cost for PEMELs. This paper proposes the combination of both technologies into a Hybrid Hydrogen Electrolyzer System (HHES) to obtain a fast response for frequency regulation with reduced costs. A decentralized dynamic power sharing control strategy is proposed where PEMELs respond to the fast component of the frequency deviation, and AELs respond to the slow component, without the requirement of communication.

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EPRO-PE-021

Gain and Phase: Decentralized Stability Conditions for Power Electronics-Dominated Power Systems

This paper proposes decentralized stability conditions for multi-converter systems based on the combination of the small gain theorem and the small phase theorem. Instead of directly computing the closed-loop dynamics, e.g., eigenvalues of the state-space matrix, or using the generalized Nyquist stability criterion, the proposed stability conditions are more scalable and computationally lighter, which aim at evaluating the closed-loop system stability by comparing the individual converter dynamics with the network dynamics in a decentralized and open-loop manner. Moreover, our approach can handle heterogeneous converters' dynamics and is suitable to analyze large-scale multi-converter power systems that contain grid-following (GFL), grid-forming (GFM) converters, and synchronous generators. Compared with other decentralized stability conditions, e.g., passivity-based stability conditions, the proposed conditions are significantly less conservative and can be generally satisfied in practice across the whole frequency range.

EPRO-PE-022

Fast and Accurate Non-linear Model for Synchronous Machines Including Core Losses

Over the past few years, Brazils increasing dependence on electricity has caused a continuous growth in demand and, therefore, the need to guarantee long-term energy supply to costumers. Hence, studying the devices that are responsible ensuring this continuity is critical since the improper operation of this equipment can reduce the reliability of the electrical energy distribution system, therefore requiring detailed study that incorporates simulations, modeling, and analysis of response capacity in the face of real loads. Simulink/Matlab is one of the most widely used software programs in academia. However, it does not have readymade templates for protection system equipment such as relays, fuses, and reclosers. Herein, the aim is to model the digital recloser using the S-function block of Simulink/Matlab.

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EPRO-PE-023

Predicting DC-Link Capacitor Current Ripple in AC-DC Rectifier Circuits Using Fine-Tuned Large

This paper presents a fast and accurate state-space model for synchronous machines taking into consideration the machine geometry, material non-linearities and core losses. The model is first constructed by storing the solutions of multiple static finite element (FE) simulations into lookup-tables (LUTs) to express the stator flux linkages as functions of the state variables, i.e., the winding currents and the rotor position. Different approaches are discussed to include the core loss into the model. A novel approach is presented for constructing a pre-computed LUT for the core loss as a function of the state variables and their time derivatives so that the loss can be directly interpolated when time-stepping the state-space model. The Simulink implementation of the proposed core-loss model shows a good match with time-stepping FE results with a 120-fold speedup in computation. In addition, comparison against calorimetric loss measurements for a 150-kVA machine operating under both sinusoidal and pulse-width modulated voltage supplies is presented to validate the model accuracy.

EPRO-PE-024

Capacitor Voltage Balancing Method for the Hybrid Multilevel Converter Considering Grid Voltage Sags

Compared to the traditional modular multilevel converter and alternative arm converter, the hybrid multilevel converter (HMC) exhibits superiority in terms of cost and volume. In the HMC, the pulse width of the direction switch (DS) is conventionally utilized to maintain capacitor voltage balancing (CVB). However, this method has certain limitations, including a restricted range of modulation indices and the inability to support pure reactive power operation. To address these drawbacks, a new CVB method based on the phase angle of the DS is proposed in this article. Compared to the traditional method, the proposed method enables the HMC to achieve a full range of modulation index and four-quadrant operation. Additionally, it demonstrates improved performance in terms of SM capacitance and capacitor voltage ripple, especially under severe grid voltage sags and low power factors.

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EPRO-PE-025

Progress in artificial intelligence applicationsbasedon the combination of self-driven sensorsanddeeplearning

In the era of Internet of Things, how to develop a smart sensor system with sustainable power supply, easy deployment and flexible use has become a difficult problem to be solved. The traditional power supply has problems such as frequent replacement or charging when in use, which limits the development of wearable devices. The contact-to-separate friction nanogenerator (TENG) was prepared by using polychotomy thy lene (PTFE) and aluminum (AI) foils. Human motion energy was collected by human body arrangement, and human motion posture was monitored according to the changes of output electrical signals. In 2012, Academician Wang Zhong lin and his team invented the triboelectric nanogenerator (TENG), which uses Maxwell displacement current as a driving force to directly convert mechanical stimuli into electrical signals, so it can be used as a self-driven sensor.

EPRO-PE-026

Effective Application of IoT Power Electronics Technology and Power System Optimization Control

The Internet of Things (IoT) power electronics technology, as one of the research hotspots, integrates IoT and power electronics technology to achieve intelligent and optimized control of power systems through sensors, communication, and control technologies. In order to meet current and future needs, it is necessary to optimize the operation and management of power systems using IoT power electronics technology. By analyzing the application of Internet of Things power electronics technology and the optimal dispatch of power systems, support vector machine algorithms are used to analyze and process equipment data, and perform data monitoring and anomaly detection to promote energy waste reduction and energy saving, and then start from operation and maintenance respectively. Comparative simulation experiments were conducted in five aspects: efficiency, effectiveness of power load prediction and optimization control, effectiveness of intelligent monitoring, operating costs, and data security.

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EPRO-PE-027

Efficient and Fast Wind Turbine MPPT Algorithm Using TS Fuzzy Logic and Optimal Relation

This paper proposes an efficient and fast maximum power point tracking (MPPT) algorithm for a wind turbine (WT) connected to a battery bank via a permanent magnet synchronous generator, a three-phase diode rectifier, and a dc-dc boost converter. The algorithm is based on the Takagi-Sugeno (TS) fuzzy system and optimal relation methods and is called TS-MPPT. The fuzzy system computes the converter duty cycle using an input that combines the error and its rate of change. The error is the difference between the reference current computed from the optimal relation and the rectifier current. The methods used in the algorithm resulted in a five-rule TS fuzzy system, which contributed to a fast algorithm in terms of its total execution time (TET): 89.12 s on the F28069M board. The TET attained enabled a synchronized operation of the algorithm with the converter switching frequency. Additionally, the results based on the processor-in-the-loop simulation approach show that the TS-MPPT algorithm achieves an effective MPP tracking process with an energy conversion efficiency of 99.43% and behaves properly when evaluated over the typical WT power curve

EPRO-PE-028

Genetic Algorithm-Based Optimal Sizing of Hybrid Battery/Ultracapacitor Energy Storage

The output power of an ocean wave energy (WE) system has an intermittent and stochastic characteristic. WE output power can be transferred to the grid without sudden fluctuations when combined with a hybrid energy storage system (HESS) consisting of a battery pack and an ultracapacitor (UC) module. The study presented in this paper identifies the lowest-cost HESS sizing for WE systems by using a genetic algorithm (GA) optimization method. In this study, the system cost was reduced with the HESS cost and sizing study for ocean WE converter systems, and the battery was used effectively for a longer cycle. GA optimization has been applied in the field of HESS in ocean WE systems and has brought innovation to the literature with its optimum cost and sizing study. An optimum design model is presented considering the maximum/minimum voltage and current limits and the energy storage units' temperature and depth of discharge parameters.

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