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TECHNICAL PROGRAMME OVERVIEW

Time	Ball Room Karaton	Pemandengan 1	Pemandengan 2	Pemandengan 3	Pemandengan 4
Wednesday, October 16					
13:00-14:00	S1-1: *Power Quality*	S2-1: *Control of Power Electronics 1*	S3-1: *Electrical machine and Drives 1*	S4-1: *Energy Harvest 1*	S5-1: *Renewable Energy 1*
14:00-15:00	S1-2: *Smart Grid and Power Engineering*	S2-2: *Control of Power Electronics 2*	S3-2: *Electrical machine and Drives 2*	S4-2: *Energy Harvest 2*	S5-2: *Renewable Energy 2*
15:00-16:00	S1-3: *Electric Vehicle Technology*	S2-3: *Power Converter Design 1*	S3-3: *Power Converter Design 3*	S4-3: *Multilevel Inverter*	S5-3: *Renewable Energy 3*
16:00-17:00		S2-4: *Power Converter Design 2*			

TECHNICAL PROGRAMME & ABSTRACT

Keynote Address 1

Prof. Dr. Pekik Argo Dahono
Institut Teknologi Bandung, Indonesia

Title: A DC Microgrid System for Powering Remote Areas.....N/A

Keynote Address 2

Prof. Dr. Kyo-Beum Lee
Ajou University, South Korea

Title: Overview of Power Electronics Technology for DC Transmission and Distributions.....N/A

Abstract: The growing need for highly reliable and efficient power supply of renewable energy resources and new sizeable loads necessitated novel ways to transfer electric power between them. In the current configuration, transformers are passive devices that do not enable dc systems to connect of interface the electric grid with other energy grids. With the growth of power devices and power electronic converters, direct current transmission and distribution systems using medium or high voltage provide power flow control between various energy networks.

This talk would highlight power electronics technologies for the highly reliable dc transmission and distribution systems. Various configurations of solid-state transformer (SST) would be introduced especially modular multi-cell power converters among the configurations. Special focuses are paid on two different modulation strategies for reducing power losses and providing tolerant ability of switching device failures in modular multilevel converters.

S1-1: Power Quality Room: Ball Room Karaton Time: 13:00 - 14:00

13:00 The 9-150 kHz Disturbance Characteristics of a Grid-connected Rooftop Photovoltaic System

Gusdhi Rhazhya Ramadhan and Budi Sudiarto (Universitas Indonesia, Indonesia).....1

Abstract: *The usage of renewable energy is increasing in many countries, Indonesia included. This spike of interest is supported by its environmental-friendly nature and the fact that it is one of the most effective ways to combat global warming. Solar power plants are electricity generators with the ability to convert solar energy to electricity by using solar panels.However, solar power plants are indubitably dependent on solar energy, which can cause a fluctuation of output because solar energy is affected by weather and the cloud's condition.Generally, solar power plants have a power electronics component called an inverter. Inverters are used to convert the output of solar panels, the direct current (DC), to alternating current (AC). The usage of power electronics such as inverters plus the fluctuation of the solar panel commonly cause disturbances .Inverters usually have a switching rate higher than 1 kHz, which can cause disturbance in the range of 9-150 kHz throughout the whole system.However, there is little to none standardization regarding how much emission it is allowed to radiate at the 9-150Khz. With the aforementioned concerns in mind, this writing discusses research regarding the characteristics of disturbance on the 9-150Khz frequency on the On-Grid solar power plants located at SPBU Kuningan .Measurement is done on the output side of the solar inverter. The results of research shows that the disturbance produced remains constant in correlation with changes in irradiance or power, however the disturbance produced increases as the power output changes during a short interval.*

13:20 Implementation Modified PQ in Single-Phase Harmonic Reduction Using Hybrid Shunt Active Power Filter with Hysteresis Control:

Asep Andang (Siliwangi University, Indonesia); Nurul Hiron (University of Siliwangi & UNSIL, Indonesia); Eka Priatna (Siliwangi University, Indonesia).....6

Abstract: *The development of the use of nonlinear loads in electric power systems today is due to the extensive use of electronics in equipment in everyday life, resulting in more significant harmonic waves being produced so that it affects the quality of the power system. The harmonic reduction has been made since harmonics are existing in the network starting by using a passive filter then active, and the last is a hybrid filter. In this study will be discussed the use of passive filters connected to the network and shunt connected with active filters (HAPF). The active power filter control is carried out using the hysteresis control to switch the inverter while the use of the modified PQ model is implemented to produce a reference current based on a decomposition of a single phase load current. From the results of the simulation model, there is a decrease in harmonics to 1.45% for inductive nonlinear loads and 1.46% for complex nonlinear loads*

13:40 An Automatic Single Phase Power Factor Compensator Using Fuzzy and Gain Scheduling

Gentri Adiningtyas and Novita Siti Lestari (Diponegoro University, Indonesia).....12

Abstract: *Power quality has been much concern of many researchers these days. Power factor compensator is the main topic of this research, as it is can be alternative for increasing efficiency of power quality. Power factor (cos φ) value equal or close to 1 categorized as a good power quality. In this research, an automatic power factor compensator with various capacitor values is proposed. Fuzzy logic controller and gain scheduling are applied, in order to control power factor value maximally. Capacitor value that required can be obtained from control system of the plant. Then, some capacitors will be activated with an algorithm. The software is embedded in low-cost microcontroller which will activate specific capacitor variables as the system needed. In the end of this paper is provided data of prototype performance. Already proved, prototype can compensate power factor quality of the grid.*

S2-1: Control of Power Electronics 1 Room: Pemandengan 1 Time: 13:00 - 14:00

13:00 Modelling and Design of a Current Controller for Light Rail Regenerative Inverter System

Chuen Ling Toh and Muhammad Hairi Zainol Hilmi (Universiti Tenaga Nasional, Malaysia); Pei Cheng Ooi (The University of Nottingham Malaysia Campus, Malaysia).....18

Abstract: *Three phase voltage source inverter has been proposed to transfer the braking energy of a light rail vehicle back to the utility grid. This solution saves cost in purchasing large number of energy storage modules. However, it raises some concerns on power grid integrity, such as harmonics distortion. Therefore passive filters are normally added to mitigate the harmonics. This paper proposes a grid current controller to minimize the needs of ac filters. The proposed PI controller is stable and shows good dynamic response with the settling time measured at 3.49 ms. In addition, sinusoidal grid currents are produced successfully. The total harmonics distortion index for the grid current is measured at 2.61%.*

13:20 Intelligent Control Strategies for Tuning PID of Speed Control of DC Motor - A Review

Hendril Satrian Purnama (Universitas Ahmad Dahlan & Institute of Advance Engineering and Science (IAES), Indonesia); Tole Sutikno (Universitas Ahmad Dahlan & Universiti Teknologi Malaysia, Indonesia); Srinivasan Alavandar (Agni College of Technology, India); Arsyad Cahya Subrata (Universitas Ahmad Dahlan, Indonesia).....24

Abstract: *DC motor are commonly used in industrial application, because of that advantages over other types of motors. Some applications of DC motor require more advanced control strategies of speed and position. The classic PID controller has been taking the majority of the control system worldwide. Due to its inefficiency in non linearity handling, some of the soft computing and artificial intelligent (AI) techniques were adopted to solve the uncertainties/nonlinearities existing in the system. In this paper, the several AI techniques were compared based on their performance for tuning PID of DC motor speed control. The parameters of PID controller to be tuned in terms of rise time, settling time, steady-state error and maximum overshoot. In addition, the theoretical complexity of the strategies is also compared. In general, this paper presents a brief review and comparison of intelligent control strategies for tuning PID parameters of DC motor speed control based on early research.*

13:40 Simple MPPT Based on Maximum Power with Double Integral Sliding Mode Current Control for Vertical Axis Wind Turbine

Arya Kusumawardana, Langlang Gumilar and Dwi Prihanto (Universitas Negeri Malang, Indonesia); Hendro Wicaksono (Karlsruhe Institute of Technology).....31

Abstract: *MPPT (Maximum Power Point Tracking) is important part on Wind Energy Conversion System (WECS). The selection of the appropriate method can produce maximum power at WECS. In this research, MPPT based on Maximum Power of Vertical Axis Wind Turbine (VAWT) is designed to obtain reference current. Double Integral Sliding Mode Current Control (DISMCC) was used to track the reference current for Boost Converter. To find out about performance system with purposed controller, three stages of testing are carried out. Tests are carried out on wind turbines by compared the PI controller with the proposed controller. The all of testing stage show that RMSE of system with DISMCC is better than system with PI. Moreover, system with DISMCC can produce greater power than system with PI Controller*

S3-1: Electrical Machine and Drives 1 Room: Pemandengan 2 Time: 13:00 - 14:00

13:00 3-Phase L-Dump Converter with Single Pulse Mode for Switched Reluctance Motors

Dodi Garinto (Politeknik Manufaktur Astra & Indonesian Power Electronics Center, Indonesia); Harki Yanto (Politeknik Manufaktur Astra, Indonesia).....37

Abstract: *In this paper, a novel 3-phase L-dump converter for switched reluctance motors is presented. The converter can be classified as a single switch per phase converter topology for SRM drives. The aim of this paper is to provide a low cost solution for SRM drives. This paper focused on the mechanism principle analysis of the proposed converter based on PSPICE simulation results. The voltage stresses on semiconductor devices, also the behavior of current and voltage waveforms in DCM operation with single pulse mode will be analyzed in this paper. The optimization of the proposed L-dump converter regarding current behavior in the motor winding is also discussed.*

13:20 Improved Constant Switching Frequency Torque Regulator Based DTC of IM Fed by 3L-NPC Inverter for Wide Speed Region

Samer Hakami, Ibrahim M Alsofyani and Kyo-Beum Lee (Ajou University, Korea).....42

Abstract: *Classical direct torque control (DTC) is popular for its simplicity and fast control algorithm in motor drives. However, it has two main weaknesses; unfixed inverter switching frequency and large torque ripples due to torque hysteresis controller (THC). In DTC drives, torque ripple can be minimized by replacing the two-level inverter with a three-level neutral-point clamped (3L-NPC) inverter. Nevertheless, switching frequency is still variable and low which produces higher torque ripple and asymmetrical switching signals for the inverter. To alleviate these problems, a conventional constant switching frequency torque regulator-based DTC (CSFTR-DTC) for 3L-NPC inverter was presented in the literature. However, the conventional CSFTR-DTC deteriorates from flux-droop at sector transitions at low speed operation. This results in undesirable speed oscillation and high total harmonic distortion (THD) of the stator current. Moreover, the torque ripple is still relatively high. In this paper, an improved interleaving CSFTRDTC is proposed to modify the duty cycle of torque-error status in three-level inverter to improve flux-regulation and reduce torque ripples. Simulation results are presented to validate the effectiveness of the proposed method over the conventional method.*

13:40 Operation Simulation of Doubly Fed Induction Generator (DFIG) as Stand Alone Generator

Fajril Akbar, Syarkawi Syamsuddin, Novri Andonal and Refdinal Nazir (Universitas Andalas, Indonesia).....47

Abstract: *Recently, the use of DFIG (Double Fed Induction Generator) in wind power plants in the area that has been installed grid system (on-grid) is very fast development. This power plant system can operate optimally to convert wind energy because it can operate in variations of speed ± 30% of the base design speed without wind turbine control system. However, this system cannot be implemented in areas where grid systems are not available (off-grid). Therefore, this study developed a DIFG model capable of operating alone without being connected to the grid (stand-alone). The developed DIFG model was analyzed using the SIMULINK / MATLAB program. Simulations were performed on DFIG for the capacity of 33 kW, 460 Volt, 50 Hz, 4 poles. The simulation results have shown that DFIG is capable of operating in the 1350-1650 rpm speed range at a constant peak voltage of 500 Volts ± 10% and a constant frequency of 50Hz ± 1%.*

S4-1: Energy Harvest 1 Room: Pemandengan 3 Time: 13:00 - 14:00

13:00 Application of Load Shifting Methode Using Pump Storage for Saving Cost Production of Electrical Energy in Java-Bali 500 KV Electrical Power System

Langlang Gumilar (Universitas Negeri Malang, Indonesia); AN Afandi (Universitas Negeri Malang, Indonesia & Kumamoto University, Japan); Muhammad Afnan Habibi, Arya Kusumawardana, Mahfud Jiono and Soraya Mustika (Universitas Negeri Malang, Indonesia).....53

Abstract: *Electricity energy needs increase every year. If the load continues to increase and the supply of electricity is fixed, then one day it will cause the supply to be smaller than the demand. If electricity provider is able to provide electricity in accordance with the growth of expenses, then there will be an increase in the cost of production of the electric power system as well. Electricity production costs are different every hour, because it follows changes in load curve that changes every hour. This study aims to save electricity production costs for 1 day or 24 hours using load shifting methods with pump storage. The general definition of load shifting method is to move the peak load to the base load, so that the cost of generating electricity at peak loads becomes cheaper. Another way to move peak loads to basic loads can use pump storage. Indonesia has new Cisokan Pump Storage located*

in West Java. The working principle of pump storage is when the base load will act as pump to move water from the lower reservoir to the upper reservoir, and during this process it will consume electricity. When the peak load will act as generator by draining water from the upper reservoir to the lower reservoir, so that it will reduce electricity consumption during peak loads. In this study, two scenarios will be conducted to determine whether load shifting methods using pump storage can save the cost of production of the electrical power system. The first scenario is the operation of 24-hour electric power system without pump storage. The second scenario is the operation of the electrical power system for 24 hours using pump storage. The result of this study, for scenario 1 the total cost of production for 24 hours is $ 20,251,047.78. For scenario 2, the total production cost for 24 hours is $ 20,174,721.5. From scenario 1 and 2, using pump storage as medium to load shifting methods has proven to save 24 hours of electricity power production costs of $ 76,326.28 and electricity prices are also lower in $/kWh every hour.

13:20 Design of Liquid Metal Battery Equalization System Based on Bidirectional Flyback Circuit

Abstract: *Liquid metal battery (LMB), with characteristics such as long service life, high working current and large capacity, is a potential energy storage battery that can be used for power grid level energy storage. According to the test for charging and discharging characteristics of LMB made in this paper, lower working voltage than conventional batteries makes the design of equalization system difficult. An active equalization circuit based on bidirectional flyback circuit is put forward in this paper. Equalization System including a control module and an acquisition module is designed based on this circuit. This equalization system is tested on LMB with 200Ah capacity and test results show significant improvement of equalization of cells.*

13:40 A Research on Multi-Dimensional Fuzzy Equalization Control Strategy of Series of Supercapacitor Based on Consistency of the Voltages

Abstract: *The performance difference among the series supercapacitors (SCs) will lead to performance degradation and service life shortening of the series SCs. Based on the equalization system using flyback transformer circuit, a multi-dimensional fuzzy control (MFC) strategy is studied in this paper to balance the SCs in series. According to the different states of the series SCs, the MFC strategy uses the parameters of the unit's terminal voltage, cutoff voltage of SC and operating current as inputs and calculates the equalization current required for each SC unit as an output. So, the MOSFETs of the equalization circuit are controlled according to equalization current to adjust the energy in the SC unit to be transferred in or out. And the difference of the SC units is kept within a controllable and reasonable range, which reduces the inconsistency of the SCs in series. The simulation analysis is carried out by using the SIMULINK software, which verifies the feasibility of this equalization strategy. The equalization experiment was carried out in the SC series. The experimental results prove the effectiveness of MFC strategy.*

S5-1: Renewable Energy 1 Room: Pemandengan 4 Time: 13:00 - 14:00

13:00 Biogas Energy Conversion System for Peak Load Sharing in the Presence of Utility Supply

Abstract: *Over the decades' world energy demand is on the rise, and the problem of the electric energy crisis has become very vital. In a present-day scenario, non-conventional or renewable energy resources such as wind, biogas, solar, tidal, etc. are the best solutions to meet this extended energy demand considering the cost, efficiency, and reliability of a power system. One such biogas power generation system, comprising of a gas engine and electrical generator is presented in this paper and investigated at a domestic level in the MATLAB environment. A Fuzzy Logic-based biogas control system (BCS) has been devised for peak load sharing in the presence of utility supply. The results of the simulation show the validity of the technique in terms of less percent overshoot, undershoot, and settling time as compared to PI and neuro-fuzzy controllers. Moreover, this is a cost-effective solution for peak load sharing having no electronic components.*

13:20 Reduction of DC-Link Voltage Fluctuation for Hydraulic Turbine Generation Systems Using Back-to-Back Converters

Abstract: *This paper proposes a reduction of DC-link voltage fluctuation for hydraulic turbine generation (HTG) systems using back-to-back (BTB) converters. In HTG systems, a BTB converters with two-level topology have been mainly used. Because of its strong points of being intuitive in circuit diagram and easy to maintain. A switch-open-fault in the grid-stage converter of the BTB converter causes the fluctuation of DC-link voltage in the BTB converters. It reduces the reliability of the HTG systems. To improve the performance of the HTG systems generally, supplementary circuits or components and tolerant control methods are required. Therefore, this paper proposed method to reduce the fluctuation of DC-link voltage when switch-open-fault is happened in the grid-stage converter. The validity of the proposed method to reduce the fluctuation of DC-link voltage is substantiated by simulation results.*

Abstract: *This paper describes the application of the Simulink-PSpice (SLPS) interface as a tool to simulate complex system. To demonstrate its effectiveness, it is used to simulate the efficiency of the energy retrieval circuit (ERC) for photovoltaic (PV) system. The co-simulation takes advantage of the speed of Simulink and the accuracy of PSpice to yield the most accurate results within reasonable computational time. The simulation is carried out when the ECR is experiencing partial shading condition. To validate the accuracy, the efficiency performance of the system obtained from the co-simulation is compared with experimental set-up. The results are found to be in close agreement.*

S1-2: Smart Grid and Power Engineering Room: Ball Room Karaton Time: 14:00 - 15:00

Abstract: *Regulation of rectifier trigger angle is very important in high voltage direct current (HVDC) transmission system to maintain effectiveness of power delivery in the HVDC operation. To cover this regulation, adaptive neuro-fuzzy inference system (ANFIS) controller is proposed in this research to replace proportional integral (conventional) controller. Before applied, the ANFIS controller is trained by data training that obtained from the PI controller in various scenario. The ANFIS controller performance is evaluated by assessing its percent error of current. The result shows that at start up scenario (up-ramp 6 pu/s), the percent errors of current are 4.47 and 4.61 % for ANFIS and conventional controllers, respectively. Also, when the current reference is reduced, the percent errors of current are obtained at 2.37 and 2.51 % for ANFIS and conventional controllers. The ANFIS controller is able to control the HVDC with percent errors of current are less than the percent errors of current for conventional controller in two scenarios.*

Abstract: *Photovoltaic is widely used as one of the most popular renewable energy sources. Photovoltaic is gaining more attention to be used as sources in the localized network of DC Microgrid especially for rural area. To be used as source, photovoltaics are often merged with other photovoltaics in the same DC Microgrid network. However, merging several photovoltaics attract some issues such voltage magnitude control. Without appropriate method, the generated power by photovoltaics can be circulated among them and potentially loss of power. The suitable voltage control is a control which is able to determine appropriate voltage magnitude of each Photovoltaics according to their power capacities. The performance of the proposed method is evaluated via computer simulation of Matlab Simulink with several numbers of photovoltaics, different capacities and load demands conditions. The voltages and currents profiles of the DC Microgrid network during load demands fluctuations, several numbers of Photovoltaics, and different capacities of photovoltaics are presented, discussed and evaluated. The results indicate that the superiority of the proposed method to maintain the voltage of the DC MG network within acceptable limit during several discussed conditions above. Keywords- DC-DC Converter, DC Microgrid, Photovoltaic, Voltage Control*

Abstract: *It is crucial today that economies harness renewable energies and integrate them into the existing grid. Conventionally, energy has been generated based on forecasts of peak and low demands. Renewable energy can neither be produced on demand nor stored efficiently. Thus, the aim of this paper is to evaluate Deep Learning-based forecasts of energy consumption to align energy consumption with renewable energy production. Using a dataset from a usecase related to landfill leachate management, multiple prediction models were used to forecast energy demand. The results were validated based on the same dataset from the recycling industry. Shallow models showed the lowest Mean Absolute Percentage Error (MAPE), significantly outperforming a persistence baseline for both, long-term (30 days), mid-term (7 days) and short-term (1 day) forecasts. A potential decrease of up to 23% in peak energy demand was found that could lead to a reduction of 3,091 kg in CO2-emissions per year. Our approach requires low financial investments for energy management hardware, making it suitable for usage in Small and Medium sized Enterprises (SMEs).*

S2-2: Control of Power Electronics 2 Room: Pemandengan 1 Time: 14:00 - 15:00

Abstract: *This paper proposes dynamic characteristic improvement of phase-shift full-bridge center-tapped (PSFB-CT) converter using a model predictive control (MPC). The PSFB-CT converters are used for a low voltage DC/DC converter (LDC) of electric vehicles (EVs). It usually controls the output voltage using a proportional-integral (PI) control. However, it has disadvantage in unsuitable dynamic characteristic. Additionally, the overshoot of the output voltage can be occurred in case the gain of the PI controller increases for improving the dynamic characteristic. Therefore, in this paper, the MPC method is proposed in order to improve the dynamic characteristic of the PSFB-CT converter without overshoot of the output voltage. In the proposed MPC method, the next*

state of the output power is predicted by the variation of the output power. It is calculated by the variation of output voltage and current of the PSFB-CT converter. As a result, the optimal phase-shift can be obtained. The effectiveness of proposed MPC method was proved by the simulation results.

14:20 The Impact of SRM Rotor Speed on Regenerative Braking to Optimize the Performance

Anissa Firmana Dewi and Slamet Riyadi (Soegijapranata Catholic University, Indonesia).....104

Abstract: *Switched Reluctance Motor (SRM) is an electric motor which is still being developed. SRM has various advantages offered, it can be used in various applications such as electric vehicles and so on. These advantages are allowing SRM to be applied in Electric Vehicles. Its is a technology which also developed in optimizing the performance of Electric Vehicles. Regenerative braking technology is reuse wasted energy in conventional braking as additional energy to the battery. It can maximize the performance and further the mileages of Electric vehicles. Variable speed during the braking period has a different impact on the performance of Regenerative Braking. This paper presents the impact caused by changes in speed on SRM motors. Changes in the speed produced by SRM affect changes in the current flowing into the battery. This method uses a constant PWM duty cycle. Laboratory tests have been conducted to confirm the proposed method.*

14:40 Implementation of Input Capture Method on Switched Reluctance Motor to Obtain Precise Commutation Signals

Vincent Wijaya and Slamet Riyadi (Soegijapranata Catholic University, Indonesia).....110

Abstract: *Switched Reluctance Motor (SRM) is one of the modern electric motors. It has some advantages, such as high speed and low maintenance costs. To operate this motor, a microcontroller and rotor positioning sensor are required. Photoelectric transducer often used for determining rotor position. This sensor is installed at the end of motor shaft, with a rotary disk simultaneously. However, due to manual installation process, the photoelectric transducer could not give a precise signal. It also affects the commutation signals. As a solution to this problem, a new method has been developed. In this paper, the implementation of input capture on the dsPIC30F4012 microcontroller will be explained. By utilizing the input capture facility on dsPIC30F4012, commutation signals will be produced more precise.*

S3-2: Electrical Machine and Drives 2 Room: Pemandengan 2 Time: 14:00 - 15:00

14:00 Optimization of Single-Phase Induction Motor

Mayuri Karpe (Kirloskar Brothers Limited, India); Santosh Ghosh and Naveen Shindhe (Kirloskar Brother Limited, India).....115

Abstract: *Induction Motors are responsible for consumption of nearly 40% of electricity globally, as these are the driving force behind each fan, compressor, pump and nearly every mechanical load which have rotational motion. About 30 million new electric motors are put in use every year for industrial application alone. Despite the advent of permanent magnet based motors, single phase induction motors (SPIM) out numbers all other types of induction motors, because of its simple and robust construction and low cost. Hence small improvement in the performance of SPIM may greatly impact energy consumption worldwide and reduce carbon footprint eventually, however, studies related to SPIM is neglected by the researchers as these are not covered under the minimum efficiency standards. This paper presents design optimization technique of SPIM with the objective functions of maximization of efficiency while ensuring minimum material and tooling cost implication. For the current work a 0.5 hp, 2 pole motor has been considered as a sample case. Design approaches for optimization of capacitor start and run motor with the help of the double revolving theory is presented. The optimized design is validated by Finite Element Analysis and the predicted result of FEA analysis is compared with test result and found to be in good agreement.*

14:20 Design and Simulation Permanent Magnet Synchronous Generator 1.5 kW for Ocean Current Turbine

Danang Wijaya (UGM, Indonesia).....121

Abstract: *The development of renewable energy is the main goal to reduce the use of fossil energy. This will have an impact on reducing environmental pollution such as air and water pollution. Deep ocean currents are renewable energy that can develop optimally. That is because the potential for deep ocean currents is very large. The characteristics of deep ocean currents have high current densities, so the power generated is also large. Also, turbines in a deep ocean current generator do not need land and deep ocean currents are easy to predict. So, that makes the cost calculation process easier and cheaper. The challenges in developing an ocean deep current power plant are very low current speeds and low maintenance of generators because it is difficult to reach. So, the permanent magnet synchronous generator (PMSG) is very appropriate to use. The characteristics of PMSG have a high enough efficiency, so it can be operated at low speeds. Also, maintenance from PMSG is very easy. In this paper, design a PSMG with 1.5kW of power. The focus parameters are efficiency, power factor, cogging torque, and harmonics. While the parameters of the cooling system, mechanical pressure, etc. are ignored. PMSG design uses Ansys Maxwell software. The final result is obtained PMSG power capacity of 1.5 kW with 20 poles, 30 slots. PMSG rotational speed reaches 300rpm with an efficiency of 89 %. While cogging and harmonic torque is low value.*

14:40 High-Efficiency Flux Reference for Direct Torque Control of Induction Motor

Wee Yen Goh (Universiti Teknologi Malaysia UTM, Malaysia); Nik Rumzi Nik Idris and Norjulia Mohamad Nordin (Universiti Teknologi Malaysia, Malaysia); Auzani Jidin (Universiti Teknikal Malaysia Melaka, Malaysia).....126

Abstract: *When a direct torque control (DTC) of an induction motor drive is operated below its rated torque, the stator flux reference has to be set to an optimised value (which is below its rated) in order to minimise the losses thus optimised its energy usage. The optimal flux will be calculated once the steady-state speed is reached and normally it will take some time before the new optimal flux is obtained. In this paper, an almost-optimal stator flux for a direct torque control (DTC) induction motor drive under light-loaded condition is calculated instantaneously. The high-efficiency flux reference (HEFR) scheme calculates the value of the stator flux reference, which is almost equal to the optimal flux reference, without having to wait for the steady-state speed. The proposed*

method aims to conserve the simple control structure of DTC drive system. The effectiveness of the proposed method is studied through MATLAB's simulation package.

S4-2: Energy Harvest 2 Room: Pemandengan 3 Time: 14:00 - 15:00

14:00 Design of Energy Storage System Using Retired Valve Regulated Lead Acid (VRLA) Batteries in Substations

Wu Jie, Li Hua, Cong Peijie, Qu Deyu and Liu Shan (Guangzhou Power Supply Co., Ltd, P.R. China).....132

Abstract: *Valve regulated lead acid (VRLA) batteries widely used in substations still have large residual capacities when they are retired, so they can be reused in battery energy storage systems (BESS). A reusing BESS for retired VRLA batteries is designed in this paper, and its main function is peak-load shifting. The scale of this reusing BESS is 187 kW/1.87 MWh, and 3120 retired VRLA batteries are used. The reusing BESS can be divided into five sub-BESSes. Each sub-BESS is arranged in a container and consists of six parallel battery packs. Each battery pack consists of 104 battery cells in series, and it is connected to the main grid through a power conversion system (PCS). Meanwhile, each battery pack is managed by a battery management system (BMS). The BMS can achieve the functions such as battery dynamic equalization, overvoltage/undervoltage protection of each battery cell, and automatic isolation of defective batteries. Finally, the advantages and disadvantages of this reusing BESS are demonstrated by comparing it with another design of the reusing BESS, and the economic performance of this reusing BESS is evaluated.*

14:20 Design of Solar Irradiance Measurement Based on Analytical Data Using Microcontroller

Adji Prastiantono, Muhammad Fadhil, Amien Rahardjo, Faiz Husnayain and Fauzan H. Jufri (Universitas Indonesia, Indonesia).....137

Abstract: *Based on the 2018 RUPTL, Indonesia targets the development of renewable energy plants reach 23% on 2025. With a tropical climate, Indonesia is a country that has considerable potential to use photovoltaic as a renewable energy. But in its use, photovoltaic has an obstacle that can be detrimental namely intermittent properties. These constraints can be overcome by means of planning that aims to optimize photovoltaic performance. Planning in this study is in the form of actual measurement results from solar irradiance with data based on surrounding environmental conditions such as temperature, relative humidity, rainfall, and UV intensity. Then the data is processed using the Ordinary Least Square (OLS) method. The purpose of this study is to obtain accurate solar irradiance values so that they can be used in planning photovoltaic optimization. This measurement has an error value of 18.9% which is calculated using the MAPE method by using Solar Power Meter as the actual value.*

14:40 The Application of Non-Sinusoidal Resonance Inverter on an Ozone Generator

Fri Murdiya (Universitas Riau & Universitas Riau, Indonesia); Amir Hamzah and David Andrio (Universitas Riau, Indonesia).....142

Abstract: *This investigation was successful in explaining the implementation of non-sinusoidal resonance inverter on the ozone generator that induced by the permanent magnets. , and it was designed by rearranging the capacitor and inductor resonance to produce non-sinusoidal voltage wave. The plasma occurred between an anode electrode and solid dielectric, it was sharply clear using eyes, and it also can be captured using a digital camera. It is shown that the light intensity for model 2 is lower than model 1. Paint software in Microsoft was used as an image processing tool with invert color mode to analyze the plasma pictures. It is also stated that the micro discharge between the anode electrode and solid dielectric occurred intermittently. The current pulse in model 2 is more significant than model 1, that is proportional to micro discharge in the gap. The ozone gas production in model 2 was faster than model 1 with model 2 of 41.4 ppm per minute rather than model 1 of 32.4 ppm per minute. It can be concluded that the application of non-sinusoidal resonance inverter can be applied as the high voltage power supply for ozone generator that induced by the magnetic field.*

S5-2: Renewable Energy 2 Room: Pemandengan 4 Time: 14:00 - 15:00

14:00 An Improved Evolutionary Programming (IEP) Method Under the EN50530 Dynamic MPPT Efficiency Test

Norazlan Hashim (Universiti Teknologi MARA, Malaysia); Zainal Salam (Universiti Teknologi Malaysia, Malaysia); Nik Fasdi Nik Ismail (Universiti Teknologi Mara (UiTM), Malaysia).....147

Abstract: *Nowadays, Photovoltaic (PV) system is one of the most popular renewable energy sources due to its long-term economic benefits, inexhaustible resource, and environmental friendly. One important issue of any PV system is the efficiency of its maximum power point tracking (MPPT) used to extract the available maximum power from PV system. Normally, its performance has been evaluated under a fixed environmental conditions such as irradiance (G) and temperature (T), namely static MPPT performance. For dynamic MPPT performance, it is usually analyzed using very simple staircase or trapezoidal irradiance profiles which in most cases do not reflect the real environment conditions. For more accurate close-to-reality evaluation, a dynamic MPPT efficiency test based on international standards as in EN50530 is indispensable. With regard to Soft Computing (SC) MPPT methods, there are no publications analyzing the MPPT performance under EN50530 yet. Hence, this paper presents the design and experimental evaluation of improved Evolutionary Programming (EP) based MPPT method under EN50530. The proposed concept is simulated in MATLAB Simulink and validated experimentally using a custom designed PV array simulator (PVAS), DC-DC boost converter and a resistive load. The results show that the proposed method gives higher performance compared to conventional EP.*

Abstract: *Residential roof-mounted photovoltaic (PV) systems paired battery storage system can minimize dependence on grid electricity and reduce electricity bill. Nevertheless, the economic viability of such a system is subject to the effective use of excess electricity generated, most often via net metering. With a recent decrease in the cost of residential-scale lithium-ion battery (LiB) storage systems, this might a be practical alternative. In line with above, this paper presents an economic model to determine the profitability of a roof-mounted PV-LiB system paired with the grid electricity network. The proposed model takes into account both technical and economic parameters, such as battery ageing behavior, storage investment cost, and electricity price. Moreover, the power flow paths at different interval of time are demonstrated and the result of the sensitivity analysis in term of return on investment (ROI) is presented. The results obtained shows that a higher or lower ROI is dependent on grid electricity price and energy storage system price. Also when PV system with LiB is installed, the household electricity bill will result in earnings of €2943 because of the less energy consumption the grid of about 45.7% as compared with the case without LiB.*

Abstract: *A design of hybrid FC-PV cogeneration with battery storage have to be sized optimally in order to meet the load demand requirement at the minimum annual operation cost and high reliability. In this regards, both factor of economical and reliability have been considered with the appropriate parameters. This paper present the sizing approaches for hybrid FC-PV cogeneration integrated with a battery storage. The objective function is to minimize the life cycle cost subjected to the battery and fuel cell constraints. In order to solve the formulated optimization problem, the proposed Hybrid PSOGA (HPSOGA) is utilized where the simulation results is compared to the original PSO and GA, separately. The comparison shows that the HPSOGA give fastest convergence compared to PSO and GA for the same input data. In addition, the HPSOGA give the best optimal size in comparison to the original PSO and GA. The results also prove that the optimal system sizing can deliver the energy and full fill the load demands successfully.*

S1-3: Electric Vehicle Technology Room: Ball Room Karaton Time: 15:00 - 16:00

Abstract: *The compressor on the electric bus is used on the part of the bus cooling system where the compressor is coupled with an induction motor. The room temperature on an electric bus depends on how we control the speed of the electric motor to rotate the impeller blade contained in the compressor so that the refrigerant can be channeled through the condenser and lower the room temperature. Therefore, an inverter is needed as a converter of electrical power from a 400 V DC battery source to 3 phase AC electricity, which in turn will be varied in frequency based on the Proportional Integral Differential (PID) controller to control the induction motor speed using vector control. IGBT switches contained in the inverter receive input signals in the form of ON and OFF pulses generated through the Sinusoidal Pulse Width Modulation (SPWM) method.*

Abstract: *In designing of original adaptive cruise control (ACC) systems the outer loop is commonly used to control the safe distance between host and lead vehicles, and the inner loop maintains the speed of host vehicle. The aim of this paper is to propose different approach, in which only a single loop is introduced as controller. A decision algorithm for determining a driving mode is designed as part of multistage model predictive control constraints. The nonlinear behavior of vehicle dynamic is represented by a multistage local linear model, which will be identified by using least squares method. The objective of multistage predictive control is to minimized the square of errors between the predicted values of vehicle speed and the safety distance, and their references. The proposed controller demonstrates to more efficient in terms of power computing, it is because the method can keep the optimization control problem as a quadratic programming problem. Some ACC simulation results are given, demonstrating a better performance in terms of distance and speed responses compared to the original ACC system.*

S2-3: Power Converter Design 1 Room: Pemandengan 1 Time: 15:00 - 16:00

Abstract: *In this paper, a 3-phase 3-switch 3-level 3-wire AC-DC converter topology with asymmetrical Vienna rectifier is Proposed. The asymmetrical Vienna rectifier is controlled using DCM (Discontinuous Conduction Mode) operation to achieve a simple and low cost control methods. At the same time, the advantage of the asymmetrical Vienna rectifier is studied using PSPICE simulation analysis. The aim of this paper is to provide a simple control and low cost solutions for high power factor 3-phase AC-DC converter applications. The voltage stresses on semiconductor devices, also the behavior of current and voltage waveforms in asymmetrical Vienna rectifier with DCM operation will be analyzed in this paper. The advantage of the proposed asymmetrical Vienna rectifier regarding the conduction losses is also discussed.*

15:20 An Improved Modified Capacitor-Assisted Z-Source Inverter with Reduced Capacitor Voltage Stress and Inrush Start-up Current

Nafis Subhani (Universiti Teknologi PETRONAS, Malaysia); Ramani Kannan (Universiti Teknologi Petronas, Malaysia); Karantharaj Porkumaran (Dr NGP Institute of Technology & Principal, India); Shankar Prasath J. (N. G. P. Institute of Technology, India); Madhavan Srinath (N G P Institute of Technology, India).....182

Abstract: *This paper aims to develop a new improved series modified capacitor assisted Z-source inverter (SMCA-ZSI) with reduced capacitor voltage stress and inrush start-up current. The impedance network of the proposed topology maintains the same number of components count and inverter outcome similar to traditional MCA-ZSI. The key advantages of the proposed topology are the reduced voltage stress on the main components of ZSI impedance network, i.e., capacitors. Besides, the inrush start-up current also reduced for the series connection of the whole impedance network from input DC side to output AC side. Moreover, the proposed topology provides a common ground which can help to reduce the leakage current in the photo voltaic application. For the common ground sharing feature, which is not available in the conventional MCA-ZSI, the SMCA-ZSI topology can be categorized as a doubly grounded inverter topology. The improved performances of the proposed SMCA-ZSI have been demonstrated by simulation results which are performed in Matlab/Simulink software.*

15:40 Design and Performance Comparsion of Si and SiC MOSFETs for Dual Tank LCL-Type Series Resonant Converter

Ashoka Bhat and Nirav Bhatt (University of Victoria, Canada).....188

Abstract: *This paper presents operation, analysis, design, simulation and experimental results for a fixed-frequency half-bridge dual tank high-frequency (HF) transformer isolated soft switching LCL-type series resonant dc-dc converter and its performance comparison when Si and SiC MOSFETs are used. Operation of the converter is presented with operating waveforms and equivalent circuits for different intervals. Approximate analysis approach is used to obtain design curves and design equations. A 300 W, 300 V output converter switching at 100 kHz is designed to illustrate the design procedure. PSIM simulation results are given to evaluate the performance of the designed converter. An experimental converter is built to test the performance of Si and SiC MOSFETs. It is shown that SiC MOSFETs operate with an efficiency of 97.1% at full load and at 93.7% at 20% load. This converter can be used in alternate energy applications, such as PV array, and can provide step-up operation with HF transformer isolation and high efficiency.*

S3-3: Power Converter Design 3 Room: Pemandengan 2 Time: 15:00 - 16:00

15:00 Design Equations for DC-DC Quasi-ZSC

Muhammad Ado (Universiti Teknologi Malaysia, Malaysia & Bayero University, Kano, Nigeria); Awang Jusoh and Norjulia Mohamad Nordin (Universiti Teknologi Malaysia, Malaysia).....194

Abstract: *DC-DC quasi impedance source converter (q-ZSC) with buck-boost converter gain have been recently proposed. Operation of these converters have been verified by simulation and experimental prototypes. However, the components selection for these converters were done arbitrarily due to lack of design equations. Arbitrary selection of components hinders optimal performance due to either selecting overrated or underrated components. This paper derives the design equations of a DC-DC q-ZSC and verify their validity by using them to design a converter for a specific application. Operations of three converters designed using the equations were simulated and their response confirmed the validity of the equations.*

15:20 Dual Active-Switched-Capacitor Quasi-Z-Source Inverter

Misbahul Munir, Rahmatullah Aji Prabowo, Mega Agustina, M. Aldy Wildan Maulana, Irham Fadlika and Aripriharta Aripriharta (Universitas Negeri Malang, Indonesia); AN Afandi (Universitas Negeri Malang, Indonesia & Kumamoto University, Japan); Amer Mohammad Yusuf Mohammad Ghias (Nanyang Technological University, Singapore).....200

Abstract: *This paper proposed a new qZSI topology with dual active switch capacitor network. This new proposed topology offers high voltage gain and boost factor value by using less component. In this paper, the proposed topology will be analyzed and compared with previous high boost qZSI topology. The comparison parameter in this paper including comparison of boost factor, voltage gain, inductor current ripple, diode, switch and capacitor voltage stress. In the number of components, the proposed topology also using less component to achieve high boost factor. A simulation also done in this paper to ensure the analysis result using Simulink application.*

15:40 DC-DC Converter for USB-C Power Adapter in Residential DC Electricity

Rini Nur Hasanah (Brawijaya University & Faculty of Engineering, Indonesia); Tyler Starr and Ezzeddeen Gazali (California Polytechnic State University, USA); Taufik Taufik (California Polytechnic State University, San Luis Obispo, USA).....207

Abstract: *This paper presents the development of a USB-C Power Adapter for residential DC electrical system. Although USB-C is a new and emerging technology, it is well placed to become a standard for DC power delivery. The power adapter utilizes a two-phase synchronous buck converter to interface with an existing 48V DC House infrastructure to provide output voltages of 5, 9, 15, or 20 VDC at up to 100W. Hardware design and construction of the converter were conducted and then tested. Results from the hardware test show that the USB-C power adapter was able to achieve the desired output voltages while delivering up to 100W. At full load, the power adapter was measured at 96.27% efficiency, less than 1% output voltage ripple, and less than 2% on line and load regulations. Additionally, when connecting actual consumer devices to the system, they were charged without issue and at the proper power delivery profile.*

S4-3: Multilevel Inverter 3 Room: Pemandengan 3 Time: 15:00 - 16:00

15:00 A New Unity-Gain 5-Level Active Neutral-Point-Clamped (UG-5L-ANPC) Inverter

Sze Sing Lee (Newcastle University in Singapore, Singapore); Chee Shen Lim (University of Southampton Malaysia Campus, Malaysia); Yam Siwakoti (University Technology of Sydney, Australia); Nik Rumzi Nik Idris (Universiti Teknologi Malaysia, Malaysia); Ibrahim M Alsofyani and Kyo-Beum Lee (Ajou University, Korea).....213

Abstract: *The active neutral-point-clamped (ANPC) inverter is a popular multilevel inverter for various industry applications. In a recent attempt, an improved topology that integrates a flying capacitor to enhance the voltage gain from half to unity has been presented [11]. Retaining the benefit of unity-gain, this paper proposes a new ANPC topology with two improvements. Firstly, the voltage stress of the flying capacitor is reduced by half. Secondly, the charging of the flying capacitor at 0 level is made possible to achieve uniform charging over the power cycle. Comprehensive analysis is presented and experimental results of a prototype are presented for validation. Finally, the extension of the topology with increased number of output voltage levels generation is briefly discussed.*

15:20 Improved Topology of Symmetrical Multilevel Inverter with Reduced Number of Switching Devices

Muhammad Najwan Hamidi and Dahaman Ishak (Universiti Sains Malaysia, Malaysia); Muhammad Ammirrul Atiqi Mohd Zainuri (Universiti Sains Malaysia & School of Electrical and Electronic Engineering, Malaysia).....218

Abstract: *In this paper, an improved topology of symmetrically operated multilevel inverter with reduced number of switches is proposed. A factor of merit about this topology is that it allows cascaded configuration to produce a higher number of output levels. Additionally, an appropriate technique for the required pulse width modulations (PWMs) on the switches is also described. The topology is compared with several classic and newer reduced switch multilevel inverters (MLI) in terms of the number of switches, DC sources, output levels and basic units. An in-depth study on the 9-level (9-L) operation of the proposed topology is presented where the voltage, current and power-sharing by each DC source are analysed. The power shared by the first DC source is found to be the highest, followed by the second, third and fourth DC sources. From the ideal simulation using Matlab Simulink environment, the proposed topology is capable to deliver power to the load at almost unity power ratio of above 99%, rendering it very much suitable for real time application. Furthermore, the study is extended to include the cascaded 17-level (17-L) operation of the proposed topology. It is noted that higher cascaded configuration of the proposed topology will allow higher number of output levels, resulting in lower total harmonic distortion (THD).*

15:40 New Multilevel Modified CUK Converter Family for Renewable Energy Applications

Kiran Maroti Pandav and Sagar Mahajan (University of Johannesburg, South Africa); Sanjeevikumar Padmanaban (Alborg University, Denmark); Jens Bo Holm-Nielsen (Aalborg University, Denmark); Tole Sutikno (Universitas Ahmad Dahlan & Universiti Teknologi Malaysia, Indonesia); Atif Iqbal (Qatar University, Qatar).....224

Abstract: *A new multilevel member of Modified CUK Converter (MCC) family is proposed in this paper for high voltage renewable energy application. With the specific arrangement of diodes and capacitors in MCC, the voltage gain of MCC is boosted in the proposed MCC with voltage multiplier (MCCVM) converter which can be an effective solution for renewable energy applications such as PV, fuel cell, etc. The advantageous features of the proposed converter are (a) single switch topology which required simple control scheme, (b) lower voltage stress than the output voltage, (c) continuous input and output current, (d) inverted output with the respective input voltage. The operating principle and mathematical derivation are discussed in the paper. The functionalities and performance of the proposed converter are verified by MatLab (R2016a) simulation and experimental results always show a good agreement with the theoretical analysis.*

S5-3: Renewable Energy 3 Room: Pemandengan 4 Time: 15:00 - 16:00

15:00 The Improvement of LDR Based Solar Tracker's Action Using Machine Learning

Gaafar Mustafa (DAL Group, Sudan); Baraah Sidahmed (University of Khartoum, Sudan); Mustafa Nawari (Ministry of Science and Communication, United Kingdom (Great Britain)).....230

Abstract: *Solar energy is a clean, renewable and sustainable energy source that has the potential of becoming one of the major constituents of the total global energy mix. The achievement of maximum possible conversion through photovoltaic conversion requires that the sun's direct beam directly illuminates the photovoltaic panel's surface as long as possible. This can be achieved through solar tracking. However, the tracking operation faces multiple predicaments (clouding, fog, man-made blockage and others) that breed inaccuracy, hence causing inefficiency of conversion and high power consumption due to the random tracker movement. The objective of this research is to develop an LDR (Light Dependent Resistor) based solar tracker, where Machine Learning is implemented to produce an accurate, robust, noise tolerant and relatively low cost tracker that has the ability to learn and improve its action from daily interaction with the environment. A Fourth order Polynomial Regression was selected as the Machine Learning technique. A Machine Learning based algorithm is developed and implemented in a MATLAB environment. The algorithm has the functionality of testing each LDR sensor input value and checks whether this value is within a predefined permitted deviation range in real time instants, if this condition was found to be true the LDR at that instant is approved and its furthermore used in the panel control mechanism Alternatively, if the condition was found to be false the LDR value at that time instant is discarded and replaced by a more accurate value from the previously trained Machine Learning model. The developed system was tested using Root Mean Square Error (RMSE). The system has showed a lowered and converging error response in varying environmental conditions (Sunny, Semi-Cloudy and Cloudy), thus the proposed system has proved its effectiveness in tackling the clouding and blockage problem, resulting in a cheap, robust and noise tolerant solar tracking system*

15:20 The Effect of Blade Overlap on the Performance of Savonius Wind Turbine

Ibnu Kahfi Bachtiar (Universitas Maritim Raja Ali Haji, Indonesia).....236

Abstract: *Savonius wind turbine is a simple type of wind turbine that can generate electric power at low wind speed. This study used an L type two-bladed Savonius vertical axis wind turbine. The research objective was to conduct experiments to determine the effect of blade overlaps on the performance of the Savonius wind turbine in terms of cut in speed, tip speed ratio (TSR) and maximum power coefficient (Cp). The overlap variations used in this study are 0%, 10%, 13%, 15%, 20%, 25% and 28%. The wind tunnel test in the range of 2 m/s to 9 m/s wind speed found that 10% and 13% overlap ratios give the best spin of rotor and the highest efficiency in the form of power coefficient for higher wind speed, but it will decrease the ability of cut-in speed. Otherwise overlap ratios in the range of 15%-28% will generate power coefficient in the average of 26% and suitable for low wind speed conditions (3-5 m/s).*

15:40 High Grade Liquid Fuel from Plastic Waste Pyrolysis Oil by Column Distillation

Ilham Zulfa Pradipta (Gadjah Mada University, Indonesia).....240

Abstract: *One of the detrimental pollutants in the world is plastic waste. Many methods have been tried to handle it, for example pyrolysis. Pyrolysis can convert plastic waste into crude oil which can then be used as fuel after the purification process. Distillation can separate light components of high grade fuel from the heavy fraction. The aim of this research is to purify pyrolysis oil from polyethylene plastic waste using lab scale batch column distillation with glass ball packing. Distillation is conducted by varying the boiler heater voltage at 140 volt, 180 volt, and 220 volt that will lead to different boiling point of 120-190, 193-229, and 231-264 oC, respectively. The oil obtained from distillation at heat A produced the most distillate of 42 ml compare with distillate oil at heat B (41.5 ml) and heat C (36 ml). The distillate at heat C has comparable properties to commercial fuel (gasoline) in terms of hydrocarbon composition (C5-C12), density of 0.7660 gr/ml, specific gravity of 0.7663, kinematic viscosity of 0.798 mm^2/s, and heating value of 45.901 Mj/kg.*

16:00 Monitoring Fault Diagnosis Based on Phasor Measurement Unit at Wide Area Systems

Azriyenni Azhari Zakri (Universitas Riau, Indonesia); Wazir Mustafa (Faculty of Electrical Engineering, Universiti Teknologi, Malaysia); Herman Syaibi (Universitas Riau, Indonesia); Ibim Sofimieari (Universiti Teknologi Malaysia, Malaysia).....245

Abstract: *Increasing fault diagnosis of the electric power transmission system is vital to reducing power outages to consumers. Several methods are employed to determine fault diagnosis in electric power transmission lines. The purpose of the work is to monitor fault diagnosis using Phasor Measurement Unit (PMU) at Wide Area Systems. Measurement is performed by monitoring, controlling, and protecting by combining the functions of the phasor measurement device. PMU is a part of measuring the phasor of current and voltage values at the control center. So, this study was intended to design 9-bus systems IEEE based PMU using the software. The simulation is performed in a state of three-phase short circuit faults. It is then then tested on all lines on the 9-bus systems IEEE with variations distances of 10%, 30%, 50%, 70%, and 90%. The simulation results are used as input for the fault diagnosis to determine the point of fault location on the 9-bus systems IEEE. Furthermore, it can calculate the error value, Root Mean Square Error (RMSE) and Mean Absolute Error (MAE) of the three-phase short circuit fault diagnosis on each line of the 9-bus systems IEEE. The highest error value obtained on Bus-7 to Bus-5 of fault location distance of 90% is 0.48 %. RMSE is 3.02*10-3, and MAE is 2.46*10-3. Meanwhile, the smallest error value on Bus-6 to Bus-4 of a fault location distance of 10% is 6.3*10-4 %, RMSE is 3*10-3, and MAE is 2.6*10-3.*

S2-4: Power Converter Design 2 Room: Pemandengan 1 Time: 16:00 - 17:00

16:00 Implementation of an 11-Level Inverter for Sea Water Battery System

Soedibyo Soedibyo (Institute Teknologi Sepuluh Nopember & Indonesia, Indonesia); Mochamad Ashari (Sepuluh November Institute of Technology, Indonesia); Feby Agung Pamuji (Institute Teknologi Sepuluh Nopember, Indonesia); Reynanda Bagus Widyo Astomo (Institut Teknologi Sepuluh Nopember, Indonesia).....250

Abstract: *An inverter is an electronic power device used to convert DC voltage to AC. In energy conversion and power storage systems, inverters have a very important role. With the increase in power conversion technology, the latest inverter designs are also increasing. One developing design is designed for multilevel models. Multilevel design is a combined inverter design where the output voltage will be divided into several levels and form a sinusoidal curve. In this paper, multilevel inverters will be implemented at sea water battery output. The sea water battery inside the ship has several functions. Aside from being a supply for motors in the cooling system, the battery also functions as a supply of communication and lighting systems. This is what requires the importance to reduce and even eliminate the harmonic index, because it will have an impact on the amount of losses generated and the interference that can be generated. To overcome the problem of the magnitude of the harmonic index on conventional inverters without using filters, this paper will propose an 11-level inverter design. The proposed 11-level inverter construction will be designed and simulated with PSIM software. Where the proposed load is inductive load (motor cooling in the ship) and resistive load (communication and lighting system). Where the results obtained indicate that 11 levels of inverter can reduce the level of current and voltage harmonics better than conventional inverters. In addition, this inverter shows a better Total Harmonic Distortion (THD) index, although it does not use a filter with a reduction in the average harmonic index of 85% from a conventional inverter.*

Abstract: *In this paper, the integration of digital modulator and power amplifier using resonant power converter is presented. The proposed concept can be referred as Digital Power Modulator. The aim is to improve the energy efficiency in modern digital communication systems. The converter has specification of 48 V input voltage, 50 ohm output load, 30 W output power, 500 MHz switching frequency. The voltage stresses on semiconductor devices and capacitors will be analyzed in this paper. In addition, the behavior of current and voltage waveforms will be simulated and analyzed with PSPICE software. The combination analysis of the converter in DCM (Discontinuous Conduction Mode) operation to modulate current and voltage at 50 ohm load in a resonant mode based on One Cycle On-Off Keying digital modulation technique is also provided. Simulation results show that the On-Off Keying modulation with data rate of 500 Mbps can be produced using the proposed resonant power converter.*

Abstract: *One of the key components in switching power supplies is the main switch, of which MOSFET is commonly used. High dv/dt and di/dt are inherent in MOSFET switching operation, and so it is a major source of electromagnetic emissions that may fail the standard limits. In this paper, effects of MOSFET gate driving on conducted emissions are examined. Measurements are made on a prototype of flyback LED driver. Initial design with a gate resistance of 10 ohms coupled with anti-parallel diode resulted in excessive conducted emissions at high frequency region. Those limit-exceeding frequencies were confirmed to be originating from sharp rising edges followed by oscillation during the MOSFET turn-off transition. It was then shown experimentally that the conducted emission level was effectively reduced below the Standard limit by increasing the gate resistance and eliminating the anti-parallel diode. Furthermore, instead of anti-parallel connection, parallel diode configuration was also evaluated in experiments.*