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FOREWORD FROM EDITOR-IN-CHIEF

Welcome to the latest issue in 2022 of the Journal of Mechatronics, Electrical Power, and Vehicular Technology (MEV), a peer-reviewed and broad-scope international journal. This issue consists of ten papers written by authors from different countries, such as Australia, China, India, Indonesia, Japan, Malaysia, Philippines, Taiwan, United Kingdom, and Vietnam.

We are pleased in this issue to present a diverse range of articles and papers that cover a wide range of topics within the field of Mechatronics, Electrical Power, and Vehicular Technology. One of the standout contributions in this issue is a paper by Rupesh and Tegampure on the DNN control technique in the photovoltaic system. This research has the potential to significantly impact the way we approach treatment in this area, and we are thrilled to have the opportunity to share this work with our readers.

We are also pleased to feature an article by Ramadiansyah et al. on the numerical investigation of the effect of ocean depth variations on the manipulator joint torque. This work provides development a mathematical model of a ship mounted two-DoF manipulator considering the ship dynamics and characterization of the ship motions.

In addition to these articles, we have several other papers that cover a wide range of topics, including an overview of early termination of PV-DG microgrid system, a method to find pump performance specifications when using a pump with a mixed flow type as a turbine for micro hydro power plants, investigation the impact of lightning masts placement on underground cables within high voltage substations, examination the strength of the universal joint after it was loaded with torsion, long-term forecasting for growth of electricity load based on customer sectors, optimization take-off position control of the bicopter model by investigating LQR cost matrices variation in actual experiments, plumbing leakage detection system with water level detector controlled by programmable logic controller, and a novel solution to deal with the complicated electronic circuitry for speed controller and too complex mechanical design of rotating mechanism of an orbital shaker.

We hope that you will find this issue to be a valuable resource, and we look forward to continuing to bring you the latest research and insights in the field of Mechatronics, Electrical Power, and Vehicular Technology.

Bandung, December 2022

Editor-in-Chief

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ABSTRACTS SHEET

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Jalu Ahmad Prakosa [a], Hai Wang [b], Edi Kurniawan [a], Swivano Agmal [c], Muhammad Jauhar Kholili [c] ([a] Research Center for Photonics, National Research and Innovation Agency (BRIN), Indonesia; [b] Discipline of Engineering and Energy, Murdoch University, Australia; [c] Research Center for Quantum Physics, National Research and Innovation Agency (BRIN), Indonesia)

Experimental studies of linear quadratic regulator (LQR) cost matrices weighting to control an accurate take-off position of bicopter unmanned aerial vehicles (UAVs)

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2022, vol. 13, no. 2, p. 101-112, 17 ill, 5 tab, 27 ref.

Controller design for airplane flight control is challenged to achieve an optimum result, particularly for safety purposes. The experiment evaluated the linear quadratic regulator (LQR) method to research the optimal gain of proportional-integral-derivative (PID) to hover accurately the bicopter model by minimizing error. The 3 degree of freedom (DOF) helicopter facility is a suitable bicopter experimental simulator to test its complex multiple input multiple output (MIMO) flight control model to respond to the challenge of multipurpose drone control strategies. The art of LQR setting is how to search for appropriate cost matrices scaling to optimize results. This study aims to accurately optimize take-off position control of the bicopter model by investigating LQR cost matrices variation in actual experiments. From the experimental results of weighted matrix variation on the bicopter simulator, the proposed LQR method has been successfully applied to achieve asymptotic stability of roll angle, although it yielded a significant overshoot. Moreover, the overshoot errors had good linearity to weighting variation. Despite that, the implementation of cost matrices is limited in the real bicopter experiment, and there are appropriate values for achieving an optimal accuracy. Moreover, the unstable step response of the controlled angle occurred because of excessive weighting.

(Author)

Keywords: experimental evaluation; cost matrices; LQR; bicopter; MIMO flight control.

Mohamad Luthfi Ramadiansyah [a], Edwar Yazid [a], Cheng Yee Ng [b] ([a] Research Center for Smart Mechatronics, National Research and Innovation Agency (BRIN), Indonesia; [b] Department of Civil and Environmental Engineering, Universiti Teknologi PETRONAS, Malaysia)

Numerical investigation of the effect of ocean depth variations on the dynamics of a ship mounted two-DoF manipulator system

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2022, vol. 13, no. 2, p. 113-124, 10 ill, 7 tab, 32 ref.

The dynamics of a ship need to be considered in the development of a manipulator system that will be applied to the ocean-based operation. This paper aims to investigate the effect of ocean depth variations on the ship motion as disturbances to a ship-mounted two-DoF (Degrees of Freedom) manipulator joint torque using an inverse dynamics model. Realization is conducted by deriving the mathematical model of a two-DoF manipulator system subject to six-DoF ship motion, which is derived by using Lagrange-Euler method. It is then combined with numerical hydrodynamic simulation to obtain the ship motions under ocean depth variations, such as shallow (50 m), intermediate (750 m), and deep (3,000 m) waters. Finding results show that randomness of the ship motions appears on the manipulator joint torque. In the azimuth link, maximum joint torque is found in shallow water depth with an increment of 8.271 N.m (285.69 %) from the undisturbed manipulator. Meanwhile, the maximum joint torque of the elevation link is found in intermediate water depth with an increment of 53.321 N.m (6.63 %). However, the difference between depth variations is relatively small. This result can be used as a baseline for sizing the electrical motor and developing the robust control system for the manipulator that is mounted on the ship by considering all ocean depth conditions.

(Author)

Keywords: two-DoF manipulator; inverse dynamics; ship motion; ocean depth; hydrodynamic response.

Sarid Mejiartono [a], Muhammad Fathul Hikmawan [b], Aditya Sukma Nugraha [b,c] ([a] Faculty of Mechanical and Aerospace Engineering, Bandung Institute of Technology, Indonesia; [b] Research Center for Smart Mechatronics, National Research

and Innovation Agency (BRIN), Indonesia; [c] Department of Mechanical Engineering, National Taiwan University of Science and Technology, Taiwan)

Numerical and experimental study of mixed flow pump as turbine for remote rural micro hydro power plant application

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2022, vol. 13, no. 2, p. 125-136 15 ill, 11 tab, 26 ref.

The use of a pump as opposed to a turbine/pump as turbine (PAT) for off-grid electrification applications is one of the important ways to be considered in efforts to equalize electrical energy in Indonesia. The main problem in PAT applications is how to predict pump performance if applied as a turbine to find out its best characteristics and efficiency points. This study discusses a method to find pump performance specifications when using a pump with a mixed flow type as a turbine for micro hydro power plants. The numerical method by utilizing computational fluid dynamics (CFD) based software simulations that have been proven to be accurate according to previous studies was selected for use in obtaining predictions of the pump characteristics as turbines. Then the PAT characteristics of the CFD simulation results are validated by conducting direct testing. The results of the CFD numerical simulation using ANSYS Fluent software show the performance curve of a mixed flow pump operated as a turbine at various rotating speeds. The highest efficiency for each rotating speed ranges from 35-40 %. The test results directly show the PAT characteristics, that the performance range is close to the numerical simulation results with a difference of 10 %.

(Author)

Keywords: pump as turbine (PAT); micro hydro power plant; computational fluid dynamics (CFD).

Sri Hartanto [a], Desmayadi [b] ([a] Teknik Elektro, Universitas Krisnadwipayana, Indonesia; [b] Nissinbou Industries, Inc, Japan)

Plumbing leakage detection system with water level detector controlled by programmable logic controller type Omron CPM2A

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2022, vol. 13, no. 2, p. 137-146, 10 ill, 5 tab, 26 ref.

There is a chance of leakage in the plumbing caused by water pressure in the pipes, improper installation of pipe connections, or external influences, such as earthquakes. Plumbing leakage that is detected too late can cause damage to other systems. It is necessary to have a plumbing leakage detection system to detect a leak in the plumbing. Therefore, in this research, a plumbing leakage detection system is designed with a water level detector (WLD) controlled by a programmable logic controller (PLC) type Omron CPM2A. The method used in this research is designing the optimal model form of the system, which is distinguished by designing hardware and software, testing the devices, such as power supply, WLD, and channel relay module (CRM), and making conclusions. From the results of this research, it was found that the system works well in detecting leakage of plumbing, as indicated by all transistors' ability to work well where the electrodes (E1 and E2) are connected by water. The transistor in the WLD module will work as a switch or transistor in the saturation position. In this research, it can be seen that even though there is a leakage from the relay contacts of 1.8 VDC, it is still considered in a safe condition because to provide a trigger to the 3B3D Module, a minimum of 12 VDC is required. In addition, when the relay is not working or off, the measurement at the normally closed (NC) terminal is 12 VDC.

(Author)

Keywords: channel relay module (CRM); leakage detection; programmable logic controller (PLC); water level detector (WLD).

Edwin Romeroso Arboleda (Department of Computer and Electronics Engineering, Cavite State University, Philippines)

Design, construction, and evaluation of transformer-based orbital shaker for coffee micropropagation

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2022, vol. 13, no. 2, p. 147-156, 23 ill, 2 tab, 25 ref.

This study offers a novel solution to deal with the complicated electronic circuitry for speed controller and too complex mechanical design of rotating mechanism of an orbital shaker. The developed prototype used a transformer that varies the supply voltage to control the speed of rotation of the orbital shaker. The prototype has five speed levels which depend on the input voltage. These speeds are 180 rpm at 12 V, 258 rpm at 15 V, 360 rpm at 18 V, 427 rpm at 21 V, and 470 rpm at 24 V. The prototype was tested to run continuously for 48 hours for each speed level, with speed being measured every hour using a tachometer. Statistical computation shows that the speed remains constant for the entire 48 hour period. Evaluation of results shows that the speed controller and the novel mechanical design for the orbital shaking motion achieved their functions. For this reason, it can be concluded that the prototype is durable and safe for use in orbital shaking applications.

(Author)

Keywords: DC motor; orbital shaker; rotating mechanism; speed controller; step-down transformer.

Mailugundla Rupesh [a], Vishwanath Shivalingappa Tegampure [b] ([a] Department of Electrical & Electronics Engineering, India; [b] Department of Electronics & Communication Engineering, India)

Cascade feedforward neural network and deep neural network controller on photovoltaic system with cascaded multilevel inverters: Comparison on standalone and grid integrated system

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2022, vol. 13, no. 2, p. 157-178, 31 ill, 2 tab, 21 ref.

The introduction of a micro-grid-based power generation network will help to meet the demands of consumers while reducing environmental impact. Several industrialized and emerging countries allocate considerable resources to renewable energy-based power generation and invest significant sums of money in this area. This study examines the challenges involved with electricity generation through photovoltaic (PV) systems and the integration of the same with the grid to mitigate power quality issues and improve the power factor for various loading conditions. An innovative multilayer inverter for grid-connected PV systems has been developed to enhance the voltage profile and resulted in a drop in total harmonic distortion (THD). A cascade multilevel inverter (associated with a grid-integrated PV system and managed using multiple innovative artificial intelligence controllers) was developed in this research project. Various advanced intelligent controllers, such as cascade feedforward neural networks

(CFFNN) and deep neural networks (DNN), have been analyzed under various operating situations and observed that the THD of voltage, current at the grid, and the load is less than 3 % as per the IEEE 519 standards along with this power factor is maintained nearly unity for the grid-connected system. The quality of power in terms of voltage, frequency, total harmonics distortion, and power factor are improved by using a novel deep neural network algorithm in a cascaded multilevel inverter and verified according to IEEE 1547 and IEEE 519 standards to determine the efficacy of the proposed system.

(Author)

Keywords: cascaded feedforward neural network; deep neural network; multilevel inverter; photovoltaic system; total harmonics distortion.

Hartono Yudo [a], Andi Setiawan [a], Ocid Mursid [a], Muhammad Iqbal [b] ([a] Department of Naval Architecture, Faculty of Engineering, Diponegoro University, Indonesia; [b] Department of Naval Architecture, Ocean, and Marine Engineering, University of Strathclyde, United Kingdom)

Torsional strength analysis of universal joint's ZP-11A due to yokes modification and materials

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2022, vol. 13, no. 2, p. 179-188, 15 ill, 8 tab, 20 ref.

The study examined the strength of the universal joint after it was loaded with torsion. It used different materials that can withstand tensile stress in accordance with accepted principles and made modifications to the yoke as a result of the topology optimization process. The topology optimization determined that the yoke's part needed to withstand load without changing its dimensions and minimize stress distribution. According to the results, the maximum shear stress on the spider of the original universal joint model made of JIS-SF590A steel was 84.57 MPa, the shear stress on the yoke component was 30.84 MPa, and the maximum von Mises was 341.1 MPa. As a result of using JIS-SF590A steel, yoke modification 3 has produced a reduction in shear stress of 12.97 % and a reduction in von Mises stress of 35.33 % from the original yoke. This is the most efficient design of yoke and also this modified yoke form provides a wider elevation angle and is easier to manufacture.

(Author)

Keywords: shear stress; topology optimization; universal joint; von mises.

Mostafa Nazih (Future Energy, GHD Pty Ltd, Australia)

Effect of lightning mast placement on underground power cable jacket stress within high voltage substations

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2022, vol. 13, no. 2, p. 189-200, 17 ill, 1 tab, 30 ref.

This study aims to investigate the impact of lightning masts placement on underground cables within high voltage substations. While the subject of lightning discharges near to underground cables has been covered with open cable runs and wind farms in many papers, this study focuses on lightning events within high voltage substations considering the associated effective zones, which were not covered in the available literature. Substations built within areas prone to high lightning activity experience frequent discharges that cause the potential rise of the earthing system into hundreds of kilovolts. The potentials propagating within the soil and the earthing grid affect underground cables jackets terminated within the substation. The numerical analysis of the problem is carried out using Current Distribution, Electromagnetic fields, Grounding and Soil structure analysis (CDEGS) software engine for different configurations of lightning mast placements with varied separation, electrode placement and length, soil resistivity, and lightning current. Study findings indicate that provision of lightning masts/down conductors as far as possible or at least twice the effective zone radius from cable termination/route electrodes ensures relatively lower stress voltages. Electrodes with effective zone radius length placed as close as possible to lightning masts further reduce the attainable jacket stress voltages.

(Author)

Keywords: substation earthing; lightning mast placement; high voltage; underground cable; effective zone radius.

Tinton Dwi Atmaja [a, b, c], Dalila Mat Said [a, c], Sevia Mahdaliza Idrus [a, c], Ahmad Fudholi [b, d], Nasarudin Ahmad [a], Dian Andriani [e, f], Ahmad Rajani [a, b, c], Sohrab Mirsaeidi [g], Haznan Abimanyu [h], ([a] Faculty of Electrical Engineering, Universiti Teknologi Malaysia, Malaysia; [b] Research Centre for Energy Conversion and Conservation, National Research and Innovation Agency, Indonesia, [c] Centre of Electrical Energy System, Institute of Future Energy, UTM, Malaysia; [d] Solar Energy Research Institute, Universiti Kebangsaan Malaysia, Malaysia; [e] Faculty of Civil Engineering, Universiti Teknologi Malaysia, Malaysia; [f] Research Organization for Life Sciences & Environment, National Research and Innovation Agency, Indonesia; [g] School of Electrical Engineering, Beijing Jiaotong University, China; [h] Research Organization for Energy and Manufacture, National Research and Innovation Agency, Indonesia)

Component degradation and system deterioration: an overview of early termination of PV-DG microgrid system

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2022, vol. 13, no. 2, p. 201-213, 9 ill, 3 tab, 100 ref.

Degradation of components and system failure within the microgrid system is deteriorating the performance of electrification. The aim of this study is to discuss the relationship and connections between issues resulting from degradation and deterioration in the microgrid system, in addition to introducing the prominent impacts which may eventually lead to the premature termination of the microgrid system. This study explored the microgrid degradation and deterioration issues within four microgrid sections: generation section, storage section, transmission section, and distribution section. Subsequently, this study analyzes, derives, and classifies all emerging issues into four types of prominent impacts. The degradation and deterioration invoked many component performance issues into four main damaging outcomes, namely (i) deteriorated transmission line yielded issues regarding expected energy not achieved; (ii) energy deficit and unpredicted blackout come after the depth of discharge (DOD) reduction and invoke a loss of power supply; (iii) a shorter battery life cycle, shorter transformer lifespan, and decreased DG lifetime concluded as a shorter microgrid life expectancy; and (iv) rapid microgrid broke down and the crash of the key component inadvertently fastened the time to failure and gave rise to the early failure of a microgrid system. It is envisaged that the discussion in this study can provide useful mapped information for the researcher, stakeholder, operator, and other parties for thoroughly addressing various degradation and deterioration issues and anticipating the early termination of the microgrid system.

(Author)

Keywords: expected energy not achieved; shorter lifespan; early failure; microgrid termination; loss of power supply.

Sujito [a], Ridho Riski Hadi [b], Langlang Gumilar [a], Abdullah Iskandar Syah [b], Moh. Zainul Falah [b], Tran Huy Duy [c] ([a] Intelligent Power and Advance Energy System, Jurusan Teknik Elektro, Universitas Negeri Malang, Indonesia; [b] Electrical Engineering, Electrical Engineering Department, Universitas Negeri Malang, Indonesia; [c] Electrical Engineering Department, Dalat University, Vietnam)

Long-term forecasting for growth of electricity load based on customer sectors

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2022, vol. 13, no. 2, p. 214-221, 2 ill, 7 tab, 37 ref.

The availability of electrical energy is an important issue. Along with the growth of the human population, electrical energy also increases. This study addresses problems in the operation of the electric power system. One of the problems that occur is the power imbalance due to scale growth between demand and generation. Alternative countermeasures that can be done are to prepare for the possibility that will occur in the future or what we are familiar with forecasting. Forecasting using the multiple linear regression method with this research variable assumes the household sector, business, industry, and public sectors, and is considered by the influence of population, gross regional domestic product, and District Minimum Wage. In forecasting, it is necessary to evaluate the accuracy using mean absolute percentage error (MAPE). MAPE evaluation results show a value of 0.142 % in the household sector, 0.085 % in the business sector, 1.983 % in the industrial sector, and 0.131 % in the total customer sector.

(Author)

Keywords: district minimum wage; gross regional domestic product; long-term forecasting; mean absolute percentage error; multiple linear regression.