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Aim and Scope

Journal of Mechatronics, Electrical Power, and Vehicular Technology (MEV) is an internationally peer-reviewed journal aims to provide authoritative global source of scientific information for researchers and engineers in academia, research institutions, government agencies, and industries. The Journal publishes original research papers, review articles and case studies focused on:

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FOREWORD FROM EDITOR-IN-CHIEF

Dear valued Readers

We are pleased to present the second issue in 2023 for Volume 14 of the Journal of Mechatronics, Electrical Power, and Vehicular Technology (MEV). A peer-reviewed and broad-scope international journal which is designed to advance scientific knowledge and foster innovative engineering solutions. This journal addresses both academics and practicing professionals with the aims to bridge the gap in mechatronics, electrical power, and vehicular technology and has become an increasingly recognized international journal in the past years.

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. Authors from different countries, such as Australia, Germany, Indonesia, Japan, Malaysia, Myanmar, Netherlands, Norway, South Korea, Thailand, and United Kingdom have contributed in the eleven papers to this issue.

Apriaskar, et al. proposes a new control method for bicopter that uses a genetic algorithm optimization approach in the linear quadratic (LQ-GA) control method and was tested on a balancing bicopter test platform with an input in the form of difference in pulse width modulation (PWM) signals for both rotors and an output in the form of roll angle. Arifin, et al. presents a simple, compact, and low-cost gripper to offer an accessible and readily deployable solution for research and education. The gripper utilizes a parallel four-bar linkage mechanism, minimizing the number of components and incorporating off-the-shelf parts for straightforward assembly. The next paper proposes a simple modified scheme of trapezoidal commutation circuits that can produce sinusoidal BLDC output voltage. Gumilar, et al. investigated the usage of zigzag transformers placed at point common coupling to reduce harmonics distortion in distribution systems as a whole. Characteristics of common mode conducted emission of multi-boost converters are investigated by Sudrajat, et al.

There are another six papers written in this issue about Enhancing efficiency of magnetic energy by implementing square-shaped materials adjacent to induction machine windings; Optimization of load frequency control using grey wolf optimizer in micro hydro power plants; Distracted driver behavior recognition using modified capsule networks; Design and CFD simulation of guide vane for multistage Savonius wind turbine; Water quality assessment monitoring system using fuzzy logic and the internet of things; and The Influence of Battery-Powered Engine on the Reduction of Carbon Dioxide Production from Fishing Boats.

Each issue of this journal offers valuable reports and articles to the practitioners and research experts. We encourage academic and research professionals to submit manuscripts on practical and scientific key issues in mechatronics, electrical power, and vehicular technology of all disciplines. We are looking forward to receiving extraordinary manuscripts and promoting cutting-edge technology development.

Bandung, December 2023

Editor-in-Chief

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ABSTRACTS SHEET

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Esa Apriaskar [a], Dhidik Prastiyanto [a], Aryo Baskoro Utomo [a], Akhyar Abdillah Manaf [a], Ilya Amelia [a], Dimas Alfarizky Ilham [a], Viyola Lokahita Bilqis [a], Chonlatee Photong [b] ([a] Department of Electrical Engineering, Universitas Negeri Semarang, Indonesia; [b] Faculty of Engineering, Mahasarakham University, Thailand)

Genetic algorithm-enhanced linear quadratic control for balancing bicopter system with non-zero set point

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 2, p. 105-113, 8 ill, 5 tab, 33 ref.

Bicopter is an unmanned aerial vehicle (UAV) with the advantage of saving energy consumption. However, the unique two rotors design presents a challenge in designing a controller that achieves good stability, fast settling time, and the ability to overcome oscillations simultaneously. This article proposes a new control method for bicopter that uses a genetic algorithm optimization approach in the linear quadratic (LQ-GA) control method. The GA is used to search for the best weighting matrix parameters, Q and R, in the Linear Quadratic (LQ) control scheme. The proposed control method was tested on a balancing bicopter test platform with an input in the form of difference in pulse width modulation (PWM) signals for both rotors and an output in the form of roll angle. The control system was evaluated based on the stability of the transient response and the generated control signal. The results of the tests showed that the proposed LQ-GA control method has better stability, faster settling time, and smaller overshoot than the existing PI and standard LQ control methods. Therefore, the proposed LQ-GA control method is the most suitable for use in a balancing bicopter system with a non-zero setpoint.

(Author)

Keywords: balancing bicopter; genetic algorithm; linear quadratic; roll angle; non-zero set point.

Muhammad Arifin [a], Rian Putra Pratama [a], Oka Mahendra [a], Aris Munandar [a], Catur Hilman Adritya Haryo Bhakti Baskoro [a], Muhtadin [b], Abdullah Iskandar [c] ([a] Research Center for Smart Mechatronics, National Research and Innovation Agency, Indonesia; [b] Department of Computer Engineering, Institut Teknologi Sepuluh Nopember, Indonesia; [c] Department of Computer Science and Communications Engineering, Waseda University, Japan)

An open-source parallel gripper with an embedded soft skin fingertip sensor

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 2, p. 114-126, 15 ill, 3 tab, 30 ref.

The demand for implementing robots into our daily lives has surged in recent years, necessitating safe grasping for effective interaction with the environment. However, a majority of researchers rely on commercial grippers for their experimental studies, which are typically expensive and not accessible to everyone. Despite the existence of open-source designs, the assembly process is often challenging and requires modifications to enhance secure grasping. This paper presents a simple, compact, and low-cost gripper to offer an accessible and readily deployable solution for research and education. The gripper utilizes a parallel four-bar linkage mechanism, minimizing the number of components and incorporating off-the-shelf parts for straightforward assembly. Furthermore, to enhance its capabilities, the proposed gripper implements a soft skin tactile sensor on its fingertips. These sensors offer three-directional measurements using Hall effect sensing and embedded silicone. By controlling fingertip force based on information from the tactile sensors, the gripper achieves safe grasping. The gripper is evaluated to grasp daily life objects with different properties such as shapes, sizes, and levels of deformability. Evaluation results showcase the gripper's versatility, enabling it to securely grasp various objects, including fragile items. This outcome underscores the gripper's effectiveness, versatility, and safety in practical use.

(Author)

Keywords: gripper design; open-source robotics; soft skin fingertip sensor; safe grasping.

Ratih Mar'atus Sholihah [a], Fahrul [b], Adhika Kurniawan [b], Irwan Mahmudi [a] ([a] Electrical Engineering, Tadulako University, Indonesia; [b] Electrical Engineering and Installation, Metal Industry Polytechnic of Morowali, Indonesia)

Implementation of modified trapezoidal commutation scheme for speed control of 1 kW BLDC motor

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 2, p. 127-137, 15 ill, 4 tab, 20 ref.

The commutation process in brushless DC (BLDC) motors is done electrically and depends on the rotor position feedback. The Six-Step method is the most commonly used method in BLDC control, as it is easy to implement. However, this method has a high root mean square (RMS) current. On the other hand, a perfect sinusoidal commutation method is very complicated. Therefore, this research proposes a simple modified scheme of trapezoidal commutation circuits that can produce sinusoidal BLDC output voltage. This circuit can still responsively control the speed of the BLDC motor. This scheme uses 2 Arduinos. Pulse width modulation (PWM) signal from Arduino2 is then combined with hall signals from Arduino1, resulting in six outputs which are modified electrical commutation signals. This commutation signal is used as a MOSFET controller in a 3-phase inverter to produce a sinusoidal waveform. The average efficiency obtained when implementing the commutation is 75 % at low and high speeds.

(Author)

Keywords: BLDC; modified trapezoidal commutation; motor speed control; sinusoidal waveform.

Langlang Gumilar [a], Ibram Adib Wicaksono [a], Arif Nur Afandi [a], Ahmad Asri Abd Samat [b], Quota Alief Sias [c] ([a] Department of Electrical and Informatics Engineering, Universitas Negeri Malang, Indonesia; [b] Centre for Electrical Engineering Studies, Universiti Teknologi MARA, Malaysia; [c] Department of Electrical Engineering, Chonnam National University, South Korea)

Investigation of the usage of zigzag transformers to reduce harmonics distortion in distribution systems

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 2, p. 138-149, 17 ill, 0 tab, 31 ref.

The increasing use of power electronics in various sectors leads to harmonic distortion in electric power systems, affecting power quality and equipment longevity. While harmonic filters have been used to address this issue, they are limited in effectiveness, particularly in reducing distortion across the entire distribution system. This study aims to reduce harmonic distortion using a zigzag transformer as a more comprehensive solution in mitigating harmonic distortion throughout the entire distribution system. In this research, the zigzag transformer was placed at point common coupling to reduce harmonic distortion in the distribution system as a whole. A zigzag transformer connection was configured by connecting either three windings of a single-phase transformer or one winding of a three-phase transformer. Based on the results of this research, the total harmonic distortion (THD) value has decreased from 25.26 % to 2.48 % following the implementation of the zigzag transformer. This substantial decrease in THD concludes the zigzag transformer's effectiveness as a solution for improving power quality in electrical distribution systems.

(Author)

Keywords: zigzag transformer; harmonic distortion; distribution system; non-linear loads.

Muhammad Imam Sudrajat [a, b], Afiva Riyatun Nuvus [c], Dwi Mandaris [a] ([a] Research Center for Testing Technology and Standards, National Research and Innovation Agency (BRIN), Indonesia; [b] Faculty of Electrical Engineering, Mathematics and Computer Science, University of Twente, The Netherlands; [c] Faculty of Mathematics and Natural Sciences, Universitas Negeri Jakarta, Indonesia)

Characteristics of common code conducted emission of multi-boost converters

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 2, p. 150-157, 9 ill, 1 tab, 20 ref.

One of the primary challenges faced when utilizing power converters such as a DC boost converter is electromagnetic interference (EMI) issues, one of which is common-mode (CM) noise. In order to mitigate the unwanted EMI from converters and design proper EMI filters, it is imperative to possess comprehensive insight into the characteristics of CM noise generated from the converters. This study presents the investigation regarding the characteristic of CM noise emitted by multi-boost converters when operated under varying duty cycle conditions. The research was conducted by measuring and analyzing the CM noise generated by three identical boost converters arranged in a parallel configuration. The result shows that the amplitude of each harmonic of CM noise generated by the multi-boost converters is 5 dB to 10 dB higher than CM noise from a single-boost converter. This is due to each converter being configured in the same conditions, producing a constructive interaction of the generated CM noise. Moreover, the duty cycle of pulse-width modulation (PWM) has a strong influence on the characteristic of the amplitude of each harmonic frequency. It is proven by the amplitude pattern of each harmonic of CM noise. Under duty cycle variations, the converters generate similar peaks and valley amplitude patterns as the Fourier transformation of the trapezoidal waveform used in the PWM setting.

(Author)

Keywords: common-mode (CM) noise; duty cycle; electromagnetic interference (EMI); multi-boost converters; pulse-width modulation (PWM).

Muhammad Afnan Habibi [a], Soraya Norma Mustika [a], Aripriharta [b], Adi Izhar Che Ani [c] ([a] Faculty of Applied Science and Technology, Universitas Negeri Malang, Indonesia; [b] Department of Electrical and Informatics Engineering, Universitas Negeri Malang, Indonesia; [c] Centre for Electrical Engineering Studies, Universiti Teknologi MARA, Malaysia)

Enhancing efficiency of magnetic energy by implementing square-shaped materials adjacent to induction machine windings

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 2, p. 158-165, 6 ill, 8 tab, 29 ref.

This study provides a worthwhile method for increasing the magnetic field energy and induction machine (IM) effectiveness. The coupling between the transmitter and receiver windings in the IM system can be improved by creating materials with specific electromagnetic properties. This added material has altered the magnetic flow as well as the energy of the magnetic field. Eventually, it is possible to calculate the efficiency of the magnetic field, or the ratio of primary to secondary magnetic energy. With the use of two-dimensional finite element analysis, numerical results on five cases with various configurations of a magnetic substance have been produced. This material, which varies in length or breadth, is positioned close to the windings of the transmitter, receiver, or both. Case 3, in which the

transmitter generates a magnetic field on the receiver side with a minimum energy of 0.05 J and a maximum energy of 0.015 J, is the ideal material configuration for DC current. Currently, the system efficiency is 0.29 on average. A 1 kHz transmitter's energy is constant under all conditions, but its counterpart's energy fluctuates significantly, with case 5 receiving the most energy. Therefore, case 5 turns into the optimal structural arrangement. It can be inferred that case 5 similarly dominates the other with an efficiency of 0.0026, which is much greater than that of 1 kHz efficiency, while the windings are operating at 1 MHz. This leads to stronger magnetic field coupling and increased power transfer effectiveness.

(Author)

Keywords: energy efficiency; inductive coupling; magnetic flux density; non-linear magnetic field; solenoid winding.

Irvandy Ilza Novendra [a], I Made Wirawan [a], Arya Kusumawardana [b], Aung Ko Latt [c] ([a] Department of Electrical and Informatics Engineering, Universitas Negeri Malang, Indonesia; [b] Faculty of Applied Science and Technology, Universitas Negeri Malang, Indonesia; [c] Executive Engineer (EE), Electric Power Generation Enterprise (EPGE), Ministry of Electric Power (MOEP), Myanmar)

Optimization of load frequency control using grey wolf optimizer in micro hydro power plants

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 20223, vol. 14, no. 2, p. 166-176, 15 ill, 9 tab, 22 ref.

Micro hydro power plants (MHPP) is one of the renewable energy that can be utilized as a distributed generation with controllable power output. One common issue in MHPP systems is the non-constant rotation of the generator caused by load fluctuations. This instability leads to variable frequencies, which can potentially harm electrical equipment. To address this problem, the volume of water entering through the governor can be adjusted to synchronize the turbine and generator rotation with the load. This approach helps dampen frequency oscillations and ensures that the system operates within desired limits. Therefore, there is a need for technology that can enhance the performance of micro hydro power plant units, specifically load frequency control (LFC). This research proposes the application of the grey wolf optimizer (GWO) algorithm to optimize the PID controller parameters for MHPP LFC. MHPP has been modeled in both isolated and grid-connected modes using Simulink MATLAB R2020a. The best cost function value for an isolated mode system was obtained with ISE_{im}, yielding a value of 0.067653, while for a grid-connected mode system, it was achieved with ISE_{gm}, with a value of 0.015861. The results of the frequency deviation response performance of the LFC using GWO indicate that the fastest settling time was achieved with the cost function $ITAE_{im}$ in isolated mode, and with IAE_{gm} in grid-connected mode. The cost function that produces the smallest peak overshoot and peak undershoot parameter values varied depending on changes in the system load.

(Author)

Keywords: load frequency control, grey wolf optimizer, micro hydro power plant.

Jimmy Abdel Kadar [a], Margareta Aprilia Kusuma Dewi [b], Endang Suryawati [a], Ana Heryana [a], Vicky Zilfan [a], Budiarianto Suryo Kusumo [a, c], Raden Sandra Yuwana [a], Ahmad Afif Supianto [a, d], Hasih Pratiwi [b], Hilman Ferdinandus Pardede [a] ([a] Research Center for Artificial Intelligence and Cyber Security, National Research and Innovation Agency, Indonesia; [b] Faculty of Mathematics and Natural Sciences, Sebelas Maret University, Indonesia; [c] Faculty of Electrical Engineering and Information Technology, Chemnitz University, Germany; [d] Department of ICT and Natural Sciences, Norwegian University of Science and Technology, Norway)

Distracted driver behavior recognition using modified capsule networks

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 2, p. 177-185, 11 ill, 4 tab, 36 ref.

Human activity recognition (HAR) is an increasingly active study field within the computer vision community. In HAR, driver behavior can be detected to ensure safe travel. Detect driver behaviors using a capsule network with leave-one-subject-out validation. The study was done using CapsNet with leave-one-subject-out validation to identify driving habits. The proposed method in this study consists of two parts, namely encoder and decoder. The encoder used in this study modifies Sabour's capsule network architecture by adding a convolution layer before going to the primary capsule layer. The proposed method is evaluated using a primary dataset with 10 classes and 300 images for each class. The dataset is split based on hold-out validation and leave-one-subject-out validation. The resulting models were then compared to conventional CNN architecture. The objective of the research is to identify driving behavior. In this study, the proposed method results an accuracy rate of 97.83 % in the split dataset using hold-out validation. However, the accuracy decreased by 53.11 % when the proposed method was used on a split dataset using leave-one-subject-out validation. This is because the proposed method extracts all features including the attributes of each participant contained in the input image (user-independent). Thus, the resulting model in this study tends to overfit.

(Author)

Keywords: capsule network; driver behavior detection; human activity recognition.

Dionisius Devin [a], Levin Halim [a], Bagus Made Arthaya [a], Jonathan Chandra [b] ([a] Department of Electrical Engineering, Parahyangan Catholic University, Indonesia; [b] Department of Mechanical Engineering, University of Groningen, The Netherlands)

Design and CFD simulation of guide vane for multistage Savonius wind turbine

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 2, p. 186-197, 15 ill, 3 tab, 24 ref.

This study proposes improving the performance of a fixed-axis multistage Savonius wind turbine by integrating a sixbladed guide vane. Guide vanes aim to direct the incoming wind towards the blades of the Savonius wind turbine so that it can increase the performance value of the turbine itself. There are two methods, the first method is computational fluid dynamics (CFD) simulation to evaluate the best performance guide vane angle variations. The second method is implementing real conditions using 3 m/s until 4.2 m/s wind speed. The implementation of the guide vane to the wind turbine will consider four (4) variants of angles (0°, 20°, 40°, and 60°). The purpose of testing with four kinds of guide vane angles is to find out which guide vane angle can provide the best results among other guide vane angles. This research proposed the initial design of the guide vane addition to the multistage Savonius wind turbine with a fixed rotary axis. From the CFD simulation, the implementation of a guide vane can improve the performance of the multistage Savonius wind

turbine with a fixed rotary axis. On the other hand, for the proposed initial design in this research, the 20° angle of guide vane gives the best result compared to the 0°, 40°, 60°, and without guide vane.

(Author)

Keywords: multistage Savonius wind turbine; guide vane; power coefficient; torque coefficient; CFD simulation.

Hanif Fakhrurroja [a, c], Edi Triono Nuryatno [b], Aris Munandar [c], Muhammad Fahmi [d], Novan Agung Mahardiono [c] ([a] School of Industrial Engineering, Telkom University, Indonesia; [b] UWA Centre for Medical Research, University of Western Australia, Australia; [c] Research Center for Smart Mechatronics, National Research and Innovation Agency (BRIN), Indonesia; [d] Faculty of Digital and Information Technology, Institute of Digital Economics LPKIA, Indonesia)

Water quality assessment monitoring system using fuzzy logic and the internet of things

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 2, p. 198-207, 9 ill, 5 tab, 32 ref.

Water utilization has recently been at its highest level of demand. The water needed to be clean, healthy, and determined to be suitable for consumption. Therefore, it is necessary to have a system that can monitor the water quality so thatinformation related to wate r suitability can be received regularly and in real-time. This paper addresses the critical need for real-time water quality monitoring systems. This study proposed a novel approach integrating the Tsukamoto fuzzy algorithm into an internet of things (IoT)-based framework, forming part of the Fuzzy Inference System. Our system serves as a decision support tool, enabling continuous assessment of water quality. The method categorizes water quality into three levels: good, moderate, and unhealthy, providing timely and precise suitability information. The results demonstrate the effectiveness of the fuzzy logic method in delivering accurate output. Through remotely deployed IoT devices, water suitability and status can be monitored and analyzed in real-time over the internet. This research bridges the gap between traditional water quality assessment methods and the demands of our modern, technology-driven society, ensuring a reliable supply of safe and consumable water.

(Author)

Keywords: assessment monitoring; fuzzy logic; internet of things (IoT); real-time; water quality.

Nilam Sari Octaviani [a], Dwitya Harits Waskito [a], Iskendar [a], Abdul Muis [a], Noor Muhammad Ridha Fuadi [b], Muhajirin [a], Hendra Palebangan [a], Kunto Ismoyo [a], Dewi Kartikasari [a], Nanda Itohasi Gutami [a], Kusno Ajidarmo [a] ([a] Research Center for Transportation Technology, National Research and Innovation Agency, Indonesia; [b] Cardiff Business School, Cardiff University, United Kingdom)

The influence of battery-powered engine on the reduction of carbon dioxide production from fishing boats

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 2, p. 208-214, 4 ill, 4 tab, 31 ref.

Several technologies are currently being applied in the maritime industry to reduce greenhouse gas (GHG) emissions. An example is the implementation of an electric propulsion system with a battery charged using a renewable energy source. Meanwhile, it is important to analyze the energy demand and the quantity of emissions reduced in a vessel after installing this system. Therefore, this study focused on analyzing the energy demand and emissions produced on fishing boats, specifically the "Sandeq" fishing boats in West Sulawesi. The primary objective was to quantify the carbon dioxide emissions reduced after the conventional engine of the vessel was replaced with an electric propulsion system. Moreover, the energy demand of the boat was estimated by analyzing the daily speed, length of voyage, and engine capacity. The results showed that six batteries were required to provide the power needed for daily operation. Furthermore, the electric propulsion system was able to reduce CO_2 emission by 7.94 tons annually per ship, leading to the reduction of fuel consumption and emission taxes to approximately 10 million Rupiah annually. These results were expected to encourage stakeholders to promote the transition from conventional diesel engines to electric-powered engines.

(Author)

Keywords: CO_2 emission; fishing boats; battery propulsion; West Sulawesi; boat electrification.