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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

Most valued Readers,

Welcome to the 1st issue of Volume 14 in the year 2023 of the Journal of Mechatronics, Electrical Power, and Vehicular Technology (MEV), a peer-reviewed and broad-scope international journal. This journal aims to bridge the gap in mechatronics, electrical power, and vehicular technology and is designed to advance scientific knowledge and foster innovative engineering solutions. It addresses both academics and practicing professionals, which has become an increasingly recognized international journal in the past years.

This issue consists of ten papers written by authors from different countries, such as Greece, Indonesia, United Kingdom, Japan, Netherland, USA, Hungary, 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.

The first paper a control system algorithm for a five-axis PMS CNC milling machine based on a 6-DOF Stewart platform parallel manipulator with a universal-prismatic-spherical (UPS) configuration. Lampropoulos, the author of second paper analysis includes 1,926 articles that were identified and retrieved from Scopus and Web of Science (WoS) over the period 2005 to 2022 with the aims to explore the use of artificial intelligence in smart grids and how the topic has evolved over the years. The third paper calculate the 480-kW squirrel cage induction motor (SCIM) design for the electric multiple unit (EMU) train. While, Tamba, et al. presents in their work a sum of squares (SOS) polynomial optimization approach for stability analysis of a hybrid model of buck converter which explicitly takes into account the converter's electronic switching behavior. Similar to second paper, Irawan, et al. Used bibliometric analysis to determine the growth of vertical axis wind turbine (VAWT) research, the number of VAWT studies in various countries and the most influential authors to find opportunities for research collaboration, and the challenges of future VAWT research. Research data was taken from Scopus in 1801 articles from 1970-2021.

The next article has one of the objectives to see the maximum impact of installing a photovoltaic rooftop at 1 point of customer and spread capacity for each customer. A model for forecasting the number of vehicles arriving at the battery swap station was designed by the authors of the seventh paper. The next paper is also talking about design and implementation of capacitor array as DC converters for electrical lighting in limited area. Sukra, et al. studied about impact of road load parameters on vehicle CO_2 emissions and fuel economy: a case study in Indonesia. The last paper shows analysis of lithium-ion battery packs failures in electric vehicles based on FMEA.

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, July 2023

Editor-in-Chief

Journal of

Mechatronics, Electrical Power, and Vehicular Technology

Volume 14, Issue 1, 2023

List of Contents

Journal of
Mechatronics, Electrical Power, and Vehicular Technology
Volume 14, Issue 1, 2023

ABSTRACTS SHEET

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Five-axis parallel mechanism system (PMS) CNC partial link control system based on modified inverse kinematic of 6-DOF UPS parallel manipulator

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 1, p. 1-10, 12 ill, 0 tab, 27 ref.

This paper presents a control system algorithm for a five-axis parallel mechanism system (PMS) CNC milling machine based on a 6-DOF Stewart platform parallel manipulator with a universal-prismatic-spherical (UPS) configuration. The control system reads the G-Code commands as standard CNC machine language, then extract data points and interpolates them to generate the robot trajectory patterns as motion references. Then, the control system uses the modified inverse kinematic equation to determine the length of each link to move the end effector to track the trajectory patterns from the previous G-code extraction process. The inverse kinematic equation is modified especially for the five-axis PMS CNC milling machine by including machine-offset and tools-offset parameters so it will be easier for the control system to implement the kinematic equation. As expected, the system simulation results successfully followed the G-Code program moving commands. The average error of the length control system is 0,1 mm, while the average error of the length change rate control system is 1,8 mm/s. The maximum error is 26.9 mm was caused by the system's inability to follow the motion profile in transient. It can be concluded that 6-DOF Stewart platform parallel structures, which provide better performance than serial structures, can be implemented as a new concept for the motion mechanism of five-axis CNC milling machines. The five-axis PMS CNC milling machine also promises better performance than conventional five-axis gantry structures CNC.

(Author)

Keywords: Stewart platform; parallel manipulator; parallel mechanism structure; machine tools; CNC control system.

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Artificial intelligence in smart grids: A bibliometric analysis and scientific mapping study

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 1, p. 11-34, 35 ill, 9 tab, 49 ref.

The realization of sustainable development and sustainable development goals achievement are essential. Hence, the power sector digitalization is imminent. This bibliometric and mapping study aims to explore the use of artificial intelligence in smart grids and how the topic has evolved over the years. In total, ten research questions are set to be explored. The analysis includes 1,926 articles that were identified and retrieved from Scopus and Web of Science (WoS) over the period 2005 to 2022. The analysis includes the descriptive statistics of the related studies and the annual scientific production, the identification of the most relevant and impactful authors, articles, outlets, affiliations, and countries, and the examination of the most commonly used keywords. The most popular topics and the advancement of the research focus are also explored. The study examines the results, discusses the main findings, presents open issues, and suggests new research directions. The significant role of artificial intelligence in the realization of smart grids and the digitalization of the power sector to enable sustainable development and the achievement of sustainable development goals was evident.

(Author)

Keywords: artificial intelligence; smart grid; power sector; renewable energy resources; sustainable development.

Hilda Luthfiyah [a], Okghi Adam Qowiy [a], Arga Iman Malakani [b], Dwi Handoko Arthanto [c], Fauzi Dwi Setiawan [a], Teddy Anugrah Ramanel [d], Gilang Mantara Putra [e], Syamsul Kamar [a], Asep Andi Suryandi [f, g] ([a] Research Center for Transpostation Technology, National Research and Innovation Agency (BRIN), Indonesia; [b] Research Center for

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An optimized stator and rotor design of squirrel cage induction motor for EMU train

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 1, p. 35-46, 17 ill, 7 tab, 27 ref.

This paper aims to objectively calculate the 480-kW squirrel cage induction motor (SCIM) design for the electric multiple unit (EMU) trains. This is done by optimizing the stator slot and rotor slot design to get efficiency and power factor targets. The stator slot design is achieved by limiting the width and height of the stator slot pitch according to the specified range. A depth-to-width ratio is used according to the range to optimize the design of the rotor bar slot. The design process of the induction motor consists of three steps: it determines the specification design target, calculates the specified parameters of the induction motor, and simulates the design to obtain the most optimal motor design using ANSYS Maxwell. The simulation performance values obtained an efficiency of 92.547 % and a power factor of 0.915. This value is obtained from the optimization of the rotor slot and has met the minimum requirements of efficiency and power factor in designing a SCIM. The design proposed in this paper can be developed and applied in the Indonesian domestic railway manufacturing industry.

(Author)

Keywords: squirrel cage induction motor; stator slot; rotor slot; motor efficiency; motor power factor.

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Stability analysis of a hybrid DC-DC buck converter model using dissipation inequality and convex optimization

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 1, p. 47-54, 3 ill, 0 tab, 34 ref.

The stability analysis of a DC-DC buck converter is a challenging problem due to the hybrid systems characteristic of its dynamics. Such a challenge arises from the buck converter operation which depends upon the ON/OFF logical transitions of its electronic switch component to correspondingly activate different continuous vector fields of the converter's temporal dynamics. This paper presents a sum of squares (SOS) polynomial optimization approach for stability analysis of a hybrid model of buck converter which explicitly takes into account the converter's electronic switching behavior. The proposed method first transforms the converter's hybrid dynamics model into an equivalent polynomial differential algebraic equation (DAE) model. An SOS programming algorithm is then proposed to computationally prove the stability of the obtained DAE model using Lyapunov's stability concept. Based on simulation results, it was found that the proposed method requires only 8.5 seconds for proving the stability of a buck converter model. In contrast, exhaustive simulations based on numerical integration scheme require 15.6 seconds to evaluate the stability of the same model. These results thus show the effectiveness of the proposed method as it can prove the converter stability in shorter computational times without requiring exhaustive simulations using numerical integration.

(Author)

Keywords: DC-DC buck converter; switched hybrid systems; Lyapunov method; dissipation inequality; SOS programming.

Elysa Nensy Irawan [a, b], Nuur Wachid Abdul Majid [c], Liptia Venica [a], Fahrur Aslami [d], Goro Fujita [e] ([a] Department of Mechatronics and Artificial Intelligence, Universitas Pendidikan Indonesia, Indonesia; [b] Functional Control System, Shibaura Institute of Technology, Japan; [c] Department of System and Information Technology Education, Universitas Pendidikan Indonesia, Indonesia; [d] Department of Computer Engineering, Universitas Wiralodra, Indonesia; [e] Department of Electrical Engineering, Shibaura Institute of Technology, Japan)

Analyzing the growth and trends of vertical axis wind turbine research: Insight from a bibliometric study

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 1, p. 55-61, 4 ill, 1 tab, 39 ref.

Bibliometric analysis research has been done for vertical axis wind turbine (VAWT). This study aims to determine the growth of VAWT research, the number of VAWT studies in various countries and the most influential authors to find opportunities for research collaboration, and the challenges of future VAWT research. Research data was taken from Scopus in 1801 articles from 1970-2021. The software used for data interpretation was VosViewer 1.6.19 and Tableau Public 2022.2. Based on the analysis, VAWT research has tended to increase from 1970-2021, although there was a decrease from 1987-2006. The country that has conducted the most VAWT research is China, while the author with the highest number of citations is from Italy. The most dominant research topic related to VAWT research is computational fluid dynamics (CFD), which is 50.14 % of the total. A future challenge related to VAWT research is finding a suitable turbulence model for each type of VAWT or finding an airfoil optimization method so that a model with better performance is obtained. Opportunities for research collaboration can be carried out with China or an author with the highest number of citations who has expertise in the field of CFD.

(Author)

Keywords: bibliometric analysis; Tableau Public 2022.2 software; vertical axis wind turbine (VAWT); VosViewer 1.6.19 software.

Riki Khomarudin, Kevin Marojahan Banjar-Nahor, Nanang Hariyanto (School of Electrical Engineering & Informatics, Bandung Institute of Technology, Indonesia)

Quasi-dynamic hosting capacity in radial distribution feeder

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 1, p. 62-71, 16 ill, 4 tab, 21 ref.

The target of massive installation of renewable energy is the focus of this research. Several industrial sectors continue to install photovoltaic rooftop to support green energy. One of the main objectives of this research is to see the maximum impact of installing a photovoltaic rooftop at

1 point of customer and spread capacity for each customer. This research uses a radial distribution network system that closely resembles the distribution network in Indonesia, where the load profile considers the load characteristics of industrial, commercial, and residential loads. This study uses the line equation theorem method to calculate the voltage rises by considering two current measurement points: the current at the end and the current at the base. The obtained voltage rise is then accumulated to be summed up with the customer afterward. The results are obtained by considering three scenarios: 1) voltage limits, 2) voltage limits and line loading, and 3) voltage limits, thermal, and harmonics in accordance with regulations. The obtained results are closely aligned with the simulations performed on the hosting capacity software such as DIgSILENT.

(Author)

Keywords: photovoltaic rooftop; line equation theorem; hosting capacity.

Muhammad Zakiyullah Romdlony [a], Rashad Abul Khayr [a], Aam Muharam [b], Eka Rakhman Priandana [c], Sudarmono Sasmono [a], Muhammad Ridho Rosa [a, e], Irwan Purnama [a, d], Amin [b], Ridlho Khoirul Fachri [a] ([a] School of Electrical Engineering, Telkom University, Indonesia; [b] Research Center for Transportation Technology, National Research and Innovation Agency (BRIN), Indonesia; [c] Research Center for Energy Conversion and Conservation, National Research and Innovation Agency (BRIN), Indonesia; [d] Research Center for Smart Mechatronics, National Research and Innovation Agency (BRIN), Indonesia; [e] Faculty of Science and Engineering, University of Groningen, Netherlands)

LSTM-based forecasting on electric vehicles battery swapping demand: Addressing infrastructure challenge in Indonesia

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 20223, vol. 14, no. 1, p. 72-79, 8 ill, 1 tab, 22 ref.

This article aims to design a model for forecasting the number of vehicles arriving at the battery swap station (BSS). In our case, we study the relevance of the proposed approach given the rapid increase in electric vehicle users in Indonesia. Due to the vehicle electrification program from the government of Indonesia and the lack of supporting infrastructure, forecasting battery swap demands is very important for charging schedules. Forecasting the number of vehicles is done using machine learning with the long short-term memory (LSTM) method. The method is used to predict sequential data because of its ability to review previous data in addition to the current input. The result of the forecasting using the LSTM method yields a prediction score using the root-mean-square error (RMSE) of 2.3079×10^{-6}. The forecasted data can be combined with the battery charging model to acquire predicted hourly battery availability that can be processed further for optimization and scheduling.

(Author)

Keywords: battery swap station (BSS); demand forecasting; long short-term memory (LSTM).

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Design and implementation of capacitor array as DC converters for electrical lighting in limited area

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 1, p. 80-86, 7 ill, 2 tab, 20 ref.

The widely used DC-DC converters are inductor-based DC-DC converters and inductors along with combustion. The use of inductors can lead to large power losses, as well as heavy components in real terms. The proposed converter warning array aims to increase the voltage with a large increase ratio through a switching configuration process. This switching method is very simple and uses two pulses that are opposite each other so that the array converter can work optimally, whose function is to adjust the arrangement in a parallel arrangement to a series arrangement. The advantage of using a device is that it makes DC-based DC conversion lightweight and easy to implement. Tests have been carried out on 5 hanger arrays with a power of 80 W and 65 W, and the data from the test results show that the voltage increase ratio reaches 81.5 % or 4.08 times the input voltage, which indicates that the array converter warning is able to increase the input voltage according to the number of the arrays.

(Author)

Keywords: inductor-based converter; inductor and capacitor-based converter; capacitor array.

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Impact of road load parameters on vehicle CO_2 emissions and fuel economy: A case study in Indonesia

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 1, p. 87-93, 5 ill, 1 tab, 21 ref.

Carbon dioxide (CO_2) contributes to the greenhouse effect and global warming. The Indonesian government has introduced a reduction in vehicle taxes based on the number of CO_2 emissions, meaning that lower CO_2 emissions result in lower tax rates. To measure the CO_2 emissions, vehicle testing can be conducted on a chassis dynamometer using road load (R/L) parameters to assess the vehicle's loading during the test. The United Nations Economic Commission for Europe (UN ECE) Regulation no. 101 (R101) provides predefined table values for testing, but vehicle manufacturers can also provide their own R/L values, known as actual R/L. In this study, the vehicle underwent two tests: one using the R/L values from the standard table R101 and another using the actual R/L values provided by the manufacturer through coast-down results. By employing the actual R/L values, CO_2 emissions can be reduced by up to 7.3 %. This reduction is achieved by lowering the vehicle's load by up to 17 % to enable optimal vehicle performance. Additionally, there is a potential improvement in fuel economy of up to 7.9 % for vehicles. These findings can serve as a reference for establishing future standard testing procedures.

(Author)

Keywords: road load (R/L); UN ECE R101; carbon dioxide emission; fuel economy.

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Failure assessment in lithium-ion battery packs in electric vehicles using the failure modes and effects analysis (FMEA) approach

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2023, vol. 14, no. 1, p. 94-104, 5 ill, 6 tab, 60 ref.

The use of batteries in electric cars comes with inherent risks. As the crucial component of these vehicles, batteries must possess a highly dependable safety system to ensure the safety of users. To establish such a reliable safety system, a comprehensive analysis of potential battery failures is carried out. This research examines various failure modes and their effects, investigates the causes behind them, and quantifies the associated risks. The failure modes and effect analysis (FMEA) method is employed to classify these failures based on priority numbers. By studying 28 accident reports involving electric vehicles, data is collected to identify potential failure modes and evaluate their risks. The results obtained from the FMEA assessment are used to propose safety measures, considering the importance of the potential failure modes as indicated by their risk priority number (RPN). The design incorporates safeguards against mechanical stress, external short circuits, and thermal runaway incidents. The findings of this study enhance our understanding of electric vehicle (EV) battery safety and offer valuable insights to EV manufacturers, regulators, and policymakers, aiding them in the development of safer and more reliable electric vehicles.

(Author)

Keywords: failures; safety assessment; failure mode and effect analysis; lithium-ion battery; safety system.