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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

It is my pleasure to welcome you to the 2nd issue of Volume 12 in the year 2021 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 and indexed by many internationally recognized indexers.

This issue consists of eight papers written by authors from different countries, such as Turkey, Australia, Ghana, United Kingdom, and Indonesia. The articles span a wide range of topics, from artificial intelligence to the analysis of the domestic component level. Therefore, they may be classified as follows.

The first paper presents the control of the formation of differential mobile robots based on the leader-follower approach. The second paper discusses how to determine and allocate dimensional and geometric tolerances to design a 10 kW, 500 rpm radial flux permanent magnet generator prototype components. The third paper proposes a simple hardware-in-the-loop (HIL) simulation set-up designed as instructional media for design and testing a simple control system. The fourth paper investigates the DCL of a developed multipurpose autonomous robot in Indonesia called ROM20. The fifth paper identifies loss distribution according to core materials and compares them in power density and cost. The sixth paper presents an alternative design and implementation of a low-cost solid-state OLTC. It employs a microcontroller-based control strategy, ensuring the flexibility and controllability required in programming the control algorithms. The seventh paper investigates pipe buckling strength under pure bending and external pressure by nonlinear finite element analysis. The last paper in this issue aims to design and construct an autonomous mobile robot with a vision-based system for outdoor navigation.

Since the first volume, our journal provides discretion in financial terms by waiving the article processing charge. Finally, as the Editor-in-Chief of this promising journal, I would like to acknowledge our immense gratitude to our International Editorial Board members, reviewers, and authors for their excellent works and remarkable contributions.

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.

We hope this publication will contribute to the enhancement of science and technology.

Bandung, December 2021

Editor-in-Chief

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Complete articles can be found at https://mev.lipi.go.id

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ABSTRACTS SHEET

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Nelson Luis Manuel, Nihat İnanç, Mustafa Yasin Erten (Department of Electrical & Electronics Engineering, Kırıkkale University, Turkey)

Control of mobile robot formations using A-star algorithm and artificial potential fields

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2021, vol. 12, no. 2, p. 57-67, 18 ill, 0 tab, 19 ref.

Formations or groups of robots become essential in cases where a single robot is insufficient to satisfy a given task. With an increasingly automated world, studies on various topics related to robotics have been carried out in both the industrial and academic arenas. In this paper, the control of the formation of differential mobile robots based on the leader-follower approach is presented. The leader's movement is based on the least cost path obtained by the A-star algorithm, thus ensuring a safe and shortest possible route for the leader. Follower robots track the leader's position in real time. Based on this information and the desired distance and angle values, the leader robot is followed. To ensure that the followers do not collide with each other and with the obstacles in the environment, a controller based on Artificial Potential Fields is designed. Stability analysis using Lyapunov theory is performed on the linearized model of the system. To verify the implemented technique, a simulator was designed using the MATLAB programming language. Seven experiments are conducted under different conditions to show the performance of the approach. The distance and orientation errors are less than 0.1 meters and 0.1 radians, respectively. Overall, mobile robots are able to reach the goal position and maintaining the desired formation in finite time.

(Author)

Keywords: nonholonomic WMR; leader-follower approach; formation control; A-star algorithm; artificial potential fields.

Muhammad Fathul Hikmawan [a, b], Agung Wibowo [b], Muhammad Kasim [a, c] ([a] Research Centre for Electrical Power and Mechatronics, Indonesian Institute of Sciences (LIPI), Indonesia; [b] Faculty of Mechanical and Aerospace Engineering, Bandung Institute of Technology, Indonesia; [c] School of Electrical Engineering and Telecommunications, University of New South Wales, Australia)

Geometrical and dimensional tolerance analysis for the radial flux type of permanent magnet generator design

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2021, vol. 12, no. 2, p. 68-80, 17 ill, 9 tab, 24 ref.

Mechanical tolerance is something that should be carefully taken into consideration and cannot be avoided in a product for manufacturing and assembly needs, especially in the design stage, to avoid excessive dimensional and geometric deviations of the components made. This paper discusses how to determine and allocate dimensional and geometric tolerances in the design of a 10 kW, 500 rpm radial flux permanent magnet generator prototype components. The electrical and mechanical design results in the form of the detailed nominal dimensions of the generator components, and the allowable air gap range are used as input parameters for tolerance analysis. The values of tolerance allocation and re-allocation process are carried out by considering the capability of the production machine and the ease level of the manufacturing process. The tolerance stack-up analysis method based on the worst case (WC) scenario is used to determine the cumulative effect on the air gap distance due to the allocated tolerance and to ensure that the cumulative effect is acceptable so as to guarantee the generator's functionality. The calculations and simulations results show that with an air gap of 1 ± 0.2 mm, the maximum air gap value obtained is 1.1785 mm, and the minimum is 0.8 mm. The smallest tolerance value allocation is 1 µm on the shaft precisely on the FSBS/SRBS feature and the rotor on the RPMS feature. In addition, the manufacturing process required to achieve the smallest tolerance allocation value is grinding, lapping, and polishing processes.

(Author)

Keywords: permanent magnet generator; mechanical design; tolerance analysis.

Muhammad Zakiyullah Romdlony [a], Fakih Irsyadi [b] ([a] School of Electrical Engineering, Telkom University, Indonesia; [b] Department of Electrical Engineering and Informatics, Vocational College, Universitas Gadjah Mada, Indonesia)

Hardware-in-the-loop simulation of DC motor as an instructional media for control system design and testing

Journal of Mechatronics, Electrical Power, and Vehicular

Technology, 2021, vol. 12, no. 2, p. 81-86, 5 ill, 4 tab, 18 ref.

Instructional media in control systems typically requires a real plant as an element to be controlled. However, this real plant, which is costly to be implemented, can be replaced by a virtual plant implemented in a computer and modelled in such a way that it resembles the behavior of a real plant. This kind of set-up is widely termed as hardware-in-the-loop (HIL) simulation. HIL simulation is an alternative way to reduce the development cost. A virtual plant is easy to adjust to represent various plants or processes that are widely used in industry. This paper proposes a simple HIL simulation set-up designed as instructional media for design and testing a simple control system. The experimental result on DC motor control shows that HIL simulation dynamical response is similar to the real hardware response with a small average error on measured transient response, represented in 0.5 seconds difference in settling time and 7.43 % difference in overshoot. This result shows the efficacy of our HIL simulation set-up.

(Author)

Keywords: control systems; hardware-in-the-loop (HIL); instructional media.

Vita Susanti [a], Henny Sudibyo [a], Ridwan Arief Subekti [a], Ghalya Pikra [a], Rakhmad Indra Pramana [a], Andri Joko Purwanto [a], Merry Indahsari Devi [a], Agus Fanar Syukri [b], Roni Permana Saputra [a, c] ([a] Research Centre for Electrical Power and Mechatronics – Indonesian Institute of Sciences, Indonesia; [b] Research Center for Policy and Management of Science, Technology, and Innovation– Indonesian Institute of Sciences, Indonesia; Robot Intelligence Laboratory, Dyson School of Design Engineering, Imperial College London, United Kingdom)

Domestic component level analysis for multipurpose autonomous robot

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2021, vol. 12, no. 2, p. 87-94, 5 ill, 7 tab, 34 ref.

Multipurpose autonomous robot technology has been developed to assist transportation sectors or the current emergency as the Covid-19 pandemic. A practical issue in the robotic industry concerns the domestic content in commodities, services, and a combination of goods and services commonly determined as domestic component level (DCL). To be considered a standardized national product, a product's DCL must surpass a certain level of local content composition. This research aims to investigate the DCL of a developed multipurpose autonomous robot in Indonesia called ROM20. The research was initiated by interviewing specialists in DCL calculation and robotics research to perform DCL analysis on ROM20. The next step was breaking down the ROM20 components into a second layer component, in which the amount of domestic component and overseas components can be derived. Finally, the ROM20 DCL value was calculated by dividing the cost of domestic components by the total cost of domestic and overseas components. As a digital product, the ROM20 DCL calculation result showed that the manufacturing aspect is 70 %, and the development aspect is 30 %. The overall ROM20 DCL value has been calculated as 52.23 %, which surpasses the national standard threshold at 40 % DCL value. Therefore, ROM20 can be considered a high-value standardized national product, impacting the competitiveness of local products and the fast-growing medical device industry in Indonesia.

(Author)

Keywords: domestic component level; modular system; multipurpose autonomous robot; ROM20.

Fransisco Danang Wijaya [a], Iftitah Imawati [b], Muhammad Yasirroni [a], Adha Imam Cahyadi [a] ([a] Department of Electrical Engineering and Information technology, Universitas Gadjah Mada, Indonesia; [b] Department of Electrical Engineering, Universitas Islam Indonesia, Indonesia)

Effect of different core materials in very low voltage induction motors for electric vehicle

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2021, vol. 12, no. 2, p. 95-103, 12 ill, 6 tab, 20 ref.

The use of squirrel cage induction motor for electric vehicle (EV) has been increasingly popular than permanent magnet and brushless motors due to their independence on rare materials. However, its performance is significantly affected by the core materials. In this research, induction motors performance with various core materials (M19_24G, Arnon7, and nickel steel carpenter) are studied in very low voltage. Three phases, 50 Hz, 5 HP, 48 V induction motor were used as the propulsion force testbed applied for a golf cart EV. The aims are to identify loss distribution according to core materials and compare power density and cost. The design process firstly determines the motor specifications, then calculates the dimensions, windings, stator, and rotor slots using MATLAB. The parameters obtained are used as inputs to ANSYS Maxwell to calculate induction motor performance. Finally, the design simulations are carried out on RMxprt and 2D transient software to determine the loss characteristics of core materials. It is found that the stator winding dominates the loss distribution. Winding losses have accounted for 52-55 % of the total loss, followed by rotor winding losses around 25-27 % and losses in the core around 1-7 %. Based on the three materials tested, nickel steel carpenter and M19_24G attain the highest efficiency with 83.27 % and 83.10 %, respectively, while M19_24G and Arnon7 possess the highest power density with 0.37 kW/kg and 0.38 kW/kg whereas, in term of production cost, the Arnon7 is the lowest.

(Author)

Keywords: squirrel cage induction motor; power losses; power density; power efficiency; loss distribution.

Benjamin Kommey [a], Elvis Tamakloe [b], Gideon Adom-Bamfi [b], Daniel Opoku [b] ([a] Kwame Nkrumah University of Science and Technology, PMB KNUST- COE, Ghana; [b] Kwame Nkrumah University of Science and Technology, PMB KNUST- EE, Ghana)

An alternative design and implementation of a solid state on-load tap changer

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2021, vol. 12, no. 2, p. 104-109, 7 ill, 1 tab, 25 ref.

Power quality and reliability are of great importance in the modern world, whether it be the power generated by the power utilities or the power consumed by the customer respectively. They need these supplies to be at its optimum value so that the cost is effective, and the safety of devices assured otherwise problems such as overvoltage, under-voltage, and voltage sags caused by disturbances in the power supply could be disastrous. On-load tap changers (OLTC) have therefore been used since the inception of electrical engineering. The main function of the OLTC is to change the turns of the transformer winding so that the voltage variations are limited without interrupting the secondary current. The major idea is that the electronic switches and other smart systems provide more controllability during the tap changing process, unlike mechanical switches. This paper presents an alternative

design and implementation of a low-cost solid-state OLTC and employs a control strategy that is microcontroller-based, ensuring the desired flexibility and controllability required in programming the control algorithms. It eliminates the limitations of both mechanical and hybrid OLTCs (arcing, slow response time, losses) and is user-friendly (provides an effective communication medium). Voltage regulation is achieved by varying the turns of the transformer winding whiles it is energized, supplying load current and with the tap selection carried out on the primary side. Therefore, this approach provides a less expensive system but ensures the efficiency and reliability of voltage regulation.

(Author)

Keywords: on-load tap changer; solid-state switch; potential transformer winding; voltage regulation.

Hartono Yudo [a], Wilma Amiruddin [a], Ari Wibawa Budi Santosa [a], Ocid Mursid [a], Tri Admono [b] ([a] Department of Naval Architecture, Faculty of Engineering, Diponegoro University, Indonesia; [b] Research Centre for Electrical Power and Mechatronics, Indonesian Institute of Sciences, Indonesia)

Study on the characteristics of pipe buckling strength under pure bending and external stress using nonlinear finite element analysis

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2021, vol. 12, no. 2, p. 110-116, 9 ill, 0 tab, 15 ref.

Buckling and collapse are important failure modes for laying and operating conditions in a subsea position. The pipe will be subjected to various kinds of loads, i.e., bending moment, external pressure, and tension. Nonlinear finite element analysis was used to analyze the buckling strength of the pipe under pure bending and external pressure. The buckling of elastic and elasto-plastic materials was also studied in this work. The buckling strength due to external pressure had decreased and become constant on the long pipe when the length-to-diameter ratio (L/D) was increased. The non-dimensional parameter (β), which is proportionate to (D/t) (σy/E), is used to study the yielding influence on the buckling strength of pipe under combined bending and external pressure loading. The interaction curves of the buckling strength of pipe were obtained, with various the diameter-to-thickness ratio (D/t) under combination loads of external pressure and bending moment. For straight pipes L/D = 2.5 to 40, D = 1000 to 4000 mm, and D/t = 50 to 200 were set. The curved pipes D/t = 200, L/D =2.5 to 30 have been investigated by changing the radius of curvature-to-diameter ratio (R/D) from 50 to ∞, for each one. With decreasing R/D, the buckling strength under external pressure decreases slightly. This is in contrast to the bending of a curved pipe. When the value of R/D was decreased, the flexibility of the pipe was increased. However, the buckling strength of the pipe during bending was decreased due to the oval deformation at the cross-section.

(Author)

Keywords: buckling strength; elastic buckling; elasto-plastic buckling; bending moment; external pressure.

Leonard Rusli, Brilly Nurhalim, Rusman Rusyadi (Mechatronics Department, Swiss German University, Indonesia)

Vision-based vanishing point detection of autonomous navigation of mobile robot for outdoor applications

Journal of Mechatronics, Electrical Power, and Vehicular Technology, 2021, vol. 12, no. 2, p. 117-125, 21 ill, 0 tab, 16 ref.

The vision-based approach to mobile robot navigation is considered superior due to its affordability. This paper aims to design and construct an autonomous mobile robot with a vision-based system for outdoor navigation. This robot receives inputs from camera and ultrasonic sensor. The camera is used to detect vanishing points and obstacles from the road. The vanishing point is used to detect the heading of the road. Lines are extracted from the environment using a canny edge detector and Houghline Transforms from OpenCV to navigate the system. Then, removed lines are processed to locate the vanishing point and the road angle. A low pass filter is then applied to detect a vanishing point better. The robot is tested to run in several outdoor conditions such as asphalt roads and pedestrian roads to follow the detected vanishing point. By implementing a Simple Blob Detector from OpenCV and ultrasonic sensor module, the obstacle's position in front of the robot is detected. The test results show that the robot can avoid obstacles while following the heading of the road in outdoor environments. Vision-based vanishing point detection is successfully applied for outdoor applications of autonomous mobile robot navigation.

(Author)

Keywords: Houghline transform (HoughlineP); road lines detection; simple blob detector; vanishing point determination.