e-ISSN 2088-6985
p-ISSN 2087-3379

Journal of Mechatronics, Electrical Power, and Vehicular Technology

Volume 09, Issue 2, December 2018

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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Selected Applications: including all implementations or implications related to mechatronics, electrical power, or vehicular technology.

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MEV is published by Research Centre for Electrical Power and Mechatronics - Indonesian Institute of Sciences (RCEPM-LIPI).

ISSN print: 2087-3379
ISSN electronics: 2088-6985

Electronics edition is available at:
http://www.mevjournal.com

All published article are embedded with DOI number affiliated with Crossref DOI prefix 10.14203

Publication Frequency

MEV is managed to be issued twice in every year. The first issue should be in the mid of the year (July) and the second issue is at the end of the year (December).

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LIPI Accreditation:

Accreditation Number:
633/AU/P2MI-LIPI/03/2015

Acc date: 15 April 2015
Valid thru: 15 April 2020.

RISTEKDIKTI Accreditation:

Accreditation Number:
1/E/KPT/2015

Acc date: 15 September 2015
Valid thru: 21 September 2020.

Postal Address

MEV Journal Secretariat:

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e-ISSN 2088-6985
p-ISSN 2087-3379

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FOREWORD FROM EDITOR-IN-CHIEF

Journal of Mechatronics, Electrical Power, and Vehicular Technology (MEV) is an international journal indexed by many internationally recognized indexers. Its Digital Object Identifier (DOI) Prefix is 10.14203. In this issue, seven papers are published with the total number of paper pages of 60 pages. The authors came from Indonesia, South Korea, Saudi Arabia, and Viet Nam.

Two papers are related to mechatronics which address design of a lower limb rehabilitation device, and an omnidirectional mobile robot design and its contol. Two papers fall in electrical power topic. The first paper reports design of a maximum power point tracking method using fuzzy logic for photovoltaic (PV) panels. The second paper proposes a method for battery-balancing. Three papers are classified in to vehicular technology topic. Two of them report experiment results regarding fuel mix, engine performance, and emission reduction. The rest paper deals with control method of an electric bus which provides good energy efficiency.

Since the first volume, our journal provides discretion in financial term by waiving the article processing charge. We wish to offer our thanks to the Indonesian Institute of Sciences (LIPI) for their continuing unwaving support. Also, we would like to acknowledge our immense gratitude to our International Editorial Board members, reviewers and authors.

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

Bandung, December 2018

Editor-in-Chief

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ABSTRACTS SHEET

e-ISSN: 2088-6985
p-ISSN: 2087-3379

Date of issues: 30 December 2018

Syed Yousufuddin (Department of Mechanical Engineering, Jubail University College, Saudi Arabia)

Combustion duration influence on hydrogen-ethanol dual fueled engine emissions: An experimental analysis

Journal of Mechatronics, Electrical Power, and Vehicular Technology, December 2018, vol. 9, no. 2, p. 41-48, 10 ill, 2 tab, 15 ref.

The research presented in this article expresses experimental results of combustion duration effect on a dual fueled engine. In particular, the research was focused on the emissions occurred specifically from a hydrogen-ethanol dual fueled engine. This study was performed on a compression ignition engine that was converted to run and act as a spark ignition engine. This modified engine was fueled by hydrogen–ethanol with various percentage substitutions of hydrogen. The substitution was altered from 20 to 80% at a constant speed of 1500 rpm. The various engine emission characteristics such as CO, Hydrocarbon, and NOx were experimentally determined. This study resulted that at a compression ratio of 11:1 and combustion duration of 25°CA, the best operating conditions of the engine were shown. Moreover, the optimum fuel combination was established at 60 to 80% of hydrogen substitution to ethanol. The experimental results also revealed that at 100% load and at compression ratios 7, 9, and 11; the CO and HC emissions have decreased while NOx increased and followed with the increase in the percentage of hydrogen addition and combustion duration. It was concluded that the retarding combustion duration was preferred for NOx emission control in the engine.

(Author)

Keywords: combustion duration; compression ratio; dual fuel engine; alternative fuels; compression ignition; spark timing.

Yanuandri Putrasari [a, b, *], Achmad Praptijanto [a], Arifin Nur [a], Widodo Budi Santoso [a], Mulia Pratama [a], Ahmad Dimyani [a], Suherman [a], Bambang Wahono [a, b], Muhammad Khristamto Aditya Wardana [a, b], Ocktaeck Lim [c] ([a] Research Centre for Electrical Power and Mechatronics, Indonesian Institute of Sciences, Indonesia; [b] Graduate School of Mechanical Engineering University of Ulsan Mugeo-dong, South Korea; [c] School of Mechanical Engineering University of Ulsan, South Korea)

Thermal efficiency and emission characteristics of a diesel-hydrogen dual fuel CI engine at various loads condition

Journal of Mechatronics, Electrical Power, and Vehicular Technology, December 2018, vol. 9, no. 2, p. 49-56, 7 ill, 2 tab, 19 ref.

Efforts to find alternative fuels and reduce emissions of CI engines have been conducted, one of which is the use of diesel-hydrogen dual fuel. One of the goals of using hydrogen in dual-fuel combustion systems is to reduce particulate emissions and increase engine power. This study investigates the thermal efficiency and emission characteristics of a diesel-hydrogen dual fuel CI engine at various loads condition. The hydrogen was used as a secondary fuel in a single cylinder 667 cm3 diesel engine. The hydrogen was supplied to intake manifold by fumigation method, and diesel was injected directly into the combustion chamber. The results show that the performance test yielding an increase around 10% in the value of thermal efficiency of diesel engines with the addition of hydrogen either at 2000 or 2500 rpm. Meanwhile, emission analyses show that the addition of hydrogen at 2000 and 2500 rpm lead to the decrease of NOx value up to 43%. Furthermore, the smokeless emissions around 0% per kWh were occurred by hydrogen addition at 2000 and 2500 rpm of engine speeds with load operation under 20 Nm.

(Author)

Keywords: dual-fuel hydrogen; hydrogen engines; diesel-hydrogen; diesel-hydrogen efficiency; diesel-hydrogen emissions.

Machmud Effendy*, Nuralif Mardiyah, Khusnul Hidayat (Electrical Department, University of Muhammadiyah Malang, Indonesia)

Efficiency improvement of photovoltaic by using maximum power point tracking based on a new fuzzy logic controller

Journal of Mechatronics, Electrical Power, and Vehicular Technology, December 2018, vol. 9, no. 2, p. 57-64, 10 ill, 6 tab, 15 ref.

Maximum power point tracking (MPPT) is a technique to maximize the power output of a photovoltaic (PV). Therefore, to achieve higher PV efficiency, the development of MPPT control algorithm is necessary. Recently, it was revealed that, in certain conditions, fuzzy logic controller (FLC) is better than other control algorithms and is possible to be developed. This study fabricated and implemented MPPT based on the proposed a new FLC. Input Calculator (IC) via sensors reads current and voltage of PV and generates the comparison of voltage and current of PV, then IC output becomes fuzzy algorithm input. Fuzzy algorithm produces duty cycle that drives synchronous buck converter. The result showed that MPPT system with the proposed FLC method has 99.1% efficiency while MPPT system with P&O method has 95.5% efficiency. From the obtained result, it can be concluded that the MPPT based on the proposed FLC can increase the overall efficiency of the system to 99.3%.

(Author)

Keywords: Maximum power point tracking; fuzzy logic controller; photovoltaic efficiency; synchronous buck converter.

Dao Minh Duc [a, *], Pham Dang Phuoc [a], Tran Xuan Tuy [b], Le Thi Thuy Tram [c] ([a] Faculty of Engineering Technology, Pham Van Dong University, Vietnam; [b] Faculty of Mechanical, University of Science and Technology, Vietnam; [c] Department of Electrical and

Electronics, Technological Colleges Quang Nam, Vietnam)

Study on the transient response of lower limb rehabilitation actuator using the pneumatic cylinder

Journal of Mechatronics, Electrical Power, and Vehicular Technology, December 2018, vol. 9, no. 2, p. 65-72, 14 ill, 0 tab, 15 ref.

A lower limb rehabilitation device was designed using the compressed air cylinder in order to answer the particular request in Vietnam. This paper is presenting the results of a study of the device response. Dynamic equation of the actuator and equations of the proportional valve have been established. The relationship between the input signal and the output signal of the actuator was derived. Inventor® software was used to design the mechanical structure of the device. Matlab® software was used to calculate the parameters values of the PID controller by simulating the response of the actuator. The results show that the response time of both knee drive and hip drive mechanisms are 8 seconds while the overshoot of both knee drive and hip drive mechanisms are 1%. Moreover, the starting torque of the knee drive mechanism is 17 Nm, and the starting torque of the hip drive mechanism is 35 Nm. The simulation results show that the PID controller gives a fast response time and a low overshoot.

(Author)

Keywords: lower limb rehabilitation; hip and knee joint; pneumatic cylinder; PID controller.

Gunawan Dewantoro*, Anton Suprayudi, Daniel Santoso (Faculty of Electronics and Computer Engineering, Satya Wacana Christian University, Indonesia)

Enhancement of motionability based on segregation of states for holonomic soccer robot

Journal of Mechatronics, Electrical Power, and Vehicular Technology, December 2018, vol. 9, no. 2, p. 73-80, 10 ill, 2 tab, 15 ref.

One of the critical issues when navigating a wheeled robot is the ability to move effectively. Omnidirectional robots might overcome these nonholonomic constraints. However, the motion planning and travel speed of the movement has been in continuous research. This study proposed segregation of states to improve the holonomic motion system with omnidirectional wheels, which is specially designed for soccer robots. The system used five separate defined states in order to move toward all directions by means of speed variations of each wheel, yielding both linear and curved trajectories. The controller received some parameter values from the main controller to generate robot motion according to the game algorithm. The results show that the robot is able to move in an omnidirectional way with the maximum linear speed of 3.2 m/s. The average error of movement direction is 4.3°, and the average error of facing direction is 4.8°. The shortest average time for a robot to make a rotational motion is 2.84 seconds without any displacement from the pivot point. Also, the robot can dribble the ball forward and backward successfully. In addition, the robot can change its facing direction while carrying the ball with a ball shift of less than 15 cm for 5 seconds. The results show that state segregations improve the robots capability to conduct many variations of motions, while the ball-handling system is helpful to prevent the ball get disengaged from the robot grip so the robot can dribble accordingly.

(Author)

Keywords: holonomic motion; omnidirectional robot; soccer robot; ball-handling.

Amin*, Kristian Ismail, Abdul Hapid (Research Centre for Electrical Power and Mechatronics, Indonesian Institute of Sciences, Indonesia)

Implementation of a $LiFePO_4$ battery charger for cell balancing application

Journal of Mechatronics, Electrical Power, and Vehicular Technology, December 2018, vol. 9, no. 2, p. 81-88, 9 ill, 2 tab, 20 ref.

Cell imbalance has always happened in the series-connected battery. Series-connected battery needs to be balanced to maintain capacity and maximize the batteries lifespan. Cell balancing helps to dispart energy equally among battery cells. For active cell balancing, the use of a DC-DC converter module for cell balancing is quite common to achieve high efficiency, reliability, and high power density converter. This paper describes an implementation of a LiFePO4 battery charger based on the DC-DC converter module used for cell balancing application. A constant current-constant voltage (CC-CV) controller for the charger, which is a general charging method applied to the LiFePO4 battery, is presented for preventing overcharging when considering the nonlinear property of a LiFePO4 battery. The prototype is made up with an input voltage of 43 V to 110 V and the maximum output voltage of 3.75 V, allowing to charge a LiFePO4 cell battery and balancing the battery pack with many cells from 15 to 30 cells. The goal is to have a LiFePO4 battery charger with an approximate power of 40W and the maximum output current of 10 A. Experimental results on a 160AH LiFePO4 battery for some state of charge (SoC) shows that the maximum battery voltage has been limited at 3.77 V, and maximum charging current could reach up to 10.64 A. The results show that the charger can maintain battery voltage at the maximum reference voltage and avoid the LiFePO4 battery from overcharging.

(Author)

Keywords: cell balancing; constant current-constant voltage (CC-CV); DC-DC converter module; LiFePO4 battery.

Rina Ristiana [a, b, *], Arief Syaichu Rohman [a], Estiko Rijanto [c], Agus Purwadi [a], Egi Hidayat [a], Carmadi Machbub [a] ([a] School of Electrical Engineering and Informatics, Institut Teknologi Bandung, Indonesia; [b] Instrumentation Development Unit, Indonesian Institute of Sciences, Indonesia; [c] Research Centre for Electrical Power and Mechatronics, Indonesian Institute of Sciences , Indonesia)

Designing optimal speed control with observer using integrated battery-electric vehicle (IBEV) model for energy efficiency

Journal of Mechatronics, Electrical Power, and Vehicular Technology, December 2018, vol. 9, no. 2, p. 89-100, 7 ill, 2 tab, 15 ref.

This paper develops an optimal speed control using a linear quadratic integral (LQI) control standard with/without an observer in the system based on an integrated battery-electric vehicle (IBEV) model. The IBEV model includes the dynamics of the electric motor, longitudinal vehicle, inverter, and battery. The IBEV model has one state variable of indirectly measured and unobservable, but the system is detectable. The objectives of this study were: (a) to create a speed control that gets the exact solution for a system with one indirect measurement and unobservable state variable; and (b) to create a speed control that has the potential to make a more efficient energy system. A full state feedback LQI controller without an observer is used as a benchmark. Two output feedback LQI controllers are designed; including one controller uses an order-4 observer and the other uses an order-5 observer. The order-4 observer does not include the battery state of charge as observer state. Whereas the order-5 observer is designed by making all the state variable as the observer state and using the battery state of charge as an additional system output. An electric passenger minibus for public transport with 1500 kg weight was used as the vehicle model. Simulations were performed when the vehicle moves in a flat surface with the increased speed from stationary to 60 km/h and moves according to standard NEDC driving profile. The simulation results showed that both the output feedback LQI controllers provided similar speed performance as compared to the full state feedback LQI controller. However, the output feedback LQI controller with the order-5 observer consumed less energy than that with the order-4 observer about 10% for NEDC driving profile and 12% for a flat surface. It is concluded that the LQI controller with order-5 observer gives better energy efficiency than the LQI controller with order-4 observer.

(Author)

Keywords: integrated battery-electric vehicle (IBEV) model; speed control; electric vehicle; linear quadratic integral; observer system; energy efficient.