

# Journal of Mechatronics, Electrical Power, and Vehicular Technology

Volume 11, Issue 2, 2020

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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

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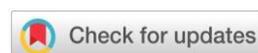
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Volume 11, Issue 2, 2020

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Volume 11, Issue 2, 2020

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Volume 11, Issue 2, 2020

## FOREWORD FROM EDITOR-IN-CHIEF

The MEV Journal has become an increasingly recognized journal in the past years and is indexed by many internationally recognized indexers greatly due to the dedicated efforts of the outstanding guest editors, the managing editors, and the advisory editors.

In this last issue of 2020, seven papers are published come from multidisciplinary topics including mechatronics, electrical power, and vehicular technology. The topics range from smart guided missile to optimization of ozone chamber for fruits/vegetables sterilization.

The first paper presents the development an air defence system that can control guided missiles automatically with high accuracy. The second paper reviews the different exoskeleton designs and presents a working prototype of a surface electromyography (EMG) controlled exoskeleton to enhance the strength of the lower leg. The third paper analyses the philosophical values of batik to be applied as design in public transportation. The fourth paper describes the purpose to gain an additional lift generated by the surface effect to increase the aerodynamic performance. The fifth paper aims to show a CFD simulation of struts, which affects the aerodynamic of VAWT. The sixth paper presents a new design of an embedded monitoring system for maintenance and production performance monitoring of a sugarcane chopper harvester in a real-time manner. The last paper in this issue has the aim to design and optimize the ozone chamber parameter using pulse width modulation (PWM).

This journal provides discretion in financial term by waiving the articleprocessing charge, since the first volume. So, we would like to acknowledge our immense gratitude to our International Editorial Board members, reviewers and authors for their excellent contributions.

Bandung, December 2020

Editor-in-Chief

# Journal of Mechatronics, Electrical Power, and Vehicular Technology

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## ABSTRACTS SHEET

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

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Kamil Faqih <sup>a</sup>, Sujito <sup>b</sup>, Siti Sendari <sup>a</sup>, Faiz Syaikhoni Aziz <sup>a</sup> (<sup>a</sup> Electrical Engineering Postgraduate, Electrical Engineering Department, Universitas Negeri Malang, Indonesia; <sup>b</sup> Intelligent Power and Advance Energy System, Electrical Engineering Department, Universitas Negeri Malang, Indonesia )

Smart guided missile using accelerometer and gyroscope based on backpropagation neural network method for optimal control output feedback

*Journal of Mechatronics, Electrical Power, and Vehicular Technology*, 2020, vol. 11, no. 2, p. 55-63, 9 ill, 0 tab, 27 ref.

As a maritime country with a large area, besides the need to defend itself with the military, it also needs to protect itself with aerospace technology that can be controlled automatically. This research aims to develop an air defense system that can control guided missiles automatically with high accuracy. The right method can provide a high level of accuracy in controlling missiles to the targeted object. With the backpropagation neural network method for optimal control output feedback, it can process information data from the radar to control missile's movement with a high degree of accuracy. The controller uses optimal control output feedback, which is equipped with a lock system and utilizes an accelerometer that can detect the slope of the missile and a gyroscope that can detect the slope between the target direction of the missile to follow the target, control the position, and direction of the missile. The target speed of movement can be easily identified and followed by the missile through the lock system. Sampling data comes from signals generated by radars located in defense areas and from missiles. Each part's data processing speed is calculated using a fast algorithm that is reliable and has a level of accuracy and fast processing. Data processing impacts on the accuracy of missile movements on any change in the position and motion of targets and target speed. Improved maneuvering accuracy in the first training system can detect 1000 files with a load of 273, while in the last training, the system can detect 1000 files without a load period. So the missile can be guided to hit the target without obstacles when maneuvering.

(Author)

Keywords: Smart missile; backpropagation; neural network; optimal control; output feedback; lock system.

Mikecon Cenit, Vaibhav Gandhi (Department of Design Engineering and Mathematics, Middlesex University London, United Kingdom)

Design and development of the sEMG-based exoskeleton strength enhancer for the legs

*Journal of Mechatronics, Electrical Power, and Vehicular Technology*, 2020, vol. 11, no. 2, p. 64-74, 12 ill, 0 tab, 73 ref.

This paper reviews the different exoskeleton designs and presents a working prototype of a surface electromyography (EMG) controlled exoskeleton to enhance the strength of the lower leg. The computer aided design (CAD) model of the exoskeleton is designed, 3D printed with respect to the golden ratio of human anthropometry, and tested structurally. The exoskeleton control system is designed on the LabVIEW National Instrument platform and embedded in myRIO. Surface EMG sensors (sEMG) and flex sensors are used coherently to create different state filters for the EMG, human body posture and control for the mechanical exoskeleton actuation. The myRIO is used to process sEMG signals and send control signals to the exoskeleton. Thus, the complete exoskeleton system consists of sEMG as primary sensor and flex sensor as a secondary sensor while the whole control system is designed in LabVIEW. FEA simulation and tests show that the exoskeleton is suitable for an average human weight of 62 kg plus excess force with different reactive spring forces. However, due to the mechanical properties of the exoskeleton actuator, it will require an additional lift to provide the rapid reactive impulse force needed to increase biomechanical movement such as squatting up. Finally, with the increasing availability of such assistive devices on the market, the important aspect of ethical, social and legal issues have also emerged and discussed in this paper.

(Author)

Keywords: leg-exoskeleton; electromyography based exoskeleton; LabVIEW myRIO; ethical, societal, and legal concerns.

Yukhi Mustaqim Kusuma Sya' bana <sup>a</sup>, Gun Bae Park <sup>b</sup> (<sup>a</sup> Research Centre for Electrical Power and Mechatronics, Indonesian Institute of Sciences, Indonesia; <sup>b</sup> Industrial Design Laboratory, Art and Design Faculty, Keimyung University, Republic of Korea)

A study on the applicability of batik for public transportation design in Indonesia

*Journal of Mechatronics, Electrical Power, and Vehicular Technology*, 2020, vol. 11, no. 2, p. 75-85, 11 ill, 1 tab, 43 ref.

This paper attempts to grant Indonesian identity in the development and importing the public transportation equipment from overseas. We reviewed and surveyed the present state issues of Indonesian public transportation equipment design development. The study analyzed the philosophical values of batik in a modern way, the possibility of batik application for important regionalism identity, and identity in design development strategy. As a result, we gather and assess the philosophical values of Batik motifs that contain geographic origin, the essences, and characteristics to be applied as design element strategies. We found the regional identity of the historical, local wisdom essence, acculturation, various colors, and original shapes of the Batik motifs. Moreover, Indonesian fancy design is also supported by other possibilities indigenous material and technique that usually used, particularly in Indonesia. These possibilities were identically Indonesian and also applicable as the sustainable public transport equipment design identity issue solution. This effort was conducted as the turning point to solve the issues of public transport equipment design strategies dependency. Thus, this research will be helpful for aesthetics research in the modern way of the public transportation equipment design concept.

(Author)

Keywords: batik philosophical values; public transportation equipment; national identity; vernacular design.

Muhammad Nanda Setiawan <sup>a</sup>, Evan Rizky Suryana <sup>b</sup>, Leo Parytta <sup>c</sup>, William Andaro <sup>c</sup> (<sup>a</sup> Department of Renewable Energy Engineering, Universitas Prasetiya Mulya, Indonesia; <sup>b</sup> Department of Engineering Physics, Multimedia Nusantara University, Indonesia; <sup>c</sup> Department of Physics Energy Engineering, Surya University, Indonesia)

Pole placement and LQR implementation on longitudinal altitude holding control of wing in surface effect vehicle

*Journal of Mechatronics, Electrical Power, and Vehicular Technology*, 2020, vol. 11, no. 2, p. 86-94, 7 ill, 6 tab, 20 ref.

The longitudinal altitude holding control system (LAHCS) of wing in surface effect (WiSE) vehicle has been developed using Simulink/Matlab. The LAHCS is designed to maintain the altitude of the vehicle stands at 1 m above the surface, with a maximum allowable deviation of 0.5 m. The purpose is to gain an additional lift generated by the surface effect to increase the aerodynamic performance. This control system is investigated using two approaches, i.e., the pole placement and the linear quadratic regulator (LQR) methods. Originally, the system shows an unstable response on the phugoid mode, indicated by the positive value of its Eigen. After the pole placement method is applied, the system is stable and capable of maintaining the reference command altitude. This method produces 0.27 of the maximum altitude deviation when the disturbance, represented by the doublet input elevator  $\pm 5^\circ$  is applied. Moreover, the time needed for the system to reach the steady-state response of altitude is around 2.2 seconds. In comparison, the LQR method is also applied to the system with the same scenario. Although the settling time response is quite similar to the previous result, its maximum altitude deviation is significantly reduced by around 80 %. In conclusion, both of the methods used to design the LAHCS are capable of maintaining the altitude of the WiSE vehicle always below its maximum deviation

tolerance.

(Author)

Keywords: wing in surface effect vehicle; altitude holding control system; pole placement method; linear quadratic regulator (LQR); phugoid mode; doublet input elevator.

Tri Admono <sup>a</sup>, Yoyon Ahmudiarto <sup>a</sup>, Amma Muliya Romadoni <sup>a</sup>, Iman Abdurahman <sup>a</sup>, Agus Salim <sup>a</sup>, Teguh Tri Lusijarto <sup>a</sup>, Mochammad Agoes Mulyadi <sup>b</sup> (<sup>a</sup> Research Centre for Electrical Power and Mechatronics, Indonesian Institute of Sciences, Indonesia; <sup>b</sup> Department of Aeronautics and Astronautics, Bandung Institute of Technology, Indonesia)

Numerical Investigation of the effect of triangle strut in vertical axis wind turbine (VAWT)

*Journal of Mechatronics, Electrical Power, and Vehicular Technology*, 2020, vol. 11, no. 2, p. 95-101, 10 ill, 3 tab, 15 ref.

Strut is used in vertical axis wind turbine (VAWT) to restraint the framework. In this study, struts are analyzed to show the pressure losses in VAWT. ANSYS computational fluid dynamics (CFD) software is used to investigate triangle strut in VAWT. This study aims to show a CFD simulation of struts, which affects the aerodynamic of VAWT. In CFD software, the aerodynamic of VAWT can be analyzed in terms of pressure losses in the struts. The simulation method starts by making a struts model, then meshing and setting up ANSYS's boundary conditions. The last iteration runs in ANSYS until convergence. Our results show the percentage of pressure losses with the variation of the angle of wind  $0^\circ$ ,  $20^\circ$ ,  $40^\circ$ , and  $60^\circ$  are 0.67 %, 0.52 %, 0.48 %, and 0.52 %. The effect of triangle strut in VAWT did not affect the wind flow to the VAWT blade. The results also indicated that the triangle strut could be applied in the multi-stage of VAWT system.

(Author)

Keywords: vertical axis wind turbine (VAWT); triangle strut; computational fluid dynamics (CFD); pressure losses..

Estiko Rijanto <sup>a</sup>, Erik Adiwiguna <sup>a</sup>, Aryo Putro Sadono <sup>a</sup>, Muhammad Hafil Nugraha <sup>a</sup>, Oka Mahendra <sup>b</sup>, Rendra Dwi Firmansyah <sup>b</sup> (<sup>a</sup> Research Centre for Electrical Power and Mechatronics, Indonesian Institute of Sciences, Indonesia; <sup>b</sup> Technical Implementation Unit for Instrumentation Development, Indonesian Institute of Sciences, Indonesia)

A new design of embedded monitoring system for maintenance and performance monitoring of a cane harvester tractor

*Journal of Mechatronics, Electrical Power, and Vehicular Technology*, 2020, vol. 11, no. 2, p. 102-110, 12 ill, 4 tab, 21 ref.

In modern sugarcane farms, sugarcane chopper harvesters are becoming widely used. A modern sugarcane chopper harvester is essentially a mechatronic system composed of a tractor and some implements with several electro-hydraulic control systems. Those control systems are controlled by electronic controller units (ECUs). It may fail during harvesting operation due to lack of maintenance, operator's awareness, skill, and field contour. This paper presents a new design of an embedded monitoring system for maintenance and production performance monitoring of a sugarcane chopper harvester in a real-time manner. A prototype of the embedded monitoring system was developed which partially realized the designed system. The experimental result showed that the main computer could communicate with other ECUs using a controller area network (CAN) bus. The dataset from four channels retrieved from the CAN bus represents the real values originating from the temperature sensor simulators. Apart

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from being sent to the CAN bus, the data are also recorded on a secure digital (SD) Card and sent to the internet of things (IoT) server. In the update time interval testing, the 100 ms interval does not give any error.

(Author)

Keywords: embedded system; cane harvester; electro-hydraulic; control system; tractor maintenance; CAN bus.

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Adi Waskito <sup>a</sup>, Rendra Dwi Firmansyah <sup>a</sup>, Djohar Syamsi <sup>a</sup>, Catur Hilman Adritya Haryo Bhakti Baskoro <sup>b</sup>, Anisya Lisdiana <sup>c</sup>, Herkuswyna Isnaniyah Wahab <sup>c</sup> (<sup>a</sup> Technical Implementation Unit for Instrumentation Development, Indonesian Institute of Sciences, Indonesia; <sup>b</sup> Research Centre for Electrical Power and Mechatronics, Indonesian Institute of Sciences, Indonesia; <sup>c</sup> Research Centre for Geotechnology, Indonesian Institute of Sciences, Indonesia)

Optimization of ozone chamber using pulse width modulation for sterilization and preservation on fruits and vegetables

*Journal of Mechatronics, Electrical Power, and Vehicular Technology*, 2020, vol. 11, no. 2, p. 111-116, 8 ill, 0 tab, 20 ref.

Ozonizer is a method used for sterilization and food preservation by utilizing ozone produced from plasma discharge. The effective way of obtaining ozone is to use dielectric barrier discharge (DBD) plasma. The manufacture of a controlled ozonizer chamber system is important to result in effective and efficient performance. The aim of this study is to design and optimize the ozone chamber parameter using pulse width modulation (PWM). The system design is added with the Arduino Mega 2560 microcontroller and the L296N motor driver as an ozone generator radiation controller by changing the pulse width modulation to determine the ozone levels produced. The experimental results show that the ozone concentration increases by 50 % on average with increasing variations of the 10 % duty cycle (PWM) and the ignition time length. The optimum value is achieved on a 70 % duty cycle for 60 - 300 seconds, where the ozone level of 3 ppm is obtained and sustained for fruits/vegetables sterilization and preservation application.

(Author)

Keywords: dielectric barrier discharge; ozone chamber; pulse width modulation; sterilization and preservation.

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