

# Journal of Mechatronics, Electrical Power, and Vehicular Technology

Volume 05, Issue 2, December 2014

## AIM AND SCOPE

**Mechatronics, Electrical Power, and Vehicular Technology (MEV)** is an internationally peer-reviewed journal providing authoritative 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:

**Mechatronics:** including control system, robotic, CNC Machine, sensor, signal processing, electronics, actuator, and mechanical dynamics.

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# **Journal of Mechatronics, Electrical Power, and Vehicular Technology**

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## **FOREWORD FROM EDITOR-IN-CHIEF**

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This issue publishes nine papers with the total number of paper pages of 72 pages. The selected papers in this issue have passed some levels of reviews and revisions based on the standard operating procedure of the journal. Five topics are related to mechatronics, one topic to electrical power and three topics to vehicular technology. The authors came from USA, Vietnam, Pakistan, Jordan, Philippines and Indonesia.

The policy up to this current issue is that both authors and readers are not charged at all. On the other hand, the editorial board is planning to improve the quality by registering the journal to other international academic citation index. Moreover, the editorial board is also considering to gradually increase the number of papers and journal's pages. All of this plan will give consequence on financial burden. Therefore, from the next issue, financial policy will probably change based on that condition.

We wish to offer our thanks to all the editorial members and Indonesian Institute of Sciences (LIPI) for their continuing unwavering support. Also, we would like to acknowledge our gratitude to this issue's International Editorial Board members, reviewers and authors.

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

Bandung, December 2014

Editor-in-Chief

# Journal of Mechatronics, Electrical Power, and Vehicular Technology

Volume 05, Issue 2, December 2014

## LIST OF CONTENTS

Proportional Derivative Active Force Control for “X” Configuration Quadcopter <i>Ni’am Tamami, Endra Pitowarno, I Gede Puja Astawa</i> .....	67-74
Design of Vibration Absorber using Spring and Rubber for Armored Vehicle 5.56 mm Caliber Rifle <i>Aditya Sukma Nugraha, Bagus Budiwantoro, Estiko Rijanto</i> .....	75-82
Evaluation of Potential Usage of Incremental-Type Rotary Encoder Application for Angle Sensing in Steering System <i>Sunarto Kaleg, Aam Muharam, Muhammad Redho Kurnia, Abdul Hapid</i> .....	83-90
Learning Efficiency of Consciousness System for Robot using Artificial Neural Network <i>Osama Shoubaky, Tala M. Sharari</i> .....	91-98
Adhesion Detection Analysis by Modeling Rail Wheel Set Dynamics under the Assumption of Constant Creep Coefficient <i>Zulfiqar Ali Soomro</i> .....	99-106
Design and Development of RC Railed Robot for Coffee Nursery Logistics <i>Marivic G. Dizon, Carlo T. Sevillano, Mark Anthony T. Cabaluna</i> .....	107-114
Comparison of Unmodulated Current Control Characteristics of Permanent Magnet Synchronous Motor <i>Anwar Muqorobin, Pudji Irasari, Taufik</i> .....	115-122
Braking System Modeling and Brake Temperature Response to Repeated Cycle <i>Zaini Dalimus</i> .....	123-128
An Experiment of Ocular Artifacts Elimination from EEG Signals using ICA and PCA Methods <i>Arjon Turnip, Iwan R. Setiawan, Edy Junaidi, Le Hoa Nguyen</i> .....	129-138

# Journal of Mechatronics, Electrical Power, and Vehicular Technology

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## ABSTRACTS SHEET

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Ni'am Tamami, Endra Pitowarno, I Gede Puja Astawa (Electronics Engineering Polytechnic Institute of Surabaya, Surabaya, Indonesia)

Proportional Derivative Active Force Control for "X" Configuration Quadcopter

*Mechatronics, Electrical Power, and Vehicular Technology*, December 2014, vol. 5, no. 2, p. 67-74, 10 ill, 2 tab, 16 ref.

This paper presents a stabilization control method for "x" configuration quadcopter using PDAFC (Proportional Derivative Active Force Control). PD is used to stabilize quadcopter, whereas AFC is used to reject disturbance uncertainty (e.g. wind) by estimating disturbance torque value of quadcopter. Simulation result shows that PDAFC is better than PD and AFC can minimize disturbance uncertainty effect. The sensitivity toward disturbance uncertainty can be set from sensitivity constant to get best performance of disturbance rejection. Constant disturbance simulation result shows that the best sensitivity constant ( $C_{sens}$ ) is 0.15, the quadcopter maximum error is 0.125 radian and can stable in 5 seconds. Fluctuated disturbance simulation result shows that PDAFC with 0.18 sensitivity constant gives lowest RMS error value, there are 0.074 radian for sine disturbance, 0.055 radian for sawtooth disturbance, and 0.092 radian for square pulse disturbance.

(Author)

Keywords: "x" configuration quadcopter, PD, AFC.

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Aditya Sukma Nugraha<sup>a</sup>, Bagus Budiwanto<sup>b</sup>, Estiko Rijanto<sup>a</sup> (<sup>a</sup>Research Center for Electrical Power and Mechatronics, Indonesian Institute of Sciences, Bandung, Indonesia; <sup>b</sup>Faculty of Mechanical and Aerospace Engineering, Institut Teknologi Bandung, Indonesia)

Design of Vibration Absorber using Spring and Rubber for Armored Vehicle 5.56 mm Caliber Rifle

*Mechatronics, Electrical Power, and Vehicular Technology*, December 2014, vol. 5, no. 2, p. 75-82, 12 ill, 4 tab, 21 ref.

This paper presents a design of vibration absorber using spring and rubber for 5.56 mm caliber rifle armored vehicle. Such a rifle is used in a Remote-Controlled Weapon System (RCWS) or a turret where it is fixed using a two degree of freedom pan-tilt mechanism. A half car lumped mass dynamic model of armored vehicles was derived. Numerical simulation was conducted using fourth order Runge Kutta method. Various types of vibration absorbers using spring and rubber with different configurations are installed in the elevation element. Vibration effects on horizontal direction, vertical direction and angular deviation of the elevation element was investigated. Three modes of fire were applied i.e. single fire, semi-automatic fire and automatic fire. From simulation results, it was

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concluded that the parallel configuration of damping rubber type 3, which has stiffness of 980,356.04 (N/m<sup>2</sup>) and damping coefficient of 107.37 (N.s/m), and Carbon steel spring whose stiffness coefficient is 5.547 x 10<sup>6</sup> (N/m<sup>2</sup>) provides the best vibration absorption.

(Author)

Keywords: vibration absorber, spring, rubber, armored vehicle, rifle.

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Sunarto Kaleg, Aam Muharam, Muhammad Redho Kurnia, Abdul Hapid (Research Center for Electrical Power and Mechatronics, Indonesian Institute of Sciences, Bandung, Indonesia)

Evaluation of Potential Usage of Incremental-Type Rotary Encoder Application for Angle Sensing in Steering System

*Mechatronics, Electrical Power, and Vehicular Technology*, December 2014, vol. 5, no. 2, p. 83-90, 13 ill, 0 tab, 15 ref.

The main target of a steering system is that the driver can change vehicle trajectory in accordance with the desired direction. Power steering has become a standard feature in automobile. It provides assisting power when the driver turns the steering wheel. The well-known power steering types include; Hydraulic Power Steering (HPS), Electro - Hydraulic Power Steering (EHPS), and Electric Power Steering (EPS). EHPS or EPS uses an Electronic Control Unit (ECU), which is specific for each vehicle. The ECU should be able to regulate power of electric motor to provide corresponding assisting power for the steering wheel. Therefore, ECU requires input signals, one of which is vehicle wheel angle that can be indicated from the vehicle steering wheel angle. Incremental type of Rotary Encoder (RE) is used in steering angle sensor on a minibus. RE specification used was 60 pulses per rotation and the minibus steering transmission specification is 3.5 round of right wheel off angle to the left wheel off angle. So we get the RE angular resolution of 6° per pulse and 105 number of pulses to half of the steering transmission ratio. Repeatability then tested against a steering angle counter module. Testing is done with a test cycle consisting 3 repetitions: condition center of the steering wheel, the steering wheel is turned to full right, then to the full left, then back to the right up to the steering wheel center. The results obtained was 2 pulses deviation, or equivalent to 12° of steering angle.

(Author)

Keywords: vehicle steering system, rotary encoder, incremental, steering wheel angle, repeatability.

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Osama Shoubaky<sup>a</sup>, Tala M. Sharari<sup>b</sup> (<sup>a</sup>Computer and Intelligent Systems Center, Jordan; <sup>b</sup>Institute of Engineering & Technology, Department of Electrical Engineering, Control Laboratory and

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Automation, Jordan)

#### Learning Efficiency of Consciousness System for Robot using Artificial Neural Network

*Mechatronics, Electrical Power, and Vehicular Technology*, December 2014, vol. 4, no. 2, p. 91-98, 9 ill, 4 tab, 18 ref.

This paper presents learning efficiency of a consciousness system for robot using artificial neural network. The proposed conscious system consists of reason system, feeling system and association system. The three systems are modeled using Module of Nerves for Advanced Dynamics (ModNAD). Artificial neural network of the type of supervised learning with the back propagation is used to train the ModNAD. The reason system imitates behaviour and represents self-condition and other-condition. The feeling system represents sensation and emotion. The association system represents behaviour of self and determines whether self is comfortable or not. A robot is asked to perform cognition and tasks using the consciousness system. Learning converges to about 0.01 within about 900 orders for imitation, pain, solitude and the association modules. It converges to about 0.01 within about 400 orders for the comfort and discomfort modules. It can be concluded that learning in the ModNAD completed after a relatively small number of times because the learning efficiency of the ModNAD artificial neural network is good. The results also show that each ModNAD has a function to imitate and cognize emotion. The consciousness system presented in this paper may be considered as a fundamental step for developing a robot having consciousness and feelings similar to humans.

(Author)

Keywords: consciousness, robot, artificial neural network.

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#### Adhesion Detection Analysis by Modeling Rail Wheel Set Dynamics under the Assumption of Constant Creep Coefficient

*Mechatronics, Electrical Power, and Vehicular Technology*, December 2014, vol. 4, no. 2, p. 99-106, 5 ill, 0 tab, 21 ref.

Adhesion level control plays significant role in order to keep smooth running of a train. To design a proper adhesion controller, adhesion dynamics needs to be analyzed. In this paper adhesion is analyzed by modeling rail wheel set dynamics under the assumption of constant creep coefficient. Equations of creepage and creep forces were derived in longitudinal, lateral and angular directions. Numerical simulation was conducted under assumption of constant creep coefficient. The creep coefficient was obtained by applying Coulomb's law of friction. From the simulation results it can be concluded that adhesion level for suitable dynamic model determination depends on assumption of creep analysis to avoid slip or derailment of rail wheelset.

(Author)

Keywords: adhesion, rail wheel set, creep coefficient, longitudinal, lateral.

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Marivic G. Dizon, Carlo T. Sevellano, Mark Anthony T. Cabaluna (Cavite State University, Indang, Cavite, Philippines)

#### Design and Development of RC Railed Robot for Coffee Nursery Logistics

*Mechatronics, Electrical Power, and Vehicular Technology*, December 2014, vol. 4, no. 2, p. 107-114, 10 ill, 5 tab, 12 ref.

The Remote Controlled (RC) Railed Robot was designed and developed to transfer polybags from manual operation to an automated logistic system. Gizduino microcontroller was used to read and interpret commands sent and received by the transceivers to the robot and a remote to command instructions to the robot. The project was tested and evaluated at the Coffee Nursery of Cavite State University by determining the speed of the robot, the effectiveness of the remote control and the accuracy of the robot to lift a pallet and place it into an empty space. Results showed that the robot was able to receive and interpret commands provided by the

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remote control as well as perform the tasks successfully. The most significant recommendation was to use a counterweight at the rear side of the robot to avoid unnecessary derailments of the robot if lifting the heavier or greater number of pallets are desired.

(Author)

Keywords: remote control, coffee nursery, gizduino microcontroller, automated logistic system.

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#### Comparison of Unmodulated Current Control Characteristics of Permanent Magnet Synchronous Motor

*Mechatronics, Electrical Power, and Vehicular Technology*, December 2014, vol. 4, no. 2, p. 107-114, 13 ill, 5 tab, 29 ref.

This paper discusses comparison of unmodulated current controls in PMSM, more specifically, on-off, sliding mode, predictive and hybrid controls. The purpose of this study is to select the most appropriate control technique to be adopted. The comparison method is preceded by modeling the motor and entering the values of the motor parameters. PI control is used for speed control and zero d-axis current is employed. Furthermore, performing simulation for each type of the selected current controls and analyzing their responses in terms of dq and abc currents, q-axis current response with step reference, as well as THD. Simulation results show that the on-off control gives the best overall performance based on its abc-axis current ripple and THD at large load torque. The hybrid control shows the best response occurring only at the fastest transient time of q-axis current but its response exhibits bad qualities compared with other controls. The predictive control yields the best responses offering the smallest d-axis ripple current and THD at small load torque condition. The sliding mode control, however, does not exhibit any prominent performance compared to the others. Results presented in this paper further indicate that for the PMSM used in the simulation the most appropriate control is the predictive control.

(Author)

Keywords: unmodulated current controls, on-off control, sliding mode control, predictive control, hybrid control.

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Zaini Dalimus (<sup>a</sup>Electrical Engineering Department, Andalas University, Indonesia)

#### Braking System Modeling and Brake Temperature Response to Repeated Cycle

*Mechatronics, Electrical Power, and Vehicular Technology*, December 2014, vol. 4, no. 2, p. 123-128, 12 ill, 2 tab, 9 ref.

Braking safety is crucial while driving the passenger or commercial vehicles. Large amount of kinetic energy is absorbed by four brakes fitted in the vehicle. If the braking system fails to work, road accident could happen and may result in death. This research aims to model braking system together with vehicle in Matlab/Simulink software and measure actual brake temperature. First, brake characteristic and vehicle dynamic model were generated to estimate friction force and dissipated heat. Next, Arduino based prototype brake temperature monitoring was developed and tested on the road. From the experiment, it was found that brake temperature tends to increase steadily in long repeated deceleration and acceleration cycle.

(Author)

Keywords: raking, kinetic energy, brake characteristic, Arduino.

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An Experiment of Ocular Artifacts Elimination from EEG Signals using ICA and PCA Methods

*Mechatronics, Electrical Power, and Vehicular Technology*,  
December 2014, vol. 4, no. 2, p. 129-138, 9 ill, 3 tab, 25 ref.

In the modern world of automation, biological signals, especially Electroencephalogram (EEG) is gaining wide attention as a source of biometric information. Eye-blinks and movement of the eyeballs produce electrical signals (contaminate the EEG signals) that are collectively known as ocular artifacts. These noise signals are required to be separated from the EEG signals to obtain the accurate results. This paper reports an experiment of ocular artifacts elimination from EEG signal using blind source separation algorithm based on independent component analysis and principal component analysis. EEG signals are recorded on three conditions, which are normal conditions, closed eyes, and blinked eyes. After processing, the dominant frequency of EEG signals in the range of 12-14 Hz either on normal, closed, and blinked eyes conditions is obtained.

(Author)

Keywords: EEG, EOG, ICA, PCA, artifacts elimination.

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