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ABSTRACTS SHEET

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Direction and Policies Needed to Support Hybrid Electric Car Research (Orig. Ind.)

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, p. 1-8, 4 ill, 13 ref.

The rising number of vehicles over the years has driven the increase of air pollution and fuel consumption. One of the solutions to overcome this problem is using hybrid electric car because it is environmentally friendly and efficient in fuel consumption. LIPI has conducted electric car research since 1997, but there were so many problems in its development that electric car cannot be developed into a national industry scale. Therefore, it is important to conduct a study that maps the problems and finds the solutions to prevent the same failure of electric car commercialization process from happening to hybrid electric car. This study was done by collecting and analyzing the primary and secondary data through interviews, discussing electric hybrid car with stakeholders, and examining earlier study results and regulations. Based on this study, several policies to support sustainability research of hybrid electric car were proposed. Some recommendations were the making of national roadmap and regulation for the usage of hybrid electric car on the road. For policy makers at LIPI, a research focus, research coordination, and pre-commercialization program were recommended.

(Author)

Keywords: national policy, hybrid electric cars, research, air pollution, national road map.

Hendri Maja Saputra ^a, Zainal Abidin ^b, Estiko Rijanto ^a (^a Pusat Penelitian Tenaga Listrik dan Mekatronik– LIPI, Bandung; ^b Teknik Mesin, Fakultas Teknik Mesin dan Dirgantara– ITB, Bandung)

Analysis of Inverse Angle Method for Controlling Two Degree of Freedom Manipulator (Orig. Ind.)

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, p. 9-16, 13 ill, 4 tab, 16 ref.

Driver mechanism with two degree of freedom (MP 2-DK) is a robotic device that can be used for various applications such as turret drive system, gutling gun, launcher, radar

antennas, and communications satellite antennas. The precision and the speed of a MP 2-DK are determined by its control system. The calculation inverse angle due to interference in six degree of freedom is necessary to control a MP 2 DK. This paper analyses three calculation methods of inverse angle which are iteration method using Jacobian matrix, reduction of matrix equations using positioning geometry, and an analytical derivation using a rotation matrix. The simulation results of the three methods showed that the first and the third methods could visually demonstrate three rotational disturbances, whereas the second method could only demonstrate the pitch and yaw (PY) disturbances. The third method required less processing time than the first and the second methods. The best method based on this research was the method of rotation matrix.

(Author)

Keywords: driver mechanism, control, inverse angle, Jacobian, geometry

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Development of Discrete Power Supply with Charge Pump Method for High Powered Sonar System (Orig. Ind.)

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, p. 17-22, 12 ill, 0 tab, 10 ref.

Power supply is one of the electronic devices that can provide electric energy for electronic systems or other systems. There are several types of power supplies that can be applied depend on the requirement and functions. One example is the use of power supply for sonar systems. Sonar system is a device which can be used to detect a target under water. The sonar system is an electronic circuit that requires a power supply with specific characteristics when the sonar functions as a transmitter and a receiver in the specific span time (when on) and the specific lag time (when off). This paper discusses the design of power supply for high-powered sonar systems with discrete methods in which high power supply is only applied when the acoustic waves radiated under water. Charge pump was used to get the appropriate output voltage from lower input voltage. Charge pump utilized a combination of series and parallel connections of capacitors. The working mode of this power supply used the lag time as the calculation of time to charge

charge pump capacitors in parallel while the span time was used for the calculation of discharging the charge pump capacitors in series.

(Author)

Keywords: power supply, charge pump, discrete method.

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Magnetic Simulation and Analysis of Radial Flux Permanent Magnet Generator using Finite Element Method (Orig. Ind.)

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, p. 23-30, 13 ill, 3 tab, 21 ref.

This paper discusses magnetic simulation and analysis of radial flux permanent magnet generator (PMG) using finite element method (FEM) by utilizing open source software FEMM 4.2. The specification of generator is 25 V, 28 A, 3 phase, 300 rpm. The analyzed magnetic flux was in the air gap, stator teeth and slots to find out the distribution pattern and its fluctuation. The simulations were conducted in no-load and nominal load (28 A) conditions. Furthermore, the maximum flux density of simulation ($B_{g(sim)}$) was used to calculate phase voltage E_{ph} to find out the magnitude of generated electromotive force (EMF). The calculation results were presented as voltage vs. rotation graph in no-load condition and voltage vs. current graph in nominal load condition. Both graphs were validated using E_{ph} from experiment result ($E_{ph(exp)}$) and E_{ph} whose B_g value was obtained from analytical calculation ($E_{ph(calc)}$). The final results showed that in no-load condition, E_{ph} graph with $B_{g(sim)}$ ($E_{ph(sim)}$) was close to $E_{ph(exp)}$ and $E_{ph(calc)}$. The error rate with respect to the experiment was 6,9%. In nominal load condition, $E_{ph(sim)}$ graph almost coincided with $E_{ph(calc)}$ graph, with the voltage drop of both was 0.441 V. Both graphs however were far different from $E_{ph(exp)}$ graph, which had 9 V of voltage drop. The overall results demonstrated that magnetic distribution pattern presented by FEM was very helpful to avoid magnetic flux accumulation in a particular segment. Besides, $B_{g(sim)}$ made the process to predict the value of E_{ph} become easier.

(Author)

Key words: simulation, magnetic flux, generator, permanent magnet, finite element .

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Design and Implementation of Anti-Windup PI Control on DC-DC Bidirectional Converter for Hybrid Vehicle Applications (Orig. Ind.)

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, p. 31-38, 16 ill, 2 tab, 10 ref.

Well-regulated DC bus voltage is the important point to guarantee power demand fulfillment in hybrid vehicle applications. Voltage regulation can be achieved with control method that determines switching signal on DC-DC converter. This paper describes the design and small scale experiment results of bus voltage regulation control for DC-DC bidirectional converter with battery and super capacitor as energy sources. The control system consisted of two

control loops. The outer loop got DC bus voltage feedback using anti-windup PI back calculation control method. This outer loop would generate a reference current for the inner loop that implemented hysteresis control. The inner control loop compared that reference current with the source current obtained from the current sensor. Simulation and experiment results showed that bus voltage was well-regulated under the load changes of 1% ripple voltage.

(Author)

Keywords: anti-windup PI, hysteresis, DC-DC bidirectional converter

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Modelling and Identification of Oxygen Excess Ratio of Self-Humidified PEM Fuel Cell System (Orig. Ind.)

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, p. 39-48, 10 ill, 2 tab, 19 ref.

One essential parameter in fuel cell operation is oxygen excess ratio which describes comparison between reacted and supplied oxygen number in cathode. Oxygen excess ratio relates to fuel cell safety and lifetime. This paper explains development of air feed model and oxygen excess ratio calculation in commercial self-humidified PEM fuel cell system with 1 kW output power. This modelling was developed from measured data which was limited in open loop system. It was carried out to get relationship between oxygen excess ratio with stack output current and fan motor voltage. It generated fourth-order 56.26% best fit ARX linear polynomial model estimation (loss function = 0.0159, FPE = 0.0159) and second-order ARX nonlinear model estimation with 75 units of wavenet estimator with 84.95% best fit (loss function = 0.0139). The second-order ARX model linearization yielded 78.18% best fit (loss function = 0.0009, FPE = 0.0009).

(Author)

Keywords: PEM fuel cell, self-humidified, oxygen excess ratio, system identification, polynomial model

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The Effect of Ethanol-Diesel Blends on the Performance of a Direct Injection Diesel Engine (Orig. Ind.)

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, p. 49-56, 9 ill, 2 tab, 26 ref.

The experiment was conducted on a conventional direct injection diesel engine. Performance test was carried out to evaluate the performance and emission characteristics of a conventional diesel engine that operates on ethanol-diesel blends. The test procedure was performed by coupling the diesel engine on the eddy current dynamometer. Fuel consumption was measured using the AVL Fuel Balance, and a hotwire anemometer was used to measure the air consumption. Some of the emission test devices were mounted on the exhaust pipe. The test of fuel variations started from 100% diesel fuel (D100) to 2.5% (DE2.5), 5% (DE5), 7.5% (DE7.5), and 10% (DE10) ethanol additions. Performance test was conducted at 1500 rpm with load

variations from 0 to 60 Nm by increasing the load on each level by 10 Nm. The addition of 5% ethanol to diesel (DE5) increased the average pressure of combustion chamber indication to 48% as well as reduced the specific fuel consumption to 9.5%. There were better exhaust emission characteristics at this mixture ratio than diesel engine which used pure diesel fuel (D100), the reduction of CO to 37%, HC to 44% and opacity to 15.9%.

(Author)

Key words: performance test, fuel supplement, bioethanol, emission, diesel engine.

Asmara Yanto^a, Zainal Abidin^b (^a Teknik Mesin, Fakultas Teknologi Industri – ITP, Padang; ^b Teknik Mesin, Fakultas Teknik Mesin dan Dirgantara – ITB, Bandung)

Development of Swept-Sine Excitation Control Method to Minimize the FRF Measurement Error

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, p. 57-64, 10 ill, 3 tab, 19 ref.

Shaker excitation in FRF (Frequency Response Function) measurement of a testing system can be controlled by using swept-sine signal source in a signal generator and it is called with swept-sine excitation. FRF's magnitude error of the system which be obtained from the FRF measurement using swept-sine excitation depends on swept function of swept-sine signal. In this paper, swept-sine signals using linear and S535 swept functions have been simulated to controlling swept-sine excitation in the FRF measurement of SDOF (Single Degree of Freedom) system. Linear swept is swept function of swept-sine signal which often be used in the FRF measurement and S535swept is a swept function has been developed in this paper. Based on simulation results, the FRF's magnitude error at system's resonant frequency which be obtained from the FRF measurement using linear swept-sine excitation can be minimized by redoing the FRF measurement using S535 swept-sine excitation.

(Author)

Keywords: FRF, swept-sine, linear swept, S535 swept, magnitude.

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A Review of Atomic Layer Deposition for Nanoscale Devices

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, p. 65-72, 8 ill, 0 tab, 53 ref.

Atomic layer deposition (ALD) is a thin film growth technique that utilizes alternating, self-saturation chemical reactions between gaseous precursors to achieve a deposited nanoscale layers. It has recently become a subject of great interest for ultrathin film deposition in many various applications such as microelectronics, photovoltaic, dynamic random access memory (DRAM) and microelectromechanic system (MEMS). By using ALD, the conformability and extremely uniformity of layers can be achieved in low temperature process. It facilitates to be deposited onto the surface in many variety substrates that have low melting temperature. Eventually it has advantages on the contribution of the wider nanodevices

(Author)

Key words: thin coating, atomic layer deposition, nanoscale devices.

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Effect of Contact Pressure on the Resistance Contact Value and Temperature Changes in Copper Busbar Connection (Orig. Ind.)

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, p. 73-80, 11 ill, 2 tab, 12 ref.

This paper discussed the influence of tightness or contacts pressure on copper busbar joints to determine changes in the value of the initial contact resistance and the maximum temperature at the joint due to high current load. The test sample using copper busbar 3 x 30 mm with configuration of bolted overlapping joint. Increasing contact pressure at the joint was measured to find out its effect on the value of contact resistance. The applied pressure was 6 to 36 MPa. Procedure of contact resistance measurement refers to the ASTM B539 standard using four-wire method. The sample subsequently loaded with the current of 350 A for 60 minutes and the maximum temperature at the joint was measured. The result shows that increasing contact pressure at the busbar joint will reduce the contact resistance and maximum temperature. The increasing of contact pressure from 6 to 30 MPa causes decreasing contact resistance from 16 $\mu\Omega$ to 11 $\mu\Omega$. Further increasing of contact pressure more than 30 MPa didn't affect the contact resistance significantly. The lowest temperature of busbar joint of 54°C was reached at a contact pressure of 36 Mpa.

(Author)

Key words: contact pressure, contact resistance, maximum temperature, copper busbar joint.

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The Effect of the Addition of Active Digester Effluent for Start-Up Accelerator in Anaerobic Digestion of Soybean Curd Industry Waste Water (Basic Research for Biogas Power Generation)

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, p. 81-86, 2 ill, 0 tab, 17 ref.

Biogas production from soybean curd industry waste water was studied in laboratory scale to improve the application of anaerobic digestion process. The problem with the soybean curd waste water was the fact that it did not sufficiently contain anaerobic microorganisms required in biogas production. Therefore, it is necessary to add a well-developed population of anaerobic microorganisms to accelerate the start-up of the anaerobic digestion. This research was aimed to verify the influence of the addition of active digester effluent into the soybean curd waste water batches in an anaerobic digestion process. Batch experiments were done in two digesters. The first digester was only fed with soybean curd waste water while the second digester was fed with soybean curd waste water and

active digester effluent from a digester processing cow manure which was very rich in anaerobic microorganism consortium. The results indicated that soybean curd industry waste water did not contain methanogenic bacteria but there were existed some acidogenic bacteria. The addition of active digester effluent accelerated the anaerobic digestion start-up and directed the process pathway towards methanogenic process so that more methane was obtained. The high methane content obtained (more than 64% volume) was very potential for power generation. The capacity of soybean curd industry must be as high as 697.13 kg soybean per day to generate the electric energy of 8.4 kWh.

(Author)

Key words: active digester effluent, start-up, anaerobic digestion, soybean curd waste water, anaerobic bacteria, methanogenic process, electric energy.

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Analytical and Numerical Deflection Study on the Structure of 10 KW Low Speed Permanent Magnet Generator

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, p. 87-94, 12 ill, 1 tab, 17 ref.

Analytical and numerical studies of the deflection in the structure of 10 kW low speed permanent magnet generator (PMG) have been discussed in this paper. This study is intended to prevent failure of the structure when the prototype is made. Numerical analysis is performed with the finite-element method (FEM). Flux density, weight and temperature of the components are the required input parameters. Deflection observed is the movements of the two main rotor components, namely the rim and shaft, is here the maximum allowable deflection at the air gap between rotor and stator should be between 10% to 20% of the air gap clearance or 0.1000 mm to 0.2000 mm. Base on the analysis, total deflection of the analytic calculation is 0.0553 mm, and numerical simulation is 0.0314 mm. Both values are in the acceptable level because it is still below the maximum allowable deflection. These results indicate that the structure of a permanent magnet generator (rim and shaft) can be used safely.

(Author)

Keywords: permanent magnet generator, finite element, air gap, deflection.

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Design of a DC-AC Link Converter for 500w Residential Wind Generator

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, p. 95-102, 10 ill, 2 tab, 24 ref.

As one of alternative sources of renewable energy, wind

energy has an excellence prospect in Indonesia, particularly in coastal and hilly areas which have potential wind to generate electricity for residential uses. There is urgent need to locally develop low cost inverter of wind generator system for residential use. Recent developments in power electronic converters and embedded computing allow improvement of power electronic converter devices that enable integration of microcontrollers in its design. In this project, an inverter circuit with suitable control scheme design was developed. The circuit was to be used with a selected topology of Wind Energy Conversion System (WECS) to convert electricity generated by a 500W direct-drive permanent magnet type wind generator which is typical for residential use. From single phase AC output of the generator, a rectifier circuit is designed to convert AC to DC voltage. Then a DC-DC boost converter is used to step up the voltage to a nominal DC voltage suitable for domestic use. The proposed inverter then will convert the DC voltage to sinusoidal AC. The duty cycle of sinusoidal Pulse-Width Modulated (SPWM) signal controlling switches in the inverter was generated by a microcontroller. The lab-scale experimental rig involves simulation of wind generator by running a geared DC motor coupled with 500W wind generator where the prototype circuit was connected at the generator output. The experimental circuit produced single phase 240V sinusoidal AC voltage with frequency of 50Hz. Measured total harmonics distortion (THD) of the voltage across load was 4.0% which is within the limit of 5% as recommended by IEEE Standard 519-1992.

(Author)

Key words: Wind Energy, inverter, converter, microcontroller, generator, residential electricity.

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Analysis and Development of Walking Algorithm Kinematic Model for 5-Degree of Freedom Bipedal Robot

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, p. 103-110, 11 ill, 3 tab, 15 ref.

A design of walking diagram and the calculation of a bipedal robot have been developed. The bipedal robot was designed and constructed with several kinds of servo bracket for the legs, two feet and a hip. Each of the bipedal robot leg consists of 5-degrees of freedom, three pitches (hip joint, knee joint and ankle joint) and two rolls (hip joint and ankle joint). The walking algorithm of this bipedal robot was based on the triangle formulation of cosine law to get the angle value at each joint. The hip height, height of the swinging leg and the step distance are derived based on linear equation. This paper discussed the kinematic model analysis and the development of the walking diagram of the bipedal robot. Kinematics equations are derived, the joint angles are simulated and coded into Arduino board to be executed to the robot.

(Author)

Keywords: bipedal robot, kinematics model, kinematics analysis, 5-degree of freedom, walking algorithm.

Sutisno^a, Andreas Prasetya Adi^a (^a LAPAN)

Vibration Disturbance Damping System Design to Protect

Payload of the Rocket

Mechatronics, Electrical Power, and Vehicular Technology,
December 2012, vol. 3, no. 2, p. 111-116, 8 ill, 0 tab, 13 ref.

Rocket motor generates vibrations acting on whole rocket body including its contents. Part of the body which is sensitive to disturbance is the rocket payload. The payload consists of various electronic instruments including : transmitter, various sensors, accelerometer, gyro, the embedded controller system, and others. This paper presents research on rocket vibration influence to the payload and the method to avoid disturbance. Avoiding influence of vibration disturbance can be done using silicone gel material whose typical damping factors are relatively high. The rocket vibration was simulated using electromagnetic motor, and the vibrations were measured using an accelerometer sensor. The measurement results were displayed in the form of curve, indicating the vibration level on some parts of the tested material. Some measurement results can be applied to determine the good material to attenuate vibration disturbance on the instruments of the payload

Key words: motor, rocket, vibration, payload, silicone.

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LEMBAR ABSTRAK

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Bulan Terbit vol. 3, no. 1: Juli 2012
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Kata kunci yang dicantumkan adalah istilah bebas. Lembar abstrak ini dapat diperbanyak tanpa izin dan biaya.

Ridwan Arief Subekti ^a, Agus Hartanto ^a, Vita Susanti ^a (^a Pusat Penelitian Tenaga Listrik dan Mekatronik – LIPI, Bandung)

Arah dan Kebijakan yang Diperlukan dalam Menunjang Penelitian Mobil Listrik Hibrid

Mechatronics, Electrical Power, and Vehicular Technology, Juli 2012, vol. 3, no. 1, hal. 1-8, 4 ill, 0 tab, 13 ref.

Peningkatan jumlah kendaraan bermotor dari tahun ke tahun menyebabkan peningkatan pencemaran udara dan konsumsi BBM. Salah satu cara untuk mengatasi masalah tersebut adalah dengan menggunakan kendaraan mobil listrik hybrid karena ramah lingkungan dan hemat BBM. LIPI telah mengembangkan penelitian mobil listrik sejak tahun 1997. Akan tetapi muncul berbagai permasalahan yang menyebabkan mobil listrik tersebut tidak dapat berkembang ke skala industry nasional. Oleh karena itu dilakukan suatu kajian untuk memetakan permasalahan dan mencari solusi agar kegagalan proses komersialisasi mobil listrik tidak terulang pada mobil listrik hybrid yang saat ini penelitiannya masih berjalan. Kajian ini dilakukan dengan mengumpulkan dan menganalisis data primer dan sekunder melalui wawancara, diskusi dengan pihak terkait, serta mempelajari hasil kajian dan peraturan yang ada. Berdasarkan kajian ini selanjutnya direkomendasikan beberapa usulan kebijakan untuk menunjang kesinambungan penelitian mobil listrik hybrid. Beberapa rekomendasi yang diusulkan antara lain adalah perlunya dukungan pemerintah pusat melalui program nasional mobil listrik hybrid yang didukung dengan adanya road map nasional dan peraturan legalitas penggunaan mobil listrik hybrid di jalan raya, sedangkan untuk pengambil kebijakan di lingkungan LIPI, direkomendasikan adanya focus penelitian, koordinasi penelitian dan program pra komersialisasi.

(Penulis)

Kata kunci: kebijakan nasional, mobil listrik hybrid, penelitian, polusi udara, road map nasional.

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Analisis Metode Sudut Balik untuk Pengendalian Mekanisme Penggerak Dua Derajat Kebebasan

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, hal. 9-16, 13 ill, 4 tab, 16 ref.

Mekanisme penggerak dua derajat kebebasan (MP 2-DK) merupakan peralatan robotik yang dapat digunakan untuk berbagai aplikasi seperti system penggerak turret, peluncur roket/rudal, antena radar, dan antena komunikasi satelit. Tingkat presisi dan kecepatan gerak MP 2-DK sangat ditentukan oleh system kendalinya. Untuk pengendalian MP 2-DK perlu dihitung sudut balik akibat gangguan enam derajat kebebasan (rotasi: roll, pitch, yaw, translasi: b_x , b_y , b_z). Makalah ini membahas hasil analisis 3 metode perhitungan sudut balik, antara lain metode iterasi menggunakan matriks Jacobian, penurunan persamaan geometri menggunakan matriks posisi, dan penurunan secara analitis menggunakan matriks rotasi. Hasil simulasi dari ketiga metode membuktikan bahwa metode pertama dan ketiga secara visual dapat mempresentasikan ketiga gangguan rotasi yang terjadi, sedangkan metode kedua hanya mempresentasikan gangguan pitch dan yaw (PY) saja. Metode ketiga memerlukan waktu proses lebih cepat dari pada metode pertama dan metode kedua. Metode yang terbaik berdasarkan penelitian ini adalah metode ketiga (metode matriks rotasi).

(Penulis)

Kata kunci: mekanisme penggerak, pengendalian, sudut balik, Jacobian, geometri.

Kristian Ismail ^a, Syamsu Ismail ^b (^a Pusat Penelitian Tenaga Listrik dan Mekatronik – LIPI, Bandung; ^b Pusat Penelitian Elektronika dan Telekomunikasi – LIPI, Bandung)

Rancang Bangun Catu Daya Diskrit dengan Metode Charge Pump untuk Sistem Sonar Berdaya Tinggi

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, hal. 17-22, 12 ill, 0 tab, 10 ref.

Catu daya adalah salah satu perangkat elektronika yang dapat menyediakan energy listrik untuk system elektronika atau system lainnya. Terdapat beberapa jenis catu daya yang dapat diaplikasikan sesuai dengan kebutuhan dan fungsinya, salah satu contohnya adalah penggunaan catu daya untuk sistem sonar. Sistem sonar adalah alat pendeteksi keberadaan target di bawah air, system tersebut berupa rangkaian elektronika yang memerlukan catu daya dengan karakteristik yang spesifik. Catu daya dibutuhkan pada saat sonar sebagai pemancar dan sebagai penerima dalam rentang

waktu (saat on) dan jeda waktu (saat off) yang spesifik. Untuk memenuhi karakteristik dan spesifikasi tersebut, maka digunakan catu daya diskrit yang menggunakan metode charge pump untuk mengumpulkan energy listriknya. Dalam tulisan ini dibahas tentang rancang bangun catu daya yang digunakan untuk menyediakan energy listrik bagi sistem sonar berdaya tinggi dengan metoda diskrit yaitu pengaktifan catu daya tinggi tidak kontinyu melainkan hanya pada saat gelombang akustik diradiasikan di bawah air. Metoda pengumpulan energy ke komponen pengubah tegangan menggunakan charge pump. Charge pump pada catu daya yang dikembangkan ini memanfaatkan kombinasi hubungan seri dan parallel kapasitor. Cara kerja catu daya ini menggunakan jeda waktu sebagai perhitungan waktu untuk pengisian kapasitor charge pump secara parallel sedangkan rentang waktu digunakan untuk perhitungan pengosongan kapasitor charge pump secara seri.

(Penulis)

Kata kunci: catu daya, charge pump, metode diskrit.

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Simulasi dan Analisis Magnetik Generator Magnet Permanen Fluks Radial Menggunakan Metoda Elemen Hingga

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, hal. 23-30, 13 ill, 3 tab, 21 ref.

Dalam makalah ini dibahas simulasi dan analisis magnetik generator magnet permanen (GMP) fluks radial menggunakan metoda elemen hingga (MEH) dengan perangkat lunak terbuka FEMM 4.2. Generator memiliki spesifikasi 25 V, 28 A, 3 fasa, 333 rpm. Fluks magnet yang dianalisis adalah pada celah udara, gigi dan alur stator untuk mengetahui pola distribusi dan fluktuasinya. Simulasi dilakukan dalam keadaan tanpa beban dan dengan beban nominal (28 A). Selanjutnya kerapatan fluks celah udara maksimum hasil simulasi ($B_{g(sim)}$) digunakan untuk menghitung tegangan fasa E_{ph} guna mengetahui besarnya electromotive force (EMF) yang dibangkitkan. Hasil perhitungan ditampilkan berupa grafik tegangan vs. putaran untuk kondisi tanpa beban dan grafik tegangan vs. arus untuk kondisi beban nominal. Kedua grafik tersebut divalidasi dengan E_{ph} hasil eksperimen ($E_{ph(exp)}$) dan E_{ph} yang nilai B_g nya diperoleh dari perhitungan analisis ($E_{ph(calc)}$). Hasil akhir menunjukkan bahwa dalam kondisi tanpa beban grafik E_{ph} dengan $B_{g(sim)}$ ($E_{ph(sim)}$) mendekati $E_{ph(exp)}$ maupun $E_{ph(calc)}$. Tingkat kesalahan terhadap eksperimen sebesar 6,9%. Untuk kondisi beban nominal, grafik $E_{ph(sim)}$ hamper berimpit dengan $E_{ph(calc)}$, dengan tegangan jatuh keduanya sebesar 0,441 V. Namun kedua grafik tersebut berbeda cukup jauh dengan grafik $E_{ph(exp)}$ yang tegangan jatuhnya 9 V. Dari keseluruhan hasil yang diperoleh menunjukkan bahwa pola distribusi magnet yang disajikan oleh MEH sangat membantu untuk menghindari penumpukan fluks magnet pada segmen tertentu. Selain itu $B_{g(sim)}$ sangat memudahkan dalam memprediksi besarnya E_{ph} .

(Penulis)

Kata kunci: simulasi, fluks magnet, generator, magnet permanen, elemen hingga.

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Perancangan dan Implementasi Kendali PI Anti-Windup pada Konverter DC-DC Dua Arah untuk Aplikasi Kendaraan Hibrid

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, hal. 31-38, 16 ill, 2 tab, 10 ref.

Tegangan DC bus yang teregulasi dengan baik merupakan hal yang sangat penting pada aplikasi kendaraan hibrid, karena menjamin terpenuhi permintaan daya beban. Regulasi tegangan dapat dicapai dengan menerapkan metode kendali tertentu yang akan menentukan sinyal penyaklaran pada konverter DC-DC. Paper ini menjelaskan perancangan dan hasil eksperimen kendali regulasi tegangan bus pada konverter DC-DC dua arah (bidirectional converter) untuk skala kecil, dengan sumber berupa baterai dan superkapasitor. Sistem kendali terdiri dari dua buah loop kendali. Loop kendali luar mendapatkan umpan balik dari tegangan bus menerapkan metoda anti-windup PI back calculation. Pengendali ini akan menghasilkan arus referensi untuk loop kendali dalam yang menerapkan kendali histeresis. Loop kendali dalam membandingkan arus referensi tersebut dengan arus sumber yang diperoleh dari bacaan sensor arus. Hasil simulasi dan eksperimen menunjukkan bahwa tegangan bus teregulasi dengan baik ketika terjadi perubahan beban dengan riak tegangan sekitar 1%.

(Penulis)

Kata kunci: anti-windup PI, histeresis, konverter DC-DC dua arah.

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Pemodelan dan Identifikasi Rasio Kelebihan Oksigen pada Sistem *Self-Humidified* PEM Fuel Cell

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, hal. 39-48, 10 ill, 2 tab, 19 ref.

Salah satu parameter pengoperasian fuel cell adalah rasio kelebihan oksigen yang menggambarkan perbandingan antara jumlah oksigen yang bereaksi dengan jumlah oksigen yang dipasok pada katode fuel cell. Rasio kelebihan oksigen penting untuk diperhatikan karena berkaitan dengan keselamatan operasi dan usia penggunaan fuel cell. Makalah ini memaparkan teknik penentuan model masukan udara dan perhitungan rasio kelebihan oksigen pada self-humidified PEM fuel cell komersial dengan daya keluaran 1 kW. Pemodelan dilakukan berdasarkan data hasil pengukuran yang relatif terbatas pada sistem loop terbuka. Persamaan rasio kelebihan oksigen kemudian ditentukan dengan menggunakan model pasokan udara. Identifikasi loop terbuka dengan model ARX dilakukan untuk memperoleh hubungan antara rasio kelebihan oksigen terhadap nilai arus stack dan tegangan motor fan. Berdasarkan hasil identifikasi sistem diperoleh bahwa estimasi polinomial linier ARX orde 4 menghasilkan tingkat kecocokan 56,26% (loss function = 0,0159; final prediction error (FPE) = 0,0159) dan estimasi model non linier ARX orde 2 dengan estimator wavenet 75 unit menghasilkan tingkat kecocokan 84,95% (loss function = 0,0139). Untuk kemudahan perancangan sistem kontrol, linearisasi dilakukan pada model non linier ARX dan menghasilkan model ARX orde 2 dengan tingkat kecocokan 78,18% (loss function 0,0009; FPE 0,0009).

(Penulis)

Kata kunci: PEM fuel cell, self-humidified, rasio kelebihan oksigen, identifikasi sistem, model polinomial.

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Pengaruh Penambahan Etanol pada Solar Terhadap Motor Diesel Injeksi Langsung

Mechatronics, Electrical Power, and Vehicular Technology, July 2012, vol. 3, no. 1, hal. 49-56, 9 ill, 2 tab, 26 ref.

Eksperimen dilakukan pada motor diesel dengan sistem injeksi langsung (direct injection). Uji prestasi ini dilakukan guna melihat karakteristik prestasi dan emisi motor diesel konvensional terhadap penambahan etanol sebagai bahan bakar suplemen pada solar. Uji prestasi dilakukan dengan menempatkan motor uji pada perangkat Eddy current dynamometer. Konsumsi bahan bakar diukur dengan menggunakan perangkat AVL Fuel Balance sementara untuk pengukuran konsumsi udara digunakan hotwire anemometer. Beberapa perangkat uji emisi dipasang pada saluran gas buang motor diesel untuk mengukur emisi. Beberapa variasi campuran solar dengan etanol diujikan pada penelitian ini. Campuran bahan bakar yang diujikan mulai dari solar 100% (D100), penambahan etanol 2,5% (DE2,5), 5% (DE5), 7,5% (DE7,5), dan pada campuran 10% etanol (DE10). Uji prestasi dilakukan pada 1500 rpm dengan variasi pembebanan mulai dari 0 Nm (no load) sampai 60 Nm (full load) dengan penambahan beban setiap 10 Nm. Penambahan 5% etanol dalam solar dapat meningkatkan tekanan rata-rata indikasi ruang bakar sebesar 48% disertai penurunan konsumsi bahan bakar spesifik mencapai 9,5%. Pada rasio campuran ini terjadi perbaikan karakteristik emisi gas buang di mana emisi karbon monoksida (CO) tereduksi hingga 37 %, emisi hidrokarbon (HC) tereduksi hingga 44%, dan kadar kepekatan emisi gas buang tereduksi hingga 15,9% jika dibandingkan dengan motor diesel yang menggunakan bahan bakar solar murni (D100).

(Penulis)

Kata kunci: uji prestasi, pencampur solar, etanol, emisi, motor diesel.

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Pengembangan Metode Pengontrolan Eksitasi *Swept-Sine* untuk Meminimalisasi Kesalahan Pengukuran FRF

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, hal. 57-64, 10 ill, 3 tab, 19 ref.

Eksitasi shaker pada pengukuran FRF (Fungsi Respon Frekuensi) dari suatu sistem uji dapat dikontrol dengan sinyal swept-sine yang bersumber dari sebuah generator sinyal dan disebut dengan eksitasi swept-sine. Kesalahan magnitudo FRF sistem yang diperoleh dari pengukuran FRF dengan eksitasi swept-sine bergantung kepada fungsi swept dari sinyal swept-sine. Pada makalah ini, sinyal swept-sine dengan fungsi linear swept dan S535 swept telah disimulasikan untuk mengontrol eksitasi swept-sine pada pengukuran FRF Sistem 1-DK (Satu Derajat Kebebasan). Linear swept adalah fungsi swept dari sinyal swept-sine yang sering digunakan pada pengukuran FRF dan S535

swept adalah sebuah fungsi swept yang dikembangkan pada makalah ini. Berdasarkan hasil simulasi, kesalahan magnitudo FRF pada frekuensi resonansi sistem yang diperoleh dari pengukuran FRF dengan eksitasi linear swept-sine dapat diminimalisasi dengan mengulang kembali pengukuran FRF dengan eksitasi S535 swept-sine.

(Penulis)

Kata kunci: FRF, swept-sine, linear swept, S535 swept, magnitudo.

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Review Deposisi Lapisan Tipis untuk Peralatan Skala Nano (Orig. Eng.)

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, hal. 65-72, 8 ill, 0 tab, 53 ref.

Atomic layer deposition (ALD) adalah teknik penumbuhan lapisan tipis yang menggunakan reaksi kimia jenuh antara gas pendahulu untuk mendapatkan deposisi lapisan skala nano. Teknik ini menjadi subyek yang sangat menarik saat ini untuk deposisi lapisan sangat tipis pada berbagai aplikasi seperti mikroelektronik, photovoltaic, dynamic random access memory (DRAM) dan sistem mikroelektromekanik (MEMS). Dengan menggunakan ALD keseragaman dan penglarasan dari lapisan dapat dicapai pada temperatur proses yang rendah. Deposisi lapisan dengan teknik ini dapat digunakan pada beragam substrat yang memiliki temperatur leleh yang rendah. Keuntungan dari ALD adalah teknik deposisi ini memiliki kontribusi yang luas untuk aplikasi peralatan skala nano

(Penulis)

Kata kunci: lapisan tipis, atomic layer deposition, peralatan skala nano.

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Pengaruh Tekanan Kontak Terhadap Nilai Tahanan Kontak dan Perubahan Temperatur pada Sambungan Busbar Tembaga

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, hal. 73-80, 11 ill, 2 tab, 12 ref.

Paper ini membahas pengaruh kekencangan atau tekanan kontak pada sambungan busbar tembaga untuk mengetahui perubahan nilai tahanan kontak awal dan temperatur maksimum pada sambungan akibat pembebanan arus yang tinggi. Sampel uji menggunakan busbar tembaga ukuran 3 x 30 mm untuk konfigurasi sambungan tumpang tindih dengan baut tunggal. Peningkatan tekanan kontak pada sambungan diukur untuk mengetahui pengaruhnya terhadap nilai tahanan kontak. Besarnya tekanan kontak yang diterapkan adalah 6 sampai 36 MPa. Prosedur pengukuran tahanan kontak mengacu pada standar ASTM B539 menggunakan metode empat kawat. Selanjutnya sampel dibebani dengan arus 350 A selama 60 menit kemudian diukur temperatur maksimum pada masing-masing tekanan kontak. Hasil pengujian menunjukkan bahwa nilai tahanan kontak pada sambungan busbar akan semakin kecil dengan meningkatnya tekanan kontak. Peningkatan tekanan kontak

dari 6 sampai 30 MPa menurunkan nilai tekanan kontak dari 16 micro ohm sampai 11 micro ohm. Peningkatan tekanan kontak pada tekanan lebih dari 30 MPa tidak menyebabkan kenaikan tahanan kontak secara signifikan. Temperatur terendah sambungan busbar adalah 54°C dan dicapai pada tekanan kontak 36 MPa.

(Penulis)

Kata kunci: tekanan kontak, tahanan kontak, temperatur maksimum, sambungan busbar tembaga.

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Pengaruh Penambahan Effluent Digester Aktif untuk Mempercepat *Start-Up* Peruraian Anaerobik Air Limbah Industri Tahu (Riset Dasar Pembangkit Listrik Tenaga Biogas) (Orig. Eng.)

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, hal. 81-86, 2 ill, 0 tab, 17 ref.

Untuk memperluas aplikasi proses peruraian anaerobik, telah dilakukan proses pembuatan biogas skala laboratorium dengan substrat air limbah industri tahu. Masalah yang dihadapi adalah sedikitnya bakteri-bakteri anaerobik di dalam air limbah tersebut. Oleh karena itu, untuk mempercepat start-up pembuatan biogas diperlukan starter yang banyak mengandung bakteri-bakteri anaerobik. Penelitian ini bertujuan untuk menguji pengaruh penambahan effluent digester aktif sebagai starter pada peruraian anaerobik air limbah tahu. Penelitian dilakukan dalam dua buah digester batch berisi 600 gram bahan baku, dimana digester pertama berisi air limbah tahu saja dan digester ke-2 berisi air limbah tahu dan starter effluent digester kotoran sapi aktif yang sangat kaya akan konsorsium bakteri-bakteri anaerobik. Hasil percobaan menunjukkan bahwa air limbah tahu mengandung bakteri asidogen tetapi tidak mengandung bakteri metanogen. Penambahan effluent digester aktif sebagai starter mempercepat star-up peruraian anaerobik dan mengarahkan jalannya proses ke metanogenesis sehingga diperoleh produk akhir berupa metana. Kadar metana yang dihasilkan mencapai di atas 64% sehingga sangat potensial untuk pembangkit listrik. Energi listrik sebesar 8,4 kWh dapat dibangkitkan dari industri tahu dengan kapasitas 697,13 kg kedelai per hari.

(Penulis)

Kata kunci: effluent digester aktif, start-up, peruraian anaerobik, air limbah tahu, bakteri anaerobik, metanogenesis, energi listrik.

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Kajian Defleksi Analitis dan Numerik pada Struktur Generator Magnet Permanen Kecepatan Rendah Kapasitas 10 KW (Orig. Eng.)

Mechatronics, Electrical Power, and Vehicular Technology,

December 2012, vol. 3, no. 2, hal. 87-94, 12 ill, 1 tab, 17 ref.

Studi secara analitis dan numerik mengenai defleksi pada struktur generator magnet permanen (GMP) kecepatan rendah kapasitas 10 kW telah dibahas dalam makalah ini. Studi ini dimaksudkan untuk mencegah kegagalan struktur saat prototipe sudah dibuat. Analisis numerik dilakukan dengan metode elemen hingga (MEH). Kerapatan fluks, berat dan suhu komponen merupakan parameter-parameter masukan. Defleksi yang diamati adalah gerakan dua komponen utama rotor yaitu rim dan poros, di sini defleksi maksimum yang diizinkan pada celah udara antara rotor dan stator harus berkisar antara 10% sampai 20% dari clearance celah udara atau 0,1000 mm sampai 0,2000 mm. Berdasarkan hasil analisis, defleksi total hasil perhitungan analitis adalah 0,0553 mm sedangkan simulasi numerik adalah 0,0314 mm. Kedua nilai tersebut memenuhi persyaratan karena masih di bawah defleksi maksimum yang diizinkan. Hasil tersebut menunjukkan bahwa struktur generator magnet permanen (rim dan poros) dapat digunakan secara aman.

(Penulis)

Kata kunci: generator magnet permanen, elemen hingga, celah udara, defleksi.

Riza Muhida ^{a,b}, Ahmad Firdaus A. Zaidi ^c, Afzeri Tamsir ^{a,b}, Rudi Irawan ^{b,d} (^a Department of Informatics and Computer, Surya College of Education (STKIP Surya), Serpong; ^b International Institute for Clean Energy and Climate Change (IICECC), Serpong; ^c School of Mechatronics Engineering, University Malaysia Perlis, Malaysia; ^d Department of Physics, Surya College of Education (STKIP Surya), Serpong)

Perancangan Konverter DC-AC untuk Generator Tenaga Angin bagi Penggunaan Perumahan Jenis 500W (Orig. Eng.)

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, hal. 95-102, 10 ill, 2 tab, 24 ref.

Salah satu sumber energi terbarukan, yaitu tenaga angin memiliki prospek yang bagus di Indonesia khususnya di pinggiran pantai dan di pegunungan, dimana energi angin ini memiliki potensi untuk menyediakan listrik di perumahan. Agar pengembangan pembangkit listrik tenaga angin ini dapat berkelanjutan, maka penting untuk memproduksi inverter secara lokal. Perkembangan teknologi saat ini di bidang konversi elektronika daya dan teknologi tertanam memungkinkan untuk mengintegrasikan antara mikrokontroler dan converter daya. Dalam penelitian ini, rangkaian inverter dengan skema kontrol yang sesuai telah dikembangkan. Rangkaian yang digunakan telah dipilih untuk pembangkitin listrik tenaga angin bagi perumahan dengan besar konversi 500W. Dari keluaran generator berupa tegangan AC kemudian diubah ke DC, lalu digunakan konverter DC ke DC untuk meningkatkan tegangan ke nilai nominal tegangan DC yang sesuai untuk penggunaan domestik. Konverter DC-AC yang didesain akan mengubah tegangan DC menjadi AC. Sinyal siklus yang dibangkitkan oleh mikrokontroler berupa Sinusida Modulasi Lebar Pulsa akan mengontrol switch di dalam rangkaian inverter, sinyal siklus ini akan dijadikan referensi oleh inverter untuk menghasilkan bentuk tegangan sinusida sebagai tegangan keluaran dari inverter yang akan digunakan sebagai sumber listrik di perumahan. Mengingat kecepatan angin di Indonesia selalu berubah maka dikembangkan suatu alat pengesanan dalam skala laboratorium, yaitu suatu rig simulator, kecepatan rig

simulator ini dapat dikontrol untuk menghasilkan kecepatan yang berbeda, rig simulator terdiri dari suatu DC motor yang dihubungkan ke poros generator untuk memutar 500W generator angin, tegangan yang dihasilkan oleh generator ini dihubungkan dengan rangkaian konverter DC-AC yang telah dirancang. Hasil percobaan menunjukkan bahwa rangkaian konverter ini mampu menghasilkan tegangan keluaran AC sebesar 240V, dan frekuensi 50Hz. Hasil pengukuran distorsi harmonik keseluruhan sebesar 4% dari tegangan yang dihasilkan ke beban, nilai ini masih memenuhi rekomendasi standard 519-1992 dari IEEE.

(Penulis)

Kata kunci: energi angin, inverter, konverter, mikrokontroler, generator, perumahan.

Gerald Wahyudi Setiono ^a, Prianggada Indra Tanaya ^b, Henricus Riyanto Hendradji ^a (^a Department of Mechatronics Engineering, Swiss German University, Serpong; ^b Department of Industrial Engineering, Swiss German University, Serpong)

Analisis dan Pengembangan Model Kinematik Algoritma Berjalan untuk 5-Derajat Kebebasan Bipedal Robot (Orig. Eng.)

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, hal. 103-110, 11 ill, 3 tab, 15 ref.

Makalah ini merupakan pengembangan desain untuk algoritma berjalan dan kalkulasi bipedal robot. Dalam hal ini, bipedal robot didesain dan dikonstruksi dengan bagian pinggul, telapak kaki dan beberapa jenis dudukan servo untuk kakinya. Setiap kaki terdiri dari 5-derajat kebebasan, 3 pitch (engsel pinggul, lutut dan engkel) dan dua roll (sendi pinggul dan engkel). Algoritma berjalan untuk nilai sudut tiap engsel dari bipedal robot ini berdasarkan formula cosinus dan sinus dari segitiga. Tinggi hip, tinggi kaki yang diayun dan jarak tempuh melangkah diturunkan berdasarkan persamaan linear. Makalah ini akan mendiskusikan analisis model kinematik dan pengembangan diagram berjalan dari bipedal robot. Persamaan kinematika diturunkan, sudut-sudut joint disimulasikan dan diubah kedalam kode program untuk dieksekusikan pada robot, menggunakan Arduino board.

(Penulis)

Kata kunci: bipedal robot, model kinematik, analisis kinematik, 5-derajat kebebasan, algoritma berjalan.

Sutisno ^a, Andreas Prasetya Adi ^a (^a Bidang Kendali dan Telemetri, Pusat Teknologi Roket - LAPAN)

Perancangan Sistem Peredam Gangguan Getaran untuk Melindungi Beban-Guna Roket (Orig. Eng.)

Mechatronics, Electrical Power, and Vehicular Technology, December 2012, vol. 3, no. 2, hal. 111-116, 8 ill, 0 tab, 13 ref.

Motor roket dapat menimbulkan getaran yang menggetarkan roket beserta isinya. Bagian yang rentan mengalami gangguan adalah beban-guna roket. Beban-guna ini terdiri dari berbagai peralatan elektronik seperti : transmitter, macam-macam sensor, akselerometer, gyro, embedded controller system, dan lain sebagainya. Pada makalah ini disajikan penelitian pengaruh getaran motor roket terhadap beban-guna dan cara mengatasi gangguan tersebut. Untuk mengatasi pengaruh gangguan getaran dapat dilakukan dengan menggunakan bahan silicone gel. Silicone gel dipilih sebagai bahan isolator karena memiliki faktor redaman spesifik yang relatif tinggi dibandingkan dengan beberapa bahan lain. Getaran motor roket disimulasikan menggunakan motor listrik dan diukur menggunakan sensor akselerometer. Hasil pengukuran ditampilkan dalam bentuk kurva, yang menunjukkan level getaran pada beberapa bagian benda uji. Hasil dari beberapa percobaan dapat digunakan untuk menentukan bahan peredam yang baik untuk mengurangi getaran yang mengganggu instrumen pada beban-guna.

(Penulis)

Kata kunci: motor, roket, getaran, beban-guna, silikon.

Journal of Mechatronics, Electrical Power, and Vehicular Technology

Volume 03, 2012

AUTHORS INDEX

- Afzeri Tamsir, "Design of A DC-AC Link Converter for 500W Residential Wind Generator," 03(2): 95-102
- Agus Hartanto, "Direction and Policies Needed to Support Hybrid Electric Car Research," 03(1): 1-8
- Agus Risdiyanto, "Effect of Contact Pressure on the Resistance Contact Value and Temperature Changes in Copper Busbar Connection," 03(2): 73-80
- Ahmad Firdaus A. Zaidi, "Design of A DC-AC Link Converter for 500W Residential Wind Generator," 03(2): 95-102
- Amin, "Design and Implementation of Anti-windup PI Control on DC-DC Bidirectional Converter for Hybrid Vehicle Applications," 03(1): 31-38
- Andreas Prasetya Adi, "The Effect of Ethanol-Diesel Blends on the Performance of a Direct Injection Diesel Engine," 03(2): 111-116
- Arifin Nur, "The Effect of Ethanol-Diesel Blends on the Performance of a Direct Injection Diesel Engine," 03(1): 49-56
- Arini Wresta, "The Effect of the Addition of Active Digester Effluent for Start-up Accelerator in Anaerobic Digestion of Soybean Curd Industry Waste Water (Basic Research for Biogas Power Generation)," 03(2): 81-86
- Asmara Yanto, "Development of Swept-sine Excitation Control Method to Minimize the FRF Measurement Error," 03(2): 57-64
- Budi Prawara, "A Review of Atomic Layer Deposition for Nanoscale Devices," 03(2): 65-72
- Dyah Kusuma Dewi, "Analytical and Numerical Deflection Study on the Structure of 10 kW Low Speed Permanent Magnet Generator," 03(2): 87-94
- Edi Leksono, "Modelling and Identification of Oxygen Excess Ratio of Self-Humidified PEM Fuel Cell System," 03(1): 39-48
- Edy Riyanto, "A Review of Atomic Layer Deposition for Nanoscale Devices," 03(2): 65-72
- Estiko Rijanto, "A Review of Atomic Layer Deposition for Nanoscale Devices," 03(2): 65-72
- Estiko Rijanto, "Analysis of Inverse Angle Method for Controlling Two Degree of Freedom Manipulator," 03(1): 9-16
- Gerald Wahyudi Setiono, "Analysis and Development of Walking Algorithm Kinematic Model for 5-Degree of Freedom Bipedal Robot," 03(2): 103-110
- Hendri Maja Saputra, "Analysis of Inverse Angle Method for Controlling Two Degree of Freedom Manipulator," 03(1): 9-16
- Henricus Riyanto Hendradji, "Analysis and Development of Walking Algorithm Kinematic Model for 5-Degree of Freedom Bipedal Robot," 03(2): 103-110
- Hilman S. Alam, "Analytical and Numerical Deflection Study on the Structure of 10 kW Low Speed Permanent Magnet Generator," 03(2): 87-94

- Hilman S. Alam, "Magnetic Simulation and Analysis of Radial Flux Permanent Magnet Generator using Finite Element Method," 03(1): 23-30
- Iman Kartolaksiono Reksowardojo, "The Effect of Ethanol-Diesel Blends on the Performance of a Direct Injection Diesel Engine," 03(1): 49-56
- Justin Pradipta, "Modelling and Identification of Oxygen Excess Ratio of Self-Humidified PEM Fuel Cell System," 03(1): 39-48
- Kristian Ismail, "Development of Discrete Power Supply with Charge Pump Method for High Powered Sonar System," 03(1): 17-22
- Maulana Arifin, "Effect of Contact Pressure on the Resistance Contact Value and Temperature Changes in Copper Busbar Connection," 03(2): 73-80
- Muh. Zakiyullah Romdlony, "Design and Implementation of Anti-windup PI Control on DC-DC Bidirectional Converter for Hybrid Vehicle Applications," 03(1): 31-38
- Muhammad Kasim, "Magnetic Simulation and Analysis of Radial Flux Permanent Magnet Generator using Finite Element Method," 03(1): 23-30
- Noviadi Arief Rachman, "Effect of Contact Pressure on the Resistance Contact Value and Temperature Changes in Copper Busbar Connection," 03(2): 73-80
- Prianggada Indra Tanaya, "Analysis and Development of Walking Algorithm Kinematic Model for 5-Degree of Freedom Bipedal Robot," 03(2): 103-110
- Pudji Irasari, "Analytical and Numerical Deflection Study on the Structure of 10 kW Low Speed Permanent Magnet Generator," 03(2): 87-94
- Pudji Irasari, "Magnetic Simulation and Analysis of Radial Flux Permanent Magnet Generator using Finite Element Method," 03(1): 23-30
- Ridwan Arief Subekti, "Direction and Policies Needed to Support Hybrid Electric Car Research," 03(1): 1-8
- Riza Muhida, "Design of a DC-AC Link Converter for 500W Residential Wind Generator," 03(2): 95-102
- Rudi Irawan, "Design of a DC-AC Link Converter for 500W Residential Wind Generator," 03(2): 95-102
- Sutisno, "The Effect of Ethanol-Diesel Blends on the Performance of a Direct Injection Diesel Engine," 03(2): 111-116
- Syamsu Ismail, "Development of Discrete Power Supply with Charge Pump Method for High Powered Sonar System," 03(1): 17-22
- Tua Agustinus Tamba, "Modelling and Identification of Oxygen Excess Ratio of Self-Humidified PEM Fuel Cell System," 03(1): 39-48
- Vita Susanti, "Direction and Policies Needed to Support Hybrid Electric Car Research," 03(1): 1-8
- Wiratni Budhijanto, "The Effect of the Addition of Active Digester Effluent for Start-up Accelerator in Anaerobic Digestion of Soybean Curd Industry Waste Water (Basic Research for Biogas Power Generation)," 03(2): 81-86
- Yanuandri Putrasari, "The Effect of Ethanol-Diesel Blends on the Performance of a Direct Injection Diesel Engine," 03(1): 49-56
- Zainal Abidin, "Analysis of Inverse Angle Method for Controlling Two Degree of Freedom Manipulator," 03(1): 9-16
- Zainal Abidin, "Development of Swept-sine Excitation Control Method to Minimize The FRF Measurement Error," 03(2): 57-64

Journal of Mechatronics, Electrical Power, and Vehicular Technology

Volume 03, 2012

AFFILIATION INDEX

| | |
|--|--------------------------------------|
| Department of Electrical Engineering - University of Notre Dame | 39 |
| Department of Informatics and Computer, Surya College of Education (STKIP Surya) | 95 |
| Department of Industrial Engineering, Swiss German University (SGU) | 103 |
| Department of Mechatronics Engineering, Swiss German University (SGU) | 103 |
| Directorate of Technology for Manufacturing Industry, Agency for Assessment and Application of Technology (BPPT) | 87 |
| International Institute for Clean Energy and Climate Change (IICECC) | 95 |
| Laboratory of Combustion Engine and Propulsion System - ITB | 49 |
| Laboratory of Energy Management, Engineering Physics - ITB | 39 |
| Laboratory of Food and Bioprocess Engineering, Chemical Engineering Department, Faculty of Engineering, Gadjah Mada University (UGM) | 81 |
| Mechanical Engineering, Faculty of Industrial Technology - ITP | 57 |
| Mechanical Engineering, Faculty of Mechanical and Aerospace Engineering - ITB | 9, 57 |
| National Institute of Aeronautics and Space (LAPAN) | 111 |
| Research Centre for Electrical Power and Mechatronics - LIPI | 1, 9, 17, 23, 31, 49, 65, 73, 81, 87 |
| Research Centre for Electronics and Telecommunication - LIPI | 17 |
| School of Electrical Engineering and Informatics (STEI) - ITB | 31 |
| School of Mechatronics Engineering, University Malaysia Perlis | 95 |
| Technical Implementation Unit for Instrumentation Development - LIPI | 23, 87 |

Journal of Mechatronics, Electrical Power, and Vehicular Technology

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