CONTENTS

Welcome to Singapore!

Dear Professors and distinguished delegates,

Welcome! On behalf of the organizing committees, I would like to thank all the Conference Chairs, Program Chairs and the technical Committees. Their high competence and professional advice enable us to prepare the high-quality program. We hope all of you have a wonderful time at the conference and also in Singapore.

We believe that by this excellent conference, you can get more opportunity for further communication with researchers and practitioners with the common interest in the area of green energy and applications.

In order to hold more professional and significant international conferences, your suggestions are warmly welcomed. We look forward to meeting you again next time.

Best Regards!

Yours sincerely,

Prof. Chan Siew Hwa, Nanyang Technology University, Singapore
Prof.Tyrone Fernando, University of Western Australia, Australia
Ms. Emma Wang, International Association of Computer Science and Information Technology, Singapore

Note & Tips

Note:

- The organizer won't provide accommodations, and we suggest you make an early reservation.
- You can register at any working time during the conference
- Certificate of Participation will be awarded by the Session Chair after presentations.
- Please arrive at the designated conference room 30 minutes earlier, in case some authors are not able to make the presentation on time.

Warm Tips for Oral Presentation:

- Get your presentation PPT or PDF files prepared
- Regular oral presentation: about 15 minutes (including Q&A)
- Keynote speech: about 40 minutes (including Q&A)
- Plenary speech: about 30 minutes (including Q&A)
- Laptop (with MS-Office & Adobe Reader), projector & screen, laser sticks will be provided by the conference organizer

Attention!

- Please keep your belongings (laptop and camera etc.) with you

Conference Venue

Nanyang Executive Centre in NTU

http://www.ntu.edu.sg/nec/Pages/default.aspx

Add: 60 Nanyang View, Singapore 639673

Nanyang Executive Centre is located at the Yunnan Garden Campus of Nanyang Technological University, offering a premier venue for corporate trainings, retreats and private events.

The 170 guestrooms and suites have been designed to meet the needs of both training executives and business travellers. All the guestrooms are equipped with a work area and other modern amenities to ensure they provide guests with a pleasant stay. Complimentary Wi-Fi is available to all guests in their rooms, lobby and function spaces.

Contact

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Technical Program at a Glance

March 23, 2016 Registration

March 23	**Venue: Lobby**	***10:00-17:00***	**Participants Onsite Registration & Conference Materials Collection**

Afternoon Schedule of March 23,2016

14:00-14:15	**Travel from NEC to the Water and Energy Research Lab in school of EEE**
14:15—15:00	**Lab tour in WERL**
15:00-15:05	**Walk to LaCER in school of EEE**
15:05-15:50	**Lab tour in LaCER**
15:50-16:05	**Walk from LaCER to Fuel Cell Lab in School of MAE**
16:05-16:50	**Lab tour in Fuel Cell Lab**
16:50-17:00	**End**

Note: The campus tour was supposed to be on March 25, however, it is Good Friday and being a public holiday in Singapore. Therefore, the campus tour has to be moved forward to the afternoon of March 23.

Schedule of March 24

March 24 09:00-12:00	**Venue: Small Lecture Room 5**	***09:00-09:10***	**Opening Remarks**	**Prof. Chan Siew Hwa, Nanyang Technology University, Singapore**
		09:10-09:50	**Keynote Speech**	**Prof. Tyrone Fernando, University of Western Australia, Australia**
		9:50-10:30	**Keynote Speech**	**Prof. Chan Siew Hwa, Nanyang Technology University, Singapore**
		10:30-10:50	***Group Photo & Coffee Break***	
		10:50-11:30	**Keynote Speech**	**Dr. Peng Wang Nanyang Technological University, Singapore**
		11:30-12:00	**Plenary Speech**	**Dr. Qudaih Yaser Kyushu Institute of Technology, Japan**
March 24 12:00-13:00	***Lunch @ Fusion Spoon***			
March 24 13:00-19:15	**Venue: Small Lecture Room 5**	***13:00-15:45***	**Session I Power system and electrical automation**	**11 presentations**
		15:45-16:00	***Coffee Break***	
		16:00-19:15	**Session II Energy and environmental engineering**	**13 Presentations**
March 24 19: 20-20:30	***Dinner @ Fusion Spoon***			

Keynote Speaker

Prof. Chan Siew Hwa
Nanyang Technological University, Singapore

Dr. Chan joined NTU as a Lecturer in 1991 after obtaining his PhD and subsequently working as a postdoctoral researcher at Imperial College London. He is now a Full Professor in the School of Mechanical & Aerospace Engineering (MAE). He is concurrently holding 2 appointments as the Co-Director of the Energy Research Institute at NTU (ERI@N), and the Deputy Director of Maritime Institute at NTU (MI@NTU). He is also a Non-Executive Director of Maz Energy Pte Ltd, where he provides technical advices to the Board since 2004. Funded by Royal Armament Research and Development Establishment (RARDE, UK), Dr. Chan's PhD and post-doctoral research was inclined to Heavy-Duty Internal Combustion Engines for military application. He then extended his research interest to Fuel Cell and Fuel Reforming since 1997. He is the Organizer and Program Chair of the 1st World Hydrogen Technologies Convention (WHTC), Singapore and an active promoter and advocate of Hydrogen Economy in Singapore. From April 2006 till March 2008, he held a joint appointment with A*Star as Programme Director of SERC Fuel Cell Programme. Under this appointment, he led a team of more than 100 researchers from 4 A*Star research institutes working closely with industries on fuel cells. His research has gained him a number of international recognition. In 2000, he received the prestigious George-Stephenson Award from the Institution of Mechanical Engineers, UK (IMechE, UK) for his research in Automotive Engineering. This award is to memorize Sir George Stephenson (1781 – 1848), the Father of Railways, who built the first public railway line in the world using steam locomotives. In 2007, he received the Scientific Achievement Award in the field of Hydrogen Treatment of Materials and the Great Activities in the World Hydrogen Movement, awarded by International Association for Hydrogen Energy, USA (IAHE, USA). He was the only reviewer, outside of UK, invited by UK Energy Research Centre (UKERC) to comment on the UK National Fuel Cells Roadmap. He is the editorial board member of "Fuel Cells – from

fundamentals to systems" and also "Journal of Power Technologies". Dr. Chan is also a member of Management Board of Energy Studies Institute as well as a member of Advisory Board of Horizon Fuel Cell Technologies. He has published 190 refereed journal papers with total citations of more than 6000 and h-index of 41. He owns a number of patents in fuel cells and hydrogen technology. He is the recipient of "World's Most Influential Scientific Minds 2014" Award by Thomson Reuters. His research achievements are also matched with his competency in teaching. In 2000, Dr. Chan received the Teacher-of-the-Year Award, NTU; the year he taught Thermodynamics.

Keynote Speaker

Prof. Tyrone Fernando
University of Western Australia, Australia

Tyrone Fernando obtained his bachelor of engineering with honours and the degree of doctor of philosophy from the University of Melbourne in 1990 and 1996 respectively. In 1996 he joined the University of Western Australia, School of Electrical Electronic and Computer Engineering (EECE) where he is currently a Professor. He was the Deputy Head of School in 2009 and 2010. His research interests are in Power Systems, Biomedical Engineering and Control theory. He has served as an Associate Editor for IEEE Transactions on Information Technology in Biomedicine and also as guest editor for the journal of Optimal Control Applications and Methods. He is currently an Associate Editor for IEEE Transactions on Circuits and Systems II. He is a senior member of the IEEE.

Keynote Speaker

Dr. Peng Wang
Nanyang Technological University, Singapore

Dr Peng Wang received his B.Sc. degree from Xian Jiaotong University, China, in 1978, and M. Sc. and Ph.D. degrees from the University of Saskatchewan, Canada, in 1995 and 1998 respectively. He has being served as committee member, deputy chair and chair of IEEE PES Singapore Chapter for more than 10 years. Currently he is an associate professor in Nanyang Technological University, Singapore and honorary professor in Taiyuan University of Technology. His research areas include power system planning, operation and reliability analysis; power market analysis; renewable sources integration; AC, DC and hybrid AC/DC microgrids; and smart grid operation and control. He is PIs and Co-PIs of the over S$20m projects from different companies such as Rolls-Royce, Schneider Electric Singapore, Alstom, ST-Electronics, and different government organizations in Singapore and USA. He is also an international adviser for two largest projects with over RMB¥50m from Chinese Government. He has published over 250 papers in prestigious journals and international conferences with over 4000 citations and H index 32 and received two best paper awards in two international conferences and the outstanding power engineer award from IEEE PES. He has been invited to give talks in many universities and conferences. He is an associate editor of IEEE Trans on Smart Grid.

Keynote Speeches

Venue: Small Lecture Room 5 & Time: 9:00-10:30

Opening Remarks 9:00-9:10	 ***Prof. Chan Siew Hwa*** ***Nanyang Technology University, Singapore*** **Title:** Electrolyzer/Fuel Cell: A Bridge Towards A More Sustainable Future
Keynote Speech 09:10-09:50	 ***Prof. Tyrone Fernando*** ***University of Western Australia, Australia*** **Title:** Estimating the Dynamic States of Generators in a Complex Power System **Abstract**—Due to significant recent investment in power system infrastructure,

	PMUs are widely available in power distribution networks. In this talk I will present real time phasor measurement unit (PMU) based monitoring algorithms using different methods and approaches to dynamically estimate the states of generators in a complex power system. Such algorithms can allow us to develop complementary algorithms for control functions of the power grid. Complete real time knowledge of the state of a power grid provides a complete and a reliable database, based on which, control functions can be reliably deployed in order to analyze contingencies, and to determine any required corrective actions. The talk will be primarily based on the Functional Observer based approach to dynamically estimate the states of generators in a complex power system.
Keynote Speech 09:50-10:30	 ***Prof. Chan Siew Hwa*** ***Nanyang Technology University, Singapore*** **Title:** Electrolyzer/Fuel Cell: A Bridge Towards A More Sustainable Future **Abstract**—The growth of the use of renewable energy for power generation is increasing. The prediction of market penetration of renewable energy resources is controversial as different organizations might predict the growth according to their interests. For instance, an oil company would downplay the growth, while a renewable energy company would project the highest renewable energy penetration in the market share. Small output renewable energy sources could easily be balanced within the energy network, but the large incrementing percentage of global renewable power highlights a substantial need for energy storage. Currently, renewable energy sources contribute 17% of the global energy, in which ~9% is extracted from conventional biomass and the rest is from "modern" renewable energy sources including wind, solar power, geothermal energy, and biofuels. This presentation highlights the importance of electrolyzer and fuel cell, and how it could bridge fossil energy economy to the hydrogen economy, where hydrogen is regarded as an energy vector in the pursuit of green growth economy. Seawater electrolysis, co-electrolysis of greenhouse gases (CO2 and H2O), and conversion of syngas to "artificial" natural gas will be covered in this presentation.
10:30-10:50	***Coffee Break & Group Photo***

Keynote Speeches & Plenary Speeches

Venue: Small Lecture Room 5 & Time: 10:50-12:00

Keynote Speech 10:50-11:30

Dr. Peng Wang

EEE School and ERI@N

Nanyang Technological University, Singapore

Title: Future Power Grids A Hybrid AC/DC Grid Solution

Abstract—It has been over 100 years since Thomas Edison builtthe first DC electricity supply system on September 4, 1882, at Pearl Street in New York City of the United States. Many prominent events have occurred in the electricitysupply industry after that. The first one,"The War of Currents"started in 1888.Thomas Edison and his direct current (DC) distribution systemwere on one side andGeorge Westinghouse and Nikolai Tesla with alternating current (AC) system were on other side. The War "ended" in about 1891 whenAC won as the dominant power supply medium. The key behind the AC win was the invention of the transformer which caneasily step up medium voltage to high and extra high voltage for long distance power transfer from a remote AC generation station toload centers hundreds of kilometers away with lower transmission losses. Transformers canalsostep down high voltage back to low voltage at load stations to supply the low voltage equipment.Since the end of the war, AC power systems have been developed and expanded at a tremendous speed from the initial small isolated networks each supplyingonly lighting and motor loads with a few hundreds of customers, to its current scale of super interconnected networks each supplying billions of customers over large geographic areasin one or several countries. The voltage levelsand capacitiesof transmission networkshave increased from the first commercialized three phase AC system with only 2.4 kV, 250 kW in the town of Redlands, USA to the first commercial long-distance,

	ultra-high-voltage, AC transmission line in China with 1000 kV, 2000MW. Transmission distance has been increased from several miles to over thousands of kilometers/miles.With all such major achievements, small wonder that the AC power system became the Top Engineering Achievement of the 20th Century. Does this mean that DC is gone? The answer is an unambiguous no. What has happened in the past 50 years such as applications of advanced power electronics and control technologies, evolution of power system loads, and integration of renewable generation in power grid, really calls for arethink about DC and AC in electricity supply systems. In this talk, a novel power network architecture hybrid AC/DC will be presented. The advantages of the new architecture and the new challenges and issues for the control and operation of the hybrid grid will be discussed.
Plenary Speech 11:30-12:00	 ***Dr. Qudaih Yaser*** ***Kyushu Institute of Technology, Japan*** **Title:** Upgrading Electrical Power Systems to a Smart Grid with Storage Systems **Abstract**—The world is in an energy transition. Energy storage systems are one of the keys helping in integrating and utilizing renewable energy in an optimal level. However, energy storage is already an important part of the power system ranging from small applications as in the electronic devices to a bigger size of storage used in power stations and recently to be used as power sources to backup renewable energy in the form of community based storage banks. In addition, Electric Vehicles (EV) are considered as a mobile storage systems in different applications. With the demand increasing, environmental issues, fossil oil depletion and economic instability renewable energy sources (RES) became attraction and action all over the world. Due to the unpredictable changes in the environment phenomenon where RES use natural resources, the dependency on storage systems in different technologies and applications significantly increased. On the other hand, different optimization techniques have been introduced and others have been proposed in order to provide a technical and practical solutions for the best utilization of energy storage to the advanced and conventional power systems. In Japan, there are real practical implementation to the smart grid in the form of smart communities as in Kitakyushu city. The Smart Grid represents a

	vision for upgrading the electrical power systems in a sophisticated manner. The deployment of Smart Grid idea into existing power system is leading to the optimization of grid operation, enhancing grid security, and creating new markets for the utilization of renewable and sustainable energy.
12:00-13:00	***Lunch @ Fusion Spoon***

Session I

Power System and Electrical Automation

Venue: Small Lecture Room 5

Time: 13:00-15:45

Session Chair:

Prof. Tyrone Fernando
University of Western Australia, Australia

Papers: A0022, A0026, A0035, A0040, A0052, A0054, A0305, A0037, A0027, A0045, A0029

***Please arrive at the designated conference room 30 minutes earlier, in case some authors are not able to make the presentation on time.**

A0022 13:00-13:15	Study of Micro Grid Hybrid System of Photovoltaic and Diesel Engine **Dwi Novitasari**, Y S Indartono, J E Harjono, MIrsyad, Tri D Rachmildha I K Reksowardojo New and Renewable Energy Research Center, InstitutTeknologi Bandung, Indonesia **Abstract—**Indonesia has abundant potentials of new and renewable energy that can be used for electricity generation, especially in rural areas which have no access for grid electricity yet. The energy resources can be from solar, water, biomass or biofuel. Many villagers still use diesel generators to produce electricity in their villages. It is considered expensive because fuel price in rural areas increases 2-3 times than the normal price due to transportation cost. Hybrid system using renewable energy resources is one of the solutions to produce electricity in affordable cost for rural area. The idea is to combine diesel generators and photovoltaic toproduce electricity. Moreover, the diesel engine fuel can be replaced with biofuel. This study will analyze the hybrid system in a small scale which consists of 1 kWp photovoltaic and 3 kW diesel engine. Electric load power will vary. The system is controlled by a single bidirectional inverter whichconverts power from DC to AC and vice versa.
A0026 13:15-13:30	A Cost Benefit Analysis of Restarting Japan's Nuclear Power Plants Suryo Ariyanto Nugroho and **Zhuoxiang Yang** The University of Tokyo, Japan **Abstract—**This paper tries to provide a cost-benefit analysis (CBA) for the issue of restarting the nuclear power plants in Japan. The analysis compares the scenarios of "With" and Without" restarting the 43 nuclear power plants, and the net present value (NPV) and benefit-cost ratio (BCR) are calculated based on the discounted value of benefit and cost components for the time horizon of 20 years in both scenarios. The main benefits include reduction in CO2 emission and fuel life cycle cost and increasing the energy supply security. And main costs consist of upgrading and safety regulations compliance cost, operational and maintenance cost, decommissioning cost, and risk of reactors' accident. Three benefits and four costs are monetized and used in the NPV calculation. Furthermore, the sensitivity analysis is implemented by using different values of social discount rate, social cost of carbon, and also the risk of reactor's accident cost. Based on the NPV, BCR, and

	sensitivity analysis, it is suggested that the government of Japan should restart all of those 43 nuclear power plants. Thus, by implementing this policy, the government can cut down Japan's greenhouse gas emission, as well as reducing the dependency on the import of fossil fuels.
A0035 13:30-13:45	Evaluation Index of Equipment Utilization Efficiency in Substation Considering Distributed Generation Xiaojian Chen, Xiang Li, Fenglu He and **Ziheng Zhang** South China University of Technology, School of Electric Power, China **Abstract—**With the development of distributed generation (DG), traditional evaluation index of equipment utilization efficiency is not objective in some situations. To solve this problem, a comprehensive evaluation method of equipment utilization efficiency in substation is proposed in this paper. Based on the characteristics of distribution network including DG, two indexes, the burden rate and the load rate, are considered. Then, the indexes are further analyzed that they are specified into the injected indexes and the bidirectional indexes. From the operation data of transformers, the specified indexes are calculated representatively and it is indicated that bidirectional indexes could reflect the equipment utilization efficiency in substation more objectively. The presented method provides a new perspective of evaluating the equipment utilization efficiency in substation considering DG.
A0040 13:45-14:00	The Performance Evaluation of Horizontal Axis Wind Turbine Torque and Mechanical Power Generation Affected by the Number of Blades Rodney H.G. Tan1 and **Matthew Y.W. Teow** KDU University College, School of Engineering, Malaysia **Abstract—**This paper presents the evaluation of horizontal axis wind turbine torque and mechanical power generation and its relation to the number of blades at a given wind speed. The relationship of wind turbine rotational frequency, tip speed, minimum wind speed, mechanical power and torque related to the number of blades are derived. The purpose of this study is to determine the wind energy extraction efficiency achieved for every increment of blade number. Effective factor is introduced to interpret the effectiveness of the wind turbine extracting wind energy below and above the minimum wind speed for a given number of blades. Improve factor is introduced to indicate the improvement achieved for every increment of blades. The evaluation was performance with wind turbine from 1 to 6 blades. The

	evaluation results shows that the higher the number of blades the lower the minimum wind speed to achieve unity effective factor. High improve factors are achieved between 1 to 2 and 2 to 3 blades increment. It contributes to better understanding and determination for the choice of the number of blades for wind turbine design.
A0052 14:00-14:15	Power-Level Regulation and Simulation of Nonlinear Pressurized Water Reactor Core With Xenon Oscillation Using H-Infinity Loop Shaping Control **Gang Li**, Bin Liang, Xueqian Wang, Xiu Li and Kang Wang Tsinghua University, National Laboratory for Information Science and Technology, 100084 Beijing, China **Abstract—**This investigation is to solve the power-level control issue of a nonlinear pressurized water reactor core with xenon oscillations. A nonlinear pressurized water reactor core is modeled using the lumped parameter method, and a linear model of the core is then obtained through the small perturbation linearization way. The H∞loop shapingcontrolis utilized to design a robust controller of the linearized core model.The calculated H∞loop shaping controller is applied to the nonlinear core model. The nonlinear core model and the H∞ loop shaping controller build the nonlinear core power-level H∞loop shaping control system.Finally, the nonlinear core power-level H∞loop shaping control system is simulatedconsidering two typical load processes that are a step load maneuver and a ramp load maneuver, and simulation results show that the nonlinear control system is effective.
A0054 14:15-14:30	Integration of Hybrid PV/Wind Generation System Using Fuzzy MPPT in Grid Connected System for Remote Area **Soedibyo**, Thohaku Abdul Hadi, Hadyan Perdana Putra, Heri Suryoatmojo, Mochamad Ashari Electrical Engineering Department, Institut Teknologi Sepuluh Nopember, Indonesia **Abstract—**Photovoltaic and wind are renewable energy resources that widely used and grow rapidly in fulfilling electricity demand. Powers from both technologies depend on sunlight intensity and wind speed. For small scale power generation, DC voltage from both technologies is low and requires step-up converter to raise DC voltage ratio before converted into AC voltage. To optimize this system, step-up converter must have high ratio and efficiency to a distance of wide voltage input.

	This paper proposed an operation simulation and arrangement of DC-DC converter along with DC-AC from hybrid source PV-Wind which integrated to grid utilities without using storage device. High Gain Integrated Cascade Boost (HGICB) is DC-DC converter that has quadratic voltage ratio and used in this research. Then DC link connected to Voltage Source Inverter (VSI) which interconnected with utility grid and controlled by current control method. The total installed capacity of hybrid source is 4.4 kW. Wind turbine uses PMSG along with full bridge rectifier. To maximize and stabilize the generated power, MPPT fuzzy is used. Result from the simulation shows that converter capable to maintain maximum power whether from PV and wind turbine which canalized to utility grid in various irradiation condition, wind speed, and grid load alteration.
A0305 14:30-14:45	Investigating the Role of Wind Turbine Pitch using CFD **Dorit Sobotta**, Robert Howell and Lou Jing German Aerospace Centre, Rotorcraft, Institute of Flight Systems, Germany **Abstract—**Horizontal axis wind turbines are an attractive renewable energy source due to their very low carbon emission during their life cycle. In this study the effect of pitching the rotor blades of the NREL Phase VI rotor has been investigated in detail using CFD in order to allow a detailed torque analysis. Initial investigations have shown that at low rotational speeds the inboard section of the blade is responsible for the majority of the power generation. As the rotational speed increases the power producing section is shifted towards the blade tip. These trends are less pronounced when the blade is pitched which allows the blade to generate significantly more power at low rotational speeds. The improved low speed performance however comes at the cost of a significantly lower maximum power output. These findings are particularly relevant for turbines operating in unfavourable wind environments and for small scale turbines which solely rely on their aerodynamic torque for starting.
A0037 14:45-15:00	Research on Harmonic Characteristics Influence for Distribution Network with Renewable Energy Wei Huang, **Yuyao Yang** and Xiangmin Huang School of Electric Power, South China University of Technology, China **Abstract—**In order to study the influence on harmonic characteristics of distribution network with renewable energy, a simplified model of

	distribution network is established to analyse theory while considering the influence of cable on the system capacitive current. Establishing an actual distribution network model by Digsilent to research the harmonic characteristics impact when photovoltaic power with PV incorporated the distribution network in a variety of different access , while using constant current source model as harmonic source model which often been used in engineering practices. The simulation results show that: optimizing the access location and dispersion of PV can decrease the waveform distortion levels in distribution network and a certain number of high-order harmonic will magnify by a specific grid structure, deteriorating the distribution network power quality.
A0027 15:00-15:15	Economic and Energy Efficiency of The Solid Biofuels Produced from Digested Pulp **Wojciech Czekała**, Sylwia Bartnikowska, Aleksandra Lewicka, Artur Bugała, Zbyszek Zbytek, Andrzej Lewicki Industrial Institute of Agricultural Engineering, Poland **Abstract—**One of the methods of renewable energy production is biogas plant. Products of anaerobic digestion are biogas and residual material called digested pulp or digestate. This material is commonly used as a fertilizer. One of a new possibility of digested pulp management is solid biofuels production after separation. This paper presents the calculation of cost for production of briquettes from digested pulp. The performed economic analysis proves that the production of briquettes from digested solid fraction (DSF) can be profitable and provide additional income for the biogas
A0045 15:15-15:30	Long – Term Performance Evaluation of A Fixed and Solar Follow – Up Systems With Modified Astronomical Positioning in Polish Conditions Artur Bugała, Grażyna Frydrychowicz – Jastrzębska, Zbyszek Zbytek, **Jacek Dach**, Damian Janczak Institute of Biosystems Engineering, Poznan University of Life Sciences, Poland **Abstract—**The paper presents a physical construction of a measurement stand consisting of a photovoltaic module operating in a fixed optimal configuration and in a solar tracking with a modified astronomical positioning. In order to reduce the electric energy consumption by two direct current linear motors system is positioned three times a day during winter months. Prepared energy balance, using annual measurements, confirmed the legitimacy of using two - axis Sun tracking units for central Poland. Basing on the daily and monthly electricity production

	and solar irradiance for both photovoltaic units a mathematical formula with proposed correction factors is presented to calculate with good accuracy monthly electric energy generation for a fixed photovoltaic installation. The results of calculations were compared with measurements showing good correlation.
A0029 15:30-15:45	Optimization of the Selection Process of the Co-Substrates for Chicken Manure Fermentation Using Neural Modeling Andrzej Lewicki, Artur Bugała, Hanna Piekarska-Boniecka, Aleksandra Lewicka, **Piotr Boniecki**, Marta Cieślik Poznan University of Life Sciences, Institute of Biosystem Engineering, Poland **Abstract—** Intense development of research equipment leads directly to increasing cognitive abilities. However, along with the raising amount of data generated, the development of the techniques allowing the analysis is also essential. Currently, one of the most dynamically developing branch of computer science and mathematics are the Artificial Neural Networks (ANN). Their main advantage is very high ability to solve the regression and approximation issues. This paper presents the possibility of application of artificial intelligence methods to optimize the selection of co-substrates intended for methane fermentation of chicken manure. 4-layer MLP network has proven to be the optimal structure modeling the obtained empirical data.
15:45-16:00	***Coffee break***

Session II

Energy and Environmental Engineering

Venue: Small Lecture Room 5

Time: 16:00-19:15

Session Chair:

Assoc. Prof. Ir. Dr. Matthew Teow

KDU University College, School of Engineering, Malaysia

Papers: A0016, A0038, A0031, A0032, A0304, A0307, A0308 A0309, A0012, A0310, A0028, A0047, A0017

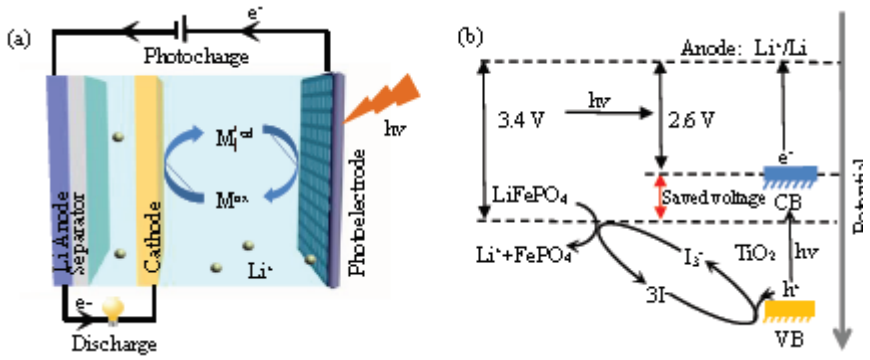
***Please arrive at the designated conference room 30 minutes earlier, in case some authors are not able to make the presentation on time.**

A0016 16:00-16:15	Influence of Different Preparation Methods of Copper Loading on Na-Y Zeolite for Green Gas Emission **P.Worathanakul** and N.Rakpasert KMUTNB, Thailand **Abstract—**This research was focused on different preparation methods of copper loading on zeolite. Cu cation supported on Na-Y zeolite (Cu-Y) was prepared by aqueous solution ion exchange and incipient wetness impregnation methods. Different amounts of copper (II) were loaded in the Na-Y zeolite. The catalysis materials were characterized by X-ray diffraction, X-ray fluorescence and Brunauer-Emmett-Teller. The results show that Cu loading did not change the structure of Na-Y zeolite. The obtained Cu/Y has enlarged pore size and octahedral shaped crystal with approximately 0.19 ± 0.08 μm diameter. 5.5 wt. % Cu/Y with impregnation method clearly exhibits a higher BET surface area and a total pore volume than 5.5 wt. % solution ion exchanged.
A0038 16:15-16:30	Sustainability or Bust: Malaysian Home Buyers' Stated Preferences for Sustainable Housing **A. Syahid**, M. A. Tareq, and S. A. Zaki Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia, Kuala Lumpur **Abstract—**The lack of data on sustainable home buying behaviour in developing countries such as Malaysia is due to the absence of sustainable housing itself. However, it is still possible to solicit home buyers for their stated preferences and quantify its effects on housing demand. In this study, a sample of 300 responses to a discrete choice experiment (DCE) on sustainable housing features was analysed using the "support.CEs" program. This study found that the addition of sustainable features; renewable energy generation, enhanced soundproofing and ventilation, energy saving features, and higher green area ratios significantly increase home buyer's willingness to pay (WTP) for sustainable housing.
A0031 16:30-16:45	Energy and Economic Potential of Maize Straw Used for Biofuels Production **Zbyszek Zbytek**, Jacek Dach, Tadeusz Pawłowski, Anna Smurzyńska, Wojciech Czekała, Damian Janczak

	Industrial Institute of Agricultural Engineering, Poland **Abstract—**The paper presents the energy and economic comparison of two technologies of maize straw utilization: solid biofuel production (briquettes) and methane fermentation. The research experiments have shown that maize straw is the material which can be efficiently implemented in both technologies. Maize straw usage as briquettes can generate more energy (10.956 GJ Mg-1) than methane fermentation (9.74). In Europe, biogas is used in co-generation units for production of electric and heat energy. Due to higher price of electricity, economic profitability of maize straw usage for biogas production is over twice higher (182 USD) than in case of briquettes production (96 USD)
A0032 16:45-17:00	Oscillatory Reactions in the Acetone-Glucose-Sodium Bromate-Sulfuric Acid System with A Tetraazamacrocyclic Copper(II) Complex as A Catalyst **Lin Hu**, Bin Bin Li, San Chun Wei,Ye Gui Wang, Mi Wei Hu,Wen Yuan Xu Institute of Applied Chemistry, East China Jiaotong University, China **Abstract—**The behavior of glycolysis concerning the biochemical reaction was thought to be similar to the oscillatory reaction with glucose being the substrate. The objective of this research is to find a new oscillatory system and study its relevant properties, so new Cu(II)-catalyzed oscillating reaction involved glucose and acetone as the double substrates was investigated systematically. As a function of reaction temperature and concentration of glucose, bromate, and acetone, the features in this novel oscillation system was studied. The results showed that the activation energy reached up to 90.839 KJ/mol and the oxidized product of the double substrates provided the impetus in the course of the new oscillating reaction. A tentative mechanism was considered on the basis of FNK
A0304 17:00-17:15	Installation Of On- Grid Solar System In Southern Provinces Of Vietnam Thang Sy Le, **Dao Thị Anh Truong**, Linh Viet Le Saigon Technology University, Vietnam **Abstract—**Vietnam has great potential for solar power yet the country does not have favourable social conditions and policies for implementation. While waiting for the government to support with legal rights on this issue, we have developed the on-grid solar system

	in parallel with grid electricity and those with smaller scale that applies to different levels of power consumption.
A0307 17:15-17:30	A Hydrophobic Ionic Liquid Based Li-O2 Battery System in the Humid Atmosphere **Shichao Wu** and Haoshen Zhou Graduate School of System and Information Engineering, University of Tsukuba, Japan **Abstract—**Li-air batteries have attracted extensive research effort because of the extremely high theoretical energy density of ~3500 Wh kg-1. However, most of the previous work focused on the batteries in pure O2 atmosphere to avoid the moisture related problems towards Li anode and the discharged cathode with lithium peroxide (Li2O2) as the discharge products. Herein, we constructed a superior Li-O2 battery sustaining in humid atmosphere by integrating a hydrophobic ionic liquid based electrolyte and MnO2 and RuO2 supported on Super P composite cathode. In humid atmosphere, the discharge products were completely converted to lithium hydroxide compounds through Li2O2+2H2O↔2LiOH+H2O2 with the aid of MnO2 in cathode to promote H2O2 decomposition. During charge, RuO2 in cathode can efficiently catalyze the oxidative decomposition of lithium hydroxide compounds at low potential. At the relative humidity of 51%, the ultralow charge potential was achieved (~3.34 V) and the batteries exhibited excellent cycling stability (200 cycles). The remarkable performance is benefited from the synergistic effect of the unique ionic liquid, composite cathode and moisture. A possible mechanism and a feasible prototype of Li-air battery were proposed. It is the first time to obtain the excellent performance in the humid atmosphere and we believe these results will accelerate the pace of realizing practical Li-air battery.
A0308 17:30-17:45	The Novel Materials in Rechargeable Batteries with Potential Development **Songyan Bai** and Haoshen Zhou Department of Engineering Mechanics and Energy, Tsukuba University, Japan **Abstract—**The promising sodium (Na) ion batteries (NIB)havesuffered a big challengewith reduced operating voltage, lower energy densityand the bigger radii of sodium ions (Na+/Li+,1.02 vs 0.76 Å)1. In tradition, thespinel Li4Ti5O12has a relatively high lithiation voltage plateau at 1.54 V versus Li/Li+and long-life cycling2.

	Herein, Na4Ti5O12, have been investigated for use as an anode in NIBs. Herein, we investigate the pure Na4Ti5O12as an anode for sodium ion batteries. We prepare this Na4Ti5O12material by a simple solid-state method. Proportional amounts of TiO2and Na2CO3were mixed and ball milled for 24h, calciningat 600 ˚C for 15h under argon atmosphere.The anode electrodes were prepared withactive material,Acetylene Black (AB), andpolytetrafluoroethylene(80%: 15%: 5%). The anode electrodes were pressed onto an aluminium screen and dried at 100℃ for 5 h. The electrolyte is 1 M NaPF6in ethylene carbonate/dimethyl carbonate (EC/DEC, 1 : 1 (v/v)). The cells were charged and discharged in0.1–2.5 V at a constant current density of 20 mA g-1at 25℃for cyclingtesting. The morphology of Na4Ti5O12isuniformly distributed within 100–300 nm. The crystal structure and phase purity are examined by the XRD methodwithoutcrystalline impurities.It can be refined as space group-P3, based on distorted close-packed layers consisting of oxygen and sodium ions,in which titanium ions occupy the central positions of octahedral Ti-O building units.The theoretical specific capacity of Na4Ti5O12is 102 mA h g−1, considering two Na+ions are reversibly inserting/extracting into the Na4Ti5O12structures.Thismay causes poor kinetics forthesodium ioninsert/extract process. It means that the relative tunnel sizes can't satisfy the increasing requirementsthatcan be partly attributed as the major reasonsforthe electrochemical performance of Na4Ti5O12in NIBs.
A0309 17:45-18:00	Integrating a Photoelectrode into a Li-ion Battery for Saving Electric Energy **Qi Li**, Na Li, Masayoshi Ishida and Haoshen Zhou International Graduate School of System and Information Engineering, University of Tsukuba, Japan. **Abstract—**Directly utilizing solar energy to power an energy storage device−such as rechargeable lithium-ion batteries (LIBs)−is considered as an ideal solution of energy storage for saving electric energy. But so far, the photoassisted chargeable LIB without using a photovoltaic cell is still an unexplored field. Herein, a novel strategy to save the input electric energy for LIBs by using a photoelectrode with redox shuttle has been introduced and demonstrated with LiFePO4 as an example. With the aid of TiO2 photoelectrode and iodide/triiodide (I-/I3-) redox shuttle, we demonstrate that a photoassisted chargeable Li-LiFePO4 battery with a charge voltage of 2.78 V, which is lower than the discharge voltage of 3.41 V, resulting in ～20% electric energy

	saving. By using appropriate redox shuttles, the concept of "photocharging" could be applied to other materials, such as LiCoO2, LiMnPO4 and LiMn2O4, thereby opening a new avenue for the application in solar energy conversion and storage.  Figure Schematic illustration (a) and the energy diagram (b) of a photoassisted chargeable LIB
A0012 18:00-18:15	Outlook of Solar Thermal Applications in Taiwan Keh-Chin Chang, Tzong,-Shyng Leu, Wei-Min Lin and **Kung-Ming Chung** NCKU Research and Development Foundation **Abstract**—Taiwan's long-term reliance on imported fossil energy in addition to the external environment costs incurred for nuclear energy has generated considerable controversy. The government is thus actively promoting the use of renewable energy. Since 2000, domestic installations of solar water heaters have increased substantially because of the long-term subsidies provided for such systems. However, data on the annual installation area of solar collectors in recent years indicated that the solar thermal industry in Taiwan has reached a bottleneck. The long-term policy providing subsidies must thus be revised. It is proposed that future research for thermal applications in Taiwan should focus on building-integrated solar thermal, photovoltaic/thermal, and industrial heating processes. Regarding building-integrated solar thermal systems, the current subsidy model can be continued (according to area of solar collectors); nevertheless, the application of photovoltaic/thermal and industrial heating systems must be determined according to the thermal output of such systems.

A0310
18:15-18:30

Lowering the Charging Voltage of Li-O2battery by Incorporating a C3N4 Photocatalyst

Yang Liu and Haoshen Zhou
The University of Tsukuba, Japan

Abstract—The non-aqueous Li-O2batteriesare considered promising for electric vehicleapplicationsas a result of their remarkably high theoretical energy density (>3 kW h kg-1). However, the high charge overpotential is one of the major challenges that currently prevent their practical implementation. In this respect, we propose to reduce the high charge potential by incorporating a g-C3N4 photocatalyst into the Li-O2battery.

The photoassisted chargeable Li-O2battery consists of a Li anode, a non-aqueous electrolyte contain I3-/I-couple and g-C3N4 grown on carbon paper simultaneously as an oxygen electrode and a photoelectrode as shown in Fig.1. On the charge under illumination, the I-ions areoxidized to I3-ionsby the photoexcited holes, and the I3-ionsin turn oxidize the Li2O2andthenreduced back to I-ions. Meanwhile, the phototexcited electrons transferto the anode, reducing the Li+to Limetal.

As presented in Fig. 2, by introducing g-C3N4 photocatalyst,the charging voltage can be reduced to 1.9V, the lowest valueto date. It should be noted that the charging voltage is even much lower than the discharge voltage (2.7 V), resulting in the high.

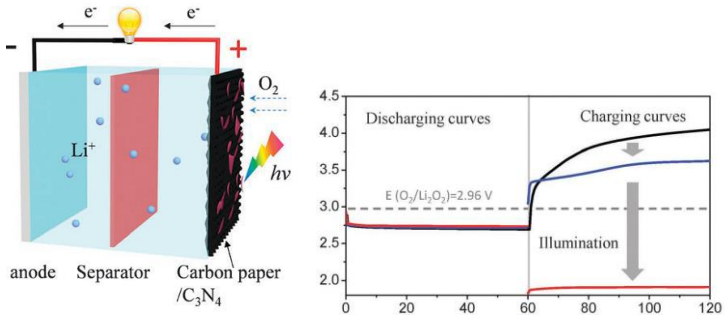


Fig.1. Schematic of photoassistedchargeable Li-O2 battery Fig.2The comparison of charge-discharge curves of a Li-O2 battery without I-ion redox mediator(black), a Li-O2 battery with I-ion redox mediator(blue) and the photoassisted chargeable Li-O2 battery(red)

A0028 18:30-18:45	Influence of Carbon Dioxide, Temperature, Medium Kind and Light Intensity on the Growth of Algae Chlamydomonasreinhardtii and Scenedesmus Obliquus Przemysław Piotr Olejnik, **Andrzej Lewicki**, Piotr Boniecki, Aleksandra Lewicka, Damian Janczak, Wojciech Czekała Institute of Biosystem Engineering, Poznan University of Life Sciences, Poland **Abstract—**Microalgae attracts the attention ofscientists because ofthe possibility of using in the energy industry as one of the substrates for the production of renewable energy. So far, the greatest emphasis was put on attempts to obtain strains, and technologies of their culturing, in order to efficiently acquire fat from cells and its further conversion to biodiesel using transesterification reaction. Increasingly, algae are considered also as an efficient biomass producer, which can be used as a substrate for methane production in biogas plants. In this study the influence of different physical and chemical conditions, on the growth of two algae species: Chlamydomonas reinhardtii and Scenedesmus obliquuswas investigated. Based on the literature and the data obtained for the algae growth on the standard medium and the digestate remaining after fermentation, one may suggest further investigations on the use of other liquid waste from agriculture and industry for algae breeding, including chemical analysis and supplementation of these mediums so as to provide the best conditions for their growth.
A0047 18:45-19:00	Construction Project of A Hybrid Constructed Wetland Systems **Aleksandra Lewicka**, Krzysztof Jóźwiakowski, Anna Dębska, Zbyszek Zbytek,Damian Janczak, Wojciech Czekała Institute of Environmental Engineering, Poznan University of Technology, Poland **Abstract—**Rural areas with dispersed development still face problems with the management of sewage. This is due to poor sewage infrastructure. Existing septic tanks are often leaky and pose a threat to the environment. In recent years, there is more and more interest in domestic sewage treatment plants. They should be characterized by reliability and ease of use, and especially high efficiency of contaminant removal.The aim of this study was to design a householdconstructed wetland systems, chich consists of: primary settling tank, two soil – plant beds, well filter filled with rocks oraz well absorbent. It is expected that such a solution provides high effects

	of sewage treatment. An important advantage of this type of treatment plant is its aestheticsand that it blends well in a home garden. Current study results of hybrid constructed wetland systemsall over the worldconfirm their high effectiveness during many years of operation.
A0017 19:00-19:15	An Approach to Determine the Weibull Parameters and Wind Power Analysis of Saint Martin's Island, Bangladesh **Khandaker Dahirul Islam**, Dr. Natthawud Dussadee and Dr. Tanate Chaichana School of Renewable Energy, Maejo University, Thailand. **Abstract**—This paper explores wind speed distribution using Weibull probability distribution and Rayleigh distribution methods that are proven to provide accurate and efficient estimation of energy output in terms of wind energy conversion systems. Two parameters of Weibull (shape and scale parameters k and c respectively) and scale parameter of Rayleigh distribution have been determined based on hourly time-series wind speed data recorded from October 2014 to October 2015 at Saint Martin's island, Bangladesh. This research has been carried out to examine three numerical methods namely Graphical Method (GM), Empirical Method (EM), Energy Pattern Factor method (EPF) to estimate Weibull parameters. Also, Rayleigh distribution method has been analyzed throughout the study. The results in the research revealed that the Graphical method followed by Empirical method and Energy Pattern Factor method were the most accurate and efficient way for determining the value of k and c to approximate wind speed distribution in terms of estimating power error. Rayleigh distribution gives the most power error in the research. Potential for wind energy development in Saint Martin's island, Bangladesh as found from the data analysis has been explained in this paper.
19:20-20:30	***Dinner @ Fusion Spoon***

Poster Session

A0015	Coordinated Low Voltage Ride through strategies for Permanent Magnet direct drive Synchronous Generators Zhang Ge, Yang Yiyun, Xiao Jing, Gao Like, XiaoYuanyuan Guangxi Power Grid CompanyElectric Power Research Institute, China **Abstract**—By analyzing the mechanism of the low voltage ride through on the permanent magnet direct drive synchronous wind power generating units, this paper proposes a coordinated control strategy for permanent magnet synchronous generator. In order to avoid over speed operation of the generation units over voltage on DC capacitor and over current on convert, the improved pitch angle control and inverter control are used. When the grid voltage drops, the captured wind power is cut down by the variable pitch system, which limits the speed of the generator, the generator side converter keeps the DC capacitor voltage stabile; and the grid side converter provides reactive power to the grid to help the grid voltage recover. The control strategy does not require any additional hardware equipment, with existing control means, the unit will be able to realize low voltage ride through. Finally, based on Matlab/Simulink to build permanent magnet direct drive wind power generation system, the simulation results verify the correctness and effectiveness of the control strategy.
A0019	Research on Short-Term Wind Power Prediction Based on Combined Forecasting Models Chi Zhang, Jie Zeng, Ning Xie, Ping Yang, Yu-jia Zhang, Zhen Zhang Electric Power Research Institute, Guangdong Power Grid Corporation, , China **Abstract**—Short-term wind power forecasting is crucial for power grid since the generated energy of wind farm fluctuates frequently. In this paper, a physical forecasting model based on NWP and a statistical forecasting model with optimized initial value in the method of BP neural network are presented. In order to make full use of the advantages of the models presented and overcome the limitation of the disadvantage, the equal weight model and the minimum variance model are established for wind power prediction. Simulation results show that the combination forecasting model is more precise than single

	forecasting model and the minimum variance combination model can dynamically adjust weight of each single method, restraining the forecasting error further.
A0020	Multilayer PV-storage Microgrids Algorithm for the Dispatch of Distributed Network Ping Yang, Yu-jia Zhang, Zhi-rong Xu, Xu Yin, Shao-xiong Zhou, Jin-yong Lei School of Electric Power, South China University of Technology, China **Abstract**—In recent years, due to the support of our country, PV-storage microgrid develops rapidly. However, the flexible network operation modes of PV-storage microgrid change flexibly and the operating characteristics with a large amout of sources is highly complicated. Based on the existing microgrid coordinate control methods, this paper proposes multilayer PV-storage microgrid algorithm for fitting dispatch of distributed network, which achieves maximum output of renewable energy when meeting the scheduling requirements of network, by building PV-storage microgrid type dynamic simulation system in a variety of conditions in PSCAD. Simulation results show that the heuristic algorithm proposed can achieve microgrid stable operation and satisfy the demands of the dispatch in distributed network.
A0021	A Photovoltaic Power Station Equivalent Method Based on Real-time Digital Simulator Ping Yang, Qun-ru Zheng, Si-bo Song, Ting He, Xu Yin, Jin-yong Lei School of Electric Power, South China University of Technology, China. **Abstract**—As a clean energy power generation technology, photovoltaic generation has the characteristics of low carbon, green and environmental protection. More and more countries pay close attention to it, more than one megawatt demonstration projects of grid photovoltaic power station has been commenced or built. In order to study interconnection characteristics of large-scale photovoltaic power station better, reduce the effects of photovoltaic power station to the grid, we need to set up photovoltaic power station simulation model. However, the model of photovoltaic power station is complex, the speed of system simulation become slow after establish. In this paper, a real-time digital simulator based on the photovoltaic power station equivalent method will be given, through the proposed hierarchical

	equivalence method can simplify the process of equivalent of photovoltaic power station, shortening the period of equivalent model, and can be carried out in the process of each layer of the equivalent model accuracy validation, improve the accuracy of the equivalent model.
A0023	A Hybrid Model for Short-term Wind Power Forecasting based on MIV, Tversky Model and GA-BP Neural Network Jie Zeng, Chi Zhang, Ning Xie, Ping Yang, Chen-yu Xu, Zhen Zhang Electric Power Research Institute, Guangdong Power Grid Corporation, China **Abstract**—Wind power forecasting, which is necessary for wind farm, is significant to the dispatch of power grid since the characteristics of wind change intermittently. In this paper, a hybrid model for short-term wind power forecasting based on MIV, Tversky model and GA-BP neural network is formulated. The Mean Impact Value (MIV) method is used to monitor the input variable of BP neural network which will simplify the neural network model and reduce the training time. And the Tversky model is used for cluster analysis, which keeps watch over the similar training set of BP neural network. In addition, the genetic algorithm (GA) is used to optimize the initial weights and thresholds of BP neural network to achieve the global optimization. Simulation results show that the method combined with MIV, Tversky and GA-BP can improve the accuracy of short-term wind power forecasting.
A0041	Wind Farm Dynamic Equivalence Based on the Wind Turbine Output Active Power Sequence Clustering Zhang Ge, Yang Yiyun, Xiao Jing Guangxi Power Grid Company Electric Power Research Institute, China **Abstract**—In order to reduce the complexity of simulation model containing wind farms in the context of keeping the accuracy static, this paper put forward a kind of Dynamic Equivalence method aiming at making output characteristic of the connecting point of wind farm consistent. Based on the output power sequence of wind turbines, geometric template matching algorithm is used to obtain the characteristic of that power sequence and then Attribute Threshold Clustering Algorithm is used to classify wind turbine. In each cluster, the parameter of wind turbine is made equal according to the principle of constant power output character and then be distinguished according to AMPSO. At last, this paper takes a practical wind farm as an example and respectively simulates the conditions of fault of system side and

	variation of wind speed, which is used in comparing the output characteristic of detailed model and Equivalent model. Results show that the output characteristic of the connecting point of wind farm keeps consistent after equivalent and that the Clustering Algorithm can reflect the operating characteristics of the wind turbine in the whole moment of any time period. It can also be saw that Equivalent method is reasonable and effective, which has certain value in engineering application.
A0043	Parameters Extraction for Perovskite Solar Cells Based on Lambert W- Function Junyu Ge, Manlin Luo, Wanli Pan, Na li and Wei Peng School of Physics and Electronics, Hunan University, China **Abstract**—The behaviors of the solar cells are decided by the device parameters. Thus, it is necessary to extract these parameters to achieve the optimal working condition. Because the five-parameter model of solar cells has the implicit equation of current-voltage relationship, it is difficult to obtain the parameters with conventional methods. In this work, an optimized method is presented to extract device parameters from the actual test data of photovoltaic cell. Based on Lambert W-function, explicit formulation of the model can be deduced. The proposed technique takes suitable method of selecting sample points, which are used to calculate the values of the model parameters. By comparing with the Quasi-Newton method, the results verify accuracy and reliability of this method.

Note

Note