Conference Proceedings
November 2015

NAGOYA JAPAN

LSBE
International Conference on
Life Science & Biological Engineering

ACEAT
Annual Conference on
Engineering and Technology

ICFA
International Conference on
Fundamental and Applied Sciences

Conference Proceedings

November 4-6, 2015
Nagoya, Japan

The Joint Confrerence of

LSBE

International Conference on Life Science & Biological Engineering

ACEAT

Annual Conference on Engineering and Technology

ICFA

International Conference on Fundamental and Applied Sciences

LSBE
International Conference on Life Science & Biological Engineering
ISBN 978-986-89298-1-4

ACEAT
Annual Conference on Engineering and Technology
ISBN 978-986-90827-7-8

ICFA
International Conference on Fundamental and Applied Sciences
ISBN 978-986-5654-32-0

Content

General Information for Participants

■ Registration

The registration desk will be situated on the **6F** at the **ANA CROWNE PLAZA Hotel Grand Court Nagoya** during the following time:

08:00-17:00 Thursday, November 5, 2015

08:15-16:00 Friday, November 6, 2015

- ◆ For onsite registration, payment must be made in cash (USD or JPY). Credit card is not acceptable.

■ Lunch

Lunch will be served in **ORCHID GARDEN**, 2F at the ANA CROWNE PLAZA Hotel Grand Court Nagoya during the following time:

12:00-13:30 Thursday, November 5, 2015

12:00-13:30 Friday, November 6, 2015

■ Wireless Internet Service (WiFi)

Free WiFi service is available at **LOBBY AREA**, ANA CROWNE PLAZA Hotel Grand Court Nagoya. Please connect with the password "**grandcourt**".

■ Name Badges

Every registered participant will be issued a name badge upon registration. For identification purposes, participants are strongly requested to wear badges at all times while in the venue.

■ Organizer

Higher Education Forum (HEF)

Tel: + 886 2 2740 1498丨www.prohef.org

■ A Polite Request to All Participants

Participants are requested to arrive in a timely fashion for all addresses, whether to their own, or to those of other presenters. Presenters are reminded that the time slots should be divided fairly and equally between the number of presentations, and that they should not overrun. The session chair is asked to assume this timekeeping role and to summarize key important issues in each topic.

Sandals or Slippers　Tank Top　Shorts

■ Preperation for Oral Presentations

All presentation rooms are equipped with a screen, an LCD projector, and a laptop computer installed with Microsoft PowerPoint. You will be able to insert your USB flash drive into the computer and double check your file in PowerPoint. We recommend you bring two copies of the file in case that one fails. You may also link your own laptop to the provided projector; however please ensure you have the requisite connector.

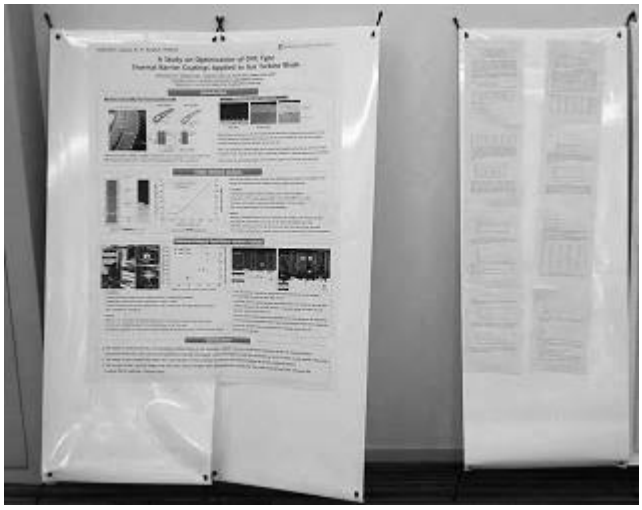
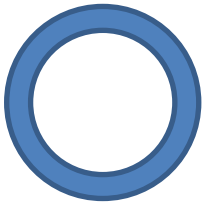
■ Preparation for Poster Presentation

Materials Provided by the Conference Organizer:

1. X-frame display & Base Fabric Canvases (60cm×160cm)
2. Adhesive Tapes or Clamps

Materials Prepared by the Presenters:

1. Home-made Poster(s)
2. Material: not limited, can be posted on the canvases
3. Recommended poster size: 60cm*160cm

	
A 60cm*160cm poster illustrates the research findings.	1. Wider than 60cm (left) 2. Copy of PowerPoint slides in A4 papers (right)
	

Conference Venue General Information

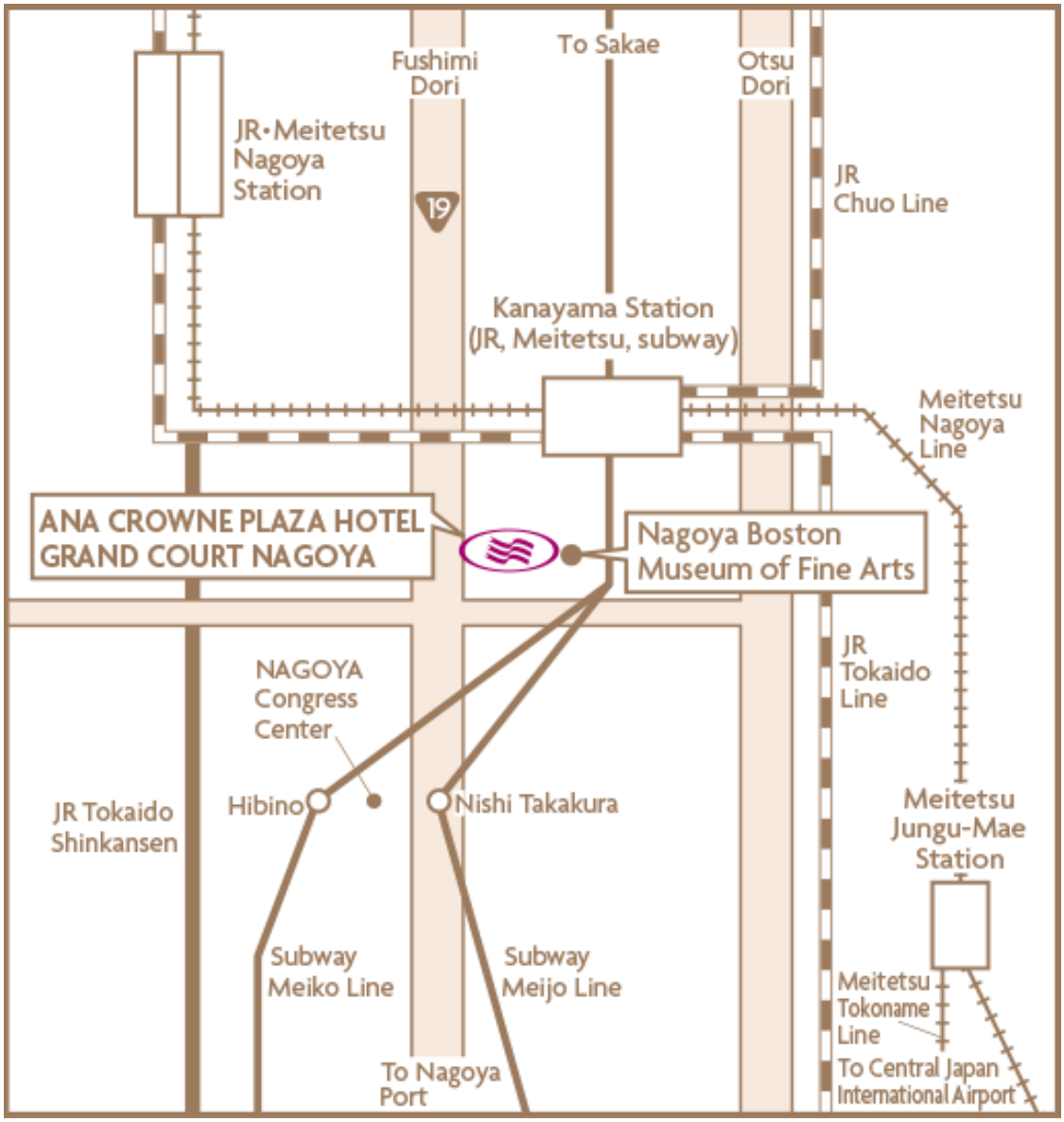
ANA CROWNE PLAZA Hotel Grand Court Nagoya

Add: 1-1-1 Kanayama-cho, Naka-ku, Nagoya 460-0023 Japan

Tel: +81 52 683 4111 Fax. +81 52 683 4121

Official Web site: http://www.anacrowneplaza-nagoya.jp/english/

Ideally situated for business travel as well as sight-seeing, the ANA Crowne Plaza Hotel Grand Court Nagoya is a soaring high-rise structure, conveniently located in Kanayama, Nagoya's second major center.

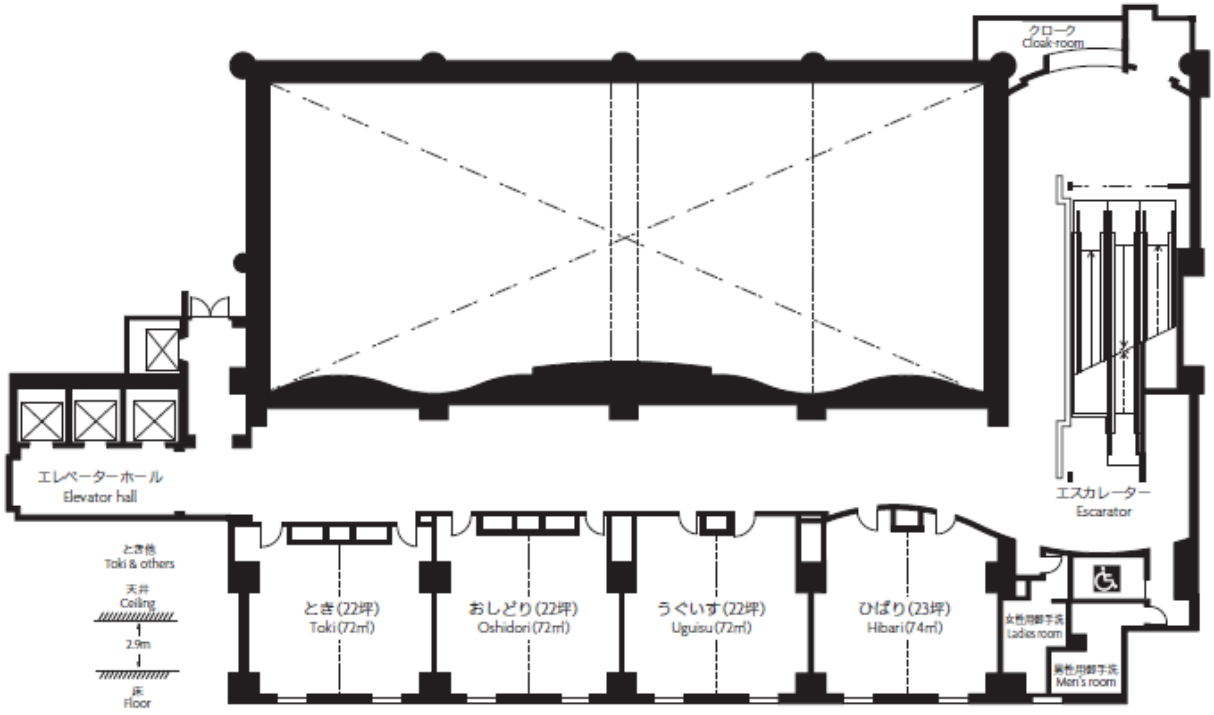


Access to Conference Venue

From Nagoya Station:	About 5 minutes by train (From Nagoya station to Kanayama station JR or Meitetsu line) About 15 minutes by car
From Kanayama Station:	About 1 minute walk
From Sakae Area:	About 5 minutes by subway (From Sakae station to Kanayama station on Meijyo line)
From Central Japan International Airport (Centrair):	About 25 minutes by Meitetsu Railways
From Nagoya Airport:	About 35 minutes by car

Floor Plan

6F, ANA CROWNE PLAZA Hotel Grand Court Nagoya



Conference Committee

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Program at a Glance

Wednesday , November 4
HEF Internal Meeting and Staff Training

Thursday, November 5		
Oral Sessions **6F, ANA CROWNE PLAZA Hotel Grand Court Nagoya**		
Time	**Schedule**	**Venue**
08:00-17:00	Registration	Foyer
08:45-10:15	Biological Engineering	UGUISU
	Electrical and Electronic Engineering (1) /Information Engineering and Technology (1)	HIBARI
10:15-10:30	Break	Foyer
10:30-12:00	**Natural Science Keynote Speech** Connected Design- Toward New Design Principles from an Evolutionary and Global Perspective	OSHIDORI
12:00-13:00	Lunch Time	
13:00-14:30	Life Sciences (1)	UGUISU
14:30-14:45	Break	Foyer
14:45-16:15	Life Sciences (2)	UGUISU
16:15-16:30	Break	Foyer
16:30-17:30	Information Engineering and Technology (2)	TOKI
	Mechanical Engineering and Technology	OSHIDORI
	Life Sciences (3)	UGUISU

Thursday, November 5		
Poster Sessions **6F, ANA CROWNE PLAZA Hotel Grand Court Nagoya**		
Time	**Schedule**	**Venue**
11:30-12:30	Poster Session (1) Life Sciences (1) / Biological Engineering / Environmental Engineering / Food, Agriculture and Veterinary Sciences / Mechanical Engineering and Technology	HIBARI
14:30-15:30	Poster Session (3) Chemical Engineering / Electrical and Electronic Engineering / Engineering Sciences / Information Engineering and Technology/ Materials Science and Engineering / Nanotechnology	
16:00-17:00	Poster Session (4) Life Sciences (2)	

Friday, November 6		
Oral Sessions **ANA CROWNE PLAZA Hotel Grand Court Nagoya, 6F**		
Time	**Schedule**	**Venue**
08:15-16:00	Registration	Foyer
08:45-10:15	Life Sciences (4)	UGUISU
	Information Engineering and Technology (3)	HIBARI
10:15-10:30	Break	Foyer
10:30-12:00	Life Sciences (5)	UGUISU
	Electrical and Electronic Engineering (2)	HIBARI
12:00-13:00	Lunch Time	
13:00-14:30	Life Sciences (6)	UGUISU
	Computer Engineering and Technology	HIBARI
14:30-14:45	Break	Foyer
14:45-16:15	Civil Engineering	OSHIDORI
	Environmental Engineering / Food, Agriculture and Veterinary Sciences	UGUISU
	Aeronautics & Aerospace Engineering / Chemical Engineering	HIBARI

Natural Science Keynote Speech

OSHIDORI, 6F **10:30-12:00** **Thursday, November 5**

Dr.Yoshiro Miyata
Professor
Faculty of Engineering
Tomohiro Ueshiba (Chukyo University),
Mihoko Kamei (Sugiyama Jogakuen University)
Japan

Topic: Connected Design- Toward New Design Principles from an Evolutionary and Global Perspective

Abstract of Speech

For the children of the 20th century like ourselves, technologies are something that have made our daily lives more and more convenient and comfortable like air conditioning and microwaves. The problem with these user-friendly technologies designed to maximize our immediate utilities of getting energy and food is that, when we turn them on, the processes of producing the foods and energies are mostly invisible. As a result, it is hard to appreciate the work of the people who produce these resources that support our daily lives. Also, it is hard to get curious and motivated to learn about these technologies and scientific knowledge behind them. Thus, we live in a society in which people and resources that support our lives are not appreciated and it is difficult to get motivated to contribute to the community. This is especially a serious issue in countries like Japan in which we rely almost all energies and 70% of foods on imports from around the world. Fortunately, we can find a hope when we look back in history for a million years, and examine the natural environments in which our ancestors developed the early technologies. In these environments, daily activities for securing food and energy, like crafting tools and maintaining fire, etc., served the functions of not only these immediate utilities but also of learning and constructing human relations in the community. According to “Urge Theory” (Toda, 1981), our emotions necessary for

learning like curiosity and challenge or social emotions of appreciation and contribution are parts of our mental/social system that have evolved in order to survive in the natural environments. Such system that took over a million years to evolve cannot have degenerated in just one hundred years or so of living with modern technologies. Our challenge is how to re-activate these emotions that support learning and social relations even in our modern environments.

In the keynote, we will share some of our efforts in World Museum Project, a network of schools and educators in more than 30 countries on the five continents who collaborate to create artworks with globally meaningful themes. In "World Peace Song Project", we collaborated with a multi-cultural musician group to create a song of peace that children around the world can sing in their own languages. We premiered the song in a workshop and concert in Nagoya in March, 2014, which was streamed live via the internet for the participants around the world to view and send comments to be displayed on the concert stage. In "Aichi Workshop Gathering", many adults and students in the community collaborated to create a network of spaces for the local children to experience and learn technologies ranging from hand-crafts to computer programming.

Brief Introduction of Dr. Yoshiro Miyata

Yoshiro Miyata has been on the faculty of the School of Engineering (formally School of Computer and Cognitive Sciences), Chukyo University in Japan since 1989. As a holder of a BS in Physics from Waseda University, a MS in Bioengineering from Osaka University, and a Ph.D. in Psychology from University of California at San Diego, he has always been interested in the relations between the physical, biological, psychological and social worlds. He started his research on the design of everyday things as a member of the User Centered System Design (UCSD) research group at University of California at San Diego (UCSD) while at the same time working on brain-inspired models of human cognition in the Parallel Distributed Processing research group. His interests in cognitive processes represented in connections in the brain has since expanded to connections between individuals, and connections with artifacts and natural environments. Having worked in the multi-cultural and multi-disciplinary environment at UCSD, Bell Communications Research and University of Colorado at Boulder, he has come to believe in the power of collaboration across cultures and

disciplines. In 2010, he started to collaborate with a few schools in Japan and other countries. This collaboration has evolved into the World Museum Project involving people from more than 30 countries on the 5 continents in 2014. In World Museum Project, he has coordinated many cross-cultural projects involving hundreds of children with themes ranging from foods, music, animals, to crafts and arts.

Oral Sessions –November 5

Biological Engineering

UGUISU, 6F

08:45-10:15, Thursday, November 5

Session Chair: ***Prof. Chu-Yang Chou***

LSBE-1707
The Subcellular Changes of 0.4T SMF Exposure DPSCs
Wei-Zhen Lew｜*Taipei Medical University*
Ya-Hui Lin ｜*Taipei Medical University*
Haw-Ming Huang｜*Taipei Medical University*

LSBE-1708
The Combined Effect of Chemical and Physical Stimulation on Dental Pulp Stem Cells
Kun-Yu Huang｜*Taipei Medical University*
Haw-Ming Huang｜*Taipei Medical University*

LSBE-1705
Histological and Molecular Evaluation of Healing Bone Treated with Human Dentin Materials
Yu-Chih Huang｜*Taipei Medical University*
Meng-Yin Yeh｜*Taipei Medical University*
Haw-Ming Huang｜*Taipei Medical University*

LSBE-1714
Optimization of Genetic Transformation of Single Cell Suspension Culture of Banana Mediated by Agrobacterium Tumefaciens Harboring Plasmid pART-TEST7
Dian Magfirah Hala｜*Institut Technology Bandung*
Fenny M. Dwivanny ｜*Institut Technology Bandung*
Rizkita R. Esyanti｜*Institut Technology Bandung*

LSBE-1681
Effect of Different Amino Acid for Growth and Pigmentation of Monascus on Rice Starch Solid Surface Medium
Teerin Chysirichote｜*King Mongkut's Institute of Technology Ladkrabang*

LSBE-1793

The Correlation between Fractional Flow Reserve and Wall Shear Stress in a Patient-Specific Coronary Arterial Models with Virtual Narrowing

Kyung Eun Lee | *Kangwon National University*
Gook Tae Kim | *Kangwon National University*
Eun Bo Shim | *Kangwon National University*

LSBE-1785

Co-Digestion of Anaerobic Digestate of Pig Manure and Vegetable Wastes

Yu-Shan Lin | *National Taiwan University*
An-Chi Liu | *National Taiwan University*
Chu-Yang Chou | *National Taiwan University*

Electrical and Electronic Engineering (1) / Information Engineering and Technology (1)

HIBARI, 6F

08:45-10:15, Thursday, November 5

Session Chair: ***Prof. Lan-Rong Dung***

ACEAT-468
An Automatic Detection Algorithm of Abandoned Objects and Abandoner for Surveillance Systems
Sheng-Fuu Lin | *National Chiao Tung University*
Yi-Chieh Sun | *National Chiao Tung University*
Jiao-Rou Liao | *National Chiao Tung University*

ACEAT-490
Adaptive Battery Equalization Algorithm for Capacitor-Based Battery Management System
Lan-Rong Dung | *National Chiao Tung University*
Yu-Syuan Peng | *National Chiao Tung University*

ACEAT-511
A Design of Vehicle's Positioning System
Der-Cherng Liaw | *National Chiao Tung University*
Sung-Ming Lo | *National Chiao Tung University*

ACEAT-695
Nonlinear Fault-Tolerant Control Scheme with Application to Electric Vehicles
Chih-Chiang Chen | *National Chiao Tung University*
Ching-Yi Hung | *National Chiao Tung University*
Lian-Cyun Li | *National Chiao Tung University*
Yew-Wen Liang | *National Chiao Tung University*

ACEAT-682

High Step-Up Ratio DC-DC Converter Using Class-E Resonant Inverter and Class-DE FB Rectifier for Low Voltage Renewable Energy System

Chaiyan Thongsongyod｜*King Mongkut's University of Technology Thonburi*
Itsda Boonyaroonate｜*King Mongkut's University of Technology Thonburi*
Chainarin Ekkaravarodome｜*King Mongkuts University of Technology North Bangkok*
Kohji Higuchi｜*University of Electro-Communications*
Kamon Jirasereeamornkul｜*King Mongkut's University of Technology Thonburi*

ACEAT-670

A GAHP-Based Quantitative Method for Risk Assessment of Debris-Flow Hazards

Li Jeng Huang｜*National Kaohsiung University of Applied Science*

Life Sciences (1)

UGUISU, 6F

13:00-14:30, Thursday, November 5

Session Chair: ***Prof. Mayura Soonwera***

LSBE-1700
Pediculicidal Potential of Herbal Shampoos from *Zingiber officinale* Roscoe and *Camellia sinensis* (L.) Kuntze on Mortality of Head Louse (*Pediculus humanus capitis* De Geer)
Mayura Soonwera｜*King Mongkut's Institute of Technology Ladkrabang*

LSBE-1701
Pretreatment of Cellulose from Cassava Rhizome by Two-Stage Chemical Reagents for High Yield of Bioethanol Production
Anissara Ontanee｜*Khon Kaen University*
Bunpot Klinpratoom｜*Khon Kaen University*
Chalerm Ruangviriyachai｜*Khon Kaen University*

LSBE-1709
Molecular Cloning, Expression and Characterization of α-Globin from Crocodile (*Crocodylus siamensis*) in *Pichia pastoris*
Preeyanan Anwised｜*Khon Kaen University*
Theeranan Temsiripong｜*Sriracha Moda Co.,Ltd.*
Sompong Klaynongsruang｜*Khon Kaen University*

LSBE-1716
Endophytic Bacteria as Potential Growth Promoters in Para Rubber Seedling
Kulwadee Khotchanalekha｜*Khon Kaen University*
Saowanit Tongpim｜*Khon Kaen University*

LSBE-1721
Alkaline-Acid Pretreatment and Enzyme Hydrolysis of Vetiver Grass for Bioethanol Production
Khajeewan Subsamran｜*Khon Kaen University*
Polson Mahakhan｜*Khon Kaen University*
Jutaporn Sawaengkaew｜*Khon Kaen University*

LSBE-1694

Toxicity of Herbal Essential Oils as Larvicide and Pupicide Against Immature Stage of Housefly, *Musca domestica* L.

Aksorn Chantawee | *King Mongkut's Institute of Technology Ladkrabang*
Mayura Soonwera | *King Mongkut's Institute of Technology Ladkrabang*

Life Sciences (2)

UGUISU, 6F

14:45-16:15, Thursday, November 5

Session Chair: ***Prof. Suwanna Niamsanit***

LSBE-1723
Screening and Optimization of Extracellular Thermo-Stable Dextranase Producing Fungi
Patcharaporn Nonyong | *Khon Kaen University*
Suwanna Niamsanit | *Khon Kaen University*

LSBE-1727
Optimization for Cellulase Production from *Trematosphaeria biappendiculata* on Cellulosic Waste under Solid State Fermentation
Thanaphon Thongrutsamee | *Khon Kaen University*
Saksith Suriyagamon | *Khon Kaen University*
Sakda Daduang | *Khon Kaen University*
Wandee Bunyatratchata | *Khon Kaen University*

LSBE-1731
Bioactivity of Secalonic Acid FIsolated from the Fungus *Aspergillusaculeatus* KKU-CT2
NatanongYodsing | *Khon Kaen University*
Ratsami Lekphrom | *Khon Kaen University*
Watchara Sangsopha | *Khon Kaen University*
Sophon Boonlue | *Khon Kaen University*

LSBE-1735
Effect of Vitamin D_3-Mediated Human Antimicrobial Peptide LL-37 Activity against *Burkholderia pseudomallei* in Human Lung Epithelial Cell (A549)
Tiparpa Mattrasongkram | *Khon Kaen University*
Sakawrat Kanthawong | *Khon Kaen University*
Sorujsiri Chareonsudjai | *Khon Kaen University*
Suwimol Taweechaisupapong | *Khon Kaen University*

LSBE-1747

Feasibility Study of Dextranase from Aspergillus sp. X26 to Degrade Dextran in Sugarcane Juice

Suwanna Niamsanit | *Khon Kaen University*
Nipa Milintawisamai | *Khon Kaen University*
PattaraponLanwonk | *Khon Kaen University*

LSBE-1695

Bioefficacy of Three Herbal Essential Oils as Adulticide Against Housefly, Musca Domestica L. (Diptera: Muscidae)

Aksorn Chantawee | *King Mongkut's Institute of Technology Ladkrabang*
Mayura Soonwera | *King Mongkut's Institute of Technology Ladkrabang*

[15] Chaubey, M.K. 2008. Fumigant toxicity of essential oils from some common spices against pulse beetle, *Callosobruchus chinensis* (Coleoptera: Bruchidae), *Journal Oleo Science*, 57 (3), 171-179.
[16] Kostic, I., Petrovic, O., Milanovic, S., Popovic, Z., Stankovic, S., Todorovic, G. and Kostic, M. (2013). Biological activity of essential oils of *Athamanta haynaldii* and *Myristica fragrans* to gypsy moth larvae, *Industial Crops and Products*, 41, 17-20.
[17] Tennyson, S., Samraj, D.A., Jeyasundar, D. and Chalieu, K. 2013. Larvicidal Efficacy of plant oils against the dengue vector Aedes aegypti (L.) (Diptera:Culicidae), *Middle-East Journal of Scientific Research*, 13 (1), 64-68.
[18] Jaiswal, P., Kumar, P., Singh, V.K. and Singh, D.K. 2009. Biological Effect of *Myristica fragrans, Department of Zoology*, 11, 21-29.
[19] Yorulmaz Salman, S. and Erbas, S. 2014. Contact and repellency effects of *Rosa damascene* Mill. Essential oil and its two major constituents against *Tetranychus urticae* Koch(Acari: Tetranychidae), *Turkish Journal Of Entomology*, 38 (4), 365-376.
[20] Uner, N., Ozcan Oruc, E., Canli, M. and Sevgiler, Y. 2001. Effect of cypermethrin on antioxidant enzyme activity and lipid peroxidation in liver and kidney of the freshwater fish, Oreochomis niloticus and Cyprinus carpio (L.), *Bulletin Environmental contamination and Toxcicology*, 67 (5), 657-664.
[21] Chakravarthi, K., Rambabunaravaneni, B. and Philip, G. 2007. Study of cypermethrin cytogenesis effect on human Lymphocytes using in-vitro Techniques, *Journal of Applied Sciences and Environment management*, 11 (2), 77-81.

Information Engineering and Technology (2)

TOKI, 6F

16:30-17:30, Thursday, November 5

Session Chair: ***Prof. Kai-Wen Lien***

ACEAT-458
Concepts for Designing User Interface of Auto Application
Yih-Jiun Lee｜*Chinese Culture University*
Yi-Chen Hsu｜*National Taipei University of Education*
Jen-Chih Lin｜*National Taipei University of Education*
Yu-Wei Su｜*National Taipei University of Education*

ACEAT-464
A Design of Mobile Supported Earthquake Information Exchange System
Yih-JIun Lee｜*Chinese Culture University*
Kai-Wen Lien｜*Chienkuo Technology University*
Ping-Hsiang Hsu｜*Chinese Culture University*

ACEAT-469
A Fair Online Examination Platform for Group-Testing
Ching-Yi Chiu｜*Chinese Culture University*
Yih-Jiun Lee｜*Chinese Culture University*
Yu-Ching Chen｜*Chinese Culture University*

ACEAT-504
A Health Management System Using Gamification for Exercise Motivation
Kuan-Yu Chiang｜*Chinese Culture University*
Yih-Jiun Lee｜*Chinese Culture University*

Mechanical Engineering and Technology

OSHIDORI, 6F

16:30-17:30, Thursday, November 5

Session Chair: ***Prof. Jung-Hua Chou***

ACEAT-510
Water-Cooled Roof to Reduce Solar Heat Uptake
M. K. Lai | *SEGi University*
G. Darmaraj | *SEGi University*

ACEAT-426
Regression Analysis of Coupling Effects of Thermal and External Forces on a Precision Machine Center
Ko-Ming Ni | *Ling Tung University*

ACEAT-461
Gearbox Fault Diagnosis Based on Energy Proportion Spectrum
Zhuting Yao | *North University of China*
Hongxia Pan | *North University of China*

ACEAT-679
Design and Implementation of Amphibious Robot with Theo Jansen Linkage
Ting-Ya Liu | *National Cheng Kung University*
Jung-Hua Chou | *National Cheng Kung University*

ACEAT-552
Drag Reduction by Agar Powder in Rectangular Pipe
Yanua Anwas | *University of Indonesia*
Gunawan Gunawan | *University of Indonesia*
Satoshi Ogata | *Tokyo Metropolitan University*

Life Sciences (3)

UGUISU, 6F

16:30-17:30, Thursday, November 5

Session Chair: ***Prof.Siriporn Phasomkusolsil***

LSBE-1690
Evaluation of Repellency Effect of Thai Essential Oils in Coconut and Soybean Oil Base against Aedes Aegypti (Linn.), Anopheles Dirus (Peyton and Harrison) and Culex Quinquefasciatus (Say)
Mayura Soonwera | *King Mongkut's Institute of Technology Ladkrabang*
Siriporn Phasomkusolsil | *Armed Forces Research Institute of Medical Sciences*

LSBE-1692
Pediculicidal Activity of Herbal Shampoo from Hog-Plum, Spondias Pinnata (L.f.) Kurz, (Anacarbiaceae) against Head Lice, Pediculus Humanus Capitis De Geer. (Pediculidae: Phthiraptera) in Thailand
Sirawut Sittichok | *King Mongkut's Institute of Technology Ladkrabang*
Mayura Soonwera | *King Mongkut's Institute of Technology Ladkrabang*

LSBE-1693
Insecticidal Activity of Herbal Shampoos Base on Dillenia Indica L. (Dilleniaceae) and Amomum Krervanh Pierre (Zingiberaceae) against Head Louse (Pediculus Humanus Capitis De Geer.)
Orawan Wongnet | *King Mongkut's Institute of Technology Ladkrabang*
Mayura Soonwera | *King Mongkut's Institute of Technology Ladkrabang*

LSBE-1696
Efficacy of Ethanolic Extracts from Thai Herbs against Larvae and Pupae of Culex Quinquefasciatus (Say) (Culicidae)
Nuttavich Cotchakaew | *King Mongkut's Institute of Technology Ladkrabang*
Mayura Soonwera | *King Mongkut's Institute of Technology Ladkrabang*

Oral Sessions –November 6

Life Sciences (4)

UGUISU, 6F

08:45-10:15, Friday, November 6

Session Chair: ***Prof. Sang Hee Lee***

LSBE-1706
Suppression of Enteropathogenic E. Coli Pathogenesis on Human Enterocytes Driven by the Quorum Quenching, Cytoprotective and Immunomodulatory Bioactivities of Gundelia Tournefortii L.
Glenn Gallego Oyong | *De La Salle University*
Mohsen Bahrami | *Yazd Shahid Sadoughi University of Medical Sciences*
Reymund Gallego Oyong | *Concentrix Philippines*
Esperanza Chua Cabrera | *De La Salle University*

LSBE-1650
Novel Carbapenem-Hydrolyzing Class D β-Lactamase (CHDL) from Multidrug-Resistant Clinical Isolates
Jung Hun Lee | *Myongji University*
Sang Hee Lee | *Myongji University*

LSBE-1755
Effect of Dietary Supplementation of Banana (Musa Acuminata) Peel Flour on the Growth, Cytokine Responses, and Disease Susceptibility of Rohu, Labeo Rohita
Sib Sankar Giri | *Seoul National University*
Cheng Chi | *Seoul National University*
Hyoun-Joong Kim | *Seoul National University*
Saekil Yun | *Seoul National University*
Venkatachalam Sukumaran | *Periyar Maniammai University*
Se Chang Park | *Seoul National University*

LSBE-1662

Unlocking the Anti-Inflammatory Potential of Medicinal Mushroom: Amauroderma Rugosum (Blume & T. Nees) Torrend

Pui Mun Chan | *University of Malaya*
Yee Shin Tan | *University of Malaya*
Kek Heng Chua | *University of Malaya*
Umah Rani Kuppusamy | *University of Malaya*
Vikineswary Sabaratnam | *University of Malaya*

LSBE-1722

Evaluation of Protective Effects of Myricetin Derivatives from Syzygium Malaccense against Diabetic Retinopathy: An in Vitro Approach

Bavani Arumugam | *University of Malaya*
Chua Kek Heng | *University of Malaya*
Uma Devi Palanisamy | *Monash University Malaysia*
Umah Rani Kuppusamy | *University of Malaya*

Information Engineering and Technology (3)

HIBARI, 6F

08:45-10:15, Friday, November 6

Session Chair: ***Prof. Fu-Min Chang***

ACEAT-668
Optimal Replacement Policy for a Two-unit System with Shock Damage Interaction
Yu-Hung Chien | *National Taichung University of Science and Technology*

ACEAT-672
Reliability of a Vacation Queue with an Un-Reliable Server
Jau-Chuan Ke | *National Taichung University of Science and Technology*
Ching-Chang Kuo | *National Taichung University of Science and Technology*

ACEAT-673
Availability of the Repairable System with Switching Failure and Reboot Delay
Ching-Chang Kuo | *National Taichung University of Science and Technology*
Jau-Chuan Ke | *National Taichung University of Science and Technology*

ACEAT-677
The Optimal T-policy for Multi-Phase Service and an Unreliable Server
Jau-Chuan Ke | *National Taichung University of Science and Technology*
Tsung-Yin Wang | *National Taichung University of Science and Technology*

ACEAT-666
Reliability-Based Analysis for a Standby System with Imperfect Coverage Subject to a Repairable Service Station
Fu-Min Chang | *Chaoyang University of Technology*
Chia-Jung Chang | *National Taichung University of Science and Technology*
Ying-Lin Hsu | *National Chung-Hsing University*
Ying-Cheng Tseng | *National Chung-Hsing University*

Life Sciences (5)

UGUISU, 6F

10:30-12:00, Friday, November 6

Session Chair: ***Prof. Aleksandra Malyska***

LSBE-1729
Antioxidant and Anti-Inflammatory Activities of Helicteres Isora L. Fruit Extracts
Acharaporn Rattanamaneerusmee | *Mahidol University*
Krit Thirapanmethee | *Mahidol University*
Pattamapan Lomarat | *Mahidol University*
Mullika Traidej Chomnawang | *Mahidol University*

LSBE-1740
Investigation of Bioactive Compounds in Euphorbiaceae Latex and Their Anticancer Activity on PC-3M-Pro4 MCherry and MDA-B1-231
Mo Awwanah | *Leiden University*
Lanpeng Chen | *Leiden University*
Aline Coqueiro | *Leiden University*
B. Ewa Snaar-Jagalska | *Leiden University*
Young Hae Choi | *Leiden University*

LSBE-1698
Legumes for Sustainable Feed Production in Europe – Legal and Social Implications
Aleksandra Malyska | *Institute of Bioorganic Chemistry Polish Academy of Sciences*
Joanna Gracz | *Institute of Bioorganic Chemistry Polish Academy of Sciences*
Tomasz Twardowski | *Institute of Bioorganic Chemistry Polish Academy of Sciences*

LSBE-1734
In Vitro Anti-Hepatitis C Virus Activity of Cladogynos orientalis Zipp. Extracts
Piyanoot Thongsri | *Mahidol University*
Khanit Sa-Ngiamsuntorn | *Mahidol University*
Pongtip Sithisarn | *Mahidol University*
Mullika T. Chomnawang | *Mahidol University*
Krit Thirapanmethee | *Mahidol University*

LSBE-1646

Neuraminidase Inhibitors Potential of Some Xanthone from Garcinia Sp as New Anti-Influenza Agent

Muchtaridi Muchtaridi | *Universitas Padjadjaran*
Habibah A. Wahab | *Universiti Sains Malaysia*
Aisyah Saad Abdul Rahim | *Universiti Sains Malaysia*
Ida Musfiroh | *Universitas Padjadjaran*
Anas Subarnas | *Universitas Padjadjaran*
Agung Kurniawan | *Universitas Padjadjaran*

Electrical and Electronic Engineering (2)

HIBARI, 6F

10:30-12:00, Friday, November 6

Session Chair: ***Prof. Chaur-Chin Chen***

ACEAT-625

FPGA-Realization of a Six-Axis Servo Control IC for a Robot Manipulator

Ying-Shieh Kung｜*Southern Taiwan University of Science and Technology*
Yu-Jen Chen｜*Southern Taiwan University of Science and Technology*
Jin-Mu Lin｜*Southern Taiwan University of Science and Technology*
Hsin-Hung Chou｜*Industrial Technology Research Institute*

ACEAT-493

Data Visualization by PCA, LDA, and ICA

Tsun-Yu Yang｜*National Tsing Hua University*
Chaur-Chin Chen｜*National Tsing Hua University*

ACEAT-521

Prototyping of Mobile-Based Tourism Directory to Increase Tourism Potential and Enhance Role of Small and Medium Enterprises

Thomas Suselo｜*University of Atma Jaya Yogyakarta*
Suyoto｜*University of Atma Jaya Yogyakarta*
Yudi Dwiandiyanta｜*University of Atma Jaya Yogyakarta*

ACEAT-577

The Estimation of Rotor Position and Speed for a Sensorless PMSM Drive Using High Frequency Signal Injection

Ying-Shieh Kung｜*Southern Taiwan University of Science and Technology*
Risfendra Risfendra｜*Southern Taiwan University of Science and Technology*
Yi-De Lin｜*Southern Taiwan University of Science and Technology*
Liang-Chiao Huang｜Industrial Technology Research Institute

ACEAT-577
The Estimation of Rotor Position and Speed for a Sensorless PMSM Drive Using High Frequency Signal Injection

Ying-Shieh Kung[a*], Risfendra[a], Yi-De Lin[a] and Liang-Chiao Huang[b]

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Abstract

Based on the high frequency signal injection (HFSI), the estimation of the rotor position and speed for a sensorless permanent magnet synchronous motor (PMSM) is presented in this work. Firstly, the mathematical model for PMSM is derived. Secondly, HFSI is described which a high frequency sinusoidal voltage is injected into the estimated d-axis, and the high frequency current response in q-axis is acquired to further estimate the rotor position and rotor speed through a signal modulation process. Finally, to evaluate the effectiveness and correctness of the proposed rotor position estimation system, a co-simulation by using ModelSim and Simulink is applied. The PMSM, inverter, HFSI and speed command are performed in Simulink and the space vector pulse width modulation (SVPWM) and coordinate transformation described by a hardware description language (HDL) is executed in ModelSim. Some simulation cases are also demonstrated.

Keyword: High frequency signal injection (HFSI), Sensorless PMSM drive, Rotor position estimation, ModelSim/Simulink co-simulation.

1. Introduction

The conventional PMSM control needs a speed sensor or an optical encoder to measure the rotor speed and feedback it to the controller for ensuring the precision speed control. Such sensor presents some disadvantages such as drive cost, machine size, reliability and noise immunity. In recent year, a sensorless control without position and speed sensors for PMSM drive become a popular research topic in literature [1-5]. In those researches, there are two approaches which one is model-based approach and another is nonmodel-based approach. In the former, there are back electromotive force (Back EMF), sliding mode observer (SMO) [2], extended Kalman filter (EKF) [3], etc. In the latter, the well-known method is the high frequency signal injection (HFSI) [4]. The HFSI is suitable for the interior PMSM

which belongs to the salient pole machine or suitable for the surface PMSM when the saturation saliency phenomenon is occurred [4]. Compare with the model-based approach, the HFSI is insensitive to the PMSM parameter, and it can estimate the rotor position of PMSM very well at low speed and standstill condition.

Recently, a co-simulation work by electronic design automation (EDA) Simulator Link has been gradually applied to verify the effectiveness of HDL code in the motor drive system [6-7]. The EDA Simulator Link provides a co-simulation interface between Simulink [8] and HDL simulators-ModelSim [9]. Therefore, EDA Simulator Link lets you use MATLAB code and Simulink models as a test bench that generates stimulus for an HDL simulation and analyzes the simulation's response. In this paper, a co-simulation by EDA Simulator Link is applied to the estimation of the rotor position and speed for a sensorless PMSM drive. The PMSM, inverter, HFSI and speed command are performed in Simulink and the SVPWM and coordinate transformation described by VHDL code is executed in ModelSim. Some simulations will validate the effectiveness of the estimation of the rotor position and rotor speed for a sensorless PMSM drive using HFSI.

2. The HFSI-based estimator in PMSM drives

The estimator architecture of PMSM drive based on HFSI [4] is shown in Fig.1. It includes a PMSM, an inverter, a V/F controller and a HFSI-based estimator. The simulation environment is constructed by using ModelSim and Simulink, and its estimation algorithm is described as follows.

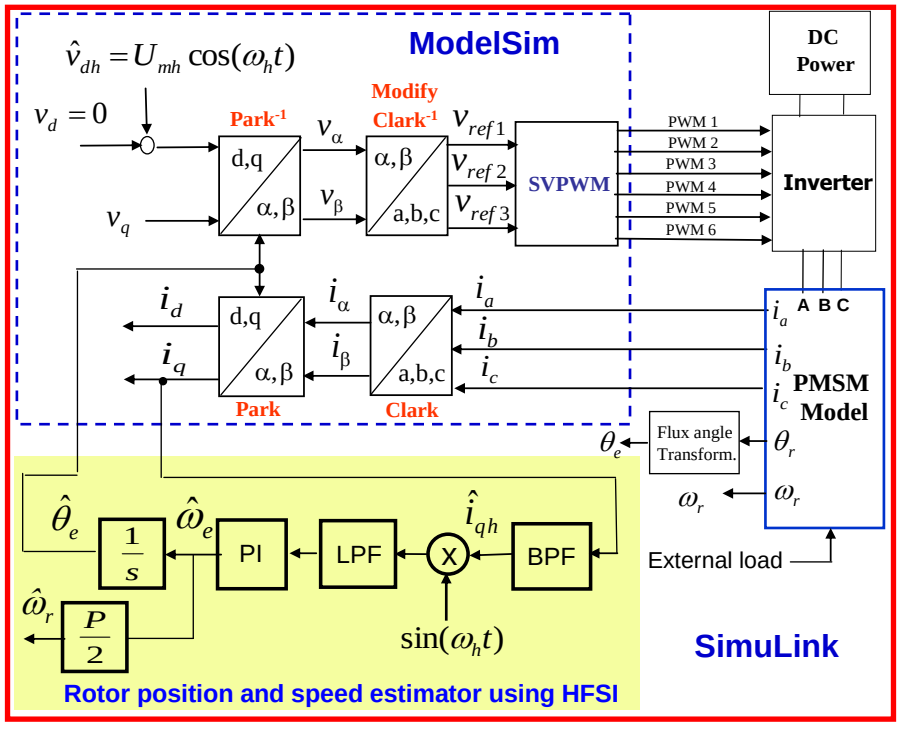


Fig. 1 The estimator architecture of PMSM using HFSI

The mathematical modeling of PMSM in d-q synchronous rotating axis can be expressed as follows.

$$v_d = r_s i_d + L_d \frac{di_d}{dt} - \omega_e L_q i_q \tag{1}$$

$$v_q = r_s i_q + L_q \frac{di_q}{dt} - \omega_e L_d i_d + \omega_e \lambda_f \tag{2}$$

where v_d , v_q are the d-axis and q-axis voltages; i_d , i_q are the d-axis and q-axis currents; L_d , L_q are the d-axis and q-axis inductances; r_s is a stator resistor; λ_f is the magnetic field linkage; ω_e is the electrical rotating frequency.

When PMSM operates in the low speed or near standstill condition, the ω_e approaches to zero; therefore, the cross coupling item and back EMF can be ignored. In addition, when a high frequency signal (ω_h) with $\omega_h L_q >> r_s$ is injected, the (1)-(2) can be further reduced as

$$v_d = L_d \frac{di_d}{dt} \tag{3}$$

$$v_q = L_q \frac{di_q}{dt} \tag{4}$$

Before applying the HFSI, three reference frames are defined and shown in Fig. 2. The α-β axis is the stator reference coordinate; d-q axis is the actual rotating synchronous reference coordinate; $\hat{d}$-$\hat{q}$ is the estimated rotating synchronous reference coordinate. The angle between d-q axis and α-β axis is θ_e, and between $\hat{d}$-$\hat{q}$ axis and α-β axis is $\hat{\theta}_e$. Further, the estimated error is defined as

$$\Delta\theta_e = \theta_e - \hat{\theta}_e \tag{5}$$

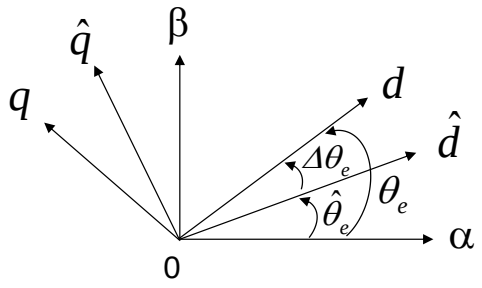


Fig. 2 The relationship among three reference frames [4]

If a high frequency voltage is injected to $\hat{d}$ axis, the high frequency voltage equation in $\hat{d}$ - $\hat{q}$ axis is presented as follows

$$\hat{v}_{dh} = U_{mh}\cos(\omega_h t) \quad (6) \quad \hat{v}_{qh} = 0 \quad (7)$$

where $\hat{u}_{dh}, \hat{u}_{qh}$ are high frequency voltages in $\hat{d}$ - $\hat{q}$ axis; U_{mh} is the voltage magnitude; ω_h is the high frequency value. If the (6)-(7) are transformed from $\hat{d}$ - $\hat{q}$ axis to d - q axis, the high frequency voltage in d - q axis are respectively derived as follows

$$v_{dh} = U_{mh}\cos(\omega_h t)\cos\Delta\theta_e \quad (8)$$

$$v_{qh} = -U_{mh}\cos(\omega_h t)\sin\Delta\theta_e \quad (9)$$

where u_{dh}, u_{qh} are high frequency voltages in d - q axis. Further, substituting (8)-(9) into (3)-(4) and neglecting the inductance variation, the high frequency current response are

$$i_{dh} = \frac{U_{mh}\sin(\omega_h t)\cos\Delta\theta_e}{\omega_h L_d} \quad (10)$$

$$i_{qh} = -\frac{U_{mh}\sin(\omega_h t)\sin\Delta\theta_e}{\omega_h L_q} \quad (11)$$

where i_{dh}, i_{qh} are high frequency currents response in d - q axis. Continuously proceeding the coordinate transformation, high frequency currents response in $\hat{d}$ - $\hat{q}$ axis can be obtained as follows.

$$\hat{i}_{dh} = \frac{U_{mh}}{2\omega_h L_q L_d}((L_q + L_d) + (L_q - L_d)\cos(2\Delta\theta_e))\sin(\omega_h t) \quad (12)$$

$$\hat{i}_{qh} = \frac{U_{mh}(L_q - L_d)}{2\omega_h L_q L_d}\sin(2\Delta\theta_e)\sin(\omega_h t) \quad (13)$$

where $\hat{i}_{dh}, \hat{i}_{qh}$ are high frequency currents response in $\hat{d}$ - $\hat{q}$ axis, and from (12), it

shows that $\hat{i}_{qh}$ includes $\Delta\theta_e$ information. Therefore, if we can control the $\Delta\theta_e$ to be zero, the rotor position can be estimated. To reach this goal, firstly, let $\hat{i}_{qh}$ multiplies $\sin(\omega_h t)$ function and the formulation is become as follows.

$$\hat{i}_{qh}\sin(\omega_h t)=\frac{U_{mh}(L_q-L_d)}{4\omega_h L_q L_d}\sin(2\Delta\theta_e)[1-2\cos(2\omega_h t)] \tag{14}$$

From (14), it consists of a dc component and a harmonic item. If this output in (14) sends to a low pass filter, as follows,

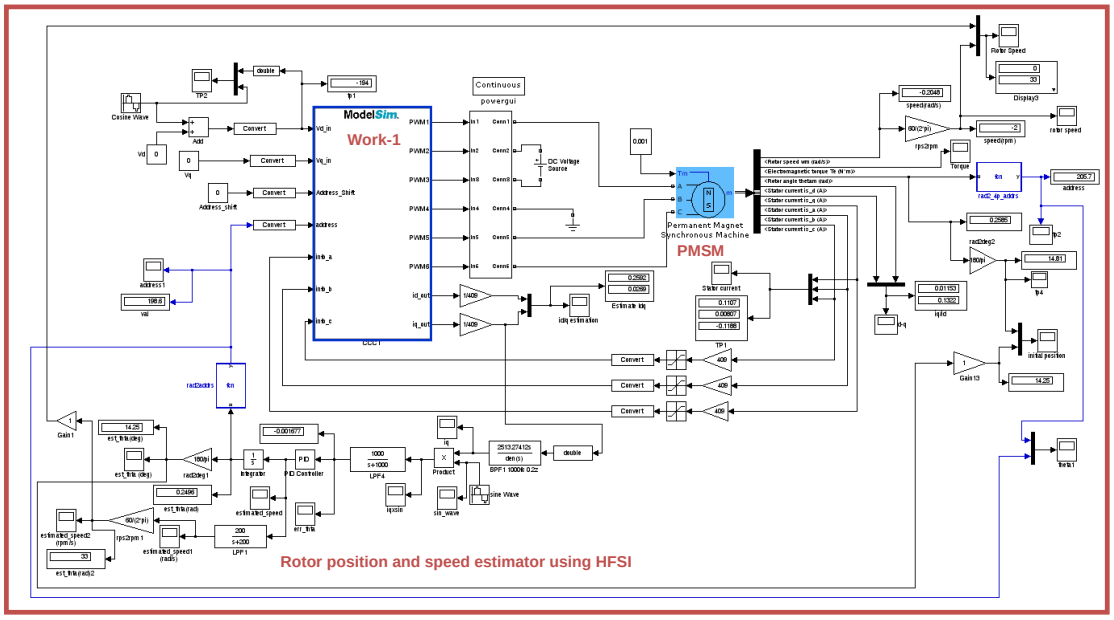
$$f(\Delta\theta)=LPF(\hat{i}_{qh}\sin(\omega_h t))=\frac{U_{mh}(L_q-L_d)}{4\omega_h L_q L_d}\sin(2\Delta\theta_e) \tag{15}$$

the harmonic item will be filtered and only the dc component is left. The *LPF* in (15) represents low pass filter. Further, if we assume that the $\Delta\theta_e$ is small enough in (15), the $\sin(2\Delta\theta_e)\approx 2\Delta\theta_e$. Thus, a PI controller is applied to tune $\Delta\theta_e$ to zero, the initial rotor position θ_e can be estimated. The signal modulation process in HFSI algorithm is shown in Fig. 1.

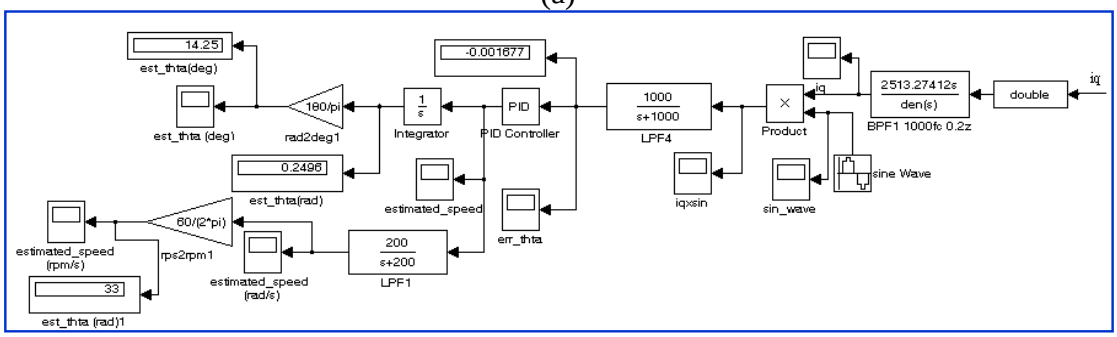
3. Simulation system and results

The estimator architecture of PMSM using HFSI is shown in Fig.1. Firstly, a high frequency voltage (HFV) in d-axis is injected with magnitude by 200 (0.1 unit) and 1kHz frequency cosin function. The HFV, through coordinate transformation, SVPWM, inverter, etc. will further generate a corresponding voltage to supply to PMSM. Secondly, the q-axis current can be acquired after detecting the three phase currents and through by Clark and Park transformation. Thirdly, the q-axis current will be sent to the signal modulation process in HFSI algorithm for the purpose of estimating the rotor position and rotor speed. In the design of the signal modulation process in Fig.1, the q-axis current is detected and sent into a 1kHz band-pass filter; then the output value multiplies with a 1kHz sinusoidal signal. Further, a first order low-pass filter with 160Hz cut-off frequency and a PID controller with Kp=180, Ki=20 and Kd=0 are cascaded with this signal. Via to the aforementioned signal modulation, the rotor speed can be estimated, and rotor position after integral the estimated rotor speed can be obtained.

In the design of the simulation, a combination of the ModelSim and Simulink is applied to co-simulate the HFSI-based rotor position and speed estimation for PMSM drive, and it is shown in Fig. 3. In the Simulink environment, it includes a ModelSim work, a HFSI-based estimator, a PMSM, an IGBT-based inverter, and some input signals and output displays. In ModelSim, it performs the V/F control with coordinate transformation and SVPWM. PMSM model and IGBT model are the components of the Matlab toolbox - SimPowerSystems. The work in Fig. 3(a) is implemented by digital hardware using VHDL. The clocks of 50MHz and 12.5MHz will supply the work in ModelSim. The designed PMSM parameters are that pole pairs is 8, stator phase resistance is 1.3Ω, stator inductance in d-axis is 4.3mH and in q-axis is 6.3mH, inertia is J=0.000108 kg*m^2 and friction factor is F=0.0013 N*m*s. The difference values are set in d-axis inductance and q-axis inductance to create the effect of saturation saliency. In addition, the initial electrical position (or flux angle) is the initial rotor position multiplies the pole pairs of the motor.



(a)



(b)

Fig. 3 ModelSim/Simulink co-simulation architecture for (a) the overall system (b) the only signal modulation process of HFSI

In simulation, the initial rotor position is firstly tested. A high frequency voltage (HFV) in d-axis is injected with magnitude by 200 (0.1 unit) and 1kHz frequency cosin function. Additionally, the voltage in q-axis is set to zero. The initial rotor position is set to 15 degree (the initial flux angle be 120 degree) in PMSM model. Use the same designed parameters of the low-pass filter and PID controller as before, the simulation results are shown in Fig. 4. The initial flux angle tracking response is shown in Fig. 4(a). It presents that the tracking time is about 0.02 s and a little steady state error with 2-3 degrees occurred. Figure 4(b) reveals the estimated rotor speed response. However, it should be zero, but the estimated rotor speed appears maximun 170 rpm before 0.03s. From Fig. 4(a)-4(b), it shows that the steady-state time to acquire the initial rotor position is about 0.03s. In Fig. 4(c)-4(d), it also presents the signal results of $i_q * \sin(\omega t)$ before and after low-pass filter. The results demonstrate that the first order filter with 160Hz cut-off frequency is available. At the same simulation condition but different initial rotor position setting with 5 degree (initial flux angle be 40 degree) and 20 degree (initial flux angle be 160 degree) are also tested. The simulation results at two cases are shown in Fig. 5. In case of the initial flux angle with 40 degree, the tracking time of estimated rotor position to initial rotor position is 0.01s, but in case of initial flux angle with 40 degree, the tracking time needs 0.025s. However, from Figs. 4-5, it demonstrates that the HFSI can accurately estimate the initial rotor position if initial flux angle is less than 180 degree.

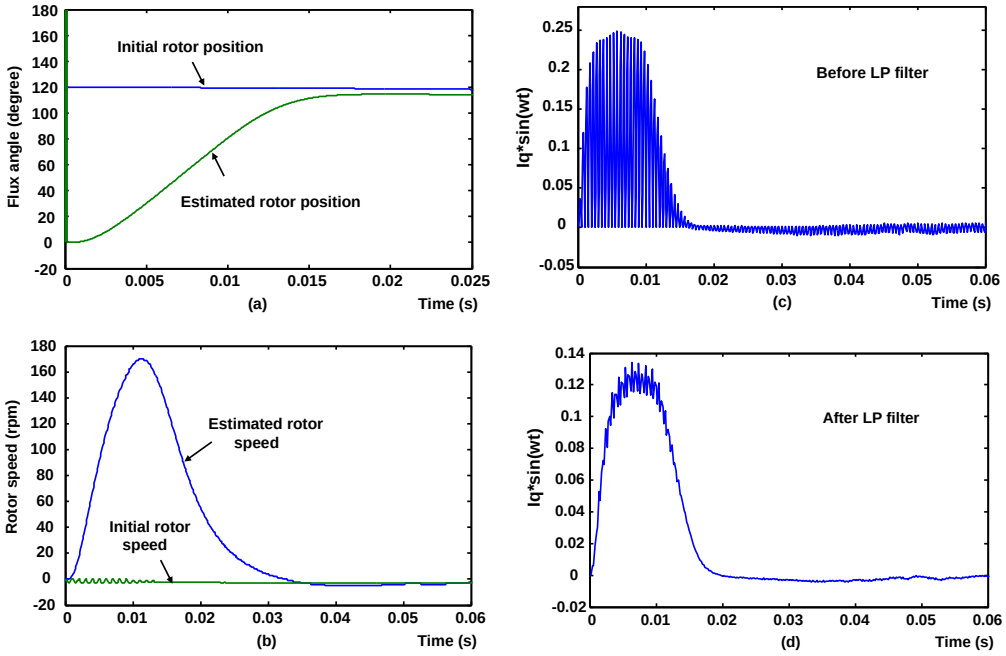


Fig. 4 The simulation results of the initial rotor position estimation (a) the estimated rotor position response (b) the estimated rotor speed response (c) the signal before low-pass filter (d) the signal after low-pass filter

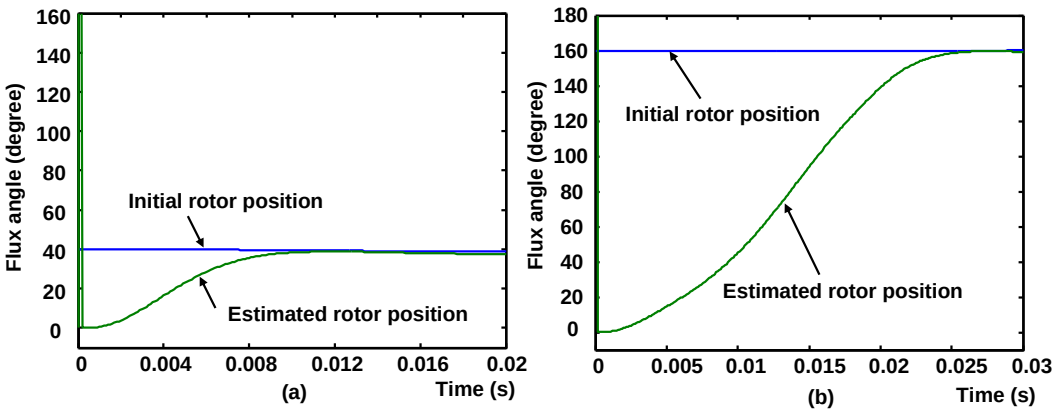


Fig. 5 The simulation results of the initial rotor position estimation under the condition of (a) the initial flux angle is 40 degree and (b) the initial flux angle is 160 degree

After confirming the success of initial rotor position, the estimation of rotor position and rotor speed applying HFSI at low-speed running condition for PMSM drive are tested and simulated. The ModelSim/Simulink co-simulation architecture is shown in Fig. 3 which is a V/F control system. However, the V_d in work-1 is designed with a 1kHz high frequency cosin function with magnitude by 200, but V_q is set to a constant value. To do the test, V_q is designed with two kinds of step command with magnitude which one is 100 (0.05 unit) and another is ± 60 (± 0.03 unit). The initial rotor position is set to 15 degree (Initial flux angle be 120 degree) in PMSM model. The parameters of PMSM model in Fig. 3 is set to the same as before. When V_q command is the first case with magnitude being 100, the simulation result is shown in Fig. 6(a). At the beginning time, the estimated rotor position using HFSI estimator will track the initial rotor position. However, after the time large than 0.025s, the estimated rotor position can follows up the real rotor position, but with 34 degree (flux angle) phase lag. In the rotor speed tracking, although the estimated rotor speed has large tracking error with 170rpm in the beginning time, but it can track the actual rotor speed very well after 0.065s. Finally, the motor runs between 126 rpm and 132rpm condition. When V_q command is belongs to the second case with magnitude being ± 60, the simulation result is shown in Fig. 6(b). The speed transient response and the initial rotor position tracking are very similar with the first case. However, when the V_q command is 60, the estimated rotor speed is run with oscillation and speed values is within 80rpm and

87rpm, but the V_q command is 60, the estimated rotor speed is oscillated within -85rpm and -92rpm. It is also shown that the estimated rotor position can follow up the actual rotor position very well but with 25 degree (flux angle) phase lag. From the Fig. 6, it demonstrates that the rotor position and rotor speed estimation using HFSI can give very good tracking results, although it appears some phase lag phenomenon.

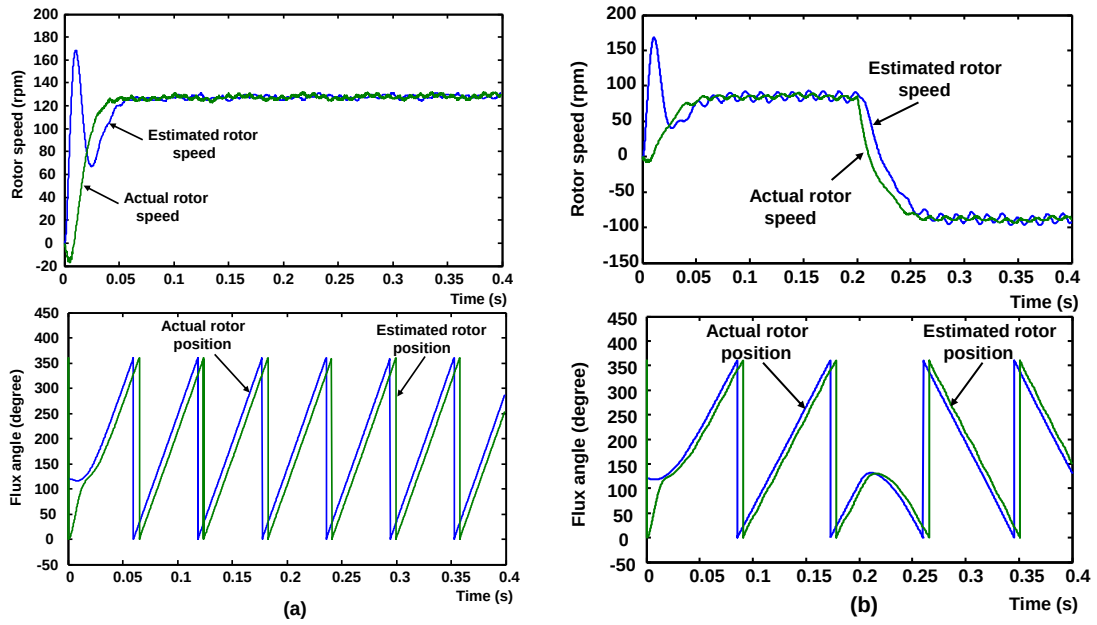


Fig. 6 The simulation results of the rotor position and speed estimation using HFSI under (a) V_q =100 and (b) $V_q = \pm 60$

4. Conclusion

This work has been presented a rotor position and speed estimation for a sensorless PMSM drive based on HFSI and successfully demonstrated through co-simulation by using Simulink and ModelSim. Simulation results show that the initial rotor position can be accurately estimated within about 0.025 second. It also shows that the estimated rotor speed and track actual rotor speed well at the low speed condition. In the future, the hardware implementation of HFSI algorithm can be carried on and verified in FPGA (Field Programmable Gate Array).

Acknowledgement

The financial support provided by Bureau of Energy, Ministry of Economics Affairs of Taiwan is gratefully acknowledged. The authors also gratefully acknowledge the support of Green Energy and Environment Research Laboratories, Industrial Technology Research Institute, Taiwan.

References

[1] P.P. Acarnley and J.F. Watson, "Review of Position-Sensorless Operation of Brushless Permanent-Magnet Machine," *IEEE Trans. on Indus. Electron.*, vol. 53, no. 2, pp. 352~362, Apr. 2006.

[2] H. Kim, J. Son, and J. Lee, "A High-Speed Sliding-Mode Observer for the Sensorless Speed Control of a PMSM," *IEEE Trans. on Indus. Electron.*, vol. 58, no. 9, pp. 4069~4077, Sep. 2011.

[3] S. Bolognani, R. Oboe, and M. Zigliotto, "Sensorless Full-Digital PMSM Drive with EKF Estimation of Speed and Rotor Position," *IEEE Trans. on Indus. Electron.*, vol. 46, no. 1, pp.184~191, Feb. 1999.

[4] B. Liu, B. Zhou, H. Liu, J. Li, L.Wang and Q. Wang, "Research on Initial Rotor Position Estimation for SPMSM," *Proceedings of the 2014 17th International Conference on Electrical Machine and Systems (ICEM),* pp. 768-774, 2014.

[5] T. Nimura, S. Doki and M. Fujitsuna, "Position Sensorless Control of PMSM with a Low-frequency Signal Injection," *Proceedings of the 2014 International Power Electronics Conference*, pp.3079-3084, 2014.

[6] B. Alecsa, M. N. Cirstea, and A. Onea, "Simulink Modeling and Design of an Efficient Hardware-Constrained FPGA-Based PMSM Speed Controller," *IEEE Trans. on Indus. Inform.*, vol. 8, no. 3, pp. 554~562, Aug., 2012.

[7] Y.S. Kung, Nguyen Vu Quynh, C.C. Huang, L.C. Huang, "Simulink/ModelSim co-simulation of sensorless PMSM speed controller, " *Proceedings of the 2011 IEEE Symposium on Industrial Electronics and Applications (ISIEA 2011)*, pp. 24-29, 2011.

[8] The Mathworks, Matlab/Simulink Users Guide, *Application Program Interface Guide*, 2004.

[9] Modeltech, ModelSim Reference Manual, 2004.

ACEAT-519

Influence of Dimensionless Tube Spacing, Fin Density and Reynolds Number on Heat Transfer Rate For In-Line Configuration

Md Mustafizur Rahman | *Universiti Malaysia Pahang*

Tahseen A. Tahseen | *Tikrit University*

M. Ishak | *Universiti Malaysia Pahang*

Life Sciences (6)

UGUISU, 6F

13:00-14:30, Friday, November 6

Session Chair: ***Prof. Suat Hian Tan***

LSBE-1749

Acute and Subchronic Toxicity of Anthocyanin in Sweet Purple Potato (Ipomoea Batatas L) Cultivar of Gunung Kawi

Retty Ratnawati | *University of Brawijaya*
Aswaty Nur | *University of Brawijaya*
Ratih Paramita S | *University of Brawijaya*
Ciptati | *Institute Technology of Bandung*
Natasya Silvaira | *University of Brawijaya*
Herman Y | *University of Brawijaya*
Jiaali RS | *University of Brawijaya*
Albert C | *University of Brawijaya*
Leonardo R | *University of Brawijaya*
Chintya Y | *University of Brawijaya*
Elvira I | *University of Brawijaya*
Edrik S | *University of Brawijaya*
Raymond P.H | *University of Brawijaya*
Desty | *University of Brawijaya*
Indah | *University of Brawijaya*
Tya | *University of Brawijaya*

LSBE-1751

Isolation and in Vitro Screening of Beneficial Endophyte Bacteria against Fusarium Wilt in Banana (Musa Acuminata AAA Group cv. Pisang Ambon Kuning)

Listya Utami Karmawan | *Bandung Institute of Technology*
I Nyoman Pugeg Aryantha | *Bandung Institute of Technology*
Fenny Martha Dwivany | *Bandung Institute of Technology*

LSBE-1838

Squid (Loligo sp.) Ink Extract as Auto Inducer Inhibitor of Vibrio Harveyi, in Vitro

Mohamad Fadjar | *University of Brawijaya*
Kartini Zaelani | *University of Brawijaya*
Abdul Rahim Faqih | *University of Brawijaya*

LSBE-1748

Plant Stress Response Towards Different Light Spectrum

Suat Hian Tan | *Universiti Malaysia Pahang*
Willy Xiu Fa Wong | *Universiti Malaysia Pahang*

LSBE-1737

Study on the Prevalence of Metallo Beta-Lactamase among Multidrug Resistant Pseudomonas Aeruginosa

Wariya Yamprayoonswat | *Mahidol University*
Mullika Traidej Chomnawang | *Mahidol University*
Piyatip Khuntayaporn | *Mahidol University*

Computer Engineering and Technology

HIBARI, 6F

13:00-14:30, Friday, November 6

Session Chair: ***Prof. Suoyto Suyoto***

ACEAT-315

The Influence of Self Adaptive Exploration and Exploitation Archetypes on Clustering

Phichete Julrode | Phuket Rajabhat University

ACEAT-439

Aggressive Handover Decision in Dense Urban 3GPP Cellular Networks by Prediction of Mobility Markov Chain

Chao-Lei Pan | *National Chung Cheng University*
Jen-Yi Pan | *National Chung Cheng University*
Ko-Wei Chang | *National Chung Cheng University*

ACEAT-502

A Study of Fuzzy Rule-Based Hand Gesture Recognition Approach Using Depth Image

Hung-Chi Chu | *Chaoyang University of Technology*
Yen-Chi Chen | *Chaoyang University of Technology*
Jiun-Jian Liaw | *Chaoyang University of Technology*

ACEAT-506

Identify Encrypted P2P Traffic Using Edge

Chuan-Mu Tseng | *Feng Chia University*
Yu-Si Yang | *Feng Chia University*
Tzong-Jye Liu | *Feng Chia University*

ACEAT-516

Mobile Application Design for 3D Modeling Indonesia Ring Jewelry Ornament with Multimedia Interactive

Suyoto Suyoto | *University of Atma Jaya Yogyakarta*
Thomas Suselo | *University of Atma Jaya Yogyakarta*
B. Yudi Dwiandiyanta | *University of Atma Jaya Yogyakarta*

ACEAT-659

Determine the Best Location of Disaster Emergency Response Command Post Using Hill Climbing and Ant Colony Algorithms

Albertus Joko Santoso | *University of Atma Jaya Yogyakarta*
Findra Kartika Sari Dewi | *University of Atma Jaya Yogyakarta*
Thomas Adi Purnomo Sidhi | *University of Atma Jaya Yogyakarta*

Environmental Engineering / Food, Agriculture and Veterinary Sciences

UGUISU, 6F

14:45-16:15, Friday, November 6

Session Chair: ***Prof. Shyi-Tien Chen***

ACEAT-330

Comparison between Open-Path and Point Air Quality Monitoring: the Case of Ozone Monitoring by a DOAS Instrument

Amin Nawahda | *Sohar University*

ACEAT-462

Contribution of Active Species in Combustion Process to the Reduction of Diesel NOx Emission

Keiichiro Yoshida | *Osaka Institute of Technology*

ACEAT-669

Treatment of Municipal Wastewater by H_2O_2/UV Oxidation Combined with RO Separation

Hsing Yuan Yen | *Kao Yuan University*

Shan Yu Chang | *Kao Yuan University*

ACEAT-681

Adsorption of Dyes Using Adsorbents Made from Three Recycled Materials

Shyi-Tien Chen | *National Kaohsiung First University of Science and Technology*

Yi-Li Lin | *National Kaohsiung First University of Science and Technology*

ICFA-1060

Effect of Nitrogen and Phosphorus on Soluble Polysaccharide Accumulation in Marine Green Macroalgae (Ulva Rigida)

Pakawan Setthamongkol | *Kasetsart University*

Suriyan Tunkijjanukij | *Kasetsart University*

Jintana Salaenoi | *Kasetsart University*

Aeronautics & Aerospace Engineering / Chemical Engineering

HIBARI, 6F

14:45-16:15, Friday, November 6

Session Chair: ***Prof. Yanhua Wu***

ACEAT-517

A Study on the Advanced Risk Assessment of Runway Safety Areas with Enhanced Algorithm

Jehyung Jeon | *Korea Aerospace University*
Jehwan Song | *Korea Aerospace University*
Hyunsoo Kim | *Korea Aerospace University*
Byungheum Song | *Korea Aerospace University*

ACEAT-518

Dynamic Performance of Flexible Tandem Wings in Counterstroking Flight

Yingying Zheng | *Nanyang Technological University*
Yanhua Wu | *Nanyang Technological University*

ACEAT-513

Innovative Approach for the Development of Upgrading Process at GTL Complex

Jiwon Seo | *Inha University*
Sungwon Hwang | *Inha University*
Dong Ju Moon | Korea Institute of Science and Technology

ACEAT-514

Modeling and Optimization of Multi-tubular Mixed Reforming Reaction System in GTL Process

Ji Woon Hahm | *Inha University*
Young Gi Hong | *Inha University*
Dong Ju Moon | Korea Institute of Science and Technology
Sung Won Hwang | *Inha University*

ACEAT-574

Removal of Acid Dyes from Solution Using Coconut Shell Charcoal

Siriwan Srisorrachatr | *Srinakharinwirot University*

ACEAT-718

Effect of Pressurized Hot Water Extraction on the Antioxidant Activity of Extract

Siti Machmudah | *Sepuluh Nopember Institute of Technology*
Sugeng Winardi | *Sepuluh Nopember Institute of Technology*
W Wahyudiono | *Nagoya University*
Hideki Kanda | *Nagoya University*
Motonobu Goto | *Nagoya University*
W Widiyastuti | *Sepuluh Nopember Institute of Technology*

Poster Session (1)

Life Sciences (1) / Biological Engineering / Environmental Engineering / Food, Agriculture and Veterinary Sciences / Mechanical Engineering and Technology

HIBARI, 6F

11:30-12:30, Thursday, November 5

LSBE-1713

The Study of Pitavastatin Induce the Pancreatic Cancer Cell Apoptosis and Molecule Mechanism

Meng-Xian Lin｜*National Chung Hsing University*
Chi-Chen Lin｜*National Chung Hsing University*

LSBE-1720

Bioethanol Production from Mushroom Cultivation Waste Material Using Cellulosic Enzyme by Local Penicillium Oxalicum HS1-3

Kaewkanlaya Sotthisawad｜*Sakon Nakhon Rajabhat University*
Polson Mahakhan｜*Khon Kaen University*
Kanit Vichitphan｜*Khon Kaen University*
Sukanda Vichitphan｜*Khon Kaen University*
Jutaporn Sawaengkaew｜*Khon Kaen University*

LSBE-1717

Optimization of Cellulase Production from Aspergillus Tubingensis HS1-5 under Solid State Fermentation on Vetiveria Zizanioides

Jutaporn Sawaengkaew｜*Khon Kaen University*
Polson Mahakhan｜*Khon Kaen University*
Panida Janthasee｜*Khon Kaen University*
Kanit Vichitphan｜*Khon Kaen University*
Sukanda Vichitphan｜*Khon Kaen University*

LSBE-1758

Structural Connectome of the Fruit Flies

Chi-Tin Shih | *Tunghai University*

LSBE-1733

Dietary Effect of Cordyceps Militaris Ethanolic Extract on Lysozyme Gene Expression in Pacific White Shrimp, Penaeus Vannamei

Dharaneedharan Subramanian | *Jeju National University*
Dong-Hwi Kim | *Jeju National University*
So-Hyun Park | *Jeju National University*
Kyung-Mi Moon | *Jeju National University*
Ha-Ri Choi | *Jeju National University*
Min-Sok Gang | *Jeju National University*
Moon-Soo Heo | *Jeju National University*

LSBE-1664

Rhodomyrtone Suppresses Metastasis in Human Squamous Cell Carcinoma

Sirinun Nilwarangkoon | *Srinakharinwirot University*
Ramida Watanapokasin | *Srinakharinwirot University*
Wilawan Mahabusrakum | *Prince of Songkla University*
Malatee Tayeh | *Srinakharinwirot University*

LSBE-1665

Goniothalamin Induces Apoptosis in Human Breast Cancer Cells through Akt Pathways

Ramida Watanapokasin | *Srinakharinwirot University*
Sukanda Innajak | *Srinakharinwirot University*
Wilawan Mahabusrakum | *Prince of Songkla University*

LSBE-1639

Function of Chromokinesin KIF4A in Interphase

Zi Jia Khong | *Nanyang Technological University*
Yeung Li Hoi | *Nanyang Technological University*

LSBE-1724

Tangeretin Derivative, 5-Acetyloxy-6,7,8,4′-Tetramethoxyflavone Induces G2/M arrest, Apoptosis and Autophagy in Human Non-Small Lung CancerCells in Vitro and in Vivo

Yi Rong Li｜*National Chung Hsing University*
Shiming Li｜*Huanggang Normal University*
Chi-Tang, Ho｜*Rutgers University*
Chi Chen, Lin｜*National Chung Hsing University*

LSBE-1725

Naringenin Inhibits Dendritic Cell Maturation and Has Therapeutic Effects in Murine Model of Imiquimod -Induced Psoriasis

Ya Hsuan Chao｜*National Chung Hsing University*
Fan-Yu Yangb｜*National Chung Hsing University*
Chi-Chen Lina｜*National Chung Hsing University*

ACEAT-501

Segmentation of Polypoidal Choroidal Vasculopathy Using Random Walk

Ming-Yu Tsou｜*National Chung Cheng University*
Chao-Liang Lu｜*National Chung Cheng University*
Wei-Yang Lin｜*National Chung Cheng University*
Chia-Ling Tsai｜*Iona College*
Shih-Jen Chen｜*Taipei Veterans General Hospital*

ACEAT-671

The Physiological Signal Integrated ECG and PPG for Health Data Analysis

Priharta Ari｜*National Kaohsiung University of Applied Sciences*
Guo-Sheng Liao｜*National Kaohsiung University of Applied Sciences*
Gwo-Jia Jong｜*National Kaohsiung University of Applied Sciences*
Ya-Chuan Hung｜*National Kaohsiung University of Applied Sciences*
Cheng-Che Lee｜*National Kaohsiung University of Applied Sciences*
Feng-Wei Chang｜*National Kaohsiung University of Applied Sciences*

LSBE-1704

Development of a 3D Printable and CT Visible Ferromagnetic Magnetite-Based Polylactide Composite Bone Screw

Haw-Ming Huang｜*Taipei Medical University*
Jy-Jiunn Tzeng｜*Taipei Medical University*
Ya-Hui Chan｜*Taipei Medical University*

LSBE-1744

Effects of Citrus Peel on the LPS-induced inflammatory responses in a Zebrafish Model

Eui Jeong Han | *Chonnam National University*
Soo Yeon Park | *Chonnam National University*
Ju Hyung Um | *Chonnam National University*
Eun Ji Shin | *Chonnam National University*
Ginnae Ahn | *Chonnam National University*

LSBE-1807

Highly Transparent, Liquid Absorbing Film for Ophthalmic Application

Yu Bing Liou | *Industrial Technology Research Institute*
Ying Wen Shen | *Industrial Technology Research Institute*
Hsin Yi Hsu | *Industrial Technology Research Institute*
Chin Tsun Huang | *Industrial Technology Research Institute*
Hsin Hsin Shen | *Industrial Technology Research Institute*
Hsin Ying Wang | *Industrial Technology Research Institute*

LSBE-1796

The Multi-Scale Modelling of iFR (Instant Flow Reserve) and FFR (Fractional Flow Reserve)

Kyung Eun Lee | *Kangwon National University*
Eui Cheol Jung | *Kangwon National University*
Eun-Seok Shin | *University of Ulsan College of Medicine*
Eun Bo Shim | *Kangwon National University*

LSBE-1795

The Effects of Helical Inflow on Fractional Flow Reserve in a Virtual Stenotic Arterial Geometry

Kyung Eun Lee | *Kangwon National University*
Gook Tae Kim | *Kangwon National University*
Eun Bo Shim | *Kangwon National University*

LSBE-1797

Computational Assessment of the Effect of Coronary Stenotic Geometric Factors on Pulsatile Flow in a Bifurcation

Kyung Eun Lee | *Kangwon National University*
Sung Woong Shin | *Kangwon National University*
Eun Bo Shim | *Kangwon National University*

ACEAT-503

Traceable Calibration of Condensation Particle Counters for Single Particle Detection per Cubic Centimeter

Yen-Liang Lin｜*Industrial Technology Research Institute*
Guo-Dung Chen｜*Industrial Technology Research Institute*
Hsin-Chia Ho｜*Industrial Technology Research Institute*

ACEAT-678

Effect of Composite Fouling on the Removal of Pharmaceuticals and Personal Care Products by Nanofiltration

Yi-Li Lin｜*National Kaohsiung First University of Science and Technology*
Wei-Ping Huang｜*National Kaohsiung First University of Science and Technology*

ICFA-1075

Comparison Study of Particle Size for Nanomaterial in Cosmetic and Food by Several Measurement Techniques

Guo Dung Chen｜*Industrial Technology Research Institute*
Han Fu Weng｜*Industrial Technology Research Institute*
Yun San Chien｜*Industrial Technology Research Institute*

ACEAT-696

Residual Powder Removing System for SLS 3D Printing Platform

S.J. Chang｜*National Yunlin University of Science*
H. J. Zhao｜*National Yunlin University of Science*

Poster Session (3)

Chemical Engineering / Electrical and Electronic Engineering / Engineering Sciences / Information Engineering and Technology / Materials Science and Engineering / Nanotechnology /

HIBARI, 6F

14:30-15:30, Thursday, November 5

ACEAT-471

Preparation of Carbon Coated Si/MnO2 Nanoneedle Ternary Composites as Supercapacitor Electrode

Ilgeun Oh | *Chung-Ang University*
Myeongjin Kim | *Chung-Ang University*
Kiho Kim | *Chung-Ang University*
Hyun Ju | *Chung-Ang University*
Kisang Ahn | *Chung-Ang University*
Joohoen Kim | *Chung-Ang University*

ACEAT-662

A Single-Balanced Down-Conversion Mixer Fabricate in GaN-on-Si HEMT Technology

Hsuan-Ling Kao | *Chang Gung University*
Cheng-Lin Cho | *National Tsing Hua University*
Li-Chun Chang | *Ming Chi University of Technology*
Bo-Wen Wang | *Chang Gung University*

ICFA-1055

Fabrication and Investigation of the Bionic Compound Eyes Visual System

Hsuan-Yu Lin | *National Formosa University*
Jyun-Jheng Hsu | *National Formosa University*
Hsin Her Yu | *National Formosa University*

ICFA-1068

Fabrication and Characterization of a Low Reflectance Nanostructure Film by Soft-Lithography

Chi-Chung Peng｜*Ming Chi University of Technology*
Hsin Her Yu｜*Ming Chi University of Technology*
Yuan-Chang Yang｜*Ming Chi University of Technology*
Jyun-Jheng Hsu｜*Ming Chi University of Technology*

ACEAT-667

Implementation of Ambulance Alert Sound Recognition in Taiwan Using Android Device

Ho-Shyuan Tang｜*Chaoyang University of Technology*
Jiun-Jian Liaw｜*Chaoyang University of Technology*
Hung-Chi Chu｜*Chaoyang University of Technology*

ACEAT-441

Cross-Linked, Monodisperse, Micro-Sized Poly(Methyl Methacrylate) Particles by Seed Swelling Polymerization

Yi-Chun Chen｜Industrial Technology Research Institute
Yu-Chen Kao｜Industrial Technology Research Institute
Yen-Ding Chen｜Industrial Technology Research Institute

ICFA-1079

Optimization on Spontaneous Hall Effect in Amorphous CoSiB/Pt/CoSiB Sandwich Structure

Young Kwang Kim｜*Sejong University*
Sung Yong Kim｜*Sejong University*
Hana Lee｜*Sejong University*
Hwa Yong Noh｜*Sejong University*
Jong Hwa Eom｜*Sejong University*
Tae Wan Kim｜*Sejong University*

ICFA-1080

The Phase Transformation of FePt Films by Using E-Beam

Kim Sung Yong | *Sejong University*
Lee Hana | *Sejong University*
Kim Young Kwang | *Sejong University*
Noh Hwa Yong | *Sejong University*
Eom Jong Hwa | *Sejong University*

ICFA-1054

Two-Dimensional Hexagonal Atomic Layers as Raman Scattering Enhancers Triggered by Pressure and Charge Transfer

Hyunmin Kim | *Daegu Gyeongbuk Institute of Science and Technology*
Youngbin Lee | *Sungkyunkwan University*
Soon Moon Jeong | *Daegu Gyeongbuk Institute of Science and Technology*
Jeong-Ho Cho | *Sungkyunkwan University*
Jong-Hyun Ahn | *Yonsei University*

Poster Session (4)

Life Sciences (2)

HIBARI, 6F

16:00-17:00, Thursday, November 5

LSBE-1752

Transcriptome Analysis of in Vitro Psoriatic Model Treated with Quercetin and Dithranol by RNA-Seq

Chalinee Ronpirin | *Thammasat University*
Tewin Tencomnao | *Chulalongkorn University*

LSBE-1685

Emulsion from Natural Products Improved Skin Lesion from Fungal Infection in Dogs

Suvara K Wattanapitayakul | *Srinakharinwirot University*
Linda Chularojmontri | *Thammasat University*
Lalana Kongkaneramit | *Srinakharinwirot University*
Orapin Gerdprasert | *Srinakharinwirot University*
Malai Taweechotipatr | *Srinakharinwirot University*

LSBE-1742

A Glycine-Rich Protein of Sea Hare Eggs Has Anti-Cancer Activity Against u937 Cells, A Leukemia Cell Line

WonWoo Lee | *Jeju National University*
Ginnae Ahn | *Chonnam National University*
Won-Suck Kim | *Silla University*
Kil-Nam Kim | *Korea Basic Science Institute*
Eun-A Kim | *Jeju National University*
Nalae Kang | *Jeju National University*
Jae Young Oh | *Jeju National University*
You-Jin Jeon | *Jeju National University*

LSBE-1745

Dieckol Isolated from Ecklonia Cava Inhibits Inflammation Responses in in Vivo Models

Ju Hyung Um | *Chonnam National University*
Eui Jeong Han | *Chonnam National University*
Soo Yeon Park | *Chonnam National University*
Won Woo Lee | *Jeju National University*
Ginnae Ahn | *Chonnam National University*

LSBE-1683

Unusual Branches of Coeliac Trunk and Superior Mesenteric Artery – A Case Report

Surekha Devadasa Shetty | *Manipal University*
Satheesha Nayak B | *Manipal University*
S.N Somayaji | *Manipal University*
Mohandas Rao K.G | *Manipal University*

LSBE-1682

Multiple Arterial Variation of Palm: A Case Report

Jyothsna Patil | *Manipal University*
Naveen Kumar | *Manipal University*
Swamy Ravindra S | *Manipal University*
Mohandas Rao KG | *Manipal University*

LSBE-1788

Peptides Derived from Scales of Branchiostegus Japonicus Attenuate Ultraviolet B-Induced Oxidative Damage and Photo-Aging in Skin Cells

Minchang Oh | *Jeju National University*
Mei Jing Piao | *Jeju National University*
Kyung Ah Kang | *Jeju National University*
Susara Ruwan Kumara Madduma Hewage | *Jeju National University*
Xia Han | *Jeju National University*
Madushan Dilhara Jayatissa Pattage Fernando | *Jeju National University*
Jin Won Hyun | *Jeju National University*

LSBE-1791

3,5,7-Trihydroxyflavone Defenses Human Keratinocytes Against Ultraviolet B Induced Oxidative Stress

Susara Ruwan Kumara Madduma Hewage｜*Jeju National University*
Kyoung Ah Kang｜*Jeju National University*
Mei Jing Piao｜*Jeju National University*
Min Chang Oh｜*Jeju National University*
Xia Han｜*Jeju National University*
Madushan Dilhara Jayatissa Pattage Fernando ｜*Jeju National University*
Jin Won Hyun｜*Jeju National University*

LSBE-1800

Involvement of 1,3,5-Trihydroxybenzene Stimulates AMPK and JNK Signaling Pathway in Prevention Ultraviolet B Radiation-Induced NOX4/ROS

Mei Jing Piao｜*Jeju National University*
Kyoung Ah Kang｜*Jeju National University*
Susara Ruwan Kumara Madduma Hewage｜*Jeju National University*
Min Chang Oh｜*Jeju National University*
Xia Han｜*Jeju National University*
Madushan Dilhara Jayatissa Pattage Fernando｜*Jeju National University*
Jin Won Hyun｜*Jeju National University*

LSBE-1801

The Antioxidant Activity of Americanin B, A Novel Lignan Compound, Enhancement of Heme Oxygenease Expression Mediated by Nrf2 via Erk and PI3K/Akt Pathway

Jian Zheng｜*Jeju National University*
Mei Jing Piao｜*Jeju National University*
Kyoung Ah Kang｜*Jeju National University*
Susara Ruwan Kumara Madduma Hewage｜*Jeju National University*
Min Chang Oh｜*Jeju National University*
Xia Han｜*Jeju National University*
Madushan Dilhara Jayathissa Pattage Fernando｜*Jeju National University*
Jin Won Hyun｜*Jeju National University*

LSBE-1781

Pixel Circuit Employing Simple Operation for High-Resolution AMOLED Displays

Yen-Ting Liu | *National Cheng Kung University*
Ching-En Lee | *National Cheng Kung University*
Chun-Ming Lu | *National Cheng Kung University*
Chih-Lung Lin | *National Cheng Kung University*

LSBE-1782

AQP1 is Involved in Acid Secretion by Ionocyte of Zebrafish

Jiun-Lin Horng | *Taipei Medical University*
Pei-Lin Chao | *National Taiwan Normal University*
Po-Yen Chen | *National Taiwan Normal University*
Tin-Han Shih | *National Taiwan Normal University*
Li-Yih Lin | *National Taiwan Normal University*

LSBE-1799

Standing Stability System Based on Kinect Multimedia for Old People

W-M Hsieh | *National Taipei University of Education*
C-C Chen | *Hwa Hsia University of Technology*
S-Y Tan | *National Taipei University of Education*
Y-S Hwang | *National Taipei University of Education*
S-C Chen | *Taipei Medical University*
Y-L Chen | *National Taipei University of Education*

LSBE-1810

Primer/Probe Optimization of RT q-PCR for Identification of Double-Stranded (ds) RNA in Rhizoctonia Solani

Mary S. Chey | *Indiana University of Pennsylvania*
Ashlee M. Long | *Indiana University of Pennsylvania*
Seema Bharathan | *Indiana University of Pennsylvania*
Narayanaswamy Bharathan | *Indiana University of Pennsylvania*

LSBE-1812

PCR Cloning and Sequence Analysis of Double-stranded (ds) RNA from a Mycovirus in the Fungus Rhizoctonia solani

Tanvi Shree Bharathan | *1MS Ramaiah Medical College*
Mary Chey | *Indiana University of Pennsylvania*
Seema Bharathan | *Indiana University of Pennsylvania*
Bharathan Narayanaswamy | *Indiana University of Pennsylvania*

ACEAT-577
The Estimation of Rotor Position and Speed for a Sensorless PMSM Drive Using High Frequency Signal Injection

Ying-Shieh Kung[a*], Risfendra[a], Yi-De Lin[a] and Liang-Chiao Huang[b]

[a] Department of Electrical Engineering,

Southern Taiwan University of Science and Technology, Tainan, Taiwan

[b] Green Energy and Environment Research Laboratories,

Industrial Technology Research Institute, Hsinchu, Taiwan

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Abstract

Based on the high frequency signal injection (HFSI), the estimation of the rotor position and speed for a sensorless permanent magnet synchronous motor (PMSM) is presented in this work. Firstly, the mathematical model for PMSM is derived. Secondly, HFSI is described which a high frequency sinusoidal voltage is injected into the estimated d-axis, and the high frequency current response in q-axis is acquired to further estimate the rotor position and rotor speed through a signal modulation process. Finally, to evaluate the effectiveness and correctness of the proposed rotor position estimation system, a co-simulation by using ModelSim and Simulink is applied. The PMSM, inverter, HFSI and speed command are performed in Simulink and the space vector pulse width modulation (SVPWM) and coordinate transformation described by a hardware description language (HDL) is executed in ModelSim. Some simulation cases are also demonstrated.

Keyword: High frequency signal injection (HFSI), Sensorless PMSM drive, Rotor position estimation, ModelSim/Simulink co-simulation.

1. Introduction

The conventional PMSM control needs a speed sensor or an optical encoder to measure the rotor speed and feedback it to the controller for ensuring the precision speed control. Such sensor presents some disadvantages such as drive cost, machine size, reliability and noise immunity. In recent year, a sensorless control without position and speed sensors for PMSM drive become a popular research topic in literature [1-5]. In those researches, there are two approaches which one is model-based approach and another is nonmodel-based approach. In the former, there are back electromotive force (Back EMF), sliding mode observer (SMO) [2], extended Kalman filter (EKF) [3], etc. In the latter, the well-known method is the high frequency signal injection (HFSI) [4]. The HFSI is suitable for the interior PMSM

which belongs to the salient pole machine or suitable for the surface PMSM when the saturation saliency phenomenon is occurred [4]. Compare with the model-based approach, the HFSI is insensitive to the PMSM parameter, and it can estimate the rotor position of PMSM very well at low speed and standstill condition.

Recently, a co-simulation work by electronic design automation (EDA) Simulator Link has been gradually applied to verify the effectiveness of HDL code in the motor drive system [6-7]. The EDA Simulator Link provides a co-simulation interface between Simulink [8] and HDL simulators-ModelSim [9]. Therefore, EDA Simulator Link lets you use MATLAB code and Simulink models as a test bench that generates stimulus for an HDL simulation and analyzes the simulation's response. In this paper, a co-simulation by EDA Simulator Link is applied to the estimation of the rotor position and speed for a sensorless PMSM drive. The PMSM, inverter, HFSI and speed command are performed in Simulink and the SVPWM and coordinate transformation described by VHDL code is executed in ModelSim. Some simulations will validate the effectiveness of the estimation of the rotor position and rotor speed for a sensorless PMSM drive using HFSI.

2. The HFSI-based estimator in PMSM drives

The estimator architecture of PMSM drive based on HFSI [4] is shown in Fig.1. It includes a PMSM, an inverter, a V/F controller and a HFSI-based estimator. The simulation environment is constructed by using ModelSim and Simulink, and its estimation algorithm is described as follows.

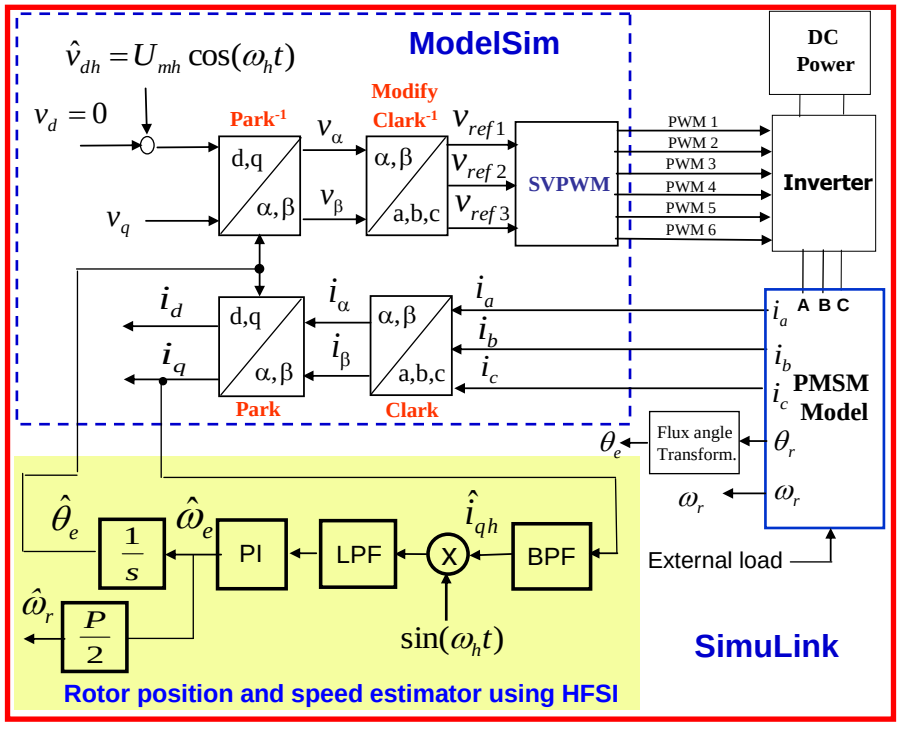


Fig. 1 The estimator architecture of PMSM using HFSI

The mathematical modeling of PMSM in d-q synchronous rotating axis can be expressed as follows.

$$v_d = r_s i_d + L_d \frac{di_d}{dt} - \omega_e L_q i_q \tag{1}$$

$$v_q = r_s i_q + L_q \frac{di_q}{dt} - \omega_e L_d i_d + \omega_e \lambda_f \tag{2}$$

where v_d , v_q are the d-axis and q-axis voltages; i_d , i_q are the d-axis and q-axis currents; L_d , L_q are the d-axis and q-axis inductances; r_s is a stator resistor; λ_f is the magnetic field linkage; ω_e is the electrical rotating frequency.

When PMSM operates in the low speed or near standstill condition, the ω_e approaches to zero; therefore, the cross coupling item and back EMF can be ignored. In addition, when a high frequency signal (ω_h) with $\omega_h L_q >> r_s$ is injected, the (1)-(2) can be further reduced as

$$v_d = L_d \frac{di_d}{dt} \tag{3}$$

$$v_q = L_q \frac{di_q}{dt} \tag{4}$$

Before applying the HFSI, three reference frames are defined and shown in Fig. 2. The α-β axis is the stator reference coordinate; d-q axis is the actual rotating synchronous reference coordinate; $\hat{d}$-$\hat{q}$ is the estimated rotating synchronous reference coordinate. The angle between d-q axis and α-β axis is θ_e, and between $\hat{d}$-$\hat{q}$ axis and α-β axis is $\hat{\theta}_e$. Further, the estimated error is defined as

$$\Delta\theta_e = \theta_e - \hat{\theta}_e \tag{5}$$

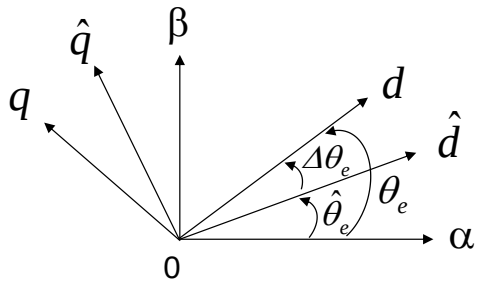


Fig. 2 The relationship among three reference frames [4]

If a high frequency voltage is injected to $\hat{d}$ axis, the high frequency voltage equation in $\hat{d}$ - $\hat{q}$ axis is presented as follows

$$\hat{v}_{dh} = U_{mh}\cos(\omega_h t) \quad (6) \quad \hat{v}_{qh} = 0 \quad (7)$$

where $\hat{u}_{dh}, \hat{u}_{qh}$ are high frequency voltages in $\hat{d}$ - $\hat{q}$ axis; U_{mh} is the voltage magnitude; ω_h is the high frequency value. If the (6)-(7) are transformed from $\hat{d}$ - $\hat{q}$ axis to d - q axis, the high frequency voltage in d - q axis are respectively derived as follows

$$v_{dh} = U_{mh}\cos(\omega_h t)\cos\Delta\theta_e \quad (8)$$

$$v_{qh} = -U_{mh}\cos(\omega_h t)\sin\Delta\theta_e \quad (9)$$

where u_{dh}, u_{qh} are high frequency voltages in d - q axis. Further, substituting (8)-(9) into (3)-(4) and neglecting the inductance variation, the high frequency current response are

$$i_{dh} = \frac{U_{mh}\sin(\omega_h t)\cos\Delta\theta_e}{\omega_h L_d} \quad (10)$$

$$i_{qh} = -\frac{U_{mh}\sin(\omega_h t)\sin\Delta\theta_e}{\omega_h L_q} \quad (11)$$

where i_{dh}, i_{qh} are high frequency currents response in d - q axis. Continuously proceeding the coordinate transformation, high frequency currents response in $\hat{d}$ - $\hat{q}$ axis can be obtained as follows.

$$\hat{i}_{dh} = \frac{U_{mh}}{2\omega_h L_q L_d}((L_q + L_d) + (L_q - L_d)\cos(2\Delta\theta_e))\sin(\omega_h t) \quad (12)$$

$$\hat{i}_{qh} = \frac{U_{mh}(L_q - L_d)}{2\omega_h L_q L_d}\sin(2\Delta\theta_e)\sin(\omega_h t) \quad (13)$$

where $\hat{i}_{dh}, \hat{i}_{qh}$ are high frequency currents response in $\hat{d}$ - $\hat{q}$ axis, and from (12), it

shows that $\hat{i}_{qh}$ includes $\Delta\theta_e$ information. Therefore, if we can control the $\Delta\theta_e$ to be zero, the rotor position can be estimated. To reach this goal, firstly, let $\hat{i}_{qh}$ multiplies $\sin(\omega_h t)$ function and the formulation is become as follows.

$$\hat{i}_{qh}\sin(\omega_h t)=\frac{U_{mh}(L_q-L_d)}{4\omega_h L_q L_d}\sin(2\Delta\theta_e)[1-2\cos(2\omega_h t)] \tag{14}$$

From (14), it consists of a dc component and a harmonic item. If this output in (14) sends to a low pass filter, as follows,

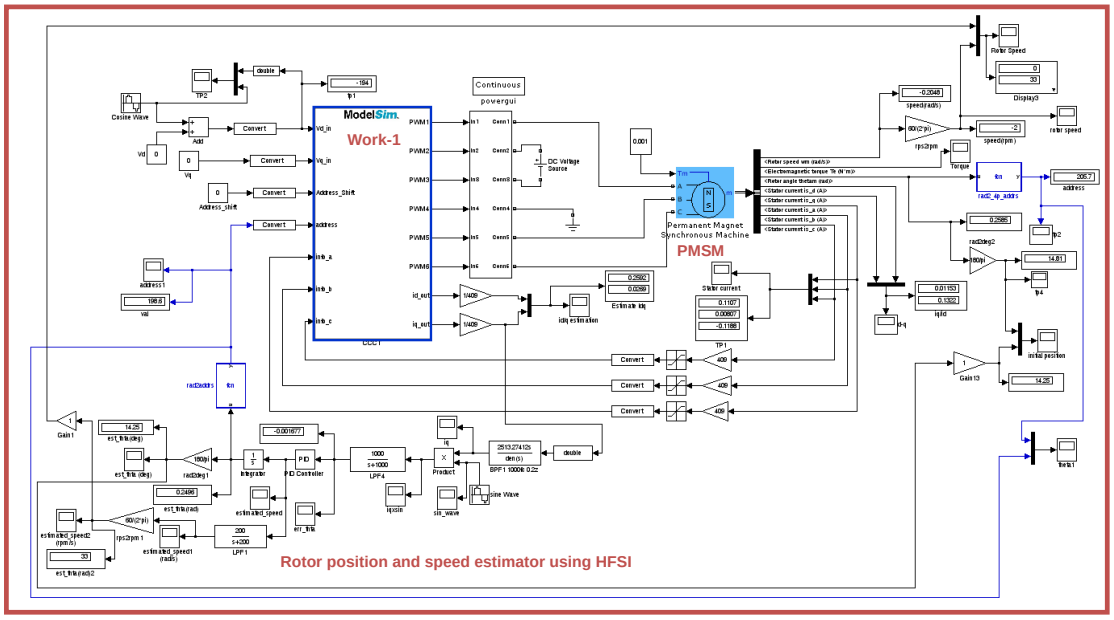
$$f(\Delta\theta)=LPF(\hat{i}_{qh}\sin(\omega_h t))=\frac{U_{mh}(L_q-L_d)}{4\omega_h L_q L_d}\sin(2\Delta\theta_e) \tag{15}$$

the harmonic item will be filtered and only the dc component is left. The *LPF* in (15) represents low pass filter. Further, if we assume that the $\Delta\theta_e$ is small enough in (15), the $\sin(2\Delta\theta_e)\approx 2\Delta\theta_e$. Thus, a PI controller is applied to tune $\Delta\theta_e$ to zero, the initial rotor position θ_e can be estimated. The signal modulation process in HFSI algorithm is shown in Fig. 1.

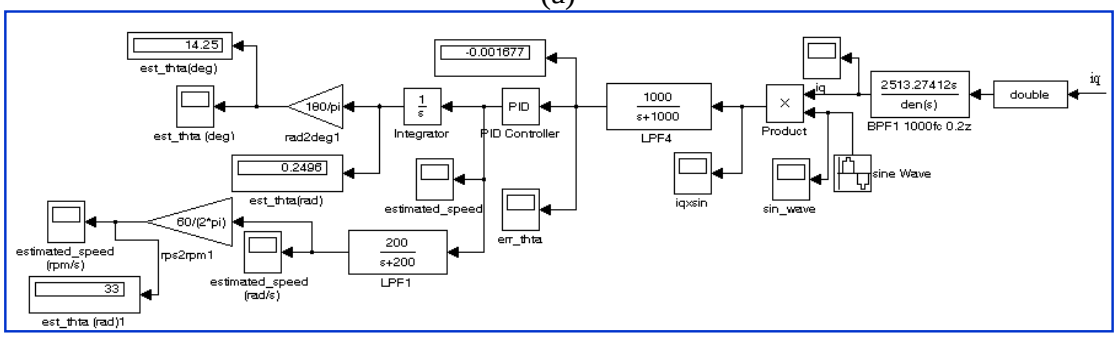
3. Simulation system and results

The estimator architecture of PMSM using HFSI is shown in Fig.1. Firstly, a high frequency voltage (HFV) in d-axis is injected with magnitude by 200 (0.1 unit) and 1kHz frequency cosin function. The HFV, through coordinate transformation, SVPWM, inverter, etc. will further generate a corresponding voltage to supply to PMSM. Secondly, the q-axis current can be acquired after detecting the three phase currents and through by Clark and Park transformation. Thirdly, the q-axis current will be sent to the signal modulation process in HFSI algorithm for the purpose of estimating the rotor position and rotor speed. In the design of the signal modulation process in Fig.1, the q-axis current is detected and sent into a 1kHz band-pass filter; then the output value multiplies with a 1kHz sinusoidal signal. Further, a first order low-pass filter with 160Hz cut-off frequency and a PID controller with Kp=180, Ki=20 and Kd=0 are cascaded with this signal. Via to the aforementioned signal modulation, the rotor speed can be estimated, and rotor position after integral the estimated rotor speed can be obtained.

In the design of the simulation, a combination of the ModelSim and Simulink is applied to co-simulate the HFSI-based rotor position and speed estimation for PMSM drive, and it is shown in Fig. 3. In the Simulink environment, it includes a ModelSim work, a HFSI-based estimator, a PMSM, an IGBT-based inverter, and some input signals and output displays. In ModelSim, it performs the V/F control with coordinate transformation and SVPWM. PMSM model and IGBT model are the components of the Matlab toolbox - SimPowerSystems. The work in Fig. 3(a) is implemented by digital hardware using VHDL. The clocks of 50MHz and 12.5MHz will supply the work in ModelSim. The designed PMSM parameters are that pole pairs is 8, stator phase resistance is 1.3Ω, stator inductance in d-axis is 4.3mH and in q-axis is 6.3mH, inertia is J=0.000108 kg*m^2 and friction factor is F=0.0013 N*m*s. The difference values are set in d-axis inductance and q-axis inductance to create the effect of saturation saliency. In addition, the initial electrical position (or flux angle) is the initial rotor position multiplies the pole pairs of the motor.



(a)



(b)

Fig. 3 ModelSim/Simulink co-simulation architecture for (a) the overall system (b) the only signal modulation process of HFSI

In simulation, the initial rotor position is firstly tested. A high frequency voltage (HFV) in d-axis is injected with magnitude by 200 (0.1 unit) and 1kHz frequency cosin function. Additionally, the voltage in q-axis is set to zero. The initial rotor position is set to 15 degree (the initial flux angle be 120 degree) in PMSM model. Use the same designed parameters of the low-pass filter and PID controller as before, the simulation results are shown in Fig. 4. The initial flux angle tracking response is shown in Fig. 4(a). It presents that the tracking time is about 0.02 s and a little steady state error with 2-3 degrees occurred. Figure 4(b) reveals the estimated rotor speed response. However, it should be zero, but the estimated rotor speed appears maximun 170 rpm before 0.03s. From Fig. 4(a)-4(b), it shows that the steady-state time to acquire the initial rotor position is about 0.03s. In Fig. 4(c)-4(d), it also presents the signal results of $i_q * \sin(\omega t)$ before and after low-pass filter. The results demonstrate that the first order filter with 160Hz cut-off frequency is available. At the same simulation condition but different initial rotor position setting with 5 degree (initial flux angle be 40 degree) and 20 degree (initial flux angle be 160 degree) are also tested. The simulation results at two cases are shown in Fig. 5. In case of the initial flux angle with 40 degree, the tracking time of estimated rotor position to initial rotor position is 0.01s, but in case of initial flux angle with 40 degree, the tracking time needs 0.025s. However, from Figs. 4-5, it demonstrates that the HFSI can accurately estimate the initial rotor position if initial flux angle is less than 180 degree.

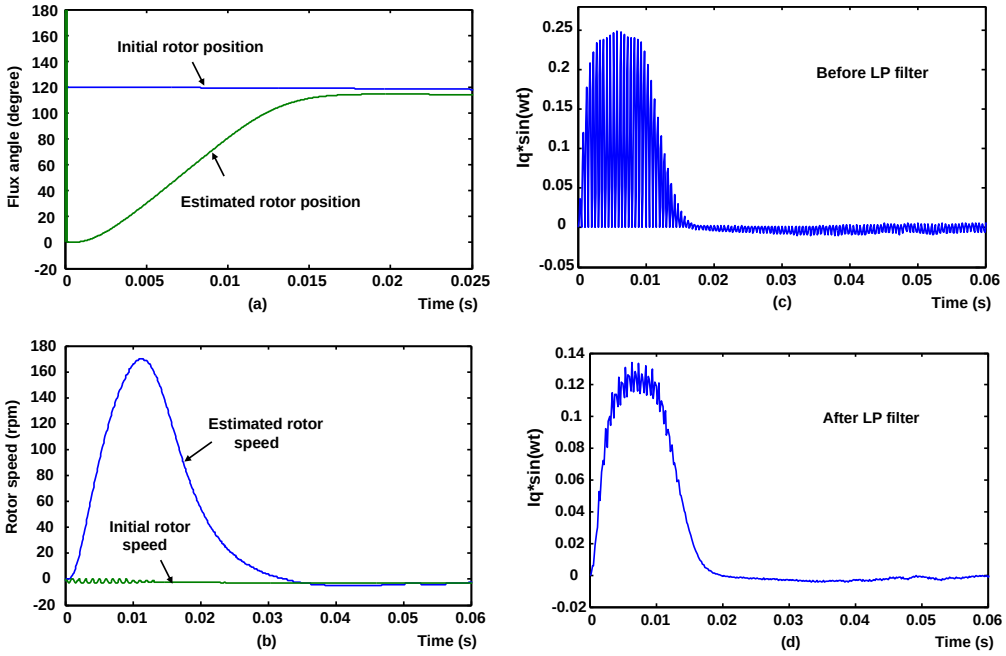


Fig. 4 The simulation results of the initial rotor position estimation (a) the estimated rotor position response (b) the estimated rotor speed response (c) the signal before low-pass filter (d) the signal after low-pass filter

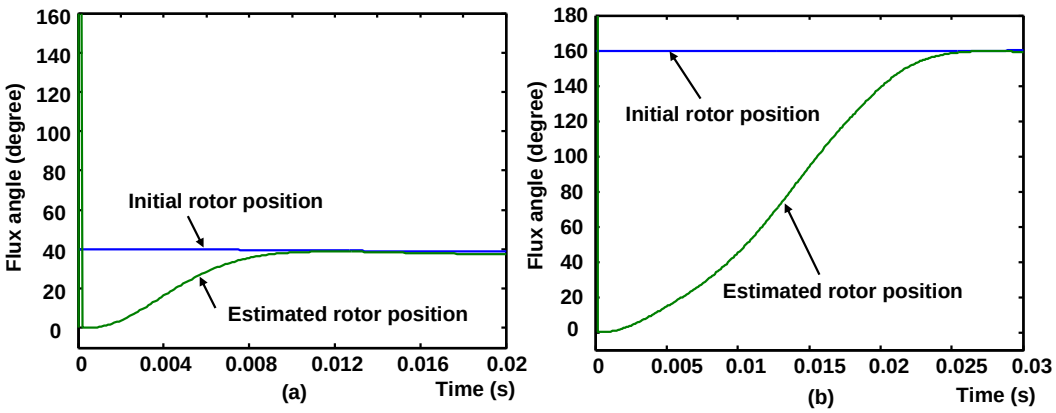


Fig. 5 The simulation results of the initial rotor position estimation under the condition of (a) the initial flux angle is 40 degree and (b) the initial flux angle is 160 degree

After confirming the success of initial rotor position, the estimation of rotor position and rotor speed applying HFSI at low-speed running condition for PMSM drive are tested and simulated. The ModelSim/Simulink co-simulation architecture is shown in Fig. 3 which is a V/F control system. However, the V_d in work-1 is designed with a 1kHz high frequency cosin function with magnitude by 200, but V_q is set to a constant value. To do the test, V_q is designed with two kinds of step command with magnitude which one is 100 (0.05 unit) and another is ± 60 (± 0.03 unit). The initial rotor position is set to 15 degree (Initial flux angle be 120 degree) in PMSM model. The parameters of PMSM model in Fig. 3 is set to the same as before. When V_q command is the first case with magnitude being 100, the simulation result is shown in Fig. 6(a). At the beginning time, the estimated rotor position using HFSI estimator will track the initial rotor position. However, after the time large than 0.025s, the estimated rotor position can follows up the real rotor position, but with 34 degree (flux angle) phase lag. In the rotor speed tracking, although the estimated rotor speed has large tracking error with 170rpm in the beginning time, but it can track the actual rotor speed very well after 0.065s. Finally, the motor runs between 126 rpm and 132rpm condition. When V_q command is belongs to the second case with magnitude being ± 60, the simulation result is shown in Fig. 6(b). The speed transient response and the initial rotor position tracking are very similar with the first case. However, when the V_q command is 60, the estimated rotor speed is run with oscillation and speed values is within 80rpm and

87rpm, but the V_q command is 60, the estimated rotor speed is oscillated within -85rpm and -92rpm. It is also shown that the estimated rotor position can follow up the actual rotor position very well but with 25 degree (flux angle) phase lag. From the Fig. 6, it demonstrates that the rotor position and rotor speed estimation using HFSI can give very good tracking results, although it appears some phase lag phenomenon.

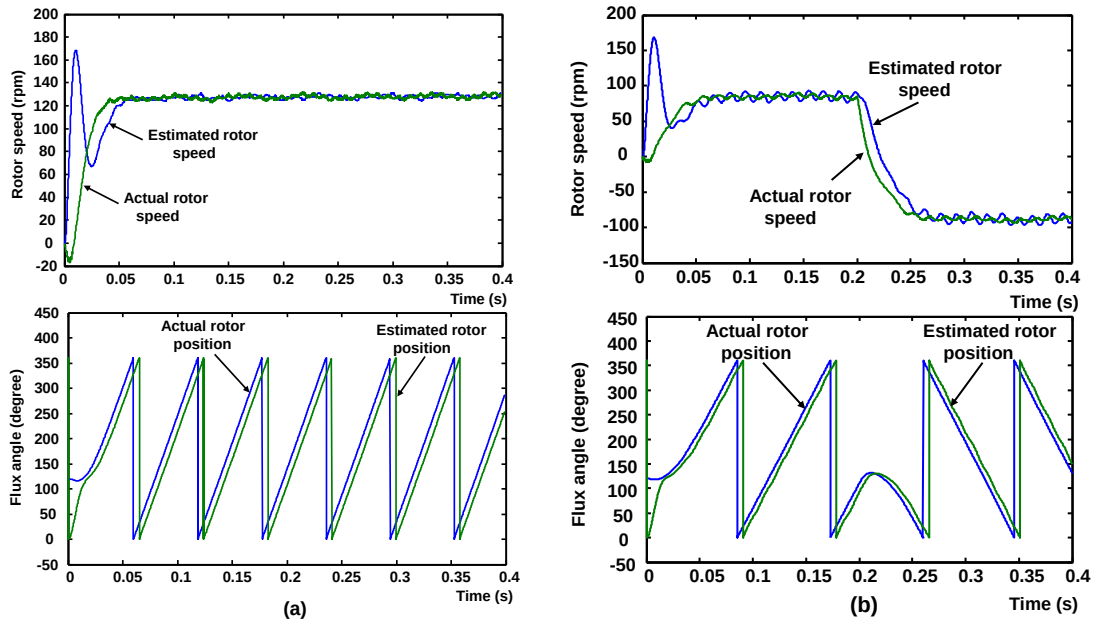


Fig. 6 The simulation results of the rotor position and speed estimation using HFSI under (a) V_q =100 and (b) $V_q = \pm 60$

4. Conclusion

This work has been presented a rotor position and speed estimation for a sensorless PMSM drive based on HFSI and successfully demonstrated through co-simulation by using Simulink and ModelSim. Simulation results show that the initial rotor position can be accurately estimated within about 0.025 second. It also shows that the estimated rotor speed and track actual rotor speed well at the low speed condition. In the future, the hardware implementation of HFSI algorithm can be carried on and verified in FPGA (Field Programmable Gate Array).

Acknowledgement

The financial support provided by Bureau of Energy, Ministry of Economics Affairs of Taiwan is gratefully acknowledged. The authors also gratefully acknowledge the support of Green Energy and Environment Research Laboratories, Industrial Technology Research Institute, Taiwan.

References

[1] P.P. Acarnley and J.F. Watson, "Review of Position-Sensorless Operation of Brushless Permanent-Magnet Machine," *IEEE Trans. on Indus. Electron.*, vol. 53, no. 2, pp. 352~362, Apr. 2006.

[2] H. Kim, J. Son, and J. Lee, "A High-Speed Sliding-Mode Observer for the Sensorless Speed Control of a PMSM," *IEEE Trans. on Indus. Electron.*, vol. 58, no. 9, pp. 4069~4077, Sep. 2011.

[3] S. Bolognani, R. Oboe, and M. Zigliotto, "Sensorless Full-Digital PMSM Drive with EKF Estimation of Speed and Rotor Position," *IEEE Trans. on Indus. Electron.*, vol. 46, no. 1, pp.184~191, Feb. 1999.

[4] B. Liu, B. Zhou, H. Liu, J. Li, L.Wang and Q. Wang, "Research on Initial Rotor Position Estimation for SPMSM," *Proceedings of the 2014 17th International Conference on Electrical Machine and Systems (ICEM),* pp. 768-774, 2014.

[5] T. Nimura, S. Doki and M. Fujitsuna, "Position Sensorless Control of PMSM with a Low-frequency Signal Injection," *Proceedings of the 2014 International Power Electronics Conference*, pp.3079-3084, 2014.

[6] B. Alecsa, M. N. Cirstea, and A. Onea, "Simulink Modeling and Design of an Efficient Hardware-Constrained FPGA-Based PMSM Speed Controller," *IEEE Trans. on Indus. Inform.*, vol. 8, no. 3, pp. 554~562, Aug., 2012.

[7] Y.S. Kung, Nguyen Vu Quynh, C.C. Huang, L.C. Huang, "Simulink/ModelSim co-simulation of sensorless PMSM speed controller, " *Proceedings of the 2011 IEEE Symposium on Industrial Electronics and Applications (ISIEA 2011)*, pp. 24-29, 2011.

[8] The Mathworks, Matlab/Simulink Users Guide, *Application Program Interface Guide*, 2004.

[9] Modeltech, ModelSim Reference Manual, 2004.