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Message from Conference General Chair

LUO Fang Lin
General Chair, Organizing Committee

On behalf of the Organizing Committee of the First IEEE Conference on Industrial Electronics and Applications in 2006 (ICIEA 2006), it gives me great pleasure in welcoming all delegates to ICIEA 2006 and to Singapore.

The First IEEE Conference on Industrial Electronics and Applications (ICIEA 2006) is held from 24th to 26th May 2006, Marina Mandarin Hotel, Singapore. The Conference is organized by IEEE Industrial Electronics (IE) Chapter and co-organized with IEEE Industry Applications/Power Electronics (IA/PEL) Chapter and IEEE Singapore Section, and technically supported by IEEE Industrial Electronics Society (IES). The purpose of the conference is to create a forum for scientists, engineers and practitioners throughout the world to present the latest techniques in Industrial Electronics. Conference scope covers all practical aspects of the theory and methods of electronics, control, systems, instrumentation for industrial applications. In addition to the technical sessions, there will be keynote sessions.

This conference received overwhelming response whereby 600 papers were submitted from 32 countries/regions. After careful and rigorous peer review, 450 papers were accepted. Finally, authors of 309 papers from 28 countries/regions registered to present their papers in the 45 oral sessions and 3 interactive sessions. This conference attracts a great number of world-wide experts and serves as a gathering for them to discuss and share the research and development in Industrial Electronics and Applications. This conference is also a forum offering a good chance for fresh experts and PhD students to demonstrate their novel approaches in wide-interested areas.

I am very glad to mention that the Proceedings of ICIEA 2006 will be included in the IEEE Xplore database and indexed by EI Compendex.

It is indeed our honour to invite three reputable IEEE Fellows as our keynote speakers. They are Professor Bogdan 'Dan' Wilamowski, Professor Joachim Holtz and Professor David J. Hill who are well-known Professors in this subject area and they have contributed a lot in the areas of their interests. We would like to express our sincere appreciation to them for accepting our invitation.

This conference has gained good prestige. Many organisations expressed great interest to organize subsequent ICIEA conferences. I am very pleased to announce that the second IEEE ICIEA-2007 locally organized by HIT (Harbin Institute of Technology) will be held in Harbin, P. R. China and the third IEEE ICIEA-2008 locally organized by SYU (Southern Yangtze University) will be held in Wuxi, P. R. China.

Members of the International Advisory Committee deserve special appreciation as they played a key supportive role in the conference organization. We would like to thank all authors, session chairpersons, reviewers and delegates for their great support and contribution to ICIEA 2006.

The Organizing Committee, colleagues and friends who have been working behind-the-scenes deserve special mention too. Without their unfailing cooperation, hard work and dedication, this event would simply not been possible.

I understand that many delegates are here in Singapore for the first time. I would like to encourage you to explore the beautiful sights of Singapore during your stay. To make this conference an enjoyable and memorable experience, we have arranged a tour to the Night Safari on 24th May 2006 at a highly subsidized rate for registered delegates. The Banquet will be held on 25th May 2006 and we have lined up interesting cultural programmes to entertain you.

Finally, may I wish you an enriching, enjoyable and pleasant stay in Singapore.

ORGANIZERS / ORGANIZING COMMITTEE

Organized by:
IEEE Industrial Electronics (IE) Chapter
IEEE Industry Applications/Power Electronics (IA/PEL) Chapter
IEEE Singapore Section

Technical Sponsor
IEEE Industrial Electronics Society

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(A Division of Centre for Continuing Education)
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60 Nanyang View
Singapore 639673
Tel: +(65) 6790-4723
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URL: http://www.ieee.org/ICIEA2006

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Xu, Longya, Ohio Univ.
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Zhou, Xiao Xin, Chinese Academic Institute

WELCOME TO SINGAPORE

→ Transport
Public transportation, including buses and MRT (Mass Rapid Transport) system provides access for visitors to most areas of the island. There are also taxis which can be hired from taxi stands, hailed by the roadside, or booked by phoning the numbers listed below.

CityCab	6552 2222
Comfort Cablink	6552 1111
TIBS Taxi	6555 8888

A booking fee is usually charged when hired by telephone.

Website: http://lta.gov.sg

→ Changing Money
The service is available at the airport around the clock, at banks and hotels, and most shopping centres have licenced money changers. Visitors are advised not to change money with unlicensed operator. Most banks open from 9.30am to 3.00pm on weekdays and 9.30am to 11.30am on Saturdays.

→ Charge and Credit Cards
Credit cards are widely accepted in Singapore, hotels, retailers, restaurants, travel agents and even some taxis readily accept international credit cards.

→ Drinking Water
Water in Singapore is safe enough to drink from the tap.

→ Electricity
Singapore's voltage is 220 – 240 AC, 50 Hertz. Ask your hotel if you need a transformer to convert it to 110 - 120 AC, 60 Hertz.

→ Medical Facilities
Most hotels have their on-call doctor. In the case of emergency, dial 995 for an ambulance. Pharmaceuticals are available at many outlets including supermarkets, department stores, hotels and shopping centres.

→ Lost Passport / Singapore Immigration Service
If you have lost your passport, you need to make police report, then head to Immigration & Checkpoints Authority to get a temporary visa. Finally, inform your embassy so you can get though customs when you reach home.

Website: http://ica.gov.sg

→ Post Office/ Telecoms
Most hotels provide postal services at the front desk. The Changi Airport Post Office is open from 8am to 9.30pm daily. Basic Postal services are available at the Singapore Post Pte Ltd branches.

International Direct Dialling is available at the Comcentre. IDD calls calls can also be made from the numerous phonecard and credit card phones located at the Singapore Post branches and around the city area. Phonecards are available from most money changers, stationery shops and post offices in $3 to $5 denominations. A 20% levy is normally imposed on IDD calls made from hotels.

Website: http://www.singpost.com.sg

→ Smoking

Smoking in public areas, taxis, lifts, cinemas, theatres, government offices and air-conditioned restaurants and shopping centres is against the law. First offenders may be fined up to a maximum of $1000. The rule of thumb is, if there's an ashtray provided on the premises, you can smoke there.

→ Tipping

Tipping is not a way of life in Singapore. It is prohibited at the airport and discouraged at hotels and restaurants where a service charge of 10% is added to your bill.

→ Useful Phone Numbers

Police	999 (no charge)
Ambulance/ Fire	995 (no charge)
Ambulance (Non- emergeny)	6777 0000
Singapore Tourism Board	800 736 2000
www.stb.com.sg	

Embassies

Embassy of Japan 62358855
16 Nassim Road
Singapore 258390

American Embassy	6476 9100	Embassy of Ireland	6238 7616
Australian High Commission	6836 4100	Embassy of Mexico	6298 2678
Belgium Royal Embassy	6220 7677	Embassy of The Union of Myanmar	6735 0209
Brazil Embassy	6256 6001	Embassy of Sweden	6415 9720
British High Commission	6424 4200	Germany Embassy	6737 1355
Canadian High Commission	6325 3200	Indian High Commission	6737 6777
Chinese Embassy	6734 3273	Malaysian High Commission	6235 0111
Danish Embassy Royal	6355 5010	New Zealand High Commission	6235 9966
Embassy of Chile	6223 8577	Netherlands Embassy Royal	6737 1155
Embassy of Finland	6253 4035	Sri-Lanka High Commission	6254 4595
Embassy of the Republic of France	6880 7800	Switzerland Embassy	6468 5788
Embassy of Greece	6220 8622		

Sightseeing Destinations

Asian Civilisation Museum
39 Armenian Street

Ancestral heritage of the Eastern Civilisations with important Chinese ceramics, imperial porcelain and aspects of Chinese architecture is on display in this museum.

Open: Mondays 12 noon to 6pm, Tuesdays to Sundays: 9am to 6pm Fridays till 9pm.

Chinatown Heritage Centre
46, 48, 50 Pagoda Street

This centre showcases the rich heritage of Chinatown. Beautifully restored, highlights include the living cubicles and tailor shop which recreate the bygone era.

Open Mondays to Sundays 10am to 7pm.

Jurong Bird Park
Jalan Ahmad Irahim
Website: http://www.birdpark.com.sg

There are more than 8,000 Birds and a waterfall aviary in this attraction. Enjoy a scenic panorail ride in this breathtaking park and watch the Birds of Prey Show.

Open 9am to 6pm daily.

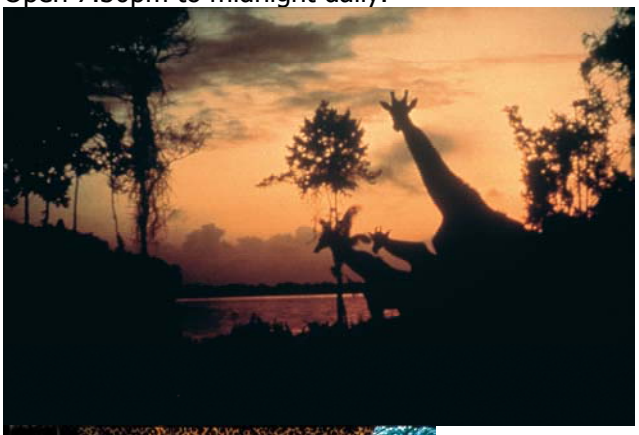
Singapore Zoological Gardens &
Night Safari
Mandai Lake Road
Website: http://www.zoo.com.sg ; http://www.nightsafari.com.sg

The Singapore Zoological Gardens, an open-concept zoo which is home to more than 2,000 creatures, has attracted international acclaim because of its clever use of rock walls and streams as natural barriers.

Open 8.30 to 6pm daily.

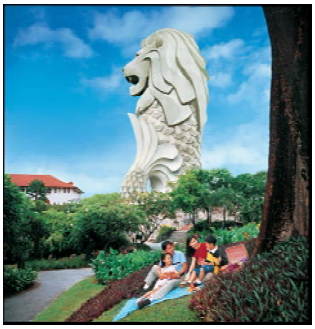
Next to the Zoo is the Night Safari, another world-class attraction, where you can look a single-horned rhinoceros in the eye, prowl through the dark with a pack of striped hyenas and look out for leopards. Strike out on your own along the walking trail or relax in a tram ride - whichever you choose, Night Safari is a wild adventure not to be missed.

Open 7.30pm to midnight daily.



Sentosa Island
Website: http://www.sentosa.com.sg

An island resort, playground for everyone with an assortment of activities – from panoramic rides to nature trails and lots of rich history.



Singpapore Botanic Gardens
Cluny Road

The Gardens epitomises the tropical island's luxuriant parks. Spread over 52 hectares and close to the centre of the city, the Gardens is a combination of untouched primary forest and specialty gardens displaying frangipanis, roses, ferns and desert plants, to name a few. There are numerous plant species here, including many rare specimens, reflect the Gardens' richness and diversity of plant life.

The present orchid enclosure has 20,000 orchid plants on display. The National Orchid Garden promises sprawling orchid displays, water features, and an exotic bromeliad collection from Central and South America. Other attractions for visitors' enjoyment include Palm Valley, Eco-Lake and outdoor concerts on Symphony Lake.
Open 5am to 12 midnight daily.

More Places of Interest

Visit Website: http://www.visitsingapore.com/

GENERAL INFORMATION ON CONFERENCE

ORGANISERS

The ICIEA 2006 is organised by IEEE Industrial Electronics (IE) Chapter of Singapore and co-organised with IEEE Industry Applications/Power Electronics (IA/PEL) Chapter of Singapore and IEEE Singapore Section.

TECHNICAL CO-SPONSOR

IEEE Industrial Electronics Society

LANGUAGE

The conference and all its activities will be conducted in English.

REGISTRATION

The registration desk is located at the Secretariat Room, Vanda 4 Room, Level 6, Marina Mandarin Singapore. The opening hours are:

Tuesday, May 23	4.00 pm – 6.30 pm
Wednesday, May 24	7.45 am – 10.30am (Ballroom Foyer, Level 1)
	10.30am – 5.30 pm
Thursday, May 25	8.00 am – 5.30 pm
Friday, May 26	8.30 am – 5.30 pm

Registration fee is S$900 for IEEE members and S$1,000 for non-members. Student rate is S$800.

Registration fee includes one copy of CD-ROM proceedings, Conference Programme/Abstracts, conference bag, three lunches, six tea-breaks, one conference banquet and 5% goods & services tax. Student registration does not include the banquet.

All delegates are required to register upon arrival. Each delegate will be given a name badge and it has to be worn at all times during the conference. Delegates/Accompanying Persons who have registered for the Banquet and the Night Safari Tour will also be given tickets.

PRESENTATION OF ORAL PAPERS

Type of Oral Presentations	Duration of presentation (including Q & A)
Keynote	60 minutes
General	20 minutes

A laptop and LCD projector will be available for the presentation. Speakers who are using MS PowerPoint presentation are required to pre-load their presentation file in the Laptop provided at least 30 minutes before the session starts. Please pass the USB drive or CD-ROM to the Technical Support Staff who will be stationed in each room to help you with the presentation. You can also use your own laptop.

PRESENTATION OF INTERACTIVE (POSTER) PAPERS

The poster session will be held on 25 May 2006 at the Ballroom Foyer, Level 1. Presenters are requested to station beside your poster during the poster viewing session. The maximum size of the poster is 1m (height) x 0.8m (width).

1050 – 1220	Session TA6
1400 – 1530	Session TM6
1630 - 1800	Session TP6

Presenters are required to put up their posters on the display panel provided at least 15 minutes before the session starts and remove it when the session is over.

NIGHT SAFARI TOUR

The Night Safari Tour will be held on 24 May 2006, Wednesday. Registered delegates can purchase the subsidised ticket at S$20. Ticket for accompany person is S$45. No refund of ticket will be allowed.

6.30 pm Assemble at Marina Mandarin Hotel Main Entrance
6.40 pm Departure to Night Safari by air-conditioned coach
(Please wear your name badge & show your tour ticket before you board the coach)
7.20 pm Arrival at Night Safari
9.45 pm Return to Marina Mandarin Hotel by air-conditioned coach
10.30 pm Back at hotel

COCKTAIL RECEPTION CUM CONFERENCE BANQUET

The cocktail reception will be held on 25 May 2006, Thursday at 7.00 pm, Vanda Ballroom foyer, Level 5, Marina Mandarin Hotel. The banquet will commence at 7.30 pm. Free flow of soft drinks and Chinese tea would be provided. Other beverages would be chargeable. Additional tickets at S$80 can be purchased from the Secretariat.

7.00 pm Cocktail Reception
7.30 pm Commencement of Dinner
8.00 pm Speech by the Conference General Chair, Dr Luo Fang Lin
8.10 pm Cultural Performance

- *Indian Folk Dance*
  This dance portrays the richly clad Radha consort of Lord Krishna. She performs with her Lord in a dance of celebration for the prosperity of the land.

- *Chinese Plate Spinning Act*
  Miss Hwa has been travelling around the world for performances since 1990's. While spinning 3 plates on both hands, she is still able to perform the various acrobat stunts. She will definitely capture the audience full attention.

- *Ronggeng Dance*
  This is a very popular Malay social dance. Here, the dancers dance gracefully to the popular rhythms and beat of the music. The audience will also be invited by the dancers to try this dance. Just swing your arms and legs in time to the music, which is light and catchy.

- *The Amazing Fire Eater/Magic Show/Illusion Act- Head Chopping*
  During his performance, he will hold the audience spell by his fiery and hilarious moments where he eats, plays, cooks and

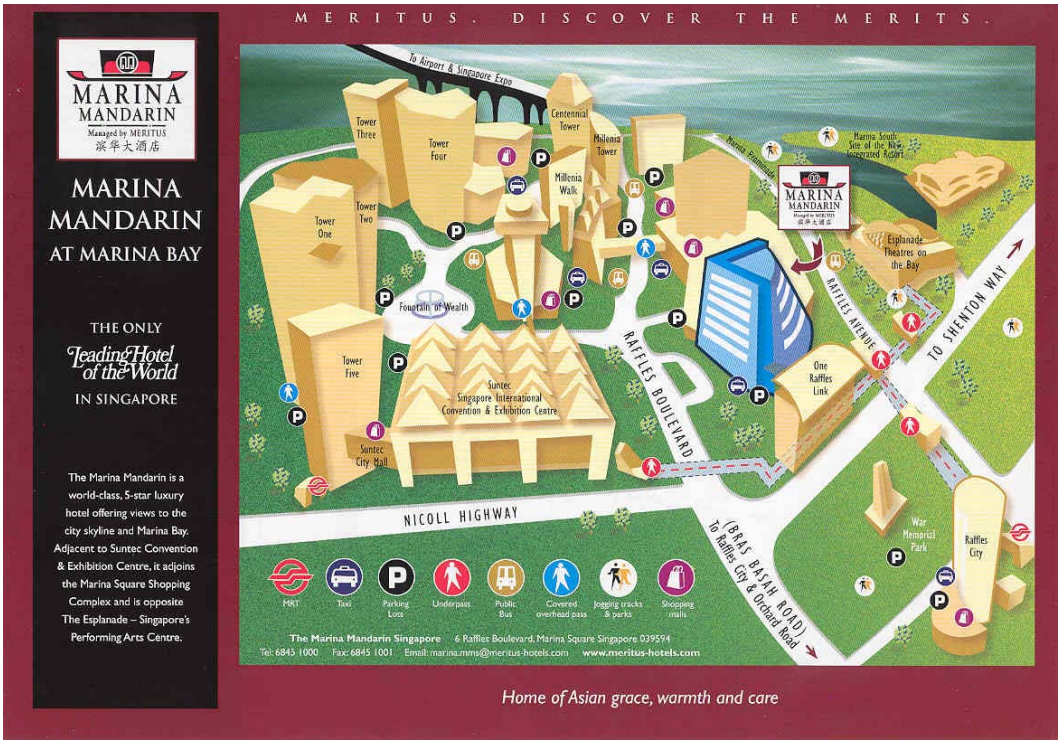
drinks with fire. He will burn the tissue and change it into $10 note. He also creates illusion like head chopping. Do participate if you dare.

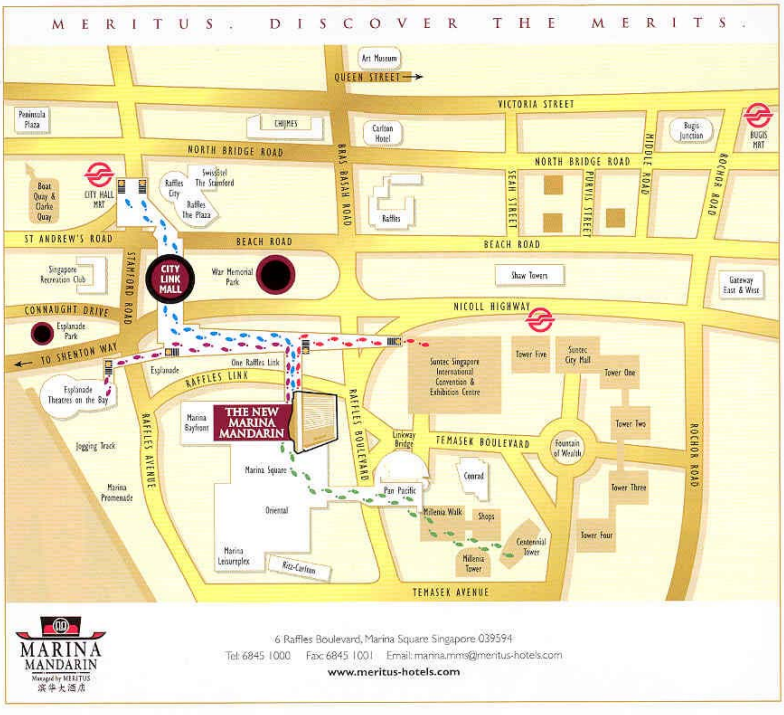
10.00 pm End of Banquet

INTERNET ACCESS

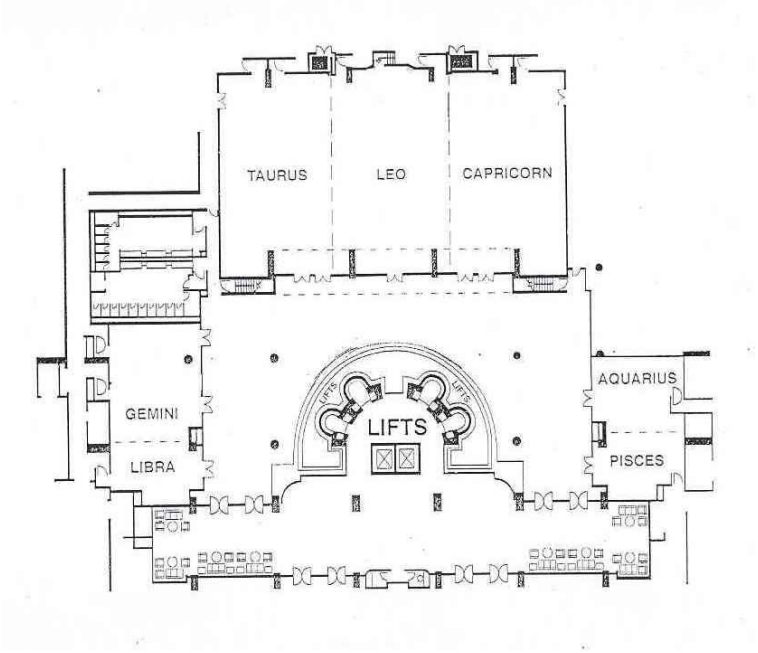
Complimentary internet access will be provided at the Secretariat Room, Vanda 4, Level 6. Please limit your access to 15 minutes per day.

CONFERENCE VENUE



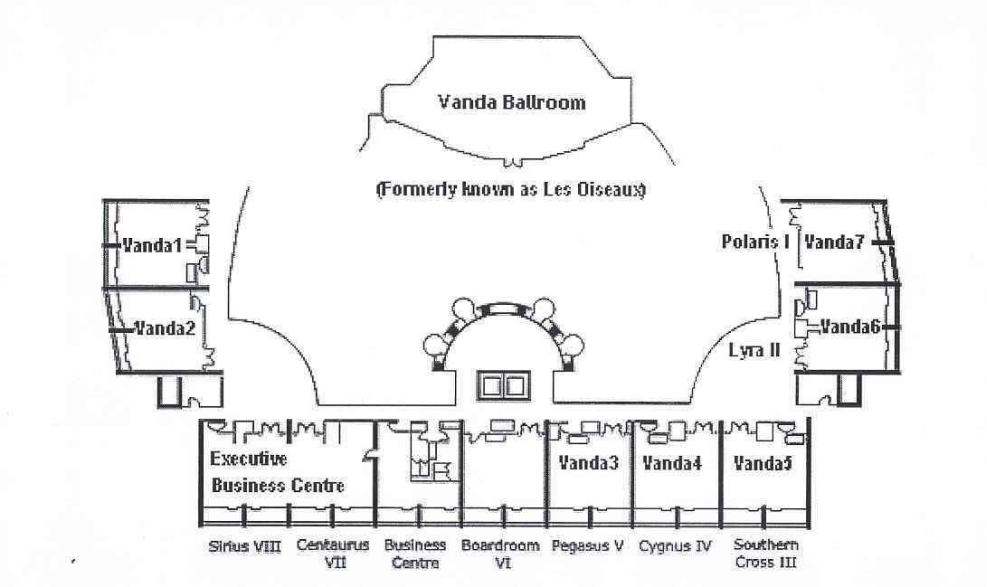


FLOOR PLAN OF CONFERENCE VENUE (Level 1)



Technical Sessions at Pisces, Taurus, Libra, Gemini and Aquarius, Level 1.
Tea-break & Poster Sessions at Ballroom Foyer.

FLOOR PLAN OF CONFERENCE VENUE (Level 5 & 6)



Secretariat/Internet Room at Vanda 4, Level 6.
Lunch & Conference Banquet at Vanda Ballroom, Level 5.

KEYNOTE ADDRESS

Implementations of Methods of Computational Intelligence

Professor Bogdan 'Dan' Wilamowski
Director of Alabama Microelectronics, Science and Technology Center, Auburn University
USA

Abstract

Comparison of various methods of computational intelligence are presented and illustrated with examples. These methods include neural networks, fuzzy systems, and evolutionary computation. The presentation is focused on neural networks, fuzzy systems and neuro-fuzzy architectures. Various leaning method of neural networks including supervised and unsupervised methods are presented and illustrated with examples. General learning rule as a function of the incoming signals is discussed. Other learning rules such as Hebbian learning, perceptron learning, LMS - Least Mean Square learning, delta learning, WTA – Winner Take All learning, and PCA - Principal Component Analysis are presented as a derivation of the general learning rule. Architecture specific learning algorithms for cascade correlation networks, Sarajedini and Hecht-Nielsen networks, functional link networks, polynomial networks, counterpropagation networks, RBF-Radial Basis Function networks are described. Dedicated learning algorithms for on chip neural network training are also evaluated. The tutorial focuses on various practical methods such as Quickprop, RPROP, Back Percolation, Delta-bar-Delta and others. Main reasons of convergence difficulties such as local minima or flat spot problems are analyzed. More advance gradient-based methods including pseudo inversion learning, conjugate gradient, Newton and LM - Levenberg-Marquardt Algorithm are illustrated with examples.

Advantages and disadvantages of fuzzy systems will be presented. Detailed comparison of Mamdani and Takagi-Sugeno approaches will be given. Various neuro-fuzzy architectures will be discussed. In the conclusion advantages and disadvantages of neural and fuzzy approaches will be discussed with a reference to their hardware implementation.

Biography

Currently, Dr. Wilamowski is Director of AMSTC – Alabama Microelectronics Science and Technology Center and Professor of Electrical and Computer Engineering Department at Auburn University. He was the Director of the Institute of Electronics (1979-1981) and the Chair of the Solid State Electronics Department (1987-1989) at the Technical University of

Gdansk, Poland. He was VP for Research at Research Center for Specialized Integrated Circuits, Torun, Poland. (1987-1989). He was Professor at the University of Wyoming (1989-2000). From 2000 to 2003, he was Associate Director of Microelectronics Research and Telecommunication Institute at University of Idaho and he was a Professor in Electrical and Computer Engineering Department and in Computer Science Department at the University of Idaho. Dr. Wilamowski was with the Communication Institute at Tohoku University, Japan (1968-1970) and he spent one year at the Semiconductor Research Institute, Sendai, Japan as a JSPS Fellow (1975-1976). He was a visiting scholar at Auburn University (1981-1982 and 1995-1996), and a visiting professor at the University of Arizona, Tucson (1982-1984).

Dr. Wilamowski received two PhDs, one in Computer Science and another in Electrical Engineering. He is the author of four textbooks, about 90 journal and 190 conference publications, and 27 patents. His main areas of interest are: computational intelligence including neural networks and fuzzy systems, electron devices and solid-state electronics, mixed signal and analog signal processing, CAD development, computational intelligence, and network programming. He was the major professor for about 120 graduate students. For contributions to industrial electronics and static induction devices he was named IEEE Fellow in 2000.

Dr. Wilamowski was instrumental in establishing the IEEE Jun-ichi Nishizawa Medal and currently serves as the Chair of the Medal Selection Committee. In Industrial Electronics Society, he has served as Newsletter Editor (1997-1999), Member of Finance Committee (1997-2004), Treasurer (1998-2001), President Elect (2001-2003), President (2004-2005); in Neural Network Society/Council he served as AdCom Member (1998-2004), VP for Finance and Treasurer (2001-2003). Currently he is VP for Finance the IEEE Computational Intelligence Society He is currently Associate Editor for: IEEE Transactions on Industrial Electronics, IEEE Transactions on Industrial Informatics, IEEE Transactions on Neural Networks, IEEE Transactions on Education, International Journal of Hybrid Intelligent Systems, Journal of Intelligent and Fuzzy, and Journal of Computing. He served as the General Chair, Technical Program Committee Chair, and Member of Organization Committees of various conferences such as IECON, ISIE, ICIPS, ICRAM, IIZUKA, ITM, and ICIT.

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Sensorless Control of Induction Machines – with or without Signal Injection?

Professor Joachim Holtz, Fellow, IEEE
Electrical Machines and Drives Group, University of Wuppertal
Germany

Abstract

Sensorless control of induction motors is an attractive technology which has gained considerable market share in the past few years. Improvements are still sought with respect to simplicity, robustness and accuracy at very low speed. Two basic methodologies are competing to reach this goal. Algorithms that rely on the fundamental machine model excel through their simplicity, even when more sophisticated and detailed models are implemented for the components of the drive system. Additional hardware for the acquisition of the machine terminal voltage can be spared when modelling the inverter as a nonlinear component. Immunity to noise and offset drift is achieved by appropriate estimators. Parameter estimation schemes adapt the control system to any given machine.

Most critical conditions exist around zero stator frequency. The induction motor then becomes an unobservable system. Nevertheless can the fundamental machine model provide sustained controllability in this region for a larger time duration. It is required, though, that the offset drift does not change.

Such limitations are not experienced when the anisotropic properties of the machine are exploited. The injection of additional high-frequency signals subjects the motor to transient conditions. Its response bears the spatial orientations of the anisotropies as a signature. Machines with closed rotor slots exhibit only one anisotropy which is caused by magnetic saturation. Its angular orientation, the field angle, can be determined, provided that load-dependent deviations are identified and compensated. Open slot rotors exhibit spatially discrete magnetic structures in addition. Identifying this anisotropy yields a high-resolution rotor position signal of high dynamic bandwidth; the influence of the saturation anisotropy must be adaptively compensated.

It is the nonlinear properties of two different anisotropies, of which only one can be utilized at a time, which makes carrier injection methods for sensorless control highly sophisticated. Their design is not general as it must match the properties of the particular drive motor. In addition, the nonlinearities of the PWM inverter require identifying complex and time-variable compensation functions for every operating point. These nonlinearities do not interfere when the transient excitation of the inverter switching are exploited to acquire the anisotropy signals.

Model based estimation methods, on the other hand, enable zero stator frequency operation for extended time periods; even so, permanent stability cannot be guaranteed. Nevertheless is the less complicated implementation of model based methods a distinct advantage which makes these the good choice for most applications. If long-term stability at zero stator frequency is an issue, anisotropic properties of the machine may be exploited as a temporary addition.

Biography

Joachim Holtz graduated in 1967 and received the Ph.D. degree in 1969 from the Technical University Braunschweig, Germany.

In 1969 he became Associate Professor and, in 1971, Full Professor and Head of the Control Engineering Laboratory, Indian Institute of Technology in Madras, India. He joined the Siemens Research Laboratories in Erlangen, Germany, in 1972. In 1973 he became Head of the Research and Development Group New Traffic Technologies in which capacity he developed the linear synchronous motor concept for magnetically levitated high-speed trains. He invented a speed sensorless drive control system for this motor and designed a magnetic guidance system for levitated trains.

From 1976 to 1998, he was Professor and Head of the Electrical Machines and Drives Laboratory, Wuppertal University, Germany. He is presently a Consultant.

Dr. Holtz has extensively published; he has contributed 10 invited papers in journals, among which 2 invited papers in the *Proceedings of the IEEE,* and 16 invited conference papers. He has earned 11 Prize Paper Awards. He is the coauthor of four books, and has been granted 31 patents. He has decisively influenced the technology advancement in the area of power electronics and drive control, among others by his inventions of a sensorless drive control system (1975), the three-level inverter (1977), the space vector modulation method for inverter control (1982), and of sensorless position control for induction motors (1998).

He is a recipient of the IES Dr. Eugene Mittelmann Achievement Award, of the IAS Outstanding Achievement Award, of the PELS William E. Newell Award, of the IEEE Third Millenium Medal, and of the IEEE Lamme Medal. He has earned 11 IEEE prize paper awards. He is a Fellow of the IEEE. Dr. Holtz is Past Editor-in-Chief of the IEEE Transactions on Industrial Electronics, Distinguished Lecturer of the IEEE Industry Applications Society, and of the IEEE Industrial Electronics Society. He is Chairman of the IAS IDC Nominations and Awards Committee, Senior AdCom Member of the IEEE Industrial Electronics Society, member of the IEEE IAS Static Power Converter Committee, and member of the IEEE IAS Industrial Drives Committee.

Dr. Holtz is the recipient of the IEEE Industrial Electronics Society Dr. Eugene Mittelmann Achievement Award, the IEEE Industrial Applications Society Outstanding Achievement Award, the IEEE Power Electronics Society William E. Newell Field Award, the IEEE Third Millenium Medal, and the IEEE Lamme Gold Medal. He is a Fellow of the IEEE.

Complex Networks: Design and Control

Professor David J. Hill
Federation Fellow
Department of Information Engineering
Research School of Information Sciences and Engineering
Australian National University, Australia

Abstract

Complex networks such large electronic circuits, power grids, and the Internet provide many challenges for engineers. In particular, technology and advanced societies generally have apparently become dependent on large networks to an extent beyond our capability to design and control them to operate securely. The recent spate of collapses in power grids and virus attacks on the Internet illustrate the need for research on modelling, analysis of behaviour, systems theory, planning and control in such networks. Coincidentally, the techniques of analysis and control for complex systems generally are evolving to be network-based, e.g graph theory, neural networks, controller networks. This seminar will describe recent progress in the area of complex networks with emphasis on security issues in design and control.

Biography

David J Hill received the BE and BSc degrees from the University of Queensland, Australia, in 1972 and 1974, respectively. He received the PhD degree in Electrical Engineering from the University of Newcastle, Australia, in 1976. He is currently an Australian Research Council Federation Fellow in the Research School of Information Science and Engineering at The Australian National University. He has held academic and substantial visiting positions at the universities of Melbourne, California (Berkeley), Newcastle (Australia), Lund (Sweden), Sydney and Hong Kong (City). He holds honorary professorships at The University of Sydney, Huazhong University of Science and Technology, China, South China University of Technology, City University of Hong Kong and Northeastern University, China. His research interests are in network systems, circuits and control with particular experience in stability analysis, non-linear control and applications. He is a Fellow of the Institution of Engineers, Australia and the Institute of Electrical and Electronics Engineers (IEEE), USA; he is also a Foreign Member of the Royal Swedish Academy of Engineering Sciences.

PRGRAMME OVERVIEW

PARALLEL SESSION		PISCES	TAURUS	LIBRA	GEMINI	AQUARIUS	Foyer
Wednesday 24 May 2006	**0845 – 0900** **Opening Ceremony, Taurus/Leo Ballroom, Level 1** **0900 – 1000** **Keynote Speech I, Taurus/Leo Ballroom, Level 1** **Implementations of Methods of Computational Intelligence** by **Professor Bogdan 'Dan' Wilamowski, Auburn University, USA**						
	Session 1 **1020 – 1220**	WA1 Adaptive and Intelligent Systems I	WA2 Non-linear Systems and Control I	WA3 Networked Control Systems	WA4 Power Quality Control I	WA5 Neural Networks and Applications	
	Session 2 **1320 - 1520**	WM1 Adaptive and Intelligent Systems II	WM2 Non-linear Systems and Control II	WM3 Control Applications	WM4 Power Quality Control II	WM5 Robust Control and Filtering	
	Session 3 **1540 – 1740**	WP1 Process Control	WP2 Non-linear Systems and Control III	WP3 Bio-medical I	WP4 System Theory and Applications	WP5 Control Theory	
Thursday 25 May 2006	**0900 - 1000** **Keynote Speech II, Taurus/Leo Ballroom, Level 1** **Sensorless Control of AC Machines around Zero Speed – with or without Signal Injections?** by **Professor Joachim Holtz, University of Wuppertal, GERMANY**						
	Session 1 **1020 - 1220**	TA1 Motor Drives I	TA2 FACTS & PFC	TA3 HF Converter and SMPS	TA4 Switching CCT and Converters I	TA5 Motion Control	TA6 Poster Session I
	Session 2 **1320 - 1520**	TM1 Motor Drives II	TM2 Power Devices and Components	TM3 Bio-medical II	TM4 Switching CCT and Converters II	TM5 Filtering	TM6 Poster Session II
	Session 3 **1540 - 1800**	TP1 Industrial Applications	TP2 Harmonic Analysis and Compensations	TP3 Energy Systems	TP4 Switching CCT and Converters III	TP5 Robotics	TP6 Poster Session III
	1900 - 2200 **Conference Banquet, Vanda Ballroom, Level 5**						
Friday 26 May 2006	**0900 - 1000** **Keynote Speech III, Taurus Ballroom, Level 1** **Complex Networks: Design and Control** by **Professor David J. Hill, Australian National University, AUSTRALIA**						
	Session 1 **1020 - 1220**	FA1 Motor Drives III	FA2 High Performance Control	FA3 Instrument System	FA4 Switching CCT and Converters IV	FA5 Multimedia Signal Processing I	
	Session 2 **1320 - 1520**	FM1 Motor Drives IV	FM2 Secure Communication	FM3 Communications	FM4 Sensor Network	FM5 Multimedia Signal Processing II	
	Session 3 **1540 - 1740**	FP1 Classification and Segmentation	FP2 Internet Technology and Industry Applications	FP3 Signal Processing and Industry Applications	FP4 Modeling Estimation and Simulation	FP5 Process Automation	

*** Lunch will be served at Vanda Ballroom, Level 5.**

TECHNICAL PROGRAMME

WA1

Session Title : Adaptive and Intelligent Systems I

Session Chair : Mr. S Saad Azhar ALI
Dr. Jing ZHOU

Date : 24 May 2006, Wednesday

Time : 10:20am - 12:20pm

Venue : Pisces, Level 1

WA1.1 10:20am-10:40am P0638
Adaptive Output Feedback Control for Uncertain Systems with Unknown Disturbance
J Zhou, C Y Wen
Nanyang Technological University

In this paper, we present a new scheme to design adaptive controllers for both linear and nonlinear uncertain systems in the presence of unknown disturbances. The control design is achieved by introducing certain well defined functions and a new linkage term in the adaptive update law. For the design and implementation of the controller, no knowledge is assumed on the unknown system parameters and disturbances. It is shown that the proposed controller can guarantee global uniform ultimate boundedness. A bound for the truncated L_2 norm of the tracking error is obtained as a function of design parameters.

WA1.2 10:40am-11:00am P0639
U-model Based Adaptive Tracking Scheme for Unknown MIMO Bilinear Systems
S S A Ali, F M Al-Sunni, M Shafiq
King Fahd University of Petroleum and Minerals

Bilinear systems are attractive candidates for many dynamical processes, since they allow a significantly larger class of behaviours than linear systems, yet retain a rich theory which is closely related to the familiar theory of linear systems. A new technique for the control of unknown MIMO bilinear systems is introduced. The scheme is based on the U-model with identification based on Radial Basis Functions neural networks which is known for mapping any nonlinear function. U-Model is a control oriented model used to represent a wide range of non-linear discrete time dynamic plants. The proposed tracking scheme is presented and verified using simulation examples.

WA1.3 11:00am-11:20am P0172
Adaptive Flight Controller Design based on RBF Network
J C Lu, J G Yan
Northwestern Polytechnical University

This paper designs a self-adaptive controller for the short-period longitudinal mode of an aircraft. At first, the parameter space method is used to find admissible set of feedback controller parameters for 40 different flight conditions in the flight scope. Then, all designed parameters are used for training a Radial Basis Function (RBF) network. In this way, the network can remember and output the designed parameters for relevant velocity and altitude. Thus, the controller parameters can be regulated adaptively by changing flight conditions. Simulation results show that the control system meets the military specifications for all 40-flight conditions. At the same time, it indicates that the technique proposed in the paper is effective and essential.

WA1.4 11:20am-11:40am P0325
A Novel Internal Model Control Scheme for Adaptive Tracking of Nonlinear Dynamic Plants
*T Khan, *M Shafiq*
King Fahd University of Pertoleum and Minerals
*King Fahd University of Petroleum and Minerals

Adaptive tracking of nonlinear dynamic plants is presently an active area of research. The design of on-line nonlinear controller for tracking of nonlinear plants has always been an inevitable computationally complex procedure. In this paper a novel method to facilitate controller design for output tracking of wide range of nonlinear plants based on a new control oriented model known as U-model is presented. The

use of U-model alleviates the computational complexity of on-line nonlinear controller design that arises when using other modelling frame works such as NARMAX model. The U-model utilizes only past data for plant modelling and standard root solving algorithm for control law formulation. The control structure of the scheme contains two feedback loops. The innerloop, where inverse of the plant is developed based on adaptive U-model. Outer-loop, which is designed using linear control theory to improve tracking and disturbance rejection properties of the overall system. The effectiveness of the proposed scheme is illustrated by simulating a nonlinear plant and by real-time speed control of a laboratory scale DC motor.

WA1.5 11:40am-12:00pm P0631

Backstepping Position Control for Induction Motor based on Neural Network

Z C Ji, Y X Shen
Southern Yangtze University

A robust backstepping control strategy is used in designing position tracking control system of induction motor. Neural networks are employed in every step of backstepping to design the fictitious controller until the actual controller is finished. The solution of regression matrix in backstepping method can be eliminated; the online adjustment of weights can ensure the boundary of position tracking error by choosing proper weight adjusting algorithm. Simulation is made on Matlab/Simulink platform, and the results verify the availability of the proposed method.

WA1.6 12:00pm-12:20pm P0466

Study on the Control Strategy for Parallel Operation of Inverters based on Adaptive Droop Method

*S Y Yang, C W Zhang, X Zhang, *R X Cao, **W X Shen*
Hefei University of Technology
*Hefei Sunlight Power Supply Co.Ltd
**Monash University Malaysia

This paper studies droop method based wireless parallel operation of inverters. With conventional droop method, the voltage deviation is usually quite severe to achieve good power sharing among the inverters connected in parallel. To overcome this problem, an adaptive droop method is developed by which the trade-off between voltage regulation and power sharing is relieved significantly. In addition, the second order filter rather than the first order filter that is adopted to obtain the average power drawn from each module improves the transient response. Experiment has been carried out on the system with two inverters in parallel. The results have validated the strategy developed.

WA2

Session Title : Non-linear Systems and Control I

Session Chair : Assoc. Prof. LUO Fang Lin

Date : 24 May 2006, Wednesday

Time : 10:20am - 12:20pm

Venue : Taurus, Level 1

WA2.1 10:20am-10:40am P0137
Mixed Boiler-turbine Coordinated Control System Mathematical Model based on Mechanism Modelling and Parameter Identification
*Z X Han, *X H Qi, **M Liu, Z Zhang, C X Zhou*
China Electric Power Research Institute
*Northeast China Electric Power Institute
**China Agricultural University

Based on the excellence of mechanism mathematical model and system identification model, this paper established a mixed model of boiler-turbine coordinated control system, which combines mechanism analysis and parameter identification. To configure the model into a Distributed Control System (DCS) of the unit generator, by comparing the model parameters trend curve with the unit generator actual parameters trend curve during the same period, result can be obtained that the modelling method given by this paper is correct and exact. In addition, this paper also first time gives the method of checking mathematical model correctness and accuracy, and engineering practice shows that this method is simple and effective.

WA2.2 10:40am-11:00am P0155
Semi-active Control Performance of Railway Vehicle Suspension Featuring Magnetorheological Dampers
G S Gao, S P Yang
Shijiazhuang Railway Insitute

A semi-active control of railway vehicle suspension system with magnetorheological (MR) damper is presented. At first a MR damper working in flow mode is designed. Performance testing is done for this damper with INSTRON machine. Then a mathematical model, modified Bouc-Wen model, is adopted to characterize the performance of the MR damper, with optimization method and experimental results of MR damper, the coefficients of the model are determined. A scaled half train model is set up including the model of the model of the MR damper in its suspension system and a semi-active control strategy is adopted to control the vibration of the system. Simulation results show that with the semi-active control the vibration of suspension system is well controlled.

WA2.3 11:00am-11:20am P0252
Control of Pendubot with Chaotic Perturbation
*P Awootsopa, U Sritheerawirojana, *N Komine, P Sooraksa*
King Mongkut's Institute of Technology, Ladkrabang
*Tokai University

This research aims to improve the performance of controlling a Pendubot disturbed by chaotic perturbation. The perturbation is in the form of chaotic noises generating using a logistic map type. The control mechanism comprises of two fuzzy controllers working in parallel: one for the actuator located at the first link, the other is for the second one. The propose architecture is said to be robust in the sense that the system can cope with the injected chaotic perturbation proved by simulation results.

WA2.4 11:20am-11:40am P0174
Robust Model Predictive Control for a Class of Nonlinear Systems with Uncertainty
Q Yang, S R Li
China University of Petroleum

The purpose of this paper is to design a robust nonlinear model predictive controller for a class of single input single output nonlinear systems with uncertainty. The controller structure is designed by using backstepping technique, and the controller parameters are tuned online by using model predictive control. The overall model predictive control scheme is proved to guarantee stability by using Lyapunov function. The simulation of a continuous fermenter process also shows that the controller is valid and can be applied to practical system.

WA2.5 11:40am-12:00pm P0646
Memory-based Control of Nonlinear Dynamic Systems Part I - Design and Analysis
Y D Song
North Carolina A&T State University

This paper presents a control design method based on short-term memory concepts. The main idea is to

make use of certain memorized information such as current system response, previous system response and past control experience to build control action. Fundamentally, the desired control signal in the scheme is "learned" and generated from observing and processing the most recent experience stored in a memory. System performance can be continuously improved during system operation without requiring detail system dynamics. There is no need to repeatedly run the system with the same task. Another advantage of this approach is that the overall required memory space does not grow with time and is much smaller than most existing learning control methods. The first part of the paper addresses the detail design and analysis of the proposed method. The second part of the paper presents the application results of the method to numerous examples/systems.

WA2.6 12:00pm-12:20pm P0647

Memory-based Control of Nonlinear Dynamic Systems Part II - Applications

Y D Song, Z Sun, X H Liao, R Zhang
North Carolina A&T State University

In the first part of the paper we presented a memory-based approach for nonlinear system control. The method is not to assume the system is described by a linear model plus perturbations; not to linearize the system; not to estimate certain parameters based on the linear parametric assumption; not to determine the bounds on certain nonlinear functions; not to use infinite switch frequencies; not to involve ad hoc membership functions; not to run the system repeatedly for the same task. Instead, the control scheme is solely based upon certain memorized information such as current system response, previous system response and past control experience. Fundamentally, the desired control signal in the scheme is "learned" and generated from observing and processing the most recent experience stored in a memory. These features are confirmed via applying this method to via numerous examples considered by other researchers in the literature. Simulation results are presented here.

WA3

Session Title : Networked Control Systems

Session Chair : Assoc. Prof. Boon Hee SOONG
Dr. Branislav HREDZAK

Date : 24 May 2006, Wednesday

Time : 10:20am - 12:20pm

Venue : Libra, Level 1

WA3.1 10:20am-10:40am P0499
Predictive Control Applied Queuing Strategy in Networked Control Systems
L M Lu, S A Zhu, J Meng, Y Y Jiang
Zhejiang University

Networked control systems (NCSs) is drawn a lot of attention recently. A new method is proposed in this paper, which involves the predictive control algorithm. A queuing strategy is presented for coping with the networked delay, so that NCSs can be stabilized and achieve quite a good dynamic performance for both linear and nonlinear plants. The advantages of this method are (1) no need to redesign the existed predictive controllers; (2) no requirement of clock synchronization; (3) only slight influence of bad network condition such as package loss. Simulations and experiments are designed to show these advantages.

WA3.2 10:40am-11:00am P0431
Application of Parity Relation and Stationary Wavelet Transform to Fault Detection of Networked Control Systems
H Ye, Y Q Wang
Tsinghua University

Problems related to Fault Detection of Networked Control Systems have been studied in this paper. The influence of unknown and random network-induced delay on conventional Fault Detection systems based on Parity Relation and H2 optimization is first analyzed. Then a new procedure for designing Fault Detection systems for Networked Control Systems with random network-induced delay and unknown inputs based on Stationary Wavelet Transform and Parity Relation is proposed. The residual generator designed with the new approach is robust to both the random network-induced delay and the unknown input.

WA3.3 11:00am-11:20am P0203
A New Method for Fault Detection of Networked Control Systems
Y Q Wang, H Ye, G Z Wang
Tsinghua University

Fault detection of networked control systems (NCS) is a new research region. The key point of the issue is how to deal with the network-induced delay. In this paper, influence of the delay is regarded as multiplicative faults and a new fault detection approach robust to the delay is proposed. Simulation results show that it can operate well even in conditions that delay is longer than the sampling period.

WA3.4 11:20am-11:40am P0662
A Novel Protocol of QoS Multicasting for Large Scale MANET
*W Wang, B H Soong, *J Chew*
Nanyang Technological University
*DSO National Laboratories

QoS-enabled multicast protocol for Mobile Ad-hoc Network (MANET) has recently drawn attention from researchers because of its potential and broad applications in various fields. It is challenging to design a multicast protocol which meets Quality of Service (QoS) requirement when the bandwidth availability is very limited, e.g. military wireless communication network. Other constrains may include stringent real-time requirement, robustness and harsh environment etc. In this paper, we propose an Integrated Services (IntServ) bandwidth-based multicast routing protocol, named Hybrid QoS Multicast Routing Protocol (HQMRP), which combines reactive and proactive schemes to build source-based trees, and performs route maintenance to accommodate the ad-hoc environment. Different design choices have been investigated through intensive simulation work in order to find their most suitable working scenarios.

WA3.5 11:40am-12:00pm P0270

Use of Command Input Shaping Method to Compensate Clock/Seed Timing Track Closure in Phase Lock Loop

Q Li, J L Zhang, B Hredzak, G X Guo
Data Storage Institute

In all servo writing technologies used in hard disk drives industry, servo track propagation process has to be synchronized using clock/seed timing track in order to ensure proper alignment of the propagated servo patterns. Before the clock/seed timing track can be used to synchronize the servo propagation, clock/seed timing track closure must be guaranteed. Incorrect closure will disturb the operation of the phase-lock loop circuit and adversely affect the quality of the propagated servo patterns. This paper proposes a novel method for fast compensation of clock/seed timing track closure. The method is based on command input shaping technique. A compensation signal is injected between phase detector and low pass filter of the phase-lock loop circuit to compensate the clock/seed timing track closure. Experimental and simulation results verifying the proposed method are presented.

WA3.6 12:00pm-12:20pm P0153

Active Power Filter Designed by Energy Balancing Control

S Janjornmanit, C Dechthummarong, S Panta
Rajamangala University of Technology, Lanna

This paper presents design of active power filter by novel idea of energy balancing control. The control objective can be achieved by fully closed-loop control. The reference current is firstly identified by using the concept of energy calculation and control. The source current is then forced to follow the reference current by current controller. The proposed approach is constructed in single-phase system and verified by simulation results.

WA4

Session Title : Power Quality Control I

Session Chair : Asst. Prof. Sumant G KADWANE
Asst. Prof. Semaan GEORGES

Date : 24 May 2006, Wednesday

Time : 10:20am - 12:20pm

Venue : Gemini, Level 1

WA4.1 10:20am-10:40am P0209
Modelling and Comparative Evaluation of Control Techniques Applied to a PWM Three-Phase Four-Wire Shunt Active Power Filter
*H Y Kanaan, *S Georges, A Hayek, **K Al-Haddad*
Saint-Joseph University
*Notre-Dame University
**Ecole de Technologie Superieure

Current harmonics, which are injected in the utility by nonlinear loads, cause major problems that tend to deteriorate the power quality at the mains. To reduce such harmonics, Active Power Filters (APF) are commonly employed. In this paper, two multiple-loops are considered. The APF is used to compensate the current distortion and the reactive power created by a typical 60 kW industrial load. The first control scheme is based on the use of hysteresis current controllers for the current wave shaping, whereas the second one employs linear PI regulators designed on the bases of a small signal averaged model of the converter. Both control schemes are designed to ensure voltage regulation at the AC side. The control systems are implemented using Matlab/Simulink tools. The performance of both control approaches are finally evaluated and compared through the obtained simulation results

WA4.2 10:40am-11:00am P0448
The Analysis of Nonlinear Dynamical Behaviours of Active Power Filter and its Capability of Suppressing EMI
K Ding, X M Zha, Y P Chen
Wuhan University

In this paper, the nonlinear behaviors of active power filter (APF) are analyzed and the method to suppress the EMI is presented. The cause of nonlinear phenomenon mainly comes from the nonlinear specialty of the power switch in the converter. This article raises the nonlinear problem caused by the instability of the gate drive voltage of IGBT. the problem can be changed into the transmission process analysis of the instant pulse current produced from the process of IGBT on-off, the refrain of structural stability problem which caused by IGBT' control voltage translated into interdiction of the spreading plus of the instant electric pulse or attenuation of spreading path, after the research of switching power supply in methods of simulation and test result. It is certain that flyback switching power supply can be used in the auxiliary switch power of APF and it will be useful for the APF to restrain the nonlinear problem.

WA4.3 11:00am-11:20am P0454
Research on a Novel VAR Continuous Compensator and Harmonic Suppression
*L Z Chen, Y Meng, Q Z Zhou, *P S Ye*
Anhui University of Technology
*Shanghai Jiaotong University

A novel reactive power continuous compensation and harmonic suppression on power supply is proposed. The paper introduces its essential principles and presents realizable scheme of key technology. Finally, feasibility of this technology is analyzed by simulation and verified by experiment.

WA4.4 11:20am-11:40am P0504
An 18-Pulse AC-DC Converter for Power Quality Improvement in Vector Controlled Induction Motor Drives
B Singh, G Bhuvaneswari, V Garg
Indian Institute of Technology, Delhi

This paper deals with a novel autotransformer based improved power quality eighteen-pulse ac-dc converter feeding vector controlled induction motor drives (VCIMD's). The design of the proposed autotransformer is presented along with the necessary modifications required for making it suitable for retrofit applications, where presently a 6-pulse diode bridge rectifier is used. The proposed ac-dc converter is found capable of improving the power quality parameters in the wide operating range of the drive. The effect of load variation on VCIMD is also studied to demonstrate the effectiveness of the proposed ac-dc converter. A set of power quality indices on input ac mains and on dc bus for a VCIMD

fed from various ac-dc converters are also given to compare their performance. Laboratory prototypes of proposed autotransformer based 12-pulse and 18-pulse ac-dc converters are developed and test results are presented to validate the proposed design and developed model of the converter system.

WA4.5 11:40am-12:00pm P0284

Converter Based DC Motor Speed Control using TMS320LF2407A DSK

S G Kadwane, S Phani Vepa, B M Karan, T Ghose
Birla Institute of Technology, Mesra

This paper deals with real time DC motor speed control, using the low-cost new generation TMS320LF2407A digital signal processor. A PID controller is designed using MATLAB functions to generate a set of coefficients associated with the desired controller characteristics. The controller coefficients are then discretised and included in an assembly language or C program that implements the PID controller. Code composer studio is used to load and run the PID controller to achieve real time control. Furthermore, the PID parameters can be adjusted while the motor is running, so that the online adjustment is achieved. Speed control is investigated on a DC motor with speed feedback. According to the error in speed, followed by PID action DSP processor will change the duty cycle of the PWM, which is given as the input to the buck converter. Results show the improvement of system outputs as expected with a PID controller, with actual system outputs matching theoretical calculations.

WA5

Session Title : Neural Networks and Applications

Session Chair : Dr. Wenxiang XIE

Date : 24 May 2006, Wednesday

Time : 10:20am - 12:20pm

Venue : Aquarius, Level 1

WA5.1 10:20am-10:40am P0220
On Passivity Analysis of Bi-directional Associative Memory Neural Networks with Time Delay
X Y Lou, B T Cui, Y X Shen
Southern Yangtze University

The passivity conditions for bi-directional associative memory neural networks with time-varying delays and uncertainties are considered in this paper. We firstly derive the passivity condition for bi-directional associative memory neural networks with constant time delay, and then extend the result to the case with time-varying delays and uncertainties. Based on Lyapunov functionals and linear matrix inequalities, the passivity conditions are presented. The results obtained in this paper improve and extend some of the previous results.

WA5.2 10:40am-11:00am P0226
A Comparison of Strategies for Unbalance Sample Distribution in Support Vector Machine
L K Luo, H Peng, Q S Zhang, C D Lin
Xiamen University

In applications of support vector machine (SVM), we often meet the problem that the distributions of two types of samples are unbalanced. Some authors had put forward some strategies to deal with this problem, but up to now comparisons of these strategies haven't been conducted. Comparing with four kinds of strategies which are reselecting sample, adjusting penalty weight, increasing dummy ordinary sample and increasing dummy support vector sample, this paper points out that the front two kinds of strategies which don't increase dummy sample are more suitable for practical problem than the back two kinds of strategies which increase dummy sample. In strategies that increase dummy sample, the strategy that increases the dummy support vector sample precedes to the strategy that increases dummy ordinary sample. Meanwhile, this paper also points out that the more unbalanced the sample distribution is, the better the effects of these strategies are. These conclusions have an instructive meaning and a reference value to choices of strategies for unbalance sample distribution problem.

WA5.3 11:00am-11:20am P0520
Multi-Classifier Combination for Banks Credit Risk Assessment
*Q F Zhou, C D Lin, *W Yang*
Xiamen University
*Shanghai Jiaotong University

Credit risk assessment problem belongs essentially to a classification problem. In this paper, a Multi-classifier Combination algorithm has been developed for banks credit risk assessment. We adopt Back-Propagation (BP) algorithm as the meta-learning algorithm and compared the methods of Bagging and Boosting to construct the Multi-classifier System (MCS). Experimental results on real client¡¯s data illustrate the effectiveness of the proposed method.

WA5.4 11:20am-11:40am P0522
Torque and Speed Estimator for Sensorless Induction Motor Drive using Cascade Neural Networks
A Goedtel, I N D Silva
University of Sao Paulo

Many electronic drivers for the induction motor control are based on sensorless technologies. The proposal of this work is to present an efficient estimator of torque and speed, from transient to steady state, using artificial neural networks. The method proposed is based on off-line training considering different types of load and wide range of voltage applied to the induction motor. The inputs of the network are the RMS voltage and current of the induction motor and the control processing effort is reduced to simple matrix solving after the neural network is trained. Simulation results are also presented to validate the proposed approach.

WA5.5 11:40am-12:00pm P0586
MPG Prediction based on BP Neural Network
J Meng, X Y Liu
Zhejiang University

In this article, we use the data mining theory to construct a BP neural network model to predict MPG

(mile per gallon). Based on the nonlinear properties of the six variables given, considering the imperfection using two main variables at the same time, we've processed the problem via data preparation, model selection, construction, modification and error comparison as well as model adaption period. At the end of this article, we've discussed the principles of acquiring proper parameters based on the distinctions of the neural network chosen and give some possible improving directions. In this manner, in case the original data is given, the predicted MPG result will come out automatically and satisfactorily.

WA5.6 12:00pm-12:20pm P0187

Application of Fuzzy Neural Network Predictive Control in Material Proportioning System

*D Q Feng, X H Xu, *M R Fei, T J Chen*
Zhengzhou University
*Shanghai University

In accordance with the technique features of material proportioning belt system in the cement production, e.g., inertia, time lag, non-linearity and frequent disturbance in work field, a fuzzy neural network predictive controller based on neural network prediction model is designed. By combining fuzzy control, neural network and predictive control, it can enhance self-studying, tracking and anti-interference capabilities of the algorithm, and the neural network can compensate with the limitation of conventional predictive control that based on linear model. With this algorithm the weigh belt is controlled, and the simulation experimental curves show that the control effect of the material flow is effective, and the precision of ingredient proportion has evidently improved.

WM1

Session Title : Adaptive and Intelligent Systems II

Session Chair : Dr. Sumana CHOWDHURI
Assoc. Prof. King Jet TSENG

Date : 24 May 2006, Wednesday

Time : 1:20pm - 3:20pm

Venue : Pisces, Level 1

WM1.1 1:20pm-1:40pm P0128
Recurrent Fuzzy Neural Network using Genetic Algorithm for Linear Induction Motor Servo Drive
F J Lin, P K Huang
National Dong Hwa University

A recurrent fuzzy neural network (RFNN) using genetic algorithm (GA) is proposed to control the mover of a linear induction motor (LIM) servo drive for periodic motion in this paper. First, the dynamic model of an indirect field-oriented LIM servo drive is derived. Then, an on-line training RFNN with backpropagation algorithm is introduced as the tracking controller. Moreover, to guarantee the global convergence of tracking error, analytical methods based on a discretetype Lyapunov function are proposed to determine the varied learning rates of the RFNN. In addition, a realtime GA is developed to search the optimal weights between the membership layer and the rule layer of RFNN on-line. The theoretical analyses for the proposed RFNN using GA controller are described in detail. Finally, experimental results show that the proposed controller provides high-performance dynamic characteristics and is robust with regard to plant parameter variations and external load disturbance.

WM1.2 1:40pm-2:00pm P0329
Intelligent Decentralized Controllers for Multi Area Power Systems
*Y Narri, *P S Srinivas*
Jawaharlal Nehru Technological University
*M.V.G.R. College of Engineering

This paper deals with the design of decentralized controllers based on conventional approach and intelligent approach using fuzzy concept. In conventional approach a simple method decentralized Kalman filter based regulator to place closed loop eigenvalues at desired locations by minimizing the linear quadratic performance index of each decoupled sub-system is presented. It also presents the stability analysis of a linear time-invariant continuous time interconnected systems. The effectiveness of the fuzzy logic control scheme is tested by considering a load-frequency control problem of a two-area power system.

WM1.3 2:00pm-2:20pm P0550
Fuzzy Self-adjusted and Realtime Learning Algorithm for Vehicle Lateral Control
J Yang, N N Zheng, X J Lv, H Cheng
Xi'an Jiaotong University

In this paper we deal with the vehicle lateral problem. More precisely, we solve this problem by properly applying fuzzy self-adjusted and realtime learning algorithm to the two degree of freedom vehicle lateral dynamic model. The model is set up by plenty of experiments in real driving environment.

WM1.4 2:20pm-2:40pm P0236
Online Decouple and Control of Multivariable Nonlinear System based on Neural Network
*X L Li, *L Yang, Y Bai*
North China Electric Power University
*Beijing Institute of Technology

Aimed at Neural Network can approach any nonlinear dynamic system with arbitrary accuracy, the frame of distributed NN decoupling system are proposed to decouple the MIMO nonlinear system. The learning algorithm of NN is online, which makes a set of cross-correlation function as the target function, and adopts hybrid genetic algorithm to train neural decoupler. When the decoupling is completed, the single nerve cell self-adaptor PID is used to control two SISO systems. The efficiency of the algorithm has been shown by numerical simulations combining nonlinear system.

WM1.5 2:40pm-3:00pm P0490

Performance Studies of Fuzzy Logic based PI-like Controller Designed for Speed Control of Switched Reluctance Motor

*S Chowdhuri, *S Biswas, **A Mukherjee*
Calcutta University
*Jadavpur University
**Bengal Enggineering and Science University, Shibpur

Switched Reluctance Motor (SRM) has gained significant interest in the field of industrial drive. The controller used to drive the machine is conventional PI controller. But the machine characteristics are very much nonlinear. This poses a problem for conventional controller design as regards to maintaining steady performance. There is also a need to adapt to variable operating conditions. Fuzzy logic based heuristics is prospective since the exact analytical modelling of the system is difficult. PC implementation of the controller offers great flexibility in both design and maintenance phase. This work implements a PI like fuzzy logic controller (FLC) for SRM, which is found to work successfully in real time conditions. The work compares the performance of the FLC with respect to the conventional PI controller.

WM1.6 3:00pm-3:20pm P0603

Improvement of the Twin Rotor MIMO System Tracking and Transient Response using Fuzzy Control Technology

C S Liu, L R Chen, B Z Li, S K Chen, Z S Zeng
National Formosa University

In this paper, a method to obtain the optimal parameters of PID (Proportional, Integral and Derivative) controllers for the Twin Rotor Multi-Input Multi-Output System (TRMS) by using the optimal method, combined with the model reduced method, is proposed. The Fuzzy control method with the multi-section gains and derivatives is also presented for the improvement of the tracking performance and the disturbance problem from the air flow. Both methods are implemented by the new real-time control system. The simulation results and the experiment verification show the effectiveness of the proposed methods.

WM2

Session Title : Non-linear Systems and Control II

Session Chair : Prof. Yeng Chai SOH
Prof. Fanglai ZHU

Date : 24 May 2006, Wednesday

Time : 1:20pm - 3:20pm

Venue : Taurus, Level 1

WM2.1 1:20pm-1:40pm P0538
Observers with Multiple Sliding Modes for Uncertain Linear MIMO Systems
*K C Veluvolu, S Pavuluri, Y C Soh, W J Cao, *Z Y Liu*
Nanyang Technological University
*Harbin Institute of Technology

In this paper, sliding mode observers for uncertain MIMO linear systems are developed in both the continuous and discrete-time domains. The uncertainties are characterized as unknown inputs to the system. We propose a sliding mode observer with multiple sliding modes to completely eliminate the disturbances in the sliding mode. It is shown that in the sliding mode, the system is completely stable and the estimated states converge to the actual states asymptotically. The gain design is based on standard Lyapunov analysis. Existence of the discrete-time sliding mode is proved and the gain design is based on the boundary layer thickness for the case of discrete-time systems. Numerical results demonstrate the effectiveness of the proposed method.

WM2.2 1:40pm-2:00pm P0377
The Observer Design for Lipschitz Nonlinear Systems based on LMI
F L Zhu
Guilin University of Electronic Technology

This paper deals with the design methods of full-order and reduced-order observers for Lipschitz nonlinear systems. Under the assumption that a LMI is feasible, we point out there exists a full-order observer. By a way of coordinate transformation, we also put forward a design approach of reduced-order observer under the some assumption and the gain matrix of reduced-order observer is based on the solution of the LMI. The developed theory is used successfully in the design of an observer for a flexible joint robotic system.

WM2.3 2:00pm-2:20pm P0224
Discrete-time Observers with Multiple Sliding Modes for a Class of Nonlinear Uncertain Systems
*K C Veluvolu, Y C Soh, W J Cao, *Z Y Liu*
Nanyang Technological University
*Harbin Institute of Technology

This paper designs discrete-time sliding mode (DSM) observer design for a class of nonlinear uncertain systems. The Taylor series expansion and nonlinear transformation are used to convert the nonlinear continuous time system into the discrete-time model. Multiple sliding modes were introduced to compensate for multiple disturbance terms in the subsystems by appending them to a constant gain observer. A strategy is developed to guarantee the convergence of the estimation error to a bound within a specified boundary layer. Existence of discrete-time sliding mode is guaranteed and the relation between the boundary layer thickness and the sliding mode gain design are obtained.

WM2.4 2:20pm-2:40pm P0386
Design of Functional Observer for Linear System with Unknown Disturbance and its Application to Disturbance Attenuation
R Suzuki, M Ikemoto, M Tani, S Furuya, N Kobayashi
Kanazawa Institute of Technology

This paper presents a reduced-order functional observer for linear system with unknown disturbance from H-infinity performance point of view. The proposed reduced-order functional observer can be designed under a less strict existence condition. The controller scheme based on the proposed functional observer can simultaneously estimate a state-function and unknown disturbance, and can be applied to disturbance attenuation problems. Numerical example is given to illustrate the properties of the proposed reduced-order functional observer.

WM2.5 2:40pm-3:00pm P0259

Compatible Control for Multi-objective System based on Linear Matrix Inequality

Q S Hu, L H Xu, Z Q Zou
Tongji University

In a real multi-objective control plant, all the objects have certain acceptable range. Taking linear uncertain system as model, by adopting linear matrix inequality (LMI) optimization method, we research the compatibility of different objectives in multi-objective control problem. A two-layer controller design method is proposed, i.e. the first layer obtains the compatible interval objectives which meets the customer's demand best by compatible optimization and the second layer designs the controller using traditional methods based on the result of first layer. The new method overcomes the drawback of traditional methods which design the controller taking the "accuracy point" as objectives and are difficult to be adopted in practical application. This new design approach fills the gap between theory and application to a certain degree.

WM2.6 3:00pm-3:20pm P0478

State Estimation via a Serial Network with Different Transmission Periods

Y S Suh, V H Nguyen, Y S Ro, H J Kang
University of Ulsan

This paper considers an estimation problem, where sensors are connected through a serial network and sensor data are sent to the estimation board periodically. A rate monotonic scheduling is used for sensor data packets scheduling. Given the bandwidth, the design parameter affecting estimation error is the transmission period of each sensor. A new optimization algorithm to determine transmission period of each sensor is proposed so that the overall estimation error covariance is small in the Kalman filter framework. The computed transmission period is depending on system models and noise covariances. The proposed algorithm is verified through a numerical simulation.

WM3

Session Title : Control Applications

Session Chair : Dr. Jinfei SHEN
Assoc. Prof. Jun MENG

Date : 24 May 2006, Wednesday

Time : 1:20pm - 3:20pm

Venue : Libra, Level 1

WM3.1 1:20pm-1:40pm P0657
Research on Fault Tolerant Inverter Based Permanent Magnet Synchronous Motor Direct Torque Control Drives
D Sun, J Meng
Zhejiang University

This paper investigates the integrated performance of a permanent magnet synchronous motor (PMSM) direct torque control (DTC) drive system based on inverter faults. A switch-redundant inverter with fault tolerant capability is introduced to the drive system to substitute the standard 6-switch 3-phase inverter before fault occurrence; two 4-switch inverters will be reconfigured when the open-phase or short-switch faults occur. Modelling of the 4-switch inverters are analyzed, and a modified DTC strategy based on these two post-fault 4-switch inverters is proposed for the disturbance-free operation of the PMSM drive system. The proposed PMSM DTC system are simulated under both healthy and faulty condition, the integrated simulation results verify that the modified PMSM DTC drive systems under both two 4-switch inverters are able to operate stably and continuously with acceptable performance.

WM3.2 1:40pm-2:00pm P0636
PDM and PSM Hybrid Power Control of a Series-Resonant Inverter for Induction Heating Applications
J F Shen, H B Ma, W X Yan, J Hui, L Wu
Southern Yangtze University

This paper presents a high-frequency series-resonant inverter for induction heating applications, which is characterized by the pulse-ensity-modulation (PDM) and phase-shift-modulation (PSM) hybrid power control strategy. The inverter is kept to work at load resonant state for all load conditions and achieves zero-current-switching or zero-voltage-switching (ZCS ZVS) for switches of the inverter. Compared with PDM only schemed inverters, the PDM/PSM hybrid control schemed inverters present many advantages, such as: more steady output current, continuous power regulation, and operating in continuous current mode (CCM). When compared with PSM only schemed inverters, they achieve smaller phase-shift as well as hardly any distortion in output current. Even working under light load status, the inverter can realize quasi-sinusoid output current waveform with less fluctuation in peak value.

WM3.3 2:00pm-2:20pm P0637
Power Control for Induction Heating by Asymmetrical Pulse Density Modulation
W X Yan, Z C Ji, X L Lu
Southern Yangtze University

To adjust the power of serial-resonant inverters for induction heating applications, asymmetrical Pulse Density Modulation (APDM) power controlled strategy is described, analysed and designed. The Pulse Density Modulation (PDM) is introduced to overcome the drawbacks of the classical control modes such as Pulse Width Modulation, Pulse Frequency Modulation and Phase Shift Modulation. One characteristic of PDM is that it operates at resonant frequency with Zero-current and zero-voltage switching for a wide range of output power variations. Normal PDM often considered as symmetry pattern for the power switches. While in some case of low quality of the resonant loads, the load current is incontinuous in stage of low density, the phase loop locked circuit cannot work efficiently, and the advantage of PDM will disappear. APDM provides two times wide range of output power variations at the same operation period of PDM, and the switches also cut off at Zero Current Switching and open at Zero Voltage Switching.

WM3.4 2:20pm-2:40pm P0654
DSP Based Direct Torque Control of 12-phase Synchronous Propulsion Motor Drives
*C D Du, X F Zhang, *X D Gao*
Naval University of Engineering
*Shanghai Zhonghua Shipbuilding Ltd.

In this paper, a detail implementation of direct torque control scheme (DTC) for DSP based 12-phase synchronous propulsion motor drive is described. TMS320LF2407A and TMS320C33 are used to

construct the dual-dsp drive board which allows sophisticated control algorithm adopted by the proposed control scheme. By this means, we control the torque and flux linkage with composed voltage vectors and select voltage vectors for each inverter module separately, which simplifies the control of 12-phase synchronous motor. Experimental results confirm that an ideal control capability is obtained for the control model.

WM3.5 2:40pm-3:00pm P0634

DPLL in Cooperated with PI Controller for HF-Inverter Control System

J Hui, X H Zang, F J Zhang, J F Shen
Southern Yangtze University

This paper presents a HF (High Frequency)-Inverter using a Digital Phase-Locked Loop (DPLL) technique in cooperated with PI controller to ensure its output power factor up to unity and operating frequency tracking the load-resonant frequency rapidly and precisely. In the dynamic condition, when the error between the frequencies of the operation and load resonance of the proposed inverter and its frequency is greater than or equal to a specified error range, only the PI controller is utilized to pull rapidly the operating frequency into the phase-locked loop locking range. Otherwise the operating frequency is only controlled by the DPLL when the error is smaller than the presetting range. Using the DPLL, it can make both frequencies and phases of the output voltage U0 and its current I0 achieve to be identical, so that the inverter always operates in the load-resonant or quasi-load resonant condition in steady-state. Furthermore the PI-DPLL control performance and the dynamic responses of the inverter system are emulated and compared by MATLAB/SIMULINK. Finally an experimental induction heating power has been implemented to evaluate the control performances. The cost-effective prototype HF-Inverter power is operated successfully at outputs up to 40Kw, at 60KHz of switching frequency and input DC540V.

WM3.6 3:00pm-3:20pm P0642

Estimation of Blast Duration and Coordinated Control Strategy for Hot-Blast-Stove System

*J S Sun, J C Yang, G Q Hou, *J T Yin*
Hebei Polytechnic University
*Hebei Vocational Institute of Energy Technology

In this work, CBR (Case-Based Reasoning) is used as a powerful tool for estimating the blast duration based on the statistical data of the just terminated on-gas phase. This CBR estimating method is easy to be implemented and the estimated result is shown to be satisfied. Based on the on-line estimation of blast duration, a novel coordinated control strategy for the hot blast stove system was proposed, which takes a smooth and higher blast air temperature as its control objective and is realized by means of adjusting dynamically the heating intensity of the current on-gas stove.

WM4

Session Title : Power Quality Control II

Session Chair : Dr. G BHUVANESWARI

Date : 24 May 2006, Wednesday

Time : 1:20pm - 3:20pm

Venue : Gemini, Level 1

WM4.1 1:20pm-1:40pm P0508
The Suppression of Resonance by a New Hybrid Power Filter
*Q Tao, K P Liu, L Zhou, *Q Q Chen*
Wuhan University
*De Montfort University

Lots of structures of hybrid power filter are produced consisting of tuned filter and active filter. It can reduce the rating of active filter and cost of the harmonic compensators, and also can improve the compensation performance compare to the passive and active filter using alone by preventing the resonance occurring. However, the resonance still may occur under some condition. A new hybrid power filter by employing an active filter and C-type filter is proposed in this paper, which can reduce the rating of this harmonic compensator, and moreover, the resonance can be suppressed reasonable. A simulation result will be presented in this paper, it proves that this kind of topology is effective on the harmonic compensation and elimination of resonance.

WM4.2 1:40pm-2:00pm P0578
A Twelve-Phase AC-DC Converter for Power Quality Improvement in Direct Torque Controlled Induction Motor Drives
B Singh, G Bhuvaneswari, V Garg
Indian Institute of Technology, Delhi

This paper presents the design and analysis of a star connected autotransformer based twelve-phase ac-dc converter for improving power quality at the point of common coupling (PCC) in direct torque controlled induction motor drives (DTCIMD's). A star connected autotransformer with five windings per phase is used to realize the twelve-phase ac-dc converter. The basic design equations are derived to calculate the number of turns in different windings for achieving harmonic reduction in the proposed autotransformer based ac-dc converter. The designed twelve-phase ac-dc converter is found capable of suppressing up to 21st harmonics in the supply current along with the power factor improvement close to unity in the wide operating range of the drive. The effect of load variation on DTCIMD is also studied to demonstrate the effectiveness of the proposed ac-dc converter.

WM4.3 2:00pm-2:20pm P0597
An Electric Energy Quality Meter using Hardware Reconfigurable Computing
*A Hafner, *C R Erig Lima, *H S Lopes*
University of the West of Santa Catarina
*Federal Technological University of Parana

The use of electronic loads in production processes has been increased lately in the industries, aiming at improving automation and products quality. At the same time, operational costs are reducing, including the cost of electric energy. Together with these advantages many problems appear, such as electromagnetic interferences and harmonics, justifying the insertion of quality and amount of electric energy meters (EEQ meter) for evaluations and analyses for both, consumers and companies. This work describes and analyses several issues in the implementation of an EEQ meter, emphasizing the functional block implementation using hardware reconfigurable computation. The advantages of this approach, such as execution time and parallelism, are explored in this paper.

WM4.4 2:20pm-2:40pm P0275
The Automatic Following Control of Arc Suppression Coil with Thyristor Switched Capacitors
Y Q Xu, Z P Wang, H Zhang
North China Electric Power University

Various neutral grounding techniques are applied in Medium Voltage distribution networks in the world. With the applications of microcomputer technique and power electric technique in this area have led to significant modifications in arc suppression coil grounding technology. The principle and automatic following control method of arc suppression coil with TSC (Thyristor Switched Capacitors) are described in this paper. A new grounding system with TSC arc suppression coil is developed. The results of field tests are analyzed. They show that the design of

TSC arc suppression coil is correct and the automatic following system is reliability.

WM4.5 2:40pm-3:00pm P0425

Different Control Strategies for Unified Power Quality Conditioner at Load Side

*A J Laxmi, G T Ram Das, *K U Rao, K Sreekanthi, **R Katuri*
Jawaharlal Nehru Technological University
*Vidyasagar College of Engineering
**Dr. B.V.Raju Institute of Technology and Science

This paper presents the compensation principle using PI, FUZZY & ANN control strategies of the UPQC in detail. The UPQC is an Active Filter (AF) and it compensates the reactive power, harmonics in both the voltage and current caused by loads. The UPQC makes use of two back to back connected IGBT based Voltage Source Inverters (VSIs) with a common dc bus. One inverter is connected in series and the other one is placed in shunt with the load. The shunt inverter works as a current source and it compensates the current harmonics. The series inverter works as a voltage source and it helps in compensating the voltage harmonics. Previous works presented a control strategy for shunt active filter with PI control. Then, this control straregy was extended to develop the three different controllers for shunt and series active filters. The simulation results of these control strategies are listed for comparison and verification of results.

WM4.6 3:00pm-3:20pm P0658

A Single Neuron PID Controller Based PMSM DTC Drive System Fed by Fault Tolerant 4-Switch 3-Phase Inverter

D Sun, J Meng
Zhejiang University

This paper presents an adaptive single neuron based PID speed controller to substitute the traditional PID controller usually used in the fault tolerant 4-switch 3-phase (4S3Ph) inverter fed permanent magnet synchronous motor (PMSM) direct torque control (DTC) drive system to improve the system performance. Based on the structure and principle analysis of the single neuron PID controller, a modified weight training algorithm is obtained by combining the supervisory Delta learning rule with the non-supervisory Hebbian learning rule to achieve the controller parameters on-line self-study and optimization. The single neuron PID controller based 4S3Ph inverter fed PMSM DTC drive is modelled and studied by MATLAB/SIMULINK, simulation results show that both steady state and dynamic performance of the PMSM DTC drive system has been improved with stronger self-adaptivity and robustness comparing with the system utilized traditional PID controller.

WM5

Session Title : Robust Control and Filtering

Session Chair : Prof. Pierre APKARIAN

Date : 24 May 2006, Wednesday

Time : 1:20pm - 3:20pm

Venue : Aquarius, Level 1

WM5.1 1:20pm-1:40pm P0282
Robust H_∞ Filtering of Linear System with Norm-Bounded Uncertainty
*J W Wu, *K M Tsang*
Harbin Engineering University
*The Hong Kong Polytechnic University

In this paper, the robust H-inf filter for the linear system with norm-bounded uncertainty is investigated. The uncertainty on the system matrices is represented in linear fractional representation (LFR) form which can approximate an uncertain input-output relation by a set of quadratic constrains; the constrained optimization problem is converted into an unconstrained dynamic game type problem by the so-called S-procedure theorem; the LMIs are used to analysis and synthesis the filter.

WM5.2 1:40pm-2:00pm P0624
Developing a Robot Control Scheme Robust to Uncertain Model Parameters and Unmodeled Dynamics
M Danesh, M Keshmiri, F Sheikholeslam
Isfahan University of Technology

In robot manipulators, inertia parameters of robot may be not known precisely and some dynamics such as friction torques that are usually difficult to be modelled and may be ignored. In this paper, we present a robust manipulator control approach that includes a feedback-feedforward compensation to compensate for the uncertain parameters and unmodeled dynamics and disturbances. The stability of the overall system is analyzed through Lyapunov direct method. For the proposed approach, global uniform asymptotic stability of the system is established. In addition, we present a continuous control law and guarantee the uniform ultimate boundedness of the tracking error. The simulation results are exhibited to support the theoretical issues.

WM5.3 2:00pm-2:20pm P0410
Non-synchronized H_∞ Estimation of Piecewise Linear Systems
J Xu, L H Xie
Nanyang Technological University

Piecewise linear (PWL) systems are mostly partitioned based on their state variables. Due to the output noise and estimation errors, the transitions of actual state and its estimate may not be synchronized. In this paper, we consider the non-synchronized H infinity estimation problem for both continuous-time and discrete-time PWL systems. This paper extends the authors' previous work and presents a number of less conservative design approaches.

WM5.4 2:20pm-2:40pm P0391
Robust H_∞ Filtering for Discrete-Time Systems with Nonlinear Uncertainties
*X Zhu, *X M Yin*
Agilent Technologies Singapore Pte Ltd
*Singapore Institute of Manufacturing Technology

In this paper, we consider the problem of robust H_Infinite .ltering for discrete-time systems with norm-bounded nonlinear uncertainties. The class of uncertain systems is described by a state-space model with linear nominal parts and norm-bounded nonlinear uncertainties on both state and output measurements. We proposed a method of converting such type of nonlinear uncertain system to a linear uncertain system, and presented a methodology for designing a robust H_Infinite filter.

WM5.5 2:40pm-3:00pm P0577
Robust H_infinity Controller Design for Time-delayed Systems with Uncertainty
J G Zuo, S A Zhu
Zhejiang University

This paper concerns a problem of robust H¡Þ control for uncertain systems with time-varying delay, and the time-delay is time-varying and unknown but is norm-bounded. A new delay-dependent robust H¡Þ controller is presented in terms of matrix inequalities (LMI). In this paper, the H¡Þ control law is assumed to be a memoryless state feedback and is on the size of time-derivative. The close-loop system with the designed controller is asymptotically stable and

guarantees the H¡Þ norm-bound for all the admissible uncertainties.

WM5.6 3:00pm-3:20pm P0372
Modeling and Force Tracking Control of Hydraulic Actuator for an Active Suspension System
Y M Sam, H Khisbullah
University Technolog of Malaysia

This paper presents modelling and force tracking control of a non-linear hydraulic actuator applied in a quarter-car active suspension system. The controller structure of the active suspension system was decomposed into two loops namely outer loop and inner loop controllers. Outer loop controller is used to calculate the optimum target force to reject the effects of road disturbances, while, the inner loop controller is used to keep the actual force close to this desired force. The results of the study show that the inner loop controller is able to track well the target force ranging from sinusoidal to random functions of target force. The performance of outer loop controller also shows significant improvement in terms of body acceleration, body displacement and suspension displacement as compared to the passive suspension system.

WM5.7 3:20pm-3:40pm P0125
Frequency Domain H_∞ Synthesis using Nonsmooth Techniques
*P Apkarian, *D Noll*
ONERA and Paul Sabatier University
*Paul Sabatier University

We develop nonsmooth optimization techniques to solve H‡ synthesis problems under additional structural constraints on the controller. Our approach avoids the use of Lyapunov variables and therefore leads to moderate size optimization programs even for very large systems. The proposed framework is very versatile and can accommodate a number of challenging design problems including static, fixed-order, fixed-structure, decentralized control, design of PID controllers and simultaneous design and stabilization problems. Our algorithmic strategy uses generalized gradients and bundling techniques suited for the H‡-norm and other nonsmooth performance criteria. Convergence to a critical point from an arbitrary starting point is proved (full version [1]) and numerical tests are included to validate our methods.

WP1

Session Title : Process Control

Session Chair : Prof. Junghui CHEN
Assoc. Prof. Ryoichi SUZUKI

Date : 24 May 2006, Wednesday

Time : 3:40pm - 5:40pm

Venue : Pisces, Level 1

WP1.1 3:40pm-4:00pm P0444
Decoupling Control of Multivariable System based on Adjoint MatrixP
*Y G Kong, *F Zhang, A K Xue*
Hangzhou Dianzi University
*Hangzhou Electric Power Bureau

A decoupling control method is given based on the adjoint matrix of transfer function This method can realize the entirely decoupling control of the multivariable system, and neednot solve the inverse of transfer function, avert the infeasible problem of tranditional decoupling control method.

WP1.2 4:00pm-4:20pm P0136
Fault Detection of the Cascade Control System based on Output Performance
J H Chen, Y Yea, C K Kong
Chung-Yuan Christian University

Based on the achievable variance of the control outputs, a fault diagnosis of cascade control systems is developed. Without any prior knowledge of the complex operating processes and/or a prior external input to perturb the operating system, the accurate fault identification can be achieved by a series of the statistical hypothesis procedure that is applied to the current measured data. To isolate the possible faults, the output variances of the primary and the secondary loop can be separated into the cascade-invariant (CI) and cascade-dependent (CD) terms, respectively, by the Diophantine decompositions. After a sequence of the hypotheses testing is performed on the CI and DI terms of the current control and the achievable performance conditions, the hierarchy diagnostic trees for the primary and the secondary outputs are respectively established to explore the possible faults. The final faults can be inferred by merging both diagnosis trees.

WP1.3 4:20pm-4:40pm P0161
Internal Model Control based on Parallel Self-learning Neural Network for Superheated Steam Temperature System
*D G Peng, H Zhang, P Yang, *Y Wang*
Shanghai University of Electric Power
*East China Normal University

As to the superheated steam temperature control system has large time constant, long time-delay and time-varying in thermal power plant, a control strategy of internal model control based on parallel self-learning neural network is presented in this paper, which recurs to the identification ability for complex nonlinear of the neural network to identify the model and inverse model of the object. It divides the control system into two processes: control process and parallel self-learning process. Control process realizes the function of the internal model control, which includes the NNM, NNC and a feedback robust stable controller (RC). The parallel self-learning process is used to train the NNC and then its weights are copied to control process online. Simulation results show that this strategy has perfect control performances, strong robustness and self-adaptive ability.

WP1.4 4:40pm-5:00pm P0240
Internal Model Control Scheme for Sensorless Force Control and its Application to Rubbing Machines
*R Suzuki, T Torita, N Kobayashi, *E P Hofer*
Kanazawa Institute of Technology
*University of Ulm

In many industrial factories, usually, grinding, lapping, and polishing machines use force sensors for finishing tasks. In this paper, a modified internal model control (IMC) scheme for a sensorless force control is proposed to such kind of rubbing machines. The IMC has disturbance decoupling property, good tracking performance and disturbance estimation property. In order to extend the conventional IMC scheme to a rubbing machine, we consider a novel control scheme based on the IMC, and discuss stability of the closed loop system. Moreover, effectiveness of the proposed scheme is confirmed by comparative experiments.

WP1.5 5:00pm-5:20pm P0470

Model Predictive Control based On Fuzzy Linearization Technique for HVAC Systems Temperature Control

*L Jia, H L Lv, *W J Cai*
Shandong University
*Nanyang Technological University

The Heating, Ventilating, and Air-Conditioning systems (HVAC systems) are typical nonlinear time-variable multivariate systems with disturbances and uncertainties. A new Mamdani fuzzy model predictive control strategy based on sum-min inference was proposed to control HVAC systems in this paper. The resolution relationship of two inputs and single output variables of the Mamdani fuzzy controller was obtained by its structure analysis. Then the fuzzy linearization predictive model at k+1 sampling time on base of its resolution equation was designed. And at P ahead horizon predictive models were got. The predictive control strategy based fuzzy linearization predictive model was given and the procedure to implement the control algorithm was outlined. Finally simulation test results showed that the proposed fuzzy model predictive control approach is effective in HVAC systems temperature control applications. Compared with the conventional PID control, this fuzzy model predictive control algorithm has less overshoot and shorter setting time.

WP2

Session Title : Non-linear Systems and Control III

Session Chair : Assoc. Prof. Changyun WEN

Date : 24 May 2006, Wednesday

Time : 3:40pm - 5:40pm

Venue : Taurus, Level 1

WP2.1 3:40pm-4:00pm P0166
Lagrange Stability of a Class of Nonlinear Discrete-time Systems
Y Yang, L Huang
Peking University

In this paper, a new method for robust Lagrange stability analysis of a class of nonlinear discrete-time systems is proposed. Both the linear part structured and unstructured uncertainties are considered in a unified way. Sufficient conditions for robust Lagrange stability are established in terms of linear matrix inequalities (LMIs). With this LMI approach, the largest allowable magnitude of the admissible perturbation was given explicitly by solving a generalized eigenvalue minimization problem which is essentially a convex optimization problem and numerically efficient. Illustrative example confirmed the efficiency and accuracy of the proposed approach.

WP2.2 4:00pm-4:20pm P0436
Feed-water Control Scheme Design of Two Different Structure Double-hearth Benson Once-through Boilers and its Application
*Z X Han, *X H Qi, **G Zhou*
China Electric Power Research Institute
*Northeast China Electric Power Institute
**Yaomeng Power Plant Company Ltd.

Based on the compare of two steam feed-water systems of unit 1 and unit 2 in YaoMeng Power Plant, two different BENSON once-through boiler feed-water control schemes are designed in this paper, and the state feedback control based on the incremental mode state observer is adopted in both feed-water control schemes. Engineering practice shows that adopting the control scheme of unit 1 and the second control scheme of unit 2 given in this paper can make the feed water control effect excellence, meanwhile, the results also proves that the robustness of incremental mode state observer is very well.

WP2.3 4:20pm-4:40pm P0534
The Insistence Cybernetics on the Basis of Operating Time-Varying Parametrons and it's Applicable Exemplification
R G Di, S B Liu
East China Jiaotong University

A number of new control concepts are presented which have rarely been announced. The time-varying circuit, which makes use of Controllable Time-Varying Elements (CTE) and is controlled by computer, is able to realize certain complicated functions in electrical technology. The problems to be discussed involve the transformation from the existing constant-voltage source into the called Expectant Current Source (ECS). The descriptions of some complicated problems only have need of formulations so as to they are short and sweet. As a result, with only computer software the current-waveform of a supply may be directly transformed into an arbitrary one, which does not need miscellaneous analyses and syntheses. Thus some quite intractable problems in electrical application can be satisfactorily settled by means of solving the derived Equations of Operating Parametron (EOP). The potential applicable possibility and development of the cybernetics is elucidated. This discovery of the relationship between cybernation and parametrons not only will lead to the realization of a complex cybernation-system, but also form the basis for a new and original cybernetics, which will be on the point of being an extremely valuable tool in both designing and operating varitrol in the near future.

WP2.4 4:40pm-5:00pm P0215
Hybrid Quantum Evolutionary Algorithms based on Particle Swarm Theory
Y Yu, Y F Tian, Z F Yin
Lanzhou University

Inspired by the idea of hybrid optimization algorithms, this paper proposes two hybrid quantum evolutionary algorithms (QEA) based on combining QEA with particle swarm optimization (PSO) to improve the performance of QEA . The main idea of the first method called PSEQEA is to embed the evolutionary

equation of PSO in the evolutionary operator of QEA; while the main idea of the second method called PSSQEA is to replace the evolutionary operator of QEA using the evolutionary equation of PSO which is redefined the meanings of the original evolutionary equations. The experiment results of the knapsack problem, the function optimization problems and multiuser detection problem show that the both of the proposed methods not only have simpler algorithm structure, but also perform better than conventional QEA and PSO in terms of ability of global optimum.

WP2.5 5:00pm-5:20pm P0620

Adaptive Position Control of Three Degrees Freedom Platform

A Taheri, M R Tarihi
Malik Ashtar University

This paper describes the implementation of a hybrid self-tuning regulator for the positioning of motors in 3-degree of freedom table in image stabilizer. This system has three motors in yaw, pitch, and roll axis for control of table. The servo motors are permanent-magnet dc motors in which no speed reducer is used. Experimental results obtained with three dc motors in yaw, pitch and roll axial. There are two innovative aspects of this work. First, parameter estimation is used to adapt the feed forward compensation terms instead of the gains of the feedback controller, as usually is the case in conventional indirect self-tuning regulators. Second, the complete adaptive controller has been implemented with c program and pcl812 card and encoder card and motor driver for command the motors. In result one method with hybrid increase accuracy system, specially when input error signal is large and need to maximum speed control system.

WP3

Session Title : Bio-medical I

Session Chair : Dr. Xing ZHU

Date : 24 May 2006, Wednesday

Time : 3:40pm - 5:40pm

Venue : Libra, Level 1

WP3.1 3:40pm-4:00pm P0402
Face Recognition based on Extended Locally Linear Embedding
L Zhu, S A Zhu
Zhejiang University

Face image data taken with various capturing devices are usually high dimensional and not very suitable for accurate classification. In this paper, a new face recognition method based on nonlinear dimensionality reduction is proposed. The extended locally linear embedding (ELLE) first embeds the high dimensional face data into a low dimensional hidden manifold. Then the linear discriminant analysis (LDA) is performed to find an optimal projection direction for classification. The proposed method was tested and evaluated using the AT&T and Yale face databases. Recognition rates were compared with Eigenface, Fisherface and LLE. Experimental results indicated the promising performance of the proposed method.

WP3.2 4:00pm-4:20pm P0492
Design of Bipolar Pulse Generator for Biomedical Applications
L R Chen, N Y Chu, M H Yang, Y M Su
National Formosa University

Electric pulse field methods are powerful tools for cell characterization and manipulation and are wildly used in biotechnology and medical applications. A pulse generator (PG) is the device which provides the desired electric pulse field. In this paper, a low cost AC-Powered Bipolar PG (AC-BPG), directly powered by normal AC power (i.e., utility power), is proposed. Since there is no high-voltage DC power supply in the proposed AC-BPG, the circuit complexity and cost is effectively reduced. Furthermore, the voltage of the generated bipolar pulse of the AC-BPG can easily be controlled to match specific applications. This function is not easy to be implemented in conventional pulse generators after a fixed high-voltage DC power supply is selected. In order to assess the performance of the proposed AC-BPG, a prototype is designed, realized and tested. Experimental results show that the AC-BPG can actually generate a 0-1,300V pulse with 56 duration, without overshoot and ringing. Using a 1-4 mm standard commercial cuvette, the AC-BPG can provide electric pulse fields of 0-13 KV/cm to be used in bioelectronics, medical and industrial applications.

WP3.3 4:20pm-4:40pm P0545
Iris Recognition Basing on Multi-resolution Analysis
L L Pan, M Xie
University of Electronic Science and Technology of China

Multi-resolution decomposition is very effective for analyzing and extracting the information content of images. According to this idea, we apply this theory to iris recognition system. In the iris localization part, in order to avoid the influence of eyelash, we detect the edge points of iris through the detail signals of some rows at appropriate resolutions. Then, we set two circles to these edge points to obtain the exact boundary of iris. In the feature extracting part, we select out some rows of the normalized iris image after enhancing as the feature vector and only extract the approximation signals of these vectors to construct the final feature vector for matching. The greatest merit of this algorithm is its stability, for the results are seldom affected by lash occlusion problem. From our experiments on 2400 iris images of CASIA (the Institute of Automation, Chinese Academy of Sciences), the validity of this algorithm has been testified.

WP3.4 4:40pm-5:00pm P0392
Hand Posture Recognition in Gesture-Based Human-Robot Interaction
*X M Yin, *X Zhu*
Singapore Institute of Manufacturing Technology
*Agilent Technologies Singapore Pte Ltd

Natural and friendly interface is critical for the development of service robots. Gesture-based interface offers a way to enable untrained users to interact with robots more easily and efficiently. In this paper, we present a posture recognition system implemented on a real humanoid service robot. The system applies the RCE neural network based color segmentation algorithm to separate hand images from complex backgrounds. The topological features

of the hand are then extracted from the silhouette of the segmented hand region. Based on the analysis of these simple but distinctive features, hand postures are identified accurately. Experimental results on gesture-based robot programming demonstrated the effectiveness and robustness of the system.

WP3.5 5:00pm-5:20pm P0557

3D-3D Registration: Surface Rendering Plus Skull and Soft Tissue Registration

C Sinthanayothin, W Tharanon
Advance Dental Technology Center

The CT-skull and 3D-soft tissue from digital surface scan has been registered together in order to see the bones inside the facial surface. This can be done using 3 main methods. Firstly, by applying the segmentation to the CT data, which is the DICOM images, for the skull and skin parts. Secondly, by developing the 3D surface rendering based on Marching cube technique to form the 3D objects of skull and skin respectively. Next, by applying the semi-automatic registration technique to register CT-skin with the 3D-soft tissue from digital surface scanner. The last method requires the knowledge on how to let the user interact with the object and get the depth in 3D. Also the knowledge on the 3D rotation is needed in order to match the directions between two objects. Then the result can be shown the bone under the facial soft tissue, which could be applied to other applications of medical treatment simulation. How they might aid in the simulation after the surgical treatment or moving bone.

WP4

Session Title : System Theory and Applications

Session Chair : Dr. Jiaxin YUAN
Prof. Tomohiro MURATA

Date : 24 May 2006, Wednesday

Time : 3:40pm - 5:40pm

Venue : Gemini, Level 1

WP4.1 3:40pm-4:00pm P0273
A New Algorithm for Transient Stability Emergency Control based on Power Switching
X M Zhang, S W Mei, Q Lu
Tsinghua University

Emergency control has become a necessary measure to maintain power system stability, for complexity of operating modern power system is continuously increasing. The basic idea proposed by this paper is to find a proper strategy to switch the unbalance power and achieve the goal of exhausting the superfluous energy, which drives system to be unstable. From the view of Newton's second law, the unbalance power is the essential reason, which dominates transient stability. This paper firstly analyzes the relation between the unbalance power and transient stability, the effect of generator tripping. Then a new kind of criterion for transient stability assessment and an index for evaluating control measure are given. The algorithm proposed establishes the direct relation between the original system and controlled system. It doesn't depend on mode identification and avoids blindfold searching. Cascading faults and multi-swing instability can be easily handled. The simulation performed on New England system has proved the rationality of the algorithm.

WP4.2 4:00pm-4:20pm P0139
Modelling and Evaluation of Recovery Control for Degradable/Recoverable Information Systems
T Murata
Waseda University

This paper proposes an effective design method of degradable/recoverable information system by using two methods of Sate Diagram Matrix (SDM), which is a structural state based description formalism, and Total High Performance Time (THPT) which is a performance-related system reliability measure. SDM is useful to identify pending states for restoring system state from a degraded state to a normal state. Control method of recovery procedure in the pending states is detailed by using Extended Stochastic Petri Net (ESPN) to evaluate THPT. We illustrate effectiveness of combining these methods for degradable/recoverable information system behavioural specification and performance-related reliability evaluation through an application of storage system with mirrored disks.

WP4.3 4:20pm-4:40pm P0218
The Research of Inverter's Control based on Immune Genetic Algorithm
J X Yuan, B C Chen, C H Tian, Y Shen
Wuhan University

This paper evaluates Immune Genetic Algorithms (IGA) as a new nonlinear technique for control of inverter. The so-called IGA strategy is characterized by its speediness, diversity, tolerance and memory. It is well suited for on-line microprocessor implementation. A special C program for the algorithm is compiled. And the dynamic experimental platform based on DSP was built. Simulation and experiment results show that the algorithm quickly converged to the good solution within 25th iterations, and the solution's fitness and switching loss are great improved compared with the traditional control strategies.

WP4.4 4:40pm-5:00pm P0175
Research of Humanoid Intelligent Control System based on Knowledge Driving
H H Zhu, D F Chen
Wuhan University of Technology

The paper analyses the domestic and international developing actuality of humanoid intelligent control system, bring forward the concept of humanoid intelligent control system based on knowledge driving, establishes the integrated architecture model of multisource information fusion (MSIF), and introduces the system structure and its key technique. The system architecture and control method which the paper presented is very important to resolve the problem of accurate control in complex system.

WP4.5 5:00pm-5:20pm P0430

Prediction of Transcription Factor Binding Sites using Genetic Algorithm

X Y Chang, W G Zhou, C G Zhou, Y C Liang
Jilin University

Identification of Transcription Factor Binding Sites (TFBS) from the upstream region of genes remains a highly important and unsolved problem particularly in higher eukaryotic genomes. In this paper, we propose a new approach to predict TFBS. This approach uses Position Weight Matrix (PWM) to represent Binding Sites and uses genetic algorithm (GA) to search the best matrix. A new coding method so called multiple-variable coding is proposed in GA. We apply it on two transcription factors reb1 and mg1. The result shows that this approach can find most of the known sites, which indicates that this method is very effective.

WP5

Session Title : Control Theory

Session Chair : Prof. Congxin LI
Prof. Chia-Ju WU

Date : 24 May 2006, Wednesday

Time : 3:40pm - 5:40pm

Venue : Aquarius, Level 1

WP5.1 3:40pm-4:00pm P0633
Design of Sliding Mode Controller for Uncertain Distributed Parameter Systems with Delays
H X Wen, B T Cui, Y X Shen
Southern Yangtze University

This paper presents a new design approach of a sliding mode controller for a class of uncertain Distributed Parameter systems with delays. The system is invariant on the sliding surface. A class of variable structure control system is proposed. Some criteria are established for the stability and bifurcation in a mutual model with a delay τ which τ is regarded as a parameter. It is shown that designed linear time-delay control systems provide guaranteed robust reliable stability despite possible actuator failures.

WP5.2 4:00pm-4:20pm P0319
Position Control of Shape Memory Alloy Actuators by using Self Tuning Fuzzy PID Controller
N B Kha, K K Ahn
University of Ulsan

Shape Memory Alloy (SMA) actuators, which have ability to return to a predetermined shape when heated, have many potential applications in aeronautics, surgical tools, robotics and so on. Although the number of applications is increasing, there has been limited success in precise motion control since the systems are disturbed by unknown factors beside their inherent nonlinear hysteresis or the surrounding environment of the systems is changed. This paper presents a new development of SMA position control system by using self-tuning fuzzy PID controller. The use of this control algorithm is to tune the parameters of the PID controller by integrating fuzzy inference and producing a fuzzy adaptive PID controller that can be used to improve the control performance of nonlinear systems. The experimental results of position control of SMA actuators using conventional and self tuning fuzzy PID controller are both included in this paper.

WP5.3 4:20pm-4:40pm P0539
Synchronization of Chaotic Systems in the Presence of Noise
*Y Ji, C Y Wen, *Z G Li, Y C Soh*
Nanyang Technological University
*Institute for Inforcomm Research

Recently, a lot of efforts have been devoted to the synchronization of chaotic systems for chaotic secure communication. However, all the results on perfect synchronization are obtained under the ideal condition that the chaotic systems in both the transmitter side and the receiver side are noise free. In this paper, we relax this condition by designing a controller for the driven system based on the bounds of the system noise. Perfect synchronization of the two systems is theoretically established. Numerical results also illustrate the robustness and effectiveness of the proposed scheme.

WP5.4 4:40pm-5:00pm P0235
A New Type of Embedded Autolevelling Control System based on ARM Microcontroller for Carding Machine
R Z Xu, W Guo, C X Li
Shanghai Jiaotong University

Autolevelling control system plays an important role in carding machine to ensure high quality of output sliver. Currently industrial-grade personal computer (IPC) control is the most prevalent form for autoleveller. With the development of semiconductor and integrated circuit (IC) technology, embedded system based on highly integrated microcontroller unit (MCU) shows great potential in traditional industrial control. A new type of carding machine autolevelling control system based on 32 bit ARM7TDMI-cored MCU is proposed to replace the former IPC control unit. First, IPC control system for carding machine is presented, and then the new ARM-based embedded autolevelling control system are discussed in details, including hardware structure, function modules, software structure and some key technologies. Comparison of these two types of control system is also given. This new type

of autoleveller has been put into practical use and shows excellent performance in control precision and reliability, together with its smaller size, lower cost and lower power consumption against IPC control system.

WP5.5 5:00pm-5:20pm P0408

Time-Optimal Control of an Omni-Directional Mobile Robot

*L C Lai, *C N Ko, *T L Lee, C J Wu*
National Yunlin University of Science and Technology
*Nan Kai Institute of Technology

The time-optimal control problem of a three-wheeled omni-directional mobile robot is addressed in this paper. Different from usual cases, in which the Pontryagin's Minimum Principle (PMP) is used, an iterative procedure is proposed to transform the time-optimal problem into a nonlinear programming (NLP) one. In the NLP problem, the count of control steps is fixed initially and the sampling period is treated as a variable in the optimization process. The optimization object is to minimize the sampling period such that it is below a specific minimum value, which is set in advance considering the accuracy of discretization. To generate initial feasible solutions of the formulated NLP problem, genetic algorithms (GAs) are adopted. Since different initial feasible solutions can be generated, the optimization process can be started from different points to find the optimal solution. In this manner, one can find a time-optimal movement of the omni-directional mobile robot between two configurations. To show the feasibility of the proposed method, simulation results are included for illustration.

TA1

Session Title : Motor Drives I

Session Chair : Prof. Tian-Hua LIU
Prof. Fengge ZHANG

Date : 25 May 2006, Thursday

Time : 10:20am - 12:20pm

Venue : Pisces, Level 1

TA1.1 10:20am-10:40am P0342
Hybrid Electric Vehicles with Multilevel Cascaded Converter using Genetic Algorithm
*P G Song, E Y Guan, L Zhao, *S P Liu*
East China Jiaotong University
*Southeast University

Multilevel converters as a novel kind of converters used in high voltage and high power application field, can generate near sinusoidal voltages with only fundamental frequency switching; and have almost no electromagnetic interference or common-mode voltage. This paper presents 11-level cascaded converter as an application for high-power and/or high-voltage Hybrid Electric Vehicles (HEVs). The cascade inverter is a natural fit for large automotive all-electric drives because it uses several levels of dc voltage sources, which would be available from batteries or fuel cells. In the work presented here, it is shown how the switching times (angles) in a multilevel inverter can be chosen to achieve a required fundamental voltage and not generate or weaken the specific higher order harmonics. In this paper, agenetic algorithm (GA) optimization technique is applied to multilevel inverter to determine optimum switching angles for cascaded multilevel inverters for minimizing some predominant lower order harmonics via a cost function while maintaining the required fundamental voltage. This technique can be applied to multilevel inverters with any number of levels. By a Matlab program, the optimum switching angles are calculated offline to weaken the 5th, 7th, 11th and 13th harmonics to less than 0.5%. Then, these angles are used in a simulation and experimental hardware prototype, and the results show the superiority of the converters over two-level pulse width modulation-based drives.

TA1.2 10:40am-11:00am P0611
Active Clamp ZVT Boost Converter
J B Li, Y J Shi, Z X Niu, D F Zhou
Information Engineering University

In this paper, the technique of active clamp is applied in ZVT boost converter and forms active clamp ZVT boost converter. This converter is not only simple in topology but also achieves ZVT in both the main switch and the auxiliary switch. The boost diode turns off naturally and there is no reverse recovery loss. Current of the boost inductor flows in bi-direction and the usage rate of the magnetic core is increased. Operating intervals of the converter are presented and analyzed. Performances of this converter are discussed. A design example with simulating results and experimental results is presented. Conclusions are given at last.

TA1.3 11:00am-11:20am P0143
Dynamic Simulation of a Novel Adjusting Speed Induction Machine with Inner and Outer Rotors
F G Zhang, Y Li, F X Wang
Shenyang University of Technology

In this paper, a novel induction machine with inner and outer double rotors has been presented. The Double Rotors Induction Machine (DRIM) has the advantages of slow leakage inductance and high operation performance. This paper describes simply its structure and special windings. The electric-magnetic relationship and mathematic model of the DRIM have been built in actual coordinate, and the simulating program in MATLAB language has also been finished. Moreover, the simulation results and its analysis are given in this paper. The research shows that the operation characteristic of the DRIM is similar to the conventional induction machine.

TA1.4 11:20am-11:40am P0555
A Study on the Minimum Vibration of Linear Pulse Motor Considering Magnetic Characteristics
Y H Cho, J H Suh, K S Lee
Dong-A University

Linear pulse motor (LPM) has the vibration during the operation because of magnetic characteristic which is caused by the mechanical configuration and the electromagnetic property. This paper proposes the calculation of thrust on the base of magnetic equivalent circuit for the purpose of the vibration minimization of LPM. The permeance of LPM is

calculated and simulated from the construction tooth. The thrust is compared with the analytical method, the 3D finite element method (FEM) and the experimental values. The vibration of LPM is measured and estimated to select the input current wave for an optimal operation condition.

TA1.5 11:40am-12:00pm P0196

A Novel Micro Permanent Magnet Synchronous Motor Drive System without using a Rotor Position

Y H Chang, T H Liu, C C Wu
National Taiwan University of Science and Technology

This paper proposes a novel shaft position/speed estimating technique for a micro permanent magnet synchronous motor. By using the special characteristics of the micro motor, the back emf of the motor can be easily detected. In addition, the shaft position/speed can be derived according to the back emf. After obtaining the rotor position and speed, a closed-loop drive system can be achieved. A TMS-320-LF2407A DSP is used to estimate the shaft position/speed. In addition, a current controlled circuit, PWM circuit, and an inverter are implemented to control the stator current, and then control the motor. As a result, a closed-loop system is thus achieved. Experimental results validate the theoretical analysis and show the correctness and feasibility of the proposed estimating technique.

TA1.6 12:00pm-12:20pm P0400

Analytical Investigation of Influence of DC-Link Voltage Ripple on PWM VSI Fed Induction Motor Drive

J Klima
Technical Faculty of CZU in Prague

Analytical analysis and mathematical model of three-phase voltage source inverter with space-vector PWM feeding an induction motor drive under DC-link ripple voltage components are presented in this paper. The analytical expressions for the voltage and current space-vectors as a function of the DC-link voltage pulsation are derived. From the current space vectors the torque behavior is estimated again as a function of DC-link voltage pulsation it is shown, that DC-link ripple voltage components with angular frequency w0 may cause large torque pulsation with the same angular frequency. The proposed analytical method is based on the mixed p-z approach enabling presentation of the results in lucid and closed-form.

TA2

Session Title : FACTS & PFC

Session Chair : Prof. Gary W CHANG

Date : 25 May 2006, Thursday

Time : 10:20am - 12:20pm

Venue : Taurus, Level 1

TA2.1 10:20am-10:40am P0190
A New Method for Adaptive Distance Relay Setting in the Presence of SSSC using Neural Networks
H Rastegar, A P Khansaryan
Amirkabir University of Technology

The control parameters of Static Synchronous Series Compensator (SSSC) can significantly influence the apparent impedance seen by a distance relay, thus making it over-reach or under-reach for different cases. In this paper, a new method for setting the distance relays in the presence of SSSC for a first zone protection is presented. This paper reveals the problem imposed by SSSC and suggests a neural network-based approach as a solution. The boundaries of the relay operation characteristic are modified according to the control parameters of SSSC to avoid incorrect operations of the distance relay. Artificial Neural Networks (ANNs) have been used for the task.

TA2.2 10:40am-11:00am P0505
A New Approach for Modelling of UPFC in Power Flow and Optimum Power Flow Studies
M Mashayekh, A Kazemi, S Jadid
Iran University of Science and Technology

In this paper a new model for UPFC in PSAT software is proposed. The impact of this model in power flow and optimal power flow (OPF) in analyzed. This analysis is based on comparison of the results in every line before and after installation of UPFC in a test system. It is shown that the model introduced in this paper, is easy to do in steady state analysis and shows acceptable results.

TA2.3 11:00am-11:20am P0569
Simulation of Cascaded H-Bridge Converter Based DSTATCOM
*K Anuradha, *B P Muni, **A D Rajkumar*
VNRVJ Institute of Engineering and Technology
*Bharat Heavy Electricals Limited
**Osmania University

Voltage source converter based DSTATCOM has been established as the most preferred solution for management of reactive power in distribution utilities and for improving voltage regulation, power factor and power quality in industries. For high power applications, cascaded H-Bridge converter is the most ideal choice compared to neutral point clamped inverter and two-level inverter with series connected power devices. This paper presents the analysis, modeling and simulation studies on a cascaded H-Bridge converter based DSTATCOM for power factor improvement in power distribution set-up.

TA2.4 11:20am-11:40am P0167
Analyzing Input Harmonic Currents of a Six-pulse AC/DC Converter by an Efficient Time-domain Approach
G W Chang, Y C Chin, S H Lee
National Chung Cheng University

This paper presents an efficient approach for analyzing harmonic currents generated by a six-pulse AC/DC converter in steady state. The approach is carried out in time-domain and the interactions between the system and the converter are considered in the study. In calculating harmonic currents generated by the converter, the Poincare map based approach is applied to increase the computational efficiency and solution accuracy. The computed ac-side harmonic components of the converter current are then extracted via FFT. Solutions obtained by the proposed method are compared with those obtained by using a brute force time-domain simulation tool, Simulink of Matlab. It is shown that the harmonic currents determined by the proposed approach well agree with those obtained by the simulation tool, but the solution time is significantly reduced. In addition, the proposed method also can be applied to analyze harmonic currents produced by other types of power-electronic devices operating periodically.

TA2.5 11:40am-12:00pm P0487

Synthetic Application of FPSS and TCSC for Improvment of Voltage and Current Profile in Electrical Power Systems

A Kazemi, M Mousavi, M Kalantar
Iran University of Science and Technology

In this paper the ability of fuzzy logic to design power system stabilizer for generating proper control signal has been demonstrated. The selected TCSC is mounted at the center of transmission line and fuzzy power system stabilizer uses the variation of electric power and its derivative as input signal. Also using triangular membership function, the complementary signal is obtained. The study system is simulated using MATLAB Simulink 6.5. Then, applying a symmetrical three phase short circuit fault, oscillations are created in power system. The major area of this paper is damping this oscillation by using fuzzy power system and TCSC. Finally, in this study a comparision between controllers of PSS and PSS+TCSC and also FPSS+TCSC to damp this oscillation is done.

TA3

Session Title : HF Converter and SMPS

Session Chair : Prof. Bor-Ren LIN
Prof. S P NATARAJAN

Date : 25 May 2006, Thursday

Time : 10:20am - 12:20pm

Venue : Libra, Level 1

TA3.1 10:20am-10:40am P0584
Development of Neuro Controller for Negative Output Self-Lift Luo Converter
*R Kayalvizhi, S P Natarajan, *P Padmaloshani*
Annamalai University
*Krishnasamy Enggineering College

The present work deals with the application of neuro control theory for the closed loop operation of negative output self-lift Luo converter, which is a newly developed DC-DC converter. Due to the time-varying and switching nature of the power electronic converters, their dynamic behavior becomes highly non-linear. Conventional controllers are incapable of providing good dynamic performance and hence neural network can be utilized as a feedforward controller for controlling power electronic converters. The neuro controller presented in this work is off-line trained using quasi-Newton backpropagation algorithm. The performances of the chosen Luo converter with neuro control are evaluated in this paper (using MATLAB coding) under load and line disturbances. The simulation results are presented. They validate the neuro control developed.

TA3.2 10:40am-11:00am P0219
Modified Pulse Adjustment Technique with Variable States to Control DC-DC Converters Operating in Discontinuous Conduction Mode and Driving Constant Power Loads
A Khaligh, A Emadi
Illinois Institute of Technology

The stability of the DC power electronics based power distribution systems is a significant design consideration because of the potential for negative impedance induced instabilities. In this paper, Pulse Adjustment technique, a novel digital control technique to control DC-DC converters loaded by constant power loads (CPLs) is introduced. This novel digital control treats converter as a digital system and regulates output voltage with the help of two predefined state variables. This method uses high-power and low-power duty cycles instead of traditional PWM, to regulate the output voltage of converter. The constant power load behavior is valid up to a certain frequency. An ideal constant power load is somehow the worst case, and for this reason the studies are done in the worst case. For transient situations we proposed a Modified version of Pulse Adjustment controlling method with variable high-power duty cycle which can stabilize the DC system. Besides, Pulse Adjustment technique with variable high-power duty cycle can be modified to achieve efficient line regulation.

TA3.3 11:00am-11:20am P0592
An Adaptive Noise Canceling Method for Single-Phase Unified Power Quality Conditioner
A Kazemi, M Sarlak, M Barkhordary
Iran University of Science and Technology

The most important problems related to Unified Power Quality Conditioner (UPQC) control is that of finding a method which can obtain an exact harmonic reference signal for control aim, particularly in the practical case where the harmonics and the system frequency of a power system are time changing. In this paper, application of Adaptive Noise Canceling (ANC) theory in UPQC is presented. It uses a primitive input including the corrupted signal and a reference input correlated with the fundamental component of the system voltage. The reference input is adaptively filtered and deducted from the primary input to obtain the desired control reference signal. It is verified by the simulation results.

TA3.4 11:20am-11:40am P0367
Reduction of Common Mode EMI in a PWM Inverter through Fine-Tuning Gating Signals
K Zhang, Y B Zhou, Z Y Liu
Huazhong University of Science and Technology

In PWM converters, high dv/dts due to fast switching of the power devices can cause serious common mode electromagnetic interference (CM EMI). Theoretically, a single-phase full-bridge inverter under bipolar SPWM operation should produce very low CM noise because the two phase legs operating in a complementary manner can compensate for

each other. However, in practice this ideal scenario will never happen due to different transmission delays of the gating signals. In this paper, a method to compensate those differences in transmission delays through fine-tuning the pulse edges of gating signals is proposed and examined with experiment. Experiment on a DSP-controlled single-phase full-bridge inverter shows that this method can effectively reduce the CM noise up to 4MHz without any hardware expense. Limitations of the method are also discussed based on the experimental results.

TA3.5 11:40am-12:00pm P0374
Digital Power Electronics
F L Luo
Nanyang Technological University

High frequency switching circuits can effectively increase the power density, efficiency, reliability and flexibility, and reduce power losses and equipment cost. Consequently, high-frequency switching circuits have been paid much attention in recent decades. These performances are thoroughly different from traditional analogue control systems. Till now there is no suitable theory to describe the characteristics of the switching circuits and systems. A new theory entitled "Digital Power Electronics" presents the clue of switching operation (switching period T = 1/f, f is the switching frequency) and the pumping-filtering process, resonant operation and soft-switching methodology, and researched the rules of power switching circuits and systems. The new parameters Energy Factor (EF), Pumping Energy (PE), Stored Energy (SE), Capacitor- Inductor stored energy Ratio (CIR) and time constants ƒä and ƒäd. Using these new parameters, ZOH/FOH/SOH and the z-transform can well describe the characteristics of power switching circuits and systems.

TA3.6 12:00pm-12:20pm P0150
Three-Phase Phase-locked Loop Control of a New Generation Power Converter
*W Phipps, *M J Harrison, R M Duke*
University of Canterbury
*Eaton Powerware Ltd

This paper describes the development of a new generation of power converter, used to power telecommunications equipment. A telecommunications converter must comply with the psophometric noise standard CCIF-1951 and the IEC1000-3-2 harmonic standard. While the IEC1000-3-2 standard is easily met with active power factor correction techniques, a high degree of effort is usually required to meet with the psophometric standard. Therefore, a control methodology utilising a three-phase phase-locked loop is introduced as a method of complying with the psophometric standard under distorted mains conditions. Simulations show that combining this with a novel feedback controller, results in an improved load step response over using a traditional proportional integral type controller.

TA4

Session Title : Switching CCT and Converters I

Session Chair : Asst. Prof. Sumedha RAJAKARUNA
Mr. Miao ZHU

Date : 25 May 2006, Thursday

Time : 10:20am - 12:20pm

Venue : Gemini, Level 1

TA4.1 10:20am-10:40am P0643
Modelling and Analysis of Super-Lift Converters with Switching Signal Flow Graph Method
M Zhu, F L Luo
Nanyang Technological University

This paper presents a novel modelling and analytical method for super-lift converters based on the switching signal flow graph (SFG). The capacitor voltage-lift technique adopted in the dc/dc conversion is modeled by the proposed method. In addition, the effects caused by parasitic parameters and diodes' voltage drop are taken into account. The general guidelines for drawing switching SFG and the derivation of models are provided. With the applications to the examples, the proposed method shows the advantages of high convenience and practicability to the super-lift converters. Both the circuit simulation and experimental results are provided to support the theoretical analysis.

TA4.2 10:40am-11:00am P0164
A Power Balance Control Technique for Operating a Three-Phase AC to DC Converter using Single-Phase CUK Rectifier Modules
U Kamnarn, V Chunkag
King Mongkut's Institute of Technology, North Bangkok

The analysis and design of a single-stage three-phase AC to DC converter using single-phase CUK rectifier modules is discussed based on power balance control technique. The proposed system is formed by an inputside star-connected of three single-phase CUK rectifier modules with parallel connected at DC outputs. The control strategy consists of single voltage loop control and three-inductor current calculator. The main objective of the proposed system is to reduce the number of stages and improve dynamic response of DC bus voltage for distributed power system. The proposed schemes offer simple control strategy, flexibility in either 3-phase delta or star connected and simpler design. The proposed system is discussed and compared to a parallel CUK PFC circuit based on power balance control technique. A power balance control technique for controlling the three-phase AC to DC converter is proposed which guarantees a step load changes of the phase modules and allows to continue the system operation also in case of loss module conditions including one and/or two-module operation. The simulation results indicate that proposed system are offer the fast transient response and power factor closed to unity.

TA4.3 11:00am-11:20am P0200
Analysis and Design of Half-Bridge Converter with Two Current Doubler Rectifiers
B R Lin, C L Huang, C H Tseng
National Yunlin University of Science and Technology

A new half bridge converter with two current doubler rectifiers is proposed. Two transformers are used in the proposed converter. The primary windings of two transformers are connected in series to reduce the voltage stress across the magnetizing inductor. Two current doubler rectifiers at the secondary sides are connected in parallel to reduce the current stress of secondary winding and rectifier diodes. The asymmetrical pulse-width modulation technique is used in the proposed converter to regulate the dc output voltage and improve the duty cycle utilization. The transformer leakage inductance and the output capacitance of switching switches are used to resonant during the transition interval between two switches in order to achieve zero voltage switching (ZVS). The operation principle and design considerations of the proposed converter are provided. Experimental results for a 100W (5V/20A) prototype are presented to verify the theoretical analysis and circuit performance.

TA4.4 11:20am-11:40am P0206
An Interleaved Series-Parallel Combination of Two-Transistor Forward Converters
Y F Chen, L G He
Nanjing University of Aeronautics and Astronautics

A novel DC/DC converter with interleaved series combination is proposed in this paper. The converter is made up of two two-transistor forward converters which work alternately. One advantage of this topology is that it can reduce the voltage stress on switch by the series combination of input. The other is that the filter size can be minished due to the parallel combination of output which can increase the working frequency of the whole system by one time. A novel circuit which can realize the self-startup function is also introduced in this paper.

TA4.5 11:40am-12:00pm P0622

Development of Fuzzy Logic Control for Paralleled Positive Output Elementary Luo Converters

*R Kayalvizhi, S P Natarajan, *S Anbumalar*
Annamalai University
*Sri Manakula Vinayagar Enggineering College

DC-to-DC converters are widely used in applications such as computer power supplies, car auxiliary power supplies, servomotor drives and medical equipments. Luo converter is a recently developed DC-DC converter. Positive output Luo converter performs the conversion from positive source voltage of one level to positive load voltage of another required level. Parallel connection of Luo converters are used when available converters are of lower current rating but load requires higher current. Because of dissimilarity in devices and components used in each converter, current drawn or supplied by each converter may be unequal which will lead to converter failure or mal-operation. Therefore the main control issues in parallel-connected converters are to equalize the output currents among the converters and to ensure constant load voltage under supply and load disturbances. The objective of this work is to develop Fuzzy Logic Control (FLC) for paralleled positive output Luo converters using MATLAB software. The simulation results are presented and evaluated. They validate the fuzzy logic control developed.

TA5

Session Title : Motion Control

Session Chair : Asst. Prof. Ning LIU
Assoc. Prof. Changyun WEN

Date : 25 May 2006, Thursday

Time : 10:20am - 12:20pm

Venue : Aquarius, Level 1

TA5.1 10:20am-10:40am P0262
Adaptive Tracking Control of a Piezoelectric Micropositioner
H J Shieh, P K Huang
National Dong Hwa University

In this study, an adaptive tracking control is proposed for trajectory tracking of a piezoelectric micropositioner which is often used to trajectory scanning applications in microscopy. To describe the dynamics of motion of a single-axis piezoelectric micropositioner approximately, a mathematical model composed of a linear differential equation about motion of mechanical systems and a specified hysteresis function is developed. Then, an adaptive tracking control based on this developed model is proposed. The main purpose of the linear differential equation is to describe the motion dynamics of the mechanical component and the specified hysteresis function is to emulate the hysteresis behaviour due to the stacked piezoelectric actuators built-in inside the micropositioner. To validate the proposed control approach, a PC-based control system which uses a laser interferometer as the displacement sensing detector is implemented. Experimental results illustrate the feasibility of the proposed controller for practical applications in trajectory tracking.

TA5.2 10:40am-11:00am P0365
Robust Tracking Control of Mechanical Servo Systems with Inertial Parameters Varying in a Large Range
Q Liu
Huaqiao University

When implementing different tasks, mechanical servo systems must adapt to various working loads with different weight or inertia, which may lead to the remarkable varying of servo system's inertial parameters. However, for such cases, motion control methods at present such as PD control and disturbance observer based robust control design, may exhibit instability or tracking performance's decline. For the problems mentioned above, a novel nonlinear control scheme, for which the varying range of inertial parameters was supposed to known, was presented. The nonlinear controller is composed of two parts: the PD control design for the reference model system, and the sliding mode control of the mechanical plant. The sliding mode technique was used for servo system to achieve robust stability and guaranteed transient response, and the boundary layer control was adopted to avoid chattering introduced by control switching. The servo system's global stability is proved by using Lyapunov's direct method, and the transient performance is analyzed. Computer simulation results developed for a DC motor servo system show the effectiveness of the proposed method.

TA5.3 11:00am-11:20am P0462
Development of a Real-time Interpolator for NURBS based on Multi-DSPs System
N Liu
Jinan University

On the analysis of current non-uniform rational B-spline (NURBS) interpolation studies, a configurable NURBS interpolation flows and a structure of two-phase pipeline mode interpolator which based on dual digital signal processor (DSP) is presented. With TMS32F2812 and TMSC6713 DSP chips, a test NURBS interpolator was built. Time delay indexes of the sub-algorithms included the configurable NURBS interpolation flows ware tested and the tasks scheduling strategy for the multi-DSPs interpolator is discussed. Experimental results showed that configurable NURBS interpolation flows are feasible and it can meet varied needs at tradeoff between speed and precision for different applications. The two-phase pipeline mode NURBS interpolator is successful to increase the interpolation speed.

TA5.4 11:20am-11:40am P0511
DSP Based Implementation of Fuzzy Precompensated PI Speed Controller for Vector Controlled PMSM Drive
B Singh, B P Singh, S Dwivedi
Indian Institute of Technology, Delhi

This paper deals with the performance analysis and hardware implementation of a Fuzzy Precompensated Proportional-Integral (FPPI) speed controller for Vector Controlled (VC) Permanent Magnet Synchronous Motor (PMSM) drive using a digital signal processor. The power circuit of the PMSM drive consists of insulated gate bipolar transistor (IGBT) based Voltage Source Inverter (VSI) and the gate driver circuit. The hardware of control circuit has current sensors and interfacing circuits. The fuzzy logic precompensation in reference speed, rotor speed estimation using sensed position signals, the vector controller and PWM current controller for the control of VSI are implemented in assembly language of DSP-ADMC401. The simulation model of the drive system is developed in MATLAB environment with simulink, PSB and FLC toolboxes to analyze the performance on the developed PMSM drive system. Simulated results are validated with test results of the PMSM drive for starting, speed reversal and load perturbation.

TA5.5 11:40am-12:00pm P0521

Application of Inductosyns in High Precision Mechanical Servo Systems

Q Liu
Huaqiao University

Great measurement errors can be made by the existence of measurement delay in sampling servo systems which use an Inductosyn as a position sensor. In order to solve the problem, a new dynamic compensation method is introduced to revise the measured output by employing linear extrapolation. In this method, the measurement errors are to be reduced, and the system tracking precision can be enhanced. Further more, based on theory analysis, this article sets a limit to measurement errors after making necessary revisions to the output. The method has been proved to be effective by both results of a simulated test and of an experiment conducted with a three-axis flight motion simulator.

TA5.6 12:00pm-12:20pm P0298

Power Alignment, New Digital Control Approach for a DC-DC Flyback Converter with Constant Power Loads

A Khaligh, A Emadi
Illinois Institute of Technology

Power electronic components are inevitable parts of advanced vehicular power systems, because of their high efficiency and high power densities. Power electronic components, when tightly regulated; behave as constant power loads (CPLs). In order to mitigate the problem of negative impedance instability this paper presents Power Alignment, a new digital control technique for converters with constant power loads (CPLs). This approach uses two predefined state variables instead of conventional pulse width modulation (PWM) to regulate the output voltage. A comparator compares actual output voltage with reference voltage and then switches between appropriate states. It needs few logic gates and comparators to implement digital control, thus making it extremely simple and easy to develop a low cost application specific integrated circuit (ASIC) for converters with CPLs. Simulation and analytical results are presented to describe and verify the proposed technique.

TA6

Session Title : Poster Session I

Date : 25 May 2006, Thursday

Time : 10:20am - 12:20pm

Venue : Foyer

TA6.01 P0394
Convergence Speed Analysis of Iterative Learning Control Approaches
*F X Piao, Q L Zhang, *J X Xu, **L Chen*
Northeastern University
*Shenyang University of Technology
**Nanyang Technological University

In this paper, the convergence speed of the different algorithm is analysed for non-linear dynamic system. Convergence speed is one of the most important factors in iterative learning control. A definition of convergence speed is introduced, which provides a rigorous and quantified evaluation criterion for comparing the convergence speed of different iterative learning control algorithm. The convergence speed relations of PD-type and D-type learning law, PI-type and P-type learning law are given. The results show that the convergence speed of the D-type learning law is faster than the PDtype learning law, and the convergence speed of P-type learning law is faster than the PI-type learning law. Finally, numerical illustrations showed the validity of the proposed opinion.

TA6.02 P0473
Subway Train Motion Modeling and the Event-based Optimal Control
F Lu, M M Song
Shandong University

The optimization of subway train's operation time is an important problem to train's schedule. After a detail analysis of the forces in the train operation, the mathematic motion models is introduced, the event-based control technology is adopted to solve the optimal control of train, taking the traveled distance of the train as the action reference variable, the functions of velocity and acceleration of time t are transferred into the functions of action reference, the train operation can be scheduled according to the traveled distance in real-time. It can shorten the delay of the operation time caused by some uncertain events and the waiting time of the passenger, and offers a new way to the metro control.

TA6.03 P0189
A Geno-Hydra Control System: Design and Tuning Hybrid Controller based on Hydra Control Structure by using Genetic Algorithms
N Sanornoi, B Purahong, U Sritheerawirojana, P Sooraksa
King Mongkut's Institute of Technology, Ladkrabang

This paper shows how to design the hybrid control system based on hydra control structure by introducing two design strategies which are as following: Double head and Line up. These two strategies use Genetic Algorithms to improve parameters in control system and they also situate the Challenge and Best-selection processes which are the methods to compare the efficiency of the system after they have been genetically calculated. In order to select an appropriate control system in each layer, the simulation's results in the end will show the test with Non-linear plant to show the efficiency of control system after it has been developed by designing and tuning process.

TA6.04 P0349
On the Method of the Attribute Classification based on Rough Sets Theory
*J Y Deng, N Xu, *Z Y Mao*
Guangdong Institution of Education
*South China University of Technology

According to the Rough sets theory, analysis how the change of the condition attribute division infects the decision subset and decision rule support degree in the decision system. Summarize the method of selecting the best attribute classification, and provide a judge and algorithm of the best attribute classification gotten.

TA6.05 P0253
A Research of Suspension System with Hybrid Electromagnets Made of HTS Coils and Normal Conductor Coils
L Wang, G H Chen, Z X Liao, Z Jun, J S Lian
Southwest Jiaotong University

A suspension system with hybrid electromagnets made of HTS coils and normal conductor coils consumes little power and has larger suspension

gap. In this paper the mathematical model of this hybrid suspension system is introduced, its characteristics are analyzed, and a controller is designed to ensure its fixed suspension gap. The simulation proved that the controller can meet the performance specifications.

TA6.06 P0152
Synchronization of Chaotic Systems based on a Kind of Fuzzy Control
H W Wang, H Gu
Dalian University of Technology

In the paper, the fuzzy control method is proposed to control the synchronization of Chaotic Systems. Based on fuzzy dynamic model approaching non-linear system, the fuzzy model can be decomposed into local linear model. The structure of fuzzy controller designed by control theories is simple and needs few rules. The synchronization of chaotic system is studied by means of the proposed controller. It is shown the validity of the fuzzy control method based on the simulating result of the synchronization of two different chaotic systems.

TA6.07 P0151
A Learning Algorithm of Fuzzy Model based on Improved Fuzzy Clustering and QR Decomposition
H W Wang, H Gu
Dalian University of Technology

In this paper, we proposed a learning algorithm for fuzzy modeling based on the improved fuzzy clustering and QR decomposition. The improved fuzzy clustering is confirmed based on a new objective function, which includes the influence on input variables and output variables exerting input space of fuzzy model. Fuzzy inference matrix acquired from improved fuzzy clustering are analyzed on the basis of QR decomposition of Matrix. According to analyzing the redundancy of the matrix, the structure of fuzzy system is confirmed in the paper. The structure and parameters of fuzzy model are estimated by means of the proposed algorithm. We demonstrate the performance of the proposed algorithm using the simulating result of the nonlinear system.

TA6.08 P0199
Oriented Engineering Application for Voltage Security Analysis of Power Systems
*X Zhou, B J Li, *W Y Li, *C Wu, T S Xu, X C Ren*
Nanjing Automation Research Institute
*Yunnan Electric Power Dispatching Center

This paper deals with oriented engineering application of voltage security analysis of large-scale power systems, including engineering criterion of voltage security, principal objective, and systematic procedure of voltage security assessment. A systematic approach to voltage security assessment is presented in this paper. Example of Yunnan Grid voltage security analysis using systematic voltage security analysis method is presented.

TA6.09 P0248
Discussion on Power System Dual-configuration Relay Protection Scheme on EHV Networks
*H Xiao, *X B Wu, L X Zhou, X J Zeng*
Changsha University of Science and Technology
*Hunan Exceed High Voltage Transmission and Transform Company

According to the twenty-five instructions about anti-accident measure and the technical code for relaying protection and security automatic equipment, the principle and significance of dual-configuration relay protection on EHV networks is put forward. The characteristics of dual-configuration relay protection in several aspects are researched and analyzed, such as DC power supply, alternating current, alternating current voltage, transmission channel and so on. And some methods to solve the problems are present. Specific aspects of dual-configuration of relay protection are discussed and counter measures are proposed. It has great significance to provide high security and stability for power system.

TA6.10 P0145
Design of Fractional Order Controllers based on Particle Swarm Optimization
J Y Cao, B G Cao
Xi'an Jiaotong University

An intelligent optimization method for designing Fractional Order PID (FOPID) controllers based on Particle Swarm Optimization (PSO) is presented in this paper. Fractional calculus can provide novel and higher performance extension for FOPID controllers. However, the difficulties of designing FOPID controllers increase, because FOPID controllers append derivative order and integral order in comparison with traditional PID controllers. To design the parameters of FOPID controllers, the enhanced PSO algorithm is adopted, which guarantee the particle position inside the defined search spaces. The optimization performance target is the weighted combination of ITAE and control input. The numerical realization of FOPID controllers uses the methods of Tustin operator and continued fraction expansion. Experimental results show the proposed method is highly effective.

TA6.11 P0163
Model of Network Intrusion Detection System based on BP Algorithm
*Y Wang, G X Huang, *D G Peng*
East China Normal University
*Shanghai University of Electric Power

Security has become an important issue for networks. Models of network intrusion detection

system are important component of the issue. The research aims at the design and implementation of an Intrusion Detection System based on BP algorithm that can promptly detect attacks, no matter they are known or not. In this model, BP algorithm is used to learn about the normal users' behavior and the abnormal users' behavior. When the learning is over, a k-matching algorithm is given. The model is tested with the network traffic that contains both normal and abnormal data. In experiments, result proves the model is effective.

TA6.12 P0525
Research on Reverse Genetic Algorithms based on Adaptive Tuning of Mutation Probability
D P Liu
Hangzhou Dianzi University

This paper presents a modified genetic algorithms, which based on tuning of mutation probability by the value of individual fitness. The fine modular in current generation is easy to survive in the offspring, and at the same time the variety of population is also guaranteed. In modified scheme, the order of crossover and mutation is changed in order to avoid repeated computing of individual fitness. Simulation result shows that the modified scheme is prior to the GAs commonly used.

TA6.13 P0233
Secure-SPIN: Secure Sensor Protocol for Information via Negotiation for Wireless Sensor Networks
*D B Xiao, M J Wei, *Y Zhou*
Huazhong Normal University
*Wuhan University of Technology

Many routing protocols have been proposed for sensor network, but most of them have not designed with security as a goal. Sensor protocol for information via negotiation (SPIN) protocol is a basic data centric routing protocol of sensor networks. In this paper, we present the design of secure-SPIN, a secure extension for the SPIN protocol. We divide secure-SPIN into three phases and use some cryptographic functions that require small memory and processing power to create an efficient, practical protocol. Then we give security analyses of this protocol. It shows that this secure protocol may increase the data communication security in wireless sensor networks.

TA6.14 P0191
Microprocessor-based Multi-Functional Automation Laboratory for Power System
*K Wang, S Y Wang, *G Dong, **L Jiang, **X Zhang, Z C Pan*
Shandong University
*Shandong Electrical Power Corporation
**Zibo Power Supply Company

This paper describes a microprocessor-based multi-functional automation laboratory for power system. The details of the laboratory and its functions are presented. Especially, the principle of microprocessor-based excitation regulator and microprocessor-based full synchronizing control device are illustrated. Then a real power system can be simulated well through this novel laboratory. The laboratory not only make the students get familiar with the fundamentals of power system but make them learn how synchronous generators work and how they operate in a real power system.

TA6.15 P0198
Phase-Shifted Suboptimal Pulse-Width Modulation Strategy for Multilevel Inverter
J Ning, Y Y He
Northwestern Polytechnical University

Multilevel inverter has been widely investigated for high-power applications in recent years. Various topologies and modulation strategies have been proposed for utility and drive applications in the literature. There are three main types of transformerless multilevel inverters proposed so far, diode-clamped inverter, flying-capacitor inverter and cascaded inverter. The cascaded inverter has drawn tremendous interest. The most attractive features of cascaded multilevel inverters are as follows: Firstly, they require the least number of components to achieve the same number of voltage levels. Secondly, modularized circuit layout and packaging is possible and there are no extra clamping diodes or voltage balancing capacitors. Various multilevel PWM methods have been proposed during the past two decades. They can be classified into two catalogues, carrier-based PWM method and space vector PWM (SVPWM) method. Carrier-based PWM is superior to SVPWM for five-level converter and above. In order to overcome the disadvantages of low modulation index and fundamental component existing in Subharmonic PWM (SHPWM) and Phase-shifted PWM (PSPWM), a new triangular carrier-based phase-shifted suboptimal PWM (PS-SUB-PWM) suitable for cascaded multilevel converters is proposed in this paper. The triangular carriers in this method are same as that in the PSPWM method, but the modulation waveform is modified by adding the 3rd, or the 6th, or the 9th harmonics and so on to it. Injecting harmonics into modulation waveform makes modulation index and fundamental component increase. Through analysis of PS-SUB-PWM strategy, the parameters of optimal wave and switching angles are derived. The simulation results indicate that the proposed method is validity.

TA6.16 P0322
Study of Electric Power Quality Improvement in Ship Networks
X Y Xu, M He, H Y Zheng
Shanghai Maritime University

In this paper, the reason for the deterioration of electric power quality in ship networks these years is discussed. And the necessity of improvement of marine power quality is described considering the effects of this phenomena on economical operation of ship and reliability of marine systems. Afterwards, the Criteria of power quality that have been issued in China are introduced, as well as the specific demands on marine power quality. Then, relevant solutions which are applied nowadays to improve power quality of electric network according to the five aspects of power quality - harmonics, fluctuation and flick of voltage, voltage deviation, unbalance of three-phase voltage and current, frequency deviation - are discussed. Finally, the applicability of the employment of the relevant solutions to marine electric power system is discussed, and a new solution that is more suitable for marine use is proposed after its theoretical analysis.

TA6.17 P0640

Thermal Plants Optimization using Fuzzy Logic Controller

S Manjang, Y S Akil
Hasanuddin University

Interconnection electric power system has thermal power plants, such South Sulawesi, fuel cost is an important element in operating interconnection electric power system. Totally, in the operational cost of generation, fuel price is the greater part. And, the fuel price tends to raise from time to time. Therefore, it makes effort to cut down on the operational cost by decreasing fuel cost until minimum level. One of the methods used in handling production cost of thermal power plants is fuzzy logic. Fuzzy Logic is one of the soft computing methods with capacity to process of uncertain data, imprecision and could be implemented with lower cost. This paper discusses how to optimize the output power of thermal plants unit by including generator limits, and calculating transmission losses in interconnection electric power system. Optimization method used is fuzzy logic controller with patron based on output La Grange method.

TA6.18 P0582

A Flexible Input Currents Control Strategy for Three-Phase PFC Rectifier under Unbalanced System

*A J Jin, *H T Li, S L Li*
University of Shanghai for Science and Technology
*Guangdong Telecom

Power Factor Correction (PFC) rectifiers are essential for load side harmonic and reactive power correction. In recent years, research and applications of PFC rectifiers have attracted more attention due to the increased energy awareness in the global. The new three-phase boost PFC rectifier which is based on one cycle control and proposed by Chongming Qiao[1] is featuring excellent performance, simple circuitry, and low cost, and under balanced or unbalanced source, the input currents being kept low harmonic and linearly proportional to the non-zero sequence of the three-phase input voltages[2]. But C.Qiao's control strategy has shortcoming to control input currents flexibly under unbalanced source, for example, to minimize output filter, we want to control the input currents such that the input power is a constant[4]; or we want to control the input currents keeping balanced[4]; or we want the input currents fully in-phase with each own voltages. This paper improves the control strategy and introduces a new general current control equation which can control the input currents flexibly. By selecting different current control parameters (CCP), we can achieve four control goals: (1) the same method which has been described in literature [1]; (2) input currents fully in-phase with its own input voltages; (3) constant input power; (4) balanced input currents. Experimental results are presented to verify the theoretical analysis.

TA6.19 P0583

A New High-Frequency AC Link Three-Phase Four-Wire Power Electronic Transformer

*A J Jin, *H T Li, S L Li*
University of Shanghai for Science and Technology
*Guangdong Telecom

In this paper, a new three-phase four-wire high-frequency AC link matrix converter is discussed, and the topology of conventional matrix converter is modified with an additional transformer for three-phase four-wire electronic power distribution application. The proposed approach accomplishes high output voltage transfer ratio which is more than unity, galvanic isolation between both voltage sources and higher power density by employing a high-frequency transformer into the intermediate stage of the dual bridge matrix converter. It has a bidirectional power flow capability, controllable input source displacement power factor and lower harmonic distortion on both input and output sides. Furthermore, with three dimensional space vector PWM (3D SVPWM) and modified control strategy, the input and output currents may keep low harmonic distortion under unbalanced input voltage or variable three-phase four-wire unbalanced loads. The proposed approach is a competitive solution to the electronic power transformer. Experimental results of a three-phase four-wire 220/380V 5KVA 50Hz electronic power transformer system based on DSP controller are presented and shown to demonstrate the advantages of the proposed system.

TA6.20 P0159

Research on the Model Based Testing Method for the Magnetic Leakage Field of Flaw

Y Xie, J Y Qian
Jimei University

The principle of model based testing is presented. Structure of flaw testing system for magnetic leakage field based on MBT (model based testing) is given. Three modules of testing system: model of magnetic

leakage field, model of sensor and model of signal processing unit are described. Modeling methods, model structure and model parameter are analyzed, providing an important tool to quantitative inspection, interpretation and evaluation of the flaw signal.

TA6.21 P0486

Research for Flexible Power Supply System for Electric Arc Furnace

L S Ge, S Liu, Y X Wu
Anhui University of Technology

Based on the improved nonlinear time-variable resistance model of electric arc furnace, the power supply system simulation model is established for voltage fluctuation study by means of MAILABE/POWER system. A flexible power supply method for EAF is presented in which SVG is used, the paper applied instantaneous reactive power theory to measure instantaneous reactive current, PWM is used for current tracing feedback control to make SVG produce the required reactive current. The simulation result shows that the method is valid to overcome power sup ply voltage fluctuation and flicker.

TA6.22 P0382

Feedforward-Feedback Current Tracking Control with Input Saturation for APF in 3-phase, 4-wire Systems

*F Liu, *C Shen, *J M Chen, *S W Mei, D Z Cheng*
Chinese Academy of Sciences
*Tsinghua University

In this paper, an integrated control architecture combining with both feedforward and feedback control is proposed. The feedforward part is used to realize the exact tracking of reference trajectories, and the feedback part drives the output of APF asymptotically converge to reference trajectories. The convergence rate is adjustable by changing the gain of feedback. Furthermore, the inverse Clarke transformation is utilized to map the polyhedral exact trackable region to a cube, which greatly simply the analysis of input limitation. Subsequently, the asymptotic tracking problem is analyzed to show the effects of input saturation on the tracking performance of APF. Simulation results illustrate the effectiveness of the proposed controller.

TA6.23 P0439

Backstepping Technique based Nonlinear Controller for a Textile Dyeing Process

*B Bandyopadhyay, *J V Desai, *C D Kane*
Indian Institute of Technology, Bombay
*Textile and Engineering Institute

This paper describes a control scheme for a MIMO system using backstepping method. Backstepping method is preferred in case of uncertainties in the process and constraints acting on the control input. In the present work, backstepping method for a PMTD process is investigated in order to maintain the concentration and volume of the dye bath thereby reduce the tailing effect. The proposed control strategy is designed and simulated usingMatlab/ simulink and results are presented to validate the proposed control scheme.

TM1

Session Title : Motor Drives II

Session Chair : Assoc. Prof. Ying-Shieh KUNG
Prof. Alexander MEDVEDEV

Date : 25 May 2006, Thursday

Time : 1:20pm - 3:20pm

Venue : Pisces, Level 1

TM1.1 1:20pm-1:40pm P0285
Role of Direct Torque Control Induction Motor Drives in MEMS
*P R Thakura, *A N Thakur, B M Karan, **G S Buja*
Birla Institute of Technology, Mesra
*National Institute of Technology, Jamshedpur
**University of Padova

Direct Torque Control of three phase Induction Motor (IM) is an outstanding method and also the state- of-art based on instantaneous space vector theory. It is highly commercialized which reflects that it has many advantages over dc commutator motors and Vector control of IM. In this paper High Power Switches, Vector Control, Direct Self Control and Direct Torque control (DTC) principle and in addition to that MEMS and its various applications are elaborated. It also highlights the use of DTC in the intelligent manufacturing technology as industrial manipulator and so it can be useful for MEMS also. This is the reflection of fact that voltage vector has sampling time in microseconds which controls torque and flux. Simulation has been carried on with 5 HP IM using Power System Blocksets in Simulink/Matlab environment and results are presented to show its feasibility.

TM1.2 1:40pm-2:00pm P0294
FPGA-based Servo Control IC for PMLSM Drives with Adaptive Fuzzy Control
Y S Kung, M H Tsai, C S Chen
Southern Taiwan University of Technology

A FPGA-based servo control IC for use in a permanent magnet linear synchronous motor (PMLSM) drive is presented in this paper. Mathematic model of the PMLSM is presented and the vector control scheme is used in the current loop of the PMLSM drive. Then, to increase the performance of the PMLSM drive, an adaptive fuzzy controller (AFC) constructed by a fuzzy basis function and a parameter adjustable mechanism is derived and applied to the position loop of PMLSM drive to cope with the dynamic uncertainty and external load effect. After that, a FPGA-based control IC is designed to realize the controllers. The FPGA-based control IC has two IPs (Intellectual Properties), an Nios embedded processor IP and an application IP. The Nios processor is used to perform the function of an adaptive fuzzy position controller for PMLSM drive. The application IP is used to perform the current vector control of the PMLSM drive, which includes SVPWM generation, coordinate transformation, PI controller and the pulse detection of the quadrature encoder. At last, an experimental system has been set up and some experimental results have been demonstrated.

TM1.3 2:00pm-2:20pm P0320
Idealized Two-Axis Model of Induction Machines under Rotor Fault
*M Stocks, *F Rodyukov, **A Medvedev*
Lulea University of Technology
*Saint-Petersburg State University
**Uppsala University

In this paper a simple two-axis model for Induction Machines (IMs) with electrical rotor faults is derived. Being of reasonably low differential order, it is suitable for mathematical analysis and can serve as a ground for fault detection and fault tolerant control of the IM. The modelling is performed by applying well established idealizing assumptions regarding the magnetic and electrical properties of the motor. Typical motor faults as broken rotor bars are taken into account. The model is validated against data collected from mass-produced industrial IMs. The validation shows very good agreement between simulations and experiment, for the fault considered.

TM1.4 2:20pm-2:40pm P0564
Efficiency Optimization of Vector-Controlled PM Synchronous Motor Drives with Online Estimation of All Parameters
M Zamanifar, S Vaez-Zadeh
University of Tehran

An efficiency optimization method for vector-controlled surface permanent magnet synchronous motor (SPMSM) drives including online estimation of

all parameters is presented. The controllable electrical loss can be minimized by the optimal control of the armature current vector. Parameter variations except at near the nominal conditions have undesirable effect on the controller performance, so it is essential to estimate motor parameters. A stability study based on the second method of Lyapunov guarantees the stability and convergence of the estimated parameters under certain conditions. The simulation results show the feasibility and desirable performance of the proposed controller and observer.

TM1.5 2:40pm-3:00pm P0326

Idealized Two-Axis Model of Induction Machines under Stator Fault

*M Stocks, *F Rodyukov, **A Medvedev*
Lulea University of Technology
*Saint-Petersburg State University
**Uppsala University

In this paper, a low differential order model describing the dynamics of IMs with faulty stator is developed. The modelling is performed under well established idealizing assumptions regarding the magnetic and electrical properties of the motor. Typical motor faults as inter-turn short circuit and increased winding resistance are taken into account. The resulting model can be handled analytically and serve as a ground for fault detection and fault tolerant control of the IM. For each of the considered faults, very good agreement between simulations and experimental data collected from mass-produced industrial IMs is observed.

TM1.6 3:00pm-3:20pm P0330

Design of Neural Hysteris Band PWM Current Controller

Y Narri, A K Priya, G T Ram Das
Jawaharlal Nehru Technological University

This paper presents a neural network based current controller for a voltage source inverter. A fixed band hysterisis pulse width modulation controller is realized through an artificial neural network. A feed forward multilayer neural network is used for this purpose. The performance of the proposed neural hysterisis band pulse width modulation controller is compared with that of conventional hysterisis band pulse width modulation controller.

TM2

Session Title : Power Devices and Components

Session Chair : Assoc. Prof. Chien-Lung CHENG

Date : 25 May 2006, Thursday

Time : 1:20pm - 3:20pm

Venue : Taurus, Level 1

TM2.1 1:20pm-1:40pm P0335
Design of a New Nonlinear Fuzzy State Feedback Controller for HVDC Systems
*H R Najafi, *F Robinson*
University of Birjand
*University of Bath

This paper deals with design and stability of a new nonlinear fuzzy state feedback controller for HVDC systems. A novel simplified nonlinear dynamic model is developed for HVDC system that can be used to design the controller. The proposed nonlinear dynamic model decomposes into several linear systems around its important equilibrium points. These local linear models describe the plant dynamical behaviour at its different operating points. The proposed controller is used in the control loops of the HVDC system. The simulation is carried out based on the Cigre benchmark model. Simulation results show improvement of overall AC/DC/AC system performance when severe faults occur, compared to the conventional controller. Also, the stable behaviour of a very weak AC/DC system (SCR<2) with proposed controller is very significant when a sudden change in current order and/or a switched reduction in ESCR is applied. The same situation with conventional control brings the system into unstable region.

TM2.2 1:40pm-2:00pm P0601
A Novel Three Stage Drive Circuit for IGBT
Y X Sun, L Sun, A Esmaeli, K Zhao
Harbin Institute of Technology

IGBT is widely applied in converter circuit because of its highly switching speed and easy driving, which brings severity electromagnetic interference (EMI). High and low of the gate drive circuit performance affects the level of EMI. This paper proposed a novel three stage gate control technology for IGBT. It is based on an optimal combination of several requirements necessary for good switching performance under snubberless operation conditions. The control scheme specifically combines together the slow drive requirements for low electromagnetic interference and switching stress and the fast drive requirements for high-speed switching and low switching losses. The gate drive can also effectively dampen current and voltage oscillations generated during turn-on and turn-off respectively. This paper looks at the conflicting requirements of the conventional gate drive circuit design and demonstrates using experimental results that the proposed three-stage gate drive scheme obtains an optimal between switching speed, power dissipation and electromagnetic interference.

TM2.3 2:00pm-2:20pm P0616
Effect of Non-Sinusoidal Excitation to Inrush Current for Transformer
C L Cheng, S C Chern, J C Yeh, Y T Huang
National Formosa University

Inrush current is an important issue for transformers security and stability. Harmonic effects in power systems have been significantly increasing in the last decade. In this paper, SINm(wt) waveforms represent non-sinusoidal waveforms because studies on SINm(wt) waveforms appear to be simpler for more predictable results. A flux analysis of single-phase transformer is proposed in this paper. Furthermore, an active suppression method of inrush current is proposed. Finally, the effect of non-sinusoidal excitation to inrush current is analyzed and discussed in detail.

TM2.4 2:20pm-2:40pm P0610
Temperature Integrated Load Sharing of Paralleled Modules
*J L Barnette, *M R Zolghadri, M Walters, A Homaifar*
North Carolina A&T State University
*Sharif University of Technology

Paralleling power modules is designed to share system loads (stresses) equally to improve system reliability. Due to variations in the parameters in the power converter system, temperature mismatches may occur. These mismatches may lead to unequal life expectancy of individual converters in the total system. It is believed that equalizing the operating temperature of the semiconductor devices may improve total system reliability. In this paper a new

thermal-based load-sharing scheme for parallel converters is proposed. In this scheme, the load current is redistributed among parallel converters based on the temperature of the converters. The main idea is to minimize the relative temperature difference between parallel converters while they are supporting load current. To avoid an additional temperature sharing bus, temperature information is integrated with the current information. This information instead of current alone is used in a structure very similar to average current sharing to control the output current of each converter. In this way the converter with the highest temperature will support the least of the load current. Stability analysis of the closed loop system is presented through small signal modelling the parallel converters. Simulation and experimental results presented confirm the performance of the proposed method.

TM3

Session Title : Bio-medical II

Session Chair : Dr. Kar-Ann TOH
Dr. Ke CHEN

Date : 25 May 2006, Thursday

Time : 1:20pm - 3:20pm

Venue : Libra, Level 1

TM3.1 1:20pm-1:40pm P0651
Fingerprint Identification with Exclusive and Continuous Classification
X D Jiang, M H Liu, A C C Kot
Nanyang Technological University

Fingerprint identification from large database is a great challenge as both the accuracy and the speed of one-to-many matching may deteriorate significantly comparing to verification where only one-to-one matching is needed. For efficient large scale fingerprint identification, this paper proposes a combined classification approach, which takes advantages of exclusive and continuous classification by performing the continuous classification after the exclusive classification. To circumvent the problems of small number of human-interpretable classes in the traditional exclusive classification, a clustering technique is proposed in this work that exploits the similarities among the database templates and partitions them into much larger number of non-overlapping clusters than the conventional exclusive classification. Clustering technique serves as a coarse level classification which speeds up the followed continuous classification. Experimental results on NIST-4 fingerprint database demonstrate that the proposed approach outperforms various existing approaches in terms of not only the classification accuracy but also the classification efficiency.

TM3.2 1:40pm-2:00pm P0652
Multi-scale Feature Extraction for Face Recognition
B Mandal, X D Jiang, A C C Kot
Nanyang Technological University

Face recognition has been a very active research area in the past two decades. Many attempts have been made to understand the process how human beings perceive human faces. It is widely accepted that face recognition may rely on both componential cues (such as eyes, mouth, nose, cheeks) and non-componential/holistic information (the spatial relations between these features), though how these cues should be optimally integrated remains unclear. In this paper, we present a new different observer's view approach using multi-scale feature extraction from face images. The basic idea of the proposed method is to construct facial features from multi-scale image patches from different face components and then employ a subspace PCA method for further dimensionality reduction and good representation of facial features. Finally, combining the contributions of each component features draws the recognition decision. 2,388 frontal face images of FERET face database are used for evaluating the proposed method and results are encouraging.

TM3.3 2:00pm-2:20pm P0653
2D FDA vs. 1D FDA: Stereo Face Recognition
*J G Wang, *H Kong, W Y Yau*
Institute for Infocomm Research
*Nanyang Technological University

We made two contributions in this paper. First, a new method called Two-Dimensional Fisher Discriminant Analysis (2D-FDA) is proposed to deal with the Small Sample Size (SSS) problem in LDA based face recognition. Second, appearance and depth information are combined to improve face recognition rate. Different from the conventional 1DFDA (PCA plus LDA) approaches, 2D-FDA is based on 2D image matrices rather than column vectors so the image matrix does not need to be transformed into a long vector before feature extraction. The advantage arising in this way is that the SSS problem does not exist any more because the between-class and within-class scatter matrices constructed in 2DFDA are both of full-rank. 2D FDA and 1D FDA (PCA plus LDA) are evaluated respectively with a problem that combines appearance and depth information for face recognition. We investigate the complete range of linear combinations to reveal the interplay between these two paradigms. The recognition rate by the combination is better than either appearance alone or depth alone. It is verified that 2D-FDA outperforms 1D FDA.

TM3.4 2:20pm-2:40pm P0648
Robust Face Recognition by Fusion of Visual and Infrared Cues
S K Kim, H Lee, S J Yu, S Lee
Yonsei University

This paper proposes a robust face recognition method by fusing images acquired from visual and infrared (IR) sensors. Although current 2D image face recognition systems have reached a certain level of maturity, the performance of these systems has been limited by external conditions such as pose, expression and illumination. To alleviate some of these problems, infrared sensor based methods have been suggested. These methods showed very good performance when used in illumination variation environments. However, one of the main drawbacks of using IR sensors for recognition is that they are very sensitive to ambient temperatures. To solve this problem, we suggest a face recognition method that fuses both visual and IR techniques. We developed a visual and IR face image database with photographs taken under a wide range of imaging conditions. With this database, we are able to produce full combinations of comparative experiments in the field of face recognition. Our experiments showed that when using both modalities, results are far better in terms of recognition performance than when using only one modality. The overall average performance was observed to have improved under all imaging conditions.

TM3.5 2:40pm-3:00pm P0649
A Framework for Empirical Classifiers Comparison
*M R Abdullah, *K A Toh, D Srinivasan*
National University of Singapore
*Yonsei University

In this paper, we seek to establish a framework for empirical comparison of performance of pattern classifiers, allowing comparisons to be made consistently across different studies. As many as 106 datasets from the University of California, Irvine, Machine Learning Repository were used as comparison benchmarks. The framework provides a clear definition of the experimental setup so that it can be unambiguously reproduced or verified by others. Multiple runs of cross-validation and tuning were employed to minimize the possibility of random effects causing much biases in the results obtained. The metrics used to compare among different classifiers are based solely on simple readings obtained through classification tests. This allows future comparisons to be made readily adaptable for inclusion of new metrics.

TM3.6 3:00pm-3:20pm P0650
Learning from Target Knowledge Approximation
K A Toh
Yonsei University

This paper presents a new design approach of a sliding mode controller for a class of uncertain Distributed Parameter systems with delays. The system is invariant on the sliding surface. A class of variable structure control system is proposed. Some criteria are established for the stability and bifurcation in a mutual model with a delay τ which τ is regarded as a parameter. It is shown that designed linear time-delay control systems provide guaranteed robust reliable stability despite possible actuator failures. The classical Least Squares Error (LSE) learning method for pattern classification is to learn a classifier based on data density where the learning process (density-fitting error minimization) and the learning objective (classification error rate) do not find a good match. In this work, we propose to learn according to classification decision objectives directly. We shall work on two classification objectives namely, the Total Error Rate and the Receiver Operating Characteristics, and directly optimize the learning process according to these objectives. Using a learning model which is linear in its parameters, we propose two approximation methods to optimize these classification objectives. Our empirical results on biometrics fusion show comparable performances of the proposed methods with the widely used Support Vector Machines (SVM), with one of the approaches having a clear advantage of fast single-step solution.

TM4

Session Title : Switching CCT and Converters II

Session Chair : Prof. Chunying GONG
Assoc. Prof. Seyed Hamid FATHI

Date : 25 May 2006, Thursday

Time : 1:20pm - 3:20pm

Venue : Gemini, Level 1

TM4.1 1:20pm-1:40pm P0375
Sub-Envelope Modulation Method to Reduce Total Harmonic Distortion of AC/AC Matrix Converters
F L Luo, Z Y Pan
Nanyang Technological University

AC/AC matrix converter is an array of power semiconductor switches that connects directly a three-phase AC source to another three-phase load. It can convert an AC power source with certain voltage and frequency to another AC load with variable voltage and variable frequency directly without DC link and bulk energy storage component. Classical modulation methods such as Venturini method and space vector modulation (SVM) method using AC-network maximum-envelop modulation, implement matrix conversion successfully. However, in the mean time they cause very high total harmonic distortion (THD). Since matrix converters directly link loads to sources, high THD heavily pollutes power system, and damages other equipment's work. It restricts to apply matrix converters in industrial applications. This paper presents a novel approach: Sub-Envelope Modulation (SEM) method to reduce THD of matrix converters effectively. The approach is extended to an improved version of matrix converters and the THD can be reduced further. The algorithm of the SEM method is described in detail here. The method regarding current commutation is also proposed. Simulation and experiment results are also presented to verify the feasibility of the SEM approach. The results will be very helpful for industry applications.

TM4.2 1:40pm-2:00pm P0121
A Current-Fed Half-Bridge Oscillator for 400 Watt HID Lamp
A K Mukerjee, N Dasgupta
Indian Institute of Technology, Delhi

A current-fed half-bridge oscillator has been used to light a 400 watts high intensity discharge (HID) lamp for lighting factories, car parks or streets. The efficiency of the oscillator is approximately 89%. This oscillator is self driven and not dependent on any patented driver circuits, withstands short circuit conditions indefinitely and is not damaged even if the lamp fails or is accidentally removed. It also starts at low dc voltages as compared to conventional half bridge circuits. When used with suitable voltage multiplier circuits it can also be used with high voltage gas discharge and fluorescent lamps.

TM4.3 2:00pm-2:20pm P0318
Dynamic Properties of Interconnected Power Systems - A System Theoretic Approach
*K Zenger, A Altowati, *T Suntio*
Helsinki University of Technology
*Tampere University of Technology

Standard methods of system theory and control engineering are used to investigate the stability and performance of power units connected in series. The systems are .rst modelled in a normal multi-input multi-output form, and the dynamic properties are characterized in terms of poles and zeros. The series connection of such systems is shown to be of a similar normal form, and the internal and input-output stability can then be analyzed based on the general theory. The "minor loop gain", which has long been used to study the stability of connected power systems, is shown to be a natural result of the system theoretic approach.

TM4.4 2:20pm-2:40pm P0355
Reaserch on a Novel Interleaved Flyback DC/DC Converter
H M Wang, C Y Gong, H X Ma, Y G Yan
Nanjing University of Aeronautics and Astronautics

Flyback converter has been widely used in low-power applications because of its relative simplicity when compared with other topologies. This paper proposes a novel interleaved flyback DC/DC converter, which provides the additional benefit of recycling transformer leakage inductance energy and reducing voltage stress of the power switches. Its input and output current ripple is much smaller than basic flyback converter. The operation principle and design

considerations are analyzed and verified by the simulation and experimental results.

TM4.5 2:40pm-3:00pm P0366

Comparison of Modulation Methods for Three-Phase Multi-Level Voltage-Source Inverter from Conduction and Switching Losses Aspect

*M G Hosseini Aghdam, *S H Fathi*
Amirkabir University of Technology
*Iranian Research Organization for Science and Technology

The designer of static power converters must model the losses of converter switches to optimize the performance of system. This paper applies functional simulation model for analysis and comparison of conduction and switching losses in a multi-level voltage-source inverter using alternative modulation methods. This concept is based on semiconductor device characteristics modeling and is implemented with the help of MATLAB/Simulink. The method is fairly accurate and simple and takes a short run-time of simulation without any convergence problem.

TM5

Session Title : Filtering

Session Chair : Dr. Jiang FAN
Prof. Peizhen WANG

Date : 25 May 2006, Thursday

Time : 1:20pm - 3:20pm

Venue : Aquarius, Level 1

TM5.1 1:20pm-1:40pm P0405
An Effective Filter based on Fuzzy Technique and its Application
P Z Wang, L S Ge, S C Zheng, Y Qiao
Anhui University of Technology

In this paper, an adaptive filter, which is based on fuzzy reasoning technique, is proposed. The proposed approach firstly judges a pixel in the image to be a noise or non-noise with the fuzzy reasoning technique. If it's a fine detail, let it be. If it's an uncertain or a noise one, process it with a fuzzy weight smooth filter. Further more, to meet the requirement of some real-time application, two simplifying methods of this proposed approach are developed. The application in the sintering section image and photovoltaic array infrared image processing shows the proposed approach is more effective and feasible.

TM5.2 1:40pm-2:00pm P0604
Iterative Adaptive Switching Median Filter
K Nallaperumal, V Justin, S Subash, A Subramaniam, P Kumar
Manonmaniam Sundaranar University

The paper presents an improved median filter for salt & pepper impulse noise removal. This computationally efficient filtering technique is implemented as a two pass algorithm: In the first pass, identification of corrupted pixels that are to be filtered are perfectly detected into a flag image using an iterative fixed sized smaller window approach; In the second pass, using the detected flag image, the pixels to be modified are identified and corrected by a valid median. Experimental results have shown that the proposed algorithm performs far more superior than many of the median filtering techniques reported in terms of retaining the fidelity of the image highly corrupted by impulse noises even to the tune of ninety percent impulse noise. The proposed algorithm is free from patchy effects, does not extend black or white blocks in the image as has been found in many other adaptive median based techniques and is very effective in cases when images are corrupted with large percentage of impulse noises. This algorithm works very well for images with lower percentage of impulse noises.

TM5.3 2:00pm-2:20pm P0641
FIR Filter Design based on all Phase Symmetric Frequency Sampling Method
*X H Huang, J S Sun, *Z H Wang*
Hebei Polytechnic University
*Tianjin University

All phase symmetric frequency sampling method is put forward in this paper, which can setup shift variable according to the cut-off frequency. This method exerts inverse phase-shifts on two sub-filters, constructs a compensation filter, and at last combines sub-filters with compensation filter to form the needed low-pass, band-pass filter and notch filter. The design method is simple with a specific concept, and resolves the difficult problem of controlling the cut-off frequency accurately without changing the length of the filter in the traditional window method and frequency sampling method.

TM5.4 2:20pm-2:40pm P0234
Particle Filter for INS In-Motion Alignment
Y L Hao, Z L Xiong, Z G Hu
Harbin Engineering University

This paper presents a nonlinear dynamical model for the in-motion alignment of the inertial navigation system (INS) in the case that the observation variable is the velocity information. It allows the initial misalignment uncertainty. Therefore, this model is also suitable for the transfer alignment based on the velocity matching algorithm. Then the Gaussian particle filter (GPF) is analyzed and utilized for the nonlinear filtering. Under the turn maneuver, this paper analyzes and compares the misalignment estimation error and convergence rate of GPF with the unscented Kalman filter (UKF) when the initial misalignment is uncertain. The results of the simulation show that GPF is robust for the initial misalignment, but UKF is influenced badly. When the misalignment is large, the convergence rate of UKF

will be very slow, but GPF will not. Therefore, GPF is suitable for INS in-motion alignment.

TM5.5 2:40pm-3:00pm P0368

A Novel Design of Digital Filter for the Measurement of Power Frequency Signal

J Fan, F C Teng
Singapore Polytechnic

In an electrical power system, measurement of power frequency signals such as voltage and current is of paramount importance in monitoring the system operation and protecting equipment from damage due to system faults. This paper will address a new algorithm to calculate Discrete Fourier Transform (DFT) [1], [2]. It can be used to capture the power frequency signal from a distorted input, reduce the computing time of signal magnitude and angle, and also make effective use of memory resource of a microcontroller. The results of the various case studies are analysed to evaluate the availability of the algorithm under the different conditions. Finally the design of hardware circuitries is also presented to illustrate how to condition the analogue input signal for the digital signal processing.

TM5.6 3:00pm-3:20pm P0249

Minimal Realization of a Class of 2D Filters

*H J Fan, *L Xu, **W X Xie*
Huazhong University of Science and Technology
*Akita Prefectural University
**Seagate Technology International

It is well known that, unlike the 1D case, it is not always possible to find a minimal state-space realization for a general 2D filter or system described by a transfer function except for some particular categories. The purpose of this paper is to explore the possibility of minimal Roesser model realization for a class of 2D filters or systems which does not belong to the clarified categories. As main results, a constructive realization procedure is first proposed, which can be viewed as a kind of generalization of the well-known 1D realization approaches. Based on the proposed procedure, a sufficient condition for the existence of minimal realization of the considered class of 2D filters is derived, and the construction of such a minimal realization is shown. In addition, some further possible variations and applications of the obtained results are discussed and several illustrative examples are presented to show the details and effectiveness of the proposed approach.

TM6

Session Title : Poster Session II

Date : 25 May 2006, Thursday

Time : 1:20pm - 3:20pm

Venue : Foyer

TM6.01 P0460
Use of Ethernet for Industrial Control Networks
B Xi, Y J Fang, M C Chen, J Y Liu
Wuhan University

There are strong interests of using cheap and simple Ethernet technology for industrial control networks. However, traditional Ethernet is shared network using CSMA/CD protocol, which cannot ensure data determination and real-time reliability. Given the measured total delay distribution, this paper analyses the types of real-time data transmitted in industrial control networks and illustrate a hypothetical probability density function to describe the total delay in data delivery. Finally, the point of paper is put forward on devising an efficient method to estimate the delay probability of flows, especially those with multiple competing.

TM6.02 P0214
A Novel Active Power Filter for Harmonic Suppression and Reactive Power Compensation
X Y Xia, X Han
Changsha University of Science and Technology

A novel hybrid active power filter that can provide reactive power compensation while eliminating the harmonics effectively is proposed. The proposed one combines the series resonant injected active power filter with passive power filter. In this system, groups of single tuned filter that can suppress some special order harmonic are adopted as passive component. In its active component, coupling transformer is firstly connected with single tuned filter to make series resonant injected active power filter, and then connected in parallel with passive component. Principles of operation are also discussed in this paper. Finally, results of industrial application are given to verify that the proposed system has good characteristic of reactive power compensation and harmonic suppression.

TM6.03 P0482
The New Soft Starting Methods for Electronics Ballasts of UV Lamps based on Microcontroller
Y F Wang, D G Xu, D S Guo, X N Liu
Harbin Institute of Technology

Based on microcontroller (MCU) controlled half-bridge LCC series-parallel resonant inverters, the triple-frequency harmonics starting method and the double-capacitances starting method were respectively designed for high and middle power electronics ballasts of ultraviolet (UV) lamps. The principle and the experiments were presented and explained in details. The lamp can be ignited by using two mentioned methods without surge current at -40¡æ to 60¡æ. Finally, the application ranges, advantages and drawbacks of the two methods were compared. Also, the improved microcontroller programs make those methods more accurate than traditional methods, and the protection features during starting phase are included in the lamp soft-start programme, which can protect ballasts against all of error states during start stage.

TM6.04 P0364
Analysis and Design of a Novel Start Circuit for HID Electronic Ballast
H Yang, D G Xu, Y Q Lang
Harbin Institute of Technology

A novel starting circuit is proposed in this paper, which can provide voltage high enough to ignite HID lamp during the start-up stage. In the steady state, the lamps operate under low frequency square-wave voltage which is superposed with high frequency components to avoid acoustic resonance. In addition, analysis of the influence for starting voltage, such as different frequency and different duty ratio drive signal has been done.

TM6.05 P0469
A Control Method for PWM AC/DC Converter by use of Inductor Current Feed Forward and Feedback
*Q Zhang, C W Zhang, X Zhang, *W X Shen*
Hefei University of Technology
*Monash University Malaysia

The paper proposes a control strategy for three-phase pulse width modulated (PWM) voltage source converter (VSC) used in grid-connected distribution generation system. The key is to take the current of inductor in the filter as feedback to regulate the output current, with the addition of a feed-forward control scheme into the inner current loop. The paper

explores the fundamental performances of the usage of inductor current feed-forward for its contributions to transient system response and power factor. The proposed control method is implemented in a digital signal processor (DSP) based system and tested on an experimental 30KVA prototype unit. The results exhibit the effectiveness of the proposed control strategy.

TM6.06 P0531
Research on Dynamic Characteristics of Matrix Rectifier
*X J Yang, *W Cai, P S Ye, *Y M Gong*
Shanghai Jiaotong University
*Shanghai University

The complete circuit dq transformation of a three phase AC-DC MC, namely matrix rectifier (MR) system, is derived by utilizing circuit dq transformation technique and input current space vector algorithm. Then the model is partially differentially linearized, and the AC small signal circuit model is obtained, so is the state equation of matrix converter system. Based on the system signal-flow chart, the transfer functions of output variables to input variables are derived, then the dynamic behaviors of open loop system is analyzed theoretically. The above theoretical analysis is proved by the simulated results, laying the foundation for further system design. But the case of slightly unbalanced input voltages in practical applications is not considered here.

TM6.07 P0465
Parallel Resonant Converter with Multipliers and the Application in TWTA Power Supply
J B Li, Z X Niu, D F Zhou, Y J Shi
Information Engineering University

This paper introduces a new topology: Parallel Resonant Converter with Multipliers (PRCM), which is a good choice in high voltage applications, such as TWTA power supply. The operating principle of PRCM is analyzed in detail. Design guideline is presented. Then a design example in a TWTA power supply is introduced. At last the conclusion is given.

TM6.08 P0516
Study on Dynamic Accurate Modelling and Nonlinear Phenomena of a Push-Pull Soft Switched Converter
X Dai, X Y Huang
Chongqing University

In soft switched converters, the autonomous characteristic and complex boundary conditions bring forth complex dynamic behaviours different from those in hard switched converters characterized by fixed switched period. These characteristics also make present accurate modelling methods such as stroboscopic mapping modelling designed for fixed switching can't apply to soft switched systems. This paper proposes a numeric accurate modelling method for soft switched circuits according to those special characteristics. The application for a push pull soft switched converter exemplifies this accurate modelling method. In simulation, a frequency jump phenomena is observed. With the aid of impedance analysis, this paper discovers that the nonlinear phenomena root in the occurrence of multi zero phase angle frequencies with load parameter variation. At last, experiment observations verify these phenomena and this modelling method.

TM6.09 P0205
Simulation of PMBLDC Motor with Sinusoidal Excitation using Trapezoidal Control Strategy
R Somanatham, P V N Prasad, A D Rajkumar
Osmania University

The work reported concern with the simulation of a sensor controlled PMBLDC motor for Trapezoidal and Sinusoidal excitations. For both types of excitations Trapezoidal current control strategy is adapted. The simulated model is used to study the variation of speed, torque and current for various loads. A comparative study has been made for both types of excitations. The dynamic response was found to be better with Trapezoidal excitation than with Sinusoidal excitation on no-load. However, for steady state operation on load, Sinusoidal excitation was seen to be better.

TM6.10 P0230
Reduced-Order Linear Kalman Filter (RLKF) Theory in Application of Sensorless Control for Permanent Magnet Synchronous Motor (PMSM)
M C Huang, A J Moses, F Anayi, X G Yao
Cardiff University

This paper proposes a novel sensorless technique for PMSM based on reduced-order linear kalman filter (RLKF or LKF), Through the investigation into the comparison with Extended Kalman Filter (EKF), the proposed RLKF applied in position estimation can obtain higher precision, faster tuning on parameters than EKF and excellent dynamic speed response likewise. Experimental results prove it can match the high standard of servo industry and reliably take place of current EKF algorithm.

TM6.11 P0346
Faults Analysis on Regulating System Fed by Voltage Type Inverter and the Strategies of System Tolerance
S Q Huang
Anhui University of Technology

A new method of analysis on system faults based on softwares without any increase of hardware is brought up. The faults characters are gotten. Different faults are sorted according to the characteristics of driving system fed by voltage type

inverter. Experiments show the soft comprehensive protection can let system operate with the limits of system tolerance.

TM6.12 P0279
One Cost-effective Feedback Control Scheme for PWM Inverters Based on Repetitive Control
P F Shi, X Jian, K Zhang, L Zhou
Huazhong University of Science and Technology

One digital control scheme, which is based on voltage differential feedback control and repetitive control, is proposed in this paper. For the first form, arbitrary pole placement can't be achieved, but the pole scope in the digital field that covers almost the applicable field, and higher accuracy in steady state is attained. For the latter form, arbitrary pole assignment can be achieved with the voltage differential feedback compensator inner loop, which can improve the dynamic characteristic of inverter; the repetitive control outer loop improves the steady state performance of inverter. The scheme, which can achieve the same control effectiveness as "state feedback pole assignment plus repetitive control" without current sensor, is proved on a PWM inverter whose control system is based on DSP TMS320F240.

TM6.13 P0157
Study on a New Way of Load-matched for Voltage-Source Induction Heating Inverters
J G Li, Y R Zhong, X Ma
Xi'an University of Technology

The characteristics of three types of three-order resonant circuits, which were used in static electricity induction load-matched for voltage-source induction heating inverter is presented in this paper. The type of LCL is of more advantages. The analysing results and the designing way of LCL were given. The static state characters of this circuit were analyzed in detail and the characters curves were protracted with MATALB. The simulation and experimental results proved the theoretic analysis. Some guidance suggestions for voltage-source induction heating load-matched were also provided.

TM6.14 P0162
Neural Network-based Multi-Sensor Fusion for Security Management
*D B Xiao, *Y Zhou, M J Wei*
Huazhong Normal University
*Wuhan University of Technology

With the development of attacking technologies, the representations of security events become more and more complex, and the system security situation can't be detected or judged by some single security. In this paper, we put the theory and practical of neural network-based multi-sensor information fusion technology into security management for further study and put emphasis up on network security events fusion to optimize and improve the source events management and policy coordination in security management. We present a security management framework using neural network-based information fusion technology, and give an experimental environment to prove that the framework can provide believable security events and the output estimation for security management platform; it can serve as a reference for the response of network security events, so as to improve the response speed effectively.

TM6.15 P0156
Research and Development on Full Distribution CNC System
Z Y Chen, W Guo, C X Li
Shanghai Jiaotong University

The CNC architecture by expanding different motion cards is popular now, but it still lacks good configurable performance, the most functions of the motion card are redundant, and the control requirements cannot be met on the complex and high-precision situations. In this paper, a new Full Distribution CNC (FDCNC) system is presented. In this structure, the former two-grade interpolation is replaced with offline interpolation method; the motion control card in IPC is displaced with several intelligent nodes embedded in servo controllers. Communication between IPC and servo controllers is through CAN, which can transmit a lot of data in two directions and its communication protocol is public and standard. Thus, it gets much easier to repair, reconfigure, and replace some components. Additionally, enough information does great good to watching and diagnosing. Due to the use of Windows NT+RTX, not only developers are able to take advantage of the abundant Windows resources, but also CNC system possesses friendly graphic user interface (GUI), excellent open performance and good real-time performance. At last a running case is given.

TM6.16 P0160
Research of Control Network of Mobile Robots based on Dynamic Resource Changing
H H Zhu, Y Zhu, D F Chen, W F Li
Wuhan University of Technology

According to the dynamic characteristic of systematic resources, for instance the structure changes, information temporarily losing, resource conflict, etc., thesis builds the frame of the re-constrauct-able control network on mobile robots, solves the robust control, cooperation and communication of the mobile robots while the systematic resource was changed dynamically. Thesis introduces the systematic structure, explains the automatically constructing method of the network, and describes the self-renovating course of the network system. On the basis of the control frame of the network, users needn't care about such details as the different

management tactics of structure and matching mechanism of data transmission, etc. and is absorbed in the application-oriented service development. The intelligent mobile robot network system structured can face the complicated task and dynamic environment to harmonize the behaviour of mobile robots and schedule dynamically systematic resources.

TM6.17 P0358

A Novel Binarization Approach for License Plate

F Yang, Z Ma, M Xie
University of Electronic Science and Technology of China

Binarization of a gray scale license plate image is one of the most important steps of License Plate Recognition (LPR). It segments a license plate image into foreground and background. The foreground contains the characters to be segmented. This paper presents a compensation-based and central-scanned license plate image binarization approach. The approach enhances the license plate image with a contrast-stretching transformation at first. Then it applies a compensation-based binarization technique to the whole image and utilizes a centralscanned method to unify those license plate images with black character and white background after previous binarization. Experimental results on a number of license plate images show that our binarization approach combining compensation and central-scan is efficient even in situations of overexposure and underexposure.

TM6.18 P0321

A Dynamical Modulation Strategy of the Virtual DC-Link Voltage for Matrix Converters under Input Voltage Unbalance

D F Chen, K C Yao
National Changhua University of Education

The matrix converter is a single stage ac-ac power conversion device without dc-link energy storage elements. Any disturbance in the input voltages will be immediately reflected to the output voltages. Line voltage source unbalances can result in unwanted input harmonic currents. In order to eliminate the harmonic contents of the input current, the paper proposes a new switching strategy for a matrix converter under unbalanced conditions. In this control strategy, the virtual dc-link voltage is modulated based on the positive and negative sequence components of the input voltages and the motor speed. By using this strategy, the output current ripples are obviously reduced and input current harmonics can be effectively eliminated. Thus power quality can be improved. The matrix converter is also used to drive a PMSM servo motor. A nonlinear adaptive backstepping controller is proposed to improve the position response of the drive system. By using this controller, the system can track a time varying speed and position commands. All the control loops, including the switching strategy, current-loop, and position-loop, are implemented by TMS320LF2407A digital signal processor. The hardware circuit is very simple. Several experimental results are shown to validate the theoretical analysis.

TM6.19 P0144

The Vector Control Strategies of 12-Phase Cycloconverter-fed Synchronous Motor System

*H Lin, *B He, L Ma, *X F Zhang, Y B Zhou*
Huazhong University of Science and Technology
*Naval University of Engineering

Polyphase synchronous motors used as propelling motor in ships have a broad application foreground. It is necessary to research polyphase motor variable speed system. In this paper, the vector control strategies of 12-phase cycloconverter-fed synchronous motor are presented based on the analysis of 12-phase cycloconverter-fed synchronous motor with air gap-flux-oriented control. Further, the mathematical models of 12-phase synchronous motor in rotor d-q coordinate and in air gap-flux M-T coordinate are obtained. The simulation and experiment of the 12-phase cycloconverter synchronous motor system is carried out to verify the feasibility and validity of these strategies.

TM6.20 P0485

Discovery of Sneak Circuit Phenomena in Resonant Switched Capacitor DC-DC Converters

D Y Qiu, B Zhang
South China University of Technology

The sneak circuit phenomena were found in a family of resonant switched capacitor (RSC) DC-DC converters for the first time. Only would the disturbances of converter parameters or changes of operating condition lead to unexpected operation modes or cause undesired function of the converters. Some latent circuit paths within the RSC converters join in operation under certain conditions. A step-down RSC converter was used as an example to describe the sneak circuit phenomena and its condition by theoretical analysis and experiments. Furthermore, the proposed sneak circuit analysis method had been applied to the step-up and inverse RSC converters, and the corresponding conditions were obtained for their sneak circuit states.

TM6.21 P0461

Data Fusion in Supportability Assessment of Aeronautic Electron Systems

Q Y Su, Q Wang, S W Yan, J N Yin
Air Force Engineering University

Supportability assessment is an important job in systems life cycle and it is a certification of the working effect of Integrated Logistics Support (ILS). But in supportability assessment of systems such as aeronautic electron equipment, there are such problems as the redundancy of information, an unnecessarily wide range of time and space scope,

and a lack of accuracy. With the first ever introduction of data fusion in supportability assessment and an analysis of the suitability of data fusion in supportability assessment, this paper researches into the rules and fusion models of data fusion in supportability assessment and puts forward a brand-new strategy model of supportability data fusion. So, this paper has practical value in improving the accuracy of supportability assessment results of aeronautic electron systems and in enhancing the development of supportability assessment.

TM6.22 P0387

Synchronously Running Control Method for Four Machines of Double-Side Shear

*R L Pei, *Z J Diao, Y Fang, J X Miao, **Y Wang, **Z A Wang*
Baoshan Iron and Steel Co.Ltd
*Avago Technologies Nanyang
**Xi'an Jiaotong University

This paper mainly presents the asynchronous running control design and application for multiple electrical machines in steel industry production by an example-the double-side shear that includes four machines. In the steel producing line, the double-side shear has the task of trimming the plate fed to it by the pinch roll units on both length sides and chopping the edge scrap thus produced with the aid of the scrap shear. It performs this task in continuous operation. Four asynchronous motors are synchronously controlled by four separate inverters whose connections are realized by SIMOLINK (Siemens Motion Link) software. All control impulse signals are transferred to every inverter by PLC (Programmable Logic Controller) with less than 0.001s error. The shearing technology parameters for steel plate directly also influence the motor running status.

TP1

Session Title : Industrial Applications

Session Chair : Prof. Min HUANG

Date : 25 May 2006, Thursday

Time : 3:40pm - 5:40pm

Venue : Pisces, Level 1

TP1.1 3:40pm-4:00pm P0299
The Risk Programming of Virtual Enterprises based on Algorithms of Min / Max / Mean / Random-PSO
*M Huang, X J Wu, X W Wang, *W H Ip, *K L Yung*
Northeastern University
*The Hong Kong Polytechnic University

The classical Particle Swarm Optimization (PSO) is an effective method to find the extreme values of continuous functions, however its application in discrete space is still premature. In this text, four algorithms of PSO are proposed to solve the problem of combinatorial optimization. They are designed according to the different reactions between particle extremum and overall extremum and help to solve the problem of risk programming of virtual enterprises. Among these four algorithms of PSO, namely Min-PSO, Max-PSO, Mean-PSO, and Random-PSO, Random-PSO is concluded as the best after comparisons. Meanwhile, multi-level fuzzy synthetic evaluation is integrated to assess the overall risk level. Simulation analysis suggested that PSO is a simple but effective algorithm to solve the problem of combinatorial optimization.

TP1.2 4:00pm-4:20pm P0310
IMPOS: A Method and System for Injection Molding Optimization
*L Y Bai, *L Gong, S K Chen*
Shantou University
*IBM Watson Research

CAE techniques have, in recent years, become increasingly popular in plastic injection molding. However, in most practices, either molding parameters are not optimized or the optimization techniques are too complex to use. In this paper we discuss a fully automatic approach of Integrated Injection Molding Parameter Optimization and Simulation (IMPOS) to plastic injection molding problems. A working system has been developed. The experimental testing results with the system have demonstrated the efficacy of the method for handling quality problems in plastic injection molding such as warpage. In this method, a genetic algorithm is developed and integrated with an injection molding simulation system to achieve both parameter optimization and full automation of the process.

TP1.3 4:20pm-4:40pm P0328
Research on SA/CPM/MarKov Integrated Programming of Dynamic Risk of Virtual Enterprise
*M Huang, G J Jiang, Z H Liu, *W H Ip, X W Wang*
Northeastern University
*The Hong Kong Polytechnic University

With the emergence of global market economy and in order to respond fast to the constantly changing market demand, virtual enterprises arise at this historic moment. Risk management of virtual enterprise draws attentions of researchers. This paper proposes a three-level programming model to deal with the dynamic risk of virtual enterprise, based on non-linear integer programming, network analysis, and Markov Process. The model focuses on project organization mode and dynamic features of risk in virtual enterprise. It helps to determine the completion time of each process with the objectives of maximizing the minimum completion probability of all processes under the constraints of project investment, customers' due dates, and process quality. Furthermore, an algorithm of integrated SA/CPM/Markov is designed to solve the problem and its efficacy is shown by instances.

TP1.4 4:40pm-5:00pm P0524
Genetic Algorithms Based Parameter Identification for Nonlinear Mechanical Servo Systems
D P Liu
Hangzhou Dianzi University

Parameter identification for mechanical servo systems with nonlinear friction term is very difficult, and linear identification techniques are not adoptable because that the parameters can not be linear parameterized as well as the local minimum problem. Based on genetic algorithms, this paper presented a two-step offline method for the parameter identification of mechanical servo embedded with LuGre friction model. In the first step, four static parameters were estimated through the Stribeck

curve, and in the second step, two dynamic parameters were obtained by the typical limit cycle output of the system. Genetic algorithms with different control parameters and objective functions were used in both steps to minimize the identification errors. At last, the simulation are developed for a typical nonlinear mechanical servo systems, and the results have shown that the convergence of identified friction parameters are robust and not affected by the coupling property between the dynamic parameters and static parameters.

TP1.5 5:00pm-5:20pm P0362

A Low-Cost VLSI Implementation for VLC

Y M Lin, P Y Chen
National Cheng Kung University

In this paper, a low-cost technique to realize VLC is presented. Instead of using a large codeword table as most traditional methods did, we employed two smaller tables, symbol-address table and section-based table, to encode input symbols. Compared with those previous methods, our VLC implementation reduces about 29% to 47% memory size for MPEG-4 application, and thus needs lower hardware cost.

TP1.6 5:20pm-5:40pm P0596

An Alternative Approach to Estimate Load Torque in a Industrial Environment using Neural Networks

*A Goedtel, I N D Silva, *P J A Serni, *R A Flauzino*
University of Sao Paulo
*State University of Sao Paulo

The induction motors are largely used in several industry sectors. The dimensioning of an induction motor has still been inaccurate because in most of the cases the load behavior in its shaft is completely unknown. The proposal of this paper is to use artificial neural networks as a tool for estimating the load torque applied to the induction motor shaft rather than conventional methods, which use classical identification techniques and mechanical load modeling. Simulation results are also presented to validate the proposed approach.

TP1.7 5:40pm-6:00pm P0446

Two New Approaches to Automatic Generation and Accurate Adjustment of Vector Maps for AVL

*Y L Bao, *S G Wang, Z N Liu*
University of Science and Technology of China
*The University of North Carolina at Charlotte

Advanced Vehicle Location (AVL) needs vector maps. Two key procedures for accurately generating a vector map are (i) automatic extraction of a road network layer from a raster map to a vector map, and (ii) accurate geo-adjusting for calibration of the vector map. Their main corresponding problems are that the road pattern recognition is not measurable and the map geo-adjusting process is not accurate. This paper presents two new approaches to the solutions through (i) a closed-loop optimal control to the road and non-road pattern recognition to automatically adjust their evaluation function threshold and parameter values; and (ii) a topological discrete nonlinear adjusting method to accurately locate a group of selective points and their neighboring areas for the whole map. This approach has been successfully applied to accurate map vectorization and geo-adjusting.

TP2

Session Title : Harmonic Analysis and Compensations

Session Chair : Prof. Keiju MATSUI

Date : 25 May 2006, Thursday

Time : 3:40pm - 5:40pm

Venue : Taurus, Level 1

TP2.1 3:40pm-4:00pm P0615
Digital Controller for a Boost PFC Converter in Continuous Conduction Mode
*A Olayiwola, *B Sock, **M R Zolghadri, A Homaifar, M Walters, C Doss*
North Carolina A&T State University
*Rockwell Automation
**Sharif University of Technology

This paper introduces a design process for a R-S-T digital controller for a power factor correction circuit (PFC). This method is based on pole placement via R-S-T polynomials. The design is based on the desired time domain specification of the current and voltage loops of a PFC presented as a discretized second order s domain transfer function for voltage and current loops. The voltage and current loop polynimials are designed to achieve the same behavior as in the s domain. Overall performance of both digital controller and its analog counterpart for PFC are investigated based on the effect of a step variation in output current, step variation and tracking of the reference voltage, and the quality of the reference current and its tracking. Furthermore, errors in the parameters identification are also taken into consideration to test the robustness of both controllers. The results confirm that digital R-S-T based controllers are able to be used for high performance PFC converters.

TP2.2 4:00pm-4:20pm P0168
An a-b-c Reference Frame-Based Compensation Strategy for Series Active Power Filter Control
*G W Chang, *S K Chen, Y C Chin, W C Chen*
National Chung Cheng University
*Chungchou Institute of Technology

This paper presents a new control strategy to determine the reference compensation voltages of a series active power filter (APF) operated under nonideal supply voltages in the steady state. With using the proposed control strategy, the load-side voltages can be maintained being sinusoidal and balanced. The effectiveness of the proposed control strategy is demonstrated through simulations by using Pspice. Results show that the expected series APF performances are achieved with adopting the new control strategy.

TP2.3 4:20pm-4:40pm P0242
Interharmonic Detection based on Support Vector Machine
L Zhou, K P Liu, B W Ma, Q Tao
Wuhan University

Support vector machine (SVM) based on the principle of structure risk minimization provides a new perspective in machine learning, and has been successfully applied to many areas in the last years, especially for pattern recognition and function fitting. In this paper, because of the adjustable resolution of the SVM algorithm, a new way to measure interharmonic is put forward, namely using wide analytical domain of frequency with low resolution at first and then using narrow analytical domain of frequency with high resolution to obtain the frequency spectrum of the signal. And based on this new method, the interharmonic detection system is designed and implemented with the prevailing and powerful software platform of LabVIEW with graphical nature.

TP2.4 4:40pm-5:00pm P0286
Research on the Application of the High-capacity Hybrid Active Power Filter
X Y Xia, T L Li
Changsha University of Science and Technology

The paper presents a new high-capacity hybrid active power filter (APF) to compensate harmonics and reactive power required by nonlinear loads. The proposed one put the active component and fundamental serial resonant circuit in parallel through coupling transformer, and then put in series with passive component. Thus makes it unnecessary for APF to withstand fundamental component of power system and can improve the characteristic of suppressing harmonic current and degrade resonance of passive filter. The passive component makes reactive power compensation with active and passive component make harmonic suppression together. Finally the application results indicate that

the APF system can provide the required signals to perform filtering and compensation.

TP2.5 5:00pm-5:20pm P0308

Measurement Techniques for Distribution Feeder Impedance by High Frequency Injections

*K Matsui, M Koyama, I Yamamoto, M Hasegawa, H Kojima, *F Ueda, *H Mori*
Chubu University
*Chubu Electric Power Co,.Inc.

The line impedance could be measured by means of only passive elements such as inductors or resistors, that is presented at first. However, as the voltage and current used for the measurement are increased, the size of the inductor or resistor being used also needs to be increased, so in practice it would be virtually impossible to make an accurate measurement. Because of this, we have developed a novel measurement method for feeder impedance using an inverter circuit, which we describe secondly. In the third place, we propose another feeder impedance measurement method. The novel method is that the high frequency wave with minimum voltage is injected into the distribution feeder system. By means of this method, the feeder capacitance and the feeder inductance can be measured. These proposals are confirmed by the simulation or experiment.

TP2.6 5:20pm-5:40pm P0345

A Multi-Function Voltage Source Inverter with Power Quality Compensation

B R Lin, C L Huang, C C Yang
National Yunlin University of Science and Technology

The system analysis and circuit implementation of single-phase series-shunt compensator for nonlinear and voltage sensitive load is presented. The series compensator used in the adopted system compensates the abnormal voltage disturbance including voltage sag and swell at the load side. The shunt compensator supplies the necessary active current to keep the constant dc-link voltage of the adopted circuit and improves the power quality of ac source including the reactive current and harmonic current. The adopted series and shunt compensators are based on the neutral point clamp topology with the common dc-link. First the system analysis and operational principle of the adopted series-shunt compensator is presented. Some simulations and experimental results of a scale-down prototype circuit are presented to verify the effectiveness and validity of the proposed control scheme.

TP3

Session Title : Energy Systems

Session Chair : Dr. Dong Dong LI
Asst. Prof. Ashok S

Date : 25 May 2006, Thursday

Time : 3:40pm - 5:40pm

Venue : Libra, Level 1

TP3.1 3:40pm-4:00pm P0117
Design and Simulation of Excitation Control System for Doubly-Fed Generator
P Chen, J G Lu, Y J Yang, X Li, W H Li
Hebei University of Technology

In this paper, a new type, double-fed generator was studied. According to Park's equation, the mathematical model for double-fed generator and the mathematic model of cycloconverter are given. And with these mathematic models, the performance of double-fed generator was simulated. Second, the control strategy of the excitation system is discussed. At last, a new practical scheme of excitation control system is given and some simulation result was presented.

TP3.2 4:00pm-4:20pm P0188
Design of Field Orientd Controller to Improve Dynamic Characteristics of Three Phase Self Excited Induction Generator
A Kishore, R C Prasad, B M Karan
Birla Institute of Technology, Mesra

This paper presents the dynamic characteristics of the stand alone Three Phase-Self Excited Induction Generator (SEIG) includes loading effects on operating frequency and voltage for various transient conditions. Further to improve the dynamic characteristics of the system a field oriented controller has been proposed. Prime mover speed of the SEIG has been taken as variable speed dc motor which represent wind speed. The self excitation is mainly depending upon load speed and excitation capacitance. An inverter is connected to the stator terminals of the SEIG which manipulates the necessary excitation currents. Flux estimator estimates the rotor flux and a simple PI controller is used to estimate reference currents which further decide the switching signals in current controller for inverter. The effects of non linear magnetizing inductance have also been taken as constraint. The currents and voltage output responses of the system with and without controller has been compared, conclusions has been documented. The whole proposed system has been developed and Designed using MATLAB / SIMULINK.

TP3.3 4:20pm-4:40pm P0418
Decoupled Power Control of Wind Turbine based on Doubly-Fed Induction Generator
D D Li
Shanghai University of Electric Power

Wind turbine based on doubly-fed induction generator is widely employed in exploitation and development of wind energy, because it provides favorable performances such as variable speed operation, maximal energy product tracking and flexible control of real power and reactive power. Decoupled control of real power and reactive power is essential to power plants and power systems. A novel control strategy is presented to achieve decoupled control of the wind turbine, based on nonlinear inverse system method and neural network. With this control scheme, the system is fully decoupled to two pseudo linear subsystems by inverse system method, while the control is not dependent on system parameters so that it is robust to system disturbances.

TP3.4 4:40pm-5:00pm P0419
Analysis of Short Circuit Current of Wind Turbine-Doubly Fed Induction Generator
D D Li
Shanghai University of Electric Power

With continual installation of wind power generators, proportion of wind energy increases dramatically in electric power system, and influence of wind power must be considered in power system analysis or design. Calculation of short circuit current is an important task for wind farm and power system. Doubly fed induction generators (DFIG) are widely equipped for wind turbines, and this type of wind power generator is studied in detail in this paper. Transient of DFIG is analyzed under short circuit condition, and the theorem of constant flux linkage is applied to determine short circuit currents in the

synchronously rotating reference frame dq0. In succession, formulas for calculation of the short circuit currents are deduced. Comparison of the calculation results with simulation results shows validity of the proposed formulas.

TP3.5 5:00pm-5:20pm P0441
A Resistance-Compensated Phase-Locked Battery Charger
*L R Chen, J Y Han, *J L Jaw, **C P Chou, C S Liu*
National Formosa University
*Chienkuo Technology University
**Taiwan Police College

The resistance-compensated phase-locked battery charger (RC-PLBC) proposes as a new and fast charging circuit topology for Li-ion battery in this paper. The circuit topology of the proposed RC-PLBC is not only the same as that of a phase-locked loop (PLL) but also can compensate the pack resistance of Li-ion batteries. Therefore, a complete charging process, consisting of three sub-processes: bulk current charge, variable current charge and float charge, can be automatically implemented with fast charging behavior. The mathematical model of the proposed RC-PLBC is driven, and then the stability of the RC-PLBC is discussed. After that, a complete circuit design procedure is presented to guild the engineer to design a desired RC-PLBC. Finally, a prototype of RC-PLBC is designed according the presented design procedure and realized to verify the charging performance. Comparing with a typical phase-locked battery charger, the charge speed of the proposed RC-PLBC is improved by 18% as well as the safety is held on.

TP3.6 5:20pm-5:40pm P0467
Study on Improving Output Current Waveform of Photovoltaic Grid-Connected System
S C Zheng, P Z Wang, L S Ge
Anhui University of Technology

Residential photovoltaic grid- connected systems are distributed power generation devices that convert the dc energy from the solar arrays to high-quality ac power at the utility grid interface. In this paper, the strategy, which based on repetitive control and feedforward control of utility grid, is applied to improve the output current waveform. First, it is shown that the commonly used photovoltaic grid-connected inverter topology, based on the SPWM modulated full-bridge converter. Then, the operational principle of system is analyzed, and the repetitive control is presented. Finally, the validity of the proposed strategy and its effect on the improvement of the quality of the output current waveform are verified through simulation and experiment.

TP3.7 5:40pm-6:00pm P0126
Modeling of Integrated Power Conditioner for Photovoltaic Systems
S Ashok
National Institute of Technology, Calicut

This paper proposes a fast and efficient algorithm for tracking maximum power in photovoltaic system. The proposed hybrid algorithm initially reaches the approximate maximum power point using variable step length and subsequently the exact maximum power point by conventional incremental conductance method. The duty cycle of the boost converter used for battery charging, is adjusted under variable step length to track the maximum power point initially. Simulation done using the data measured for a typical day shows that the hybrid algorithm is best suited for fast changing atmospheric conditions. By using it for tracking the maximum power, the total energy output gets increased by approximately 3.3 times.

TP4

Session Title : Switching CCT and Converters III

Session Chair : Prof. Qianzhi ZHOU
Prof. Xing ZHANG

Date : 25 May 2006, Thursday

Time : 3:40pm - 5:40pm

Venue : Gemini, Level 1

TP4.1 3:40pm-4:00pm P0451
Analysis Continuous Conduction Mode of Buck-Boost Converter using Bridge Rectifier Control
*K Srisumrit, *K Tripech*
Mahanakorn University of Technology
*Rajamangala University of Technology, Suvarnabhumi

This paper proposes analysis continuous conduction mode of buck-boost converter using bridge rectifier control is introduced. Analysis and test the comparate between PWM control and bridge rectifier control. The duty ratios are obtained by bridge rectifier control Ix at 0.3 A this paper had tested the duty cycle at 0.8 which is bridge rectifier must be used Ix at 190 A for control the output voltage (VO) as calculated 96 V. The current Ix will increase when VO had changed if VO change the current Ix will change and result of them are the loss of equipments but the new VO will have good efficiency.

TP4.2 4:00pm-4:20pm P0455
Design of Single Phase Grid-connected Photovoltaic Power Plant based on String Inverters
*X Zhang, H Ni, D Yao, *R X Cao, **W X Shen*
Hefei University of Technology
*Hefei Sunlight Power Supply Co.Ltd
**Monash University Malaysia

Based on the design of string inverters, a high performance gird-connected photovoltaic (PV) power plant is presented. The plant consists of grid-connected single phase inverters, intelligent cluster controllers (ICC) and user-friendly monitoring software. The feed-forward control strategy based on grid voltage and load current is proposed to improve inverter's dynamic response. With an optimal maximum power point tracking (MPPT) algorithm, the maximum power output of PV modules is achieved by using forth-back voltage increment perturbation. A Sandia frequency shift based strategy which increases the anti-islanding ability of grid-connected PV power system is also discussed. The proposed system can simultaneously monitor all the inverters on-site of PV modules. The verification has been made on the experimental units. The results show that the plant has excellent capability of high efficiency, intelligent maintenance and integrated management.

TP4.3 4:20pm-4:40pm P0530
Research on Power Characteristics of Matrix Rectifier
*X J Yang, *W Cai, P S Ye, *Y M Gong*
Shanghai Jiaotong University
*Shanghai University

The complete circuit model of a three-phase AC-DC matrix converter, namely matrix rectifier, is derived using circuit dq transformation method and based on current space vector algorithm, then the whole performances are analyzed systematically and entirely, including power characteristic, such as output voltage gain and polarity, input power factor, active power, reactive power and appearance power. The derived formulas are plotted into diagrams for comparative analysis. The operation conditions of unitary input power factor are also analyzed specifically, and the four quadrant working system and power characteristics are partitioned. It is shown that the converter is one of the flexible converters like three-phase to three-phase matrix converter with the following features: (1) output DC voltage can be regulated between positive and negative maximum values, with a maximum value of 1.5 input phase voltage amplitude and depending on input current displacement and load power; (2) its power switch circuit part is equivalent to an ideal transformer, capable of performing voltage, current and impedance conversion; (3) active power at mains is dependent on input current modulation index, input filter parameters, input current displacement and load power, so are reactive power and input power factor. (4) passive power control is dependent on active power at mains.

TP4.4 4:40pm-5:00pm P0625

Switch-Linear Hybrid Power Conversion (I) - The Topologies based on Source Follower

*Q Z Zhou, *W H Hu, **B Wu, **M Z Dong*
Anhui University of Technology
*East China Jiaotong University
**Ryerson University

The paper presents a hybrid power conversion topology series. They are structured with Linear Source Follower fed by Switch-Filter for getting synthetic good performances in high efficiency, THD, load robustness from step response and category changes. Special operating regulation of the power devices are analyzed, neither like in switch conversion nor like in linear amplifiers. Some comparison experiment results with present typical topologies are presented for proving that the novel topology series have a prospect future.

TP4.5 5:00pm-5:20pm P0656

Switch-Linear Hybrid Power Conversion II - Typical Analyses in the Topology's High Efficiency

*W H Hu, *B Wu, *M Z Dong, **Q Z Zhou*
East China Jiaotong University
*Ryerson University
**Anhui University of Technology

The paper proves the high efficiency of Switch-Linear Hybrid power conversion from a typical 3phases-4lines prototype, by engineering estimation and practical test, as well as the theoretical analyses combining with the typical waveforms. It together with the sister paper (I) verifies Switch-Linear Hybrid power converters possesses the value to be applied in industry.

TP4.6 5:20pm-5:40pm P0228

Dynamic Switching Control for the Swing-up and Stabilizing Control of the Furuta Pendulum

*H S Ding, Y P Li, J Q Mao, *K H Wei, *L Yang*
Beijing University of Aeronautics and Astronautics
*Chinese Academy of Engineering Physics

This paper presents the design and simulation for the swing-up and stabilizing control of the Furuta pendulum, which is widely used to illustrate ideas emerging in the field of nonlinear control. In this paper, a dynamic switching controller is designed. The designed controller switches to the corresponding control manner in the specified region. For sing-up control, it is according to the sign of angular displacement and angular velocity of the pendulum that a proportional controller is designed. For stabilizing control, a model-based fuzzy controller is designed by utilizing the design technique of parallel distributed compensation (PDC). The solution of numerical simulation shows the efficiency of the presented method.

TP5

Session Title : Robotics

Session Chair : Prof. Chia-Ju WU
Dr. Grant A COVIC

Date : 25 May 2006, Thursday

Time : 3:40pm - 5:40pm

Venue : Aquarius, Level 1

TP5.1 3:40pm-4:00pm P0526
Development of an Embedded Industrial Vision System
M C Chen, B Xi, Y J Fang, D H Zhang
Wuhan University

A kind of remote vision system based on embedded technology was designed, which can transmit the picture data on Ethernet, being free from the distance restrict, needless repeated wiring and not easily be interfered by other parts of computer system. The software and hardware design of vision system consisting of CMOS image sensors, ARM microprocessor and embedded OS are introduced. Modularizations of hardware compatible to the standard I2C bus, detailed instruction of embedded processor and image sensor, and realization of application programs are emphasized. Further, this paper focused on discussing the design of hardware part including high-speed ARM S3C4510B processor, image sensor module and image buffering control module. Driver of uClinux, image Collecting, image compressing, network communication program are also analyzed. Finally, it used electronic design automatic software to simulate two system processes in order to verify the design. A testing board is built and fundamental experiments are operated, which indicate that this design has great performance in industrial application.

TP5.2 4:00pm-4:20pm P0409
Self-localization of Mobile Robots based on Visual Information
*L C Lai, *T L Lee, H H Wu, C J Wu*
National Yunlin University of Science and Technology
*Nan Kai Institute of Technology

A CCD camera, a stepping motor and three artificial landmarks are used for localization of a mobile robot. The CCD camera is mounted on the robot and its rotation is controlled by the stepping motor. Then from the images captured by the CCD camera, image-processing techniques are used to determine the distances between the CCD camera and the three landmarks. On the basis of these distances, one can prove that the position of the robot can be determined uniquely provided that the three artificial landmarks observed are not installed in a line. Moreover, the heading angle of the robot can be determined from the rotation angle of the stepping motor. To account for possible installation errors, a nonlinear programming method is proposed. Meanwhile, a least-squares method is also be used to increase the accuracy of localization. To show the feasibility of the proposed method, an experimental example is given for illustration.

TP5.3 4:20pm-4:40pm P0256
A Three-Phase Inductively Coupled Power Transfer System
G A Covic, J T Boys, H G Lu
The University of Auckland

This paper discusses the development of a new three phase bipolar Inductively Coupled Power Transfer (ICPT) system for improving the power profile across the width of a roadway surface for automatic guided vehicles (AGVs) and people mover systems. A prototype system was constructed that supplies 40 Amperes per phase into a thirteen meter long track to supply power to a number of moving vehicles (toy cars). Flat pick-ups are used on the underside of the vehicle and FEM software was successfully used to determine a suitable geometrical position for the cables in the track resulting in a considerably wider power delivery zone than possible using a single-phase track layout. Mutual coupling effects between the various track phases, requires additional compensation to be added to ensure balanced three-phase currents. Experimental tests verified simulation results with a high degree of accuracy.

TP5.4 4:40pm-5:00pm P0572
Dynamic Modeling and Simulation of a Switched Reluctance Motor in Electric Vehicles
*S Sadeghi, J Milimonfared, M Mirsalim, *M Jalalifar*
Amirkabir University of Technology
*Esfahan University of Technology

Shareware softwares such as Advanced Vehicle Simulator have extensively been used to simulate and design electric and hybrid vehicles. However, that software can only model the steady-state mode, and one can not see the dynamic performance of electric motors in the simulation. On the other hand, the switched reluctance motor model hasn't been seen in the Advanced Vehicle Simulator software library yet. In this paper, utilizing MATLAB/SIMULINK software, dynamic modeling of a switched reluctance motor is investigated and then simulated. In doing so, mechanical components of an electric vehicle are also called from the Advanced Vehicle Simulator software library and then linked with the electric motor. Finally a typical electric vehicle is modeled and investigated. Simulation results show the switched reluctance motor performance along with other components for a typical city drive cycle.

TP5.5 5:00pm-5:20pm P0383

Research on Loading of the Soft and Hard Tissues based on Water Hydraulic System with Fiber Bragg Grating Sensing

Y C Huang, H Y Chen, Y L Tseng
National Changhua University of Education

This paper presents the development of the designate experiment test bed, controller implementation and experiments of the water hydraulic system for soft and hard tissues via Fiber Bragg Grating (FBG) sensing measurement. In this research the conventional strain gage was replaced by FBG. Water hydraulic force is controlled by the servo motor positioning and calibrated through the pressure sensor feedback signal. Therefore, a precise positioning of the cylinder movement for actuating the tissues is driven by lead screw servo motor. Developed system can be used for observing the loading conditions of the soft and hard tissues. Signal transferring mechanism based on the dynamic response of interested tissue interface can be obtained via the developing FBG sensing apparatus.

TP5.6 5:20pm-5:40pm P0360

Experimental Results for a Nonholonomic Mobile Robot Controller Enforcing Linear Equivalence Asymptotically

*D Buccieri, D Perritaz, P Mullhaupt, *Z P Jiang, D Bonvin*
Ecole Polytechnique Federale de Lausanne
*Polytechnic University, Brooklyn

A novel control methodology for a nonholonomic mobile robot is proposed. The methodology uses a two-dimensional state extension and enforces linear equivalence asymptotically. The originality lies in the treatment of singularity. Real-time experiments carried on an autonomous mobile robot called Fouzy III illustrates and justifies the approach.

TP6

Session Title : Poster Session III

Date : 25 May 2006, Thursday

Time : 3:40pm - 5:40pm

Venue : Foyer

TP6.01 P0395
Detection and Analysis of Complex LFM Signal based on Cyclic Autocorrelation in Multipath Case
J F Shi, K R Wang
Hefei Electronic Engineering Institute

In this paper, the detection problem of complex LFM (linear frequency modulation) signal based on cyclic autocorrelation in multipath is discussed. The cyclic statistics of complex LFM is analyzed, and the detector based on the cyclic autocorrelation amplitude is constructed. Then, the detector properties are analyzed and output SNR of the detector is deduced. Finally, the performance of the detector is given through computer simulation, which is in agreement with the analytic results.

TP6.02 P0440
Wavelet Entropy Analysis of the High Resolution ECG
*B Natwong, *P Sooraksa, *C Pintavirooj, S Bunluechokchai, W Ussawawongaraya*
King Mongkut's Institute of Technology, North Bangkok
*King Mongkut's Institute of Technology, Ladkrabang

The High Resolution ECG (HRECG) is a method of detecting microvolt cardiac signals from patients who have Myocardial Infarction. These signals are called Ventricular Late Potentials (VLPs). They appear as fractionated signals with irregularity in shape on the body surface. In this study, the Continuous Wavelet Transform (CWT) and the Discrete Wavelet Transform (DWT) were used for analysis of the HRECG from the patients with and without VLPs. Then the wavelet entropy was applied to the HRECG. A disordered behavior of the system provides a high entropy value. Observations of the preliminary results in this study showed that the HRECG of patients with VLPs seems to have higher wavelet entropy than those without. In addition, the energy based on the CWT coefficient was computed. It was shown that the patient with VLPs would appear to have lower energy within the terminal QRS complex than the patient without.

TP6.03 P0554
Biometrics with Eigen-Hand
*S Tantachun, C Pintavirooj, P Lertprasert, *S Bunluechokchai*
King Mongkut's Institute of Technology, Ladkrabang
*King Mongkut's Institute of Technology, North Bangkok

Biometrics such as fingerprints, hand geometry, face and voice biometrics provide a reliable alternative for identity verification and are gaining industry and citizen acceptance. Among these, hand geometry verification has emerged as the most suitable biometric modality for medium and low security application due to its speed and unobtrusive nature. However, the applications of hand geometry have been limited due to its limited accuracy when compared to other modalities. The concept of the well-known Eigen face have been applied for palmprint image for person identification. The derived Eigen value and Eigen vector contributes to the important feature in the classification process. For training the classifiers, a library set of 50 patterns is used. The tested data consists of 100 samples and produced correct classification rate close to 95 %.

TP6.04 P0542
Design of Data Acquisition System on Embedded Linux with Dual Port Asynchronous RAM
J W Zhang, X R Xu, B Li
Hangzhou Dianzi University

The data acquisition system evaluation board is based on embedded Linux. It uses Cypress's dual port asynchronous static RAM CY7C028V to transmit data between Motorola's embedded CPU MPC823e and the data acquisition device, and makes Linux 2.4.4 kernel as its micro Operation System. This paper firstly introduces how to build dual port asynchronous RAM hardware interface. On the basis of hardware, the design of dual port asynchronous RAM driver program and the test program based on the driver are discussed in detail. The data acquisition system which can perform data acquisition, data transmission and data processing is tested and verified in the end.

TP6.05 P0560
White Blood Cell Classification based on the Combination of Eigen Cell and Parametric Feature Detection
*P Yampri, C Pintavirooj, *S Daochai, **S Teartulakarn*
King Mongkut's Institute of Technology, Ladkrabang
*Mahidol University
**Thammasart University

Numbers of white blood cells in different classes help doctors to diagnose patients. A technique for automating the differential count of white blood cell is presented. The proposed system takes an input, color image of stained peripheral blood smears. The process in general involves segmentation, feature extraction and classification. In this paper, features extracted from the segmented cell are motivated by the concept of the well-known Eigen face which is performed on the pre-classified which blood cell based on parametric feature detection. The derived Eigen value and Eigen vector contributes to the important feature in the classification process. The results presented here are based on trials conducted with normal cells. For training the classifiers, a library set of 50 patterns is used. The tested data consists of 50 samples and produced correct classification rate close to 92 %.

TP6.06 P0437
Enhanced EFCI Switch Algorithm using Model Predictive Methods
R J Zhu, J G Qi, W Wang
Dalian University of Technology

In rate-based flow control scheme, the important problem is to how to determine congestion occurrence and relief. The common methods is to set explicit feedback congestion indication (EFCI) bit in data header or nonincrease NI and congestion indication (CI) bits in RM\ cells to fulfil the task. Howerver, many studies have reported that the algorithm often cause the buffer occupancy oscillation due to time-variant delay. An enhanced EFCI switch algorithm is proposed by using queue length prediction instead of the measured queue length at the switch. The simulation results demostrated that the improved method deeply constraints oscillation magnitude at presence of large time-variant delay and queue length is controlled in limited scale to guarantee cell zero loss.

TP6.07 P0239
Design and Research on the Remote Monitor System based on Embedded Internet
*M Jiang, P Qian, *Y M Chen*
Shanghai Institute of Technology
*Shanghai University

The embedded device can be connected to the Internet in three ways. The realization of TCP/IP protocols based on the embedded operation system is discussed in detail. The hardware and software of the embedded web server and the security measure for the embedded device connected to the Internet are introduced. The applications are showed in this paper.

TP6.08 P0123
Safety Interlock Control Project for Mill Working Procedure based on Fuzzy Control
P Qian, B Xu
Shanghai Institute of Technology

This paper discusses the process control project for the mill working procedure based on Fuzzy control. Erecursive gradient control rule is analysed. The hardware configuration and software arithmetic of the project are described. The current problems are brought forward and corresponding solution is discussed.

TP6.09 P0204
Constrained Model-on-Demand Predictive Controller Design for Superheated Steam Temperature System
*J H Zhang, F Dong, *G L Hou*
North China Electric Power University
*Liverpool University

The paper presents an approach to control superheated steam temperature in power plants by Model-on-Demand predictive control algorithm. The implementing procedure is introduced in detail. The simulation results of the designed control system show that the control system can obtain satisfactory performance.

TP6.10 P0600
Robust Performance Assessment of Control System based on Relay Feedback
*J X Xu, H W Hu, *H Yang, **F X Piao*
Shenyang University of Technology
*East China Jiaotong University
**Shenyang Institute of Aeronautical Engineering

Performance assessment and monitoring of control system can be used to improve the performance of industrial process. Combined with a robustness index of a SISO control system, this paper presents a robustness assessment method based on relay feedback, which is able to conduct in-depth analyses in frequency domain according to the Nyquist curve. Simulation results have shown the effectiveness and feasibility of this method.

TP6.11 P0551
Fuzzy Control of Hybrid Fuel Cell / Battery Power Source in Electric Vehicle
M Amirabadi, S Farhangi
University of Tehran

Fuel Cell Electric Vehicles (FCEV) have higher efficiency and lower emissions compared with the

internal combustion engine vehicles. But, the fuel cell has a slow dynamic response; therefore, an auxiliary power source is needed. Controlling this hybrid system has important role in its overall performance. In this paper the fuzzy controller has been employed for controlling power management of the hybrid system. The PLECS toolbox in simulink/MATLAB has been used for simulating the power electronics circuits more accurately. Also an accurate model for the fuel cell has been used. The result of the simulations shows that this method has a good dynamic response.

TP6.12 P0449
A New Frequency Offset Estimation for OFDM-Based WLAN Systems
Z Fang, W A Xiao, Y Shi
Chinese Academy of Sciences

A new carrier frequency offset estimation scheme in orthogonal frequency division multiplexing (OFDM) is proposed. The scheme includes coarse frequency offset estimation and fine frequency offset estimation. The coarse frequency offset estimation method we present is an improvement of Zhang's method. The estimation range of the new method is as large as the overall signal-band width. A new fine frequency offset estimation algorithm is also discussed in this paper. The new algorithm has a better performance than the Schmidl's algorithm. The system we use to calculate and simulate is based on the high rate WLAN standard adopted by the IEEE 802.11 standardization group. Numerical results are presented to demonstrate the performance of the proposed algorithm.

TP6.13 P0416
Key Management Scheme based on Traditional Symmetrical Cryptogram System
Q H Wang, J W Zhang
Hangzhou Dianzi University

This article mainly introduced one kind of key assignment scheme based on traditional symmetrical cryptogram system. It divides keys in system from lowers to high into three ranks - primary key, secondary key and the host master key. The primary keys cannot appear in the plaintext form, but are transmitted and preserved in the form of encryption .The secondary keys are deposited in the working register of special key device, and related encryption transformation operations are carried on in the special key device, so it has guaranteed that there was no information appeared in plaintext form beside the key equipment, thus provided one kind of safer key management scheme.

TP6.14 P0401
Field Programmable Gate Array-based Robotic Exploration of an Indoor Environment
R K Panakala, K Sridharan
Indian Institute of Technology, Madras
We consider the problem of robotic exploration of an unknown indoor environment using a low-cost Field Programmable Gate Array (FPGA) on-board. The robot is equipped with four ultrasonic sensors and it navigates autonomously. Locations in the environment at which the robot could stand and gather sensor readings are identified. The proposed scheme is area and energy efficient.

TP6.15 P0295
The Assembly and Maintenance of the Component-based Communication Protocols for Embedded System
T Z Chen, H J Dai, P Ye, W Hu
Zhejiang University

To break through the computational capability and memory space of the embedded Communication systems, it is a flexible method to make the communication protocols Component-based. The systems can load the new Components automatically and need not halt. Furthermore, the components are described by component description language and can easy to be developed, stored, assembled and executed with component-based communication protocol architecture.

TP6.16 P0515
Modeling of HVAC based on Fuzzy RBF Neural Network
*S J Li, *W J Cai, X Q Zhang, J X Xu*
Shenyang University of Technology
*Nanyang Technological University

The paper proposed an improved algorithm of building the structure of fuzzy RBF neural network (RBFNN) for modelling of Heating, Ventilation and Air-condition (HVAC). Combining the fuzzy clustering and neural network identified the model. Experiments showed the fuzzy RBFNN could accurately identify the model of HVAC even if having strong disturbance and coupling. The results demonstrated that the model outputs could approach actual outputs.

TP6.17 P0179
Developing a Web-based Early Warning System for Fish Disease based on Water Quality Management
*N Li, Z T Fu, R M Wang, *X S Zhang*
China Agricultural University
*Suzhou University

The Suboptimal water quality, including the eutrophication and the pollutants of NH3, H2S as well as organic compounds, is the main reason of damaging fish resources, which are suffered by the aquaculture ponds in the north of China and result in great losses to Chinese aquatic products every year. Therefore, it is important and the best way to develop decision aids that can help to assess the risks of fish disease through water quality management. EWS-

FDWQ: a web-based early-warning system for fish disease based on water quality management has been developed by us. Real-time water quality monitoring and a series of water quality management mathematic models, including water eutrophic assessment, pollutant risk assessment and water quality forecast as well as potential risk early warning of fish disease, are the key advantages of our system.

TP6.18 P0147
Digital Design of 12-Phase Cycloconverter based on DSP with CPLD
*B He, X F Zhang, *H Lin, *Y B Zhou, *L Ma*
Naval University of Engineering
*Huazhong University of Science and Technology

Recently, analog control is replaced by digital control in cycloconverter-fed adjustable speed drives. However, cycloconverter has many thyristers and control signals. Multi-CPU has to be adopted for its complexity. In this paper, main circuit is redesigned due to multi-phase. An interstar winding method is used in insulating transformers to supply 12-phase power. A 12-phase cycloconverter based on DSP with CPLD is proposed. The inner structure of CPLD is designed especially to generate heavy firing pulses composed of control signal distributor, counting time delay and pulses widening, and pulses distribution parts. Simulation and experiment results denote that a digital cycloconverter based on DSP with CPLD has the convenience of design and debugging, and has preferable control performance and high reliability.

TP6.19 P0393
Time-Delay Estimation for Complex LFM Signal based on Cyclic Cross-Correlation Amplitude
J F Shi, K R Wang
Hefei Electronic Engineering Institute

In this paper, the time-delay estimator of complex LFM is discussed and constructed based on the cyclic cross-correlation amplitude. Then, the mean and variance of estimating error are deduced and the estimator performance is analyzed in detail. Finally, the performance of the estimator is given through computer simulation, which is in agreement with the analytic results.

TP6.20 P0217
A Wireless Channel Model based on Multilayer FNN
Q Liu, L Lv
Wuhan University of Technology

According to the mechanism of Feedforward Neural Network (FNN), this paper describes a wireless communication channels model based on Multilayer FNN with improved back propagation (BP) algorithm. And simulation results of this model show that the FNN model can track the time-varying characteristic of nonstationary wireless channels very well. When applied to practical wireless communication channels, several unique merits of this method are also demonstrated.

TP6.21 P0247
Hardware Framework of HAVC System Design
Z T Wang, W Hu, S W Mei, D M Xia
Tsinghua University

This paper is concerned with the hardware realization of HAVC system. Firstly, HAVC theory is introduced briefly. Then based on this, the hardware framework of HAVC is designed, which includes the following four layers; command, communication, execution and monitoring. By using the hybrid control law which is described in this presentation, the HAVC equipment for power plant is developed. Dynamic simulations have proven the validity of the HAVC hardware framework and the HAVC equipment.

TP6.22 P0553
3D Simulator System of Performance Valuation for Next Generation Port Automation
*J H Suh, Y J Song, K S Lee, *Y B Kim*
Dong-A University
*Pukyong National University

Due to the fast growing rate of the global container trade, every major port is under the pressure of meeting the projected capacity demand. As a result, alternative solutions have been sought for improving capacity and meeting the growing demand for container storage area and terminal capacity. Moreover, material handling process re-engineering is now a critical issue for logistics and supply chain managers of airline, shipping lines, terminal and warehousing enterprises around the world. Therefore, the purpose of this paper is to develop the 3D simulator for executing performance valuation of port transportation systems. The developed 3D simulator system is to measure the effectiveness of the proposed total system and compare it with existing practices. The performance analysis variables are also defined for these comparisons.

TP6.23 P0561
Directional Filter Bank: An Enhancement for Fingerprint Feature Detection
S Tantachun, C Pintavirooj, M Sangworasil, Y Kitjaidure
King Mongkut's Institute of Technology, Ladkrabang

Fingerprints is the most popular biometric modality. Fingerprint features include core, delta, ridge bifurcation, ridge ending, enclosure and short edge. In order to increase the performance of fingerprint identification system, it is essential that these directional-related features are needed to be enhanced. In this paper, we purpose the directional filter bank to enhance the fingerprint features which

later used in classification step. Our 2D FIR filter is designed using a 2D frequency-transform method which is easily implemented and easily imposed a zero phase response. Our proposed technique demonstrates the promising results.

FA1

Session Title : Motor Drives III

Session Chair : Dr. Ranjit SINGH
Prof. Fengge ZHANG

Date : 26 May 2006, Friday

Time : 10:20am - 12:20pm

Venue : Pisces, Level 1

FA1.1 10:20am-10:40am P0573
Research on Reciprocal Power-fed Linear Induction Motor Drive Test Rig for Linear Metro
J Q Liu, Z W Ma, Z P Yang, T Q Zheng
Beijing Jiaotong University

This paper presents a reciprocal power-fed linear induction motor (LIM) drive test rig for linear metro. Two inverter-fed linear induction motors on a common shaft are used in this test rig. One is as the drive motor, and the other is as the traction load. The DC links of both inverters are connected to each other to circulate the energy, and supplied from the AC mains through a four-quadrant converter. In this paper, the dynamic model of LIM is derived firstly. Then the dynamic emulation of mechanical loads is discussed, and two control strategies for both motors are presented. Lastly, simulation results are given to verify the validity of the proposed linear induction motor drive test rig.

FA1.2 10:40am-11:00am P0588
Communication-based Control Mode of Frequency Converter
H D Zhang, Q Z Zhou
Anhui University of Technology

In order to choose and apply frequency converter to the practical engineering situation rationally and correctly, especially for the effective control and adjustment of frequency converter, more attentions are paid to the comparison of two kinds of communication control modes for frequency converter, which are serial communication control and control based on Fieldbus. The advantages and shortcomings of them are discussed. It is useful for the appropriate applications of the frequency converter and relative electronic devices under the practical situation.

FA1.3 11:00am-11:20am P0589
Investigation and Suppression of the Adverse Effects of PWM Inverter Through Passive Filter Technique
A Esmaeli, K Zhao, L Sun, Q Wu
Harbin Institute of Technology

A PWM inverter fed ac induction motor drive system capable of suppressing all the adverse effects of PWM inverter is developed in this paper. A passive electromagnetic interference (EMI) filter is proposed, designed, and tested for a 4-kW drive system, is characterized by sophisticated connection of two small passive filters can compensate for common mode voltages produced by PWM inverter and can suppress leakage current. An equivalent common-mode circuit for the drive system equipped with the EMI filter is derived from experimental waveforms along with theoretical discussions verifies that the EMI filter is viable and effective in eliminating all adverse effects of PWM inverter.

FA1.4 11:20am-11:40am P0594
A Novel Induction Motor Soft Starter based on Magnetically Controlled Reactor
M Z Yu, C H Tian, B C Chen
Wuhan University

The most widely used method for the starting of large medium-voltage (MV) induction motors is reduced-voltage starting. This paper will introduce a novel reduced-voltage soft starting device which is based on the magnetically controlled reactor (MCR). At starting, three single-phase MCRs are in series with the stator winding of the motor to reduce inrush current and keep the starting current constant at preset value by adjusting the reactance of the MCRs. The proposed approach has been verified on a 10kV, 5500kW soft starter based on the MCRs.

FA1.5 11:40am-12:00pm P0608
A New Method to Mitigate the Adverse Effects of PWM Inverter
Y X Sun, A Esmaeli, L Sun
Harbin Institute of Technology

A new method to mitigate the adverse effects of PWM inverter is discussed in this paper. A PWM inverter fed ac motor drive system capable of suppressing all the adverse effects of PWM inverter based on active cancellation method is developed. An active EMI filter proposed for this system is characterized by sophisticated connection of two small separate filters, which they can mitigate common mode voltages produced by PWM inverter and can suppress leakage current. As a result small active filter with ability of reducing of all the adverse effects is approached. Experimental results show the reduction characteristics of the shaft voltage, bearing current and leakage current in the whole system.

FA1.6 12:00pm-12:20pm P0667

Characteristic Simulation of Adjusting Speed System with Doubly-fed Brushless Machine

F G Zhang, X P Wang, Z Wang, F X Wang
Shenyang University of Technology

After introducing simply the structure and operation theory of Doubly-Fed Brushless Machine (DFBM), the coupling parameters between main winding and auxiliary winding are analyzed. The mathematics model of the DFBM is derived and constant power angle control strategy in the real coordinate is also put forward in this paper. Based on SIMULINK technology, the common simulation module of DFBM has been built. The correctness and credibility of mathematics model and common simulation module have been proved by the consistency of the simulation and experimental results.

FA2

Session Title : High Performance Control

Session Chair : Prof. Ching-Tsai PAN
Prof. Tianhao TANG

Date : 26 May 2006, Friday

Time : 10:20am - 12:20pm

Venue : Taurus, Level 1

FA2.1 10:20am-10:40am P0655
Modulation Error Observation and Regulation for use in Off-line Optimal PWM Fed High Power Synchronous Motors
*A R Rezazade, A Sayyah, *M Aflaki*
Shahid Beheshti University
*Sharif University of Technology

In synchronous motors, in the range of several mega watts, operated at low switching frequencies, it is advantageous to use off-line optimal PWM, to reduce the switching losses and undesired frequency harmonic components. But low transient performance of the system restricts the use of such commands. Considering the feed-forward structure of PWM modulators, it is tried in this paper to compensate the undesired modulation-error transients that may cause high overcurrents. An 80kW setup is used to simulate the experiments in laboratory. IGBT based, two-point voltage source inverter is used, and operated at low switching frequencies to simulate GTO-based inverters that are commonly used to feed motors in this power range.

FA2.2 10:40am-11:00am P0122
A Novel Control Strategy for High-Performance Single-Phase Inverters
*J J Shieh, *C T Pan*
Ta Hwa Institute of Technology
*National Tsing Hua University

In this paper, a rather simple controller without time delay is proposed for single-phase PWM inverters to achieve good output voltage tracking, zero steady-state error, very low output impedance and audio susceptibility. To enhance the design efficiency, closed form design rules for the proposed standard module controller are further derived. The required capacitance value of the filter is also derived to minimize the size, cost and losses. Finally, some simulation results with nonlinear loads are presented to verify the effectiveness of the proposed inverters.

FA2.3 11:00am-11:20am P0280
Improved Dual-loop Control plus Repetitive Control for PWM Inverters
L Zhou, X Jian, K Zhang, P F Shi
Huazhong University of Science and Technology

This paper presents the analysis and design of a multiple-loop feedback control scheme for single-phase voltage source inverters with a L-C filter. In the proposed control scheme, a PI regulator in the outer voltage loop and a P regulator in the inner current loop are incorporated, and a plug-in repetitive controller is adopted to improve steady-state performance. Load current feed-forward compensation is additional adopted to reach minimum steady state error. Through theoretical analysis, it can be proved that dual-loop controller realizes arbitrary pole placement and thus the design procedure is greatly simplified. The superiority of the control scheme is demonstrated both by simulations and experiments.

FA2.4 11:20am-11:40am P0327
Sinusoidal Vibration Test Control of a Switching Mode Power Amplifier-Fed Electrodynamic Shaker
*J G Han, T H Tang, *X M Wang*
Shanghai Maritime University
*Suzhou Share Electrical Limited Company

This paper presents a digital acceleration controller for sinusoidal tests using switching mode power amplifier (SMPA). The proposed method is based on two control loops: one for the shaker's acceleration control and another for the SMPA output voltage control. A simple and efficient voltage-controlled method is used in the SMPA. The acceleration controller consists of feedback controller, a feedforward controller and a robust disturbance feedforward controller. Experiments show that the proposed system is capable to achieve excellent acceleration and robustness in the closed loop control from 20Hz to 200Hz

FA2.5 11:40am-12:00pm P0336
Electromagnetically Powered Gene Gun
*P Y Chen, P H Huang, *C C Lu, *F C Jhu*
National Taiwan Ocean University
*National Changhua University of Education

In this paper, an electromagnetic powered gene gun is developed based on electromagnetic mechanics. In the presented gene gun the capacitor is utilized for storing energy and then discharging to an electromagnetic energy device, and thus providing micro projectiles with electromagnetic force to generate the desired impact force. The results of the discharge impact force of the electromagnetic energy device are discussed in this paper. In order to reduce the size as well as the cost, a two-stage electromagnetic control strategy is developed in this paper, in which a single chip is applied to control the discharge time of dual capacitors in order to increase the impact force. According to the results of the experiment, with the same capacitance, the proposed gene gun can generate higher impact force with smaller size and lower cost, and the feasibility of the proposed electromagnetically powered gene gun is thus verified.

FA2.6 12:00pm-12:20pm P0503
Nonlinear Control of Power Supply for an Arc Heater
W J Guo, F Lin, X J You, T Q Zheng
Beijing Jiaotong University

This paper proposes a nonlinear control strategy for the power supply of an arc heater, the generator of the high level enthalpy to heat the air, which flows into the plasma wind tunnel. The control strategy consists of a nonlinear feed-back controller and a feed-forward controller to regulate the electric arc current. The nonlinear feed-back controller, cascading a special nonlinear function of error on the traditional PI regulator, counteracts possible disturbances in the loop. It is also robust against the load uncertainty. In addition, the controller is easy to be realized. The feed-forward controller guarantees the exact control in absence of the external disturbances. Simulation results are provided to verify the validity of the proposed control strategy.

FA3

Session Title : Instrument System

Session Chair : Prof. Stanislaw CIERPISZ
Dr. Ximing CHENG

Date : 26 May 2006, Friday

Time : 10:20am - 12:20pm

Venue : Libra, Level 1

FA3.1 10:20am-10:40am P0193
A Device for Power Quality Monitoring based on ARM and DSP
G H Yang, B Y Wen
China Agricultural University

This paper brings forward ARM and DSP structure for power quality monitoring in power station or factory. Different automatic production in industry is sensitive to different case of power quality. The new device is designed to be spot programmable to resolve the problem caused by the variation. DSP does data sampling and processing. ARM with the embedded uClinux OS deals with the communication with high-level server by Internet. The device can work as a network terminal. Networking for power quality monitoring provides basic data for site-level and net-level assessment. FPGA simplifies the peripheral electro-circuit. The hardware schematic and software design are introduced especially the module related with voltage and current sampling, data exchange, interface for communication. The simple algorithm of power quality analysis is also included.

FA3.2 10:40am-11:00am P0411
A Soft-sensing Method based on BP Neural Network for Improving Dissolved Oxygen Measurement
*Y Zhou, *Y Fang, L H Xie, S Zhang*
Nanyang Technological University
*Purechem Onyx Pte Ltd

At present, there lack of fast and stable methods for detecting some key parameters in wastewater treatment such as Dissolved Oxygen (DO), Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). In this paper, a soft-sensing method based on artificial neural networks is proposed in order to resolve this problem. A BP neural network is proposed and trained using the testing data from a practical treatment process. The simulation results show that the soft-sensing system for DO concentration measurement based on the BP neural network can give an accurate estimate of DO concentration real-time. Thus, the system can be implemented for real-time control of wastewater treatment.

FA3.3 11:00am-11:20am P0413
Errors of Ash Content Analyzers in Monitoring and Control Applications
S Cierpisz
Silesian University of Technology

The main features of on-line ash monitors as measuring gauges have been discussed in the paper: accuracy of the indirect measuring method used, response time and general reliability as monitoring and control instrumentation. Errors of these measurement methods depend on the applied method itself, but mainly on measurement conditions such as: type of coal, size distribution of coal, chemical composition of ash, homogenisation of coal in a cross section of a coal stream, moisture content. It has been shown that errors of on-line radiometric ash measurements due to sample representativeness are negligible in comparison to such errors in conventional laboratory methods. The response time of a monitor depends on the average intensity of electric pulses at the output of the radiation detector, which usually is a scintillation counter. The longer the time of measurement, the lower the statistical error of determination of pulses mean intensity. At the same time, if the input signal varies, the dynamic error of the measurement is higher. This suggests that for a given input signal and a structure of the monitor circuit, one can find an optimal averaging time of input pulses, which gives the minimum dynamic error according to the accepted criteria.

FA3.4 11:20am-11:40am P0255
A Design Methodology for Flat Pick-up ICPT Systems
G A J Elliott, J T Boys, G A Covic
The University of Auckland

In Inductively Coupled Power Transfer (ICPT) applications where roadway based electric vehicles

are required, flat pick-ups are often used due to their high tolerance to variations in physical displacement. However, the design of such systems can be complex due to the large number of geometric parameters and their substantive effect on system performance with respect to displacement. This paper presents a generic design methodology for such systems that allows the designer to quickly ascertain a first-order solution for the magnetic geometry that will meet the various system requirements.

FA3.5 11:40am-12:00pm P0373

Digital Excitation Control of an Auxiliary Power Unit Generator

*X M Cheng, F C Sun, *M G Ouyang*
Beijing Institute of Technology
*Tsinghua University

A diesel-generator can be applied to electric vehicle as an auxiliary power unit (APU). As for its generator, an excitation control method without the brushless exciter parameters is presented. Its first order lag model is obtained through the step response at zero engine speed with the Ziegler-Nichols method. And a PI controller comes out. Then the PI parameters are tuned by simulation and static experiments. At last, the PI excitation regulator is validated by both engine speed and APU voltage regulation experiments on the dSPACE controller. The results are satisfied.

FA3.6 12:00pm-12:20pm P0666

A Practical Look-back and Look-forth Pitch Tracking and Smoothing Algorithm

*D S Wang, *L Z Li, *J K Zhang*
Dalian Nationalities University
*Xidiang University

This paper presents a simple practical look-back and look-forth pitch tracking and smoothing algorithm based on dynamic programming approach. The experimental results show that this tracking and smoothing algorithm can improve the accuracy of pitch estimation when it is incorporated into the multiband excitation time domain autocorrelation pitch estimation.

FA4

Session Title : Switching CCT and Converters IV

Session Chair : Asst. Prof. Andrew, Poh Chiang LOH

Date : 26 May 2006, Friday

Time : 10:20am - 12:20pm

Venue : Gemini, Level 1

FA4.1 10:20am-10:40am P0445
A Nine-level Inverter System for an Open-End Winding Induction Motor Drive
*K Chandra Sekhar, *G T Ram Das*
R.V.R and J.C College of Engineering
*Jawaharlal Nehru Technological University

A nine-level inverter system for an open-end winding induction motor drive is presented in this paper. Multilevel inversion is achieved by feeding an open-end winding induction motor with two symmetrical 3-level inverters from both ends. The combined inverter system with open-end winding induction motor produces voltage space phasor locations identical to a 9-level inverter. A total of 4096 space phasor combinations are available in the proposed scheme, distributed over 217 space vector locations. The proposed inverter drive scheme is capable of producing the phase voltage ranging from 2-level to 9-level depending on the depth of modulation. The inverter with the higher DC-link voltage is switching less frequently, compared to the inverter with the lower DC-link voltage.

FA4.2 10:40am-11:00am P0512
Study on the Novel Boost Battery Charger
*X Zhang, L X Wang, *W X Shen*
Hefei University of Technology
*Monash University Malaysia

The paper proposes a novel boost battery charger in which a full-bridge zero-voltage and zero-current switching (ZVZCS) PWM DC/DC converter is included. For the sake of attaining output voltage up to 600V, a dual-full-bridge rectifier is designed to reduce high voltage stress and solve the problem of dynamic voltage sharing of the diodes. A phase shift PWM controller UC3895 is used as voltage and current regulator, and a PIC16F716 based controller is adopted to perform automatic mode switching. Advantages such as intelligent control and no additional active switch and snubber make the proposed charger efficient and cost effective. Theoretical analysis and experimental results both confirm the validity of the proposed design.

FA4.3 11:00am-11:20am P0619
Three-Phase Power Converter Stabilization via Total Energy-Shaping
J Mendez, Y Garcia, M T Mata
Universidad Autonoma de Nuevo Leon

The three-phase power converter mathematical model expressed in Park coordinate is represented in PCH (Port Controlled Hamiltonian) system form, which is able to manage so much constant load as variable; the controller design for the converter is carried out by the IDA-PBC (Interconnection and Damping Assignment-Passivity Based Control) technique, assigning to the closed loop dynamics to a desired energy function, modifying in a suitable form the interconnection and damping matrices. The control objectives are directed to maintain the DC regulation voltage at the output converter even with variable load, while the input power factor stays unitary; at the same time, the controller is robust to changes in the input voltage.

FA4.4 11:20am-11:40am P0177
Fundamental Modulation: Multi-pattern Scheme with an Entire Range of Modulation Indices for Multilevel Cascaded Converters
*E Y Guan, P G Song, *B Wu, L Zhao, M Y Ye*
East China Jiaotong University
*Ryerson University

The paper presents a new modulation strategy - Fundamental Modulation, which features low switching losses due to the fact that all the switches operate at the fundamental frequency, in addition, with which the converter can operate with an entire range of modulation indices (i.e. from 0 to more than 1) based on selective harmonic elimination. To realize it, a multipattern method is presented to compute the switching angles in a multilevel converter so as to produce the required fundamental voltage while at the same time not generate the selective harmonics. Including the staircase scheme, previous work has shown that it is possible to produce solutions only for higher ranges of the modulation index with selective harmonic elimination (SHE). Here multi-pattern are shown to extend the

lower range of modulation indices for which such switching angles still exist. In particular, it is shown that all patterns require solving the same set of equations where each pattern is distinguished by the location of the roots of SHE equations. The experimental result verify the precise, practicality and feasibility of Fundamental modulation with multi-pattern method.

FA4.5 11:40am-12:00pm P0244

Implementation of a New Single-phase Cycloconverter based on Single-phase Matrix Converter Topology using Sinusoidal Pulse Width Modulation with Passive Load Condition

Z Idris, M K Hamzah
Universiti Teknologi Mara

In this work the Single-phase Matrix Converter (SPMC) topology for cycloconverter operation are proposed for direct AC-AC conversion with step-down frequency operation. The well-known Sinusoidal Pulse Width Modulation (SPWM) scheme is used to synthesize the output. A Xilinx Field Programmable Gate Array (FPGA) was used to implement the controlling algorithm with IGBTs as power switching device. Prior to hardware implementation, simulations were performed to predict the behaviour. A laboratory model test-rig of the SPMC was developed to experimentally verify the result. Good agreement was obtained between simulation and laboratory experiments.

FA4.6 12:00pm-12:20pm P0301

Application of Single Phase Matrix Converter Topology in Uninterruptible Power Supply Circuit Incorporating Unity Power Factor Control

M K Hamzah, M F Saidon, S Z Mohammad Noor
Universiti Teknologi Mara

This paper presents the SPMC topology that will operate as an Uninterruptible Power Supply Circuit (UPS) incorporating Unity Power Factor Control. A single circuit is developed that performs both the rectifier and inverter operation may also incorporate active power filter operation. Commutation strategies are also implemented with reduction in spikes, a common phenomenon in matrix converter topologies. Results of simulations and selected experimental results are presented to verify that the proposed technique is feasible.

FA5

Session Title : Multimedia Signal Processing I

Session Chair : Prof. Krishnan NALLAPERUMAL

Date : 26 May 2006, Friday

Time : 10:20am - 12:20pm

Venue : Aquarius, Level 1

FA5.1 10:20am-10:40am P0479
A New Feedback Control Strategy of Video Transmission based on RTP
L H Xu, S H Ai
Tongji University

The paper sources from a project of embedded video monitor system based on MPEG_4. The system uses RTP for real-time service and uses RTCP for QoS service. First the paper discusses the basic principle of RTP/RTCP, and then puts forward a new feedback control strategy based on RTP protocol. The strategy makes the system adjust the code rate and stream size dynamic and adjust itself to network state. The strategy offsets the disadvantages of TCP and UDP, which is very useful for video monitor.

FA5.2 10:40am-11:00am P0272
Shot Boundary Detection based on Histogram of Mismatching-Pixel Count of FMB
Z P Zhang, K Liu, J H Peng
Tsinghua University in Shenzhen

A universal cut-detection algorithm is proposed based on the histogram of mismatching-pixel count of forward matching block. The proposed algorithm uses motion compensated pixel difference to improve the level of tolerance to camera and video object motion and uses histogram of mismatching-pixel count to decrease the level of sensitiveness to noise. The experimental results confirmed that the proposed algorithm was very effective and robust, and it could significantly improve the cut-detection precision compared with conventional pixel-based statistical algorithm and grey histogram algorithm.

FA5.3 11:00am-11:20am P0644
Speech Signal Compression & DSP Realization with Virtual-Value Mapping Coding
*M H Xu, *F Ran, **F Q Yu, J Wu*
Shanghai University
*Power Station Automation Technology
**Southern Yangtze University

Theoretically based on wavelet transform, a sort of virtual value mapping coding algorithm about speech signal compression is analyzed and designed in the light of frequency division character of wavelet packet transform in this paper. The algorithm is also realized on TMS320VC5402 DSP. The experiment shows that the algorithm can not only reduce the rate of coding and the space of memory effectively but also give small reconstructed-signal distortion.

FA5.4 11:20am-11:40am P0609
A New Algorithm for Removing Blocking Artifacts in JPEG Compressed Images
*K Nallaperumal, *J J Ranjani, V Justin, A Subramaniam*
Manonmaniam Sundaranar University
*Thiagarajar College of Engineering, Madura

The industry standard Joint Photographers Expert Group (JPEG) compression can lead to noticeable 'blocking artifacts' in many cases. High frequency details of the coded images are mainly contaminated by quantization noise. The deblocking approach of JPEG compressed images using overcomplete wavelet representation can be improved by preserving the image details and reducing the effect of quantization noise as much as possible. An estimation of the actual pixel is obtained from the decoded image. The edge information is extracted from this estimated image by exploiting the cross-scale correlations among the wavelet coefficients and is protected, while the blocking effects in the smooth background regions are smoothed out in the wavelet domain without much blurring. A better improvement in visual quality is achieved if Dual Tree Complex Wavelet filters are used instead of the Dyadic Discrete Wavelet Transform.

FA5.5 11:40am-12:00pm P0645
A Non-Preemptive Packet Marking Scheme
*Y Liu, *X Q Gu, Y M Sun*
Nanjing University of Science and Technology
*Southern Yangtze University

Distributed Denial of Service (DDoS) attack is among the hardest network problems. Among several countermeasures, packet making scheme is promising. In these schemes, every router marks a passing packet with a probability, so that the

convergence time for an attacking path can be achieved in little time, and the attack can be found in attack path reconstruction using IP traceback. In this paper, a new non-preemptive packet marking scheme (NPM) is given, which reduces the convergence time and false positive rate, and takes lower network and router overhead.

FA5.6 12:00pm-12:20pm P0281

Speech Stream Detection in Strong Noise based on Linear Prediction

R B Zhang, T Wu, X Y Li, D Xu
Harbin Engineering University

The speech signal is usually mixed with a great deal of noise, and the noise weakens seriously the performance of the algorithms to detect speech signal. This paper presents a robust algorithm for speech signal detection in low SNR based on the linear prediction technology. The proposed approach firstly decreases noise by using linear predication residual, then decides whether speech signal is contained or not according to the coefficients statistics of LPC. The operation to speech component is only taken in prediction residual by enhancement, which produces little impairment to the formant of the speech. As most of the energy components of speech signals exist in the region between 300Hz and 3000Hz, only those LPC coefficients in this region are taken into account, which will also reduce the influence from noise. Experiments show that it is particularly immunized for the proposed algorithm to the strong noise, especially in the white noise. At last, the performance of the algorithm is compared to the approach based on short-term energy in various noise condition, and quantified using the probability of correct classification. The results show that the proposed algorithm has an overall better performance than the referred approach, such as white noise and factory noise to low SNR.

FM1

Session Title : Motor Drives IV

Session Chair : Prof. Jenn-Jong SHIEH

Date : 26 May 2006, Friday

Time : 1:20pm - 3:20pm

Venue : Pisces, Level 1

FM1.1 1:20pm-1:40pm P0334
Torque Ripple Minimization in Interior PM Machines using FEM and Multiple Reference Frames
*B Guan, *Y F Zhao, Y Ruan*
Shanghai University
*Shanghai PowerMax Technology Inc.

Pulsating torque exists in interior permanent magnet (IPM) machines due to non-sinusoidal flux density distribution around the air-gap. These torque pulsations are reflected as speed ripple, noise and vibration, which degrade the IPM drive performance and should be minimized. Firstly, the paper proposes a mathematical model of IPM machine that takes into account space harmonics of inductances and flux linkages related to permanent magnets as a function of rotor position. The space harmonics are analyzed by the 2D finite-element method (FEM) and the motor parameters of the model are determined. Then, the pulsating torque is compensated by generating an inverse torque component through the stator current, and this procedure to predetermine the adequate current reference is based on maximum torque per ampere characteristic (MTPA). Because of the periodic nature of torque ripple, this paper presents a current control scheme that solves bandwidth limits of conventional PI controllers by means of multiple reference frames. Two different motor structures have been studied and verification for them is given.

FM1.2 1:40pm-2:00pm P0474
A Generalized State-Space Modeling of Three Phase Self-Excited Induction Generator for Dynamic Characteristics and Analysis
A Kishore, G Satish
Birla Institute of Technology, Mesra

Dynamic characteristics assessment of three phase self excited induction generator is one of the main issue in isolated applications as it proves its importance in recent years. The transient characteristics of SEIG has important role to define its better applicability. In this paper a generalized state-space dynamic model of a three phase SEIG has been developed using d-q variables in stationary reference frame for transient analysis. The proposed model for induction generator, load and excitation using state space approach can handle variable prime mover speed, and various transient conditions e.g. load perturbation, switching states etc. Also the effect of variation of excitation capacitance on system is analyzed. SEIG behavior has been investigated considering the effect of main and cross flux saturation for various transient conditions. The equation developed has been simulated using powerful software MATLAB/SIMULINK, and its responces justifies the proposed model.

FM1.3 2:00pm-2:20pm P0510
A New Discovery and Analysis on Chaos and Bifurcation in DC Motor Drive System with Full-bridge Converter
T H Tang, M Yang, H Li, D Shen
Shanghai Maritime University

In this paper, some new phenomena have been investigated in the DC motor drive system with PWM full-bridge converter. In the remarkably simple system, rich and interesting chaotic and bifurcation behaviors have been found at certain system parameters and operation conditions. In order to determine the area coverage of parameter of system fallen into chaos or bifurcation, an improved small-data algorithm is presented for system testes. The simulation results show that different bifurcation diagrams can be obtained at different system parameter conditions. Furthermore, explicit and implicit analysis has been done to explore the occurrence of chaos.

FM1.4 2:20pm-2:40pm P0562
Stability Improvement of V/Hz Controlled PWM Inverter-fed Induction Motors Drives
Z W Ma, T Zheng, F Lin
Beijing Jiaotong University

Three-phase induction motor drive systems driven by V/Hz controlled PWM voltage source inverter, which have been widely used in the industrial applications, have often suffered undesirable sustained oscillations in the light loaded state and in the low

frequency range. In this paper, we propose a new method which is effective and simple to improve the stability of V/Hz controlled induction motor drives. This method is robust, regardless of the parameters of the motors, the inverters and the operating conditions, and is suitable for general-purpose induction motor drive systems. Simulation and experimental results are presented to verify the validity of this proposed stabilizing control method.

FM1.5 2:40pm-3:00pm P0181

A Closed-Form Oriented Analysis and Design for Zero-Voltage-Switched Asymmetrical Half-bridge DC/DC Forward Converters

*J J Shieh, T J Chiou, *T M Lee*
Ta Hwa Institute of Technology
*MatriTek Incorporation

In this paper, an analytical analysis and design for the zero-voltage switching (ZVS) asymmetrical half-bridge (AHB) PWM DC/DC Forward converter is featured. To gain insight sufficient to understand as well as design the system. It concludes that the ZVS condition of the converter can definitely not be calculated by simply regarding the stored energy in leakage inductance. The derived closed-form relationships can also be used to guarantee required boundary conditions. As a result, the converter design can be optimized for ZVS in all desired operation ranges.

FM1.6 3:00pm-3:20pm P0306

Design of the CCFL Driving Piezoelectric Inverter for Large-Screen LCD Backlight

*K W Han, H S Park, Y C Lim, *S H Yang*
Chonnam National University
*Honam University

Light source of liquid crystal display (LCD) is used cold cathode fluorescent lamp (CCLF) mainly, and the lamp driving method of LCD backlight inverter of 19 inches low selects H-L (High-Low) method that is the most general lamp driving method and is using. However, medium-large sized LCD backlight inverters more than 21 inches are using H-H (High-High) method that is not existent (H-L) (high-Low) method according as need higher driving voltage and current than small size LCD. In this paper, compared with H-L (High-Low) lamp driving method applying H-H (High-High) method than is used to large sized LCD backlight inverter to the piezoelectric inverter, and verified that the characteristics of the multi lamp drives, efficiency and brightness through H-H (High-High) lamp driving method are excellent.

FM2

Session Title : Secure Communication

Session Chair : Dr. Bee Theng LAU
Dr. Zhi-Ping ZHOU

Date : 26 May 2006, Friday

Time : 1:20pm - 3:20pm

Venue : Taurus, Level 1

FM2.1 1:20pm-1:40pm P0629
A New Algorithm of Steganography based on Palette Image
Z P Zhou, Z C Ji, Y Z Wang, J J Lin
Southern Yangtze University

Some steganography methods based on palette image are introduced and a new color pairs constructing algorithm are advanced. The results of experiments support our thinking and validate that the new algorithm exceeds normal algorithm of the same category in the security. Furthermore, to improve the embedding capacity of this algorithm for unbalanced color occurrences image, the revised form of it is creatively proposed.

FM2.2 1:40pm-2:00pm P0528
Proxy Signature Schemes
B T Lau
Swinburne University of Technology, Sarawak Campus

Throughout these years, there are plenty of enhanced proxy signature schemes being developed such as threshold proxy signatures, nominative proxy signatures, one-time proxy signatures, multi-proxy signature, proxy multi-signature and proxy blind signature. Now, proxy signature schemes are applied in various areas like e-commerce, mobile agent, mobile communications, and electronic voting. The paper presents the theoretical research on proxy signature schemes that cover delegation-by-certificate, nominative and threshold proxy signature schemes.

FM2.3 2:00pm-2:20pm P0612
A Digital Watermarking Algorithm for Image based on Fractional Fourier Transform
*F Q Yu, Z K Zhang, *M H Xu*
Southern Yangtze University
*Shanghai University

A novel digital watermarking embedding and detecting algorithm for image is presented, which uses the chirp signal as a watermark and embeds in the fractional Fourier transform (FRFT) domain of the image, and the watermark position and the transform order are used as the encryption keys. With the help of the property of the impulse characteristic in the FRFT domain for chirp signal, the watermark can be detected conveniently. The experiments results have show that the proposed algorithm not only is of good imperceptibility and security and is very robust to JPEG compression and to noise attacks, but also can provide protection under the cropping and the filtering.

FM2.4 2:20pm-2:40pm P0183
MAIRF: An Approach to Mobile Agents-based Intrusion Response System
Z Q Wang, Q Zhao, H Q Wang, L J Yu
Harbin Engineering University

Intrusion Response is a hot topic in the domain of information security. First, some disadvantages of current intrusion response systems are analyzed. For solving these problems, a mobile agents-based intrusion response framework is proposed. Then the function of every entity and the operation of the system are described in details. Finally, the characteristics of system and some points that need to be improved are discussed.

FM2.5 2:40pm-3:00pm P0229
Image Watermarking Scheme based on 3-D DCT
*J W Wang, S G Lian, Z X Liu, Z Ren, *Y W Dai, H L Wang*
France Telecom R and D, Beijing
*Nanjing University of Science and Technology

Robust watermarking techniques are always used for copyright and ownership assertion purposes. And many watermark embedding schemes in transform domain are proposed, such as 2-D DFT, 2-D DCT, 2-D DWT, 3-D DCT and 3-D DWT. Among them, the former three ones are used to transform image data, and the latter two ones are used to transform video data or 3-D image data. In this paper, we present an image watermarking scheme based on 3-D DCT. A

gray-level image is decomposed into a 3-D sub-image sequence by sub-sample of zigzag scanning order that is transformed using block-based 3-D DCT. Simultaneously, we prove that the distribution of 3-D DCT AC coefficients follows the generalized Gaussian density function using the distribution relative entropy theory. To satisfy the balance between the robustness and the imperceptivity, a 3-D HVS model is improved to adjust the embedding strength. In watermark detecting, the optimum detector is used to implement the blind detection. It is shown in our experiments that the scheme is strongly robust against various attacks.

FM3

Session Title : Communications

Session Chair : Dr. Zhiliang QIN
Dr. Zhengguo LI

Date : 26 May 2006, Friday

Time : 1:20pm - 3:20pm

Venue : Libra, Level 1

FM3.1 1:20pm-1:40pm P0208
Decision-Feedback Turbo Equalization for Coded Intersymbol Interference Channels
Z L Qin
Data Storage Institute

The turbo equalizer based on the BCJR algorithm has an exponential computational complexity in terms of channel memory length. In this paper, we propose a low-complexity soft-input/soft-output (SISO) channel detector for intersymbol interference (ISI) channels based on tentative hard estimates fed back from the outer decoder in the previous iteration. It is shown that the proposed detector can greatly reduce the complexity with a negligible performance loss compared to the BCJR algorithm.

FM3.2 1:40pm-2:00pm P0254
A New Implementation of Digital Crossover Network
*D Sookcharoenphol, K Janjitrapongvej, *S Tomiyama*
King Mongkut's Institute of Technology, Ladkrabang
*Tokai University

This paper proposes a new implementation of digital crossover networks. A new filters provide highly slope rate of the magnitude response and flat group delay over the audio frequencies. Based on linear-phase IIR filter with truncate infinite impulse response to finite. This is verified by simulation and comparison with the Linkwitz-Riley design. Experimental of the filter shown that the magnitude summed over audio frequencis is flat and an efficiciency implementation are also shown.

FM3.3 2:00pm-2:20pm P0632
Channel Estimation for Transmitter Diversity OFDM Systems
L H Xing, Z H Yu, Z P Gao, L Zha
Southern Yangtze University

Orthogonal Frequency Division Multiplexing (OFDM) technique has been applied broadly in the transmission of high speed data in wireless communication. Transmitter diversity can be used with OFDM systems for performance improvement in a fading environment. In this paper, we investigate transmitter diversity for OFDM systems in high speed wireless data applications, and propose a low complexity channel estimation approach for transmitter diversity OFDM systems.

FM3.4 2:20pm-2:40pm P0547
A Throughput Comparison based on S-ALOHA between Ad Hoc and Centrally Controlled CDMA Systems
J W Zhang, Y F Chen, R He
Hangzhou Dianzi University

The paper compared the throughput of Ad Hoc CDMA WLAN systems with centrally controlled WLAN systems, which used the same S-ALOHA random access protocol. Given the same finite users, packets arrival rate and the retransmission probability, we studied the two types of systems' throughput by constructing similar Markov chains. Furthermore, we evaluated the influence of the spreading gain and error control coding on the throughput and normalized throughput. The efficiency of bandwidth utilization was also investigated by normalizing the system performance.

FM3.5 2:40pm-3:00pm P0635
Frequency Controlling and Synchronization in OFDM Communication System
L Zha, Z H Yu, L H Xing
Southern Yangtze University

Research and development are taking place all over the world to define the next generation of wireless broadband multimedia communications systems that may create "the global information Village". This system is expected to provide its users with customers' premises services that have information rates exceeding 2 Mbps. The most suitable modulation choice seems to be orthogonal frequency division multiplexing (OFDM) as a special case of multicarrier (N) transmission where a single data stream is transmitted over a number of lower rate

subcarriers. One of the main reasons to use OFDM is to increase the robustness against frequency selective fading because in fact there is no inter symbol interference (ISI) at all if a long enough cyclic prefix (CP) is included. This effectively simulates a channel performing cyclic convolution, which implies orthogonality over dispersive channels. In this paper, the research and development on OFDM is reviewed. Then, the basic principles, performance and implementation of OFDM are examined. Analysis is given to enable the selection of key elements for meeting the constraints of the required application.

FM3.6 3:00pm-3:20pm P0630

An Energy Efficient Cross-Layer Routing Algorithm for Wireless Sensor Networks

X L Lu, Y M Sun, J M Yu, W X Yan
Southern Yangtze University

Power is a precious resource in wireless sensor networks due to the limited battery capability. Once deployed, it is often difficult to charge or replace the batteries for these nodes. The capacity of batteries is not expected to improve much in the future. Prolonging the lifetime for nodes and the total network is a critical issue. Our lessons learned in working for wireless sensor networks show that energy efficiency can be improved at various layers of the communication protocol stacks. We propose an energy efficient Cross-Layer routing algorithm (E2CL) which relies on interactions between different concerned layers in order to attain longevity of sensor network. The simulation results show that our E2CL routing algorithm provides a good scheme for prolonging the lifetime of wireless sensor networks.

FM4

Session Title : Sensor Network

Session Chair : Dr. Wendong XIAO

Date : 26 May 2006, Friday

Time : 1:20pm - 3:20pm

Venue : Gemini, Level 1

FM4.1 1:20pm-1:40pm P0665
A Prototype Ultrasonic Sensor Network for Tracking of Moving Targets
*W D Xiao, J K Wu, L Shue, Y Q Li, *L H Xie*
Institute for Infocomm Research
*Nanyang Technological University

This paper describes the design and implementation details of our recently developed prototype target tracking system using ultrasonic sensor network. It reports our findings of inter-sensor interference, and suggests a dime-division based sensor scheduling strategy to avoid it. Extended Kalman Filter (EKF) algorithm is proposed as the tracking algorithm with the characteristic of variable time difference between successive time steps and variable measurement equation due to different sensors used at different time steps. A maximum likelihood data association algorithm is presented for multi-target tracking. In addition, a series of important issues including the hardware setup, software architecture, synchronization mechanism, database design, statistics for tracking and alerting management, visualization etc. are also introduced. Comparisons between different tracking algorithms are given, and the experimental results for tracking of multiple targets are demonstrated.

FM4.2 1:40pm-2:00pm P0664
Time Synchronization Simulator and its Application
C N Xu, L Zhao, Y J Xu, X W Li
Chinese Academy of Sciences

Time synchronization is a critical middleware service of wireless sensor networks. Since the performance of time synchronization algorithm is greatly influenced by many factors, benchmark for evaluating time synchronization algorithm is not only difficult but also urgently needed. Software simulation is a good solution especially in the comparison between similar algorithms. In this paper, we presented a time synchronization simulator, Simsync, for wireless sensor networks. Simsync models the distribution of packet delay and the frequency of crystal oscillator as Gaussian. Based on it, we realized reference broadcast synchronization algorithm (RBS) and broadcast time synchronization algorithm (BTS) in 3 different scenarios. Simulated results are compared with the analytic results to advocate its effectiveness.

FM4.3 2:00pm-2:20pm P0663
SNAMP: A Multi-sniffer and Multi-view Visualization Platform for Wireless Sensor Networks
*Y Yang, *P Xia, *L Huang, Q Zhou, Y J Xu, X W Li*
Chinese Academy of Sciences
*NingBo CAS IC design Center

Due to the resource-constrained features and the inherent lack of user-network interfaces, current Wireless Sensor Networks (WSNs) are suffering too limited visibility into the applications. As a result, it is often very difficult to find issues that arise during their development and deployment. Visualization is an attractive and popular way to understand behaviours of complex systems. Visualization platform is therefore a key issue to develop WSNs applications. In this paper, our self-developed Sensor Network Analysis and Management Platform (SNAMP), a novel multi-sniffer and multi-view visualization platform for WSNs is proposed and implemented. In SNAMP, data emitted by individual sensor nodes is collected by a multi-sniffer data collation network and passed to a flexible multi-view visualization mechanism. SNAMP indicates network topology, sensing data, network performance, hardware resource depletion, and other abnormalities in WSNs and allows developers adding application specific visualization functions, which will facilitate the research and development of various sensor networks and shorter the time from laboratory to applications.

FM4.4 2:20pm-2:40pm P0659
An Improvement on Discrete Wavelet Transform-based Algorithm for Vehicle Classification in Wireless Sensor Networks
X Shen, S C Wan, H Huo, T Fang
Shanghai Jiaotong University

In this paper, we present an improvement on the discrete wavelet transform (DWT)-based feature extraction algorithm used in vehicle classification in

Wireless Sensor Networks (WSN) [1] by providing a rule of selecting the best number of resolution levels which will improve the classification rate and reduce the energy consumption in local computation. DWT can provide time-frequency multi-resolution analysis (MRA) which is fast and can greatly reduce the dimensions of feature vectors. We found out that, when using wavelet, the number of resolution levels will greatly influence the effect of feature extraction and energy consumption. In this paper, Different numbers of resolution levels and corresponding time of computation are discussed. And a rule of selecting the best number of resolution levels is given. To test our algorithm, acoustic signals emitted by two kinds of vehicles are investigated, and a k-Nearest-Neighbor method is used as classifier. The experiment shows that the rule provided can obviously improve the classification rate.

FM4.5 2:40pm-3:00pm P0661
Dynamic Minimal Spanning Tree Routing Protocol for Large Wireless Sensor Networks
G Y Huang, X W Li, J He
Chinese Academy of Sciences

Hundreds or thousands of wireless sensor nodes with limited energy resource are randomly scattered in the observation fields to extract the data messages for users. Because their energy resource cannot be recharged, energy efficiency becomes one of the most important problems. LEACH is an energy efficient protocol by grouping nodes into clusters and using Cluster Heads (CH) to fuse data before transmitting to the Base Station (BS). BCDCP improves LEACH by introducing a Minimal Spanning Tree (MST) to connect CHs and adopting iterative cluster splitting algorithm to choose CHs or form clusters. This paper proposes another innovative cluster-based routing protocol named Dynamic Minimal Spanning Tree Routing Protocol (DMSTRP), which improves BCDCP by introducing MSTs instead of clubs to connect nodes in clusters. Simulation results show that DMSTRP excels LEACH and BCDCP in terms of both network lifetime and delay when the network size becomes large.

FM4.6 3:00pm-3:20pm P0660
Energy-Aware QoS Control for Wireless Sensor Network
L Zhao, C N Xu, Y J Xu, X W Li
Chinese Academy of Sciences

While a lot of research has been done on some important aspects of WSN such as architecture and protocol design, supporting Quality of Service in WSN is still a largely unexplored research field. An application-specific QoS has been defined as the sensor network resolution. The mathematical Gur Game algorithm is used to achieve optimal active sensor number. In this paper, we design a novel energy-aware algorithm based on the previous work to solve the QoS problems. The periodical sleeping mechanism is introduced into the algorithm to save energy. When the optimal number sensors are achieved in initialization stage, not all of the remaining Sleep state nodes need to wake up every second. Simulation results show our method can save more energy than the previous.

FM5

Session Title : Multimedia Signal Processing II

Session Chair : Dr. Rajan KANHIRODAN

Date : 26 May 2006, Friday

Time : 1:20pm - 3:20pm

Venue : Aquarius, Level 1

FM5.1 1:20pm-1:40pm P0138
A New FIR Filter for Image Restoration
I Ahmad, P P Mondal, R Kanhirodan
Indian Institute of Science, Bangalore

Image filtering techniques have potential applications in biomedical image processing such as image restoration and image enhancement. The potential of traditional filters largely depends on the apriori knowledge about the type of noise corrupting the image. This makes the standard filters to be application specific. For example, the well-known median filter and its variants can remove the salt-and-pepper (or impulse) noise at low noise levels. Each of these methods has its own advantages and disadvantages. In this paper, we have introduced a new finite impulse response (FIR) filter for image restoration where, the filter undergoes a learning procedure. The filter coefficients are adaptively updated based on correlated Hebbian learning. This algorithm exploits the inter pixel correlation in the form of Hebbian learning and hence performs optimal smoothening of the noisy images. The application of the proposed filter on images corrupted with Gaussian noise, results in restorations which are better in quality compared to those restored by average and Wiener filters. The restored image is found to be visually appealing and artifact-free.

FM5.2 1:40pm-2:00pm P0184
One-step Band-limited Extrapolation using Empirical Orthogonal Functions
J F Weng
Zhejiang University of Science and Technology

Under an a priori assumption of bandwidth, a one-step band-limited extrapolation procedure is systematically developed based on approximating the Fourier transform of the signal by a polynomial. In time domain, this is equivalent to expanding the known signal segment on a band-limited basis function set. The rationale of the proposed scheme is to further generate adaptively a set of empirical orthogonal functions (EOF's) purely from the sample values of this bandlimited basis function set. Computer simulation has been conducted and the results verify the effectiveness of the proposed scheme.

FM5.3 2:00pm-2:20pm P0222
Wavelet Transform based Error Concealment Approach for Image Denoising
P K Gupta, R Kanhirodan
Indian Institute of Science, Bangalore

Denoising of images in compressed wavelet domain has potential application in transmission technology such as mobile communication. In this paper, we present a new image denoising scheme based on restoration of bit-planes of wavelet coefficients in compressed domain. It exploits the fundamental property of wavelet transform - its ability to analyze the image at different resolution levels and the edge information associated with each band. The proposed scheme relies on the fact that noise commonly manifests itself as a fine-grained structure in image and wavelet transform allows the restoration strategy to adapt itself according to directional features of edges. The proposed approach shows promising results when compared with conventional unrestored scheme, in context of error reduction and has capability to adapt to situations where noise level in the image varies. The applicability of the proposed approach has implications in restoration of images due to noisy channels. This scheme, in addition, to being very flexible, tries to retain all the features, including edges of the image. The proposed scheme is computationally efficient.

FM5.4 2:20pm-2:40pm P0232
A Circular Hough Transform Hardware for Industrial Circle Detection Applications
J R Jen, M C Shie, C Chen
National Taiwan University of Science and Technology

The Hough Transform (Hough, 1962) has been used to characterize analytic features. It was first applied to the recognition of straight lines, and later extended to circles, ellipses and arbitrary shaped objects. Its main disadvantage is the computational and storage

requirements increase as a power of the dimensionality of the curve. It is not difficult to implement Circular Hough Transform (CHT) algorithm on modern personal computer. However, we intend to use FPGA or ASIC to perform CHT in this article. Modern FPGAs are capable of performing high speed operation and have large amount of embedded memory. The whole CHT circuitry with accumulator array excluded can be fitted into Altera?Stratix?1S25 chip which has more than 1Mb RAM embedded.

FM5.5 2:40pm-3:00pm P0312

Image Reconstruction by Inhomogenous Diffusion for Positron Emission Tomography

P P Mondal, R Kanhirodan
Indian Institute of Science, Bangalore

In positron emission tomography (PET), image reconstruction is a demanding problem. Since, PET image reconstruction is an ill-posed inverse problem, new methodologies need to be developed. Although previous studies show that incorporation of spatial and median priors improves the image quality, the image artifacts such as over-smoothing and streaking are evident in the reconstructed image. In this work, we use a simple, yet powerful technique to tackle the PET image reconstruction problem. Proposed technique is based on the integration of Bayesian approach with that of finite impulse response (FIR) filter. A FIR filter is designed whose coefficients are determined based on the surface diffusion model. The resulting reconstructed image is iteratively filtered and fed back to obtain the new estimate. Experiments are performed on a simulated PET system. The results show that the proposed approach is better than recently proposed MRP algorithm in terms of image quality and normalized mean square error.

FM5.6 3:00pm-3:20pm P0496

Hardware Design of Signal Processing for a Novel Audio Beam Loudspeaker based on DSP

*S M Liu, W Yao, J Meng, *L M Xu, *M Chen*
Zhejiang University
*University of Electronic Science and Technology of China

While generating audible sound with high directivity utilizing the nonlinear propagation effects of ultrasonic in the air, a solution based on DSP (Digital Signal Processor) is presented to solve the problem of distortion in audio beam loudspeaker, and the hardware system for signal processing is designed. Compared with the idealized output simulated from MATLAB, the real output of the hardware system is satisfactory. Moreover, the cost of the design is much lower than that of the past solution using pure circuit or FPGA, and the modifiable performance of DSP program makes the early research work of audio beam loudspeaker more convenient. The design is expected to accelerate the commercialization of the audio beam loudspeaker.

FP1

Session Title : Classification and Segmentation

Session Chair : Prof. Mingyi HE
Prof. Jin LI

Date : 26 May 2006, Friday

Time : 3:40pm - 5:40pm

Venue : Pisces, Level 1

FP1.1 3:40pm-4:00pm P0237
Classification of Multi-spectral/Hyperspectral Data using Genetic Programming and Error-correcting Output Codes
*M Y He, Y F Zhang, Y Z Xue, N Liang, *C Y Wen*
Northwestern Polytechnical University
*Nanyang Technological University

Genetic programming (GP) and error-correcting output codes (ECOC) are combined to develop a new classification method (GP-ECOC) for multi-class problem solving in this paper. Some additional improvements on the algorithm, modified codeword matrix and group division before classification, are also proposed to settle several existing problems in multi-spectral and hyperspectral data classification. Experimental tests using both multi-spectral and perspectral data are carried out for verification and illustration. It is observed from the obtained results that the classification precision with the newly proposed method is greatly enhanced compared with some existing methods using GP, and the proposed improvements are also effective. The algorithm of GP-ECOC and its improved versions can also be run on multi-terminals, which saves computational cost effectively.

FP1.2 4:00pm-4:20pm P0361
A Novel Approach for License Plate Character Segmentation
F Yang, Z Ma, M Xie
University of Electronic Science and Technology of China

Character segmentation is an important step in license plate recognition (LPR) system. In this paper, a novel character segmentation method of license plate is presented combining Laplacian Transformation, region growing and prior knowledge of license plate. In the proposed methodology, image preprocessing is performed to the license plate at first, and the character region in license plate is enhanced in the following. Then the edges of the characters are detected by using Laplacian Transformation and the candidate regions of characters are located by using region growing algorithm. And the character segmentation regions are determined by using prior knowledge of license plate. Finally the characters are segmented from original license plate and binarization is performed to the characters, which can make it more efficient for character recognition in OCR system. The proposed method in character segmentation is fast and accurate, and is tolerant to license plate with deformations, rotations, plate frame, rivet, the space mark, and so on. And promising results have been obtained in experiments on Chinese license plates.

FP1.3 4:20pm-4:40pm P0169
Multi-region Segmentation of CT Images based on Information Fusion
J Li, L L Zhou, H Yu, H Liang
Harbin Engineering University

In order to make both the edges and the multi-regions of a CT image more clearly, a new multi-region segmentation method based on information fusion, in which clustering segmentation algorithm is combined with edge detection, is proposed in this paper. Firstly the CT image is segmented by the K-means clustering algorithm and Canny edge detection operator to obtain two images with clear regions and distinct edges respectively. Secondly these two images are synthesized to form a new one by the information fusion method based on features. The advantage of the method is that value K and the initial clustering centroids are determined automatically according to the image histogram and no need for the rectification of images before the images are fused. Experimental results show that the images are clearly segmented into multi-regions and the distinct image edges are preserved simultaneously as well.

FP1.4 4:40pm-5:00pm P0668

A Simple Anti-Aliasing Method For Straight Line Drawing based on DSP Platform

*D S Wang, *X Chen, **H L Toh, **F Yang*
Dalian Nationalities University
*Agency for Science Technology And Research
**Nanyang Technological University

A simple and practical anti-aliasing method for a color straight line drawing is presented in this paper. The method has been applied in a DSP-based display system to remove the undesired jaggies occurred in the line drawing. The experimental results show that this method can produce a good visual effect on the low resolution display screen.

FP1.5 5:00pm-5:20pm P0238

Multi-spectral and Panchromatic Image Fusion based on Local Information Entropy and its Distribution Property

*Y F Zhang, M Y He, M Y Weng, *C Y Wen, S Leroy*
Northwestern Polytechnical University
*Nanyang Technological University

HIS image fusion model has been widely used in the fusion of multi-spectral image with low spatial resolution and panchromatic image with high spatial resolution. In this paper, a new fusion algorithm is proposed by considering some existing problems in certain algorithms using HIS model, such as spectral distortion and sensitivity to noise. The proposed algorithm adopts gradient pyramid structure and determines fusion rule according to local information entropy and its distribution. Subjective qualitative evaluation and objective quantitative analysis of experiment results prove that this new algorithm can fuse spatial characteristics effectively and introduce less spectral distortion. And it also outperforms some classical algorithms in immunity to the noise in panchromatic image.

FP2

Session Title : Internet Technology and Industry Applications

Session Chair : Prof. Yuanlu BAO
Asst. Prof. Le-Ren CHANG-CHIEN

Date : 26 May 2006, Friday

Time : 3:40pm - 5:40pm

Venue : Taurus, Level 1

FP2.1 3:40pm-4:00pm P0154
Development of Virtual Impulse Laboratory
P K Agrawal, . Chandan, N K Kishore
Indian Institute of Technology, Kharagpur

Natural phenomena such as lightning result in transient overvoltages and overcurrents thus interrupting the power supply. To avoid this, an analysis of impulse voltages and currents is a must. Apart from existing high voltage laboratories, a need was felt to develop a virtual laboratory which being user-interactive will have facilities for generating virtual impulse voltages and currents. Hence an interactive web based laboratory is introduced now to determine the impulse generator settings in order to virtually realize standard impulse voltages and currents. This solution also aims to develop software that enables the user to pre-select the values of circuit elements that will be required to generate impulse voltages and currents for test purposes. These impulses have to meet a voltage-time-curve with certain tolerances according to IEC 60060-1. This application makes the software useful for impulse testing of power apparatus. The input is fed by the user using the web based interface. These values sent by the client machine are then received by the server. The server processes the input data using the software which runs using programs in Java and PHP. If need arises to access the available database, developed using MSSQL, the database is accessed. The output data is then sent to the client machine and is displayed in Java applet on the user's browser.

FP2.2 4:00pm-4:20pm P0459
Implementation of Industrial Ethernet Communication based on Embedded Systems
Y J Fang, B Xi, M C Chen, J Y Liu
Wuhan University

There is a strong interest of using cheap and simple Ethernet technology for industrial network. However, traditional way uses a microcontroller (such as Rabbit 2000) in 8bit mode, which cannot meet the demands of industrial communication. In order to realize communication over industrial Ethernet in 32bit mode, this paper describes a method using S3C4510B 32bit RISC microprocessor and uClinux embedded OS to realize industrial communication. The hardware of network interface and software development under uClinux was also present. The application result shows that the application has low cost but well performance in industrial field.

FP2.3 4:20pm-4:40pm P0165
Design and Realization of Delay Mapping Receiver based on GPS for Sea Surface Wind Measurement
D K Yang, Q S Zhang, Y Q Zhang, R L Hu
Beihang University

The Delay Mapping Receiver (DMR) is for receiving and processing the reflected GPS signal to get the information of wind of sea surface by recording the reflected GPS signal and matching it to the theoretical model. The hardware structure, software design and difference from normal GPS receiver are introduced in this paper. The test results at near sea of Tianjin of China are provided, which prove the design of DMR is successful and the collected data are useful for the sea surface wind measurement.

FP2.4 4:40pm-5:00pm P0274
Extended Petri-net for Workflow Modelling
L Zhang
Beijing University of Aeronautics and Astronautics

Along with the application of workflow in the area of industry and business, workflow modelling techniques encounter a great challenge. The power of expressiveness and analysis is one of the key problems in workflow modelling. Based on a rigorous analysis of various workflow models, description net (DWF_net for short) was proposed based on Petri-net. In DWF_net control variable (CV for short) was introduced for describing complex data structure and transition consisted of entry function and body function. Some mechanisms were added to allow for a direct support of complex process description.

DWF_net could be mapped onto Petri-net by peeling the semantic information of case. So the analysis method of DWF_net was built on Petri-net analysis techniques. Finally, an industrial example was introduced to illustrate how to apply the proposed model to describe and analysis various complex process.

FP2.5 5:00pm-5:20pm P0287

A Remote Supervisory Control for Motor Driving System using Windows Mobile-based Pocket PC

K C Lin, L R Chang-Chien
National Cheng Kung University

This paper reports on the implementation of wireless remote supervisory control of motor driving system based on Mobile Pocket-PC. The supervisory functions include control on motor rotation and speed; monitoring on system parameters and operating states. Because the motor control platform is no longer confined in the limited working field but can be mobilized to anywhere at anytime, the integration of manufactory process would become more convenient whereas wireless communication network is available. Test results verify the feasibility of the proposed platform to achieve wireless remote supervisory control.

FP3

Session Title : Signal Processing and Industry Applications

Session Chair : Dr. Wenxiang XIE
Assoc. Prof. Wenjian CAI

Date : 26 May 2006, Friday

Time : 3:40pm - 5:40pm

Venue : Libra, Level 1

FP3.1 3:40pm-4:00pm P0363
Ionospheric Interference Suppression in HFSWR
L Huang, B Y Wen, M Yao
Wuhan University

Over the past two decades, significant advances have been made in the use of high frequency surface wave radar (HFSWR) for remote sensing in an ocean environment. As one of the main outside interference, ionospheric interference may badly affect radar's performance. An effective method for ionospheric interference suppression in HFSWR based on timesharing coherent side-lobe cancellation (CSLC) is presented. Experimental results acquired with the HF system OSMAR confirm that the method can achieve effective ionospheric interference suppression, but not decreasing the strength of the first-order sea echo.

FP3.2 4:00pm-4:20pm P0567
Cone-Beam X-Ray Tomography with Arbitrary-Orientation X-Ray Tube
D Sueseenak, T Chanwimalueang, W Narkbuekaew, K Chitsakul, C Pintavirooj
King Mongkut's Institute of Technology, Ladkrabang

X-ray Computed Tomography is a technique to reconstruct an image of trans-axial slab of the object from a series of x-ray radiographs taken at a prior-known angle. Sequences of x-ray radiographs are served as two-dimensional projection data for a 3D tomography. The most popular Feldkamp Algorithm which is based on Filtered Backprojection (FBP) approaches has shown to perform well for 3D reconstruction. Conventional x-ray computed tomography was implemented on a c-arm x-ray apparatus where the x-ray tube and detector is capable of rotating to capture radiograph at any specific angle. In this paper, the concept of x-ray computed tomography for non c-arm x-ray apparatus was presented. In the purposed method, the cross-section of the object can be reconstructed from the multiple-viewed radiographs taken with arbitrary orientation of x-ray tube. The simulation results demonstrated the potential of such method.

FP3.3 4:20pm-4:40pm P0621
Fuzzy Hidden Markov Models and Fuzzy NN Models in Speaker Recognition
A Taheri, M R Tarihi, H Vafadar Ali
Malik Ashtar University

The fuzzy HMM algorithm is regarded as an application of the fuzzy expectation-maximization (EM) algorithm to the Baum-Welch algorithm in the HMM. The Texas Instruments p4 used speech and speaker recognition experiments and show better results for fuzzy HMMs compared with conventional HMMs. Equation and how estimation of discrete and continuous HMM parameters on based this two algorithm is explained and performance of two speech recognition method for one hundred is surveyed. This paper show better results for the fuzzy HMM, compared with the conventional HMM. After of that work we use Fuzzy-Neural Network system was proposed for Farsi speech recognition. Instead of using the fuzzy membership input with class membership desired-output during training procedure as proposed by several researches. we used the fuzzy membership input with fundamental binary desired-output. This can reduce the misunderstood training, decrease the training time and also improve the recognition ability.

FP3.4 4:40pm-5:00pm P0495
Impulsive Interference Mitigation in High Frequency Radar
L Huang, B Y Wen
Wuhan University

An effective method for impulsive interference mitigation in high frequency (HF) radar based on the detect-excise-and-extrapolate idea is presented. The key to the method's success is suppressing the ocean clutter in the time domain prior to detecting the impulsive interference. The method performed well on ocean echo data acquired with the HF radar system OSMAR.

FP3.5 5:00pm-5:20pm P0302

Small Signal Measurement for Embedded System Applications

T Song
University of Maryland

A cost-effective multi-channel small signal measurement system for microcontroller-based data acquisition and control applications was presented. The system can be used for sensors with small signal output and operated for industrial applications with high electromagnetic noise. By combination of hardware filter and software data processing the problem of electromagnetic noise effect was addressed. Multichannel inputs capability and its response time were discussed.

FP3.6 5:20pm-5:40pm P0568

Miniatured Computed Tomography System and Calibration

*Y Pitithreerapab, T Chanwimalueang, C Pintavirooj, *P Tosranon*
King Mongkut's Institute of Technology, Ladkrabang
*King Mongkut's Institute of Technology, North Bangkok

In this paper, we focus on a miniature computed tomographic system with application in 3D modelling of bony structure of a small animal. Our system consists of an x-ray source, a rotating platform and an x-ray array detector unit. The rotating platform is controlled by a personal computer which can rotate the sitting object to arbitrary angle. The x-ray array detector is used to capture the 2D x-ray signal that traversing the object placed on the platform. The x-ray detector is an image intensifier tube of which the 2D image is coupled to the computer via a CCD camera. Feldkamp Conebeam technique is engaged for reconstructing tomograms due to its simplicity. Volume rendering technique together with the shading effects is performed on a stack of cross-sectional image to realize the data into 3D visualization. The algorithms are applied to the practical situation where a series of x-ray radiographs of an animal' bone are collected from the system. The 3D modelling of such bone is performed on the cross-sectional images reconstructed with Feldkamp Conebeam. The results are very satisfactory.

FP4

Session Title : Modeling Estimation and Simulation

Session Chair : Dr. Zhengguo LI

Date : 26 May 2006, Friday

Time : 3:40pm - 5:40pm

Venue : Gemini, Level 1

FP4.1 3:40pm-4:00pm P0556
3D Modeling from Multiple Projections with Arbitrary-Posed Camera
S Gimjumpa, W Narkbuekaew, M Sangworasil, C Pintavirooj
King Mongkut's Institute of Technology, Ladkrabang

Tomographic imaging is a technique for exploration of a cross-section of an inspected object without destruction. In this research, the series of photographs taken around the opaque object under the ambient light is completely served as the projections- the so-called photo-graphic tomography. From the process of tomography, the outcome is the stack of pseudo cross-sectional image. Not the internal of cross section is authentic, but the edge or contour is valid. In this paper, the concept for 3D modeling using photographic tomography was extended to the case where the camera pose can be varied arbitrary. In such case, camera pose is determined using general camera modeling technique. The extracted geometric transform matrix is used to reorient reconstructed data before implementing the traditional tomographic process. The simulation result is very promising.

FP4.2 4:00pm-4:20pm P0585
A High-Frequency Transmission Line Model for the Low Voltage Power Distribution Network
X X Wei, Y Li
Harbin Institute of Technology

Four-wire cables are necessary to the communication of the distribution network. This paper presents a novel approach to model the power line cables through the per-unit-length parameters. In this approach, different effect caused by surrounding are considered, the calculated results are compared with the measurements performed on the power line cables. This comparison shows a good agreement between simulated and measured results. And it reaps the advantages of distinct of the modelling approaches.

FP4.3 4:20pm-4:40pm P0669
Partial Discharge Phenomena due to Electrical Treeing in XLPE
J J Yang, D M Zhang
Nanyang Technological University

Increased electrical stress due to cable joints was simulated by point-plane electrode configuration. Electrical tree formed in XLPE insulation sliced from 220kV rated cable was diagnosed by partial discharge and dielectrometry measurements and optical observation. With increasing voltage at the rate of 1kV/10min, various analyses for PD pulses distribution in 20 ms and single pulses were carried out to compare the effects of applied voltage. Two types of electrical trees have been found out based on PD analysis and optical recording. Observed light emission supported the theory of emission by protons due to high-energy electrons. The analysis was supported with dielectrometry measurements on the sample before and after tree formation. And also, typical models were developed to study the mechanism of treeing.

FP4.4 4:40pm-5:00pm P0315
Partial Discharge Sources Detection and Location with an Electromagnetic Vector Sensor
*L X Zhou, *W G Li*
Changsha University of Science and Technology
*Huabei University of Electric Power

Partial discharge (PD) sources identification and location is one of the key problems for transformers PD Online monitoring. Electromagnetic vector sensor (EMVS) is capable of measuring the complete electric and magnetic fields induced by electromagnetic signals at one point. Using its detecting data, we can estimate the electromagnetic sources' spatial parameters and polarizations. In this paper, a single EMVS is proposed to measure the radiating ultra-high frequency (UHF) signal for PD detection and location. With the narrowband data filtered from the EMVS output signal, the number of PD sources can be estimated exactly by using minimum describing length (MDL) rule, the spatial parameters and polarizations of PD sources can be

obtained by adopting MUSIC algorithm. The results of simulate experiment show that this method is capable of identifying three PD sources and estimating their azimuths, elevations and polarizations. It is practical and hopeful to realize the PD location in transformer online PD monitoring.

FP4.5 5:00pm-5:20pm P0194

Power Analysis of Computer Game Algorithms for Handheld Embedded System

Y R Lai, S J Ruan
National Taiwan University of Science and Technology

Handheld PDAs are rapidly gaining in popularity and the capabilities of such devices are increasing at an accelerated pace. Computer game is one of the software applied in most mobile embedded devices that be requested to handle more and more functions in recent year. Most researches of computer games focus on AI performance, computer vision, even social sciences. On the other hand, a large and increasing number of embedded systems are subject to tight power constraints, but strangely no one pays attention to the games on mobile embedded device at present. Our work recognizes the need to provide embedded software designers with feedback about the effect of different algorithms of computer games on energy consumption early in the design cycle. The ability to efficiently analyze battery life under different design choices of games is an important aid in designing battery-efficient systems. In this paper, we present a comprehensive analysis of energy requirements in a wide range of the most used algorithms in different computer game types. Based on our results, we conclude and discuss various opportunities for realizing energy-efficient implementations of game algorithms. We believe that such investigations will be an important first step towards addressing the challenges of energy efficient algorithms for battery-constrained systems.

FP4.6 5:20pm-5:40pm P0278

Simulation of Traveling Wave Dielectrophoresis using a Meshless Method

*D F Chen, H J Du, *W H Li, **C Shu*
Nanyang Technological University
*University of Wollongong
**National University of Singapore

Manipulation and separation of micron-sized particles, particularly biological particles, using the dielectrophoretic effect is an emerging application in BioMEMS technology. This paper presents a numerical simulation for the four-phase traveling dielectrophoresis (DEP) using a novel meshless method - weighted least square finite difference (LSFD) scheme. The exact boundary condition and nonuniform point distribution were used in the calculation. Numerical results including the electrical potential, electrical field, traveling wave DEP forces and particle behavior are presented. Although the LSFD scheme was originally proposed in solving incompressible viscous flow, it is further demonstrated in this paper that the method is also well suited for solving various DEP problems in which extremely high gradient of electric field exists in the computational domain, e.g. edges of the electrodes. The LSFD method enables the computational ease of free point/mesh distribution in these areas, and hence it is feasible in the modelling of DEP systems.

FP5

Session Title : Process Automation

Session Chair : Prof. Jianhua ZHANG
Assoc. Prof. Minghe LI

Date : 26 May 2006, Friday

Time : 3:40pm - 5:40pm

Venue : Aquarius, Level 1

FP5.1 3:40pm-4:00pm P0283
A Low-Cost Automated Measurement System for Quality Control of AMLCD Manufacturing
L W Cheng, S J Ruan
National Taiwan University of Science and Technology

In this paper, an automated measurement system which inspects performance of AMLCD for manufacturing process is described. Without using an additional optical bench or stages, the system provides operators with a low-cost tool to test AMLCD for quality control. In addition, we demonstrated this system for testing some performance of LCD monitors.

FP5.2 4:00pm-4:20pm P0450
Convergence Analysis of Wafer Alignment Algorithm based on Object Transformation
*H T Kim, *H J Yang, S C Kim*
AM Technology
*Korea Polytechnique University

This paper analyzes the convergence of the automatic wafer alignment algorithm, which is similar to numerical root-finding. An iterative, simple equation for wafer alignment with a convergence constant was derived from object transformation. The convergence speed of the iteration could be varying the convergence constant n. To demonstrate the algorithm, an experiment for an alignment was done on the dicing machine. The alignment was repeated until the error was under sub-pixel level on the inspection system. The constant was varied to monitor its effect on iterative alignment speed. The result showed the convergence speed could be controlled but the compensation values found by the iterative action had the same solution.

FP5.3 4:20pm-4:40pm P0414
Soft Monitoring of a Coal Separation Process
S Cierpisz
Silesian University of Technology

A simulation analysis of a new method to identify a coal gravitational separation process is presented in the paper. The washability characteristic of a raw coal, the partition curve of a washing machine and separation densities have been identified. On-line identification is performed with the use of a soft monitoring system consisting of belt scales for yield measurements of products, on-line radiometric ash monitors and software interpreting these measurements. The method has been tested using a simulation model for the three-product coal separation process in a jig.

FP5.4 4:40pm-5:00pm P0399
The Research for Soft Measuring Technique of Sintering Burning Through Point
M H Li, J Wang
Anhui University of Technology

Accurate control for Burning Through Point (BTP) can not only make the sintering process stable but also use the sintering area effectively. The condition of BTP affects the sintering output and quality. Currently there are no instruments that can be used to measure BTP online. In this paper, the online judgment of BTP is researched. The math model will be built based on the relation of measurable variables with BTP to judge the BTP online. Quadratic curve is fitted according to three measured points including the highest waste gas in five windboxes at discharge end. Leading correction for inertia measuring elements is also taken. Based on the math model derived, a feedback correction of BTP by bring in the temperature of waste gas in flue is needed duo to air leakage at discharge end to ensure the accurate of BTP judgment. In the paper an application of Soft measuring technique of BTP is introduced. Digital filter algorithm suitable to inertia and slow time-various characteristics of temperature is also introduced.

FP5.5 5:00pm-5:20pm P0264
Diagonal Recurrent Neural Networks with Application to Multivariable Temperature Control
*J H Zhang, *G L Hou*
North China Electric Power University
*Liverpool University

A multivariable control strategy for steam temperature control system in a power plant is presented with the aid of diagonal recurrent neural networks (DRNN). There exists strong couple between reheating process and desuperheating process in this system. The unknown controlled process dynamics are identified by two diagonal recurrent neuro-identifiers (DRNI), which provide the sensitivity information of the objects to two diagonal recurrent neuro-controllers (DRNC) respectively. The convergence of the proposed control algorithm is analyzed. The control strategy has been used in the simulation to control reheating steam temperature and superheated steam temperature of a 200MW coal fueled power plant, the simulation verifies the effectiveness of the proposed method.

FP5.6 5:20pm-5:40pm P0517
Intelligent Control of Spot Welding Inverter based on Single Chip Microcomputer
S J Li, C J Lin, Y L Chang
Shenyang University of Technology

The article studies the use of a single chip microcomputer for the intelligent control of the constant current spot welding inverter based on fuzzy control. The core control and fuzzy logic of the spot welding control system is achieved by the single chip microcomputer Atmel 89C51. The control system guarantees the welding quality for different material, thickness and time of the welding.

AUTHORS INDEX

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