AUCC
Australian Control Conference
4th-5th November, 2013
Perth, Australia

Final Program and Book of Abstracts

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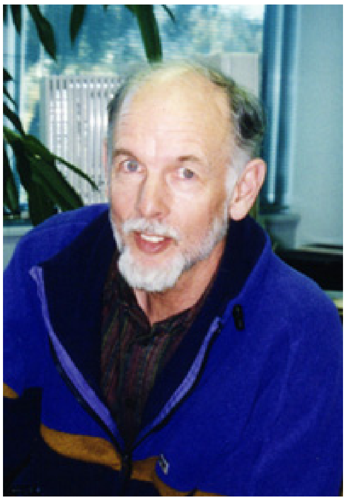
AUCC2013
Dedicated to the memory of
Professor John Barrett Moore



3 April 1941 - 19 January 2013

John Moore was born in China to Australian parents working there as missionaries, but the family returned to Australia early in John's life due to Japanese war campaign operations in China. Until the age of 11 when his father died, they lived in country Victoria. They then moved to Brisbane and there John completed high school and studied electrical engineering at the University of Queensland. He completed bachelor and master degrees, and then secured a green card to move to the US. There he found a job with Fairchild Semiconductor in what is now known as Silicon Valley, and designed the world's first integrated circuit flip-flop. He also developed an algorithm for factoring polynomials that was included in basic IBM software for many years.

After several years, he resumed studies, obtaining a PhD in electrical engineering at the University of Santa Clara. Towards the end of these studies, and just following his marriage to his wife Jan, he accepted a post at Newcastle University where Brian Anderson was establishing an Electrical Engineering department. They started work at approximately the same time, and spent 15 years there before both moving to the ANU in 1982, to start a new department of Systems Engineering, where John worked till his retirement in 2006.

John's research work garnered many accolades. At younger ages than normal, he was an IEEE Fellow, Fellow of the Australian Academy of Science and Fellow of the Australian Academy of Technological Sciences. Besides papers contributing to a wide variety of control systems, signal processing and communications problems, he authored a number of textbooks, including three with Brian Anderson. Brian was however just one of his many collaborators, which were drawn from round the globe, as were his numerous PhD students including some who became very highly reputed.

Not long after retiring, John was diagnosed with kidney cancer in 2007. That he survived as long as he did, most of the time with a high quality of life, is a testament to his vigorous and imaginative fight against the disease, with whole-hearted support from his wife, other family members, and friends.

Table of Contents

Welcome from the AUCC General Chair

I would like to welcome all of the participants to the 3rd Australian Control Conference (AUCC) and the city of Perth on behalf of the AUCC 2013 Organising and Technical Program Committees, as well as our main sponsor Engineers Australia. AUCC is a conference series that is organized by Engineers Australia through its National Committee for Automation, Control and Instrumentation (NCACI). The conference is technically co-sponsored by the IEEE Control Systems Society and is held annually in various locations in Australia. The first AUCC was held in Melbourne in 2011 and the next AUCC will be held in Canberra in 2014.

This year the conference is being held at the Esplanade Hotel Fremantle – by Rydges which provides excellent facilities and is located at the corner of Marine Terrace and Essex Street, Fremantle, WA. Renowned as Western Australia's premier tourist destination, Fremantle is rich in history, culture and tradition and an ideal conference and convention location. The conference will be held in Carnac, Garden, Rottnest and Abrolhos rooms. The conference is dedicated to Late Professor John Moore, who passed away early this year.

I would like to thank all authors for their submissions and hope that they will find the conference useful and interesting. There were 125 submissions including 123 regular papers and 2 industry abstracts to AUCC 2013, of which 83 regular papers and 2 industry abstracts have been included in the technical program; the program consists of two Plenary Lectures, Oral Sessions and Interactive (Poster) Sessions. I hope that you will find many interesting and exciting presentations and enjoy interactions with your colleagues from Australia and overseas.

There are many organisations which I would like to thank for their financial and technical support. I would like to thank NCACI for ensuring support from Engineers Australia as the main financial sponsor of the conference. The conference was further financially supported by University of Western Australia, Murdoch and Curtin Universities. I would also like to thank the IEEE, and the Control Systems Society in particular, for technically co-sponsoring the conference and agreeing to acquire the AUCC proceedings for publication in IEEE Xplore. I would like to thank Control Systems Society Outreach Fund for sponsoring the student travel award. I would also like to thank all previous and current members of the AUCC Steering Committee for their expertise that made AUCC possible. I would also like to thank the Members of NCACI for their continued support and in particular Professor Ljubo Vlacic for his step-by-step guidance in organizing this conference. I believe that we have achieved a high quality technical program this year and for this I would like to thank the members of the Technical Program Committee, in particular the Chairs, Dr. Lorenzo Ntogramatzidis and Prof. Parisa Bahri for their hard work and for providing their recommendations in a timely fashion. Also, I would like to thank all of the anonymous reviewers whose detailed reviews were essential in achieving a technical program of the highest quality. I would like to thank my good friend Pradeep Misra who replied to my many queries regarding the papercept for putting together this technical program. I would like to thank all of the members of the Organising Committee in particular Mr. Xin Zhang who handled many updates to conference webpage in a timely fashion. I would also like to thank Prof. Roberto Togneri who organized the visa letters for the overseas delegates. Special thanks to George Vokalek of Casual Productions and Caroline Johnson of IEEE who were instrumental in solving ISBN and IEEE Xplore, Letter of Acquisition issues.

A/Prof. Michael Cantoni chaired a selection committee for Student Best Paper Award consisting of himself, A/Prof. Khac Duc Do and Dr. Lorenzo Ntogramatzidis. I would also like to thank Mrs. Joan O'Brien for typesetting the Final Program and the Book of Abstracts. Finally, Robyn Boak and Mirerva Holmes from Engineers Australia have provided a great deal of assistance to the conference in matters such as registration and finances. Finally, I wish all participants a successful and stimulating conference.

Victor Sreeram
General Chair

Welcome from the Engineers Australia National Committee on Automation, Control and Instrumentation (NCACI)

ENGINEERS AUSTRALIA
Automation Control and Instrumentation

Dear AUCC 2013 Participants

On behalf of the Engineers Australia National Committee on Automation, Control and Instrumentation (NCACI), it gives me great pleasure to welcome you to AUCC 2013, the third conference of the new Australian Control Conference series.

I hope that you will find AUCC 2013 to be an inspiring and rewarding experience.

I would like to acknowledge the significant effort of the Conference General Chair, Professor Victor Sreeram and his team for the planning, preparation and operation of the conference.

I would like to extend our thanks to all committee members and paper reviewers for their hard work, invaluable support and the generosity with which they provided their time and expertise in order to make this conference a success.

Last but not least, thank you conference participants for joining us on this journey. I wish all of you a most rewarding experience at AUCC2013.

I look forward to meeting you now and in many years to come.

Dr Michael J Lees MIEAust CPEng, SMIEEE, RPEQ, NPER

Chair, NCACI

AUCC2013 Organising Committee

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Victor Sreeram
University of Western Australia

Technical Program Chairs
Lorenzo Ntogramatzidis
Curtin University

Parisa Bahri
Murdoch University

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Wanquan Liu
Curtin University

Local Arangements
Roberto Togneri
University of Western Australia

Finance & Registration
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University of Western Australia

Publicity & Sponsorships
Xin Zhang
Curtin University

Conference Secretary
Khac Duc Do
Curtin University

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University of Melbourne

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University of New South Wales

Ljubo Vlacic
Griffith University

Matthew James
Australian National University

Reza Moheimani
University of Newcastle

Mark Pszczel
DSTO

Victor Sreeram
University of Western Australia

Wei Xing Zheng
University of Western Sydney

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Chairs: **Lorenzo Ntogramatzidis, Curtin University**
Parisa Bahri, Murdoch University

Bijnan Bandyopadhyay, Indian Institute of Technology, Bombay, India
Jie Bao, University of New South Wales, Australia
James Douglas Biggs, University of Strathclyde, U.K.
Adrian Bishop, NICTA Australia
Michael Cantoni, University of Melbourne, Australia
Subhrakanti Dey, Uppsala University, Sweden
Gamini Dissanayake, University of Technology, Sydney, Australia
Daoyi Dong, University of New South Wales, Australia
Peter Dower, University of Melbourne, Australia
Jason Ford, Queensland University of Technology, Australia
Abdul Ghafoor, National University of Science and Technology, Pakistan
Qing-Long Han, Central Queensland University, Australia
Yiguang Hong, Institute of Systems Science, Chinese Academy of Sciences
Shoudong Huang, University of Technology, Sydney, Australia
Matthew James, Australian National University
S. Janardhanan, Indian Institute of Technology, New Delhi, India
Sai-ho Steve Ling, University of Technology, Sydney
Wanquan Liu, Curtin University, Australia
Ryan Loxton, Curtin University, Australia
Ian Manchester, University of Sydney, Australia
Rick Middleton, University of Newcastle, NSW, Australia
Boris Miller, Monash University, Australia
William Moase, University of Melbourne, Australia
Reza Moheimani, University of Newcastle, NSW, Australia
Girish Nair, University of Melbourne, Australia
Dragan Nesic, University of Melbourne, Australia
Hendra Ishwara Nurdin, University of New South Wales, Australia
Pubudu Pathirana, Deakin University, Australia
Jonathan Paxman, Curtin University, Australia
Ian Petersen, University of New South Wales, Australia
Hemanshu Pota, University of New South Wales, Australia
Daniel Quevedo, University of Newcastle, NSW, Australia
Robert Schmid, University of Melbourne
Maria Seron, University of Newcastle, NSW, Australia

Iman Shames, University of Melbourne, Australia
Rahul Sharma, University of Queensland, Australia
Victor Sreeram, University of Western Australia
Steven Weidong Su, University of Technology, Sydney, Australia
Ying Tan, University of Melbourne, Australia
Roberto Togneri, University of Western Australia
Valery Ugrinovskii, University of Newcastle, NSW, Australia
Ljubo Vlacic, Griffith University, Australia
Erik Weyer, University of Melbourne, Australia
Wei Xing Zheng, University of Western Sydney

Invitation to the Fourth Australian Control Conference

I would like to invite all Australasian and International researchers and professional engineers in Systems and Control to take part in the fourth Australian Control Conference (AUCC 2014) to be held in Canberra in 2014. The conference will be held on the campus of the Australian National University on Monday the 17 and Tuesday the 18 November 2014. We will be offering a dynamic scientific program including plenary and semi-plenary presentations. Located in central Canberra the university conference venue is walking distance from cosmopolitan cafes and restaurants along with quality and budget accommodation. The city of Canberra is known as the bush capitol of Australia and combines urban areas with natural bushland. Walk around the lake foreshore in the morning to get some exercise or make your way through the Botanic Gardens and up Black Mountain during lunch (both only 10 minutes' walk from the conference venue). Access is easy and convenient with close proximity to the airport, public transport and affordable parking.

November in Canberra is one of the most pleasant climates in Australia. It is after the spring winds and before the full heat of summer arrives in January. The average daily maximum is 23.5 degrees Celsius although it drops to a nippy 10 degrees during the evening. It is sunny 8 days in 10 with light winds.

I look forward to seeing all of you in Canberra in 2014.

With best regards

Robert Mahony

Plenary Lecture 1

Speaker: Iven Mareels

Title: Systems Engineering for Irrigation Management

Abstract:

Under the "no change scenario", the world is headed for a water crisis. This is the main message that can be gleaned from a variety of documents over the last decade from a variety of organisations such as the US Defence, the "World Water Group", UNESCO, UNICEF and the WWF.

As the "blue" planet is not running out of water, this water crisis is one of an economic water shortage, aggravated by a water management crisis.

Because of its abundance, earth's water is poorly monitored; e.g. for most water basins there is no real water balance, and most countries cannot present a balanced water account. Clearly, without adequate measurement, management is severely hampered, which forms the basis for the management crisis.

As climate change continues, the temporal and spatial distribution of water is becoming more erratic, and is diverging from society's needs. Urbanisation and population growth further exacerbate this problem. Moreover, the world wants to realise a number of equity goals, the so called millennium targets, all of which are predicated on the availability of more clean water for more people. These observations, combined with the fact that the true value of water is never brought into the picture (perhaps because access is so fundamental to life) and the risk of the absence of water is normally forgotten, lead to the market failing to provide adequate and sustainable water distribution systems.

In this presentation, large scale, gravity fed, flood irrigation systems are discussed. These account for 50% of the world's water usage. Over a period of nearly 15 years, a team drawn from the University of Melbourne and Rubicon Water pioneered a novel measure-model-manage approach for the exploitation of such systems. The new approach yields a 100% improvement in water productivity. Large scale commercial systems are in place in China, USA, Canada, Chile, New Zealand and Australia.

After a brief introduction to the civil engineering aspects of such systems, the control / management objectives are discussed. Next follow the models used, with an emphasis on how to construct and maintain large scale models (as some of the irrigation systems have a state space of 100k+, 20k input variables, and a similar number of output variables). A particular control design strategy is introduced that allows one to develop systems that can be retrofitted, expanded and maintained with relative ease, despite their complexity. Limitations, open problems, and next steps are briefly described.

Biography:

Iven Mareels obtained the (ir) Masters of Electromechanical Engineering from Gent University Belgium in 1982 and the PhD in Systems Engineering from the Australian National University, Canberra, Australia in 1987.

Since 1996, he is a Professor of Electrical and Electronic Engineering in the Department of Electrical and Electronic Engineering, the University of Melbourne. In June 2007, he became Dean of the School of Engineering, the University of Melbourne.

In 2013 he received *The Asian Control Association Wook Hyun Kwon Education Award*. He was a recipient of a 2008 Clunies Ross Medal, Academy of Technological Sciences and Engineering for his work on *Smart Irrigation Systems*. In 2007 he received the inaugural Vice-Chancellor's Knowledge Transfer Excellence award from the University of Melbourne. In 2005, he was named *IEEE CSS Distinguished Lecturer*, and in 1994 received the Vice-Chancellor's Award for Excellence in Teaching from the Australian National University.

He is a Fellow of the Royal Flemish Academy of Belgium for Science and the Arts, (KVAB); a Fellow of the Academy of Technological Sciences and Engineering, Australia, a Fellow of the Institute of Electrical and Electronics Engineers (USA), a member of the Society for Industrial and Applied Mathematics, a Fellow of the Institute of Engineers Australia. He is registered as a Corporate Professional Engineer and he is a member of the Engineering Executives chapter of Engineers Australia.

For his services to engineering and science he received in 2003 the Centenary Medal, and in 2013 became a Commander in the Order of the Crown (Belgium).

Presently he is the Chair of the Technical Board of the International Federation of Automatic Control (and ex-officio Vice-President) for 2008-2014. He is a member of the National Committee for Automation Control and Instrumentation.

He has extensive experience in consulting for both industry and government. He has strong interests in education and has taught a broad range of subjects in both mechanical and electrical engineering curricula. He was one of the main developers (1990-1996) of the Bachelor of Engineering at the Australian National University and one of the architects (2006-…) of the Bologna Model aligned 3+2 Master of Engineering education at Melbourne.

His research interests are in adaptive and learning systems, nonlinear control and modelling. His research focuses on the modelling and control of large scale systems, both engineered as well as natural systems, such as networks for water, and power transmission, and the neural networks in the brain.

Iven Mareels has published 5 books, 120 journal publications, 16 book chapters and 262 conference publications. He holds 15 international patents.

Plenary Lecture 2

Speaker: Richard Middleton

Title: Systems Biology: What does Systems and Control have to offer Biomedicine?

Abstract:

There has been much talk about 'systems biology', that is, the application of systems and control ideas to biological systems. In some cases, it is viewed as a fad of limited real value; in other cases, it may be proposed as a universal solution to difficult biological questions. In this talk I will discuss these issues, and use two examples to illustrate the benefits and new insights that may come from combining a systems and control approach with detailed biomedical understandings.

The first example is a systems approach to understanding Parkinson's Disease, a debilitating and very costly problem for our society. This disease is well understood from a symptomatic viewpoint, however, the causal mechanistic basis of the disease origins and progression is limited. A second example concerns treatment design for mutating pathogens such as HIV. In this context, some clinical treatment problems may be formulated as a kind of control problem, and I will examine insights that systems and control may have to offer.

Biography:

Professor Richard H. Middleton completed his Ph.D. (1987) from the University of Newcastle, Australia. He was a Research Professor at the Hamilton Institute, The National University of Ireland, Maynooth from May 2007 till 2011 and is currently Professor at the University of Newcastle and Director of the Priority Research Centre for Complex Dynamics Systems and Control. In 2011, he was President of the IEEE Control Systems Society. He is a Fellow of IEEE and of IFAC, and his research interests include a broad range of Control Systems Theory and Applications, including Robotics, control of distributed systems and Systems Biology with applications to Parkinson’s Disease and HIV Dynamics.

AUCC2013 Best Student Paper Award

AUCC Best Student Paper Award recognises excellence in a paper presented at Australian Control Conference whose primary author is a student. Due to a special format of AUCC 2013 that consists of a single oral track and several poster sessions, only the content of the papers (and not the presentations) are evaluated by the selection committee. As a part of the greater commitment to promoting, encouraging and training future engineers in Australia, the Engineers Australia sponsors a prize for the best student paper. The award consists of a framed certificate and AUD $500.

Nine papers were nominated for the Best Student Paper Award at AUCC 2013. The committee consisting of Associate Professor Michael Cantoni (Chair), Associate Professor Khac Duc Do and Dr. Lorenzo Ntogramatzidis shortlisted three papers. They are:

Authors: Alireza Mohammadi, Dragan Nesic and Chris Manzie
• Finalist: Alireza Mohammadi
Nominator: Dragan Nesic
Paper Title: *Emulation Design for a Class of Extremum Seeking Controllers: Case Studies in ABS Design and Spark Timing Calibration*

Authors: Jiahu Qin and Changbin Yu
• Finalist: Jiahu Qin
Nominator: Changbin Yu
Paper Title *An examination of coordination for homogeneous linear agents under arbitrary network topology*

Authors: Timothy L. Molloy and Jason J. Ford
• Finalist: Timothy L. Molloy
Nominator: Jason J. Ford
Paper Title: *Consistent HMM Parameter Estimation using Kerridge Inaccuracy Rates*

The winner of the AUCC2013 Best Student Paper Award will be announced at the Conference Banquet on Monday, 4th November 2013.

AUCC2013 Student Travel Award

AUCC2013 has received funding of US $5,000 from the CSS Outreach Fund to support student travel to the conference. The funds will be used to support the student travel expenses to attend the conference. In order to apply for the student travel award, students are required to meet the following eligibility requirements:

- the student should be enrolled full time at a university.
- have an accepted paper at the conference, with the student as the first named author.

The travel award is not expected to cover the total cost of the conference travel being undertaken. It is necessary for applicants to ensure that other funding was available. Therefore, preference will be given to students who have obtained partial support from their university or supervisor. Due to limited funding, the total number of travel awards, and total amount awarded per student will depend on the number of applications received.

Thirteen applications confirming the student eligibility and stating the reasons for seeking student travel award were received. A total of AUS $5,500 (US $5,000) will be distributed equally among the thirteen applicants.

AUCC2013 Sponsors

Engineers Australia. Engineers Australia is the national forum for the advancement of engineering and the professional development of our members. With more than 85,000 members embracing all disciplines of the engineering team, Engineers Australia is the largest and most diverse professional body for engineers in Australia. Engineers Australia is steered by a representative body, the National Congress, who elects and monitors the Council of Engineers Australia. There are numerous committees, colleges, technical societies and other groups that actively contribute to the organisation as a whole. Engineers Australia works closely with academic institutions to accredit courses and programs, and ensure they are aligned with international benchmarks. http://www.engineersaustralia.org.au/

IEEE Control Systems Society. The IEEE Control Systems Society is an international scientific, engineering, and professional organisation that was founded in 1954 and is dedicated to the advancement of research, development, and practice in automation and control systems. The society and its members are involved in a number of activities, including **publishing** journals and a magazine, holding a number of conferences, and sponsoring committees in various areas of technical specialisation. http://www.ieeecss.org

The IEEE Control Systems Society (CSS) Outreach Fund. The IEEE Control Systems Society (CSS) Outreach Fund provides financial resources for projects that will benefit CSS and the controls community in general. Examples of projects that we can support include (not an exhaustive list): Outreach activities for pre-university students and teachers, Outreach activities for developing nations, Promotional materials for CSS or the field Workshops on control-related topics CSS membership drives.

University of Western Australia: Established in 1911, the University's ground-breaking research, quality academic staff and state-of-the-art facilities combine to offer a vibrant student experience.

As Western Australia's premier university, UWA was equal first overall in Australia based on key measures in the Good Universities Guide 2014 including student demand, graduate outcomes, graduate starting salaries, getting a full-time job research intensivity and research grants. The University of Western Australia ranks 91st in the world in the highly respected Shanghai-Jiao Tong University's Academic Ranking of World Universities.

UWA is the only Western Australian university to belong to the Group of Eight – a coalition of the top research universities in Australia – and it is one of only two Australian members of the Worldwide Universities Network, a partnership of 18 research-led universities from Europe, Africa, the Americas and the Asia-Pacific. The University is also a foundation member of the

Matariki Network of high quality, research-intensive universities with a particular focus on student experience.

Murdoch University is a research-led university with a reputation for world class research in selected areas of knowledge. Our researchers engage with significant social and scientific challenges of our time. Additionally, we have a reputation for excellence in teaching fuelled by our enthusiasm for research, the creation of new knowledge and its dissemination for the benefit of our communities both locally and abroad. Murdoch courses are available at its three campuses in Western Australia, as well as partner institutes in Singapore, Dubai and Malaysia.

The School of Engineering and Information Technology features world-class facilities and a highly qualified faculty, focused on preparing students for careers in dynamic and challenging sectors. The School's Engineering discipline boasts course offerings in Electrical Power Engineering, Environmental Engineering, Industrial Computer Systems Engineering, and Instrumentation and Control Engineering.

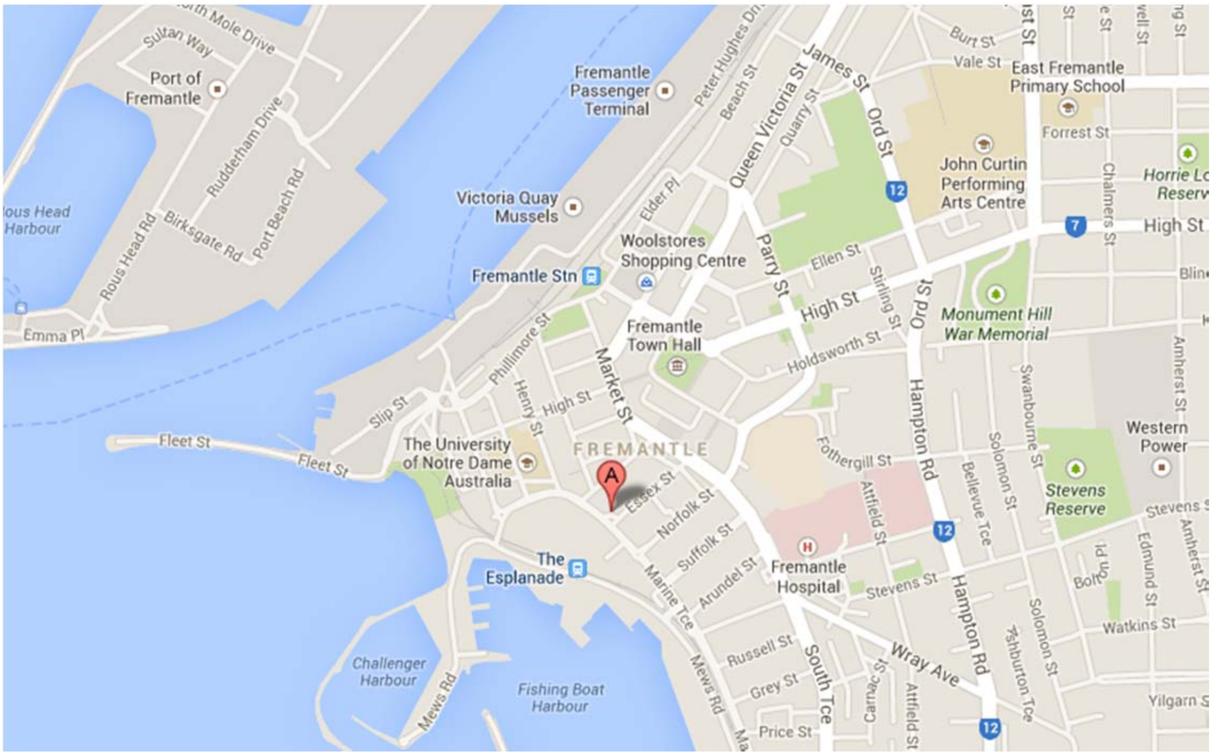
Curtin University was established in 1966 as the Western Australian Institute of Technology (WAIT). It gained university status and was renamed Curtin University of Technology in 1987. Curtin is a university with a global outlook having well established campuses in Singapore and Sarawak, Malaysia. Curtin has more than 46,000 students studying all over the world. This includes over 10,000 international students from 120 countries studying at Perth, Sydney and other Australian locations. Curtin is one of only two Western Australian universities to rank in the prestigious Shanghai Jiao Tong Annual Ranking of World Universities (2011). Curtin is one of only two Western Australian universities to rank in the Times Higher Education's 2011-2012 world university rankings. The 2012 Quacuarelli Symonds World Universities Ranking by Subject has listed Curtin among the top 200 universities in the world across nine categories, up from five in 2011. The Department of Mechanical & Mechatronic Engineering is internationally competitive. All members of its staff are active in research.

Conference Information

CONFERENCE VENUE

The 2013 Australian Control Conference (AUCC 2013) will be held at the Esplanade Hotel Fremantle – by RYDGES which is at the corner of Marine Terrace and Essex Street, Fremantle, 6160, Western Australia.

The plenary and oral presentation session will take place in Carnac and Garden rooms. The poster presentations will be held in Rottnest room.

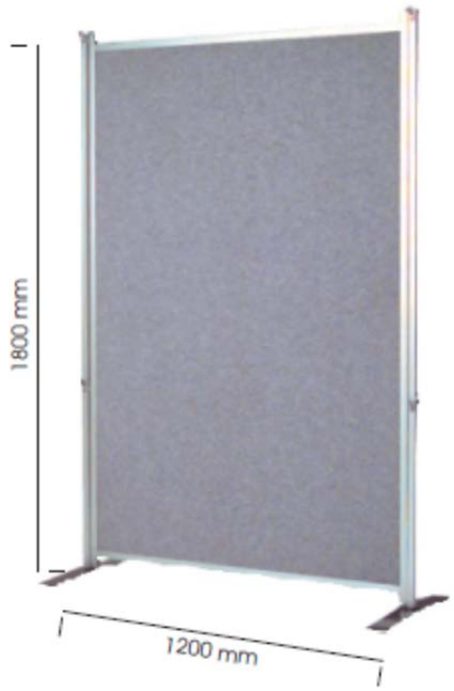


Audio and visual equipment for oral sessions (Carnac & Garden rooms):

A laptop will be available for presenters to upload their slides in PowerPoint or PDF format. Alternatively, presenters may bring their own laptop and plug into the AV equipment.

Poster boards (Rottnest room):

Poster boards will be of dimensions 1.2m horizontal by 1.8 m vertical.



Poster Board Upright

Arrival, Morning and Afternoon Tea & coffee:

Tea and coffee will be provided during the following times:

Monday: 8:30 to 9:00, 10.00 to 10.30 and 15.30 to 16.00 Rottnest room

Tuesday: 8:30 to 9:00, 10.00 to 10.30 and 15.30 to 16.00 Abrolhos room

Buffet Lunch (Monday and Tuesday, 12:30 to 13:30): Atrium Garden Restaurant

On-Site Registration

Conference delegates and their companions will receive their badges, conference materials, social event tickets at the desk. Participants are kindly requested to wear their name badges during all events of the AUCC2013.

Registration Fees

Member Full Fee	AUD$550.00
Student	AUD$350.00
Non-Members Full Fee	AUD$600.00

Opening hours of the registration desk:

November 3 (Sunday) 17.00 – 19.00

November 4 (Monday) 8:00 – 17:00

November 5 (Tuesday) 8.00 – 12:30

Opening Ceremony

Date: November 3, 2013 (Sunday)

Time: 6 pm to 8 pm

Venue: Abrolhos room

Conference Dinner

Date: November 4, 2013 (Monday)

Time: 6.00 pm– 9:00 pm

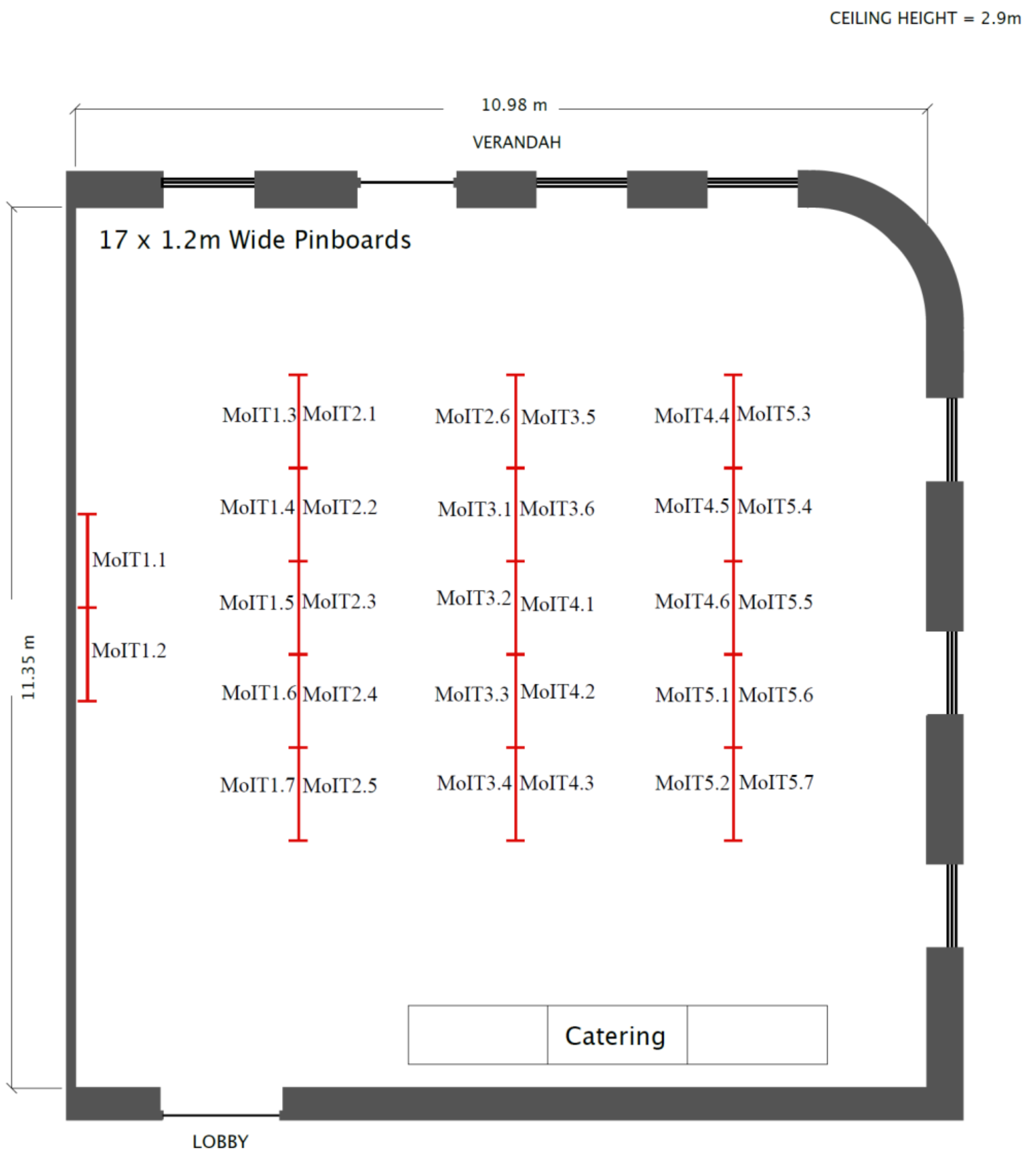
Venue: Resort Pool

Closing Ceremony

Date: November 5, 2013 (Tuesday)

Time: 6 pm to 8 pm

Venue: Abrolhos room

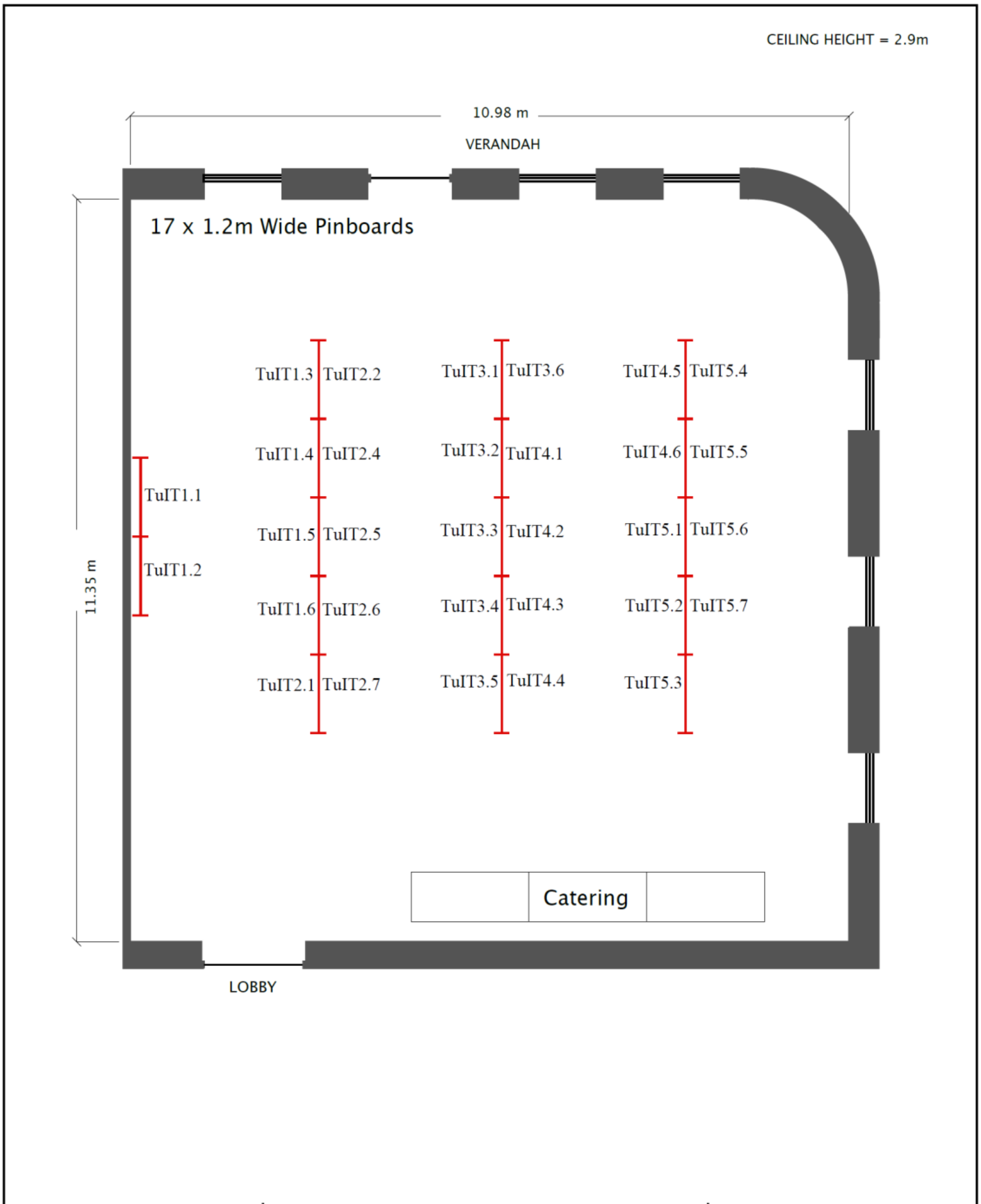


ESPLANADE HOTEL FREMANTLE by RYDGES

Poster Boards Floor Plan for Monday

Esplanade Hotel Fremantle
Rottnest Room

AVPartners™



ESPLANADE HOTEL FREMANTLE by RYDGES	Poster Boards Floor Plan for Tuesday Esplanade Hotel Fremantle Rottnest Room	AVPartners™

AUCC 2013 Technical Program Monday November 4, 2013

Track T1	Track T2	Track T3	Track T4	Track T5
		08:45-09:00 MoPO Carnac & Garden Welcome from the AUCC General Chair		
		09:00-10:00 MoKP Carnac & Garden Plenary Lecture 1: Systems Engineering for Irrigation Management by Professor Iven Mareels		
		10:30-12:25 MoAOP1 Carnac & Garden Late Professor John Moore Plenary Session		
		13:30-15:30 MoBOP2 Carnac & Garden Nonlinear Systems and Control -I		
16:00-17:30 MoIT1 Rottnest Signal Processing and Filtering	16:00-17:30 MoIT2 Rottnest Intelligent and Learning Systems	16:00-17:30 MoIT3 Rottnest Nonlinear Systems and Control -II	16:00-17:30 MoIT4 Rottnest Control Applications-II	16:00-17:30 MoIT5 Rottnest Stochastic/Robust/Optimal Control

AUCC 2013 Technical Program Tuesday November 5, 2013

Track T1	Track T2	Track T3	Track T4	Track T5
		09:00-10:00 TuPP Carnac & Garden Plenary Lecture 2: Systems Biology: What Does Systems and Control Have to Offer Biomedicine? by Professor Richard Middleton		
		10:30-12:30 TuAOP1 Carnac & Garden Control Applications -I		
		13:30-15:30 TuBOP2 Carnac & Garden Control Methods		
16:00-17:30 TuIT1 Rottnest Process Control & Instrumentation	16:00-17:30 TuIT2 Rottnest Consensus and Multi-Agent Systems	16:00-17:30 TuIT3 Rottnest System Modelling and Identification	16:00-17:30 TuIT4 Rottnest Linear Systems	16:00-17:30 TuIT5 Rottnest Micro and Nano Systems

Content List of 2013 Australian Control Conference

Technical Program for Monday November 4, 2013

MoIT2	Rottnest
Intelligent and Learning Systems (Interactive Session)	

16:00-17:30	MoIT2.1
Evolutionary Algorithms for Self-Tuning Active Vibration Control of Flexible Beam, pp. 104-108.	
Fadil, Muhammad Anas	Univ. Teknologi Malaysia
Mat Darus, Intan Zaurah	Univ. Teknologi Malaysia

16:00-17:30	MoIT2.2
Active Vibration Control of Flexible Plate with Free-Free-Clamped-Clamped Edges Using Genetic Algorithm, pp. 109-114.	
Hadi, Muhamad Sukri	Univ. Teknologi Malaysia
Mat Darus, Intan Zaurah	Univ. Teknologi Malaysia
Mohd Yatim, Hanim	Univ. Teknologi Malaysia

16:00-17:30	MoIT2.3
Design of Adaptive I-PD Control System with Variable Reference Model, pp. 115-120.	
Shiota, Tsuyoshi	Keio Univ.
Ohmori, Hiromitsu	Keio Univ.

16:00-17:30	MoIT2.4
Sampling-Based Learning Control of Quantum Systems with Bounded Inputs and Uncertainties Via Path Planning, pp. 121-126.	
Chen, Chunlin	Nanjing Univ.
Long, Ruixing	Princeton Univ.
Qi, Bo	Acad. of Mathematics and Systems Science, Chinese Acad. of S
Dong, Daoyi	UNSW

16:00-17:30	MoIT2.5
Identification for Automotive Air-Conditioning System Using Particle Swarm Optimization, pp. 127-132.	
Md Lazin, Md Norazlan	Univ. Teknologi Malaysia
Mat Darus, Intan Zaurah	Univ. Teknologi Malaysia
Ng, Boon Chiang	Univ. Teknologi Malaysia
Mohamed Kamar, Haslinda	Univ. Teknologi Malaysia

16:00-17:30	MoIT2.6
Control the Active and Reactive Powers of Three-Phase Grid-Connected Photovoltaic Inverters Using Feedback Linearization and Fuzzy Logic, pp. 133-140.	
Thao, Nguyen Gia Minh	Waseda Univ.
Uchida, Kenko	Waseda Univ.

MoIT3	Rottnest
Nonlinear Systems and Control -II (Interactive Session)	

16:00-17:30	MoIT3.1
Enhanced Fault Detection and Isolation in Modern Flight Actuators, pp. 141-146.	
Ossmann, Daniel	German Aerospace Center (DLR)

16:00-17:30	MoIT3.2
MEMS Based Oscillator Incorporating a Displacement Sensor, pp. 147-151.	
Moore, Steven I.	Univ. of Newcastle
Moheimani, S.O. Reza	Univ. of Newcastle

16:00-17:30	MoIT3.3
The Application of Discrete Sliding Mode Control in Parabolic PDE Dynamics, pp. 152-157.	
Argha, Ahmadreza	Univ. of Tech. Sydney
Li, Li	Univ. of Tech. Sydney
Su, Steven Weidong	Univ. of Tech. Sydney
Nguyen, Hung T.	Univ. of Tech. Sydney

16:00-17:30	MoIT3.4
Finite-Time Boundedness and Stabilization of Discrete-Time Nonlinear Quadratic Systems, pp. 158-163.	
Wei, Yunliang	Nanjing Univ. of Science and Tech.
Zheng, Wei Xing	Univ. of Western Sydney

16:00-17:30	MoIT3.5
New Results on Practical Set Stability of Switched Nonlinear Systems, pp. 164-168.	
Zhang, Yi	China Univ. of Petroleum, Beijing
Yang, Jing	China Univ. of Petroleum, Beijing
Xu, Honglei	Curtin Univ.
Teo, Kok Lay	the Curtin Univ. of Tech.

16:00-17:30	MoIT3.6
Autonomous Forced Landing System for Light General Aviation Aircraft in Unknown Environments, pp. 169-170.	
Arain, Bilal Ahmed	Queensland Univ. of Tech.
Warren, Michael David	Queensland Univ. of Tech.
Yang, Xilin	Australian Res. Centre for Aerospace Automation and Queensla
Gonzalez, Luis Felipe	Queensland Univ. of Tech. (QUT)/ Australian Res. C
Mejias Alvarez, Luis	Queensland Univ. of Tech.
Upcroft, Ben	Queensland Univ. of Tech.

MoIT4	Rottnest
Control Applications-II (Interactive Session)	

16:00-17:30	MoIT4.1
Control of a High-Speed Nanopositioner for Lissajous-Scan Video-Rate AFM, pp. 171-176.	
Yong, Yuen	Univ. of Newcastle
Bazaei, Ali	Univ. of Newcastle
Moheimani, S.O. Reza	Univ. of Newcastle

16:00-17:30	MoIT4.2
Predictive Control of Wind Turbines with Storage, pp. 177-182.	
Sharma, Rahul	The Univ. of Queensland
Yan, Ruifeng	The Univ. of Queensland
Kearney, Michael	The Univ. of Queensland

16:00-17:30	MoIT4.3
Triangulation-Based Path Planning for Patrolling by a Mobile Robot, pp. 183-188.	
an, vatana	Univ. of central florida
Qu, Zhihua	Univ. of Central Florida

16:00-17:30	MoIT4.4
Robust LQ Control for Parallel Wheeled Inverted Pendulum, pp. 189-194.	
Nagaya, Shuma	Nanzan Univ.
Morikawa, Takamitsu	Nanzan Univ.
Takami, Isao	Nanan Univ.
Chen, Gan	Nanzan Univ.

16:00-17:30	MoIT4.5

An Analytical Characterisation of Cold-Load Pickup Oscillations in Thermostatically Controlled Loads, pp. 195-200.

Perfumo, Cristian	CSIRO
Braslavsky, Julio H.	Commonwealth Scientific and Industrial Res. Organisation
Ward, John Kelvin	CSIRO
Kofman, Ernesto	Departamento de Control, FCEIA, UNR

16:00-17:30 MoIT4.6

Stability Analysis for Interconnected Systems with ``Mixed" Passivity, Negative-Imaginary and Small-Gain Properties, pp. 201-206.

Das, Sajal	The Univ. of New South Wales @theAustralianDefenceForce Aca
Pota, Hemanshu R.	Univ. of New South Wales
Petersen, Ian R.	Australian Defence Force Acad.

MoIT5 Rottnest

Stochastic/Robust/Optimal Control (Interactive Session)

16:00-17:30 MoIT5.1

Distributed Nullforming without Prior Frequency Synchronization, pp. 207-211.

Kumar, Amy	Univ. of Iowa
Dasgupta, Soura	Univ. of Iowa
Mudumbai, Raghuraman	Univ. of Iowa

16:00-17:30 MoIT5.2

The Effect of Sample/Hold Time on Initial Feasible Set in Model Predictive Control Design, pp. 212-217.

Zhou, Dexiang	Nanyang Tech. Univ.
Ling, Keck-Voon	Nanyang Tech. Univ.

16:00-17:30 MoIT5.3

Heteroclinic Optimal Control Solutions for Attitude Motion Planning, pp. 218-223.

Biggs, James Douglas	Univ. of Strathclyde
Maclean, Craig	Strathclyde Univ.
Caubet, Albert	Univ. of Strathclyde

16:00-17:30 MoIT5.4

A Gap Metric Perspective of Well-Posedness for Nonlinear Feedback Interconnections, pp. 224-229.

Khong, Sei Zhen	Lund Univ.
Cantoni, Michael	Univ. of Melbourne
Manton, Jonathan H.	The Univ. of Melbourne

16:00-17:30 MoIT5.5

Optimal Control of Time-Inhomogeneous Markov Chains with Application to Dam Management, pp. 230-237.

McInnes, Daniel James	Monash Univ.
Miller, Boris	Monash Univ. Clayton Campus

16:00-17:30 MoIT5.6

Application of Stochastic Control to Analysis and Optimization of TCP, pp. 238-243.

Miller, Boris	Monash Univ. Clayton Campus
Miller, Alexander	Inst. for Information Transmission Problems, RAS

16:00-17:30 MoIT5.7

On Effectiveness of the Mirror Decent Algorithm for a Stochastic Multi-Armed Bandit Governed by a Stationary Finite Markov Chain, pp. 244-250.

Miller, Boris	Monash Univ. Clayton Campus
Nazin, Alexander V.	V.A.Trapeznikov Inst. of Control Sciences, RAS

Technical Program for Tuesday November 5, 2013

TuAOP1 Carnac & Garden
Control Applications -I (Regular Session)
Chair: Bruggemann, Troy Sterling — Queensland Univ. of Tech.
Co-Chair: Manzie, Chris — The Univ. of Melbourne

10:30-10:50 TuAOP1.1
Energy-Based Control of Bidirectional Vehicle Strings, pp. 251-256.
Knorn, Steffi — Univ. of Newcastle
Donaire, Alejandro — The Univ. of Newcastle
Aguero, Juan C. — The Univ. of Newcastle
Middleton, Richard H. — The Univ. of Newcastle

10:50-11:10 TuAOP1.2
Active Piezoelectric Shunt Control of an Atomic Force Microscope Micro-Cantilever, pp. 257-262.
Fairbairn, Matthew William — The Univ. of Newcastle, Australia
Müller, Philipp — Univ. of Stuttgart
Moheimani, S.O. Reza — Univ. of Newcastle

11:10-11:30 TuAOP1.3
Computation Time Analysis of Centralized and Distributed Optimization Algorithms Applied to Automated Irrigation Networks, pp. 263-269.
Farhadi, Alireza — Sharif Univ. of Tech.
Dower, Peter M. — The Univ. of Melbourne
Cantoni, Michael — Univ. of Melbourne

11:30-11:50 TuAOP1.4
A Fundamental Solution for an Infinite Dimensional Two-Point Boundary Value Problem Via the Principle of Stationary Action, pp. 270-275.
Dower, Peter M. — The Univ. of Melbourne
McEneaney, William — Univ. of California, San Diego

11:50-12:10 TuAOP1.5
Emulation Design for a Class of Extremum Seeking Controllers: Case Studies in ABS Design and Spark Timing Calibration, pp. 276-281.
mohammadi, alireza — Univ. of Melbourne
Nesic, Dragan — Univ. of Melbourne
Manzie, Chris — The Univ. of Melbourne

12:10-12:30 TuAOP1.6
Automated Aerial Inspection Guidance with Improved Turn Planning, pp. 282-288.
Bruggemann, Troy Sterling — Queensland Univ. of Tech.
Ford, Jason — Queensland Univ. of Tech.

TuBOP2 Carnac & Garden
Control Methods (Regular Session)
Chair: Cantoni, Michael — Univ. of Melbourne
Co-Chair: Ntogramatzidis, Lorenzo — Curtin Univ.

13:30-13:50 TuBOP2.1
Fault-Tolerant Control under Controller-Driven Sampling Using Virtual Actuator Strategy, pp. 289-294.
Osella, Esteban N. — CONICET
Haimovich, Hernan — Univ. Nacional de Rosario
Seron, Maria M. — The Univ. of Newcastle

13:50-14:10 TuBOP2.2
An Examination of Coordination for Homogeneous Linear Agents under Arbitrary Network Topology, pp. 295-300.
Qin, Jiahu — The Australian National Univ.
YU, Changbin — Australian National Univ.

14:10-14:30 TuBOP2.3
Model Predictive Control for a Class of Systems with Uncertainty in Scheduled Load, pp. 301-306.
Neshastehriz, Amir Reza — The Univ. of Melbourne
Shames, Iman — Univ. of Melbourne
Cantoni, Michael — Univ. of Melbourne

14:30-14:50 TuBOP2.4
A Pruning Algorithm for Managing Complexity in the Solution of a Class of Linear Non-Quadratic Regulator Problems, pp. 307-312.
Zhang, Huan — The Univ. of Melbourne
Dower, Peter M. — The Univ. of Melbourne
McEneaney, William — Univ. of California, San Diego

14:50-15:10 TuBOP2.5
Coherent Quantum Observers for N-Level Quantum Systems, pp. 313-318.
Miao, Zibo — Australian National Univ.
Duffaut Espinosa, Luis Augusto — Univ. of New South Wales at ADFA
Petersen, Ian R. — Australian Defence Force Acad.
Ugrinovskii, Valery — Univ. of New South Wales
James, Matthew R. — Australian National Univ.

15:10-15:30 TuBOP2.6
Notes on Coherent Feedback Control for Linear Quantum Systems, pp. 319-324.
Petersen, Ian R. — Australian Defence Force Acad.

TuIT1 Rottnest
Process Control & Instrumentation (Interactive Session)

16:00-17:30 TuIT1.1
Multirate Dissipativity-Based Distributed MPC, pp. 325-330.
Zheng, Chaoxu — Univ. of New South Wales
Tippett, Michael James — Univ. of New South Wales
Bao, Jie — The Univ. of New South Wales
Liu, Jinfeng — Univ. of Alberta

16:00-17:30 TuIT1.2
Optimization Tuning of Pi Controller of Quadruple Tank Process, pp. 331-335.
Zainal Abidin, Nurhuda — Univ. Teknologi Malaysia
Sahlan, Shafishuhaza — Univ. Teknologi Malaysia (UTM)
Abdul Wahab, Norhaliza — Univ. Teknologi Malaysia

16:00-17:30 TuIT1.3
The Control of Beer Production: Insights into the Controller Topology of a Large Australian Brewery, pp. 336-341.
Lees, Michael — Carlton & United Breweries
Ellen, Robert — EGA Tech.
Brodie, Paul — Carlton & United Breweries

16:00-17:30 TuIT1.4
Obsolescence Management of Electronic and Control Systems, pp. 342-347.
Cuculoski, Vlatko — Murdoch Univ. Perth Western Australia, Monash Univ. Gi

16:00-17:30	TuIT1.5

Design of Stable Model Reference Adaptive System Via Lyapunov Rule for Control of a Chemical Reactor, pp. 348-353.

Tahersima, Hanif	Hong Kong Univ. of Science & Tech.
Saleh, Mohammadjafar	Iran Univ. of science and Tech.
Mesgarisohani, Akram	Honk Kong Univ. of science and Tech.
Tahersima, Mohammadhossein	Kyoto Univ.

16:00-17:30	TuIT1.6

Cascaded Model Predictive Control of a Quodrotor UAV, pp. 354-359.

Chen, Xi	RMIT Univ.
Wang, Liuping	RMIT Univ.

TuIT2 — Rottnest
Consensus and Multi-Agent Systems (Interactive Session)

16:00-17:30	TuIT2.1

Global Leader-Following Consensus of Discrete-Time Linear Multiagent Systems Subject to Actuator Saturation, pp. 360-363.

Wang, Qingling	Harbin Inst. of Tech.
Gao, Huijun	Harbin Inst. of Tech.
YU, Changbin	Australian National Univ.

16:00-17:30	TuIT2.2

On the Uniform Global Pre-Asymptotic Stability of Closed Sets for Switched Hybrid Systems, pp. 364-368.

Wang, Wei	The Univ. of Melbourne
Postoyan, Romain	CNRS
Nesic, Dragan	Univ. of Melbourne

16:00-17:30	TuIT2.4

Non-Robustness of Gradient Control for 3-D Undirected Formations with Distance Mismatch, pp. 369-374.

Sun, Zhiyong	Shandong Computer Science Center; Australian National Univ.
Mou, Shaoshuai	Yale Univ.
Anderson, Brian D.O.	Australian National Univ.
Morse, A. Stephen	Yale Univ.

16:00-17:30	TuIT2.5

Guaranteed Cost Tracking for Uncertain Coupled Multi-Agent Systems Using Consensus Over a Directed Graph, pp. 375-378.

cheng, Yi	Univ. of New South Wales at Australian Defence Force Acad.
Ugrinovskii, Valery	Univ. of New South Wales
Wen, Guanghui	Southeast Univ.

16:00-17:30	TuIT2.6

On Iterative Learning Control for Synchronization of MIMO Heterogeneous Systems, pp. 379-384.

Yang, Shiping	National Univ. of Singapore
Tan, Ying	The Univ. of Melbourne
Xu, Jian-Xin	National Univ. of Singapore

16:00-17:30	TuIT2.7

Is There a Need for Fully Converged CFD Solutions? Global Extremum Seeking Applied to Aerodynamic Shape Optimisation, pp. 385-390.

Lee, Kuan Waey	The Univ. of Melbourne
Moase, William	The Univ. of Melbourne
Manzie, Chris	The Univ. of Melbourne
Hutchins, Nicholas	The Univ. of Melbourne
Ooi, Andrew	The Univ. of Melbourne
Vethecan, Jerome	BAE Systems Australia
Riseborough, Paul	BAE Systems Australia

TuIT3 — Rottnest
System Modelling and Identification (Interactive Session)

16:00-17:30	TuIT3.1

Rapid Parameter Identification for an Electromechanical Brake, pp. 391-396.

Lee, Chih Feng	The Univ. of Melbourne
Manzie, Chris	The Univ. of Melbourne

16:00-17:30	TuIT3.2

Comparison Study of the Taylor Series Based Discretization Method for Nonlinear Input-Delay Systems, pp. 397-402.

Zheng, Zhang	Chonbuk National Univ.
Baek, Seung Jun	Chonbuk National Univ.
Chong, Kil To	Chonbuk National Univ.

16:00-17:30	TuIT3.3

Controllability and Stability of Discrete-Time Antilinear Systems, pp. 403-408.

Wu, Ai-Guo	Harbin Inst. of Tech. Shenzhen Graduate School
Duan, Guang-Ren	Harbin Inst. of Tech.
Liu, Wanquan	Curtin Univ. of Tech.
Sreeram, Victor	Univ. of Western Australia

16:00-17:30	TuIT3.4

Optimal Boundary Control for the Heat Equation with Application to Freezing with Phase Change, pp. 409-414.

Backi, Christoph Josef	Norwegian Univ. of Science and Tech.
Gravdahl, Jan Tommy	Norwegian Univ. of Science & Tech.

16:00-17:30	TuIT3.5

Comparison of Prediction Error Methods and Subspace Identification Methods for Rivers, pp. 415-420.

Nasir, Hasan Arshad	Univ. of Melbourne
Weyer, Erik	Univ. of Melbourne

16:00-17:30	TuIT3.6

A Frequency Limited Model Reduction Technique for Linear Discrete Systems, pp. 421-426.

Du, Xin	Shanghai Univ.
Jazlan, Ahmad	Univ. of Western Australia
Sreeram, Victor	Univ. of Western Australia
Togneri, Roberto	Univ. of Western Australia
Ghafoor, Abdul	National Univ. of Science and Tech.
Sahlan, Shafishuhaza	Univ. Teknologi Malaysia (UTM)

TuIT4 — Rottnest
Linear Systems (Interactive Session)

16:00-17:30	TuIT4.1

Distributed Model Predictive Control for Networks with Changing Topologies, pp. 427-434.

Tippett, Michael James	Univ. of New South Wales
Bao, Jie	The Univ. of New South Wales

16:00-17:30	TuIT4.2

On Eigenvalue-Eigenvector Assignment for Componentwise Ultimate Bound Minimisation in MIMO LTI Discrete-Time Systems, pp. 435-440.

Heidari, Rahmat	Univ. of Newcastle
Seron, Maria M.	The Univ. of Newcastle
Braslavsky, Julio H.	Commonwealth Scientific and

Industrial Res. Organisation

16:00-17:30 TuIT4.3

Limited Frequency Interval Gramians Based Model Reduction for Nonsingular Generalized Systems, pp. 441-444.

Imran, Muhammad Imran — National Univ. of Sciences & Tech.
Ghafoor, Abdul — National Univ. of Science and Tech.
Akram, Safia — National Univ. of Sciences and Tech.
Sreeram, Victor — Univ. of Western Australia

16:00-17:30 TuIT4.4

Stability Analysis for Interconnected Systems with ``Mixed" Negative-Imaginary and Passivity, pp. 445-449.

Das, Sajal — The Univ. of New South Wales @theAustralianDefenceForce Aca
Pota, Hemanshu R. — Univ. of New South Wales
Petersen, Ian R. — Australian Defence Force Acad.

16:00-17:30 TuIT4.5

Characterization of Sign Controllability for Linear Systems with Real Eigenvalues, pp. 450-455.

Hartung, Christoph — Univ. of the German Armed Forces, Munich
Reissig, Gunther — Univ. of the Federal Armed Forces Munich
Svaricek, Ferdinand — Univ. of the German Armed Forces, Munich

16:00-17:30 TuIT4.6

Robust Repeated Pole Placement, pp. 456-460.

Schmid, Robert — Univ. of Melbourne
Ntogramatzidis, Lorenzo — Curtin Univ.
Nguyen, Thang — Univ. of Exeter
Pandey, Amit — Department of Electrical and Electronic Engineering, TheUniversi

TuIT5 Rottnest

Micro and Nano Systems (Interactive Session)

16:00-17:30 TuIT5.1

Analysis and Application of Modulated-Demodulated Control, pp. 461-466.

Karvinen, Kai Steven — Univ. of Newcastle
Moheimani, S.O. Reza — Univ. of Newcastle

16:00-17:30 TuIT5.2

A MIMO Controller Design for Damping, Tracking, and Cross Coupling Reduction of Nanopositioners, pp. 467-472.

Das, Sajal — The Univ. of New South Wales @theAustralianDefenceForce Aca
Pota, Hemanshu R. — Univ. of New South Wales
Petersen, Ian R. — Australian Defence Force Acad.

16:00-17:30 TuIT5.3

A New Robust Damping and Tracking Controller for High Speed Nanopositioning, pp. 473-478.

Das, Sajal — The Univ. of New South Wales @theAustralianDefenceForce Aca
Pota, Hemanshu R. — Univ. of New South Wales
Petersen, Ian R. — Australian Defence Force Acad.

16:00-17:30 TuIT5.4

Design and Control of a MEMS Micro-Gripper with Integrated Electro-Thermal Force Sensor, pp. 479-484.

Piriyanont, Busara — The Univ. of Newcastle
Moheimani, S.O. Reza — Univ. of Newcastle
Bazaei, Ali — Univ. of Newcastle

16:00-17:30 TuIT5.5

On the Performance of an MPC Controller Including a Notch Filter for an AFM, pp. 485-490.

Rana, Md. Sohel — The Univ. of New South wales, Canberra
Pota, Hemanshu R. — Univ. of New South Wales
Petersen, Ian R. — Australian Defence Force Acad.

16:00-17:30 TuIT5.6

Coherent-Classical Estimation for Quantum Linear Systems, pp. 491-496.

Petersen, Ian R. — Australian Defence Force Acad.

16:00-17:30 TuIT5.7

Stability of Quantum Markov Systems in the Heisenberg Picture, pp. 497-500.

Pan, Yu — Australian National Univ.
Amini, Hadis — Stanford Univ.
Miao, Zibo — Australian National Univ.
Ugrinovskii, Valery — Univ. of New South Wales
James, Matthew R. — Australian National Univ.

Technical Program for Monday November 4, 2013

MoAOP1	Carnac & Garden
Late Professor John Moore Plenary Session (Plenary Session)	
Chair: Teo, Kok Lay	the Curtin Univ. of Tech.
Co-Chair: Jiang, Danchi	Univ. of Tasmania

10:30-10:45 MoAOP1.1

*Biography of Late Professor John Barrett Moore**

Anderson, Brian D.O. — Australian National Univ.

John Moore was born in China to Australian parents working there as missionaries, but the family returned to Australia early in John's life due to Japanese war campaign operations in China. Until the age of 11 when his father died, they lived in country Victoria. They then moved to Brisbane and there John completed high school and studied electrical engineering at the University of Queensland. He completed bachelor and master degrees, and then secured a green card to move to the US. There he found a job with Fairchild Semiconductor in what is now known as Silicon Valley, and designed the world's first integrated circuit flip-flop. He also developed an algorithm for factoring polynomials that was included in basic IBM software for many years.

After several years, he resumed studies, obtaining a PhD in electrical engineering at the University of Santa Clara. Towards the end of these studies, and just following his marriage to his wife Jan, he accepted a post at Newcastle University where Brian Anderson was establishing an Electrical Engineering department. They started work at approximately the same time, and spent 15 years there before both moving to the ANU in 1982, to start a new department of Systems Engineering, where John worked till his retirement in 2006.

10:45-11:10 MoAOP1.2

Computing Monotone Policies for Markov Decision Processes by Exploiting Sparsity, pp. 1-6

Krishnamurthy, Vikram — Univ. of British Columbia
Rojas, Cristian R. — KTH Royal Inst. of Tech.
Wahlberg, Bo — KTH Royal Inst. of Tech.

This paper considers Markov decision processes whose optimal policy is a randomized mixture of monotone increasing policies. Such monotone policies have an inherent sparsity structure. We present a two-stage convex optimization algorithm for computing the optimal policy that exploits the sparsity. It combines an alternating direction method of multipliers (ADMM) to solve a linear programming problem with respect to the joint action state probabilities, together with a sub-gradient step that promotes the monotone sparsity pattern in the conditional probabilities of the action given the state. In the second step, sum-of-norms regularization is used to stress the monotone structure of the optimal policy. The algorithm is illustrated on a numerical example and a more advanced application, for future work, is outlined.

11:10-11:35 MoAOP1.3

HMM Relative Entropy Rate Concepts for Vision-Based Aircraft Manoeuvre Detection, pp. 7-13

Molloy, Timothy Liam — Queensland Univ. of Tech.
Ford, Jason — Queensland Univ. of Tech.

Machine vision is emerging as a viable sensing approach for mid-air collision avoidance (particularly for small to medium aircraft such as unmanned aerial vehicles). In this paper, using relative entropy rate concepts, we propose and investigate a new change detection approach that uses hidden Markov model filters to sequentially detect aircraft manoeuvres from morphologically processed image sequences. Experiments using simulated and airborne image sequences illustrate the performance of our proposed algorithm in comparison to other sequential change detection approaches applied to this application.

11:35-12:00 MoAOP1.4

A SOM Algorithm Based Procedure for MRI Image Processing under Significant Rician Noise, pp. 14-19

Jiang, Danchi — Univ. of Tasmania

In this paper, a self-organizing map (SOM) based procedure is proposed for MRI image processing. Such images are usually corrupted by Rician noise generated during the image formation processing due to the nature of MRI technique. Rician noise is non-additive, signal dependent, and highly nonlinear, significantly different from those commonly discussed in images. These features make it very difficult to separate the signal from noise. A SOM algorithm is carefully applied to accurate MRI image processing by taking the decent Rician noise feature into consideration, resulting in a novel procedure for denosing and segmentation. The procedure is intuitively developed and justified, and demonstrated using simulation examples on a typical knee cartilage MRI image.

12:00-12:25 MoAOP1.5

Optimal Control with a Cost of Changing Control, pp. 20-25

Yu, Changjun — Curtin Univ.
Teo, Kok Lay — the Curtin Univ. of Tech.
Tay, Teng Tiow — outreach lesson

In this paper, we consider a class of optimal control problems where the variation of the control variable is appended as a penalty term into the cost function to reduce the fluctuation of the control. A new computational approach is developed for solving this type of problems, based on control parametrization technique used in conjunction with the time scaling transform, the constraint transcription method and a smoothing technique. This computational method is supported by rigorous convergence analysis.

MoBOP2	Carnac & Garden
Nonlinear Systems and Control -I (Regular Session)	
Chair: Dower, Peter M.	The Univ. of Melbourne
Co-Chair: Paxman, Jonathan Patrick	Curtin Univ.

13:30-13:50 MoBOP2.1

Global Tracking Control of Quadrotor VTOL Aircraft in Three Dimensional Space, pp. 26-33

Do, Duc — The Univ. of Western Australia
Paxman, Jonathan Patrick — Curtin Univ.

This paper presents a new method for the design of controllers for quadrotor vertical take-off and landing (VTOL) aircraft which globally asymptotically track reference trajectories in three dimensional space. Roll and pitch angles plus the total thrust are considered immediate controls to track references in position and yaw angle of the aircraft. The control design is based on the newly introduced one-step ahead backstepping, standard backstepping and Lyapunov's direct methods. A combination of Euler angles and unit-quaternions are used to represent the aircraft attitude and angular velocities. The results are illustrated with simulations.

13:50-14:10 MoBOP2.2

Control of Infrastructure Inspection Aircraft Vertical Dynamics in the Presence of Thermal Disturbances, pp. 34-40

Techakesari, Onvaree — Queensland Univ. of Tech.
Bruggemann, Troy Sterling — Queensland Univ. of Tech.
Ford, Jason — Queensland Univ. of Tech.

The low-altitude aircraft inspection of powerlines, or other linear infrastructure networks, is emerging as an im- portant application requiring specialised control technologies. Despite some recent advances in automated control related to this application, control of the underactuated aircraft vertical dynamics has not been completely achieved, especially in the presence of thermal disturbances. Rejection of thermal disturbances represents a key challenge to the control of inspection aircraft due to the underactuated nature of the dynamics and specified speed, altitude, and pitch constraints. This paper proposes a new vertical controller consisting of a backstepping elevator controller with feedforward-feedback throttle controller. The performance of our proposed approach is evaluated against two existing candidate controllers.

14:10-14:30	MoBOP2.3

Stability of (integral) Input-To-State Stable Interconnected Nonlinear Systems Via Qualitative Equivalences, pp. 41-46

Kellett, Chris — Univ. of Newcastle
Dower, Peter M. — The Univ. of Melbourne

The input-to-state stability (ISS) framework has proven successful for analysing interconnections of ISS and integral ISS systems. We present several new sufficient conditions for the stability of interconnected systems derived by examining qualitatively equivalent formulations of the underlying stability properties.

14:30-14:50	MoBOP2.4

Closeness of Solutions and Averaging for Nonlinear Systems on Riemannian Manifolds, pp. 47-52

Taringoo, Farzin — McGill Univ.
Nesic, Dragan — Univ. of Melbourne
Tan, Ying — The Univ. of Melbourne
Dower, Peter M. — The Univ. of Melbourne

An averaging result for periodic dynamical systems evolving on Euclidean spaces is extended to those evolving on (differentiable) Riemannian manifolds. Using standard tools from differential geometry, a perturbation result for time-varying dynamical systems is developed that measures closeness of trajectories via a suitable metric on a finite time horizon. This perturbation result is then extended to bound excursions in the trajectories of periodic dynamical systems from those of their respective averages, on an infinite time horizon, yielding the specified averaging result. Some simple examples further illustrating this result are also presented.

14:50-15:10	MoBOP2.5

On Constrained Continuous-Time Nonlinear Control Systems, pp. 53-60

De Dona, Jose Adrian — The Univ. of Newcastle
Levine, Jean — Ec. des Mines, CAS

In this paper, the problem of state and input constrained control is addressed. We obtain a local description of the boundary of the admissible subset of the state space where the state and input constraints can be satisfied for all times. This boundary is made of two disjoint parts: the subset of the state constraint boundary on which there are trajectories pointing towards the interior of the admissible set or tangentially to it; and a barrier, namely a semipermeable surface which is constructed via a minimum-like principle.

15:10-15:30	MoBOP2.6

Strongly Convex Attainable Sets and Low Complexity Finite-State Controllers, pp. 61-66

Weber, Alexander — Univ. of the Federal Armed Forces Munich
Reissig, Gunther — Univ. of the Federal Armed Forces Munich

We present several novel results related to the concept of strong convexity, culminating in sufficient conditions for attainable sets of continuous-time nonlinear dynamical systems to be strongly convex. Based on these results, we propose a method to over-approximate attainable sets by intersections of supporting balls, which greatly improves upon the accuracy of previously proposed approximations based on supporting half-spaces. The latter advantage can be exploited, for example, when the method is used in algorithms that compute discrete abstractions of continuous plants. As we demonstrate by an example, the design of finite-state controllers can then be based on coarser state space quantizations, which directly translates into a reduced complexity of the controllers.

MoIT1	Rottnest
Signal Processing and Filtering (Interactive Session)	

16:00-17:30	MoIT1.1

An Iterative LMI Approach to IIR Noise Transfer Function Optimization for Delta-Sigma Modulators, pp. 67-72

Li, Xianwei — Harbin Inst. of Tech.
Gao, Huijun — Harbin Inst. of Tech.
YU, Changbin — Australian National Univ.

This paper is concerned with the issue of noise shaping of delta-sigma modulators. The shaped noise transfer function (NTF) is assumed to have infinite impulse response (IIR), and the optimization objective is minimizing the maximum magnitude of the NTF over the signal frequency band. By virtue of the generalized Kalman-Yakubovich-Popov lemma, the optimization of NTFs is converted into a minimization problem subject to quadratic matrix inequalities, and then an iterative linear matrix inequality algorithm is proposed to solve this alternative minimization problem. The proposed result overcomes the limitation of the latest method that can deal with NTFs with finite impulse response only. A design example is provided to demonstrate that the proposed design method has an advantage over the benchmark one in improving the signal-to-noise ratio.

16:00-17:30	MoIT1.2

Consistent HMM Parameter Estimation Using Kerridge Inaccuracy Rates, pp. 73-78

Molloy, Timothy Liam — Queensland Univ. of Tech.
Ford, Jason — Queensland Univ. of Tech.

In this paper, we propose a novel online hidden Markov model (HMM) parameter estimator based on Kerridge inaccuracy rate (KIR) concepts. Under mild identifiability conditions, we prove that our online KIR-based estimator is strongly consistent. In simulation studies, we illustrate the convergence behaviour of our proposed online KIR-based estimator and provide a counter-example illustrating the local convergence properties of the well known recursive maximum likelihood estimator (arguably the best existing solution).

16:00-17:30	MoIT1.3

A Review on Reduced Order Approximation for Digital Filters with Complex Coefficients Using Model Reduction, pp. 79-84

Jazlan, Ahmad — Univ. of Western Australia
Sreeram, Victor — Univ. of Western Australia
Togneri, Roberto — Univ. of Western Australia
Mousa, Wail — King Fahd Univ. of Petroleum

This paper provides a review accompanied with examples regarding the usage of four basic discrete time model reduction techniques namely Balanced Truncation, Hankel Optimal Approximation, Impulse Response Gramians and Least Squares for the purpose of approximating an FIR digital filter with complex coefficients by its equivalent reduced order IIR digital filter. Simulation results indicate that stable reduced order IIR filters approximants with computational savings can be obtained using all the four techniques. However for a specified order, some model reduction techniques result in reduced order models which better approximate the original FIR digital filter compared to other techniques. The criteria used for comparison between the performances of the four model reduction algorithms were passband magnitude root mean squared error (RMSE) and computational cost. Two numerical examples are provided to demonstrate the application of model reduction techniques for complex coefficient filters and to compare the performances.

16:00-17:30 MoIT1.4

Energy-Sorted Prony Analysis for Identification of Dominant Low Frequency Oscillations, pp. 85-90

Patel, Viresh — Veermata Jijabai Tech. Inst.
Bhil, Sudhir — VJTI
Kazi, Faruk — Indian Inst. of Tech. Bombay
WAGH, SUSHAMA — V. J. T. I.

In modern power system, the large size areas are interconnected for better power pooling that results in increased system inertia. However, this makes power to flow over long distances and pushing tie lines to operate closer to their maximum capacity. Operating tie lines closer to maximum capacity increase the possibility of inter-area oscillations (0.1-1 Hz) between two areas and is dominating near high load density area. The modern power system with growing interconnection creates more challenges in inter-area stability analysis. This paper proposes energy-sorted Prony method for online identification of dominant modes corresponding to Low Frequency Electromechanical Oscillations (LFEOs) in highly interconnected power system using Phasor Measurement Unit (PMU) data. The proposed method overcomes the disadvantage of basic Prony method i.e., higher false alarm rate. This disadvantage is due to trivial modes that get introduced because of higher order system used in basic Prony method. The proposed method introduces a new methodology that uses the energy-sorted Prony that calculates the energy of all modes and sorts them according to energy content, this reduces the higher false alarm rate. To verify the effectiveness of the proposed method, a test signal and a two-area, four-machine system are used and the simulated results are presented.

16:00-17:30 MoIT1.5

Performance Analysis of TDOA Based Localization Using SDRs, pp. 91-92

Wei, Junming — Australian National Univ.
YU, Changbin — Australian National Univ.

This paper presents the result of implementing a low cost Time Difference of Arrival (TDoA) based localization system using Software Defined Radios (SDRs) and the result shows reasonable localization accuracy. The error sources that degrade the localization accuracy in real-world experiments are also discussed.

16:00-17:30 MoIT1.6

Face Hallucination: How Much It Can Improve Face Recognition, pp. 93-98

Xu, Xiang — curtin Univ.
Liu, Wanquan — Curtin Univ. of Tech.
Li, Ling — Curtin Univ.

Face hallucination has been a popular topic in image processing in recent years. Currently the commonly used performance criteria for face hallucination are peak signal noise ratio (PSNR) and the root mean square error (RMSE). Though it is logically believed that hallucinated high-resolution face images should have a better performance in face recognition, we show in this paper that this 'the higher resolution, the higher recognition' assumption is not validated systematically by some designed experiments. First, we illustrate this assumption only works when the image solution is sufficiently large. Second, in the case of very extreme low resolutions, the recognition performance of the hallucinated images obtained by some typical existing face hallucination approaches will not improve. Finally, the relationship of the popular evaluation methods in face hallucination, PSNR and RMSE, with the recognition performance are investigated. The findings of this paper can help people design new hallucination approaches with an aim of improving face recognition performance with specified classifiers.

16:00-17:30 MoIT1.7

Asynchronous L2 − L∞ Filtering for Markov Jump Systems, pp. 99-103

Zhang, Ying — Harbin Inst. of Tech.
Zhang, Rui — Chinese Acad. of Sciences
Wu, Ai-Guo — Harbin Inst. of Tech. Shenzhen Graduate School

This study considers the design of l2 − l∞ filters for Markov jump systems under asynchronous switching. The asynchronous behavior described by a stochastic variable is considered to be random mismatch between system modes and candidate filters. The jumping process of the filtering error system is modeled as a two component Markov chain. Using a stochastic parameter-dependent approach, sufficient conditions for the addressed filtering problem are btained. By solving the proposed conditions, a desired l2 −l∞ filter can be constructed for any admissible random mismatch. Moreover, a key relationship of l2 −l∞ performance between the presented results and the classical mode-dependent, mode-independent filtering is demonstrated. A numerical example is provided to illustrate the validity and potential of the developed method.

MoIT2 — Rottnest

Intelligent and Learning Systems (Interactive Session)

16:00-17:30 MoIT2.1

Evolutionary Algorithms for Self-Tuning Active Vibration Control of Flexible Beam, pp. 104-108

Fadil, Muhammad Anas — Univ. Teknologi Malaysia
Mat Darus, Intan Zaurah — Univ. Teknologi Malaysia

This paper presents the development of self tuning Active Vibration Control (AVC) strategy for flexible beam structure. An experimental procedure has been conducted on flexible beam structure with clamped-free boundary condition. The beam is forced to vibrate using external force and set of input-output vibration data is acquired .Using the input-output data, the flexible beam is modelled using Least Squares (LS) algorithm incorporating Auto Regressive (ARX) model structure. The AVC controllers developed are proportional-derivative (PD) and proportional-integral-derivative (PID) controllers. The parameters of PD and PID controllers are tuned using iterative learning algorithm (ILA) and evolutionary Particle Swarm Optimization (PSO) techniques. By comparing the mean squared error (MSE) between PSO tuned PD, PSO tuned PID and PID with ILA controllers, it was found that the PID controller tuned using ILA (PID-ILA) has performed better than PSO tuned PID (PID-PSO), however, amongst all three controllers the PSO tuned PD (PD-PSO) has performed the best.

16:00-17:30 MoIT2.2

Active Vibration Control of Flexible Plate with Free-Free-Clamped-Clamped Edges Using Genetic Algorithm, pp. 109-114

Hadi, Muhamad Sukri — Univ. Teknologi Malaysia
Mat Darus, Intan Zaurah — Univ. Teknologi Malaysia
Mohd Yatim, Hanim — Univ. Teknologi Malaysia

This paper presents an investigation of system modeling using genetic algorithm and active vibration control of flexible plate structure. The experimental rig was designed and fabricated with free-free-clamped-clamped edges boundary condition in this research. The experimental study was conducted using experimental rig complete with data acquisition and instrumentation system to collect the input-output data of flexible plate structure. This input-output data used to develop the system identification to obtain a dynamic model of flexible plate based on auto-regressive with exogenous input structure. The developed model using genetic algorithm were validated using mean squared error, one step-ahead prediction and correlation test. The fitness function of genetic algorithm is mean squared error between the measured and estimated outputs of flexible plate. The validations of developed model were presented in time domain and frequency domain. The modeling of flexible plate using genetic algorithm was used in active vibration control system design for vibration suppression on the plate structure. The performance of developed controller assessed in term of spectral attenuation obtained for resonance modes.

16:00-17:30 MoIT2.3

Design of Adaptive I-PD Control System with Variable Reference

Model, pp. 115-120

Shiota, Tsuyoshi — Keio Univ.

Ohmori, Hiromitsu — Keio Univ.

As one of the control schemes which overcome model uncertainty, there is a model reference adaptive control. In the conventional adaptive control method, the reference model is designed in advance. However, this reference model should also be essentially re-designed according to characteristic change of a controlled object. Therefore, in this paper, we propose an adaptive I-PD control scheme with variable reference model and show the validity by the numeric simulation.

16:00-17:30 — MoIT2.4

Sampling-Based Learning Control of Quantum Systems with Bounded Inputs and Uncertainties Via Path Planning, pp. 121-126

Chen, Chunlin — Nanjing Univ.

Long, Ruixing — Princeton Univ.

Qi, Bo — Acad. of Mathematics and Systems Science, Chinese Acad. of S

Dong, Daoyi — UNSW

Robust control design is a central problem for quantum systems in practical implementation and applications. In this paper, we formulate the control problem of a quantum system with bounded uncertainties as the problem of steering this system to a target state with bounded controls via an optimized evolution path to achieve a satisfactory level of fidelity. To find the optimized path (controls), we present a combined design method of sampling-based learning control and path planning. The numerical results on an example of a four-level quantum system show the effectiveness of the proposed learning control design method.

16:00-17:30 — MoIT2.5

Identification for Automotive Air-Conditioning System Using Particle Swarm Optimization, pp. 127-132

Md Lazin, Md Norazlan — Univ. Teknologi Malaysia

Mat Darus, Intan Zaurah — Univ. Teknologi Malaysia

Ng, Boon Chiang — Univ. Teknologi Malaysia

Mohamed Kamar, Haslinda — Univ. Teknologi Malaysia

This paper present the representation of the dynamic model of the temperature an automotive air conditioning system (AAC) as the speed of the air conditioning compressor is varied. The performance of system identification of an AAC system using Recursive Least Squares (RLS) and Particle Swarm Optimization (PSO) techniques measured and discussed. The input - output data are collected through an experimental study using an AAC system integrated with air duct system experimental rig complete with data acquisition and instrumentation system. The single input single output dynamic model was established by using Autoregressive with exogenous input (ARX) model. Recursive Least Squares and Genetic Algorithms were validated using one step-ahead prediction (OSA), mean squared error (MSE) and correlation tests. The comparison results between these parameter estimation optimization techniques were highlighted. It was found that the estimated models using these two methods proposed are comparable, acceptable and possible to be used as a platform of new controller development and evaluation the performance of AAC system in the future work. Amongst all, it was found that the Particle Swarm optimization method produce the best ARX model with the lowest prediction MSE value of 8.5472×10-5 as compared to the Recursive Least Squares performance.

16:00-17:30 — MoIT2.6

Control the Active and Reactive Powers of Three-Phase Grid-Connected Photovoltaic Inverters Using Feedback Linearization and Fuzzy Logic, pp. 133-140

Thao, Nguyen Gia Minh — Waseda Univ.

Uchida, Kenko — Waseda Univ.

This paper presents two techniques based on the feedback linearization (FBL) method to control the active and reactive output powers of three-phase grid-connected photovoltaic (PV) inverters. Wherein, the first suggested control scheme is an adoption of the direct FBL approach. The other is an appropriate combination of the FBL and fuzzy logic (FBL-FL), and it is also the main proposed method of this research. In detail, a unique fuzzy logic controller (FLC) is designed to enhance the effectiveness of the suggested FBL, especially in reducing fluctuations in the active and reactive output powers at the steady state. In this study, the demonstrative PV inverter uses a three-level DC-AC converter, an L-type filter and a 250V/10kV wye-wye transformer to inject the energy, obtained from PV array with a nominal power of 100kW, into the 10kV/60Hz three-phase grid. Simulations illustrate that two suggested control schemes have good performances in regulating independently active and reactive output powers to the references, even within parametric uncertainties. Furthermore, comparisons of simulation results, obtained from the traditional PI control and two the presented FBL-based structures, show salient advantages of the proposed FBL-FL technique in terms of quick response, slight overshoot, small steady-state oscillation and high robustness.

MoIT3 — Rottnest

Nonlinear Systems and Control -II (Interactive Session)

16:00-17:30 — MoIT3.1

Enhanced Fault Detection and Isolation in Modern Flight Actuators, pp. 141-146

Ossmann, Daniel — German Aerospace Center (DLR)

Due to their central location in the control system, actuation systems of primary control surfaces in modern, augmented aircraft must show an increased reliability. A traditional approach is based on hardware redundancy. In this way, modern actuation systems of one single control surface consist of up to two actuators and three sensors. These different dynamic subsystems are all prone to faults themselves and can be monitored. This paper presents the setup of a fault detection and diagnosis(FDD) system to systematically detect and isolate faults in the subcomponents of an actuation system. Based on the achievable fault signature matrix of the system, a residual filter is designed using nullspace theory. The residuals of the proposed filter form the basis of the decision making process to detect an isolate the faults. The developed FDD system is implemented into a nonlinear aircraft model, allowing a profound validation of the FDD system's detection and isolation performance for different actuator and sensor fault scenarios.

16:00-17:30 — MoIT3.2

MEMS Based Oscillator Incorporating a Displacement Sensor, pp. 147-151

Moore, Steven I. — Univ. of Newcastle

Moheimani, S.O. Reza — Univ. of Newcastle

This paper outlines the design and performance of an oscillator that incorporates a new type of MEMS resonator. The MEMS resonator is similar in design to many other electrostatically actuated MEMS resonators in the literature. However, the novel aspect of the resonator is the use of electrothermal displacement sensors to capture its motion. Due to the high resolution of these sensors compared to other sensor technologies used in MEMS, there is the potential for oscillators using this type of resonators to have good phase noise performance. However, due to the low bandwidth of the sensors, only low frequency oscillators can be fabricated with this technology. Despite the differences in dynamics between typical electrostatic or piezoelectric transduced resonators, the oscillator topology using a feedback gain was found to be robust at sustaining oscillations. This was due to the interaction between the dynamics of the capacitive feedthrough and the mechanical system in the device. The frequency of the fabricated oscillator is 8844Hz

16:00-17:30	MoIT3.3

The Application of Discrete Sliding Mode Control in Parabolic PDE Dynamics, pp. 152-157

Argha, Ahmadreza	Univ. of Tech. Sydney
Li, Li	Univ. of Tech. Sydney
Su, Steven Weidong	Univ. of Tech. Sydney
Nguyen, Hung T.	Univ. of Tech. Sydney

In this paper, the problem of applying Discrete Sliding Mode Control (DSMC) on spatially finite-dimensional systems arising from discretization of bi-variate Partial Differential Equations (PDEs) describing spatio-temporal systems is studied. To this end, heat transfer PDE is discretized to create 2D discrete dynamics and eventually this 2D spatio-temporal discrete form is represented in 1D vectorial form. In order to study the effect of discrepancy between original PDE dynamics and their discrete schemes, an uncertainty term is also considered for the obtained discrete dynamics. According to the notion of strong stability and, in addition, using scaling matrices (similarity transformation), a new method for considering the stability of discrete-time systems in the presence of general uncertainty term (matched and unmatched) is developed. It is also shown that the proposed method in this paper can be used for the case with spatial constraints on the actuation. Consequently, as special cases, the problem of spatially piece-wise constant, sparse and also boundary control input are studied.

16:00-17:30	MoIT3.4

Finite-Time Boundedness and Stabilization of Discrete-Time Nonlinear Quadratic Systems, pp. 158-163

Wei, Yunliang	Nanjing Univ. of Science and Tech.
Zheng, Wei Xing	Univ. of Western Sydney

This paper deals with the problems of finite-time boundedness and stabilization for discrete-time nonlinear quadratic systems. Some sufficient conditions are derived, under which the finite-time boundedness of nonlinear quadratic systems is guaranteed. By using a similar method, the finite-time stability for discrete-time nonlinear quadratic systems is also established as a corollary. Moreover, to solve the finite-time stabilization problem, a stabilizing state feedback controller is designed. A simulation example is provided to illustrate the efficiency of the proposed technique.

16:00-17:30	MoIT3.5

New Results on Practical Set Stability of Switched Nonlinear Systems, pp. 164-168

Zhang, Yi	China Univ. of Petroleum, Beijing
Yang, Jing	China Univ. of Petroleum, Beijing
Xu, Honglei	Curtin Univ.
Teo, Kok Lay	the Curtin Univ. of Tech.

In this paper, we consider the practical set stability problem of a switched nonlinear system, in which every sub- system has one unique equilibrium point and these equilibrium points are different from each other. Based on the new concepts such as "-practical set stability and a -persistent switching law, we explicitly construct a closed bounded set _ and prove that under an appropriate -persistent switching law the switched system is "-practically (asymptotically) set stable with respect to _. Finally, we present a numerical example to illustrate the results obtained.

16:00-17:30	MoIT3.6

Autonomous Forced Landing System for Light General Aviation Aircraft in Unknown Environments, pp. 169-170

Arain, Bilal Ahmed	Queensland Univ. of Tech.
Warren, Michael David	Queensland Univ. of Tech.
Yang, Xilin	Australian Res. Centre for Aerospace Automation and Queensla
Gonzalez, Luis Felipe	Queensland Univ. of Tech. (QUT)/ Australian Res. C
Mejias Alvarez, Luis	Queensland Univ. of Tech.
Upcroft, Ben	Queensland Univ. of Tech.

This paper presents a system which enhances the capabilities of a light general aviation aircraft to land autonomously in case of an unscheduled event such as engine failure. The proposed system will not only increase the level of autonomy for the general aviation aircraft industry but also increase the level of dependability. Safe autonomous landing in case of an engine failure with a certain level of reliability is the primary focus of our work as both safety and reliability are attributes of dependability. The system is designed for a light general aviation aircraft but can be extended for dependable unmanned aircraft systems. The underlying system components are computationally efficient and provides continuous situation assessment in case of an emergency landing. The proposed system is undergoing an evaluation phase using an experimental platform (Cessna 172R) in real world scenarios.

MoIT4	Rottnest
Control Applications-II (Interactive Session)	

16:00-17:30	MoIT4.1

Control of a High-Speed Nanopositioner for Lissajous-Scan Video-Rate AFM, pp. 171-176

Yong, Yuen	Univ. of Newcastle
Bazaei, Ali	Univ. of Newcastle
Moheimani, S.O. Reza	Univ. of Newcastle

Conventionally, raster-based trajectory is used in atomic force microscopy (AFM) for scanning applications. A triangle reference, which is one of the two input signals used to construct the raster trajectory, contains high order harmonics of its fundamental frequency that can excite the mechanical resonant modes of a nanopositioner. To achieve video-rate scanning, high-bandwidth nanopositioners with lateral dominant modes above 20 kHz are often required when using the raster-pattern in order to avoid vibrations. In this paper, we achieve video-rate scanning on a 11.3-kHz nanopositioner using a smooth scan trajectory known as Lissajous-scan pattern. The Lissajous trajectory can be constructed by tracking two monotonic sinusoidal waveforms on the lateral axes of the nanopositioner. Using the internal model (IM) controllers, good tracking performance of 2-kHz sinusoids was achieved. High-quality AFM images of a calibration specimen were successfully recorded at 18 frames/s using the proposed Lissajous trajectory and control strategies.

16:00-17:30	MoIT4.2

Predictive Control of Wind Turbines with Storage, pp. 177-182

Sharma, Rahul	The Univ. of Queensland
Yan, Ruifeng	The Univ. of Queensland
Kearney, Michael	The Univ. of Queensland

The large-scale use of wind power generation continues to be hindered due to its intermittency. Among the potential solutions to this problem, the adoption of battery-based storage systems is widely seen as inevitable. The aim of this paper is to develop a real-time model-based optimisation approach for the coordinated control of a wind turbine equipped with battery storage. First, the mathematical model of the wind turbine-battery system is systematically reduced using singular perturbation theory. Then, the obtained reduced-order model is utilised in the control system development. The control system is devised using a real-time implementable version of model predictive control whereby the nonlinear dynamics are linearised at each sampling instant to simultaneously overcome the computational issues due to nonlinear optimisation and performance degradation issues due to linearisation at only one operating point. The effectiveness of the proposed controller in reducing wind intermittency through the optimal management of the battery storage is demonstrated using simulation studies involving real wind-data from an Australian wind farm.

16:00-17:30	MoIT4.3

Triangulation-Based Path Planning for Patrolling by a Mobile Robot, pp. 183-188

an, vatana	Univ. of central florida
Qu, Zhihua	Univ. of Central Florida

This paper addresses a systematic coverage planning with a circular sensor mobile robot, having kinematic and dynamic constraints. The static or dynamic objects in the area of interest are also assumed to be circular. Our approach, unlike existing approaches published in literature, allows local and global coverage optimization analytically, in terms of minimal distance-path or energy consumptions [1-9]. Our approach follows six steps. First, given an arbitrary number of statically circular objects in an area of interest, apply the Delaunay Triangulation Method. Second, find the minimum number of visible polygon in each triangle, face, or triangulated-face found in Step One. Third, apply the Novel Circular Waypoint Coverage Placement Algorithm (CWCP) to find the minimum number of waypoints in each face. Fourth, generate a tour by applying the nearest neighbor Traveling Salesman's algorithm (TSP) to link the waypoints found in Step 3. Fifth, apply cublic Spline interpolation to make the tour continuous and differentiable. Sixth, apply the Trajectory Planning Technique to steer the mobile robot from a given arbitrary position and orientation to the desired position and orientation, the waypoints found in Step Three.

16:00-17:30 MoIT4.4

Robust LQ Control for Parallel Wheeled Inverted Pendulum, pp. 189-194

Nagaya, Shuma	Nanzan Univ.
Morikawa, Takamitsu	Nanzan Univ.
Takami, Isao	Nanan Univ.
Chen, Gan	Nanzan Univ.

In this study, we consider a controller of the parallel wheeled inverted pendulum named Beauto Balancer Duo. The mathematical model of the inverted pendulum is derived by using the Euler Lagrange formula. Kinetic coefficients of the motor are derived from a specification sheet. The inverted pendulum has an uncertain viscous friction coefficient around the wheel, that causes perturbation of the dynamics. Therefore, an upper bound and a lower bound of the viscous friction coefficient are estimated by several experiments. Two controllers are synthesized in order to compare by simulations and experiments. One controller provides optimal performance only for a nominal model, and other controller has a robustness for the range of the viscous friction coefficient. From comparing two controllers, an accuracy of the derived mathematical model and an accuracy of the estimated viscous friction coefficient are verified.

16:00-17:30 MoIT4.5

An Analytical Characterisation of Cold-Load Pickup Oscillations in Thermostatically Controlled Loads, pp. 195-200

Perfumo, Cristian	CSIRO
Braslavsky, Julio H.	Commonwealth Scientific and Industrial Res. Organisation
Ward, John Kelvin	CSIRO
Kofman, Ernesto	Departamento de Control, FCEIA, UNR

Large groups of thermostatically controlled loads can be controlled to achieve the necessary balance between generation and demand in power networks. When a significant portion of a population of thermostatically controlled loads is forced to change their on-off state simultaneously, the aggregate power demand of such population presents large, underdamped oscillations, a well-known phenomenon referred to by power utilities as “cold-load pickup”. Characterising these oscillations and, in general, the aggregate dynamics of the population facilitates mathematical analysis and control design. In this paper we present a stochastic model for the power response and derive simple expressions for the period and envelope of the oscillations.

16:00-17:30 MoIT4.6

Stability Analysis for Interconnected Systems with ``Mixed" Passivity, Negative-Imaginary and Small-Gain Properties, pp. 201-206

Das, Sajal	The Univ. of New South Wales @theAustralianDefenceForce Aca
Pota, Hemanshu R.	Univ. of New South Wales
Petersen, Ian R.	Australian Defence Force Acad.

An analytical framework to examine the finitegain stability for a positive feedback interconnection between two stable, linear time-invariant systems where one system has “mixed” passivity, negative-imaginary and small-gain properties and the other system has “mixed” negative-imaginary, negative-passivity, and small-gain properties is proposed. A classical Nyquist argument is used to examine the stability of the interconnected systems and the usefulness of the proposed framework is illustrated by a numerical example.

MoIT5 Rottnest

Stochastic/Robust/Optimal Control (Interactive Session)

16:00-17:30 MoIT5.1

Distributed Nullforming without Prior Frequency Synchronization, pp. 207-211

Kumar, Amy	Univ. of Iowa
Dasgupta, Soura	Univ. of Iowa
Mudumbai, Raghuraman	Univ. of Iowa

We present a novel approach to the problem of distributed nullforming where a set of transmitters cooperatively transmit a common message signal in such a way that their individual transmissions precisely cancel each other at a designated receiver. Under our approach, each transmitter iteratively makes an adjustment to the phase and frequency of its transmitted RF signal, by effectively implementing an algorithm to reduce the amplitude of the overall received signal to zero. We show that this algorithm can be implemented in a purely distributed fashion at each transmitter as each transmitter needs only an estimate of its own channel gain to the receiver, and a feedback signal from the receiver, that is common across all the transmitters. This is an important advantage of our approach and assures its scalability; in contrast any non-iterative approach to the nullforming problem requires that each transmitter know every other transmitter's channel gain. We prove analytically that the algorithm practically, globally converges to a null at the designated receiver. By practical convergence we mean that (i) the algorithm always converges to a stationary trajectory, (ii) that though some of these trajectories may not correspond to a null, those that do not are locally unstable, while those that do are locally stable. We also present numerical simulations to illustrate the robustness of this approach. A key novelty of this paper is that unlike its predecessors it does not ass

16:00-17:30 MoIT5.2

The Effect of Sample/Hold Time on Initial Feasible Set in Model Predictive Control Design, pp. 212-217

Zhou, Dexiang	Nanyang Tech. Univ.
Ling, Keck-Voon	Nanyang Tech. Univ.

Sample/Hold (S/H) time plays an important role in the implementation of Model Predictive Control (MPC). The purpose of this paper is to investigate how the S/H time effects the size of initial feasible set in MPC design. Many factors influence S/H time choice, e.g. the process dynamics, the computational power of the implementation platform, etc. An illustrated example is given to show how to select S/H time in MPC designs, especially from the perspective of trade-off between their on-line computational complexity, initial feasible set, and closed-loop performance.

16:00-17:30	MoIT5.3

Heteroclinic Optimal Control Solutions for Attitude Motion Planning, pp. 218-223

Biggs, James Douglas — Univ. of Strathclyde
Maclean, Craig — Strathclyde Univ.
Caubet, Albert — Univ. of Strathclyde

An analytical attitude motion planning method is presented that exploits the heteroclinic connections of an optimal kinematic control problem. This class of motion, of hyperbolic type, supply a special case of analytically defined rotations that can be further optimised to select a suitable reference motion that minimises accumulated torque and the final orientation error amongst these motions. This analytical approach could be used to improve the overall performance of a spacecraft's attitude dynamics and control system when used alongside current flight tested tracking controllers. The resulting algorithm only involves optimising a small number of parameters of standard functions and is simple to implement.

16:00-17:30	MoIT5.4

A Gap Metric Perspective of Well-Posedness for Nonlinear Feedback Interconnections, pp. 224-229

Khong, Sei Zhen — Lund Univ.
Cantoni, Michael — Univ. of Melbourne
Manton, Jonathan H. — The Univ. of Melbourne

A differential geometric approach based on the gap metric is taken to examine the uniqueness of solutions of the equations describing a feedback interconnection. It is shown that under sufficiently small perturbations on the Frechet derivative of a nonlinear plant as measured by the gap metric, the uniqueness property is preserved if solutions exist given exogenous signals. The results developed relate the uniqueness of solutions for a nominal feedback interconnection and that involving the derivative of the plant. Causality of closed-loop operators is also investigated. It is established that if a certain open-loop mapping has an inverse over signals with arbitrary start time (i.e. zero before some initial time), then the closed- loop operator is causal provided the latter is weakly additive.

16:00-17:30	MoIT5.5

Optimal Control of Time-Inhomogeneous Markov Chains with Application to Dam Management, pp. 230-237

McInnes, Daniel James — Monash Univ.
Miller, Boris — Monash Univ. Clayton Campus

We consider a time-inhomogeneous Markov chain with a compound Poisson process as an input as an important approximation to get the solution of real problems. Outflows are comprised of both controlled and uncontrolled counting processes. We demonstrate the utility of this model in the specific problem of demand control and flood prevention in a nearly full dam, where the dam is modeled as a continuous-time controllable Markov chain under control resource constraints. This work significantly extends previous results because the inflow of rain is potentially sudden and of large volume, so a compound Poisson process is preferred to simple counting processes. On the other hand the safe release of water is constrained and so is modelled as a simple counting process. A proof of the infinitesimal generator of the Markov chain with these characteristics is given and a numerical example demonstrates the effectiveness of the controls.

16:00-17:30	MoIT5.6

Application of Stochastic Control to Analysis and Optimization of TCP, pp. 238-243

Miller, Boris — Monash Univ. Clayton Campus
Miller, Alexander — Inst. for Information Transmission Problems, RAS

The article considers the optimal stochastic control approach to the analysis of TCP. Generally the analysis of TCP schemes is based on so-called fluid models which provide the asymptotic behavior of the queuing system where the number of jobs is huge. At this level of consideration only the asymptotic results could be obtained and the real performance of existing protocols is still unclear particularly if there are the seasonal changes and congestions. Meanwhile, the models of controllable Markov chains (CMC) are more appropriate to the analysis of control of flows in the Internet that has been observed by many authors long ago. The principal difficulty of the CMC application is the high dimension particularly for connected controllable Markov chains (CCMC). But nowadays this problem is less important due to the development of multiprocessor supercomputers that make the numerical solution of the optimal control problems for CMC more achievable. Models of CCMC arise in queuing systems with many service lines where some idle lines may be used to avoid the congestion if the principal lines have been subjected the huge workload. Here we suggest the tensor form of such CMC description and give the dynamic programming equation in corresponding tensor form. As an example we consider the system with two service lines, namely the main and reserve ones, having different service rates and the cost of service.

16:00-17:30	MoIT5.7

On Effectiveness of the Mirror Decent Algorithm for a Stochastic Multi-Armed Bandit Governed by a Stationary Finite Markov Chain, pp. 244-250

Miller, Boris — Monash Univ. Clayton Campus
Nazin, Alexander V. — V.A.Trapeznikov Inst. of Control Sciences, RAS

In this article, we study the effectiveness of the Mirror Descent Randomized Control Algorithm recently developed for a class of homogeneous finite Markov chains governed by the multi-armed bandit with unknown mean losses. For this algorithm we prove the explicit, non-asymptotic both upper and lower bounds for the rate of convergence of the mean losses to the optimal value at a given (finite) time horizon. These bounds are very similar as functions of problem parameters and time horizon, but with different logarithmic term and absolute constant. Numerical example illustrates theoretical results.

TuAOP1	Carnac & Garden
Control Applications -I (Regular Session)	
Chair: Bruggemann, Troy Sterling	Queensland Univ. of Tech.
Co-Chair: Manzie, Chris	The Univ. of Melbourne

10:30-10:50 TuAOP1.1

Energy-Based Control of Bidirectional Vehicle Strings, pp. 251-256

Knorn, Steffi	Univ. of Newcastle
Donaire, Alejandro	The Univ. of Newcastle
Aguero, Juan C.	The Univ. of Newcastle
Middleton, Richard H.	The Univ. of Newcastle

It is shown how some classes of symmetric bidirectional heterogeneous vehicle strings can be modelled using a Hamiltonian framework. Hamiltonian systems theory is applied to show stability and string stability of certain vehicle strings. We also indicate how this analysis might be extended to classes of nonlinear controllers.

10:50-11:10 TuAOP1.2

Active Piezoelectric Shunt Control of an Atomic Force Microscope Micro-Cantilever, pp. 257-262

Fairbairn, Matthew William	The Univ. of Newcastle, Australia
Müller, Philipp	Univ. of Stuttgart
Moheimani, S.O. Reza	Univ. of Newcastle

The benefits of decreasing the quality (Q) factor of an Atomic Force Microscope (AFM) micro-cantilever, when operating in tapping mode, using passive piezoelectric shunt control have been previously demonstrated. A passive electrical impedance is placed in series with the cantilever oscillation voltage to control the Q factor of the cantilever. The amount of Q factor reduction obtainable using this method is limited due to the passive nature of the shunt impedance. This work demonstrates that further decreases in the cantilever Q factor may be obtained through the use of an active impedance. The active impedance is designed in such a way that the piezoelectric shunt controller emulates a PPF controller in a displacement feedback loop. The damping obtained with this controller is compared with the maximum damping obtainable with a passive impedance.

11:10-11:30 TuAOP1.3

Computation Time Analysis of Centralized and Distributed Optimization Algorithms Applied to Automated Irrigation Networks, pp. 263-269

Farhadi, Alireza	Sharif Univ. of Tech.
Dower, Peter M.	The Univ. of Melbourne
Cantoni, Michael	Univ. of Melbourne

This paper compares the computation time of two algorithms for solving a structured constrained linear optimal control problem with finite horizon quadratic cost within the context of automated irrigation networks. The first is a standard centralized algorithm based on the active set method that does not exploit problem structure. The second is distributed and is based on a consensus algorithm, not specifically tailored to account for system structure. It is shown that there is a significant advantage in terms of computation overhead (the time spent computing the optimal solution) in using the second algorithm in large-scale networks. Specifically, for a fixed horizon length the computation overhead of the centralized algorithm grows as ${cal O}(n^5)$ with the number n of sub-systems. By contrast, it is observed via a combination of analysis and experiment that given n times resources for computation the computation overhead of the distributed algorithm grows as ${cal O}(n)$ with the number n of sub-systems.

11:30-11:50 TuAOP1.4

A Fundamental Solution for an Infinite Dimensional Two-Point Boundary Value Problem Via the Principle of Stationary Action, pp. 270-275

Dower, Peter M.	The Univ. of Melbourne
McEneaney, William	Univ. of California, San Diego

A new approach for solving two-point boundary value problems for conservative infinite dimensional systems is investigated. This new approach seeks to exploit the principle of stationary action in reformulating and solving such problems in the framework of optimal control. A specific and highly simplified problem involving a one dimensional wave equation is considered. The construction of a solution to an attendant optimal control problem is identified as crucial in applying this new approach.

11:50-12:10 TuAOP1.5

Emulation Design for a Class of Extremum Seeking Controllers: Case Studies in ABS Design and Spark Timing Calibration, pp. 276-281

mohammadi, alireza	Univ. of Melbourne
Nesic, Dragan	Univ. of Melbourne
Manzie, Chris	The Univ. of Melbourne

The vast majority of extremum seeking designs in the literature are in continuous-time, however their practical implementation is typically done using digital technology. In this paper, a sampled-data implementation of extremum seeking controllers using emulation design methods is studied to address this gap. The conditions under which the emulated controller preserves the performance of the continuous-time plant are investigated. The main result also provides a guideline on how to tune the controller parameters including sample period in order to achieve the desired performance. The examples of anti-lock braking and spark timing calibration are used to illustrate the proposed design method through simulation and experimental tests.

12:10-12:30 TuAOP1.6

Automated Aerial Inspection Guidance with Improved Turn Planning, pp. 282-288

Bruggemann, Troy Sterling	Queensland Univ. of Tech.
Ford, Jason	Queensland Univ. of Tech.

Aerial inspection of pipelines, powerlines, and other large linear infrastructure networks has emerged in a number of civilian remote sensing applications. Challenges re- late to automating inspection flight for under-actuated aircraft with LiDAR/camera sensor constraints whilst subjected to wind disturbances. This paper presents new improved turn planning strategies with guidance suitable for automation of linear infras- tructure inspection able to reduce inspection flight distance by including wind information. Simulation and experimental flight tests confirmed the flight distance saving, and the proposed guidance strategies exhibited good tracking performance in a range of wind conditions.

TuBOP2	Carnac & Garden
Control Methods (Regular Session)	
Chair: Cantoni, Michael	Univ. of Melbourne
Co-Chair: Ntogramatzidis, Lorenzo	Curtin Univ.

13:30-13:50 TuBOP2.1

Fault-Tolerant Control under Controller-Driven Sampling Using Virtual Actuator Strategy, pp. 289-294

Osella, Esteban N.	CONICET
Haimovich, Hernan	Univ. Nacional de Rosario
Seron, Maria M.	The Univ. of Newcastle

We present a new output feedback fault tolerant control strategy for continuous-time linear systems with bounded disturbances. The strategy combines a digital nominal controller under controller-driven (varying) sampling with virtual-actuator (VA)-based controller reconfiguration to compensate for actuator faults. In the proposed scheme, the controller controls both the plant and the sampling period, and performs controller reconfiguration by engaging in the loop the VA adapted to the diagnosed fault. The VA also operates under controller-driven sampling. Two independent objectives are considered: (a) closed-loop stability with setpoint tracking and (b) controller reconfiguration under faults. Our main contribution is to extend an existing VA-based controller reconfiguration strategy to systems under controller-driven sampling in such a way that if objective (a) is possible under controller-driven sampling (without VA) and objective (b) is possible under uniform sampling (without controller-driven sampling), then closed-loop stability and setpoint tracking will be preserved under both healthy and faulty operation for all possible sampling rate evolutions that may be selected by the controller.

13:50-14:10	TuBOP2.2

An Examination of Coordination for Homogeneous Linear Agents under Arbitrary Network Topology, pp. 295-300

Qin, Jiahu	The Australian National Univ.
YU, Changbin	Australian National Univ.

This paper formulates the coordination control for homogeneous linear multi-agent systems under network topology without any structural confinement. This general setting is proved to be able to unify most of the existing models such as (leaderless and leader-following) synchronization/consensus control and containment control, which are usually considered separately using different analyses, within the same framework. More importantly, it can unravel the most general coordination behavior inherent in network of diffusively coupled agents with identical dynamics. Coordination analysis for such a general framework is successfully performed based on the mixed tools from Lyapunov stability theory, matrix analysis, and algebraic graph theory, which is proved being effective in specifying the convergence rate as well.

14:10-14:30	TuBOP2.3

Model Predictive Control for a Class of Systems with Uncertainty in Scheduled Load, pp. 301-306

Neshastehriz, Amir Reza	The Univ. of Melbourne
Shames, Iman	Univ. of Melbourne
Cantoni, Michael	Univ. of Melbourne

This paper considers the problem of following open loop trajectories that are in some sense optimal for a nominal load schedule. A Model Predictive Control (MPC) scheme is formulated to adjust the nominal open-loop control based on measurements taken at each time-step, with a view to mitigating uncertainty in the schedule. Analysis results are derived to establish recursive feasibility of the receding horizon scheme and to prove closed-loop stability for an appropriate set of initial conditions. An equivalent affine disturbance feedback parametrisation of the adjustment policy is provided for efficient computation. Simulation results for a short stretch of an irrigation channel demonstrate the effectiveness of the scheme.

14:30-14:50	TuBOP2.4

A Pruning Algorithm for Managing Complexity in the Solution of a Class of Linear Non-Quadratic Regulator Problems, pp. 307-312

Zhang, Huan	The Univ. of Melbourne
Dower, Peter M.	The Univ. of Melbourne
McEneaney, William	Univ. of California, San Diego

This paper develops an efficient computational method for solving a class of discrete time linear regulator problems, in which the payoff functions are not necessarily quadratic. The proposed method exploits the convexity of the payoff functions and approximates the attendant value function via a max-plus sum of affine functions. As the number of affine functions represented in this approximation can grow exponentially with the number of iterations of the computational method, effective pruning algorithms to manage complexity are essential. Two such algorithms are developed in this work. The utility of these algorithms is demonstrated via an example.

14:50-15:10	TuBOP2.5

Coherent Quantum Observers for N-Level Quantum Systems, pp. 313-318

Miao, Zibo	Australian National Univ.
Duffaut Espinosa, Luis Augusto	Univ. of New South Wales at ADFA
Petersen, Ian R.	Australian Defence Force Acad.
Ugrinovskii, Valery	Univ. of New South Wales
James, Matthew R.	Australian National Univ.

The purpose of this paper is to find coherent quantum observers for open n-level quantum systems. Recently, a class of linear coherent observers has been developed for quantum harmonic oscillators. However, open n-level quantum systems, which are characterized by bilinear quantum stochastic differential equations, escape the realm of linear quantum stochastic systems. Therefore, in this paper we show how a coherent quantum observer is designed to track the corresponding n-level quantum plant asymptotically in the sense of mean values. We also discuss suboptimal quantum observers in the sense of least mean squares estimation.

15:10-15:30	TuBOP2.6

Notes on Coherent Feedback Control for Linear Quantum Systems, pp. 319-324

Petersen, Ian R.	Australian Defence Force Acad.

This paper considers some formulations and possible approaches to the coherent LQG and H^infty quantum control problems. Some new results for these problems are presented in the case of annihilation operator only quantum systems showing that in this case, the optimal controllers are trivial controllers.

TuIT1	Rottnest
Process Control & Instrumentation (Interactive Session)	

16:00-17:30	TuIT1.1

Multirate Dissipativity-Based Distributed MPC, pp. 325-330

Zheng, Chaoxu	Univ. of New South Wales
Tippett, Michael James	Univ. of New South Wales
Bao, Jie	The Univ. of New South Wales
Liu, Jinfeng	Univ. of Alberta

Process units may operate different time scales (for example, reactors with different volumes) thus requiring plantwide control systems with multiple sampling rates to avoid over or under sampling. Moreover, it may be preferable to sample critical variables at a higher rate than non-critical ones to decrease capital. Motivated by the above considerations, this paper addresses the issue of distributed multirate model predictive control design for chemical process networks. In order to ensure the closed-loop stability and achieve a minimum performance, dissipativity-based constraints are included in the design of the individual local controllers.

16:00-17:30	TuIT1.2

Optimization Tuning of Pi Controller of Quadruple Tank Process, pp. 331-335

Zainal Abidin, Nurhuda	Univ. Teknologi Malaysia
Sahlan, Shafishuhaza	Univ. Teknologi Malaysia (UTM)
Abdul Wahab, Norhaliza	Univ. Teknologi Malaysia

In this paper, a swarm intelligence method, Particle swarm optimization (PSO) is presented for determining the optimal proportional-integral (PI) controller parameters of the quadruple tank process (QTP). In QTP, when the multivariable zero is the right half plane (RHP), the system is non-minimum phase which makes the tuning of controller difficult since limitation occur for linear feedback design. To overcome the limitation, the system's performance during minimum phase and non-minimum phase is investigated for a decentralized PI-tuning. To estimate the performance of the proposed PSO-PI controller, the performance index i.e. ITAE is utilized. From the results obtained, the proposed approach yields better performance in terms of settling time and maximum overshoot compared to the manual tuning method. Hence, the proposed method more efficient in improving the step response of a quadruple tank process.

16:00-17:30 TuIT1.3

The Control of Beer Production: Insights into the Controller Topology of a Large Australian Brewery, pp. 336-341

Lees, Michael — Carlton & United Breweries
Ellen, Robert — EGA Tech.
Brodie, Paul — Carlton & United Breweries

A significant portion of industrial automatic control is powered by PID controllers. However there is little published literature on the details and quantity of controller types used in industry. Food and beverage represents an important segment of manufacturing in Australia. This paper presents a review of the automatic/regulatory control topology in one of Australia's largest breweries. Details of the site's 505 PID loops as well as the industrial networked control systems are included. As there is very little published material of this type it makes an important contribution to the existing literature. It is intended that this material can assist further research by providing evidence-based information on the quantity of controller types used in this segment of industry and details on some of the current issues and opportunities.

16:00-17:30 TuIT1.4

Obsolescence Management of Electronic and Control Systems, pp. 342-347

Cuculoski, Vlatko — Murdoch Univ. Perth Western Australia, Monash Univ. Gi

The fast changing pace of electronic and control systems dictates the necessity to start planning for asset obsolescence at early stages of the asset lifecycle. Monitoring and managing the obsolescence following a planned strategy through the asset lifecycle, will achieve cost effective long term system availability and reliability. Activities such as life of type purchases, special order manufacturing or stepping up the maintenance, individually, will not eliminate the long term obsolescence problems. Obsolescence management strategy has to include all of these but also must be flexible, versatile and be able to offer multiple paths to achieve the ultimate goal: cost effective sustainment of an asset without compromising the asset capability, availability and reliability. Obsolescence management strategy also has to be flexible enough to accommodate for possible future changes in the capability requirements. Unfortunately not many assets have a developed obsolescence management strategy until they are affected by obsolescence. For these reasons, steps presented in this paper were developed to assist with the asset support and to provide methodology for proactive obsolescence management. This approach may also encourage the asset owners to take the necessary steps early, before the inevitable obsolescence strikes again.

16:00-17:30 TuIT1.5

Design of Stable Model Reference Adaptive System Via Lyapunov Rule for Control of a Chemical Reactor, pp. 348-353

Tahersima, Hanif — Hong Kong Univ. of Science & Tech.
Saleh, Mohammadjafar — Iran Univ. of science and Tech.
Mesgarisohani, Akram — Honk Kong Univ. of science and Tech.
Tahersima, Mohammadhossein — Kyoto Univ.

In this paper, two model reference adaptive control strategy including MIT rule and Lyapunov rule are used to design iterative learning controllers for a chemical-reactor system with uncertain parameters, initial output resetting error and input disturbance. The learning controller compensates for the unknown parameters, uncertainties, and nonlinearity using adaptation law which updates control parameters. It is shown that the internal signals remain bounded if we use a Lyapunov base algorithm, but the algorithm via MIT rule can't guarantee the stability of system in all conditions. The output tracking error will converge to a profile which can be tuned by design parameters and the convergence speed is improved if the adaptation gain is large. The proposed control algorithm was simulated using MATLAB / Simulink software package to validate the performance of designed algorithm.

16:00-17:30 TuIT1.6

Cascaded Model Predictive Control of a Quodrotor UAV, pp. 354-359

Chen, Xi — RMIT Univ.
Wang, Liuping — RMIT Univ.

When using a linear controller for controlling a non-linear system, the controller is most effective when the system is working near the operating conditions. This paper proposes a model predictive controller with cascaded structure, which has the ability to maintain the state variables within the vicinity of a given operating condition by imposing operational constraints. The controller is validated on the quadrotor position control problem and shows satisfactory performance.

TuIT2 — Rottnest

Consensus and Multi-Agent Systems (Interactive Session)

16:00-17:30 TuIT2.1

Global Leader-Following Consensus of Discrete-Time Linear Multiagent Systems Subject to Actuator Saturation, pp. 360-363

Wang, Qingling — Harbin Inst. of Tech.
Gao, Huijun — Harbin Inst. of Tech.
YU, Changbin — Australian National Univ.

This paper investigates the problem of global leader-following consensus of a discrete-time linear multiagent system subject to actuator saturation. Global leader-following consensus algorithm is developed with proper choice of relative coupling gains. Under the assumption that each agent is marginally stable, it is shown that global consensus of the discrete-time multiagent system can be reached under the general undirected graph provided that its generated graph contains a directed spanning tree. Numerical examples are provided to demonstrate the theoretical results.

16:00-17:30 TuIT2.2

On the Uniform Global Pre-Asymptotic Stability of Closed Sets for Switched Hybrid Systems, pp. 364-368

Wang, Wei — The Univ. of Melbourne
Postoyan, Romain — CNRS
Nesic, Dragan — Univ. of Melbourne

We investigate the stability of a class of dynamical systems that switch among a given finite family of hybrid systems. We propose sufficient conditions tailored to this particular type of hybrid systems which guarantee the uniform global pre-asymptotic stability (UGpAS) of a given closed set. We first assume this set to be UGpAS for each system of the family. A slow switching condition is then presented to maintain this property for the overall system. We introduce for this purpose the concept of hybrid dwell time which characterizes the length of the hybrid time intervals between two successive switching instants.

16:00-17:30 TuIT2.4

Non-Robustness of Gradient Control for 3-D Undirected Formations with Distance Mismatch, pp. 369-374

Sun, Zhiyong — Shandong Computer Science Center; Australian National Univ.

Mou, Shaoshuai — Yale Univ.
Anderson, Brian D.O. — Australian National Univ.
Morse, A. Stephen — Yale Univ.

Gradient control laws can be used for effectively achieving undirected formation shape, by assuming that interagent distances between a certain set of joint agent pairs can be accurately specified and measured. This paper examines the formation behavior in a 3-D space context in the case that the neighboring agent pairs have slightly differing views or estimates about the desired interagent distances they are tasked to maintain. It is shown, by using a tetrahedron formation example, that the final formation shape will be slightly distorted as compared to the desired one. Further, in general each agent's motion will be a combination of rotation and translation. Specifically, a helical movement can be observed in the presence of distance mismatch.

16:00-17:30 — TuIT2.5

Guaranteed Cost Tracking for Uncertain Coupled Multi-Agent Systems Using Consensus Over a Directed Graph, pp. 375-378

cheng, Yi — Univ. of New South Wales at Australian Defence Force Acad.
Ugrinovskii, Valery — Univ. of New South Wales
Wen, Guanghui — Southeast Univ.

This paper considers the leader-follower control problem for a linear multi-agent system with directed communication topology and linear nonidentical uncertain coupling subject to integral quadratic constraints (IQCs). A consensus-type control protocol is proposed based on each agent's states relative to its neighbors and leader's state relative to agents which observe the leader. A sufficient condition is obtained by overbounding the cost function which guarantees a suboptimal bound on the system consensus control and tracking performance. The effectiveness of the proposed method is demonstrated using a simulation example.

16:00-17:30 — TuIT2.6

On Iterative Learning Control for Synchronization of MIMO Heterogeneous Systems, pp. 379-384

Yang, Shiping — National Univ. of Singapore
Tan, Ying — The Univ. of Melbourne
Xu, Jian-Xin — National Univ. of Singapore

This work addresses a leader-follower synchronization problem of a group of agents whose dynamics are represented by general nonlinear multi-input multi-output (MIMO) equations. The group of agents can be non-identical, and their dynamics contain both parametric and lumped nonparametric uncertainties. A distributed adaptive and robust iterative learning control (ILC) algorithm is proposed. It is shown that under appropriate conditions, the proposed ILC algorithm can synchronize the trajectories of all followers to the desired one even only a few followers are able to access the trajectory of the leader. Simulation study supports the theoretical developments.

16:00-17:30 — TuIT2.7

Is There a Need for Fully Converged CFD Solutions? Global Extremum Seeking Applied to Aerodynamic Shape Optimisation, pp. 385-390

Lee, Kuan Waey — The Univ. of Melbourne
Moase, William — The Univ. of Melbourne
Manzie, Chris — The Univ. of Melbourne
Hutchins, Nicholas — The Univ. of Melbourne
Ooi, Andrew — The Univ. of Melbourne
Vethecan, Jerome — BAE Systems Australia
Riseborough, Paul — BAE Systems Australia

Optimisation of aerodynamic shapes using computational fluid dynamics approaches has been successfully applied over a number of years, however the typical optimisation approaches employed utilise gradient algorithms that guarantee only local optimality of the solution. While numerous global optimisation techniques exist, they are usually too time consuming in practice. In this paper we show that interpreting the convergence of computational fluid dynamics solvers as plant dynamics allows recent results in global extremum seeking to be deployed. This alleviates the computational burden of requiring full convergence of the computation fluid dynamics solver. The approach is demonstrated on a simple example involving drag minimisation on a NACA aerofoil.

TuIT3 — Rottnest

System Modelling and Identification (Interactive Session)

16:00-17:30 — TuIT3.1

Rapid Parameter Identification for an Electromechanical Brake, pp. 391-396

Lee, Chih Feng — The Univ. of Melbourne
Manzie, Chris — The Univ. of Melbourne

A rapid parameter identification procedure for a prototype automotive electromechanical brake is proposed, which is intended to support post-production quality control checks and quick model-based controller tunings. Instead of using a few different experimental manoeuvres that isolate the identification of certain sets of model parameters, an experiment optimisation is performed to single out the best trajectory that facilitates the identification of the whole sets of parameters while minimising covariance in the estimates. Utilising the measurements obtained from the optimal experimental design, both output error method and prediction error method are employed to estimate the parameters, and their estimation accuracy and evaluation speed are compared. Experimental results show that the proposed method has reduced the time required for experiments significantly with improved estimation accuracy.

16:00-17:30 — TuIT3.2

Comparison Study of the Taylor Series Based Discretization Method for Nonlinear Input-Delay Systems, pp. 397-402

Zheng, Zhang — Chonbuk National Univ.
Baek, Seung Jun — Chonbuk National Univ.
Chong, Kil To — Chonbuk National Univ.

A general order hold time discretization method for input-driven nonlinear continuous time-delay systems is proposed which can be applied for different order sampling hold assumptions. It is based on a combination of Taylor series expansion and the theory of sampling and hold where the mathematical structure for the new discretization scheme is introduced in detail in this paper. The performance of the proposed discretization procedure is compared by different types of systems through various sampling rates, time delays, input signals, order of sampling hold assumptions and truncation orders. Results show that the proposed scheme is applicable for use in control systems and several useful summarized rules for this method are presented in the conclusion.

16:00-17:30 — TuIT3.3

Controllability and Stability of Discrete-Time Antilinear Systems, pp. 403-408

Wu, Ai-Guo — Harbin Inst. of Tech. Shenzhen Graduate School
Duan, Guang-Ren — Harbin Inst. of Tech.
Liu, Wanquan — Curtin Univ. of Tech.
Sreeram, Victor — Univ. of Western Australia

In this paper, the discrete-time antilinear systems are investigated. Firstly, a closed-form expression for the state response of discrete-time antilinear systems is established. Secondly, the concepts of reachability and controllability are proposed for discrete-time antilinear systems. With the closed form expression of the state reponse as tools, anti-Gram criteria for reachability are given. In addition, a matrix rank criteria for reachability and controllability is given for time-invariant antilinear systems. In addition, an anti-Lyapnov equation approach is given to check the stability of the time-invariant antilinear systems.

16:00-17:30 — TuIT3.4

Optimal Boundary Control for the Heat Equation with Application *to Freezing with Phase Change*, pp. 409-414

Backi, Christoph Josef — Norwegian Univ. of Science and Tech.
Gravdahl, Jan Tommy — Norwegian Univ. of Science & Tech.

In this paper an approach for optimal boundary control of a parabolic partial differential equation (PDE) is presented. The parabolic PDE is the heat equation for thermal conduction. A technical application for this is the freezing of fish in a vertical plate freezer. As it is a dominant phenomenon in the process of freezing, the latent heat of fusion is included in the model. The aim of the optimization is to freeze the interior of a fish block below -18 °C in a predefined time horizon with an energy consumption that is as low as possible assuming that this corresponds to high freezing temperatures.

16:00-17:30 — TuIT3.5

Comparison of Prediction Error Methods and Subspace Identification Methods for Rivers, pp. 415-420

Nasir, Hasan Arshad — Univ. of Melbourne
Weyer, Erik — Univ. of Melbourne

Data based modelling is an important tool in the operation and management of rivers. In this paper, we compare Prediction Error Methods (PEM) and Subspace Identification Methods (SIM) for system identification of rivers. PEM can incorporate the available prior information and can accommodate the non-linearities in the model structure with ease. The models obtained by SIM are linear, and it is generally difficult to incorporate prior information, but SIM is well suited to MIMO systems such as rivers. In this paper, we simulate a few typical river scenarios and use the simulated data to obtain PEM and SIM based models. The models are compared using several measures and for the scenarios considered it is found that PEM has an edge over SIM.

16:00-17:30 — TuIT3.6

A Frequency Limited Model Reduction Technique for Linear Discrete Systems, pp. 421-426

Du, Xin — Shanghai Univ.
Jazlan, Ahmad — Univ. of Western Australia
Sreeram, Victor — Univ. of Western Australia
Togneri, Roberto — Univ. of Western Australia
Ghafoor, Abdul — National Univ. of Science and Tech.
Sahlan, Shafishuhaza — Univ. Teknologi Malaysia (UTM)

This paper describes the model reduction framework for single-input single-output (SISO) discrete-time systems based on the preservation parameters such as Markov properties of the original system by applying a Frequency-Limited Impulse Response Gramian based Balanced Truncation method. This proposed method extends the Frequency-Limited Impulse Response Gramians model reduction method for continuous systems described in the recent paper in [20] to be applicable for discrete time systems. A numerical example is provided to compare the performances between various frequency limited model reduction methods at an arbitrarily selected frequency range within the passband of a digital filter. The stability of the reduced order models are also checked for each scenario.

TuIT4 — Rottnest

Linear Systems (Interactive Session)

16:00-17:30 — TuIT4.1

Distributed Model Predictive Control for Networks with Changing Topologies, pp. 427-434

Tippett, Michael James — Univ. of New South Wales
Bao, Jie — The Univ. of New South Wales

Results are presented which extend the recent distributed model predictive control approach based on dissipativity to allow for process and controller networks with changing topologies. In this unified approach, both known and unknown changes in the process and controller networks may be accounted for within the same framework. The controllers reconfigure themselves for known changes in the network topology. A robust control approach is also developed to deal with unknown variations in the topology. Closed-loop stability and minimum performance of the process network is ensured by placing a dissipative trajectory constraint on each controller. This allows for the interaction effects between units to be captured in the dissipativity properties of each process, and thus, accounted for by choosing suitable dissipativity constraints for each controller.

16:00-17:30 — TuIT4.2

On Eigenvalue-Eigenvector Assignment for Componentwise Ultimate Bound Minimisation in MIMO LTI Discrete-Time Systems, pp. 435-440

Heidari, Rahmat — Univ. of Newcastle
Seron, Maria M. — The Univ. of Newcastle
Braslavsky, Julio H. — Commonwealth Scientific and Industrial Res. Organisation

This paper deals with eigenvalue-eigenvector assignment in order to minimise ultimate bounds on the states of a linear time-invariant (LTI) discrete-time system in the presence of non-vanishing bounded disturbances. As opposed to continuous-time systems, for which eigenstructure assignment with large magnitude stable eigenvalues can yield arbitrarily small ultimate bounds for “matched” perturbations, for discrete-time systems, ultimate bounds cannot be smaller than certain values depending on the disturbance bounds. Moreover, these smallest bounds are not achievable by assigning the closed-loop eigenvalues to zero (an intuitive conjecture that parallels the continuous-time case). The first contribution of the paper, for single-input systems, are conditions on the zeros of the transfer function between the control input and a state to minimise the ultimate bound corresponding to that state. These conditions generalise a result recently presented by the authors. The second, and main, contribution of the current paper is to characterise, for multiple-input systems, the eigenstructure of the closed-loop system so that some ultimate bounds are minimised to their minimum values. The number of ultimate bound components that can be minimised is constrained by the number of control inputs. For m-input system, the minimisation problem of m _ 1 ultimate bound components can be solved without restrictions, while in order to minimise an additional bound, an additional restrictive

16:00-17:30 — TuIT4.3

Limited Frequency Interval Gramians Based Model Reduction for Nonsingular Generalized Systems, pp. 441-444

Imran, Muhammad Imran — National Univ. of Sciences & Tech.
Ghafoor, Abdul — National Univ. of Science and Tech.
Akram, Safia — National Univ. of Sciences and Tech.
Sreeram, Victor — Univ. of Western Australia

Limited frequency interval Gramians based model reduction technique for generalized nonsingular systems is presented. The technique extends results of existing limited frequency interval Gramians schemes for standard systems. Numerical examples are also included.

16:00-17:30 — TuIT4.4

Stability Analysis for Interconnected Systems with ``Mixed'' Negative-Imaginary and Passivity, pp. 445-449

Das, Sajal — The Univ. of New South Wales @theAustralianDefenceForce Aca

Pota, Hemanshu R. Univ. of New South Wales
Petersen, Ian R. Australian Defence Force Acad.

This paper presents an analytical framework to examine the unconditional stability of two stable, linear time-invariant systems in a positive feedback interconnection where one system has ``mixed" negative-imaginary and passivity properties and other system has ``mixed" negative-imaginary and negative-passivity properties. The examination of the stability of above mentioned interconnection is done by using Nyquist criteria, and it is shown that the positive feedback interconnection between such two systems is guaranteed to be finite-gain stable. A numerical example is presented in the paper to demonstrate the usefulness of the proposed analytical framework.

16:00-17:30 TuIT4.5

Characterization of Sign Controllability for Linear Systems with Real Eigenvalues, pp. 450-455

Hartung, Christoph Univ. of the German Armed Forces, Munich
Reissig, Gunther Univ. of the Federal Armed Forces Munich
Svaricek, Ferdinand Univ. of the German Armed Forces, Munich

A linear time-invariant system of the form dx/dt = A x(t) + B u(t), or x(t+1) = A x(t) + B u(t) is sign controllable if all linear time-invariant systems whose matrices A' and B' have the same sign pattern as A and B are controllable. This work characterizes the sign controllability for systems, whose sign pattern of A allows only real eigenvalues. Moreover, we present a combinatorial condition which is necessary for sign controllability and we show that if this condition is satisfied, then in all linear time-invariant systems with that sign pattern, all real eigenvalues of A are controllable. In addition, it is proven that the decision whether a linear time-invariant systems is not sign controllable is NP-complete. We want to emphasize, that our results cover the single and the multi-input case.

16:00-17:30 TuIT4.6

Robust Repeated Pole Placement, pp. 456-460

Schmid, Robert Univ. of Melbourne
Ntogramatzidis, Lorenzo Curtin Univ.
Nguyen, Thang Univ. of Exeter
Pandey, Amit Department of Electrical and Electronic Engineering, TheUniversi

We consider the classic problem of pole place- ment by state feedback. Recently [1] offered an eigenstructure assignment algorithm to obtain a novel parametric form for the pole-placing gain matrix to deliver any set of desired closed-loop eigenvalues, with any desired multiplicities. In this paper we employ this parametric formula to introduce an unconstrained nonlinear optimisation algorithm to obtain a gain matrix that delivers any desired pole placement with optimal robustness.

TuIT5 Rottnest
Micro and Nano Systems (Interactive Session)

16:00-17:30 TuIT5.1

Analysis and Application of Modulated-Demodulated Control, pp. 461-466

Karvinen, Kai Steven Univ. of Newcastle
Moheimani, S.O. Reza Univ. of Newcastle

We review the modulated-demodulated control technique, emphasize its linear time invariant nature and develop state space controller models. We have previously outlined the implementation of a modulated-demodulated positive position feedback controller and extend upon this result with the implementation of a resonant controller. Negative imaginary systems theory has important implications in the control of many practical systems and use of the derived state space model simplifies the design of negative imaginary controllers. To conclude, we demonstrate the closed loop control of the quality factor of a Bruker DMASP microcantilever and highlight improvements in atomic force microscopy (AFM). The modulated-demodulated control technique is well suited to the control of systems with high-frequency resonant dynamics.

16:00-17:30 TuIT5.2

A MIMO Controller Design for Damping, Tracking, and Cross Coupling Reduction of Nanopositioners, pp. 467-472

Das, Sajal The Univ. of New South Wales @theAustralianDefenceForce Aca
Pota, Hemanshu R. Univ. of New South Wales
Petersen, Ian R. Australian Defence Force Acad.

This paper presents the design and implementation of a multi-input multi-output (MIMO) controller using a resonant controller, an integral controller, and a velocity feedback controller for damping, tracking and cross coupling reduction of a nanopositioner used in most of the scanning probe microscopes (SPMs). The MIMO dynamics identification of the system are done by using measured data and the design of the controller is based on to achieve large bandwidth and small cross coupling effects between the axes of the nanopositioner. The controller design presented in this paper is able to achieve a bandwidth close to the first resonance frequency of a nanopositioner which is five times greater than the bandwidth that can achieved by using a standard integral controller. Experimental images at scanning rates of 62.5 Hz and 125 Hz obtained by using the proposed controller and the built-in proportional-integral (PI) controller in a SPM are given to illustrate the effectiveness of the proposed controller.

16:00-17:30 TuIT5.3

A New Robust Damping and Tracking Controller for High Speed Nanopositioning, pp. 473-478

Das, Sajal The Univ. of New South Wales @theAustralianDefenceForce Aca
Pota, Hemanshu R. Univ. of New South Wales
Petersen, Ian R. Australian Defence Force Acad.

This paper presents the design and implementation of a novel control architecture with a resonant controller, an integral controller, and a velocity feedback controller to improve the high speed imaging performance of a nanopositioning stage, piezoelectric tube scanner (PTS) used in most of the commercial atomic force microscopes (AFMs). The design of the controller is done by considering the lateral and longitudinal axes of the PTS as an independent single-input single-output (SISO) system. The controller proposed in this paper is able to achieve a bandwidth close to the first resonance frequency of the PTS and the controller is robust against the changes in resonance frequency of the scanner due to the load change on the scanner. The performance of the proposed controller is illustrated by comparing with an integral controller and it is shown that the bandwidth increased by the proposed controller is five times greater than the bandwidth that can be achieved by using the integral controller in a commercial scanner. Experimental images with the open-loop, closed-loop and built-in AFM proportional integral controller are presented at scanning rates of 62.5 Hz and 125 Hz to demonstrate the advantage of the proposed controller.

16:00-17:30 TuIT5.4

Design and Control of a MEMS Micro-Gripper with Integrated Electro-Thermal Force Sensor, pp. 479-484

Piriyanont, Busara The Univ. of Newcastle
Moheimani, S.O. Reza Univ. of Newcastle
Bazaei, Ali Univ. of Newcastle

This paper presents design and control of a MEMS micro-gripper with integrated electro-thermal force sensor. Due to the small foot-print of the sensor, it leads to a smaller size device, and a larger and more stable gripping force due to more space allocated for actuation. A nonlinear analytical model is generated to predict the gripping arm static characteristics. The model shows significant consistency with the experimental data. System identification was performed using an experimental step response data. A feedback loop with integrator is implemented to measure and track the desired gripping force. The Pick-and-Place operations on a 85 um micro-bead are carried out using the fabricated gripper as the end effector. The experimental results show that the microgripper can successfully grasp and release the micro-object while tunning the gripping force in real time.

16:00-17:30	TuIT5.5

On the Performance of an MPC Controller Including a Notch Filter for an AFM, pp. 485-490

Rana, Md. Sohel	The Univ. of New South wales, Canberra
Pota, Hemanshu R.	Univ. of New South Wales
Petersen, Ian R.	Australian Defence Force Acad.

The imaging performance of an atomic force microscope (AFM) at high scanning speeds is limited due to the nonlinear behavior of its scanning unit; i.e., the piezoelectric tube scanner (PTS). In order to increase the imaging speed of the AFM, a model predictive control (MPC) scheme is applied in both the X and Y piezo axes of the PTS to reduce its nonlinearity effects and a modified MPC-Notch scheme is used to improve in damping of the resonant mode. In order to verify the performance improvement achieved by the proposed schemes, scanned images from them, the existing AFM proportional-integral (PI) controller, and an open-loop AFM system are compared.

16:00-17:30	TuIT5.6

Coherent-Classical Estimation for Quantum Linear Systems, pp. 491-496

Petersen, Ian R.	Australian Defence Force Acad.

This paper introduces a problem of coherent-classical estimation for a class of linear quantum systems. In this problem, the estimator is a mixed quantum-classical system which produces a classical estimate of a system variable. The coherent-classical estimator may also involve coherent feedback. An example involving optical squeezers is given to illustrate the efficacy of this idea.

16:00-17:30	TuIT5.7

Stability of Quantum Markov Systems in the Heisenberg Picture, pp. 497-500

Pan, Yu	Australian National Univ.
Amini, Hadis	Stanford Univ.
Miao, Zibo	Australian National Univ.
Ugrinovskii, Valery	Univ. of New South Wales
James, Matthew R.	Australian National Univ.

Stability of quantum Markov systems is investigated in terms of stability of invariant states. Evolutions of a quantum system in the Heisenberg picture are considered which are modeled in terms of a quantum stochastic differential equation. Using a Markov operator semigroup associated with this quantum stochastic differential equation, we derive sufficient conditions for the existence and stability of a unique and faithful invariant quantum state. The conditions are formulated in terms of algebraic constraints suitable for engineering quantum systems to be used in coherent feedback networks. To derive these conditions, we use quantum analogues of the stochastic Lyapunov stability theory.

AUCC 2013 Technical Program Monday November 4, 2013

Track T1	Track T2	Track T3	Track T4	Track T5
08:45-09:00 MoPO Carmac & Garden Welcome from the AUCC General Chair				
09:00-10:00 MoKP Carnac & Garden Plenary Lecture 1: Systems Engineering for Irrigation Management by Professor Iven Mareels				

10:30-12:25 MoAOP1 Carnac & Garden Late Professor John Moore Plenary Session				

13:30-15:30 MoBOP2 Carnac & Garden Nonlinear Systems and Control -I				

16:00-17:30 MoIT1 Rottnest Signal Processing and Filtering	16:00-17:30 MoIT2 Rottnest Intelligent and Learning Systems	16:00-17:30 MoIT3 Rottnest Nonlinear Systems and Control -II	16:00-17:30 MoIT4 Rottnest Control Applications-II	16:00-17:30 MoIT5 Rottnest Stochastic/Robust/Optimal Control

AUCC 2013 Technical Program Tuesday November 5, 2013

Track T1	Track T2	Track T3	Track T4	Track T5
09:00-10:00 TuPP Carnac & Garden Plenary Lecture 2: Systems Biology: What Does Systems and Control Have to Offer Biomedicine? by Professor Richard Middleton				

10:30-12:30 TuAOP1 Carnac & Garden Control Applications -I				

13:30-15:30 TuBOP2 Carnac & Garden Control Methods				

16:00-17:30 TuIT1 Rottnest Process Control & Instrumentation	16:00-17:30 TuIT2 Rottnest Consensus and Multi-Agent Systems	16:00-17:30 TuIT3 Rottnest System Modelling and Identification	16:00-17:30 TuIT4 Rottnest Linear Systems	16:00-17:30 TuIT5 Rottnest Micro and Nano Systems