

IRIS INSTITUTE FOR RESOURCE
INDUSTRIES AND SUSTAINABILITY



3rd **IRIS** POSTGRADUATE STUDENTS CONFERENCE:

Our Research, Your Future

PROOF

BE WHAT YOU WANT TO BE



3rd IRIS Postgraduate Students Conference: 'Our Research, Your Future' Conference Program

Morning session

9.00 – 9.10 am	Registration
9.10 – 9.30 am	Prof Kerry Walsh, A/Director of the Institute for Resource Industries and Sustainability (IRIS) Presentation of our Judges
9.30 – 10.00 am	Guest speaker – Mary Carroll, CEO Capricorn Enterprise
10.00 – 11.15 am	Md Rahat Hossain , Power Engineering Research Group <i>A Novel Hybrid Method for Solar Power Prediction</i>
Session 1: Engineering	Kakoli Chattopadhyay , Power Engineering Research Group <i>Experimental Investigation and Analysis of Energy Neutral Technology and its strategic impact on Australian Power Network,</i>
Chair: A/Prof Kristy Richardson	Ali Baniyounes , Power Engineering Research Group <i>Assessment of solar cell assisted air conditioning for an institutional building in a subtropical climate</i>
	Mitchell McClanachan , Centre for Railway Engineering <i>Train Control Optimisation,</i>
	Ronald Day , Centre for Railway Engineering <i>Error-proofing the Design Process to Prevent Design-Induced Errors</i> Including question time
11.15 – 11.45 am	Morning tea
11.45 am – 1.00 pm	Iuliana Cismaru , Process Engineering and Light Metals Centre <i>High Temperature Damage of Candidate Materials in a Shale Oil Refinery</i>
Session 2: Engineering and IT	Elise Crawford , Centre for Railway Engineering <i>Improving safety through robust and functional socio-technical systems, a human factors concern</i>
Chair: A/Prof Kristy Richardson	Gerard Ilott , Business Research Group <i>The social dimension of IT governance</i>
	Dawei Zhang , Centre for Intelligent and Networked Systems <i>Can Network-Induced Delays Benefit Tracking Performance of Network-Based Control Systems?</i>
	Qiang Lu , Centre for Intelligent and Networked Systems <i>Decision-Making in a Multi-robot System for Odour Source Localisation</i> Including question time
1.00 – 2.00 pm	Networking lunch

Afternoon session	
2.00 – 2.30 pm	Guest speaker – Helen Newell, Australian Institute for Commercialisation
2.30 – 3.45 pm	<p>Mohammad Anwar, Centre for Plant and Water Science <i>Rooftop greenery systems in subtropical climates to facilitate sustainable developments and mitigate climate change</i></p> <p>Sadia Khan, Centre for Plant and Water Science <i>Development and evaluation of a solar photocatalytic disinfection (SPCD) apparatus for treatment of aquaculture systems</i></p> <p>Rebecca Hendry, Centre for Environmental Management <i>Eucalypt Forests as Indicators of the Gradients within the Central Queensland Serpentine Landscape of Australia</i></p> <p>Khurshida Siddiqua, Centre for Environmental Management <i>Do we need to assess the atrazine toxicity to amphibians in the Australian environment?</i></p> <p>Olivia Daniels, Centre for Environmental Management <i>The effects of Limnothrix (strain AC0243) on other organisms including fungi and anurans</i> Including question time</p>
3.45 pm – 4.00 pm	Afternoon tea
4.00 pm – 4.30 pm	Announcement of the student's prizes for best presentations



DIRECTOR'S MESSAGE

The Institute for Resource Industries and Sustainability (IRIS), through its component centres and research groups, is pursuing the vision 'driving the development of a knowledge based economy'. The postgraduate cohort is an important part of this research capability.

This is the third conference of the IRIS postgraduate students, 'Our Research, Your Future', showcasing future leaders of industry and academia. This conference is an excellent opportunity to gain an overview of the range of work undertaken with IRIS, as captured within postgraduate projects. Of course only a sample of the postgraduates is presenting – selected from within their respective discipline groups. For these candidates, the conference also provides an opportunity to hone their presentation skills to a wider audience, and to receive critical feedback from peers and experts. IRIS especially values feedback from industry delegates.

To make the most of this opportunity, I encourage all students and guests attending to make this a forum to discuss research, future directions and trends, and career opportunities.

Professor Kerry Walsh
Acting Director

This event is kindly sponsored by



CQUniBOOKSHOP

THE INSTITUTE'S RESEARCH CENTRES

CENTRE FOR ENVIRONMENTAL MANAGEMENT (CEM)

CEM is well known for undertaking research and consultancies for large and small businesses and government organisations in all major areas related to environmental management, regional economics and social development. Areas of expertise include ecotoxicology and industrial water quality; freshwater terrestrial, marine and coastal ecology; and environmental economics and sustainable regional development.

CENTRE FOR PLANT AND WATER SCIENCE (CPWS)

CPWS is a recognised provider of expertise and training in the areas of bioengineering and treatment of drinking, rain and wastewaters and subsurface irrigation systems; quality food and integrated production systems including non-invasive product quality assessment; biological farming and new crop opportunities; revegetation of industrial sites and landfills; and biofuel production.

CENTRE FOR INTELLIGENT AND NETWORKED SYSTEMS (CINS)

CINS has staff with extensive expertise in the development of ICT and control solutions for the transportation, manufacturing and resource industry sectors. Some of these areas of expertise are networked control systems, robotics systems for industrial applications, scheduling applications; automation of distributed power systems, virtual reality based training and data mining.

CENTRE FOR RAILWAY ENGINEERING (CRE)

This internationally recognised centre has broad expertise covering all major areas of the railway industry and undertakes both engineering and human factors research. The centre has capabilities and expertise in the development of industrial and commercial ready products and technologies.

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PROCESS ENGINEERING AND LIGHT METALS CENTRE (PELM)

With a team of internationally respected research personnel, and advanced analytical and experimental facilities, PELM specialises in materials reliability, engineering asset management, and industrial processes. PELM also undertakes consultancies including corrosion testing, fracture and fatigue analysis, metallurgical assessment; air quality analysis and odour testing, fluid mechanics and multiphase flow, rheology and material flow characterisation, and management and thermo-fluid process and transport.

POWER ENGINEERING RESEARCH GROUP (PERG)

PERG works with our industry partners to shape the future of electricity generation, transmission and distribution in its many forms such as smart grid technologies, renewable energy systems, power quality, electrical asset management, and seeks improvement of existing generation, transmission and distribution systems.

BUSINESS RESEARCH GROUP (BRG)

The Business Research Group is driven by industry needs to secure access to adequate human and other resources, suppliers, and new markets to remain competitive. Areas of expertise include valuations of financial assets including land and property; emerging markets, finance and investments; accounting issues for resource industries; regional labour markets, workforce development and human resource management; regional business development; and research into the planning, implementation, and effectiveness of marketing strategies (including social services, events, tourism, and international marketing).



ABOUT OUR JUDGES



Mick Alexander

Mick Alexander is a Director of 'Grazing BestPrac' and the driving passion behind implementing Grazing Best Management Practices 'Grazing BMP' across Queensland's grazing industries today. Mick and his wife Noela established the rural consultancies, MKL Rural and later Grazing Best Practice as a vehicle to deliver quality training and consulting programs to the grazing community. The business focus is on implementing 'Grazing BestPractice', matching science to practical application. In 2007, Mick developed the 'Grazing BMP' model, which incorporated an exciting new training model demonstrating the linkages between various fields of science in 'the technology of growing grass'. In the past two years, more than 800 landholders have attended these programs which are said to revolutionise the jigsaw of natural systems.

Mick has been continuously involved in the grazing industry since growing up on the family farm on the Darling Downs, working in the business for 10 years and deciding there were better ways of managing the land. He completed tertiary education, initially at Dalby Agricultural College and later at University of Queensland, Gatton. Mick has a sound understanding of the links between climate, carbon and soil management issues of grazing in Australia and the economics of making the business work today. He has worked in the areas of resource management with the community Landcare movement and within the private sector for Resource Consulting Service (RCS). His focus is on assisting people to manage change in rural communities and to take action towards a happier, healthier future. Mick is passionate about agriculture and has established linkages to research and natural resource groups throughout Australia.

Penelope-Jane Fry

Penelope-Jane ('Penelope') currently serves as Reform Counsel at the Central Queensland Local Government Association, overseeing the methodology and programme for the research and development of Central Queensland's regional planning and infrastructure framework. Penelope is a strategy and alliance professional with academic and professional education in economics, science and business. Having held roles in all three levels of Australian government, the UN, academia, and the private sector her advisory specialities deal with resolving issues at the infrastructure, economy, society-environment interface. Key positions have included Executive at Infrastructure Australia (Federal Government Body), Special Advisor to the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) on tax and budget reform and infrastructure, and with academic research teams on projects such as the development of the large scale urban model for South East Queensland.

Ted Gardner

Ted Gardner is a Senior Research Fellow with the Institute for Resource Industries and Sustainability (IRIS) at CQUniversity. Ted's responsibilities at IRIS are to advance the research capacity in water and associated energy issues. Before joining IRIS in February 2011, Ted Gardner was principal research scientist in the Integrated Urban Water Systems group of CSIRO Land and Water. He lead Urban Water Security Research Alliance funded projects into decentralised technologies, and storm water harvesting and reuse in south-east Queensland. He was also Principal Scientist with the Queensland Department of Environment and Resource Management, leading the Urban Water Cycle group at the Environment Science Precinct (ESP) at Boggo Road. Ted has had 40 years' experience in the areas of edaphology, irrigation and catchment hydrology/salinity, effluent reuse, and urban water sustainability. Ted specialises in systems thinking which he has applied to the urban water cycle over the last 15 years. He is also a frequent guest lecturer at UQ and QUT, in faculties ranging from agriculture to architecture to engineering, on the topics of sustainable urban water cycle and water recycling. Ted has won several awards including Australia Day Award Public Service Medal for his work on water recycling and urban water supply in 2005. He is currently an Adjunct Professor in the School of Urban Development at the Queensland University of Technology. In 2004 Ted received the Distinguished Service Award from the Australian Water Association; Queensland Branch was also recently nominated for the Queensland Urban Utilities – Waterways Champion Award happening on 22 June 2011.

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David Gilmour

David is CQUniversity's Vocational Education and Training (VET) and Industry Business Development Manager. During his time at CQUniversity, David has been a key developer of the pathways project, a joint initiative between the University and the Department of Education, Employment and Workplace Relations (DEEWR). The initiative resulted in the establishment of GReEn Careers (Gladstone Region Engineering Career) which provides advice on engineering careers and facilitates successful career pathways for existing workers. Before joining CQUniversity, David was the CEO of the Australian Technical College (Gladstone Region Ltd). David has extensive experience in the VET education system, starting his career as an automotive and mechanical engineering lecturer and through to managing several TAFE institutions around the country.



GUEST SPEAKERS

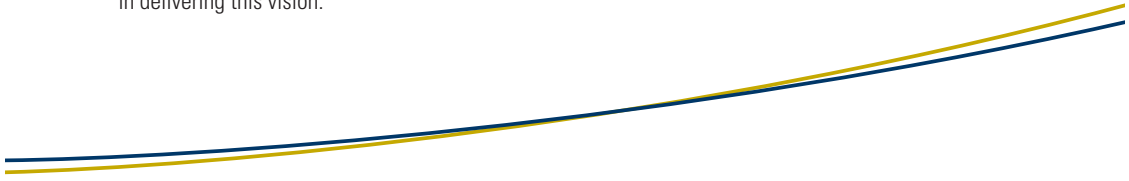


Mary Carroll, CEO Capricorn Enterprise

Mary Carroll, as Chief Executive Officer, is responsible for the overall management of Capricorn Enterprise operations including marketing, development, events, business mentoring and visitor servicing. Mary brings a combination of destination marketing, membership, corporate governance and strong relationship building skills to the organisation and has been recognised by industry with numerous awards and accolades for her contributions including Outstanding Contribution by an Individual at the 2007 CQ Southern Great Barrier Tourism and Business Awards. Mary has extensive networks with business and industry leaders, government officials and elected Members of Parliament. Her career has included a broad range of private and public sector roles, having worked for hospitality and tourism businesses and organisations, a mining engineering firm, a union and a political party. Mary's leadership has resulted in commendations for her respective employers from many organisations including the Queensland Information Centre Association (QICA), Australian Federation of Travel Agents (AFTA) and the Queensland Tourism Industry Council (QTIC). Mary also achieved finalist status for Capricorn Enterprise for Tourism Marketing at the recent 2011 Queensland Tourism Awards.

Helen Newell

Helen Newell is the Australian Institute for Commercialisation's Innovation Coach (AIC) for Central Queensland. Her work focuses on increasing research and development and innovation in Small and Medium Enterprises (SMEs) by linking businesses to programs offered by the AIC, Department of Employment, Economic Development and Innovation (DEEDI) and federal agencies. Part of her role involves delivering the AIC's TechFast program, forging links between industry and the research and development sector. Helen believes that innovation is a major driver of economic development and her passion for regional economic development prompted her career change from corporate management in 2006 to the role of export advisor with the Department of Primary Industries (QDPI), facilitating trade for Queensland's agrifood industry. This role sparked her interest in working with the research sector when she learnt how Australia's reputation as a global leader in the beef industry for clean, green products is underpinned by our research and development, and dedicated researchers. Since 2006, Helen has facilitated international delegations looking to invest in Queensland's agrifood industry. She also led trade missions generating millions of dollars in new trade, by working in partnership with scientists from QDPI and universities. In 2009 she travelled with researchers from JCU and UQ to promote Queensland's extensive tropical expertise to the Asian Development Bank and World Bank. In 2010 Helen was awarded an ISSI international fellowship, sponsored by Agrifood Skills Australia. This involved working with internationally recognised researchers from the Value Chain Research Centre at Kent University, UK. This project involved DEEDI scientists working in collaboration with industry and researchers from UQ and Kent University, to facilitate the export of high value tropical mangoes from Queensland to the UK. Helen has built strong partnerships and alliances with industry, government agencies, professional associations and community groups in Australia and internationally. Her experience in international business development covers a number of sectors including manufacturing and service industries, government regional management and the education sector. Helen's role with the AIC enables her to leverage her knowledge, skills and international connections to drive innovative economic growth and sustainability in Queensland. Helen is inspired by opportunities to facilitate co-innovation across the agrifood, mining and engineering sectors to drive SME productivity improvements in Queensland. She believes that CQUniversity will be a key partner in delivering this vision.



PRESENTATION ABSTRACTS

SESSION 1: Engineering

A Novel Hybrid Method for Solar Power Prediction

Md Rahat Hossain, PERG

Solar energy is judged to have enormous potential as a commercial power producing resource because it is so easily accessed and is geographically available across most regions of Australia. However, a major impediment to solar choice, is its volatile character and susceptibility to climate variation. Solar energy, unlike traditional power generation methods, is dependent on an external irregular source, meaning the incident solar radiation does not always radiate when electricity is needed. This irregular supply results in variability, unpredictability, and uncertainty of solar energy supply. Consequently, the accurate prediction of solar power presents a major challenge to distribution and transmission grid operators. Operators must be able to accurately calculate the amount of electricity which will be produced in order to optimally integrate large scale solar electricity into power grid operations. It is imperative to precisely predict the gains and the loads because based on that precise prediction control decisions are made. In contrast to individual power prediction schemes, the amplified intricacy of integrating renewable energy sources into the grid requires a much more sophisticated solution. One such solution is a hybrid prediction system. However using exclusively heterogeneous regression algorithms to base a hybrid prediction system is most challenging and complex. None the less, such hybrid forecasting has a significant impact on the optimum power flow, transmission congestion, power quality issues, system stability, load dispatch, and economic analysis.

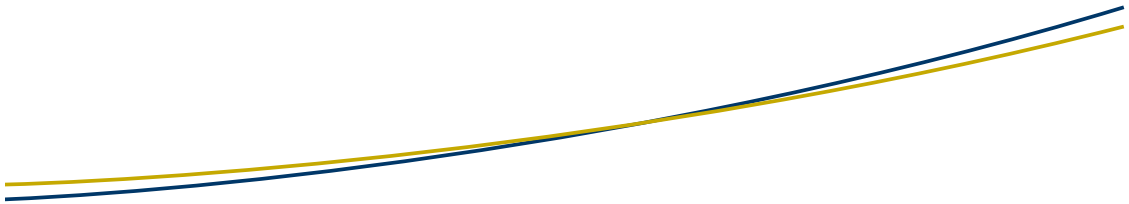
This study will develop a novel hybrid solar power prediction system to attain optimum prediction accuracy where the hybridization aspect is anchored in the top three performing heterogeneous regression algorithms. Initially, 12 widely used and well established regression algorithms will be selected for the purpose of the hybrid forecasting model development. By means of open source software Weka, the individual performance of these twelve regression algorithms will be measured through error analysis. The three best performing algorithms will be selected for the hybrid prediction model. Feature selection algorithms will be applied on those three algorithms to improve their individual prediction accuracy. Prime weaknesses of the selected three algorithms will be identified and worked out to achieve further improvement in prediction accuracy. The best possible individual results with reduced and uncorrelated error from the three algorithms will then passed through another layer of regression algorithm to develop a more error free hybrid solar

power prediction system. Another major contribution of this study is to investigate whether prediction systems with numerical weather predictions (NWP) as input will perform better than the proposed heterogeneous regression algorithms based hybrid prediction model. The hybrid forecasting model will be developed and tested for three different terms (ie short, mid and long term) and the prediction accuracy performance for different terms of the proposed hybrid forecasting model will be evaluated by comparing these against prediction errors of well known NWPs as well as other approaches for those three corresponding terms. This evaluation will also determine the suitability of the developed hybrid model for short, mid and long term prediction.

Experimental Investigation and Analysis of Energy Neutral Technology and Its Strategic impact on the Australian Power Network
Kakoli Chattopadhyay, PERG

Energy security is a challenge of the whole world and dependence on fossil fuel is going to be a challenge within 50 years time. Renewable energy and alternative sources along with micro level generation and resourcing the gap or supplying the surplus to external grid is being explored worldwide. Australia has a huge potential for renewable energy due to its strategic location. This project is expected to analyse the medium and long term impacts on house greenhouse gas emissions reduction, optimisation of policy and technology combinations that best meet greenhouse gas; the impact of energy neutral policy on electricity network, and how it may interact with existing system by utilising renewable resources, conversion to new products; cost benefit analysis of proposed changes for energy markets in Australia.





Assessment of Solar Cell Assisted Air Conditioning for an Institutional Building in a Subtropical Climate
Ali Baniyounes, PERG

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Australia has a very sunny climate, with a very high demand for air conditioning. On hot summer days the electricity grid increasingly faces the danger of overloading, due to the extensive use of air conditioners. The enormous increase in the number, and use, of air conditioners not only impacts on the security of our power supply, it also has negative environmental consequences, as well as resulting in higher power bills for consumers. New technologies are now available to replace conventional heating, ventilating and air conditioning (HVAC) and these technologies are being investigated to examine the extent of any economic and environmental benefits. Solar assisted air conditioning is an ideal option to achieve a high solar fraction which leads to a significant energy savings, as well as reduced green house gas emissions. Solar assisted air conditioning systems are environmentally friendly as they are constructed in a way that minimizes the need for chlorofluorocarbons CFC, Hydro chlorofluorocarbons HCFC or Chlorofluorocarbons HFC refrigerants, and use a low grade thermal renewable energy. They can be used either as stand-alone systems or with conventional air conditioning, to improve the indoor air temperature. Solar cooling is a new and fast growing technology, compared to other fields of solar energy applications. However, most of the current solar cooling applications are demonstration projects in nature; the technologies are advancing yet still need a lot of additional design, planning, and research and development efforts. Until now, the main barriers to the wider implementation of solar assisted air conditioning have been the high installation costs, and the lack of knowledge and familiarity with this technology between designers, developers and architects. In this research a feasibility study of a solar assisted air conditioning system will be carried out. The research program will install, develop and assess the technical, economical and environmental aspects of solar assisted air conditioning under Queensland's subtropical climate (CQUniversity Australia, Rockhampton). In addition performance of the installed solar air conditioning system will be measured and compared against a standard (existing) air conditioning system. It is expected that the study will recommend an optimum and complete solar assisted air conditioning system design and a way of implementing solar cell assisted air conditioning systems in subtropical climates with an integrated view to reduce energy costs and greenhouse gas emissions.

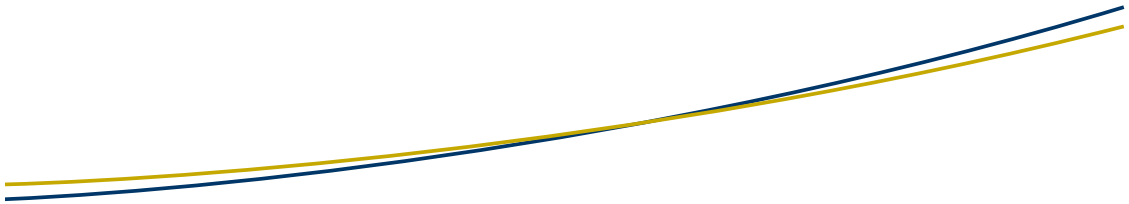
Train Control Optimisation
Mitchell McClanachan, CRE.

Heavy haul trains are very efficient at transporting large volumes of material overland. Efficiency and capacity are generally increased with an increase in the length of heavy haul trains. Rail operators in Australia and overseas are continually stretching the boundaries and increasing the size of these trains. Heavy haul coal trains in Queensland can be over 1.6 km long and weigh in excess of 10 000 tonnes. Due to the length and weight of these trains it is difficult for train drivers to operate the train optimally all the time. Optimal train operation needs to take into account multiple considerations such as time, energy, safety, wear and damage. The research presented is developing a computational method that can be used to determine optimal train driving strategies. The aim is to produce an optimisation method that can be used for any train on any track. The research uses Central Queensland coal trains as an example, but it will also be applicable to other heavy haul trains.

Error-proofing the Design Process to Prevent Design-induced Errors
Ronald Day, CRE.

Design-induced errors all too often result in incidents, accidents and disasters in safety critical systems. The study investigates the link between design process error and design-induced error and the nature of human error during the design process. The end result of this study is intended to be the production of an analytical tool to guide the design and development of new technologies so that design-induced and human response errors are minimised in safety-critical situations.





Session 2: Engineering and IT

High Temperature Damage of Candidate Materials in a Shale Oil Refinery

Iuliana Cismaru, PELM

Shale oil refining is an important emerging industry in Queensland and has the potential to help provide energy security for Australia for many years. QER Ltd has built a demonstration plant in Gladstone to prove their technology and prepare for the construction of a full-scale plant in the near future. In this project we are investigating how a number of candidate materials perform in a challenging environment in the plant: the hot reheat furnace tubes and associated piping. The project involves studying the high temperature corrosion and materials degradation behaviour of a number of candidate materials that will be installed in the demonstration plant and as part of the project we will track their behaviour in the plant over the period of the operation of the demonstration plant. The outcome of the project will be to provide a greater understanding of the behaviour of materials in this extreme environment and this will assist QER in selecting materials for operation in the full scale plant.

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Improving Safety Through Robust and Functional Socio-technical Systems, a Human Factors Concern

Elise Crawford, CRE

The introduction of new technology creates significant risk to organisations that rely on safety-critical control systems. Although great lengths are taken to validate a new system's value and reliability, existing analytical tools focus little attention on the human factors issues that impact operator adoption. Rather, these tools tend to focus on the limitations of the human, are complex and often vulnerable to misinterpretation. Therefore, to improve safety and optimise system use, I propose an analytical tool that evaluates the human factors aspects within a socio-technical system.

The Social Dimension of IT Governance

Gerard Illott, BRG

A recent publication in the Journal of Information Systems illustrated both the present need for IT governance research to be responsive to the challenges facing organisations, as well as the consequences of not having an adequate theoretical understanding of the concept of IT governance itself. By holding out what are essentially management control frameworks (such as the Control Objectives for Information and related Technology - COBIT) as a proxy for IT governance, the authors subscribed to a number of poorly supported assumptions about the form and nature

of IT governance. This presentation will present a reply paper that will challenge some of these assumptions and show the historical context behind them. By using a case study, it will then demonstrate that IT governance is a rich and dynamic social construct, and that elements of social theory offer the prospect of developing a theoretical framework for IT governance, capable of supporting and strengthening future research.

Can Network-induced Delays Benefit Tracking Performance of Network-based Control Systems?

Dawei Zhang, CINS

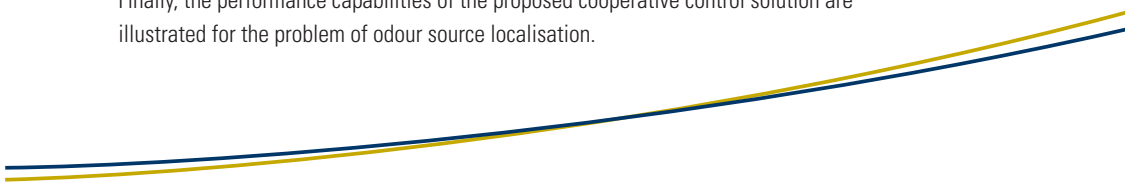
Output tracking control for network-based control systems has many beneficial applications in modern industry. Network-based control system is a feedback control system where the control loop is closed through a communication network. The insertion of the network increases system flexibility, reduces cost of installation and maintenance, and enables remote execution of output tracking control. Meanwhile, the use of the network inevitably introduces network-induced delays in the feedback control loop. Usually, network-induced delay is regarded as a main source of system instability and tracking performance degradation. In our study, from a different perspective, we consider the positive effect of network-induced delay on the tracking performance for a class of systems and show that a stable and satisfactory tracking effect can be produced by intentionally introducing network-induced delays in the static output feedback control. Some criteria on tracking performance analysis and controller design are derived. The effectiveness of the proposed method is demonstrated by performing output tracking control for a harmonic oscillator.

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Decision-Making in a Multi-robot System for Odour Source Localisation

Qiang Lu, CINS

This paper deals with the problem of odour source localisation using multiple mobile robots. A cooperative control solution, which is used to coordinate the robot group to locate the odour source, is proposed and independently executed by each robot. Firstly, a particle filter, which can estimate the position of the odour source by using all observations among the robot group, is used. Secondly, based on the estimated position of the odour source, a movement direction is planned by a leader robot, which currently detects odour clues. Thirdly, two decision-making control laws, which can enable the robot group to make a parallel motion or a circular motion in terms of the planned direction and the estimated position of the odour source, are developed. Finally, the performance capabilities of the proposed cooperative control solution are illustrated for the problem of odour source localisation.



Session 3: Environment and life sciences

Rooftop Greenery Systems in Subtropical Climates to Facilitate Sustainable Developments and Mitigate Climate Change.

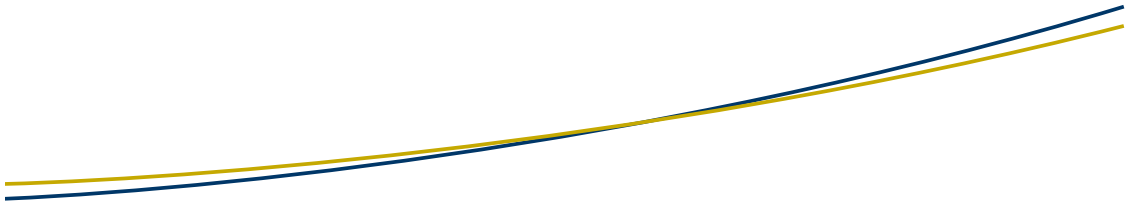
Mohammad Anwar, CPWS

Green roofs have amazing potential to reduce heat gain in buildings, reduce energy required to cool buildings, increase the thermal comfort of building occupants and increase ecosystem goods and services, however, have not fully been evaluated yet under Australian climatic conditions. The research will provide a solid base of new knowledge for transferring existing Australian building industries to the forefront of new knowledge in responding to sustainable developments and mitigating climate change. The objectives of this study are to examine the quantitative impact of a rooftop greenery system on the building's energy consumption; to examine the impact of a rooftop greenery system on the roof thermal transfer value and to study the cost savings in cooling energy of the building due to greenery systems. The novelty of this study is twofold: to investigate the potential of greenery systems as natural cooling techniques in the sub-tropical climate and to explore a mathematical model yielding a sensible and simplified representation of the dynamic thermal behaviour of a real green roofs. The community can benefit from green roofs by saving energy, improving air quality and reducing waste, which will ultimately help to improve public health and welfare. The study will also provide an eco-technical solution to climate change issues.

Development and Evaluation of a Solar Photocatalytic Disinfection (SPCD) Apparatus for Treatment of Aquaculture Systems
Sadia Khan, CPWS

Outbreaks of infectious diseases by microbial pathogens can cause substantial stock losses in aquaculture systems. There are several ways to eliminate these pathogens including the use of antibiotics, biocides and conventional disinfectants, but these leave undesirable chemical residues. Conversely, using sunlight for disinfection has the advantage of leaving no chemical residue and is particularly suited to countries with sunny climates. Titanium dioxide (TiO₂) is a photocatalyst that increases the effectiveness of solar disinfection. In recent years, several different types of solar photocatalytic reactors coated with TiO₂ have been developed for waste water and drinking water treatment. In this study a thin-film fixed-bed reactor (TFFBR), designed as a sloping flat plate reactor coated with P25 DEGUSSA TiO₂, was used. The level of inactivation of *Aeromonas hydrophila* was determined after travelling across the TFFBR under various natural sunlight conditions (300 – 1200 W m⁻²), at 3 different flow rates (4.8, 8.4 and 16.8 L h⁻¹). Changes in water quality parameters (pH, salinity, turbidity etc) were also investigated, to see whether they have any effect on microbial inactivation by TFFBR. Bacterial numbers were determined by conventional plate counting using selective agar media, cultured (i) under conventional aerobic conditions to detect healthy cells and (ii) under conditions designed to neutralise reactive oxygen species (agar medium supplemented with the peroxide scavenger sodium pyruvate at 0.05% w/v, incubated under anaerobic conditions), to detect both healthy and sub-lethally injured (oxygen-sensitive) cells. The results clearly demonstrate that high sunlight intensities (≥ 600 W m⁻²) and low flow rates (4.8 L h⁻¹) provided optimum conditions for inactivation these fish pathogens with greater overall inactivation and fewer sub-lethally injured cells than at low sunlight intensities or high flow rates. Low sunlight intensities resulted in reduced overall inactivation and greater sub-lethal injury at all flow rates. This is the first demonstration of the effectiveness of the TFFBR in the inactivation of aquaculture fish pathogens at high sunlight intensities, providing proof-of-concept for the application of solar photocatalysis in aquaculture systems. Other aquaculture pathogens such as, *Vibrio harveyi*, *Streptococcus iniae* and *Fusarium solani* were also investigated to evaluate the effect of solar photocatalysis by TFFBR.





Eucalypt Forests as Indicators of the Gradients within the Central Queensland Serpentine Landscape of Australia
Rebecca Hendry, CEM

The overstorey of the Central Queensland serpentine landscape on the east coast of Australia is dominated by two eucalypt species. These are *Eucalyptus fibrosa* subsp. *fibrosa* the most dominant tree throughout the landscape and *Corymbia xanthope* a serpentine endemic species which has a more restricted distribution. This research investigated if the foliar elements, distribution and community structure of the eucalypts reflected the gradients of the serpentine soil elements. This was achieved by surveying 30 plots (50 x 20 m) within the upland hills and mountains of the Central Queensland serpentine landscape. Basal areas of the eucalypt species were recorded and foliage samples from *E. fibrosa* subsp. *fibrosa* were collected and analysed for metal and nutrient content. Soil samples from each site were collected and analysed for major cations, bioavailable metals and fertility. Analysis of the data revealed there is a significant correlation between the proportions of basal areas occupied by the two eucalypt species and the soil Mg:Ca quotients. The proportion of basal area occupied by the endemic *C. xanthope* increased with the soil Mg:Ca quotient, whereas the proportion of basal area of *E. fibrosa* subsp. *fibrosa* decreased. The basal areas of the eucalypt species were also significantly correlated to the steepness of the slope, possibly reflecting soil moisture availability. Basal area measurements comparing the two eucalypt species provides a useful method for measuring the severity of the Mg:Ca quotients of the serpentine soils within the upland Central Queensland serpentine landscape.

Do We Need to Assess the Atrazine Toxicity to Amphibians in the Australian Environment?
Khurshida Siddiqua, CEM

Atrazine is one of the most extensively applied herbicides in Australia and is frequently detected in surface and groundwater samples collected downstream of cropping areas. Australian native frogs usually breed during late spring and summer, which is the peak time for applying atrazine to agricultural fields. Therefore, their breeding sites adjacent to the agricultural fields can potentially become contaminated with atrazine. In overseas studies, atrazine has been reported to cause reproductive and developmental abnormalities in amphibians. Subsequently, other studies were not able to reproduce these effects; hence the impact of atrazine to amphibians is now a matter of great debate. The majority of amphibian toxicity

tests have been run using the African clawed frog, *Xenopus laevis*; however, the use of Australian native frogs in toxicity testing is limited. Differences in sensitivity to environmental contaminants may exist between Australian amphibians compared to overseas frog species. To explore the inter-species variations in sensitivities to atrazine, the introduced cane toad, *Rhinella marina* and two native frogs, namely, striped marsh frog, *Limnodynastes peroni* and northern banjo frog, *Limnodynastes terrareginae* were exposed to six different treatments of atrazine ranging from 0-24mg/L for 96 hours. Native frogs showed a greater sensitivity to atrazine than the introduced cane toad. Therefore, considering the widespread use of atrazine in Australia, frequent detection in surface and ground waters, the controversial effects to amphibians, and the inter-species variations in sensitivities, it can be said that the risks of atrazine use to native frogs need to be broadly evaluated.

The Effects of Limnothrix (strain AC0243) on Other Organisms Including Fungi and Anurans
Olivia Daniels, CEM

A toxic strain of cyanobacteria (*Limnothrix* strain AC0243) was recently discovered in Central Queensland. The water-soluble toxin (*limnothrixin*) produced by *Limnothrix* (strain AC0243) was shown to be a novel protein synthesis inhibitor that also reduces Adenosine triphosphate. The toxic nature of this organism provides evidence that this strain may pose a significant risk to human and environmental health. Very little is known about *Limnothrix* (strain AC0243) due to the neoteric discovery of the strain. The proposed research will investigate the autecology of this organism. The study will explore environmental parameters such as light intensity, temperature and salinity that may catalyse bloom formation. Toxicity studies will examine the effects of the soluble toxin from this cyanobacterium on basal and advanced eukaryotic organisms, using filamentous microfungi and anurans as representative models. Allelopathy between *Limnothrix* (strain AC0243) and filamentous microfungi found in waterways will also be examined. The proposed studies will increase current knowledge on *Limnothrix* (strain AC0243) as well as aid in water management strategies.



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