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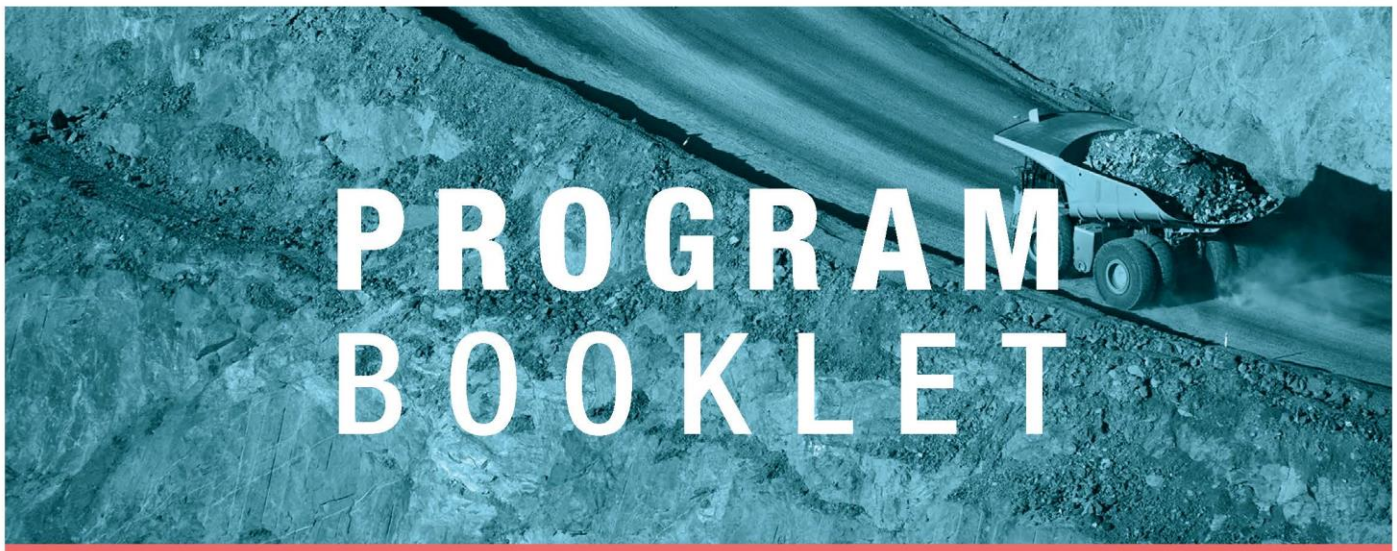

PROGRAM BOOKLET

MINING OIL GAS AGRICULTURE WATER

HYATT REGENCY PERTH 17–21 JUNE 2019

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AMSI OPTIMISE 2019

Mining | Oil | Gas | Agriculture | Water

Host: Curtin University

Venue: Hyatt Regency Perth

Monday 17 – Friday 21 June

Day 1: Monday 17 June

Program 4

Abstracts 5

Poster Abstracts 9

Day 2: Tuesday 18 June

Program 13

Abstracts 14

Day 3: Wednesday 19 June

Program 21

Abstracts 22

Day 4: Thursday 20 June

Program 28

Abstracts 29

Day 5: Friday 21 June

Program 36

Abstracts 37

DAY 1: MONDAY 17 JUNE 2019

0800 - 0900	REGISTRATION – *tea & coffee served*
0900 - 0930	Opening Ceremony & Welcome to Country
0930 - 1000	The Groundwater Grand Challenge **Professor Craig T. Simmons** National Centre for Groundwater Research & Training
1000 - 1030	
1030 - 1100	MORNING TEA
1100 - 1130	Optimising the use of pumping stations in a wastewater network **Dr Christina Burt**, Water Corporation
1130 - 1200	Intelligent Sensing for Urban Water Systems **Associate Professor Rachel Cardell-Oliver** The University of Western Australia
1200 - 1230	
1230 - 1330	LUNCH
1330 - 1400	**Keynote:** Simultaneous stochastic optimization of mining complexes / mineral value chains **Assistant Professor Amina Lamghari** University of Quebec, Canada
1400 - 1430	
1430 - 1500	APR.Intern: Open up your World **Tracey McClurg**, APR.Intern
1500 - 1530	AFTERNOON TEA
1530 - 1600	Network Optimisation in the Access Design for Underground Mines **Professor Emeritus Doreen Thomas** The University of Melbourne
1600 - 1630	
1630 - 1700	Poster Session
1700 - 1800	Welcome Reception

DAY 1 – Monday 17 June

THE GROUNDWATER GRAND CHALLENGE

Professor Craig T. Simmons, National Centre for Groundwater Research and Training (NCGRT), Flinders University

Groundwater is core to many critical contemporary issues concerning our environment, food and water security, coal seam gas and fracking, mining, energy and nuclear waste disposal. Groundwater supplies half of the world's drinking water and nearly half of the water used for growing food. Groundwater depletion and pollution are major global problems. Climate change and population growth will place additional stress on already stretched groundwater resources. This talk explores the challenges and opportunities for groundwater: spanning social, economic and environmental dimensions; to management; policy; science and research; education and training and the vital links between them.

Groundwater modelling is core to environmental impact statements that underpin mining and coal seam gas development proposals and establishing sustainable water allocation plans. The crucial role of mathematical modelling in environmental decision-making and assessment is discussed. Some critical challenges facing groundwater modelling are described together with examples from water, agriculture, mining and energy sectors. These challenges and opportunities include modelling in a risk-based framework; uncertainty analysis; model simplicity and complexity; data worth analyses; dealing with geologic heterogeneity; stochastic representation of subsurface systems; optimization problems and approaches; building physically-based, fully-integrated, simulations of catchment-scale hydrologic processes; and dealing with big data and high performance computing issues.

Professor Simmons is Matthew Flinders Distinguished Professor of Hydrogeology and Schultz Chair in the Environment at Flinders University. He is Director of the National Centre for Groundwater Research and Training. Professor Simmons is a leading international authority in hydrogeology and is considered one of Australia's foremost groundwater academics. He is a member of the Australian Government's Statutory Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC). He is also a member of the U.S. National Academies of Sciences, Engineering, and Medicine Roundtable on Unconventional Hydrocarbon Development. He is Chair of the Alligator Rivers Region Technical Committee, which oversees science in the Ranger Uranium Mine in World Heritage Listed Kakadu National Park. Professor Simmons' work has been recognised by numerous national and international research and teaching awards including the Anton Hales Medal for outstanding contributions to research in the Earth Sciences by the Australian Academy of Science and an Australian Award for University Teaching. He was named the 2015 South Australian Scientist of the Year and the 2017 Australian Water Professional of the Year. He is a 2017 Convocation Medallist of Flinders University and a 2017 Biennial Medallist of the Modelling and Simulation Society of Australia and New Zealand.

OPTIMISING THE USE OF PUMPING STATIONS IN A WASTEWATER NETWORK

Dr Christina Burt, Water Corporation

The inflow of wastewater into pumping stations, and from there, into wastewater treatment plants, follows a bi-modal curve that reveals the daily demand placed upon the system by its habitual users. The entire network, including the throughput capacity of the wastewater treatment plant, must cope with the peak demands, which means that the network is underutilized for around 80% of the day.

In this talk, we present results from a pilot study where we tested a theory that we can change the shape of the bi-modal curve by utilising an optimisation and data-driven approach for the way we use the pumping stations. We show that we can achieve our goal even though we only indirectly control the flow from the pumping stations, and though we provide a static solution for a stochastic problem.

Dr Burt obtained a PhD in Optimisation at Curtin University in 2008, for which she was awarded a Chancellor's commendation for excellent thesis. She researched network modelling and algorithms in the Department of Mathematics and Statistics at the University of Melbourne, before heading to Vienna to complete a postdoc in Transportation algorithms at the Austrian Institute of Technology. She returned to the Computer Science department at the University of Melbourne to develop decomposition algorithms for scheduling problems. In 2015 she was awarded the President's Mid-career Plenary Award for MODSIM. From 2016, she has worked in consulting, developing optimisation and artificial intelligence solutions. She has published 15 peer-reviewed articles and co-authored a book on these topics. She currently works in the Analytics Centre of Excellence at the Water Corporation, where she creates high benefit data products for stakeholders within the organisation.

INTELLIGENT SENSING FOR URBAN WATER SYSTEMS

Associate Professor Rachel Cardell-Oliver, The University of Western Australia

Many types of sensors are deployed in urban water systems including end-user smart meters, water quality sensors in water or wastewater treatment plants, and in distribution or sewer networks. But the data collected by these sensors is often under-utilized. Data mining techniques can be used to interpret sensor data for evidence-based decision-making. This talk will explore the role of sensor instrumentation and data mining in urban water systems drawing on case studies in smart water metering for households and businesses, leak detection for distribution systems, and treatment plant monitoring.

Prof Rachel Cardell-Oliver is a Computer Scientist with the School of Computer Science and Software Engineering at UWA. Her research on intelligent sensing systems integrates environmental sensing, wireless communication, and analysis of sensor data using machine learning techniques. She works with multi-disciplinary teams to address environmental challenges such as increasing public transport patronage, reducing household water consumption, understanding water use by native Australian plants, and assessing the performance of rammed earth buildings in outback Australia.

KEYNOTE: SIMULTANEOUS STOCHASTIC OPTIMIZATION OF MINING COMPLEXES / MINERAL VALUE CHAINS

Assistant Professor Amina Lamghari, University of Quebec, Canada

A mining complex or mineral value chain can be seen as a system where raw materials are extracted from one or several mineral deposits, transformed into sellable products using different processing streams, and delivered to the spot-market or customers. The supply of materials extracted from the mines represents a major source of uncertainty, referred to as geological uncertainty, and entails technical risk that must be managed. In the last decade, there has been a sustained development of models that integrate different components and aspects of mining complexes to simultaneously optimize mining, processing, stockpiling and transportation decisions while explicitly accounting for geological uncertainty, as this is essential to improving the overall mineral chain performance. In doing so, researchers have employed advanced optimization techniques to address the computational complexity of the resulting large-scale optimization problems and better incorporate endogenous and exogenous uncertainties in the key parameters (geological/mining, financial). Examples from main applications demonstrate improvements in technical risk management, blending, stockpiling, and capital investments, as well as generation of more robust schedules through better-informed decision-making. This talk surveys recent research in simultaneous stochastic optimization of mining complexes and presents a review of applications, solution methods, and key findings.

After receiving a BSc and a Master's in Applied Mathematics, Amina Lamghari obtained a PhD in Operations Research from the University of Montreal, Canada, after which she worked as a post-doctoral fellow and later as a research associate at the COSMO Stochastic Mine Planning Laboratory at McGill University. Amina is currently an assistant professor in the Management School at the University of Quebec. Her research interests are centered on various techniques and algorithms —(meta)heuristics, hyper-heuristics, and matheuristics — for optimization and their integration and application to solve complex scheduling and planning problems in an efficient manner. All of her work to date has had direct real--world applications. During the last nine years, applications in mine planning have been the main focus of her research, undertaken in response to the needs of the mining industry for more efficient and robust production schedules and operations plans. Many of the algorithms she developed were incorporated in the COSMO Suite software, a platform designed to aid in the dissemination of new stochastic mine planning optimization algorithms, techniques, and models to the mining industry.

NETWORK OPTIMISATION IN THE ACCESS DESIGN FOR UNDERGROUND MINES

Professor Emeritus Doreen Thomas FTSE, FIEAust, University of Melbourne

Reducing the cost of mining operations is an important issue for mine developers and operators faced with an extremely competitive market place for mineral commodities. In many underground mines, access is provided via a network of interconnected underground tunnels, called declines. The miners and their equipment are transported to the mine face along the declines and then the ore is hauled back to the surface. The declines have to satisfy certain constraints so that the large haulage trucks can navigate them. The problem is to design this network of navigable declines so as to minimise the cost of both constructing the network and hauling the ore. Costs of development and operations in

underground mines are so large that even a 100 metre reduction in the length of haulage paths can correspond to a $1M saving, when construction, ventilation, maintenance and haulage costs over the life of a mine are taken into account. The team has developed software tools to optimise mine layouts and these tools, which have been used in Australia, New Zealand and the United States, have been commercialised. Underpinning this new software is mathematical research which has led to significant advances in the theory of 3-dimensional navigable networks.

Professor Emeritus Doreen Thomas was Head of the School of Electrical, Mechanical and Infrastructure Engineering at the University of Melbourne; Associate Dean Research and Research Training and Adjunct Professor in the School of Mathematics and Statistics. She holds a BSc degree, from the University of Cape Town; Hons degree (Mathematics), University of the Witwatersrand; and MSc and DPhil (Mathematics), University of Oxford. Doreen has successfully applied her fundamental mathematical research in network optimisation to underground mine design and her research has been supported by both the Australian Research Council and the mining industry. She was a founding director of a spin-off company MineOptima, through which her mining software has been commercialised. MineOptima was acquired by the leading global mining software company RPM. She has been recognised with a national teaching award for her contribution to engineering education and mentorship and is a passionate ambassador for women in science and engineering. She is a Fellow of the Australian Academy of Technology and Engineering and a Fellow of Engineers Australia.

POSTER ABSTRACTS

A DIFFERENTIAL GAME THEORY MODEL OF CORPORATE GOVERNANCE

Olanike Adeoye, Victoria Institute of Strategic Economic Studies

Co-author: Professor Sardar Islam, Victoria Institute of Strategic Economic Studies

There still exists a need for compelling analysis and solutions to the identification of an optimal capital structure in the presence of information asymmetry. The study deploys the differential game theory framework as a dynamic technique which analyses the conflicts of interests between the shareholder and manager. This is done with respect to the company's optimal capital structure. The model was designed as an incentive contract between the shareholder and the manager to mitigate the agency problem of unobservable effort and cash diversion while maximizing the value of the firm which then leads to a good corporate governance system. To simulate the model, secondary data were obtained from the financial statements of Asaleo Care Limited, a consumer staple sector company in Australia. Preliminary results of the model in a Nash open-loop solution concept for Asaleo Care Limited depicts that in the absence of the incentive contract designed, market value of the company declines while the investment of the company and its earnings becomes negative over time, thereby emphasizing the significance of such robust incentive contract to manage the cash diversion and unobservable efforts problems to attain optimal mix of finance.

CLIMATE ECONOMICS ON THE EXAMPLE OF THE DICE MODEL: AN OPTIMAL CONTROL PERSPECTIVE

Dr Philipp Braun, University of Newcastle

Co-authors: Professor Christopher M. Kellett, Professor Steven R. Weller, University of Newcastle

For his work in the economics of climate change, Professor William Nordhaus was a co-recipient of the 2018 Nobel Memorial Prize for Economic Sciences. A core component of the work undertaken by Nordhaus is the Dynamic Integrated model of Climate and Economy, known as the DICE model. The DICE model is a discrete-time model which is primarily used in conjunction with a particular optimal control problem in order to estimate optimal pathways for reducing greenhouse gas emissions. In this Poster we give an introduction to the DICE model from a systems and control perspective. In addition, we indicate challenges and open problems of potential interest.

COMMUNICATION-EFFICIENT DISTRIBUTED SECOND-ORDER OPTIMIZATION METHODS FOR GENERALIZED CONVEX PROBLEMS

Rixon Crane, The University of Queensland

Co-author: Dr Fred Roosta, The University of Queensland

Continuous technological and communication advancements have enabled the collection of and access to ever-growing large scale datasets. There is a significant amount of research and development being devoted to machine learning problems in general, and the underlying optimization algorithms in particular, that are formulated on these large scale datasets. However, lack of adequate computational resources, in particular storage, can severely limit, or even prevent, any attempts at solving such optimization problems in a traditional stand-alone way, e.g., using a single machine. This can be remedied through distributed computing, in which resources across a network of stand-alone

computational nodes are “pooled” together to scale to the problem at hand. Optimization algorithms designed for distributed environments can efficiently leverage the computational resources of a network of machines. A significant issue with this framework of computing is that inter-machine communication can be expensive. Therefore, in such environments it is necessary to design algorithms that use a low number of communication rounds. There is significant potential for communication-efficient distributed second-order optimization methods. In my research we developed such methods that remedy many of the shortcomings of the existing methods.

STABILITY ANALYSIS OF NEWTON-MR UNDER HESSIAN PERTURBATIONS

Yang Liu, The University of Queensland

To alleviate several shortcomings of the classical Newton’s method and its (inexact) Newton-CG variant, while preserving their various desirable theoretical and algorithmic properties, Newton-MR has recently been introduced, which extends Newton-CG in the same manner that MINRES extends CG. Recently, stability of Newton-CG under Hessian perturbations, i.e., inexact curvature information, have been extensively studied. Such stability analysis has been leveraged in designing variants of Newton-CG, in which as a way to reduce the computational costs involving the Hessian matrix, the curvature is suitably approximated. Here, we do that for Newton-MR. Unlike the stability analysis of Newton-CG, which relies on spectrum preserving perturbations in the sense of Lowner partial order, our work here draws from matrix perturbation theory to estimate the distance between the underlying exact and perturbed sub-spaces. Numerical experiments demonstrate great degree of stability for Newton-MR, amounting to a highly efficient algorithm in large-scale problems.

OPTIMAL CONTROL OF HYBRID MANUFACTURING SYSTEMS: SMOOTHING OPTIMIZATION

Kobamelo Mashaba, Curtin University

Co-author: Dr Xu Honglei, Curtin University

The existence of critical jobs in manufacturing production line has resulted in a need of new unprecedented control tool over the hybrid manufacturing system. The aim of optimal control is primarily to gain insight of production system faster, and aid manufactures to make informed decision, on operations and implementation of lean tools, and other optimization methods. We achieve this by developing a hybrid model and a new smoothing algorithm that tackles the cost balancing between a job quality and job tardiness by finding optimal service time of the system

PROJECT MAGPIE: "A STUDY OF SYSTEM DYNAMICS AND REAL OPTION VALUATION IN MINE PLANNING AND OPTIMISATION"

Ramin Rakhsha, The University of Western Australia

Mining projects are capital intensive and inherently carry uncertainties and risks with them.

General Mine Planning techniques and software often use a static and linear (constant commodity price, discount factor, and a static risk profile) approach in regards with the risks and uncertainties for the mine plans. Almost all of the current General Mine Planning software use the Discounted Cash Flow (DCF) valuation method to maximise (optimise) the Net Present Value (NPV) as the objective for the Mine Production Plan.

This project is centred on quantification of risks and uncertainties within the mine planning cycle and integration of mine planning optimisation through non-linear means. The aim here is to use System Dynamics (SD) -an engineering/mathematical simulation method based on feedback theory- to generate a mine optimisation technique considering uncertainties and risks in the mine plan using Real Option valuation (ROV).

The project has initially tested SD applications to realise the impact of price uncertainties with a series of NPV driven mine production plans generated with a General Mine Planning (GMP) software, and will subsequently be developing ROV within SD environment for comparison reasons against the NPV and to understand the practicality of ROV and SD for Mine Planning purposes.

THE USE OF BAYESIAN CONTROL CHARTS IN QUALITY CONTROL METHODS FOR SOLAR IRRADIANCE DATA

Zoe Renwick, RMIT University

As a renewable energy source, solar radiation is attracting the attention of researchers. Estimation of the amount of solar radiation reaching the ground in predefined time intervals is required for all kinds of planning activities around solar irradiance. For example, to synchronize solar electricity generators with microgrids, we need to estimate the amount of solar irradiance in very short time intervals. Solar irradiance (the power, per square meter, received from the sun) is measured by sensors called pyranometers. Compared with other meteorological devices, pyranometers are exceptionally prone to errors. Due to the errors inherent in the measurement of solar irradiance, quality control checks are necessary to ensure we have reliable and accurate data. Currently, the most commonly used quality control checks applied to solar irradiance data are range tests and clear-sky models. These methods have a number of limitations which can be addressed by the use of Bayes' theorem. Bayesian Control charts can provide more accurate estimates by continually updating control limits as information is gathered. Preliminary results of our research have shown that the Bayesian method does have a higher rate of accuracy in detecting erroneous data points above currently used methods.

REAL TIME OPTIMISATION OF AIR QUALITY PREDICTIONS FOR AUSTRALIA THROUGH ARTIFICIAL INTELLIGENCE

Ekta Sharma, University of Southern Queensland

Co-authors: Dr Ravinesh Deo, Professor Alfio Parisi, University of Southern Queensland
Dr Ramendra Prasad, University of Fiji

Development of practical and efficient air quality regulating mechanisms is indeed a challenge. A pertinent air pollutant responsible for recurrent health-care costs with increased respiratory induced mortality in Australia is Particulate Matter (PM). In such a pressing public health problem, artificial intelligence can provide promising solution via developing models to obtain predictions through novel learning algorithms. This research project, unique in its own kind, focuses on generating real-time air quality forecasts of PM-2.5, PM-10 and the overall lower atmospheric visibility. To establish a robust optimisation model, an online sequential-extreme learning machine (OS-ELM), a powerful artificial intelligence algorithm was integrated with improved empirical mode decomposition with adaptive noise (ICEEMDAN) as a data pre-processing tool. The resulting novel data-driven, hybrid predictive model: ICEEMDAN-OS-ELM registers good predictive ability, particularly appropriate for near real-

time forecasts of PM-2.5, PM-10 and visibility at key test sites in Australia. The excellent performance of the OS-ELM hybrid model indicates its suitability as a decision-support systems tool in air quality monitoring, forecasting and subsequent health risk mitigation. Future study aspires to develop robust predictive frameworks in facilitating air quality strategies in mitigating Australia's public health risks in a coordinated way through advanced practical development of artificial intelligence approaches.

SYNTHESIS OF SUPPLY CHAIN TRANSPORT DATA USING GENERATIVE NEURAL NETWORKS

Herbert Taco Arana, Curtin University

Co-author: Professor Louis Caccetta, Curtin University

The use of optimisation and simulation models by ore producers, to support critical strategic supply chain management decisions is becoming standard industry practice. The performance of such models is crucial for meeting global demand, whilst maximising the profitability of a supply chain across its lifespan. However, their performance also often hinges on inputs which require varying levels of user intervention. This increases the risk of introducing errors which can significantly impact the performance of a model. Typical examples of this may be observed in bulk material export shipping operations where, for certain supply chain models, the inputs required consists of ship stem data. To improve the predictive value of these models, users often intervene to modify the data to reflect that which is anticipated in the future. In this research, we explore the use of machine-learning to assist in the generation of semi-synthetic data. We present a hybrid optimisation-neural-network based decision support tool that builds on current methods employed by bulk material exporters and mitigates the risk to model-mediated decisions associated with user intervention.

DAY 2: TUESDAY 18 JUNE 2019

0730 - 0800	**Business Breakfast *sponsored by BHP***
0800 - 0830	Attracting and retaining the best STEM talent to the mining, oil and gas, agriculture and water sectors
0830 - 0900	Opening presentation by **Dr Gaurav Singh**, BHP **Dr Liz Dallimore**, WA Data Science Innovation Centre **Dr Kylie Hollins**, Alcoa **Jane Mitchell**, Water Corporation **Dr Julie Howell**, Curtin University
0900 - 0930	
0930 - 1000	**Keynote:** Optimising Mine Planning and Operations **Professor Rafael Epstein** Universidad de Chile
1000 - 1030	
1030 - 1100	MORNING TEA
1100 - 1130	Solving Real World Problems through Math – Improving Mining Productivity with Operational Simulation **Chet Fong** RPM Global
1130 - 1200	
1200 - 1230	Optimisation opportunities to unlock further value from mine automation **Dr Tarrant Elkington**, Snowden
1230 - 1330	LUNCH
1330 - 1400	Optimisation Challenges in Mineral and Energy Resource Applications **Professor Peter Dowd** University of Adelaide
1400 - 1430	
1430 - 1500	Synthesis of supply chain transport data using generative neural networks **Herbert Taco Arana**, Curtin University
1500 - 1530	AFTERNOON TEA
1530 - 1600	Port Product Delivery Optimisation **Dr Stephen Beckwith** Optika Solutions
1600 - 1630	
1630 - 1700	Divide and Conquer: Taming blending constraints in mine planning models with stockpiles **Adjunct Professor Jose Charango Munizaga-Rosas,** University of Chile

DAY 2 – Tuesday 18 June

OPENING PRESENTATION: FOSTERING THE FUTURE OF APPLIED MATHEMATICS & DECISION SCIENCES AT BHP

Dr Gaurav Singh, BHP

Digital disruption and the pace of technological change is expanding the demand for skills in applied mathematics and decision science across all industries. At the same time, the STEM participation rates in secondary and tertiary education are falling in Australia. Therefore, for industries to stay competitive it is essential for them to foster the future pipeline of STEM educated professionals.

This presentation considers the STEM education and labour force trends in Australia and beyond, and outlines BHP's commitment to and investment in the current and future STEM workforce, with a spotlight on applied mathematics and decision science capability.

Gaurav has over 15 years' experience in strategic planning, operations management and advanced analytics. At BHP Gaurav is responsible for embedding advanced decision science at all organisational levels, with a focus on R&D in optimisation, simulation and machine learning algorithms. Previously he was practice lead for decision science and a principle scientist in the Geoscience projects and engineering team. Prior to joining BHP, Gaurav was a research stream leader at CSIRO where he led research and industrial projects including optimisation of supply chains, maintenance programs and rail scheduling; decision support tools development and workforce and production planning. He has also lectured in mathematics and operations research. Gaurav holds a PhD in Scheduling Theory, an MSc in Operations Research and an MA and BA(Hons) in Mathematics.

BUSINESS BREAKFAST: ATTRACTING AND RETAINING THE BEST STEM TALENT TO THE MINING, OIL, GAS, WATER AND AGRICULTURE SECTORS

Dr Liz Dallimore, WA Data Science Innovation Hub

Liz is the Director of the Western Australian Data Science Innovation Hub where she is responsible for implementing the strategic priorities of the Hub, focussed on building the data science ecosystem in WA. Prior to joining the Hub, Liz was the National Director for Research Engagement & Commercialisation at KPMG. Liz spent 12 years in consulting working with both the start-up and SME community and large corporates to help them fund and commercialise novel ideas and technologies. Liz has also worked as a scientist at the Australian Neuromuscular Research Institute (now the Perron Institute for Neurological and Translations Sciences) and at the UK's Food Standards Agency. Liz holds a PhD in Neuroscience, an MBA and a BSc. (Hons).

Dr Gaurav Singh, BHP

Gaurav has over 15 years' experience in strategic planning, operations management and advanced analytics. At BHP Gaurav is responsible for embedding advanced decision science at all organisational levels, with a focus on R&D in optimisation, simulation and machine learning algorithms. Previously he was practice lead for decision science and a principle scientist in the Geoscience projects and engineering team. Prior to joining BHP, Gaurav was a research stream leader at CSIRO where he led research and industrial projects including optimisation of supply chains, maintenance programs and rail scheduling; decision support tools development and workforce and production planning. He has also lectured in mathematics and operations research. Gaurav holds a PhD in Scheduling Theory, an MSc in Operations Research and an MA and BA(Hons) in Mathematics.

Dr Kylie Hollins, Alcoa

Kylie has experience in corporate organisations in the minerals sector, government and academia. She has experience as a director on Not-for-Profit boards in education, health and aged care. Kylie's current role is Analytics and Digital Manager (Alcoa). Previous roles have included Studies Director, Major Projects (Woodside) and Superintendent, Autonomous and Remote Operations (BHP). She has a PhD in Data Science and an MBA (Technology), UNSW. Kylie enjoys leading data science and digital teams to add business value in innovative ways.

Jane Mitchell, Water Corporation

Jane is the Head of Digital Services at Water Corporation where she is responsible for the delivery of key services for strategy and architecture, cyber security, technical delivery, operations management for infrastructure and enterprise applications, data science and geospatial. Prior to joining Water Corporation, Jane has had over 20 years of experience in private and public sectors within consultancy, strategy, enterprise and technical delivery. Jane also served for nine years with the Royal Australian Airforce within technology and communications. Jane strives to deliver business and customer value through digital services and data insights.

Dr Julie Howell, Curtin University

Julie Howell is the Associate Director Careers & Employability at Curtin University Careers. Julie's employment has substantially lain within the education sector in both Australia and Canada. Underpinning responsibilities in program management and delivery, has been a belief that access to career development support is essential for all Australians for both individual benefit and the economic growth of the country. Julie's research interests are motivated by a desire to both strongly link theory and practice and to incorporate career development learning within curricula. Julie was the National President of NAGCAS (the National Association of Graduate Careers Advisory Services) from 2013-2018 and a previous board member of Graduate Careers Australia.

KEYNOTE: OPTIMIZING MINE PLANNING AND OPERATIONS

Professor Rafael Epstein, Universidad de Chile

I will describe theoretical and applied developments of optimization systems for long-term and short-term mine planning, as well as relevant real-time optimization problems that arise in mine operations. First, I will present a deterministic long-term optimization system that has been used in large and complex real instances by CODELCO for fifteen years with positive results, that combines open-pit with underground mines, and plant processes downstream. Then, we introduced explicitly uncertainty in copper price using price scenarios and the non-anticipativity principle, with promising results in real world applications. In addition, I will show a short-term planning optimization model based on a geo-referenced structure for spatial decisions, with different techniques used to solve this hard-combinatorial model. And finally, I will present relevant problems that appear when a company has an Integrated Operations Centre, which receives all the real-time data produced by the mine and plants for the coordination and optimization of the whole operation. For this, I will show my experience in El Teniente, the world's largest underground copper mine.

Professor Epstein is an Industrial Engineer from Universidad de Chile, with a PhD in Operations Research awarded by MIT. His work has had an important impact in the improvement of the planning and the operations in the forest and the mining industries, as well as in important public tenders. He has published his work in the best journals in the area as well as in specialized books, for which he has received multiple awards and recognitions, such as the Franz Edelman Prize in 1998 given by the Institute for Operations Research and Management Sciences (INFORMS) for his work in the forest industry, the OR for Development Prize in 2002 given by the International Federation of Operation Research Societies (IFORS) for his work in large-sized tender mechanisms, the ENRE Prize for the best natural resources paper in both mining and forestry, the Chilean Innovator of the Year in 2008, and the Best Work in Engineering Prize in 2011 given by the School of Engineering of Chile for his work in logistics optimisation for the shipping industry. In addition, he has taught and formed many academics and professionals in the field of Engineering.

SOLVING REAL WORLD PROBLEMS THROUGH MATH – IMPROVING MINING PRODUCTIVITY WITH OPERATIONAL SIMULATION

Chet Fong, RPM Global

The Mining Industry is changing, and with this change comes the opportunity to capitalize on the drivers of this change. The economic conditions that drove mining booms in the past was a perfect storm that may never arise again. Companies pivot accordingly to look for the opportunities to be successful from within. How do we reduce costs while maintaining or improving productivity? How do we improve the bottom line if the commodity prices no longer flux? The Mining Industry has become hungry for solutions from within – how do we improve what we already do? Instead of relying on a step change to improve the bottom line, we turn to incremental improvements to grow. In the world of precision, math is king, and here are some examples of how we've helped companies reap the benefits of this.

Chet is a mining engineer with over 20 years' experience in the mining industry across the globe. His career spans multiple commodities across multiple roles, from business development to production planning and optimisation. His passion for mining remains the bridging technology with basic mining principles and simplifying problems to reach the solution.

OPTIMISATION OPPORTUNITIES TO UNLOCK FURTHER VALUE FROM MINE AUTOMATION

Dr Tarrant Elkington, Snowden

The mining industry is making significant strides towards automation as part of Industry 4.0, particularly in terms of machines and control. However, to support and fully exploit the benefits of automation it is important that mine planning can evolve to enable real time decision optimization. Not only does mine planning need to support the unique aspects of automation, but the planning process itself needs to be automated in order to make sense of information as and when it becomes available. There are several gaps to fill in this regard, and these will be the topic of the presentation. Several key areas will be discussed in concept as opportunities where breakthroughs are required.

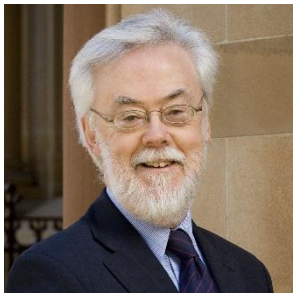
Tarrant is a mining analyst specializing in mining strategy optimization. He has worked in the mining research, consulting and software industry for the last 15 years, advising on projects across most commodities, regions and extraction methods. Tarrant is currently Global Manager of Snowden Mining Industry Consultants, managing teams of geologists, mining engineers, and software developers to assist mining companies with the evaluation, optimization and improvement of their mining projects and operations.

OPTIMISATION CHALLENGES IN MINERAL AND ENERGY RESOURCE APPLICATIONS

Professor Peter Dowd, University of Adelaide

The talk will be a personal view of the current optimisation challenges in mineral and energy resource applications and, in particular, the need for an integrated systems approach to complex mining and extraction systems problems. It will provide examples of some of the problems together with some proposed approaches and solutions to them.

Optimisation in mining and related fields tends to focus on individual components of a much larger integrated process. Independently optimising the components does not optimise the entire process. The integration of the sequence of inputs to, and outputs from, staged processes is critical for mine optimisation and for optimising the processes themselves. Optimisation must also include the effects of uncertainty at all stages of the process.



Peter's research interests are in geostatistical modelling and prediction in mineral resource, petroleum reservoir, geothermal and environmental applications; geological modelling and mathematical geology; stochastic modelling and quantified risk assessment in natural resource applications; and optimisation of mining processes. He has worked as an academic at the University of Leeds in the UK and the University of Adelaide and, over the past 20 years, has occupied senior executive positions in both institutions. He is a Fellow of the Royal Academy of Engineering, a Fellow of the Australian Academy of Technological Sciences and Engineering and has been named one of Australia's 100 most influential engineers by the Institution of Engineers Australia. In 2016 he was awarded the Krumbein Medal by the International Association for the Mathematical Geosciences – the highest honour for career achievement and distinction in the application of mathematics in the earth sciences. He is currently Professor of Mining Engineering at the University of Adelaide.

SYNTHESIS OF SUPPLY CHAIN TRANSPORT DATA USING GENERATIVE NEURAL NETWORKS

Herbert Taco Arana, Curtin University

The use of optimisation and simulation models by ore producers, to support critical strategic supply chain management decisions is becoming standard industry practice. The performance of such models is crucial for meeting global demand, whilst maximising the profitability of a supply chain across its lifespan. However, their performance also often hinges on inputs which require varying levels of user intervention. This increases the risk of introducing errors which can significantly impact the performance of a model. Typical examples of this may be observed in bulk material export shipping operations where, for certain supply chain models, the inputs required consists of ship stem data. To improve the predictive value of these models, users often intervene to modify the data to reflect that which is anticipated in the future. In this research, we explore the use of machine-learning to assist in the generation of semi-synthetic data. We present a hybrid optimisation-neural-network based decision support tool that builds on current methods employed by bulk material exporters and mitigates the risk to model-mediated decisions associated with user intervention.

Herbert is a PhD candidate at Curtin University currently working on machine learning algorithms for generating synthetic data sets for industrial modelling applications. Prior to his PhD candidature, Herbert was awarded a Master of Science (Industrial Engineering) with distinction from Curtin University. He recently completed an AMSI internship where he worked on an optimisation-based modelling support tool. Herbert has also worked in the pharmaceutical and biotech sectors and has over 7 years of experience in manufacturing process control and design.

PORT PRODUCT DELIVERY OPTIMISATION

Dr Stephen Beckwith, Optika Solutions

In the delivery of mining product to customers via port operations, significant value can be realised through a modest percentage improvement in efficiency. Port operators are challenged to investigate every opportunity to reduce cost of operations and control throughput of product to customers to generate best revenue. Optika Solutions has been investigating approaches to port product throughput optimisation via improved control of the 0 to 7 day scheduling window and further into the sub 48-hour window. We have been investigating what level of more complete port autonomy, management of assets and sensor technology is necessary to facilitate such tighter controls and gain more consistent value realisation, incorporating:

- Commodity price forecasting;
- Linking predicted commodity price to short-term scheduling;
- Live ship tracking;
- Weighted direct route optimisation; and
- Route selections.

Port operations must consider daily challenges and variabilities hence our work has included consideration of:

- New route sequence determined on equipment failure;
- Ability to run large numbers of 'What if' Scenarios in near real time; and
- Ease of use operators to interact with prescribed solutions or the choice to allow a prescribed schedule to run autonomously.

Our work indicates an opportunity to realised 5-8% uplift in revenue via these approaches to Port Operations.

Stephen is the Chief Operating Officer at Optika Solutions, a software and product solutions development company based in West Perth. He was awarded a PhD in Electrical Engineering in 1996 while working in the Artificial Intelligence and Power Systems research group at UWA. He has over 30 years' experience in the design, provision and operation of SCADA and automation systems in the water, satellite, mining and gas industries. He was a Senior Manager at the Western Australian Water Corporation, working there for 23 years. In 2008, while Operations Technology Manager and then Head of Operations Centre, he established and managed a Data Analytics team in the Operations Centre of Water Corporation. He was a Senior Project Manager at Motorola and a Control Systems Engineer at InmarSat and PCT Engineers and a Lecturer at the University of WA from 1992 – 1996.

DIVIDE AND CONQUER: TAMING BLENDING CONSTRAINTS IN MINE PLANNING MODELS WITH STOCKPILES

Adjunct Professor Jose Charango Munizaga-Rosas, University of Chile

This talk will review the classical models of open pit mine planning, it will discuss some features of the underlying mathematical model and explain why moving away from the classical formulation becomes an obstacle in real world applications. We will then explain a practical approximation to solve a real-world problem consisting on finding a mine plan considering several blending constraints. For this purpose, a model was developed which splits the overarching problem into two components: a mine extraction problem and a blending problem, all this with the use of intermediate stockpiles.
We will then discuss the model that was formulated to tackle this problem, how it was used and some results that were obtained with it. Finally, the talk will also spend some time discussing some of the practical lessons learned in developing a solution for the problem in a real-life context.
The results show that a practical solution can be achieved in reasonable time and it provides insight for strategic decision making. Some challenges remain; however, it is believed the proposed approach is a good first step in tackling the complexity associated with the problem.

Dr. Munizaga-Rosas is a Mathematical Engineer and M.Sc. in Operations Management from University of Chile, Santiago, Chile. He also holds a Ph.D. in Natural Resources Engineering from Laurentian University, Sudbury, Ontario, Canada. His research interests are deeply rooted in the application of operations research to natural resources problems with his focus mainly being in non-renewables with some brief excursions into the renewables space. Dr. Munizaga-Rosas experience spans several industries having worked in areas such as logistics, mining, oil and gas, rubber supply chain, health and insurance applications and lately data science. Currently he works as an independent consultant working in Chile, Thailand, Singapore and Australia. He currently holds a position as an Adjunct Professor in the Mining Engineering Department of University of Chile, where he is the Academic Director of the Graduate Diploma in Mineral Economics. He also teaches at the M.Sc. in Mineral Economics at Curtin University, Perth, Western Australia.

DAY 3: WEDNESDAY 19 JUNE 2019

0800 - 0830	REGISTRATION – *tea & coffee served*
0830 - 0900	Control of complex intersection areas in transient gas networks **Mark Turner**, Zuse Institute Berlin
0900 - 0930	Opportunities for Optimisation in Oil and Gas & Considerations for Uptake **Dan Sutherland** Biarri EMI
0930 - 1000	
1000 - 1030	**Keynote:** A bilevel programming model for a problem of market regulation: application to the Mexican petrochemical industry **Professor Martine Labbé**, Universite Libre de Bruxelles
1030 - 1100	MORNING TEA
1100 - 1130	Optimising the layout of a chemical process plant **Professor Maria Garcia De La Banda** Monash University
1130 - 1200	
1200 - 1230	The Wireless Industrial Sensor Environment (WISE) Program **Brad Holding** Innovation Central – Cisco Systems
1230 - 1300	
1300 - 1400	LUNCH
1400 - 1430	Threshold Risk and Uncertainty Quantification in Environmental Modelling **Professor Jerzy A. Filar** Centre for Applications in Natural Resource Mathematics
1430 - 1500	
1500 - 1530	Australian Actuaries Climate Index **Pulkit Jain**, Finity Consulting
1530 - 1600	AFTERNOON TEA
1600 - 1630	Hands-on session: Optimising crop rotation schedules **Dr Alysson M. Costa & Simon Bowly** The University of Melbourne
1630 - 1700	
1700 - 1730	

DAY 3 – Wednesday 19 June

CONTROL OF COMPLEX INTERSECTION AREAS IN TRANSIENT GAS NETWORKS

Mark Turner, Zuse Institute Berlin

Working with our project partner Open Grid Europe, who operates one of the largest and most complex gas network in Germany, we developed a Navigational System Tool (NAVI) for supporting dispatchers. Based on a prognosis of supply and demand at entries and exits, the NAVI makes suggestions for active elements, e.g., whether or not to close a valve and/or to ramp up a compressor machine. A non-convex non-linear MINLP can be formulated to 'exactly' model this problem, however in practice it does not nearly scale to the necessary network size or number of time steps. Our current approach is split into two-stages, both of which utilise MILP as approximations of their non-linear counterparts: The first takes a broader approach, capturing the transient aspects of gas-transport but only using a simplified view of compressor stations. The second stage then realises decisions based on the flow / pressure values provided by the first-stage for complex intersection areas of the original network. We conclude with visualisations of our computational experiments.

I'm currently a PhD student at Technical University Berlin, writing my thesis within the Energy Group at the MODAL Research Campus in Zuse Institute Berlin. I'm interested in combinatorial as well as network optimisation problems. The major goal of my current research is the on-line creation of a complete set of decisions for effective gas network operation while fully encapsulating the transient constraints. My previous work was centred around Steiner Trees, with both my B.Sci / Masters being completed at The University of Melbourne. In addition, a brief stint between semesters was spent at Monash University working on a crew scheduling problem.

OPPORTUNITIES FOR OPTIMISATION IN OIL AND GAS & CONSIDERATIONS FOR UPTAKE

Dan Sutherland, Biarri EMI

Oil and Gas currently account for over 50% of the world's energy demand, and according to the IEA World Energy Outlook, this demand will continue beyond 2040. In fact, gas demand is expected to be the only fossil fuel to substantially increase over the coming years becoming the largest fuel in the global energy mix. These trends highlight the importance of efficiency in gas supply.

Given the ever-increasing pressure from global competitors, the need for improved efficiency is more important than ever. Accessing the insights held within organisations data drives the ability to assess, react, and shift priorities. Given the huge volumes of data and its complexities, this talk will focus on opportunities for mathematical optimisation in gas, primarily focusing on upstream gas production.

We will deep-dive and focus on optimisation opportunities across both developing and operating projects, and core and auxiliary functions. Finally, I will finish with some considerations for the optimisation community on uptake and implementation of algorithms.
Source: https://www.iea.org/weo2018/fuels/

Dan Sutherland is the algorithmic leader of Biarri EMI, a company that enables organisations to make better business decisions, create and leverage efficiencies powered by data and mathematics. He uses the power of mathematics to deconstruct and predict patterns and changes in business process and activity focusing on improving operational efficiencies of machinery, schedules, people rostering and equipment maintenance.

As CEO, Dan has consulted and overseen successful projects in the resources sector using mathematics as the driving force to optimise;

- *short interval control & shift planning – Newcrest Mining*
- *people and activity scheduling at large scale high capital assets – Origin Energy, Shell, Santos*
- *cross-industry people rostering to proactively manage the movement & rosters of people – Harmony Gold, Origin Energy, BMA*
- *asset auto design for intensive capital projects including design of CSG & Conventional Gathering Networks*
- *further strategic and operational analytics projects for international companies – BP, Shell, Santos, Newcrest, Harmony Gold & more*

Dan graduated from the University of Queensland with a Bachelor of Science (Mathematics) First Class Honours, University Medal and as Class Valedictorian. He incorporates his background in Computational Neuroscience (field of study in which mathematical tools and theories are used to investigate brain function) to help solve complex problems in the business world. His experience fuels his passion for creating swift and innovative solutions for the Energy, Mining and Infrastructure industry.

KEYNOTE: A BILEVEL PROGRAMMING MODEL FOR A PROBLEM OF MARKET REGULATION: APPLICATION TO THE MEXICAN PETROCHEMICAL INDUSTRY

Professor Martine Labbé, Université Libre de Bruxelles

In this paper, a bilevel programming model is proposed to study a problem of market regulation through government intervention. One of the main characteristics of the problem herein analyzed is that the government monopolizes the raw material in one industry, and competes in another industry with private firms for the production of commodities. Under this scheme, the government controls a state-owned firm to balance the market; that is, to minimize the difference between the produced and demanded commodities. On the other hand, a regulatory organization that coordinates private firms aims to maximize the total product by deciding the amount of raw material bought from the state-owned firm. Two equivalent single-level reformulations are proposed to solve the problem. Additionally, three heuristic algorithms are designed to obtain good-quality solutions with low computational effort. Extensive computational experimentation is carried out to measure the efficiency of the proposed solution methodologies. A case study based on the Mexican petrochemical industry is presented. Additional instances generated from the case study are considered to validate the robustness of the proposed heuristic algorithms.

Martine Labbé is honorary professor at the Université Libre de Bruxelles (ULB). She was Professor of Operations Research at the Computer Science Department of the Faculty of Sciences. From 2007 to 2011, she was Dean of the Faculty of sciences. Her main research area is discrete optimization, including graph theory and integer programming problems and with a particular emphasis on location and network design problems. She is also specialised in bilevel programming and studies pricing problems and Stackelberg games. She served on the editorial boards of Discrete Optimization, Journal on combinatorial Optimization, Operations Research, Operations Research Letters and Transportation Science. She is now the Editor in Chief of the EURO Journal on Computational Optimization. She is the author or coauthor more than120 papers published in international journals. In 2007-2008, she was president of EURO, the Association of European Operational Research Societies. She was, in 2014 and 2015, Vice-Chair of the SIAM Activity Group on Optimization (SIAG/OPT).

OPTIMISING THE LAYOUT OF A CHEMICAL PROCESS PLANT

Professor Maria Garcia de la Banda, Monash University

Optimising the layout of the equipment and connecting pipes that form a chemical processing plant is an important and complex problem for the oil and gas industry. The aim of this optimisation problem is to minimise the total cost of the plant while ensuring its safety and correct operation. The complexity of the problem is such that it is still solved manually, taking multiple engineers years to complete and yielding solutions of unknown quality.

Monash is collaborating with Woodside to develop state of the art optimisation and visualisation technology, that is already capable of producing 3D (near) optimal plant designs in just a few hours for medium and large size plants. I will discuss the different components and technology developed during our collaboration, together with their advantages and current limitations. I will also discuss how obtaining these designs has opened up many research questions regarding solution diversity, explainability, and interactive optimisation.

Maria Garcia de la Banda is a Professor at the Faculty of Information Technology, at Monash University and has more than 25 years of experience as an academic. Prof. Garcia de la Banda's PhD, awarded in 1994, won the Universidad Politécnica de Madrid's Best PhD Award. In 1997 she was awarded the first and only prestigious Logan Fellowship for the Faculty of Information Technology at Monash University, a role she held for 6 years. In 2005 she won, with Peter Stuckey, the International Constraint Modelling Challenge. She has been an elected member of the Executive Committee of the Association of Logic Programming, and of the Association for Constraint Programming, of which she is currently president. From 2013 to 2016, she was the Deputy Dean of the Faculty of Information Technology at Monash University, and prior to this she was the Head of its Caulfield School of Information Technology.

Prof. Garcia de la Banda has extensive research experience in the modelling and solving of combinatorial problems, with particular emphasis on the (semi-)automatic analysis and transformation of constraint programming models, and has been involved in different real-world problems, including the optimization of the layout of LNG plants, and the optimization of Melbourne's water flow system.

THE WIRELESS INDUSTRIAL SENSOR ENVIRONMENT (WISE) PROGRAM

Brad Holding, Innovation Central – Cisco Systems

This talk will provide an overview of the WISE program at Innovation Central. WISE was created to help industrial organisations accelerate their adoption of Industrial IoT technologies through the trial and validation of various IoT sensors, networks, applications and analytics.

Brad has over 10 years experience in the networking and cyber security domains and is currently employed by Cisco as the lead architect at Innovation Central. He holds four Cisco Certified Internetwork Expert certifications.

THRESHOLD RISK AND UNCERTAINTY QUANTIFICATION IN ENVIRONMENTAL MODELLING

Professor Jerzy A. Filar, Centre for Applications in Natural Resource Mathematics, The University of Queensland

Mathematical models of environmental problems often demand understanding of complex dynamics and interactions between many physical and biological variables on the one hand, and human inputs on the other. Uncertainties accompanying such models stem from multiple sources. Sometimes they manifest themselves as cascading errors and at other times they involve the risk of key variables crossing undesirable thresholds. In both cases they undermine confidence in either the model or, worse still, the underlying science. We discuss these issues with illustrations from certain generic areas such as models of fishery management and integrated climate change models.

Jerzy Filar is Professor of Applied Mathematics and Director of the Centre for Applications in Natural Resource Mathematics (CARM), at the University of Queensland. In that capacity he works closely with scientists from Queensland's Department of Agriculture and Fisheries on sustainable fishery management.

Jerzy is a broadly trained applied mathematician with research interests spanning a wide spectrum of both theoretical and applied topics in Operations Research, Optimisation, Game Theory, Applied Probability and Environmental Modelling. He spent the first thirteen years of his academic career in the US, which included appointments at the University of Minnesota, The Johns Hopkins University and the University of Maryland and long-term consulting for the Environmental Protection Agency in Washington, DC. He returned to Australia in 1992 where he first worked at the University of South Australia and later at Flinders and the University of Queensland. He is the editor-in-chief of Springer's Environmental Modelling and Assessment. Jerzy is also a Fellow of the Australian Mathematical Society. He has supervised, or co-supervised, to completion 26 PhD students who are working in various universities, industries and research institutions in Australia, USA, Canada, China, Morocco, Austria and France. As a hobby he dabbles in writing science fiction which, unlike mathematics, does not need to be correct to be interesting.

AUSTRALIAN ACTUARIES CLIMATE INDEX (AACI)

Pulkit Jain, Finity Consulting

In this talk we discuss the recently launched Australian Actuaries Climate Index (AACI). The (AACI) has been developed to measure how the frequency of extreme weather conditions is changing over time. It is designed to help inform actuaries, public policymakers, companies and the general public about climate trends in Australia.

This talk will cover the use of extremes and their relevance to risk, the calculation of the index and some interesting observations from the index that are relevant to the energy and agriculture industries.

Pulkit is a senior consultant at Finity, providing actuarial and strategic advice to the insurance industry. Pulkit has spent the last 8 years consulting primarily on pricing strategy and natural hazard management. He has worked extensively with the insurance effort to rebuild Christchurch following the 2010/11 earthquakes and has also been helping insurers price for natural perils. Pulkit has a passion for understanding the effects of climate change and has more recently been working on projects to model its effects on extreme events.

HANDS ON SESSION: OPTIMISING CROP ROTATION SCHEDULES

Dr Alysson M. Costa, The University of Melbourne
Simon Bowly, The University of Melbourne

In the first part of this hands-on session, we will present a crop rotation problem in the context of sustainable vegetable production. We will develop a compact mixed-integer programming model, which will be implemented and solved with free online optimisation tools (JuliaBox/JuMP/Cbc). In the second part, the crop rotation model will be extended to include plot area planning in order to satisfy required demands. The new formulation has a large number of variables and we will present and implement a delayed column generation method for the efficient obtention of solutions.

Alysson M. Costa is a Senior Lecturer in Operations Research at the School of Mathematics and Statistics – University of Melbourne. Alysson is interested in theory and applications of Optimisation. Throughout his career, he has worked extensively with mixed integer programming (modelling and solution methods) applied to problems in different areas such as environmental water management, disaster relief operations, educational timetabling, crop rotation, assembly line balancing and city logistics, among others. He received his PhD in 2006 from HEC Montreal / University of Montreal – Canada. His thesis, titled "Models and algorithms for two network design problems", received the Cecil Graham doctoral dissertation award from the Canadian Applied and Industrial Mathematics Society. Before that, he received MSc. and B.Eng. Degrees in Electrical Engineering from the State University of Campinas – Brazil.

Simon Bowly is currently completing his PhD in the School of Mathematics and Statistics at the University of Melbourne, focusing on generating test cases that effectively stress-test optimisation algorithms. His work aims to address the lack of instance diversity in existing test sets in order to aid researchers in assessing algorithm strengths and weaknesses. He has a strong interest in algorithm development, empirical performance analysis, and automated algorithm configuration using machine learning methods. Simon has extensive experience applying optimisation and data analysis techniques to real-world problems. He is currently the lead developer for SCADA Miner, building automated tools to analyse wind farm operational data and identify performance and maintenance issues. Previously, he has worked as a consultant with Biarri Optimisation, focusing on road and rail logistics projects.

DAY 4: THURSDAY 20 JUNE 2019

0830 - 0900	REGISTRATION - TEA & COFFEE
0900 - 0930	**Keynote:** Bilevel programming, Stackelberg games and pricing problems **Professor Martine Labbé** Universite Libre de Bruxelles
0930 - 1000	
1000 - 1030	Integrated Vessel and Helicopter Routing for Offshore Oil and Gas Facilities **Dr Elham Mardaneh**, Curtin University
1030 - 1100	MORNING TEA
1100 - 1130	Bayesian atmospheric tomography for detection and estimation of methane emissions **Laura Cartwright**, University of Wollongong
1130 - 1200	Real time optimisation of air quality predictions for Australia through Artificial Intelligence **Ekta Sharma**, University of Southern Queensland
1200 - 1230	Generating mixed integer programming test instances with challenging properties **Simon Bowly**, The University of Melbourne
1230 - 1310	LUNCH (40 minutes)
1310 - 1330	**Keynote:** Solution Methods for Stochastic Mine Planning **Professor Amina Lamghari** University of Quebec, Canada
1330 - 1410	
1410 - 1440	Newton-MR: Newton's Method Without Smoothness or Convexity **Dr Fred Roosta**, University of Queensland
1440 - 1510	A flexible approach for finding the best approximation to the intersection of convex sets **Dr Minh N. Dao**, The University of Newcastle
1510 - 1530	AFTERNOON TEA
1530 - 1600	Lyapunov functions and convergence of Douglas-Rachford method for non-convex problems **Dr Bjorn Ruffer**, The University of Newcastle
1600 - 1615	Probabilistic Robust Anti-disturbance Control of Uncertain Linear Systems **Peng Cheng**, Curtin University
1615 - 1630	The Relationships Among Commitment to Change, Coping with Change, and Job Satisfaction, **Xiaoli Cao**, Curtin University
1630 - 1645	The tensor complementarity problem **Xueli Bai**, Curtin University
1645 - 1700	Mixed-integer min-max dynamic optimization and its application on identifying dynamic structure and parameters of glycerol continuous fermentation, **Juan Wang**, Curtin University
1700 - 1715	Research on loss analysis of power distribution network and auxiliary decision-making technology of loss reduction and efficiency increase, **Jie Liu**, Curtin University
1715 - 1730	An ensemble dynamic metabolic fluxes modelling of glycerol metabolism in Klebsiella pneumoniae, **Jianxiong Ye**, Curtin University
1730 -1745	Optimization of Impedance Matching Network in Wireless Power Transfer System, **Yuanyuan Liu**, Curtin University
1745 - 1800	Robust Real-Time Optimization for Blending Operation of Alumina Production **Lingshuang Kong**, Curtin University
1800 - 1900	Optional activity: Informal offsite dinner

DAY 4 – Thursday 20 June

WORKSHOP KEYNOTE: BILEVEL PROGRAMMING, STACKELBERG GAMES AND PRICING PROBLEMS

Professor Martine Labbé, Université Libre de Bruxelles

A bilevel optimization problem consists in an optimization problem in which some of the constraints specify that a subset of variables must be an optimal solution to another optimization problem. This paradigm is particularly appropriate to model competition between agents, a leader and a follower, acting sequentially. In this talk I will discuss two such problems.

In the first one, called the network pricing problem, tolls must be determined on a specified subset of arcs of a multicommodity transportation network. The leader or first level corresponds to the profit maximizing owner of the subset of arcs and the follower to users traveling at minimum cost between nodes of the network.

The second problem, called the Stackelberg bimatrix game, involve a party with the capacity of committing to a given action or strategy, referred to as the leader, and a party responding to the leader's action, called the follower. The objective of the game is for the leader to commit to a reward-maximizing strategy anticipating that the follower will best respond. This type of game finds important applications in the domain of security.

Martine Labbé is honorary professor at the Université Libre de Bruxelles (ULB). She was Professor of Operations Research at the Computer Science Department of the Faculty of Sciences. From 2007 to 2011, she was Dean of the Faculty of sciences. Her main research area is discrete optimization, including graph theory and integer programming problems and with a particular emphasis on location and network design problems. She is also specialised in bilevel programming and studies pricing problems and Stackelberg games. She served on the editorial boards of Discrete Optimization, Journal on combinatorial Optimization, Operations Research, Operations Research Letters and Transportation Science. She is now the Editor in Chief of the EURO Journal on Computational Optimization. She is the author or coauthor more than120 papers published in international journals. In 2007-2008, she was president of EURO, the Association of European Operational Research Societies. She was, in 2014 and 2015, Vice-Chair of the SIAM Activity Group on Optimization (SIAG/OPT).

INTEGRATED VESSEL AND HELICOPTER ROUTING FOR OFFSHORE OIL AND GAS FACILITIES

Dr Elham Mardaneh, Curtin University

Co-authors: Professor Ryan Loxton, Dr Qun Lin, Curtin University

Efficient transportation of cargo and personnel is crucial in the offshore oil and gas industry. This paper proposes a transportation scheduling model for offshore oil and gas operations involving both vessels (for transporting cargo) and helicopters (for transporting personnel). The vessels and helicopters interact through constraints that prohibit simultaneous visits at the offshore production facilities due

to safety regulations and limits on personnel availability. The scheduling challenge can be formulated as a mixed-integer linear programming (MILP) model and we define a set of pre-processing operations that exploit model structure to significantly streamline the model. We also present a heuristic algorithm for generating an initial feasible schedule, which can be used as a starting point for commercial MILP solvers. Simulation results for the North West Shelf project in Australia show that the proposed computational approach can generate high-quality solutions to large, industrial-scale problem instances.

BAYESIAN ATMOSPHERIC TOMOGRAPHY FOR DETECTION AND ESTIMATION OF METHANE EMISSIONS

Laura Cartwright, University of Wollongong

Co-author: Dr Andrew Zammit-Mangion, Dr Nicholas M. Deutscher, University of Wollongong
Dr Andrew Feitz, Geoscience Australia

The detection and quantification of greenhouse-gas fugitive emissions is of both national and global importance. Despite several decades of active research, it remains predominantly an open problem, largely due to model errors and misspecifications that appear at each stage of the flux-inversion processing chain. In 2015, a controlled-methane-release experiment headed by Geoscience Australia was carried out at the CO2CRC Ginninderra site, and a variety of instruments and methods were employed for quantifying the emission rate. In this talk I will present a fully Bayesian approach to atmospheric tomography for inferring the emission rate. The Bayesian framework is designed to account for uncertainty in the measurements, the meteorological data, the temporally varying background concentration, and the atmospheric model itself, when doing inversion using Markov chain Monte Carlo. We show the utility of our approach in detecting and quantifying methane emissions from both point and path instruments, and highlight its ability to reasonably quantify methane emissions in a timely manner, using data collected during the Ginninderra experiment. This work is joint with Andrew Zammit-Mangion, Andrew Feitz, and Nicholas M. Deutscher.

REAL TIME OPTIMISATION OF AIR QUALITY PREDICTIONS FOR AUSTRALIA THROUGH ARTIFICIAL INTELLIGENCE

Ekta Sharma, University of Southern Queensland

Co-author: Dr Ravinesh Deo, Professor Alfio Parisi, University of Southern Queensland
Dr Ramendra Prasad, University of Fiji

Development of practical and efficient air quality regulating mechanisms is indeed a challenge. A pertinent air pollutant responsible for recurrent health-care costs with increased respiratory induced mortality in Australia is Particulate Matter (PM). In such a pressing public health problem, artificial intelligence can provide promising solution via developing models to obtain predictions through novel learning algorithms. This research project, unique in its own kind, focuses on generating real-time air quality forecasts of PM-2.5, PM-10 and the overall lower atmospheric visibility. To establish a robust optimisation model, an online sequential-extreme learning machine (OS-ELM), a powerful artificial intelligence algorithm was integrated with improved empirical mode decomposition with adaptive noise (ICEEMDAN) as a data pre-processing tool. The resulting novel data-driven, hybrid predictive model: ICEEMDAN-OS-ELM registers good predictive ability, particularly appropriate for near real-time forecasts of PM-2.5, PM-10 and visibility at key test sites in Australia. The excellent performance of the OS-ELM hybrid model indicates its suitability as a decision-support systems tool in air quality

monitoring, forecasting and subsequent health risk mitigation. Future study aspires to develop robust predictive frameworks in facilitating air quality strategies in mitigating Australia's public health risks in a coordinated way through advanced practical development of artificial intelligence approaches.

GENERATING MIXED INTEGER PROGRAMMING TEST INSTANCES WITH CHALLENGING PROPERTIES

Simon Bowly, The University of Melbourne

The results of empirical analysis of algorithm performance are highly dependent on the diversity of test instances used. Real-world test sets alone may not fully explore the range of easy and hard cases for a given algorithm. Furthermore, without sufficient diversity in instance properties, it can be difficult to determine the root cause of good or bad algorithm performance. This is particularly true for Mixed Integer Programming (MIP) solvers, where a wide range of strategies are employed even within a single run.

To augment existing test data sets, we use Genetic Algorithms (GAs) to generate test instances with challenging properties. GAs have been used in previous work to produce instances which challenge heuristics for combinatorial problems. This talk highlights two extensions developed to generate new test cases for MIP solvers. The first develops an encoding which restricts the search space to a subset of useful instances. The second chooses in-depth performance metrics relevant to particular components of the solver in order to generate instances from which useful insights can be gained. To demonstrate the method, new test instances are generated which challenge branch variable selection strategies used in the MIP solver SCIP.

WORKSHOP KEYNOTE: SOLUTION METHODS FOR STOCHASTIC MINE PLANNING

Assistant Professor Amina Lamghari, University of Quebec, Canada

In the last 20 years, there has been increasing interest in using advanced optimization techniques to develop and manage mineral resources, to make informed decisions regarding potential risks, and to maximize value and minimize costs while satisfying the various requirements and limitations of the particular operation. More specifically, models that account for geological uncertainty and integrate the various interacting aspects of an operation that were treated separately in the past have been devised. To address such large and complex problems, researchers have employed metaheuristics, or methods combining (meta)heuristics with exact methods or machine learning techniques. The use of these approaches substantially increases the size of the instances that can be solved. This talk presents several of such solution methods.

After receiving a BSc and a Master's in Applied Mathematics, Amina Lamghari obtained a PhD in Operations Research from the University of Montreal, Canada, after which she worked as a post-doctoral fellow and later as a research associate at the COSMO Stochastic Mine Planning Laboratory at McGill University. Amina is currently an assistant professor in the Management School at the University of Quebec. Her research interests are centered on various techniques and algorithms —(meta)heuristics, hyper-heuristics, and matheuristics — for optimization and their integration

and application to solve complex scheduling and planning problems in an efficient manner. All of her work to date has had direct real--world applications. During the last nine years, applications in mine planning have been the main focus of her research, undertaken in response to the needs of the mining industry for more efficient and robust production schedules and operations plans. Many of the algorithms she developed were incorporated in the COSMO Suite software, a platform designed to aid in the dissemination of new stochastic mine planning optimization algorithms, techniques, and models to the mining industry.

NEWTON-MR: NEWTON'S METHOD WITHOUT SMOOTHNESS OR CONVEXITY

Dr Fred Roosta, University of Queensland

Establishing convergence of the classical Newton's method has long been limited to making restrictive assumptions on (strong) convexity. Furthermore, smoothness assumptions, such as Lipschitz continuity of the gradient/Hessian, have always been an integral part of the analysis. In fact, it is widely believed that in the absence of well-behaved and continuous Hessian, the application of curvature can hurt more so that it can help.

Here, we show that two seemingly simple modifications of the classical Newton's method result in an algorithm, called Newton-MR, which can be applied, beyond the traditional convex settings, to invex problems. Newton-MR appears almost indistinguishable from its classical counterpart, yet it offers a diverse range of algorithmic and theoretical advantages.

Furthermore, by introducing a weaker notion of joint regularity of Hessian and gradient, we show that Newton-MR converges globally even in the absence of the traditional smoothness assumptions. Finally, we obtain local convergence results in terms of the distance to the set of optimal solutions. This greatly relaxes the notion of "isolated minimum", which is required for the local convergence analysis of the classical Newton's method.

Numerical examples using several machine learning problems demonstrate the great potentials of Newton-MR compared with several other second-order methods.

A FLEXIBLE APPROACH FOR FINDING THE BEST APPROXIMATION TO THE INTERSECTION OF CONVEX SETS

Dr Minh N. Dao, The University of Newcastle

We propose a flexible approach for computing the resolvent of the sum of weakly monotone operators in real Hilbert spaces from individual resolvents. This relies on splitting methods where strong convergence is guaranteed. We also prove linear convergence under Lipschitz continuity assumption. The approach is then applied to computing the proximity operator of the sum of weakly convex functions, and particularly to finding the best approximation to the intersection of convex sets.

LYAPUNOV FUNCTIONS AND CONVERGENCE OF DOUGLAS-RACHFORD METHOD FOR NON-CONVEX PROBLEMS

Dr Bjorn Ruffer, The University of Newcastle

This talk will apply nonlinear stability analysis techniques to the Douglas-Rachford Algorithm, with the aim of shedding light on the interesting non-convex case, where convergence is often observed but seldom proven. The Douglas-Rachford Algorithm can solve optimisation and feasibility problems, provably converges weakly to solutions in the convex case, and constitutes a practical heuristic in non-

convex cases. Lyapunov functions are stability certificates for difference inclusions in nonlinear stability analysis.

PROBABILISTIC ROBUST ANTI-DISTURBANCE CONTROL OF UNCERTAIN LINEAR SYSTEMS

Peng Cheng, University of Curtin

We propose a novel method for constructing probabilistic robust disturbance rejection control for uncertain systems in which a scenario optimization method is used to deal with the nonlinear and unbounded uncertainties. For anti-disturbance, a reduced order disturbance observer is considered and a state-feedback controller is designed. Sufficient conditions are presented to ensure that the resulting closed-loop system is stable and a prescribed H1 performance index is satisfied. A numerical example is presented to illustrate the effectiveness of the techniques proposed and analyzed.

THE RELATIONSHIPS AMONG COMMITMENT TO CHANGE, COPING WITH CHANGE, AND JOB SATISFACTION

Xiaoli Cao, University of Curtin

The current highly changeable environment and market demands require much more change management in all kinds of organizations, even in universities and colleges. University changes and transformation also require their staff to support and involvement. Due to differences in individual characteristics, teachers' attitudes and behaviors toward to change in the universities lead to different job satisfaction. The purpose of this study is to integrate and expand people-oriented organizational change management by examining the relationship among commitment to change, coping with change, and job satisfaction. On the basis of relevant literature review, the research hypothesis is put forward, and the research model is constructed. Data were collected from 597 teachers of 10 universities undergoing significant organizational change. Results from structural equation modelling indicate that (a) the relationship between affective commitment to change and job performance was fully mediated by coping with change, (b) the relationship between continuance commitment to change and job satisfaction was only partially mediated by coping with change, and (c) normative commitment to change had a direct impact on job satisfaction. Results are discussed in terms of implications for managing universities change.

THE TENSOR COMPLEMENTARITY PROBLEM

Xueli Bai, University of Curtin

As a generalization of the linear complementarity problem and a special case of the nonlinear complementarity problem, recently, the tensor complementarity problem has been investigated in the literature. From theoretical perspective, we study the non-emptiness and compactness of the solution set, the uniqueness of the solution as well as the stability and continuity analysis. And from algorithmically perspective, we focus on designing algorithms for the tensor complementarity problem which beyond algorithmic frameworks designed for general nonlinear complementarity problems. So far, by using properties of structured tensors, many good results for the tensor complementarity problem have been obtained.

MIXED-INTEGER MIN-MAX DYNAMIC OPTIMIZATION AND ITS APPLICATION ON IDENTIFYING DYNAMIC STRUCTURE AND PARAMETERS OF GLYCEROL CONTINUOUS FERMENTATION

Juan Wang, University of Curtin

This paper models glycerol metabolism in continuous fermentation as a nonlinear mixed-integer dynamic system (NMIDS) by defining the time-varying metabolic network structure as an integer-valued function. To identify the dynamic network structure and kinetic parameters, we establish a mixed-integer min-max dynamic optimization (MIMMDO) problem with concentration robustness as objective functional. By direct multiple shooting strategy and a decomposition approach consisting of convexification, relaxation and rounding strategy, the MIMMDO problem is transferred into an approximated multistage parameter optimization problem with a large number of variables, which is further solved through a competitive particle swarm optimization (CPSO) algorithm. We also prove that the relaxation problem yields the best lower bound for the MIMMDO problem, and its solution can be arbitrarily approximated by the solution obtained from rounding strategy. Numerical results indicate that the presented NMIDS can better describe cellular self-regulation and response to inhibitions of intermediate metabolites in continuous fermentation of glycerol. Our proposed numerical methods are proved to be effective in solving the large-scale MIDO problem.

RESEARCH ON LOSS ANALYSIS OF POWER DISTRIBUTION NETWORK AND AUXILIARY DECISION-MAKING TECHNOLOGY OF LOSS REDUCTION AND EFFICIENCY INCREASE

Jie Liu, University of Curtin

The multi-time scale calculation and analysis of the power loss of distribution network are carried out by using the massive data collected by the new smart meter. In addition, big data mining technology and machine learning are applied to the analysis and prediction of distribution network loss to reveal the changing rules between the distribution network loss and the electrical/ non-electrical influence factors. Firstly, data cleaning is carried out on the collected data. Outliers are detected by the local factor algorithm based on k-means clustering pruning, and abnormal data are identified and set as vacant values. The missing values are then filled in together with other uncollected data. In view of the complex situation of data missing and the poor effect of the commonly used filling methods, the Random Forest algorithm was improved for missing data imputation, and other filling methods were compared for the data with different loss rates. This imputation algorithm based on Random Forest has high accuracy in filling effect, better robustness and generalization ability. Using the Pearson correlation, the Random Forest's features importance rank, MIC (Maximal Information Coefficient), with methods of grey correlation analysis to find out the influential factors that have strong correlation with the distribution network loss. The similarity clustering of the distribution network loss is done before the strongly correlated influencing factors and historical time series data are input into LSTM (Long Short-Term Memory) neural network. The network losses are clustered into different categories, and the network losses are predicted separately under each category. Here, the Stacking is adapted by inputting the output of the previously trained models (such as 5 LSTM models) to the second layer model, so as to obtain the final prediction results. This model can gather the advantages of previous training models, and can improve the prediction accuracy. The research result will be of great guidance to the implementation of practical comprehensive loss reduction and efficiency

improvement from the perspective of the overall operation of the distribution network. For example, provide the optimization decision for arranging the load access and distribution reasonably and planning of equipment modification.

AN ENSEMBLE DYNAMIC METABOLIC FLUXES MODELLING OF GLYCEROL METABOLISM IN KLEBSIELLA PNEUMONIAE

Jianxiong Ye, University of Curtin

Modelling of intracellular dynamics is helpful for understand cellular metabolism. In this talk, we will introduce some basic problems faced in modelling cellular metabolism. Some existing approach will be reviewed, and an example will be given to illustrate how to simulate the intracellular fluxes dynamically.

OPTIMIZATION OF IMPEDANCE MATCHING NETWORK IN WIRELESS POWER TRANSFER SYSTEM

Yuanyuan Liu, University of Curtin

Maximum efficiency transfer (MET) is an important research in the practical application of a wireless power transfer (WPT) system. The impedance matching network on the receiving side plays a very important role in converting the dynamic load impedance to the optimal impedance to achieve MET control in WPT system. The nonlinearity of the rectifier bridge circuit has a significant impact on the transmission characteristics of the system, and the impedance matching network designed based on the pure resistive equivalent rectification load will also lead to inevitable errors. According to the optimal load theory of WPT system in MET control, this paper analyzes the nonlinear characteristics of the rectifying load, and optimizes the design method of T-type impedance matching network. Finally, the effectiveness of the optimization method is verified by simulation and experiments.

ROBUST REAL-TIME OPTIMIZATION FOR BLENDING OPERATION OF ALUMINA PRODUCTION

Lingshuang Kong, University of Curtin

The blending operation is a key process in alumina production. The real-time optimization (RTO) of finding an optimal raw material proportioning is crucially important for achieving the desired quality of the product. However, the presence of uncertainty is unavoidable in a real process, leading to much difficulty for making decision in real-time. This paper presents a novel robust real-time optimization (RRTO) method for alumina blending operation, where no prior knowledge of uncertainties is needed to be utilized. The robust solution obtained is applied to the real plant and the two-stage operation is repeated. When compared with the previous intelligent optimization (IRTO) method, the proposed two-stage optimization method can better address the uncertainty nature of the real plant and the computational cost is much lower. From practical industrial experiments, the results obtained show that the proposed optimization method can guarantee that the desired quality of the product quality is achieved in the presence of uncertainty on the plant behavior and the qualities of the raw materials. This outcome suggests that the proposed two-stage optimization method is a practically significant approach for the control of alumina blending operation.

DAY 5: FRIDAY 21 JUNE 2019

0830 - 0900	REGISTRATION - TEA & COFFEE
0900 - 0930	**Keynote:** Optimization of Forest Industry Operations **Professor Rafael Epstein** Universidad de Chile
0930 - 1000	
1000 - 1030	Integrated Water Balance Optimisation at Roy Hill **Dr Giovanni Firmani**, Roy Hill Iron Ore
1030 - 1100	MORNING TEA
1100 - 1130	Potential flow of fluid from an elevated, two-dimensional source **Shaymaa Shraida**, Murdoch University
1130 - 1200	Model predictive control and distributed optimization in the context of smart grids **Dr Philipp Braun**, University of Newcastle
1100 - 1130	Potential flow of fluid from an elevated, two-dimensional source **Shaymaa Shraida**, Murdoch University
1130 - 1200	Model predictive control and distributed optimization in the context of smart grids **Dr Philipp Braun**, University of Newcastle
1200 - 1215	A knowledge management system for emergency management **Chunjuan Li**, Curtin University
1215 - 1230	Energy saving optimal and numerical simulation of new car engine vane pump **Chuanlai Yuan**, Curtin University
1230 - 1245	Research progress on energy utilization of agricultural waste in China:bibliometric analysis based on citespace, **Jiapei Wei**, Curtin University
1245 - 1300	Convergence analysis of parallel block alternating direction method of multipliers family of nonconvex problems, **Ya-zheng Dang**, Curtin University
1300 - 1330	LUNCH
1330 - 1345	Optimization of Dynamic Motorway Traffic with Distributionally Robust Joint Chance Constraints via Ramp Metering, **Chuanye Gu**, Curtin University
1345 - 1400	Research on Synergistic Innovation Mechanism of Fintech and Regtech on Balancing Efficiency and Risk, **Xiumei Lyu**, Curtin University
1400 - 1415	An efficient NLP-based Specification Recognition Method for 2D Road CAD Drawing Compliance Checking System, **Chongyi Liu**, Curtin University
1415 -1430	Event-triggered mixed control for Markov jump systems with time delay and input nonlinearity, **Yanyan Yin**, Curtin University

DAY 5 – Friday 21 June

WORKSHOP KEYNOTE: OPTIMIZATION OF FOREST INDUSTRY OPERATIONS

Professor Rafael Epstein, Universidad de Chile

We present optimization systems oriented to improve the operational performance of large forest companies. The first system optimizes truck log transportation, the second is oriented to optimally coordinate harvesting operational decisions in a year horizon, and the third one is a GIS system integrated with a heuristic procedure to optimize road design and harvesting machinery location for forest extraction operation.

Professor Epstein is an Industrial Engineer from Universidad de Chile, with a PhD in Operations Research awarded by MIT. His work has had an important impact in the improvement of the planning and the operations in the forest and the mining industries, as well as in important public tenders. He has published his work in the best journals in the area as well as in specialized books, for which he has received multiple awards and recognitions, such as the Franz Edelman Prize in 1998 given by the Institute for Operations Research and Management Sciences (INFORMS) for his work in the forest industry, the OR for Development Prize in 2002 given by the International Federation of Operation Research Societies (IFORS) for his work in large-sized tender mechanisms, the ENRE Prize for the best natural resources paper in both mining and forestry, the Chilean Innovator of the Year in 2008, and the Best Work in Engineering Prize in 2011 given by the School of Engineering of Chile for his work in logistics optimisation for the shipping industry. In addition, he has taught and formed many academics and professionals in the field of Engineering.

INTEGRATED WATER BALANCE OPTIMISATION AT ROY HILL

Dr Giovanni Firmani, Roy Hill Iron Ore

Water management is an integral part of operations at the Roy Hill mine. The water balance can be described in terms of tasks, including dewatering, water treatment, ore processing, tailing storage facility (TSF), dust suppression and surplus water disposal. The opportunity exists to optimise the cost and water footprint of the operation through integration of the water balance tasks.

The prediction of the water use is generally analysed by modelling the abovementioned tasks individually. However, the achievement of an optimal water balance plan is complex when, for example, the dewatering predictions, that are highly variable in terms of both volume and quality, may be at times in conflict with water demands for ore processing.

The purpose of this work was to optimisation the cost and water footprint of water management by analysing the results of each modelling task and evaluate the presence of critical scenarios for the future with an automated and mathematically rigorous tool. In this work, we describe the development of a software application that integrates the results of each modelling task, providing the optimal utilisation of water.

POTENTIAL FLOW OF FLUID FROM AN ELEVATED, TWO_DIMENSIONAL SOURCE

Shaymaa Shraida, Murdoch University

When fluid is pumped from an elevated source it flows downward and then outward once it hits the base. In this talk we consider a simple two dimensional model of flow from a single line source elevated above a horizontal base and consider its downward flow into a spreading layer on the bottom. A hodograph solution and linear solutions are obtained for high flow rates and full nonlinear solutions are obtained over a range of parameter space. It is found that there is a minimum flow rate beneath which no steady solutions exist. Overhanging surfaces are found for a range of parameter values. This flow serves as a model for a two-dimensional water fountain, or approximates a similar flow in a density stratified environment.

MODEL PREDICTIVE CONTROL AND DISTRIBUTED OPTIMIZATION IN THE CONTEXT OF SMART GRIDS

Dr Philipp Braun, The University of Newcastle

The energy transition, from a centralized to a decentralized and sustainable power supply using small scale power plants, presents new challenges to the distribution grid provider who is responsible for maintaining the stability of the electricity network. New procedures to ensure the overall network performance need to be developed, which are flexible with respect to the underlying network and scalable, to be able to handle the amount of data of a fast growing network of renewable energy sources. In this talk we examine model predictive control (MPC) and hierarchical distributed optimization schemes to tackle these challenges. In particular, we use a network of residential energy systems (RESs), connected to a grid provider through a point of common coupling, where every resident is equipped with local generators and local storage devices to examine hierarchical distributed optimization algorithms with a focus on flexibility (plug and play capability), scalability and convergence. The performance of the distributed optimization schemes embedded in the MPC closed loop are analyzed and illustrated through numerical simulations.

A KNOWLEDGE MANAGEMENT SYSTEM FOR EMERGENCY MANAGEMENT

Chunjuan Li, Curtin University

Over the last two decades, disaster losses remain substantial because of increasing frequently of disasters. Man-made and natural emergencies cannot be prevented, but they can be better managed. The use of knowledge management (KM) and knowledge management system (KMS) functions for emergency management (EM) is supported and recommended by existing literature. KMS can play an important role in improving the speed and quality of response actions. The KMS Success Model is useful in the broad organizational context of KMS implementation. However, the model requires modification to match the unique nature of emergency situations. Based on KMS Success Model, this paper seeks to emphasize that a KMS for emergency management must incorporate features that enable role changes and allow people to access changes based on the situational requirement.

Energy saving optimal and numerical simulation of new car engine vane pump

Chuanlai Yuan, Curtin University

In this paper, optimization of new car engine lubrication system was discussed in our study. It concluded key analysis of noise pump energy, optimal control strategy of the pump, optimal allocation of real-time detection and sensor pump working parameters. Fuel consumption and operating noise relationship model was built for energy saving and noise reduction as well as energy-saving pump optimization model, which was proposed for solving an effective energy-saving optimization model. Discussion formed a more perfect pump optimization and energy saving noise control method for automotive engine energy saving. In our study, low-power car motor lubrication system consisted of energy noise vane pump was studied. Advanced optimization control theory was used in automotive motor lubrication system, the study of new energy-saving car pump noise optimal control strategy and oil pump working parameters achieved real-time detection and sensor optimize configuration. We built oil fuel with operating noise and working parameters of the relational model for energy-saving and noise reduction, it proposed an energy smart kinds of effective optimization model for forming a more perfect energy-optimized pump control system.

Research progress on energy utilization of agricultural waste in China: bibliometric analysis based on citespace

Jiapei Wei, Curtin University

When I hold the meeting notice, I was thinking about the following questions: What topic am I good at? I work at a business school and do my research on resource management. What topics are you interested in? All of you are from around the world, focus on mathematics. I need to find something in common.so that I can exchange ideas and insights with you. After a period of observation. I found that everyone is doing a same thing every day, that is, writing articles. Writing an article is start with a review. So citespace is come to me.

Citespace is a bibliometric software. It was developed by Dr. Chaomei Chen, whom is a tenured professor at drexel university. It helps researchers identify scientific literature, discover new trends and developments in scientific development.

The first time I contact with citespace is at the time I'm reading Dr. Chen's paper by chance. It was a paper on the field of Regeneration Medicine. It was published on Expert Opinion in May 2012.In this paper, Dr. Chaomei Chen systematically reviews the totally unfamiliar research field of "regenerative medicine" with the help of CiteSpace. In order to test the extent to which CiteSpace tools and methods allow a person without relevant expertise to give a valuable overview. Finally, with structural and temporal indicators in the CiteSpace software, professor chaomei Chen identified two papers having excellent performance and important influence in the field of "regenerative medicine". The papers were written by shinya yamanaka's team from Kyoto university in Japan. By coincidence, five months after their publication, yamanaka won the 2012 Nobel Prize in physiology for the two papers.

Although our research fields are diverse and our language and culture are quite different, there are also some common things worth discussing together. That's why I chose to share citespace.

Citespace application example: A review on comprehensive utilization of agricultural resources in China from 1999 to 2018

Convergence analysis of parallel block alternating direction method of multipliers family of nonconvex problems

Ya-zheng Dang, Curtin University

The alternating direction method of multipliers (ADMM) is widely used to solve large-scale linearly constrained optimization problems, convex or nonconvex, in many engineering fields. However there is a general lack of theoretical understanding of the algorithm when the objective function is nonconvex. its theoretical convergence guarantee is still an open problem. In this paper we analyze the convergence of the ADMM for solving certain nonconvex consensus problems. We show that the classical ADMM converges to the set of stationary solutions, provided that the penalty parameter in the augmented Lagrangian is chosen to be sufficiently large and the objective function satisfies some conditions. In the problem, the objective is nonconvex and possibly nonsmooth. Our analysis does not impose any assumptions on the iterates generated by the algorithm as previous corresponding research, and flexible selection in the flexible block is employs in the process.

Optimization of Dynamic Motorway Traffic with Distributionally Robust Joint Chance Constraints via Ramp Metering

Chuanye Gu, Curtin University

This paper develops a distributionally robust joint chance constrained optimization model for motorway management. The optimization aims to minimize motorway delay via ramp metering with consideration of uncertainties in traffic demand and road capacity. The major contribution of this paper is to propose an approach to approximate a joint chance-constrained Cell Transmission Model based motorway optimization with only partial distributional information of uncertain demand and capacity. The resultant formulation is a semidefinite program. Some numerical experiments are conducted to demonstrate that the proposed approximation approach is efficient. The proposed approximation approach may provide useful insights and have broader applicability in traffic management and traffic planning problems under uncertainty.

Research on Synergistic Innovation Mechanism of Fintech and Regtech on Balancing Efficiency and Risk

Xiumei Lyu, Curtin University

In view of the fact that China's Regtech is too lagging behind the Fintech innovation and therefore brings about some prominent problems such as regulatory loopholes, time-lag mismatches and increased financial risks, I study the synergistic innovation mechanism of Regtech and Fintech, and the use of Fintech to enhance Regtech. Through the synergistic innovation mechanism, it can ensure that Fintech can achieve sustainable and healthy development in the direction of improving financial service efficiency under the premise of risk control. Furthermore, it can solve the problem that lack of motivation and ability when Fintech authorities independently develop and use Regtech to enhance supervision.

An efficient NLP-based Specification Recognition Method for 2D Road CAD Drawing Compliance Checking System

Chongyi Liu, Curtin University

2D computer-aided design (CAD) drawing compliance checking requires related specialists to do significant amount of workload. To save time and improve productivity, program-based CAD drawing compliance checking systems were introduced. However, they need people to input specifications manually which is time consuming and errors prone. This article introduces an NLP (Natural Language Processing) method to recognize and understand the official specification documents of 2D CAD. It uses up-to-date Convolutional Neural Network (CNN) algorithm to extract all related information from the documents. Also, a serial of test methods will be used to verify if the design complies with the specifications and standards in the documents. Thus, a complete automated road CAD drawing compliance checking system will be developed.

Event-triggered mixed control for Markov jump systems with time delay and input nonlinearity

Yanyan Yin, Curtin University

In this paper, the problem of event-triggered mixed H-infinity and passive control for a class of time delay stochastic Markov jump systems subject to input constraint is addressed. In order to reduce network burden, a useful event-triggered scheme is proposed. Then, due to network induced delays, a time-delay model analysis approach is used to reconstruct the system. Analysis and design methods of the state feedback event-triggered controller are derived to ensure that the resulting system is stochastically stable and satisfies mixed H-infinity and passive performance index. Sufficient conditions are obtained in terms of liner matrix inequalities. Finally, a numerical example is given to illustrate the effectiveness of the proposed approach.