Workshop on Optimisation, Metric Bounds, Approximation, and Transversality VII

WOMBAT 2022

Centre for Optimisation and Decision Science

Curtin University, Perth

Contents

About

The seventh Workshop on Optimisation, Metric Bounds, Approximation and Transversality will be held 13–15 December 2022 in Perth, Western Australia, in tandem with an industry-focused day on 16 December. This joint event will be hosted at Curtin University by Curtin Centre for Optimisation and Decision Science.

Covid Policy

Depending upon the medical needs of our diverse participants, and the evolving COVID situation, you may be asked to wear a mask at certain times during the event.

Travel

Information about travel to Australia is available at:
`https://www.australia.gov.au/travelling-to-australia`.

Information about international travel to the state of Western Australia is available at:
`https://www.wa.gov.au/government/covid-19-coronavirus/covid-19-coronavirus-information-travellers`

Apply early if you require a visa.

Organizing committee

Dr. Hoa T. Bui	Local Organiser, Curtin Centre for Optimisation and Decision Science
Dr. Scott B. Lindstrom	Local Organiser, Curtin Centre for Optimisation and Decision Science
Natasha Bartlett	Local Organiser for Industry Day, Curtin University
Dr. Matt Tam	Student Support Committee chair, The University of Melbourne
Prof. Andrew C. Eberhard	Student Support Committee co-chair, RMIT University
Prof. Alex Kruger	MoCaO treasurer

Sponsors

Facilities and catering support is provided by Centre for Optimisation and Decision Science at Curtin University. Support for the WOMBAT-ARC Training Centre Joint Day is provided by ARC Training Centre for Transforming Maintenance through Data Science. The WOMBAT student support scheme is provided by the Australian Mathematical Society special interest group Mathematics of Computation and Optimisation (MoCaO).

Timetable

CT: Contributed Talk, PL: Plenary, IS: International Speaker.

Tuesday, 13 December

9:00–9:45	**Registration and morning tea**		
9:45–10:00	**Welcome remarks**		
10:00–10:30	CT	**Guoyin Li** UNSW	Proximal methods for nonsmooth and nonconvex fractional programs: when sparse optimization meets fractional programs
10:30–11:00	CT	**Reinier Diaz Millan** Deakin University	Applications and Issues in Abstract Convexity
11:00–11:30	CT	**Daniel Uteda** U. Melbourne	First Order Methods for Minmax Optimisation
11:30–12:00	CT	**Erchuan Zhang** Edith Cowan University	Finding Extremals of Lagrangian Actions
12:00–13:00	**Lunch**		
13:00–14:00	PL	**Warren Hare** UBC Okanogan	Approximations in Model-based Blackbox Optimization
14:00–14:30	IS	**Godai Azuma** Tokyo Institute of Technology	Exactness conditions for SDP relaxation of bipartite-structured and sign-indefinite QCQPs
14:30–15:00	**Afternoon Tea**		
15:00–15:30	CT	**Andrew Eberhard** RMIT University	Representative Functions, Variational Convergence and Almost Convexity
15:30–17:00	**Collaboration Time**		

Wednesday, 14 December

9:00–9:30	CT	**Hoa Bui** CODeS, Curtin U.	Single-Projection Procedure for Infinite Dimensional Convex Optimization Problems
9:30–10:00	IS	**Stephanie Caro Torres** U. Chile and U. Alicante	Discretization and reduction of Infsup and SIP optimization problems
10:00–10:30	**Morning Tea**		
10:30–11:00	CT	**Matt Tam** U. Melbourne	Shadow Douglas-Rachford Splitting
11:00–11:30	CT	**Bethany Caldwell** U. South Australia	Splitting and projection methods for control-constrained linear-quadratic optimal control problems
11:30–12:00	CT	**Alexander Kruger** Federation University	The Radius of Metric Regularity Revisited
12:00–13:00	**Lunch**		
13:00–14:00	PL	**Natashia Boland** CODeS, Curtin U.	Time Discretization in Integer Programming (via zoom)
14:00–14:30	IS	**Tianxiang Liu** Tokyo Institute of Technology	Doubly majorized algorithm for sparsity-inducing optimization problems with regularizer-compatible constraints
14:30–15:00	**Afternoon Tea**		
15:00–15:30	IS	**Alberto De Marchi** UniBw Munich	An Interior Proximal Gradient Method for Nonconvex Optimization
15:30–16:00	CT	**Dmytro Matsypura** U. Sydney	Finding the most degree-central walks and paths in a graph: exact and heuristic approaches
16:00–17:00	**Collaboration Time**		

Thursday, 15 December

9:30–10:00	CT	**Sandy Speers** Curtin U.	An exact cutting plane method for solving p-dispersion-sum problems with Euclidean distance
10:00–10:30	**Morning Tea**		
10:30–11:00	CT	**Vera Roshchina** UNSW	Some cones are particularly nice, but how nice exactly?
11:00–11:30	CT	**Alexander Lim** U. Queensland	Inexact Non-convex Newton-MR
11:30–12:00	CT	**Mareike Dressler** UNSW	Global Optimization via the Dual SONC Cone and Linear Programming
12:00–13:00	**Lunch**		
13:00–14:00	PL	**Peter Stuckey** U. Melbourne	Discrete optimisation for Maintenance scheduling
14:00–14:30	CT	**Scott B. Lindstrom** CODeS, Curtin U.	Optimal error bounds in the absence of constraint qualifications for conic problems
14:30–15:00	**Afternoon Tea**		
15:00–17:00	**Collaboration Time**		

List of Abstracts – Talks

Tuesday 13 December

Proximal methods for nonsmooth and nonconvex fractional programs: when sparse optimization meets fractional programs

Guoyin Li

UNSW Sydney

Nonsmooth and nonconvex fractional programs are ubiquitous and also highly challenging. It includes the composite optimization problems studied extensively lately, and encompasses many important modern optimization problems arising from diverse areas such as the recent proposed scale invariant sparse signal reconstruction problem in signal processing, the robust Sharpe ratio optimization problems in finance and the sparse generalized eigenvalue problem in discrimination analysis. In this talk, we will introduce extrapolated proximal methods for solving nonsmooth and nonconvex fractional programs and analyse their convergence behaviour. Interestingly, we will show that the proposed algorithm exhibits linear convergence for sparse generalized eigenvalue problem with either cardinality regularization or sparsity constraints. This is achieved by identifying the explicit desingularization function of the Kurdyka-Łojasiewicz inequality for the merit function of the fractional optimization models. Finally, if time permits, we will present some preliminary encouraging numerical results for the proposed methods for sparse signal reconstruction and sparse Fisher discriminant analysis.

Applications and issues in abstract convexity

Reinier Diaz Millán

Deakin University

The theory of abstract convexity, also known as convexity without linearity, is an extension of classical convex analysis. There are a number of remarkable results, mostly concerning duality, and some numerical methods, however, this area has not found many practical applications yet. In this paper, we study the application of abstract convexity to function approximation. Another important research direction addressed in this paper is the connection with the so-called axiomatic convexity.

First Order Methods for Minmax Optimisation

Daniel Uteda

University of Melbourne

The point-wise maximum of finitely many smooth functions is ubiquitous in convex optimisation, since many non-smooth functions can be written in this form. However, since this maximum is non-differentiable, standard first order methods are unavailable. In this talk, we discuss how to exploit the differentiability of the functions inside the maximum by reformulating the non-smooth convex minimisation problem as a smooth saddle point problem. Even if each function has a globally Lipschitz continuous gradient, this is not preserved in the saddle formulation, and so we apply several methods for variational inequalities which only assume local Lipschitz continuity. In particular, the celebrated adaptive Golden RAtio ALgorithm (aGRAAL), which approximates the inverse of a local Lipschitz constant fully explicitly, ie, without backtracking. We therefore compare the aGRAAL against other established methods. Time permitting, we will discuss applications in wireless sensor networks, optimal recovery for PDEs, signal processing, and support vector classification.

Finding Extremals of Lagrangian Actions

Erchuan Zhang

Edith Cowan University

Given a smooth m-manifold M, a smooth Lagrangian $L : TM \to \mathbb{R}$ and endpoints $x_0, x_T \in M$, we look for an extremal $x : [0,T] \to M$ of the action $\int_0^T L(x(t), \dot{x}(t))dt$ satisfying $x(0) = x_0$ and $x(T) = x_T$. When interpolating between endpoints, this amounts to a 2-point boundary value problem for the Euler-Lagrange equation. In this talk, by dividing the interval $[0,T]$ into several sub-intervals, on which extremals can be found efficiently by shooting when good initial guesses are available from the geometry of a variational problem, we then adjust all junctions by finding zeros of vector fields associated with the velocities at junctions with Newton's method. We discuss the cases where L is the difference between kinetic energy and potential, M is a hypersurface in Euclidean space, or M is a Lie group. We make some comparisons in numerical experiments for a double pendulum, for obstacle avoidance by a moving particle on the 2-sphere, and for obstacle avoidance by a planar rigid body. This talk is based on joint work with Prof. Lyle Noakes (UWA).

Approximations in Model-based Blackbox Optimization

Warren Hare PL

University of British Columbia

A blackbox is a function that provides output without explanation of how the output was constructed. One common strategy for optimization involving blackbox functions is to numerically approximate gradients, sub-gradients, and/or Hessians and use these approximations in a classical method. In this talk, we discuss classical and novel approximation techniques for blackbox functions. We further illustrate the use of such techniques within blackbox optimization algorithms. Based on joint work with Yiwen Chen, Gabriel Jarry-Bolduc, Chayne Planiden, and Kashvi Sravastava.

Exactness conditions for SDP relaxation of bipartite-structured and sign-indefinite QCQPs

Godai Azuma IS

Tokyo Institute of Technology

For nonconvex quadratically constrained quadratic programs (QCQPs), we propose sufficient conditions under which the SDP relaxation can recover an optimal solution of a given QCQP whose aggregated sparsity pattern graph is bipartite. Nonconvex QCQPs are well-known to be NP-hard in general; however, when the rank of an optimal solution of dual SDP relaxation is large enough under the strong duality, the primal SDP relaxation has a rank-1 solution and it can recover an optimal solution of the QCQP. Recently, based on this idea, the exactness conditions for QCQPs with forest and arrow-structured sparsity structures have been proposed. Our result generalizes them in the sense that the applicable sparsity was extended to bipartite graphs. In addition, we prove that our condition covers one of existing exactness conditions for the SDP relaxation of sign-definite QCQPs in which the set of elements at the same index in all the data matrices is either all nonnegative or all nonpositive. This result is based on a conversion method from QCQPs with no specific sparsity to ones with bipartite sparsity which admit the exact SDP relaxation. We also provide instances of QCQPs such that although it is not sign-definite, our condition can detect its exactness.

Representative Functions, Variational Convergence and Almost Convexity

Andrew Eberhard

RMIT University

We develop a new epi-convergence based on the use of *bounded* convergent nets on $X \times X^*$, in the product topology of the strong on X and weak* on X^* (denoted $s \times \mathrm{w}^*$), where X is a general real Banach space. We study the propagation of the associated variational convergences through conjugation based on the pairing of $\sigma_{s\times \mathrm{w}^*}(X \times X^*)$ with $\sigma_{\mathrm{w}^* \times s}(X^* \times X)$. These results are then applied to problem of construction of a bigger-conjugate representative functions for the recession operator $\mathrm{rec}\, M$ associated with a maximal monotone operator $M : X \rightrightarrows X^*$. This is then used to study the relationship of $\mathrm{rec}\, M$ to the maximal monotone operator $N_{\overline{\mathrm{co}}\, \mathrm{dom}\, M}$ and its relationship to the almost convexity property.

Wednesday 14 December

Single-Projection Procedure for Infinite Dimensional Convex Optimization Problems

Hoa Bui

Centre for Optimisation and Decision Science, Curtin University

we consider a class of convex optimization problems in a real Hilbert space that can be solved by performing a single projection, i.e., by projecting an infeasible point onto the feasible set. Our results improve those established for the linear programming setting in Nurminski (2015) by considering problems that: (i) may have multiple solutions, (ii) do not satisfy strict complementary conditions, and (iii) possess non-linear convex constraints. As a by-product of our analysis, we provide a quantitative estimate on the required distance between the infeasible point and the feasible set in order for its projection to be a solution of the problem. Our analysis relies on a "sharpness" property of the constraint set; a new property we introduce here.

Discretization and reduction of Infsup and SIP optimization problems

Stephanie Caro Torres

IS

Universidad de Chile and University of Alicante

Infsup convex optimizations problems in $\mathbb{R}^n$ are shown to be discretizable and reducible to smaller infsup problems involving at most $n+1$ functions. The maximum in the initial problem is taken over an arbitrary (possibly infinite) family of convex extended real-valued functions indexed on a Hausdorff compact set and verifying a mere lower semi-continuity property, which in particular is satisfied by lower semi-continuous functions. Reformulations of SIP problems into Infsup problems will allow discretizations and reductions to smaller infsup problems, which are in turn written as smaller SIP problems when additional (Slater) conditions are applied. As an illustration, we give some new expressions for the subdifferential of the supremum function that are based only on the subdifferential of at most $n+1$ active functions.

Shadow Douglas-Rachford Splitting

Matt Tam

University of Melbourne

In this talk, I will introduce the shadow Douglas-Rachford method for finding a zero in the sum of two monotone operators where one is assumed to be single-valued and Lipschitz continuous. This algorithm naturally arises from a non-standard discretisation of a continuous dynamical system associated with the Douglas–Rachford splitting algorithm. More precisely, it is obtained by performing an explicit, rather than implicit, discretisation with respect to one of the operators involved. Each iteration of the proposed algorithm requires the evaluation of one forward and one backward operator.

Splitting and projection methods for control-constrained linear-quadratic optimal control problems

Bethany Caldwell

University of South Australia

Splitting and projection-type algorithms have been applied to many optimization problems due to their simplicity and efficiency but the application of these algorithms to optimal control is less common. In this talk we utilize these methods to solve control-constrained linear-quadratic optimal control problems. Instead of the traditional approach where we discretize the problem and solve it using large-scale finite-dimensional numerical optimization techniques we split the problem in two and use projection methods to find a point in the intersection of the solution sets of these two subproblems hence giving the solution to the original problem. Promising numerical results with this approach for a double integrator problem have been illustrated in [1]. Here we will extend this work to more general control-constrained linear-quadratic optimal control problems and provide numerical results and comparisons using the Method of Alternating Projections, Dykstra's algorithm, Douglas–Rachford algorithm and Aragón Artacho–Campoy algorithm.

[1] H. H. Bauschke, R. S. Burachik, and C. Y. Kaya. Constraint splitting and projection methods for optimal control of double integrator In Splitting Algorithms, Modern Operator Theory, and Applications. H. H. Bauschke et al., Springer, 2019."

The Radius of Metric Regularity Revisited

Alexander Kruger

Federation University

We extend the 2003 radius of metric regularity theorem by Dontchev, Lewis & Rockafellar by providing an exact formula for the radius with respect to Lipschitz continuous perturbations in general Asplund spaces, thus, answering affirmatively an open question raised twenty years ago by Ioffe. In the non-Asplund case, we give natural upper bounds for the radius complementing the conventional lower bound in the theorem by Dontchev, Lewis & Rockafellar.

Time Discretization in Integer Programming

Natashia Boland PL

Centre for Optimisation and Decision Science, Curtin University

Optimization problems in which the critical decisions concern the timing of activities are pervasive in real-world applications. For example, in less-than-truckload logistics, consolidation opportunities are only realized if the goods to be consolidated are available at the same time. In path planning in networks subject to congestion, the travel time along an arc can differ by the time at which the travel starts; carefully accounting for this is important in minimizing travel duration. In vendor-managed inventory situations, in which vendors replenish customers using delivery routes and the customer demand evolves in continuous time, keeping track of the timing of vehicle arrivals at customers is needed to ensure the customer does not run out of inventory at any point in time.

Optimization of timing decisions has, in the past, been done successfully with the assistance of time-expanded networks. To construct these networks, time is discretized. Such discretization is usually done a priori, and then an integer programming (IP) model solved over the resulting network. This has been successful because IP models based on time discretization are usually quite strong. Unfortunately, discretization introduces approximation. If the discretization is too coarse, solutions to the discretized model may be either suboptimal, or unobtainable, depending on how the approximation is made. But if the discretization is too fine, the networks become too large, and the IPs become intractable.

In recent years, the idea of dynamic generation of the time-expanded network has emerged, and algorithms that seek to iteratively generate only the discrete time points needed to obtain optimal solutions, and to prove their optimality, have been developed. Dubbed Dynamic Discretization Discovery (DDD), the paradigm has so far shown itself to be both powerful, and flexible. This talk will explain the key concepts of the DDD paradigm, describe how specific algorithms for selected optimization problems have been designed, and identify some of the frontiers of this line of research.

Doubly majorized algorithm for sparsity-inducing optimization problems with regularizer-compatible constraints

Tianxiang Liu IS

Tokyo Institute of Technology

We consider a class of sparsity-inducing optimization problems whose constraint set is regularizer-compatible. By exploiting absolute-value symmetry and other properties in the sparsity-inducing regularizer, we propose a new algorithm, called the Doubly Majorized Algorithm (DMA). Without invoking any commonly used constraint qualification conditions, we show that the sequence generated by DMA clusters in a new stationary point, which we define as inspired by the notion of L-stationarity. Finally, numerical performance of DMA on variants of ordered LASSO is also illustrated.

An Interior Proximal Gradient Method for Nonconvex Optimization

Alberto De Marchi IS

UniBw Munich

We consider composite minimization problems subject to smooth inequality constraints and present a flexible algorithm that combines interior point (IP) and proximal gradient schemes. While traditional IP methods cannot cope with nonsmooth objective functions and proximal algorithms cannot handle complicated constraints, their combined usage is shown to successfully compensate the respective shortcomings. We provide a theoretical characterization of the algorithm and its asymptotic properties, deriving convergence results for fully nonconvex problems, thus bridging the gap with previous works that successfully addressed the convex case. Our interior proximal gradient algorithm benefits from warm starting, generates strictly feasible iterates with decreasing objective value, and returns after finitely many iterations a primal-dual pair approximately satisfying suitable optimality conditions.

Joint work with Andreas Themelis. Preprint at arXiv:2208.00799.

Finding the most degree-central walks and paths in a graph: exact and heuristic approaches

Dmytro Matsypura

The University of Sydney

In network analysis, node centrality is used to quantify the importance of a node to the structure of the network. One of the most natural and widely used centrality measures is degree centrality, defined as the number of nodes adjacent to a given node. A simple generalization of this concept that arises in many real-life applications is to consider the centrality of node groups, including subgraphs with specific connectivity properties. In this paper, we consider the problem of finding the most central walk in a network, where the centrality of the walk is given by the size of its immediate neighborhood.

We begin with the problem of finding the most central shortest path and show that this problem can be solved in polynomial time. We then focus on finding other types of most central walks, such as general walks, trails, paths, and induced paths of some pre-defined length. We demonstrate that in contrast to the most central shortest path problem, these problems are NP-hard. We propose two types of linear MIP formulations to solve these problems exactly that rely on two interpretations of a walk: a sequence of visited nodes and a sequence of traversed edges. In addition, we develop two heuristic algorithms and demonstrate their effectiveness by comparing them with the exact solutions obtained using MIPs; we also exploit heuristic solutions to warm-start the MIP solver. Finally, we test our solution approaches using synthetic and real-life networks in an extensive computational study, which allows us to provide some interesting insights and observations.

Thursday, 15 December

An exact cutting plane method for solving p-dispersion-sum problems with Euclidean distance

Sandy Spiers

Curtin University

We answer an open question recently posed in the literature, that is to find a fast exact method for solving the p-dispersion-sum problem (PDSP), a nonconcave quadratic binary maximization problem. We show that, since the Euclidean distance matrix defining the quadratic term in (PDSP) is always conditionally negative definite, the cutting plane method is exact for (PDSP) even in the absence of concavity. As such, the cutting plane method, which is primarily designed for concave maximisation problems, converges to the optimal solution of the (PDSP). The numerical results show that the method outperforms other exact methods for solving (PDSP), and can solve to optimality large instances of up to two thousand variables.

Some cones are particularly nice, but how nice exactly?

Vera Roshchina

University of New South Wales Sydney

I would like to entertain everyone with some particularly nice properties of hyperbolicity cones, and new intriguing questions related to amenability and the facial structure of convex cones in general.

The work is based on collaboration with Bruno Lourenço and James Saunderson.

Inexact Non-convex Newton-MR

Alexander Lim

University of Queensland

The celebrated Newton's method with conjugate gradient (CG) sub-problem solver, often referred to as Newton-CG, has historically held a special place among second-order optimization methods for unconstrained minimization of convex smooth objectives. Recent advances in non-convex optimization has extended the application range of Newton-CG far beyond convex problems to non-convex settings. We consider an alternative class of Newton-type meth- ods where CG is replaced with the Minimal Residual (MINRES) method as the inner solver. This class of methods, generally termed Newton-MR, have been shown to also apply to non-convex settings and come equipped with several advantageous properties over the Newton-CG counterparts. How- ever, their application to large-scale problems remains challenging. In this talk, I will discuss inexact variants of Newton-MR, which, by approximat- ing various aspects of the algorithm, can be efficiently applied to modern big-data problems.

Global Optimization via the Dual SONC Cone and Linear Programming

Mareike Dressler

University of New South Wales Sydney

In this talk, using the dual cone of sums of nonnegative circuits (SONC), we provide a relaxation of the global optimization problem to minimize an exponential sum and, as a special case, a multivariate real polynomial. This approach builds on two key observations. First, that the dual SONC cone is contained in the primal one. Hence, containment in this cone is a certificate of nonnegativity. Second, we show that membership in the dual cone can be verified by a linear program. We implement the algorithm and present initial experimental results comparing our method to existing approaches. This is based on joint work with Janin Heuer, Helen Naumann, and Timo de Wolff.

Discrete optimisation for Maintenance scheduling.

Peter Stuckey PL

University of Melbourne

Maintenance scheduling is an important class of scheduling application that has many variations, and is a key driver of costs for many organizations, hence finding good schedules for maintenance is very important. Traditional models for maintenance scheduling make use of strong Mixed Integer Programming models and solvers that are able to scale to significant size problems. But recent approaches to discrete optimisation provide alternate solving approaches that may be suitable for some kinds of maintenance scheduling problems. I this talk I will introduce different discrete optimisation models for maintenance scheduling. An interesting challenge that arises as we are able to make better prediction models about maintenance needs is how to incorporate this into the maintenance scheduling. I will describe how we can use predict + optimise to tackle this problem, that is combining machine learning prediction models with maintenance scheduling optimisation models.

Optimal error bounds in the absence of constraint qualifications for conic problems

Scott B. Lindstrom

Centre for Optimisation and Decision Science, Curtin University

Most optimisation software tools provide end users with a so-called ‘backward error,’ given in terms of the dual problem. However, what users really need to know in order to trust or distrust their solutions is the so-called ‘forward error,’ given with respect to the primal problem. Unfortunately, forward error bounds do not need to be on the same order as their backward counterparts. For us, an ‘error bound,’ is a guarantee that allows us to upper bound the forward error using information about the backward error. Such guarantees are often very challenging to obtain. One such challenging class of problems are those solved with cones whose closest-point projections lack known simple closed forms. We developed a means of computing error bounds for many such cones. In particular, our framework frequently allows us to verify that the bounds are tight in a reasonable sense (i.e. cannot be meaningfully improved upon). This talk is principally based upon the following article, and upon related works with the authors listed above.

Scott B. Lindstrom, Bruno F. Lourenço, and Ting Kei Pong, “Error bounds, facial residual functions and applications to the exponential cone,” *Mathematical Programming*, (2022) in press.

WOMBAT-ARC Training Centre Joint Day

Timetable

Time	Activity	Presenter(s)
9:00 - 9:30	Registration and Welcome	Prof. Andrew Rohl
9:30 - 10:30	Keynotes	Dr. Guarav Singh Dr. Fabrizio Padula
10:30 - 11:00	**Morning Tea**	
11:00 - 12:00	Panel Discussion	**Challenges and opportunities for applying optimisation methodologies in industry** **Facilitor**: Dr. Aloke Phatak **Panel**: Dr. Christina Burt Dr. Guarav Singh Dr. Elham Mardaneh Prof. Ryan Loxton
12:00 - 13:00	**Lunch**	
13:00 - 13:35	Poster Session	CTMDS Researchers in Theme 3
13:35	**Networking around posters**	

Keynote panel members

Dr Christina Burt	Assignment Engine Lead, Autonomy Systems, Fortescue Metals Group
Dr Gaurav Singh	Manager - Decision Science & Group Technology, BHP
Dr Elham Mardaneh	Senior lecturer in Operations Research at Curtin university
Prof. Ryan Loxton	Director of Curtin Centre for Optimisation and Decision Science

Keynote Biographies

Senior Research Fellow, Curtin Centre for Optimisation and Decision Science

Dr. Fabrizio Padula PL

Fabrizio Padula holds an MEng degree in Industrial Automation Engineering (2009) and a PhD degree in Computer Science and Automatic Control (2013), both from the University of Brescia in Italy. Currently, he is a Senior Research Fellow at the Curtin Centre for Optimisation and Decision Science, Perth, Australia. He is a member of the IFAC, IEEE, IEEE Control Systems Society, IEEE Robotics and Automation Society and IEEE Industrial Electronic Society. Fabrizio's research focuses primarily on fractional control, tracking control, anaesthesia control, and inversion-based control. Fabrizio has published a popular monograph on fractional control, an international patent with Whirlpool, and 80 publications in international conferences and journals. Fabrizio has a keen interest in demand-driven research and has worked on advanced control techniques in industrial applications with many companies, including Rio Tinto, Tensa Equipment, Turboden, GEFRAN, FuelFix and Lynas Rare Earths.

Manager, Decision Science Chapter, Strategy and Innovation, Group Technology at BHP

Dr. Gaurav Singh PL

Gaurav offers skills in strategic planning, operations management, and advanced analytics gained over 20+ years of leadership experience. In that time, he has forged collaborative partnerships across organizations to deliver advanced analytical solutions to complex business challenges. At BHP, Gaurav orchestrates digital transformation by embedding advanced decision science at all organisational levels. He has built an R&D approach to identify and incorporate disruptive technologies and drive external research collaboration.

Gaurav has been with the ARC Training Centre for Transforming Maintenance through Data Science since the start. He mentors both Research Fellows and PhD Students, providing them valuable support on their journey in working with industry as researchers.

Panellist Biographies

Assignment Engine Lead, Autonomy Systems, Fortescue Metals Group

Dr. Christina Burt

Dr Christina Burt is a decomposition algorithm specialist, having worked in both academia and industry in London, Berlin, Vienna and Melbourne for the last 14 years. She currently leads the Assignment Engine Research squad where she builds efficient, online algorithms for fleet management software deployed in a mining context with a goal to contribute to energy management of the decarbonised mining fleet.

Director of Curtin Centre for Optimisation and Decision Science

Prof. Ryan Loxton

Ryan is the Head of Mathematics and Statistics at Curtin University and the Director of the Curtin Centre for Optimisation and Decision Science, where he leads an inter-disciplinary team focused on data-driven decision making, process optimisation, and optimal scheduling, planning, and investment allocation. Ryan has extensive experience in modelling and solving complex optimisation challenges that involve numerous decision levers, multiple conflicting trade-offs, and large, disparate data sets. He has led consulting and collaborative research and development programs across the mining, defence, energy, and manufacturing sectors, with companies ranging from small start-ups to large multinationals. Ryan was the winner of the 2020 Christopher Heyde Medal from the Australian Academy of Science and the 2019 JH Michell Medal from the Australian Mathematical Society.

Senior Lecturer in Operations Research at Curtin University

Dr. Elham Mardaneh

Elham is a senior lecturer in Operations Research at Curtin University. She received her PhD in applied mathematics in 2011. Her research is on the application of Operations Research in various industries such as oil and gas, mining, agriculture, and building with a focus on scheduling, logistics and maintenance optimisation. Her academic work engages with industry and has been published in top journals such as the European Journal of Operations Research and Knowledge-Based Systems. She is a Fellow of the Operational Research Society and a chief investigator of the ARC Training Centre for Transforming Maintenance through Data Science.

List of Participants

Alberto De Marchi	UniBw Munich
Alexander Kruger	Federation University
Alexander Lim	University of Queensland
Aloke Phatak	Curtin Institute for Computation
Andrew Eberhard	RMIT University
Bethany Caldwell	University of South Australia
Christina Burt	Assignment Engine Lead, Autonomy Systems, Fortescue Metals Group
Daniel Uteda	The University of Melbourne
Dmytro Matsypura	The University of Sydney
Elham Mardaneh	Centre for Optimisation and Decision Science, Curtin university
Erchuan Zhang	Edith Cowan University
Fabrizio Padula	Centre for Optimisation and Decision Science, Curtin university
Godai Azuma	Tokyo Institute of Technology
Gaurav Singh	Manager - Decision Science & Group Technology, BHP
Guoyin Li	UNSW Sydney
Hoa Bui	Centre for Optimisation and Decision Science, Curtin University
Mareike Dressler	UNSW Sydney
Matt Tam	University of Melbourne
Natashia Boland	Centre for Optimisation and Decision Science, Curtin University
Peter Stuckey	University of Melbourne
Reinier Diaz Millán	Deakin University
Ryan Loxton	Director of Curtin Centre for Optimisation and Decision Science
Sandy Spiers	Curtin University
Scott B Lindstrom	Centre for Optimisation and Decision Science, Curtin University
Stephanie Caro Torres	Universidad de Chile and University of Alicante
Tianxiang Liu	Tokyo Institute of Technology
Vera Roshchina	UNSW Sydney
Warren Hare	University of British Columbia

Venue: The event will be held at Nesuto Curtin Perth Hotel Beazley Avenue Bentley, WA 6102. The Hotel is located on Curtin University's main campus in Bentley.

Transport: Public transport in Perth is by bus. Buses may run a few minutes late at Rush hour, but are generally quite reliable. Curtin University is served by 2 bus stations: Curtin Bus Station, and Curtin Central Bus Station. They are indicated on the map by light blue squares. Live bus tracking is available on the Transperth app.

Fares: "Smart Rider" transit cards can be purchased at various outlets, such as *Smart Carte* at Airport Terminal 1. A list of other outlets is available at `https://www.transperth.wa.gov.au/smartrider/retail-outlets`. You can also pay by cash; if you do so, you will overpay and will not receive change.

The airport: Perth Airport has four terminals. To travel from terminals 1 & 2 to terminals 3 & 4 may take up to 1 hour. You should look up in advance which terminal your flight departs from, and plan your journey to that specific terminal.