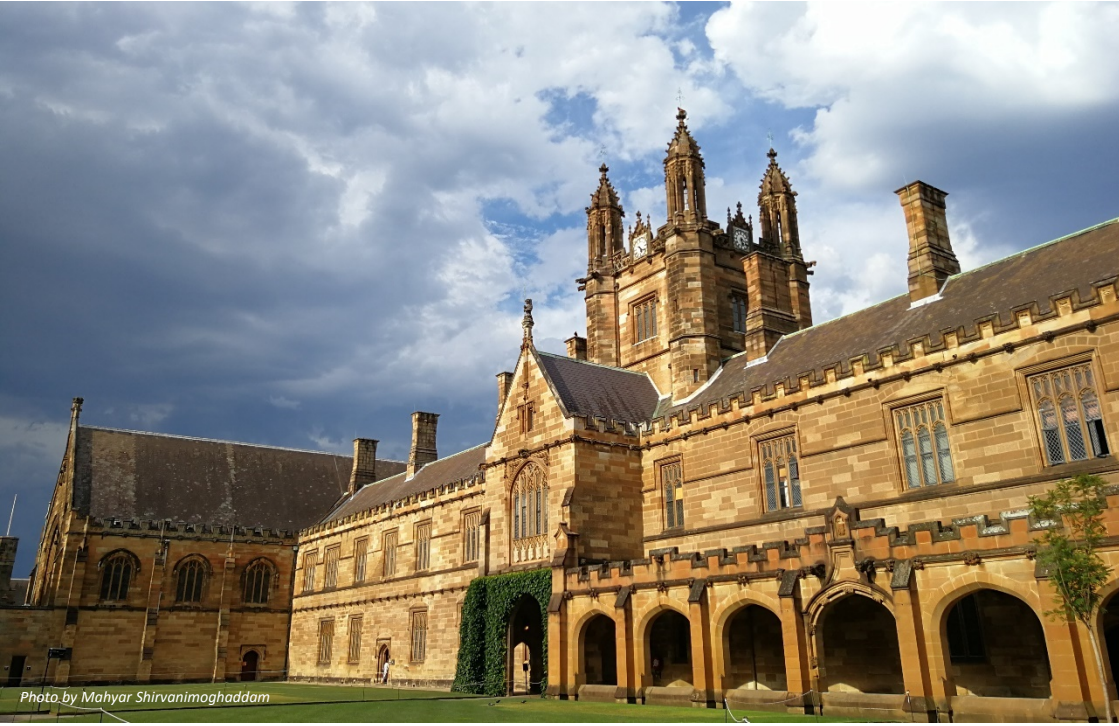



# 2019 Australian Communication Theory Workshop

## University of Sydney, Australia

## 6-8 February 2019

THE UNIVERSITY OF SYDNEY

# AUSCTW 2019

On behalf of the organizing committee, we are very pleased to welcome you to the 2019 Australian Information Theory Workshop at The University of Sydney, Australia. The University of Sydney was founded in 1850 and it was Australia's first university and is regarded as one of the world's leading universities. It is ranked as the world's 50th most reputable university.

AusCTW will bring together academics, industry experts, and post-graduate students to engage in knowledge sharing and development of next-generation communication infrastructure. During the two and a half days, the Workshop will feature 4 keynote talks by world-class researchers, invited technical oral presentations, poster presentations, and an exciting new best thesis competition. Past workshops have provided formal and informal environments to successfully foster collaborative research.

The workshop aims to

1. bring together national and international telecommunication experts from universities and industry to present latest findings in and collaborate on developing new secure and reliable communications technologies
2. support training of Australian postgraduate students by providing financial support for them to attend the conference, and encourage high-quality research through the Australian Communications Theory Best Thesis Prize
3. facilitate technology transfer between academics and industry

We are pleased to have the following keynotes, David Soldani (Huawei Australia), Zhibo Pang (ABB Sweden), Xiaojing Huang (University of Technology, Sydney) and Vincent Y. F. Tan (National University of Singapore). This year's AusCTW includes 17 Technical Talks, 2 Poster Sessions, and a new Demo Session.

We like to thank our generous sponsors for their financial support that has greatly helped put the entire program together: Faculty of Engineering and IT and School of Electrical and Information Engineering, The University of Sydney.

AusCTW2019 wouldn't have been possible to organize without the dedication of many volunteers who spent countless hours. For their work, we thank the TPC chairs, student travel grant chairs, local arrangement chairs, and finance chairs. We also thank the steering committee for their valuable feedback.

Sincerely,

AusCTW 2019 General Co-chairs

## Committee

**General Co-Chairs**

Branka Vucetic
***The University of Sydney***

Mahyar Shirvanimoghaddam
***The University of Sydney***

**Technical Program Chairs**

Yonghui Li
***The University of Sydney***

Mahyar Shirvanimoghaddam
***The University of Sydney***

He Chen
***The University of Sydney***

**Website & Publicity Chair**

Dawei Tan
***The University of Sydney***

**Local Arrangements & Finance Chair**

Rana Abbas
***The University of Sydney***

**Steering Committee**

| Member | Affiliation |
|---|---|
| Iain Collings | *Macquarie University* |
| Parastoo Sadeghi | *The Australian National University* |
| Jamie Evans | *University of Melbourne* |
| Alex Grant | *Myriota Pty Ltd* |
| Rod Kennedy | *The Australian National University* |
| Graeme Woodward | *University of Canterbury* |

**Technical Program Day 1 Wednesday 6 Feb 2019 Morning**

**9.10am-10.10am Keynote Talk**

**Prof. Xiaojing Huang**

**Title: Towards Terabit Wireless Communications**

**Abstract:** With the ever increasing demand for wireless connectivity, mobile data traffic continues to grow following the "omnify" principle, i.e., the data rate is observed to have an order of magnitude increase every five years, making wireless communication one of the most dramatic game-changing technologies. At this "omnify" pace, data rate for wireless transmission is expected to increase by a hundred time from current 10 Gbps within the next decade, achieving terabits per second. As the 5G mobile system emerges, ground based networks become more and more mature. However, there are still significant technological challenges to extend wireless coverage through the integration of space and terrestrial networks and to replace the last mile wired network with terabit wireless links. In this presentation, the evolution of wireless communication technologies is firstly reviewed, and the importance of millimetre wave radio frequency backbones in the integrated space and terrestrial networks is then addressed. An overview of the applications and technical challenges of the emerging terahertz wireless communications is given afterwards. Finally, some enabling techniques for improving spectral efficiency and power efficiency for millimetre wave and terahertz communications are discussed.

**Bio**: Xiaojing Huang received the B.Eng., M.Eng., and Ph.D. degrees in electronic engineering from Shanghai Jiao Tong University, Shanghai, China, in 1983, 1986, and 1989, respectively. He is currently a professor of information and communications technology with the School of Electrical and Data Engineering and the program leader of Mobile Sensing and Communications with the Global Big Data Technologies Centre, University of Technology Sydney (UTS), Sydney, Australia. He was with the Motorola Australian Research Centre as a Senior and then Principal Research Engineer from 1998 to 2003. He had been an Associate Professor with the University of Wollongong, Wollongong, Australia, from 2004 to 2008. He had been a Principal Research Scientist with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Sydney, Australia, and the project leader of CSIRO's microwave and millimetre wave backhaul projects from 2009 to 2014. He was a recipient of the CSIRO Chairman's Medal and the Australian Engineering Innovation Award in 2012 for exceptional research achievements in multigigabit wireless communications. With 30 years of combined industrial, academic, and scientific research experience, he has authored over 300 book chapters, refereed journal and conference papers, major commercial research reports, and has filed 31 patents. Professor Huang served as Technical Program Committee Chairs and/or Co-Chairs for a number of international conferences such as ISCIT (2007, 2010, 2012-2014, and 2016), ICUWB2013, WPMC2014, and VTC2017-Spring.

**Technical Program Day 1 Wednesday 6 Feb 2019 Morning**

**10.40am-11.00am Technical Talk**

A/Prof. Brian S. Krongold ***University of Melbourne***

**Title**: Coordinated Multipoint OFDM Transmission for Maximising Capacity or Energy Harvesting

**Abstract**: We highlight a few of our works in the area of coordinated multipoint OFDM transmission for both maximising capacity or harvested energy in a multiple-input, single-output (MISO) system. Optimisation problems are formulated based on distributed antennas having knowledge of channel state information (CSI) for all subchannels. When the CSI is magnitude plus phase, we utilise co-phasing at the coordinated transmission points to formulate and solve convex optimisation problems. The results are some interesting theorems that, at first glance, may even seem counterintuitive to classical water-filling theory. Simulation results are given to demonstrate these theorems and look deeper into the intuition behind them. Finally, we briefly outline our work on non-coherent (magnitude-only CSI) coordinated transmission for capacity maximisation and energy harvesting in MISO systems.

**11.00am-11.20am Technical Talk**

Prof. Wei Xiang ***James Cook University***

**Title**: An Australia's First – JCU's Internet of Things Engineering Program

**Abstract**: It is well known that the Internet of Things (IoT) technology is one of the most crucial digital infrastructure for the fourth industrial revolution that is revolutionizing the human society. Some consider IoT technology the frontend of big data. We would argue that IoT is a data-driven technology, which is composed of three layers, i.e., the data collection layer, data communications layer, and data processing layer. This three-layer stratification well explains why IoT technology serves as a foundation to and is inseparable from machine learning (ML)/artificial Intelligence (AI). James Cook University (JCU) prides itself on providing Australia's first IoT Engineering degree program that is accredited by Engineers Australia. Huawei also set up its first official laboratory with JCU, the JCU-Huawei Narrowband IoT Laboratory opened in February 2017. This talk will walk you through the first IoT course created in Australia, as well as the IoT projects and industry engagement that have been achieved at JCU.

**11.20am-11.40am Technical Talk**

A/Prof. Xiangyun (Sean) Zhou ***Australian National University***

**Title**: Physical Layer Security: Perfect Secrecy, Partial Secrecy, Covertness

**Abstract**: This talk will provide a brief discussion on performance metrics used in physical layer security. In particular, most existing studies make use of metrics defined based on perfect secrecy conditions, which will be discussed first. We will then look at some recently developed secrecy metrics based on partial secrecy and discuss its advantages. Towards the end of the talk, we will move beyond secrecy of content and discuss covertness of communication which is an increasingly hot topic in physical layer security.

**11.40am-12.00pm Technical Talk**

Dr. Gayathri Kongara ***Monash University***

**Title:** Role of Software Defined radio in 5G-like studies at Monash University

**Abstract:** In this presentation, I will be sharing my experience on the role of Software Defined radio (SDR) in the evaluation of waveforms for 5G systems. Specifically, my presentation will focus on massive machine type communications (mMTC) operating in asynchronous transmission environments. Standard CP-OFDM and various versions of filtered-OFDM waveforms are currently under consideration for extreme mobile broadband (eMBB) application of 5G systems. However, our study on SDR platform reveal that these waveform solutions are not well suited for mMTC scenarios. A comparison of time and frequency characteristics of the three potential candidate waveforms on the SDR platform will be presented. Over the air performance of the three waveforms in asynchronous environments will be further discussed.

# AUSCTW 2019

## Poster Session Day 1 Wednesday 6 Feb 2019 1.30pm-3.10pm

| | |
|---|---|
| Authors:<br>Title:<br>Institution: | Khurram Shahzad, Xiangyun Zhou, Shihao Yan, Jinsong Hu, Feng Shu and Jun Li<br>**Achieving Covert Wireless Communications Using a Full-Duplex Receiver**<br>*ANU* |
| Authors:<br>Title:<br>Institution: | Bijaya Paudel, Dr. Sina Vafi<br>**An Unequal Error Protection of Quasi-Cyclic Low Density Parity Check (QC-LDPC) Codes Based on Combinatorial Designs**<br>*Charles Darwin University* |
| Authors:<br>Title:<br>Institution: | Jin Yeong Tan, Lawrence Ong, Behzad Asadi<br>**A Simplified Coding Scheme for the Memoryless Broadcast Channel with Individual Secrecy**<br>*University of Newcastle* |
| Authors:<br>Title:<br>Institution: | Zhanwei Hou, Changyang She, Yonghui Li, Tony Quek, Branka Vucetic<br>**Burstiness Aware Bandwidth Reservation for Ultra-reliable and Low-latency Communications (URLLC) in Tactile Internet**<br>*USYD* |
| Authors:<br>Title:<br>Institution: | Simin Xu, Biao He, Nan Yang, and Hamid Jafarkhani<br>**Coverage Analysis of Millimeter Wave Cellular Networks with Spatial Correlation**<br>*ANU* |
| Authors:<br>Title:<br>Institution: | Changyang She, Yonghui Li, Branka Vucetic<br>**Cross-layer Design for Ultra-Reliable Low-Latency Communications**<br>*USYD* |
| Authors:<br>Title:<br>Institution: | Prameesha S. Weerasinghe, Sarah M. Erfani, Tansu Alpcan, Christopher Leckie, Margreta Kuijper<br>**Detection of Anomalous Communications with SDRs and Unsupervised Adversarial Learning**<br>*University of Melbourne* |
| Authors:<br>Title<br>Institution: | Trang Ngoc Cao, Arman Ahmadzadeh, Vahid Jamali, Wayan Wicke, Phee Lep Yeoh, Jamie Evans, and Robert Schober<br>**Diffusive Mobile Molecular Communication for Controlled-Release Drug Delivery with an Absorbing Receiver**<br>*University of Melbourne* |
| Authors:<br>Title:<br>Institution: | Min Qiu, Yu-Chih Huang and Jinhong Yuan<br>**Downlink Non-Orthogonal Multiple Access without SIC for Block Fading Channels: An Algebraic Rotation Approach**<br>*UNSW* |
| Authors:<br>Title:<br>Institution: | Mohsen Mohammadkhani Razlighi, Nikola Zlatanov, and Petar Popovski<br>**Dynamic Time-Frequency Division Duplex**<br>*Monash University* |
| Authors:<br>Title:<br>Institution: | Zainab Zaidi, Hazer Inaltekin, Jamie Evans<br>**Energy Consumption Study of small cells, CRAN, split signalling and data dense deployments**<br>*University of Melbourne* |
| Authors:<br>Title:<br>Institution: | Azam Mehboob, Kelvin Layton, William Cowley and Gottfried Lechner<br>**Improved Modulation and Coding for Spectral Efficient Communications**<br>*University of South Australia* |
| Authors:<br>Title:<br>Institution: | Shalanika Dayarathna<br>**Instantaneous Sum Rate Throughput Optimization in General Communicaion Networks**<br>*University of Melbourne* |
| Authors:<br>Title:<br>Institution: | Zhuo Sun, Zhiqiang Wei, Lei Yang, Jinhong Yuan, Xingqing Cheng, and Lei Wan<br>**Joint User Identification and Channel Estimation in Massive Connectivity with Transmission Control**<br>*UNSW* |
| Authors:<br>Title:<br>Institution: | Muhammad Usman Riaz, Hamdan Awan, Chun Tung Chou<br>**Maximum a-posteriori demodulation for molecular communication with spatially partitioned receivers**<br>*UNSW* |
| Authors:<br>Title:<br>Institution: | Yuting Fang, Adam Noel, Andrew W. Eckford, and Nan Yang<br>**On the Analysis of Bacterial Cooperation with a Characterization of 2D Signal Propagation**<br>*ANU* |
| Authors:<br>Title:<br>Institution: | Muhammad Abu Hanif and Sina Vafi<br>Construction of efficient product polar codes based on two half-rate polar codes<br>Charles Drawin University |

**Program Day 1 Wednesday 6 Feb 2019 Afternoon**

**3.40pm-4.00pm Technical Talk**

Dr. Sina Vafi ***Charles Darwin University***

**Title**: An efficient bound for burst error correcting capability of binary cyclic cyclic codes

**Abstract**: Burst error has a high impact on the quality of telecommunication and storage systems since it affects more than one sequence of symbols. The effect of this error can be mitigated by a reliable Forward Error Correcting (FEC) code. Depending on the code's characteristics, errors are corrected only if the allocated length of code is greater than the length of error patterns. In this case, an optimum code can be formed when its burst error correcting capability meets a particular bound, named as Reiger bound. Binary cyclic codes are amongst the most important types of burst error correcting codes. There are several methods that verify their performance, which are mainly constructed based on the cyclic property. As one of the newest methods, the burst error correcting capability of a cyclic code can be determined based on its parity check circulant matrix. It is constructed by specifying the length and position of the unique maximal zero spans from module-2 sums of the matrix columns. Its complexity is proportional to the number of columns involved in the calculations. Hence, a large number of sums are evident for codes with a large number of parity bits, whose correcting capabilities are close or equal to the Reiger bound value. In order to simplify complexity of the above technique, algorithms for estimating burst error correcting capability of cyclic codes are demonstrated. These are formed based on structure of the parity check polynomial and properties of the circulant matrix. Then, a method for constructing cyclic codes with the optimum (or high) performance in correction of the burst error is presented.

**4.00pm-4.20pm Technical Talk**

Dr. Kelvin Layton ***University of South Australia***

**Title**: Compensation for channels with data-dependent distortions

**Abstract**: Communication channels that can be modelled with data-dependent noise on the received symbols are considered. This includes satellite and optical channels with various types of distortion. A new demapper is proposed to incorporate the covariance of the received symbol clusters to capture the varying noise statistics across the constellation. Two communication scenarios are considered, demonstrating the demapper is advantageous when a system is dominated by distortion as opposed to thermal noise. Channel coding considerations are presented, and reductions up to 4 dB in the required SNR are achieved.

**4.20pm-4.40pm Technical Talk**

Dr. Qinghua Guo ***University of Wollongong***

**Title**: Message Passing Based Bayesian Receiver for Grant Free NOMA

**Abstract**: Grant free non-orthogonal multiple access (NOMA) is promising to support massive connectivity for internet-of-things and machine-type communications in future wireless networks. In grant free NOMA, user activity detection is performed at receiver to identify active users, so that transmission latency and control signalling overhead can be significantly reduced. We study Bayesian receivers to achieve joint user activity detection and channel estimation / joint user activity and multiuser detection in grant free NOMA, and their efficient implementations with message passing techniques.

**4.40pm-5.00pm Technical Talk**

Dr. Jingge Zhu ***University of Melbourne***

**Title**: Compute-Forward Multiple Access (CFMA)

**Abstract**: We discuss Compute-Forward Multiple Access (CFMA), a novel multiple access technique which is provably capacity achieving, and at the same time enjoys low-complexity practical implementations. This attractive feature makes CFMA a promising candidate for NOMA (Non-Orthogonal Multiple Access) techniques.

**Program Day 2 Thursday 7 Feb 2019 Morning**

**9.10am-10.10am Keynote Talk**

**Zhibo Pang**

**Title**: Last Mile Connectivity: the Bottleneck of Mission Critical Industrial IoT

**Abstract**: As important fuel of the fourth revolution of industries (Industry 4.0), Industrial IoT especially the industrial wireless connectivity has become the new driver of research in communications. To deliver the big values promised by the Industrial IoT, closing the control and optimization loops is the first step. Despite continuous efforts in the recent decades by telecom and industries, last mile connectivity is still the bottleneck for closed loop control and optimization in mission critical applications. There are significant differences between the two different worlds, consumer connectivity vs. industrial connectivity. Noticeable mistakes have been made when previous industrial connectivity technologies were developed such as the WireelssHART. To fully address the requirements of critical Industrial IoT applications (such as mining automation, autonomous robotics, power systems, factory of future, etc.), much higher performances are required including multi-gigabit-per-second data rate, sub-microsecond latency, and ultra-high reliability. Basic feasibility has been proven by the latest work on Wireless HP (high performance) at ABB based on FPGA-based SDR (software defined radio) which has outperformed the 5G URLLC by x 10 times in terms of latency. As highlighted in future research agenda, new fundamental design, standards, and chips are demanded.

**Bio**: Dr. Zhibo Pang, PhD&MBA received B.Eng. in Electronic Engineering from Zhejiang University, Hangzhou, China in 2002, MBA in Innovation and Growth from University of Turku, Turku, Finland in 2012, and PhD in Electronic and Computer Systems from the Royal Institute of Technology (KTH), Stockholm, Sweden in 2013.

He is currently a Principal Scientist on Wireless Communications at ABB Corporate Research, Västerås, Sweden, leading projects in digitalization solutions for smart buildings and homes, robotics and factories, healthcare and logistics, power electronics and power systems. He is also Affiliated Faculty and PhD Supervisor at Royal Institute of Technology (KTH). Before joined ABB, he was co-founder and CTO of startups such as Ambigua Medito AB. He is a Senior Member of IEEE and Co-Chair of the Technical Committee on Industrial Informatics.

He is Associate Editor of IEEE Transactions on Industrial Informatics and IEEE Journal of Biomedical and Health Informatics, Guest Editor of Proceedings of the IEEE, IEEE Internet of Things Journal, and IEEE Reviews in Biomedical Engineering, etc. He was awarded the “2016 Inventor of the Year Award” by ABB Corporate Research Sweden. He has 60+ patents and 50+ refereed journal papers and 40+ conference papers in these areas.

**Program Day 2 Thursday 7 Feb 2019 Morning**

---

**10.40am-11.40am Keynote Talk**

**David Soldani**

---

**Title: 5G Developments and AI-Enabled Automation**

**Abstract**: 5G systems and AI platforms have been attracting a lot of attention in recent years and plenty of results for horizontal and vertical sectors have been attained globally. The talk provides a snapshot of the global status of national 5G spectrum plans and reviews the main progresses in 3GPP standards. The main challenges of 5G deployments and solutions thereof are discussed next. Within this framework, AI applications to energy saving, network performance and quality of experience improvement are also presented. Conclusions are drawn on new business, research and innovation directions.

---

**Bio**: David Soldani received a M.Sc. degree, Laura Vecchio Ordinamento, in Electronic Engineering with magna cum laude from Università degli Studi di Firenze, Italy, in 1994; and a D.Sc. degree in Technology with distinction from Helsinki University of Technology (Aalto University), Finland, in 2006. In 2014 and 2016, he was appointed Visiting Professor and Industry Professor at University of Surrey, UK, and University of Technology Sydney, Australia, respectively.

Dr. Soldani has been active in the ICT industry for more than 20 years, successfully working on 500+ research, innovation and customer services projects for 2G, 3G, 4G and 5G ICT systems and services, and contributing to 1000+ quality deliverables – from strategic research and innovation strategies, business and work plans formulation, to modelling, simulations, emulations and proof of concepts of innovative solutions, products and services with partners and customers, globally.

He is currently back at Huawei Technologies, serving as Chief Technology Officer (CTO) in Australia. Areas of his responsibilities and expertise include, but not limited to: future wireless, network, big data value, artificial intelligence, IoT and multimedia technologies.

Prior to that he was at Nokia, as Head of 5G Technology, e2e, global, and in various technical and research management positions. Before re-joining Nokia in 2016, he was for eight years at Huawei European Research Centre, Germany, serving as Head of IP Transformation Research Centre (IPTRC), Head of Network Solution R&D and, subsequently, Head of Central Research Institute (CRI) and VP Strategic Research and Innovation, in Europe; and represented Huawei in the Board of Directors of The 5G Infrastructure Association (5G-IA) and NetWorld2020 European Technology Platform (ETP), in Europe. He has been selected many times to receive special awards in recognition of his role, commitment, professionalism, and outstanding contribution in the ICT industry; and in 2016, he was granted a Distinguished Talent (DT) visa for his profession by the Australian Government. He has published or presented numerous international papers, contributed to the publication of many books, and holds several international patents.

**Program Day 2 Thursday 7 Feb 2019 Morning**

**11.40am-12.00pm Technical Talk**

Dr. Ni Ding *Data61*

**Title:** proving Computational Efficiency of Communication for Omniscience and Successive Omniscience

**Abstract:** For a group of users in V where everyone observes a component of a discrete multiple random source, the process that users exchange data so as to reach omniscience, the state where everyone recovers the entire source, is called communication for omniscience (CO). We first consider how to improve the existing complexity O(|V|^2 * SFM(|V|) of minimizing the sum of communication rates in CO, where SFM(|V|) denotes the complexity of minimizing a submodular function. We reveal some structured property in an existing coordinate saturation algorithm: the resulting rate vector and the corresponding partition of V are segmented in $\alpha$, the estimation of the minimum sum-rate. A parametric (PAR) algorithm is then proposed where, instead of a particular $\alpha$, we search the critical points that fully determine the segmented variables for all $\alpha$ so that they converge to the solution to the minimum sum-rate problem and the overall complexity reduces to O(|V| * SFM(|V|)). For the successive omniscience (SO), we consider how to attain local omniscience in some complimentary user subset so that the overall sum-rate for the global omniscience still remains minimum. While the existing algorithm only determines a complimentary user subset in O(|V| * SFM(|V|)) time, we show that, if a lower bound on the minimum sum-rate is applied to the segmented variables in the PAR algorithm, not only a complimentary subset, but also an optimal rate vector for attaining the local omniscience in it are returned in O(|V| * SFM(|V|)) time. Finally, we show how the proposed PAR algorithm is applied to the hierarchical clustering task based on the multivariate mutual information measure.

## Poster Session Day 2 Thursday 7 Feb 2019 1.30pm-3.10pm

| | |
|---|---|
| Authors: | Armin Bazrafkan and Nikola Zlatanov |
| Title: | **On the Capacity of Massive MIMO With One-Bit ADCs and DACs at the Receiver and the Transmitter** |
| Institution: | *Monash University* |
| Authors: | Zhiqiang Wei, Lei Yang, Derrick Wing Kwan Ng, and Jinhong Yuan |
| Title: | **On the Performance Gain of NOMA over OMA in Uplink Single-cell Systems** |
| Institution: | *UNSW* |
| Authors: | Sheeraz A. Alvi, Xiangyun Zhou, and Salman Durrani. |
| Title: | **Optimal Compression and Transmission Rate Control for Node-Lifetime Maximization** |
| Institution: | *ANU* |
| Authors: | Chunhui Li, Nan Yang, and Shihao Yan |
| Title: | **Optimal Transmission of Short-Packet Communications in Multiple-Input Single-Output Systems** |
| Institution: | *ANU* |
| Authors: | Yuyue Luo, J. Andrew Zhang |
| Title: | **Optimization and Quantization of Multibeam Beamforming Vector for Joint Communication and Radio Sensing** |
| Institution: | *UTS* |
| Authors: | Michael Fasulakis |
| Title: | **Peak-to-Average-Power Reduction and MIMO Applicability of PCC OFDM to 5th Generation Networks** |
| Institution: | *Monash University* |
| Authors: | Xiaolun Jia and Xiangyun Zhou |
| Title: | **Performance Characterisation of Ambient Backscatter Relaying Systems** |
| Institution: | *ANU* |
| Authors: | Samiru Gayan, Hazer Inaltekin, Rajitha Senanayake and Jamie Evans |
| Title: | **Phase Modulated Communication with Low-Resolution ADCs** |
| Institution: | *University of Melbourne* |
| Authors: | Chentao Yue, Mahyar Shirvanimoghadda, Yonghui Li, Branka Vucetic |
| Title: | **Segmentation-Discarding Ordered-Statistic Decoding for Linear Block Codes** |
| Institution: | *USYD* |
| Authors: | Zohair Abu-Shaban, Henk Wymeersch, Thushara Abhayapala, Gonzalo Seco-Granados |
| Title: | **Single-Anchor Two-Way Localization Bounds for 5G mmWave Systems: Two Protocols** |
| Institution: | *UNSW Canberra* |
| Authors: | Fariba Abbasi Aghdam Meinagh, Emanuele Viterbo |
| Title: | **Soft Decision Decoding of polar codes with large kernels** |
| Institution: | *Monash University* |
| Authors: | Viduranga Wijekoon, Hoang Dau, Emanuele Viterbo |
| Title: | **Soft Decision Decoding of Reed-Solomon Codes based on Non-binary Matrices** |
| Institution: | *Monash University* |
| Authors: | Yizhou YANG, David Smith, Suranga Seneviratne |
| Title: | **Deep Learning Channel Prediction for Transmit Power Control in Wireless Body Area Networks** |
| Institution: | *ANU* |
| Authors: | Ziqi Chen; David Smith |
| Title: | **Heterogeneous Random Access Optimization by Deep Reinforcement Learning** |
| Institution: | *UNSW* |
| Authors: | Mohammad Rowshan and Emanuele Viterbo |
| Title: | **Stepped List Decoding: A Memory-efficient and Low-complexity Approach** |
| Institution: | *Monash University* |
| Authors: | Kameliya Kaneva, Neda Aboutorab, Sameh Sorour and Mark C Reed |
| Title: | **Cross-Layer Offloading in Fog-RANs using Device Cooperation and Network Coding** |
| Institution: | *UNSW* |
| Authors: | Mike Faulkner |
| Title: | **Additional path loss from scattered waves into cross streets @ millimetre waves** |
| Institution: | Victoria University |

**Program Day 2 Thursday 7 Feb 2019 Afternoon**

**3.40pm-4.00pm Technical Talk**

A/Prof. Parastoo Sadeghi ***Australian National University***

**Title**: A submodularity-based agglomerative clustering algorithm for the privacy funnel

**Abstract**: We propose an efficient iterative agglomerative clustering (IAC) algorithm for the privacy funnel (PF) based on the minimization of the difference of submodular functions (IAC-MDSF). The aim of PF is to maintain an acceptable mutual information between the useful data $X$ and released data $\hat X$ while minimizing the privacy leakage, which is measured as the mutual information between released data $\hat X$ and sensitive data $S$. Our IAC-MDSF algorithm starts with the original alphabet for $X$ and iteratively merges the elements in the current alphabet that minimizes the Lagrangian function $I(S; \hat X) - \lambda I(X; \hat X)$. We prove that the best merge in each iteration of IAC-MDSF can be searched efficiently over all subsets of $\hat X$ by existing MDSF algorithms. We show that the IAC-MDSF algorithm also applies to the information bottleneck (IB), a dual problem to PF. Using a real dataset, we show that our IAC-MDSF algorithm outperforms the existing iterative pairwise merge approaches for both PF and IB and is computationally much less complex. We propose an efficient iterative agglomerative clustering (IAC) algorithm for the privacy funnel (PF) based on the minimization of the difference of submodular functions (IAC-MDSF). The aim of PF is to maintain an acceptable mutual information between the useful data $X$ and released data $\hat X$ while minimizing the privacy leakage, which is measured as the mutual information between released data $\hat X$ and sensitive data $S$. Our IAC-MDSF algorithm starts with the original alphabet for $X$ and iteratively merges the elements in the current alphabet that minimizes the Lagrangian function $I(S; \hat X) - \lambda I(X; \hat X)$. We show that the IAC-MDSF algorithm also applies to the information bottleneck (IB), a dual problem to PF.

**4.00pm-4.20pm Technical Talk**

Dr. Lei Yang ***University New South Wales***

**Title**: Partially Information-Coupled Codes

**Abstract**: Spatially coupled codes, such as SC-LDPC codes and SC Turbo-like codes, have shown considerable coding gain over their uncoupled counterparts. However, these codes are generally tightly coupled in the sense that several coupled code blocks have to be decoded jointly to achieve a reasonable BER performance. This leads to an increased decoder implementation complexity compared to the uncoupled counterparts. We propose the concept of partially information coupling in which a code block shares a part of its information bits with its neighboring code blocks. This coupling concept can explore the coupling gain while keep the underlying decoder for each code block unchanged. We apply this concept to construct partially information-coupled Turbo codes, LDPC codes and Polar codes. Simulation results demonstrated that these codes can achieve considerable coding gains compared to their uncoupled counterparts.

**4.20pm-4.40pm Technical Talk**

Dr. Changyang She ***University of Sydney***

**Title**: Ultra-reliable Low-latency Communications: scenarios, solutions, and open issues

**Abstract**: Ultra-reliable low-latency communications (URLLC) has been considered as one of the three new application scenarios in the 5th Generation (5G) New Radio (NR), where the physical layer design aspects have been specified. With the 5G NR, we can guarantee the reliability and latency in radio access networks. However, for scenarios where the transmission involves both radio access and wide area core networks, the delay in radio access networks only contributes to part of the end-to-end (E2E) delay. In this talk, we outline the delay components and packet loss probabilities in three typical communication scenarios of URLLC, i.e., local area networks, mobile edge computing networks, and wide-area large-scale networks. Then, we summarize possible solutions in these three scenarios respectively. Finally, we discuss the open issues in URLLC.

**Program Day 2 Thursday 7 Feb 2019 Afternoon**
**Demo Presentation**

**4.40pm – 5.00pm Invited Demo**
Dr Wibowo Hardjawana ***University of Sydney***

**Title:** Softwarising Real-time LTE Scheduler: Concept and Prototype
**Abstract:** The future cellular network will need to be softwarised in order to provide flexibility for handling numerous types of time-varying traffic with flexible requirements. Softwarisation allows operators to change the scheduler logic of an evolved NodeB (eNodeB) at the edge base station (BS) in real-time. Two types of scheduler architectures have been proposed in the literature: 1) a distributed non-programmable scheduler in which the underlying real-time scheduling logic cannot be programmed due to tight control by the eNodeB vendor at the edge base station, and 2) a centralised scheduler in which only non-real-time scheduling logic is programmable. In this presentation, we propose a distributed real-time softwarisation architecture for a long-term evolution (LTE) resource scheduler. The scheduling logic is written as a software independently of the underlying eNodeB and executed in real-time at the edge BS with the help of a scheduler agent. The proposed softwarisation architecture is validated in an over-the-air environment with commercial LTE devices and 3rd Generation Partnership Project (3GPP) standards-compliant setup.

**5.00pm – 5.20pm Invited Demo**
Dr Yixuan Xie, ***UNSW***

In this demo presentation, I will give an overview of massive random access schemes for machine-type communications and very high-speed channel codecs for ultra-reliable digital communication or data storage systems, which were implemented at UNSW Wireless Communications Lab. The implementation of random multiple access protocol is based on Coded Slotted ALOHA (CSA) schemes. To resolve packet collisions and improve the system throughput, the Successive Interference Cancellation (SIC) detection algorithm is implemented. We show a demo of this implementation of CSA on NI USRP-RIO platforms. In addition, I will also present the design and FPGA implementation of LDPC decoder for ultra-reliable high-speed storage and communication systems, such as Fiber-optical communications, Flash memory storage devices, and deep space communications, which require high-speed error correction decoding schemes and a bit-error rate of 10^-15 or lower. Finally, an introduction of millimeter wave system with maximum 3 Gbps datalink throughput is given, and over-the-air data and video transmissions are demonstrated using 28GHz radio heads.

**Program Day 3 Friday 8 Feb 2019 Morning**

**10.40am-11.40am Keynote Talk**

**Vincent Y. F. Tan**

**Title: Minimum Rates of Approximate Sufficient Statistics**

**Abstract**: Given a sufficient statistic for a parametric family of distributions, one can estimate the parameter without access to the data. However, the memory or code size for storing the sufficient statistic may nonetheless still be prohibitive. Indeed, for n independent samples drawn from a k-nomial distribution with d=k−1 degrees of freedom, the length of the code scales as d log n + O(1). In many applications, we may not need to reconstruct the generating distribution exactly. By adopting a Shannon-theoretic approach in which we allow a small error in estimating the generating distribution, we construct various approximate sufficient statistics and show that the code length can be reduced to (d/2) log n + O(1). We consider errors measured according to the relative entropy and variational distance criteria. For the code constructions, we leverage Rissanen's minimum description length principle, which yields a non-vanishing error measured according to the relative entropy. For the converse parts, we use Clarke and Barron's formula for the relative entropy of a parametrized distribution and the corresponding mixture distribution. However, this method only yields a weak converse for the variational distance. We develop new techniques to achieve vanishing errors and we also prove strong converses. The latter means that even if the code is allowed to have a non-vanishing error, its length must still be at least (d/2) log n.

This is joint work with Prof. Masahito Hayashi (Nagoya University) and was published in the Feb 2018 issue of the IEEE Transactions on Information Theory (https://ieeexplore.ieee.org/document/8115272/).

**Bio**: Vincent Y. F. Tan was born in Singapore in 1981. He is currently an Associate Professor in the Department of Electrical and Computer Engineering (ECE) and the Department of Mathematics at the National University of Singapore (NUS). He received the B.A. and M.Eng. degrees in Electrical and Information Sciences from Cambridge University in 2005. He received the Ph.D. degree in Electrical Engineering and Computer Science (EECS) from the Massachusetts Institute of Technology in 2011. His research interests include information theory, machine learning and statistical signal processing. He is currently a Distinguished Lecturer of the IEEE Information Theory Society (2018/19).

**Program Day 3 Friday 8 Feb 2019 Morning**

**10.40am-11.00am Technical Talk**

Prof. Jinho Choi ***Deakin University***

**Title:** Machine-Type Communication for the IoT

**Abstract:** The Internet of Things (IoT) is the network to provide the connectivity for physical devices including sensors, which will have a huge impact on future industry as well as our daily life, In cellular systems (e.g., 5G), machine-type communication (MTC) is considered for the IoT with random access. For example, in the long term evolution-advanced (LTE-A) system, random access channel (RACH) procedure and narrowband IoT (NB-IoT) have been proposed for MTC to support massive connectivity. In this talk, we discuss MTC and a new random access scheme, called compressive random access (CRA) with its key features. We also show that CRA is an attractive scheme not only for random access, but also for physical-layer authentication as lightweight security in cellular IoT.

**11.00am-11.20am Technical Talk**

Dr. Vera D. Miloslavskaya ***University of Sydney***

**Title:** Design of Error-Correction Codes Decodable as Polar Codes

**Abstract**: In this talk I will give an introduction to polar codes and describe a class of linear block error-correction codes which may be efficiently decoded in the same way as polar codes. First, we look at structure of classical polar codes and discuss its relation to other well-known codes, e.g. Reed-Muller codes, Bose-Chaudhuri-Hocquenghem codes and generalized concatenated codes. Second, we consider methods for soft-decision decoding of polar codes and discuss correction capability of polar codes. Third, we identify variations of polar codes demonstrating higher correction capability compared to classical polar codes.

**11.20am-11.40am Technical Talk**

Dr. Shihao Yan ***Macquarie University***

**Title**: Gaussian Signalling for Covert Communications

**Abstract**: In covert communications, a transmitter desires to transmit information to a legitimate receiver without being detected by a warden. In this talk, we examine the optimality of Gaussian signalling for covert communications. Considering additive white Gaussian noise at both the receiver and the warden, we prove that Gaussian signalling is optimal in terms of maximizing the mutual information between transmitted and received signals subject to one covertness constraint based on KL divergence. More interestingly, we also prove that Gaussian signalling is not optimal for covert communications subject to another covertness constraint, for which as we explicitly show a skew-normal signalling can outperform Gaussian signalling in terms of achieving higher mutual information subject to the same covertness constraint. We also clarify some challenges and future research directions in the context of covert communications.

**11.40am-12.00pm Technical Talk**

Dr. Wei Ni ***CSIRO***

**Title:** Decentralize Fog Computing for Future Mobile Edge Cloud

**Abstract:** Fog computing is a promising technique which brings computing and storage capability of networks to the point of data capture, and hence provides fast response and alleviates congestions at network backbones. The effective design and operation of fog computing remain unaddressed, given the sheer size of an edge cloud and potentially selfish behaviours of edge devices. This talk presents a few recent breakthroughs in which we are able to decentralize the operations of fog computing with asymptotically diminishing optimality loss. We are also able to incentivise selfish edge servers to participate in fog computing, and discourage their selfish behaviours by designing distributed tit-for-tat mechanisms.

**NOTES**

# Venue

AusCTW will be held at **Eastern Avenue Auditorium**, The University of Sydney, Camperdown, NSW 2006.

**Banquet** on Thursday 7 Feb 2019 will be held in **The Great Hall**.

The University of Sydney mobile app provides a convenient map of the campus. (See iTunes, Google Play store). For a detailed campus map, check here or visit the map in the website of USyd.

**For Public Transport**

The University of Sydney is well connected to the Sydney CBD and Airport by train and bus services. The public transport ticketing systems (including trams) use a reloadable smart card called 'Opal'. The Opal card can bought and topped up at major railway stations and at a number of retail shops, including 7-Eleven stores. For fares and further information see the Opal Webpage. As bus, rail and ferry timetables and routes can change, we suggest you visit the Transport for NSW trip planner before you set out.

**Getting there**

**by train**

Redfern is the closest train station. It is a 10-minute walk to the main campus, and a fairly steady flow of students walks the route via Abercrombie Street at all times of day and evening. A free shuttle bus runs between Fisher Library and Redfern Station in the evening during semester.

Central station is a 15-minute walk along City Road and George Street; however, buses to and from Central are frequent and easy to catch from Parramatta Road or City Road.

**By bus**

If you are arriving by bus, there are convenient stops on Parramatta Road and City Road at our main entrances. Use the campus map to locate the closest bus stop to your destination.

**Parking**

Daytime casual parking rates (6am–3pm, Monday to Friday)

- Camperdown and Darlington campuses

Fee: $24 flat rate (valid to 6am next morning)

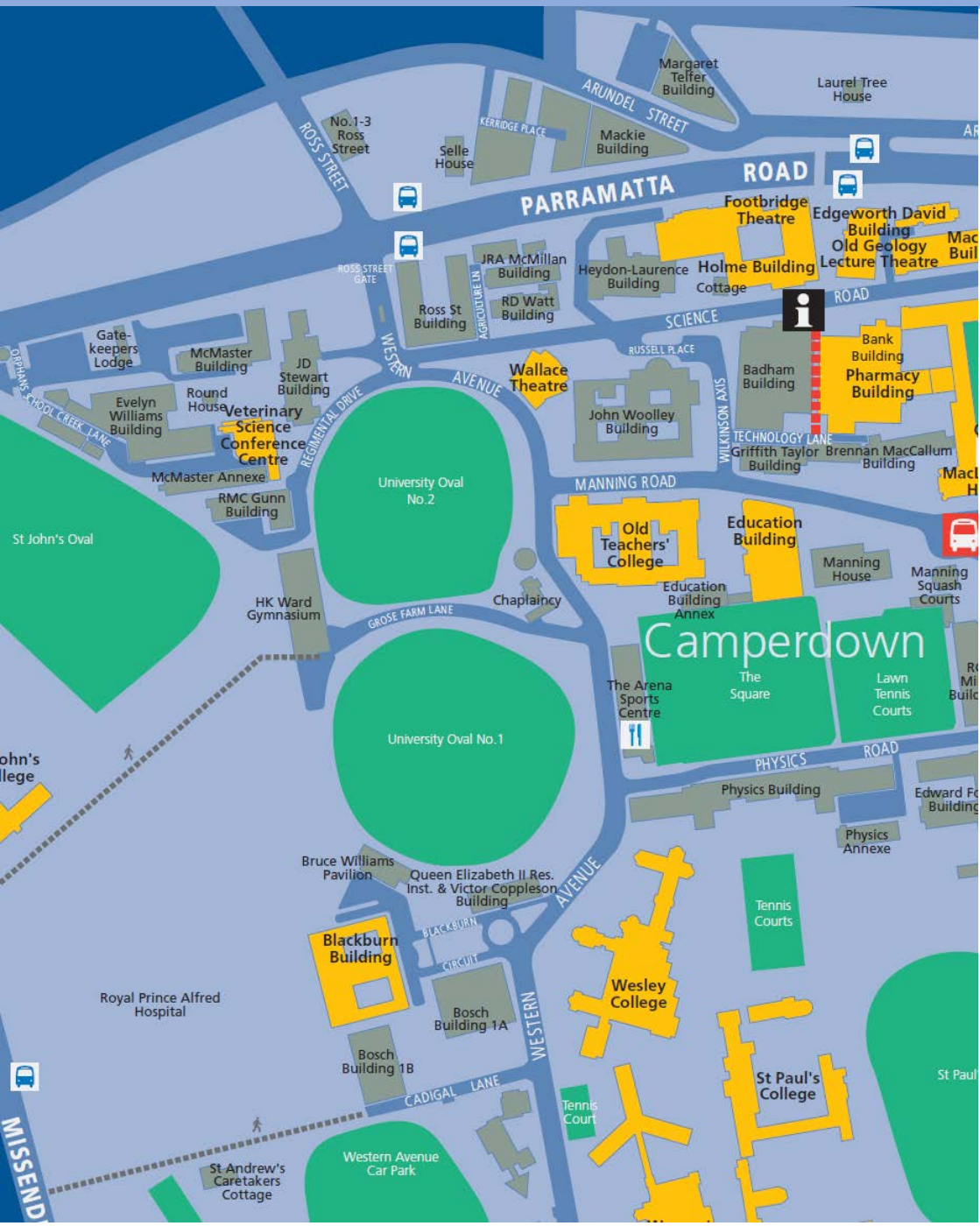
Excluding the New Law Building carpark, which is permit-holders only 6am-3pm Monday to Friday. Please use the Shepherd Street carpark during these hours.

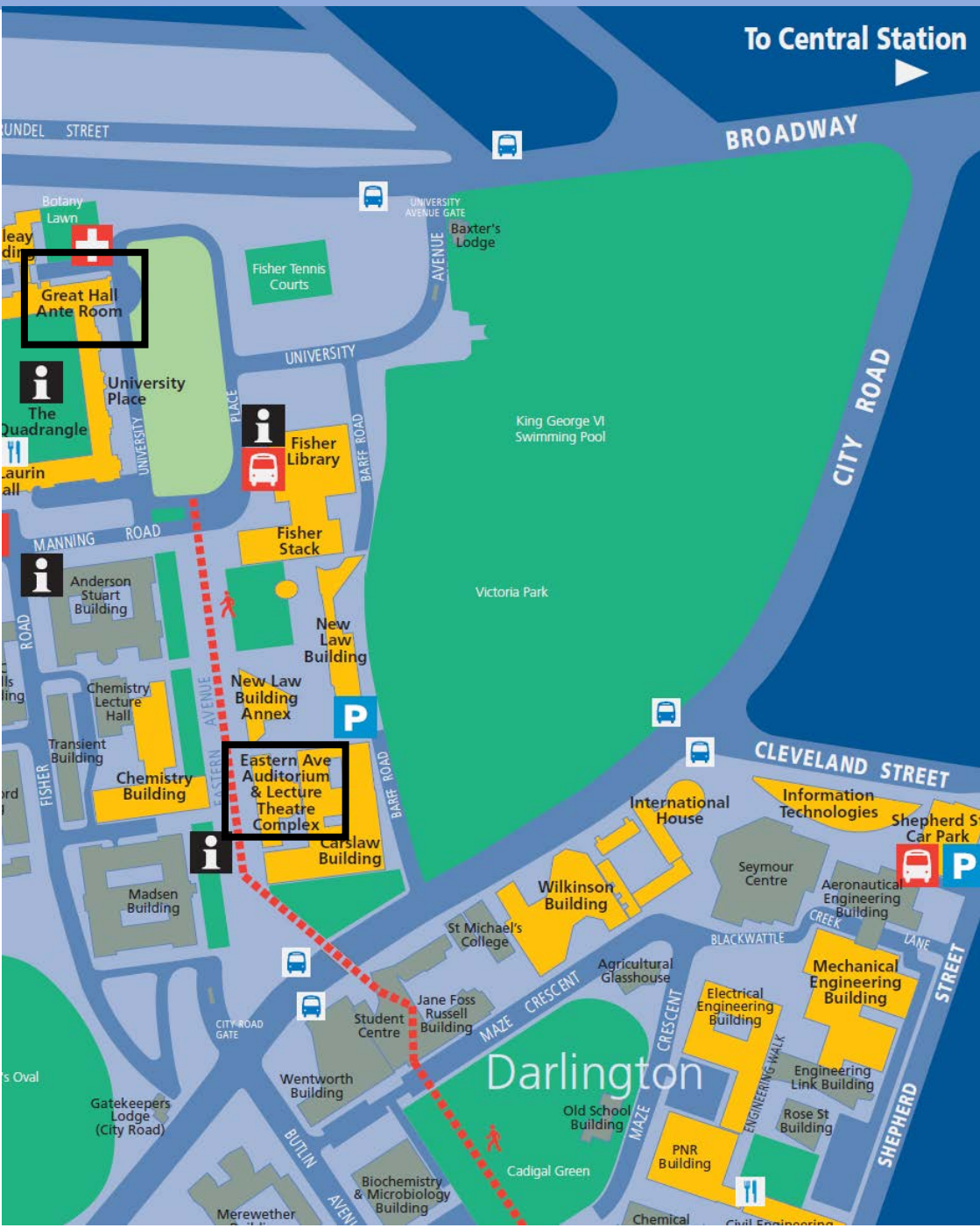
- Shepherd Street carpark

Fee: $4 per hour (to maximum $24) or $24 flat rate (valid to 6am next morning)

Evening and weekend casual parking rates (3pm–6am, Monday to Friday; 6am Saturday to 6am Monday)

# AUSCTW 2019


Margaret Telfer Building
Laurel Tree House
ARUNDEL STREET
No.1-3 Ross Street
ROSS STREET
KERRIDGE PLACE
Selle House
Mackie Building
PARRAMATTA ROAD
Footbridge Theatre
Edgeworth David Building
Old Geology Lecture Theatre
ROSS STREET GATE
JRA McMillan Building
Heydon-Laurence Building
Holme Building
Cottage
Ross St Building
AGRICULTURE LN
RD Watt Building
SCIENCE ROAD
Gate-keepers Lodge
McMaster Building
JD Stewart Building
WESTERN AVENUE
Wallace Theatre
RUSSELL PLACE
Bank Building
Pharmacy Building
Badham Building
ORPHANS SCHOOL CREEK LANE
Evelyn Williams Building
Round House
Veterinary Science Conference Centre
REGIMENTAL DRIVE
John Woolley Building
WILKINSON AXIS
TECHNOLOGY LANE
Griffith Taylor Building
Brennan MacCallum Building
McMaster Annexe
RMC Gunn Building
University Oval No.2
MANNING ROAD
Old Teachers' College
Education Building
Manning House
Manning Squash Courts
St John's Oval
HK Ward Gymnasium
GROSE FARM LANE
Chaplaincy
Education Building Annex
Camperdown
The Square
Lawn Tennis Courts
The Arena Sports Centre
University Oval No.1
PHYSICS ROAD
Physics Building
Physics Annexe
Bruce Williams Pavilion
Queen Elizabeth II Res. Inst. & Victor Coppleson Building
AVENUE
Tennis Courts
BLACKBURN CIRCUIT
Blackburn Building
Wesley College
Royal Prince Alfred Hospital
Bosch Building 1A
WESTERN
Bosch Building 1B
CADIGAL LANE
St Paul's College
Tennis Court
St Andrew's Caretakers Cottage
Western Avenue Car Park


To Central Station
BROADWAY
CITY ROAD
CLEVELAND STREET
Botany Lawn
Great Hall Ante Room
University Place
The Quadrangle
Fisher Tennis Courts
UNIVERSITY AVENUE GATE
Baxter's Lodge
AVENUE
UNIVERSITY
PLACE
Fisher Library
BARFF ROAD
King George VI Swimming Pool
MANNING ROAD
Fisher Stack
Victoria Park
Anderson Stuart Building
New Law Building
New Law Building Annex
Chemistry Lecture Hall
Transient Building
Chemistry Building
Eastern Ave Auditorium & Lecture Theatre Complex
Carslaw Building
Madsen Building
International House
Information Technologies
Seymour Centre
Wilkinson Building
Aeronautical Engineering Building
St Michael's College
BLACKWATTLE LANE
Agricultural Glasshouse
Mechanical Engineering Building
Jane Foss Russell Building
MAZE CRESCENT
Electrical Engineering Building
Student Centre
CITY ROAD GATE
Darlington
Wentworth Building
ENGINEERING WALK
Engineering Link Building
Old School Building
Rose St Building
Gatekeepers Lodge (City Road)
PNR Building
Cadigal Green
Biochemistry & Microbiology Building
SHEPHERD STREET

# AUSCTW 2019

## Program at a Glance

| | Wednesday Feb 6 | Thursday Feb 7 | Friday Feb 8 |
|---|---|---|---|
| 8.15am - 9.00am | Registration | Registration | Registration |
| 9:00am - 9.10am | Conference Opening | Announcements | Announcements |
| 9.10am -10.10am | Keynote Talk<br>Prof. Xiaojing Huang<br>*University of Technology Sydney* | Keynote Talk<br>Dr. Zhibo Pang<br>*ABB Corporate Research, Sweden* | Keynote Talk<br>A/Prof. Vincent Y.F. Tan<br>*National University of Singapore* |
| 10.10am-10.40am | Morning Tea | Morning Tea | Morning Tea |
| 10.40am-11.00am | Invited Talk<br>A/Prof. Brian S. Krongold<br>*University of Melbourne* | Keynote Talk<br>Dr. David Soldani<br>*Huawei Australia*<br>(10.40am - 11.40am) | Invited Talk<br>Prof. Jinho Choi<br>*Deakin University* |
| 11.00am-11.20am | Invited Talk<br>Prof. Wei Xiang<br>*James Cook University* | | Invited Talk<br>Dr. Vera D. Miloslavskaya<br>University of Sydney |
| 11.20am-11.40am | Invited Talk<br>A/Prof. Xiangyun (Sean) Zhou<br>*Australian National University* | | Invited Talk<br>Dr. Shihao Yan<br>*Macquarie University* |
| 11.40am-12.00pm | Invited Talk<br>Dr. Gayathri Kongara<br>*Monash University* | Invited Talk<br>Dr. Ni Ding<br>*Data61* | Invited Talk<br>Dr. Wei Ni<br>*CSIRO* |
| 12.00pm-1.30pm | Lunch | Lunch | Lunch |
| 1.30pm-3.10pm | Poster Session | Poster Session | Close |
| 3.10pm-3.40pm | Afternoon Tea | Afternoon Tea | |
| 3.40pm-4.00pm | Invited Talk<br>Dr. Sina Vafi<br>*Charles Darwin University* | Invited Talk<br>A/Prof. Parastoo Sadeghi<br>*Australian National University* | |
| 4.00pm-4.20pm | Invited Talk<br>Dr. Kelvin Layton<br>*University of South Australia* | Invited Talk<br>Dr. Lei Yang<br>*University New South Wales* | |
| 4.20pm-4.40pm | Invited Talk<br>Dr. Qinghua Guo<br>*University of Wollongong* | Invited Talk<br>Dr. Changyang She<br>*University of Sydney* | |
| 4.40pm-5.00pm | Invited Talk<br>Dr. Jingge Zhu<br>*University of Melbourne* | Demo 1<br>Dr. Wibowo Hardjawana<br>*University of Sydney* | |
| 5.00pm-5.20pm | Thesis Presentation | Demo 2<br>Dr. Yixuan Xie<br>*UNSW* | |
| 6.30pm-11.00pm | | Banquet<br>Great Hall | |