



Charles Sturt
University

Faculty of Business, Justice and
Behavioural Sciences

School of Computing, Mathematics
and Engineering

HDR Conference

16-17 November 2022

DAY 2 - 17 November 2022

09:30 am – 12:30 pm (AEST)
Breakout Rooms 1 and 2,
RSL Club, Wagga Wagga

HDR Conference 2022

The New HDR Environment, Industry and Commercialisation

Welcome to an exceptional event showcasing higher degree research from across Charles Sturt University's academic disciplines.

This conference provides HDR students the opportunity to present and discuss their research with peers, academics, industry partners and other major stakeholders of the University. The conference will include presentations from distinguished keynote speakers on specialized topics, project teams and Charles Sturt Research support teams.

Event information

Hosted by the Faculty of Business, Justice and Behavioural Sciences Associate Professor Ramudu Bhanugopan Sub-Dean (Graduate Studies).

Where: Wagga RSL Club

Start: 12pm Wednesday 16 November 2022

Finish: 1pm Thursday 17 November 2022

More information: <https://bjbs.csu.edu.au/research/hdr-conference>

YINDYAMARRA WINHANGANHA'

THE WISDOM OF RESPECTFULLY KNOWING HOW TO LIVE WELL IN A WORLD WORTH LIVING IN

We pay our respect to all First Nations elders both past and present from the lands where Charles Sturt University students reside. In particular, we acknowledge the Wiradjuri, Ngunawal, Gundungarra and Birpai peoples of Australia, who are the traditional custodians of the land where Charles Sturt University campuses are located.

Message from the Head of School

On behalf of the School of Computing and Mathematics, I welcome you to the 2022 Higher Degree Research (HDR) Conference.

Through its strong focus on and commitment to research, the School of Computing and Mathematics provides high level learning, mentoring and guidance in research supervision. Our academic staff are dedicated to our students to ensure a challenging and rewarding academic and research experience.

The School is home to about 43 academic researchers and 68 Higher Degree Research (HDR) students, working in the ICT and Mathematics disciplines. Our research focuses applied research in computing science, ICT security and applied mathematics and statistics which benefit the communities in our region. The research areas are Computational Intelligence, Cyber Security, Simulation and Modelling, Data Science Research, and Mathematics and Statistics.

Our research staff have enjoyed success in winning competitive research grants from the Australian Research Council (ARC), Mass Mining Technology (MMT) consortium, Wine Australia, Department of Industry, Innovation, and Science, and several other industry funding. Our researchers work in close collaboration with Cyber Security Cooperative Research Centre (CSCRC), CSU research centres or units like Graham Centre for Agricultural Innovation, National Wine and Grape Industry Centre (NWGIC), Institute for Land Water & Society (ILWS), and Data Science Research Unit. Our publication profile has also been significantly improved with the great increase in high-ranking journal publications. Research in Artificial Intelligence and Image Processing (FOR 0801) at CSU received a rating of world class in the ERA evaluation.

As a HDR student in the School of Computing and Mathematics you have access to highly experienced supervisors and mentors who can support and guide your research. You will have the opportunity to meet and develop ties with many of these supervisors along with other HDR students during the 2022 HDR Conference.

Once again, welcome, and I hope you enjoy the 2022 HDR Conference.

Associate Professor Irfan Altas

Head, School of Computing Mathematics and Engineering
Charles Sturt University

Day 2 Program (17 November)

Breakout Room 1 – Computing, Mathematics and Engineering (Mirage Room)

Session Chairs – Dr Quazi Mamun and Prof Manoranjan Paul

9:35am	Dr Quazi Mamun	Introduction
9:40am	Peter Dodds	Writer-Reader relationships
10:00am	Anne Chidgey	Accelerating the value of AIOps to server support in a managed services provider: a mixed methods, case study
10:20am	Ehtesham Ferdous	AI based SDN network operation centre (Online)
10:40am	Scott Atkinson	Non-haptic user interfaces in a post-covid environment
11:00am	Dristi Datta	Regression model performance analysis for soil nitrogen prediction with remote sensing data
11:20am	Jamil Ispahany	Machine learning techniques to detect ransomware: a brief review
11:40am	Ramin Ghorashi	An Evaluation of Organisation's Data Sharing and Privacy Risks
12:00pm	Mahir Habib	Cattle Information Events - Extending data schemas to meet the needs of the Australian red meat industry
12:15pm	Hürol Türen	Analysing the Forum Activities Inside the Dark Web (Online)
12:30pm	Return to main auditorium (Mirage Room)	

Breakout Room 2 - Computing, Mathematics and Engineering (Fife Room)

Session Chairs – Dr Michael Bewong and Dr Anwaar UIHaq

9.35am	Dr Michael Bewong	Introduction
9:40am	MD Ershadul Haque	A hybrid approach to represent and compress quantum image
10.00am	Demogene Smith	Identifying the role Information technology plays in the disconnect in operational delivery in public healthcare (Online)
10:20am	MD Rafiqul Islam	Video de-raining by combining physical features and data-driven network
10:40am	Muhammad Rana	A Key Management Scheme for Lightweight Block Cipher
11:00am	Peter Padiet	Malicious insider threats to data integrity
11:20am	Mehedi Tajrian	Misinformation analysis
11:40am	Gnanakumar Thedchanamoorthy	Privacy-preserving data collection for statistical aggregation
12:00pm	Faranak Tohidi	Effective Video-based point cloud compression
12:30pm	Return to main auditorium (Mirage Room)	

Presentation abstracts

In alphabetical order

Scott Atkinson

Non-Haptic User Interfaces in a Post-Covid Environment

The subject of my research over the past years has been 3D Virtual Environment User Interfaces with Non-Haptic input. It is a very specific study into what future human-computer interfaces could be, with some minor impact on currently used interfaces, and how they can be viewed and accessed differently. The major outcome from this research has been its relevance to the real world, how could this benefit the greater community. This paper has is an outline of how my research into user interfaces (UI) can be used. What was originally pure research into future user interfaces, due to the worldwide pandemic, can this research be implemented in a practical manner that could have benefits in the wider community.

Anne Chidgey

Accelerating the Value of AIOps to Server Support in a Managed Services Provider: A Mixed Methods, Case Study

The goal of this study is to identify strategies that help a Managed Services Provider quickly get the most value for server support out of their investment in AIOps (Artificial Intelligence for IT Operations). This is currently an issue because AIOps tools are expensive to purchase and time consuming to deploy. AIOps is an emerging, immature technology, however it promises to bring cost savings and labour efficiencies to IT support which is attractive to a Managed Services Provider as a competitive business advantage. The current research is focused upon the qualities and potential business benefits of the toolset itself in theoretical IT environments rather than studies set in production IT environments. Complexity and multiple monitoring data sources in modern IT systems is making it difficult for human systems engineers to maintain system performance and availability. AIOps commercial tool vendors sell the promise that an AIOps tool allows an organisation to drastically reduce labour effort while increasing an IT environments availability in today's complex IT world. This study is to observe and analyse real-world deployments using a mixed methods, case study approach, of the same AIOps tool being deployed to a variety of different customer IT environments under support by the same Managed Services Provider. The case study approach has an aim to generate knowledge from practice and highlight AIOps best practises that reduce the implementation time. AIOps is an area where more research is required.

Dristi Datta

Regression Model Performance Analysis for Soil Nitrogen Prediction with Remote Sensing Data

Soil moisture, soil organic carbon, and nitrogen content prediction are considered significant fields of study as they are directly related to plant health and food production. Direct estimation of these soil properties with traditional methods, for example, the oven-drying technique and chemical analysis, is a time and resource-consuming approach and can predict only smaller areas. With the significant development of remote sensing and hyperspectral (HS) imaging technologies, soil moisture, carbon, and nitrogen can be estimated over vast areas. This paper presents a generalized approach to predicting three different essential soil contents using a comprehensive study of various machine learning (ML) models by considering the dimensional reduction in feature spaces. In this study, we have used three popular benchmark HS datasets captured in Germany and Sweden. The efficacy of different ML algorithms is evaluated to predict soil content, and significant improvement is obtained when a specific range of bands is selected. The performance of ML models is further improved by applying principal component analysis (PCA), a dimensional reduction method that works with an unsupervised learning method. The effect of soil temperature on soil moisture prediction is evaluated in this

study, and the results show that when the soil temperature is considered with the HS band, the soil moisture prediction accuracy does not improve. However, the combined effect of band selection and feature transformation using PCA significantly enhances the prediction accuracy for soil moisture, carbon, and nitrogen content. This study represents a comprehensive analysis of a wide range of established ML regression models using data preprocessing, effective band selection, and data dimension reduction and attempt to understand which feature combinations provide the best accuracy. The outcomes of several ML models are verified with validation techniques and the best- and worst-case scenarios in terms of soil content are noted. The proposed approach outperforms existing estimation techniques.

Peter Dodds

Investigation of reader's emotional response to AI-generated stories

The project examines the marriage between creativity, storytelling and technology and explores what it is that makes good storytelling compelling and engaging and able to emotionally connect with an audience. The research will investigate whether Artificial Intelligence (AI) is able to create compelling narratives that engage and emotionally affect an audience and how important knowledge of the identity of the author plays in audience/author attachment. It will examine AI written output from the point-of-view of the reader or the audience rather than from a technical or generation method point-of-view. Developing techniques to streamline and assess emotional criteria requires a deep understanding of emotions, emotional connection and emotional responses and the bond between the author/writer and the audience. This requires recognising the importance of empathy and emotional connection in storytelling. Injecting empathy could also go some way to enabling AI to create contextually correct, emotionally challenging narratives. As part of the research exercise, the project proposes to create a suite of emotional connection metrics based on existing empirically proven, theoretically derived methodologies that measure emotional reactions. The research will investigate what elements are necessary for a story to be good and how these can be reliably measured or identified. With these two pieces of information, the final stage of the research will endeavour to create a matrix where story elements and emotional reactions can be correlated. With this correlated table, the story elements that elicit an intense or lack of intense response can be identified. This ability to identify or codify story elements will be useful for authored works by both humans and AI. It will also potentially provide pointers to ways to apply this knowledge to other creative endeavours such as the creation of visual material, moving image or audio-based media. The final question is not only can AI write as well as a human, but can it also garner strong emotional responses from an audience. Using this knowledge, the work of humans and AI can benefit by having better, more precise awareness of what works and what does not work. The creative arts and business will potentially benefit from the research project by having access to the research results and the refinement and adaptation of measurement methods to evaluate their own material. While it is not known how an audience will react to AI-created material and there is limited research looking at specifically author/audience attachment, the results will serve to provide a basis for understanding audiences in greater depth. This can benefit writers, producers, people who commission media, educators, and businesspeople. By better understanding, all authored material – AI and human - can be refined and polished. If or when AI achieves high-level, intense connections with an audience, then its storytelling will have the ability to be more immersive, more challenging, more compelling, and ultimately, more enjoyable.

Ehtesham Ferdous

AI based SDN Network Operation centre

The growing demand of network is highest ever. It is predicted that by next decade there will be about 6 trillion new users. Every single network is run and operated by a central hub known as network operation center. With the growing number NOC, there demand for a flawless network and network management system is very significant. Our research is based on a future proof network operation center that can handle the growing number of user and SDN to implement a dynamic network change management system. There have been no significant changes to the networking architecture since the start of modern networking however with the growing number of demand and its infrastructure requires more prune to failure and vulnerable to the existing and new threats. This research focuses on a Network Operation center that is capable of self-monitor and

manage using Artificial intelligence and machine learning. SDN or software defined network is archetype shift of exiting network infrastructure. SND has capability of managing and monitoring a network based on software rather than traditional human intervention. Traditional network is usually operates based on pre-defined values eg. Routing table. SDN works on smart network path determination algorithm and thus determining the next hop packet movement based on the control pane instruction. This will result in more cost efficient, faster and secure network.

Ramin Ghorashi

An Evaluation of Organisation's Data Sharing and Privacy Risks

Data sharing is considered an important method in organisations because it can provide information on processes and technologies to increase the organisational efficiency and performance. Although data sharing is beneficial for organisation's growth, however it can sometimes be challenging for some types of organisations due to privacy risks. Many organisational models such as business-to-consumer (B2C) or consumer-to-consumer (C2C) engage with other organisations simply to exchange personal data to receive services or goods. While the privacy regulations need organisations to obey the privacy principles by disclosing the details of the personal data that is collected from the consumers, there is no guidance on how these policies should be disclosed. Thus, many organisation's privacy policy's content varies to one another and understanding the relationship of these organisations can then become complicated. Our goal of this study is to develop methods to measure disclosed personal data to third party organisations, measure the privacy risks involved and analyse whether the disclosed data to the third-party organisation violates the privacy policy of the main organisations.

Mahir Habib

Cattle Information Events - Extending data schemas to meet the needs of the Australian red meat industry

During the last forty years, data-driven genetic improvements have resulted in a doubling of milk yield. Improved data standards enhance productivity, costs, and market access. Beef production has seen lower rates of genetic improvement and would benefit from data standardization. Data standardization, including an event-based data schema will improve performance recording data capture, storage, and consumption. The International Community for Animal Recording (ICAR) already developed a livestock data schema. Meat and Livestock Australia (MLA) extended ICAR's schema to deliver data standardization. This article demonstrates how those schemas can be further enhanced, modified, and used as event information messaging frameworks for data management and reduce costs in sharing information between the two systems. This new schema LEI (Livestock Event Information) improves traceability, genetic improvement, and business management, allowing third-party equipment and software manufacturers to utilize the data schemas to standardize their data flows. In the future, LEI can be updated to include poultry, seafood, and other agriculture sectors.

Md Ershadul Haque

A hybrid approach to represent and compress quantum image

In recent years, quantum image processing got a lot of attention in the field of image processing due to the opportunity to place huge image data in quantum Hilbert space. Moreover, several types of research show that the computational time of the quantum processes is faster than a classical computer. Encoding and compressing the image in the quantum domain is still a challenging issue. From the literature survey, we have proposed a hybrid approach consisting of the DCT ((Direct Cosine Transform) and EFRQI (Efficient Flexible Representation of Quantum Image) approach to represent and compress the gray image. The objective of this work is to represent and compress various gray image sizes. 16 numbers of qubits are used to represent the coefficient and its position of a grayscale image. Among those, 8 qubits are used to map the coefficient values and the rest are used to generate the corresponding coefficient XY-position. Theoretical analysis and experimental results show that the proposed DCTEFRQI scheme provides better representation and

compression compared to DCT-GQIR, DWT-GQIR, and DWT-EFRQI in terms of PSNR(Peak Signal to Noise Ratio) and bit rate.

Md Rafiqul Islam

Video De-raining by Combining Physical Features and Data-Driven Network

Capturing images in challenging conditions degrades the quality of the images, for example, during rain. These external phenomena create low contrast and blur, reducing the images' visibility. The reduced visibility affects many computer vision applications like visual traffic surveillance, intelligent vehicles, and entertainment. Rain streak removal is an essential issue in outdoor vision systems and has recently been investigated extensively, as rain can significantly reduce visibility. Recently, many approaches have been proposed to remove rain streaks from video sequences. Some approaches are based on physical features, and some are based on data-driven (i.e., deep-learning) models. Although the physical features-based methods have better rain interpretability, the challenges are extracting the appropriate features and fusing them for meaningful rain removal. The rain streaks and moving objects have dynamic physical characteristics and are difficult to distinguish. Additionally, the outcome of the data-driven models mostly depends on variations relating to the training dataset. It isn't easy to include datasets with all possible variations in model training. This paper addresses both issues and proposes a novel hybrid technique where we extract novel physical features and data-driven features and then combine them to create an effective rain-streak removal strategy. The experimental result shows that the proposed method outperforms the other methods in terms of subjective, objective, and object detection comparisons for synthetic and real rain scenarios by removing rain streaks and retaining moving objects more effectively.

Jamil Ispahany

Machine learning techniques to detect ransomware: A brief review

Ransomware attacks are increasing both in frequency and impact. Since the COVID-19 pandemic, more people work online as companies have been forced to adapt rapidly. This has created ample opportunities for cybercriminals to launch devastating online attacks. One method malicious actors have used recently is to infect corporate networks with ransomware to siphon off millions of dollars in profits. Falling under the category of malware, ransomware encrypts sensitive data and demands payments from the victim to retrieve the encryption keys to decrypt their data. This attack style has become so prolific that governments have launched task forces to fight against the growing ransomware threat, even sectioning ransomware groups. Despite this, defending against ransomware attacks has proved to be an uphill battle. To mitigate the risk of ransomware, the research community has increased their focus on detecting ransomware. Unfortunately, many of these proposals can only detect ransomware after thoroughly executing, which is not ideal in real-world scenarios. On this basis, we review ransomware detection throughout the literature focusing on their machine learning techniques and algorithms. Finally, we discuss the limitations of previous studies.

Peter Padiet

Malicious insider threats to data integrity

Insider threats continue to present a growing threat for the information security community. Malicious insider threat is characterised as one of the most damaging threats to networked systems for enterprises and government agencies. There is a distinctive set of challenges that are associated with insider threat detection in terms of massive, unbalanced data, and limited ground truth. The insider threat is the most common internal cyber security challenge for organisations, financial enterprises, and governmental agencies where many former and current employees misuse their positions of trust by interrupting regular organisational functions, while others transmit classified information or confidential data for personal or group benefits. This research uses the CERT dataset r4.2 and a series of other machine learning classifiers to predict the occurrence of a specific malicious insider threat scenario. These algorithms have been aggregated into a meta-classifier which

have a stronger predictive performance that are better than its component models. This paper describes a methodology for performing pre-processing on an organisational data log into day-to-day user summaries for classification, that can be used to track multiple classifiers.

Muhammad Rana

A Key Management Scheme for Lightweight Block Cipher

Modern cryptography's fundamental purpose is to safeguard the information resource by making it completely impenetrable and beyond compromise. Key management is a crucial integral part of cryptography, and especially, is a challenging issue for Internet of Things (IoT) devices because of their limited resources and high exposure. The main objective of this research is to design a robust key management protocol that can be implemented in a lightweight block cipher for the Internet of Things. The proposed key management is based on the pre-distribution of the partial key to make it lightweight and secure. This article proposes a lightweight key management scheme for IoT networks based on a cluster topology. Detailed information regarding the scenario-based functionality of the protocol is provided. Analyses of the suggested key management scheme's security have demonstrated its robust resistance to a variety of attacks. Based on the results of the performance evaluation, it is clear that the suggested key management technique can be used for lightweight block cipher in resource constrained IoT networks since it consumes less power and requires less storage space.

Demogene Smith

Identifying the role Information technology plays in the disconnect in operational delivery in public healthcare

With the growing collection and availability of data, and the supporting technology-based systems within healthcare, efficiency and performance insights should allow new and innovative methods to support health outcomes. The research will use empirical research modelling techniques and known frameworks to study several technology-supported and data-related frameworks. This data will link index-based care modelling, strategic planning, and operational dynamics. Specifically, reviewing formal frameworks and performance metrics required to deliver healthcare services in a public setting, informed by a historic research review, argument assessment and literature review, to provide a foundational background. It will further address healthcare information issues through a multi-method approach comparing the known generic frameworks and modelling techniques against the information technology-based business solutions. Finally, using a case study and technology to compare ten previous years of service-based performance outcomes and costings against the strategic plans.

The paper will use counterfactual simulations to ascertain if hospitals/ health services had more information regarding their behaviours and could incorporate it into planning processes, would the outcome be different. The outcomes of this study would reduce operational burden, improve strategic services alignment, and meet public value more effectively and efficiently.

Mehedi Tajrian

Fake News Analysis

Gnanakumar *Thechanamoorthy*

Privacy-preserving data collection for statistical aggregation

Local Differential Privacy (LDP) is a widely adopted technique to provide privacy guarantee to participants of data collection that aims to learn aggregate statistics. However currently available LDP mechanisms provide reasonably accurate statistics only when the data-set size is very large, in the scale of tens of thousands or millions. This research focuses on devising a novel approach for using LDP, to gather usable statistics, from smaller datasets as well. Unlike the other contemporary attempts seen in literature, we intend to focus on behavioural aspects of human nature and incorporate them in the privacy utility trade-off. This opens a new paradigm for privacy preservation in LDP. We will explore the diversity in user expectations about privacy and utility, and incorporate such expectations in an optimized way to achieve our research goal.

Faranak *Tohidi*

Effective Video-based Point Cloud Compression Using Slicing

A point cloud, a set of unordered points representing objects or scenes, recently received much attention in many fields, such as virtual reality (VR) and augmented reality (AR), since point clouds can mimic the real world's natural reality. However, a point cloud, especially a dynamic one which consists of a sequence of static point clouds, must be compressed efficiently to be practical and realistic. Video-based Point Cloud Compression (V-PCC) is the latest coding standard for the point cloud. V-PCC normally divides a point cloud into some patches and then projects onto 2D planes to apply existing video coding techniques. Generating patches and 2D projection result in losing the points' proximity and even losing some original points. Consequently, the efficiency of video coding decreases, and some artifacts appear, degrading the contents and adversely affecting the user's perception. To overcome these problems, the proposed method introduces two steps of slicing the dynamic point cloud, focusing on the similar shape proximity and amount of self-occluded points. The first step aims to maintain the proximity of the points and, therefore, to increase the efficiency of 2D video coding. The second step aims to reduce data loss by considering and including those points at risk of occlusion; therefore, these two steps can reduce the number of artifacts, resulting in a better quality of the reconstructed point cloud.

Selahattin *Hürol Türen*

Analysing the Forum Activities Inside the Dark Web

Cybercriminal activities threaten the world since the invention of the World Wide Web. Today, cybercriminals can achieve their malicious activities easier, because of the new IoT technologies and the anonymous communications methods on the Internet. Child pornography, drug dealing, human trafficking, Distributed Denial of Service (DDoS) attacks are examples of those malicious activities. Cybercriminals can communicate with each other anonymous through Dark Web, which is subset of Deep Web.

What I aim for my research is to detect illegal forum activities in the Dark Web. After I can detect the illegal activities through Machine Learning algorithms, I can use the detected illegal activities in a new developed cybersecurity maturity model. from The Prevention Detection Response Recovery (PDR²) model by Kenneth Eustace et al. (2018). Cybersecurity maturity model will have a standard for other developers and researchers, who will work with the illegal activities in the Dark Web.