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Department of Computer Science and Software Engineering

2018 Departmental Postgraduate Conference

6 & 7 September 2018

Lecture Theatre 031
Jack Erskine Building

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SEEQUENT

Thursday 6 September (Jack Erskine room 031)

Session 1 *Chair Tanja Mitrovic* **CS Honours/Masters** (Judges: Tanja Mitrovic, Andreas Willig, Tim Bell)	
9:20	**Welcome: Richard Green** **Keynote Speaker: Dr Ray Hidayat** (Verizon Connect): Software Simplicity
10:00	**Ke He**: Malware Detection with Malware Images using Deep Learning Techniques
10:15	**Anthony Yin:** Improved vertex skinning algorithms using dual quaternions for real-time 3D character animation
10:30	**David Mackay:** Analysis of Contour Based Reconstruction Algorithms for Applications in Medical Imaging
10:45	**Xiran Zhang**: Generative Adversarial Networks for Intrusion Detection
11:00	***MORNING REFRESHMENTS upstairs in the level 2 tea room***
Session 2 *Chair: Andreas Willig* **Masters** (Judges: Tanja Mitrovic, Andreas Willig, Tim Bell)	
11:30	**Cole Dishington**: Simulating Flexible Random IP Multiplexing
11:45	**Nic Robinson-O'Brien**: Application of an algebraic framework to show correctness of Boruvka's minimum spanning tree algorithm
12:00	**Rajat Arora**: Measuring the Impact of CS Unplugged among New Zealand's Primary and High School Teachers
12:15	**Chris Carr**: Deep learning based species recognition from thermal images
12:30	***LUNCH upstairs in the level 2 tea room***
Session 3 *Chair: Tim Bell* **PhD** (Judges: Walter Guttmann, Mukundan, Kourosh Neshatian)	
1:30	**Dan Barry**: UAV Search Behaviour for Wireless Transmitter Detection
1:45	**Simon Yusuf-Enoch**: Multi-Objective Security Hardening Optimisation for Dynamic Networks
2:00	**Matthew Young**: LiDAR Terrain Mapping with an Autonomous Ground Vehicle
2:15	**Huyuan Shangguan**: 3D Human Pose Estimation with a single RGB Camera
2:30	***AFTERNOON REFRESHMENTS upstairs in the level 2 tea room***
Session 4 *Chair: James Atlas*	
3:00	**Sam Schofield**: Mocap-camera calibration using circle detection
3:15	**Ori Ganoni**: Visually Realistic Simulation of Remotely Operated Underwater Vehicles
3:30	**Geela Fabic**: Supporting Novices and Advanced Students in Acquiring Multiple Coding Skills
3:45	**Dibash Basukala**: Segmentation of Substantia Nigra for the automated characterisation of Parkinson's disease

Friday 7 September (Jack Erskine room 031)

Session 5 *Chair: Fabian Gilson*	
10:00	**Bilal Ishfaq**: A Network level defence for IoT: a prototype IoT Networks Implementation
10:15	**Faiza Tahir**: Extending Worked Examples in ITS: from static to adaptive
10:30	**Sarmad Soomro**: In-Vehicle Touchscreens: Reducing Attentional Demands and Improving Performance
10:45	**Amelia Samandari**: MAC Protocols for UAV Formations
11:00	***MORNING REFRESHMENTS upstairs in the level 2 tea room***
Session 6 *Chair: Walter Guttmann*	
11:30	**Ashley Williams:** Evaluating the quality and use of grey literature for software engineering research
11:45	**Matthew Ruffell**: Automating Vulnerability Discovery and Reproducibility in Operating System Kernels with Symbolic Execution
12:00	**Rosalyn Rough**: Datamining of Bloodstain Patterns
12:15	**Haipeng Li**: Applications of multifractal methods in digital mammogram enhancement and micro calcification detection
12:30	***LUNCH upstairs in the level 2 tea room***
Session 7 *Chair: Mukundan*	
1:30	**Matthew Edwards**: Statistical Distribution of Checkerboard Corner Detection Error
1:45	**Andrew Curtis-Black**: An Enterprise Policy Description Framework for Software Defined Networking
2:00	**Caitlin Duncan**: Reported Development of Computational Thinking through Computer Science and Programming, and it's benefits for Primary School students
2:15	**Kashif Amanullah**: Teaching Computer Programming to Junior and Secondary School Children using Elementary Patterns
2:30	***AFTERNOON REFRESHMENTS* upstairs in the level 2 tea room**
Session 8 *Chair: Kourosh Neshatian*	
3:00	**Oliver Batchelor**: Machine Assisted Image Annotation
3:15	**Josh McCulloch**: Automated conductor recovery from vehicle mounted LIDAR for dynamic line rating
4:00pm	**Social gathering/Awards Ceremony in the Staff Club** Location: www.staffclub.canterbury.ac.nz/contact.shtml

Abstracts

Keynote Speaker

Dr Ray Hidayat - Verizon Connect
Ray Hidayat graduated with a PhD in Computer Science from the University of Canterbury in 2010. He then signed up as a software engineer at Telogis (now Verizon Connect), starting in a team of 4 people.
Since then, he has helped develop the processes necessary to support a growing team in a growing company, as well as develop the algorithms to optimize routes for thousands of deliveries and constraints.
Software Simplicity
Managing complexity is the ultimate challenge of software development. Ray has worked for 8 years at Verizon Connect, and in that time seen many cycles of products go from inception to legacy. In this talk, Ray will share his experiences on how software is made and remade, with examples returning to the overarching theme that when you overcome the complexities and arrive at the simple solution, you can actually get code that solves more real-world problems with less code and fewer headaches. You can get more for less.

CS Honours

Ke He
Malware Detection with Malware Images using Deep Learning Techniques
Driven by economic benefits, the number of malware attacks is increasing significantly on a daily basis. Malware Detection Systems (MDS) is the first line of defence against malicious attacks, thus it is important for malware detection systems to accurately and efficiently detect malware. Current MDS typically utilizes shallow machine learning algorithms that require feature selection and extraction, which are time-consuming and error-prone. Deep learning based approaches are based on RNNs which are vulnerable to injecting redundant API calls. We propose a method to accurately detect malware with a Convolutional neural network based on greyscale visualisation of malware binary files, and test its effectiveness on adversarial inputs.

Masters

Anthony Yin
Improved vertex skinning algorithms using dual quaternions for real-time 3D character animation
Real-time deformation techniques enable realistic representations of 3D characters. Among abundant deformation methods developed in recent years, Dual Quaternion Skinning (DQS) gradually found popularity in academic research and industry production with its advantages over another popular deformation technique, Linear Blend Skinning (LBS). Although DQS provides high efficiency and brilliant simplicity to real-time deformation applications, it also has many well-known artefacts, such as bulging joint and distorted normal. Due to the popularity within a variety of applications, it is necessary to reduce these artefacts and retain the efficiency and simplicity. Our thesis to find a novel solution to correct the position per vertex in the vertex shader, and such a solution should remain at

the level of simplicity of LBS and have a minimum cost during runtime. The implication of our work provides developers with a new real time method to overcome DQS artefacts in industry productions.

David Mackay
Analysis of Contour Based Reconstruction Algorithms for Applications in Medical Imaging
Contour-based surface reconstruction in medical imaging refers to reconstruction of a 3-dimensional surface from extracted contours from traditional medical imaging systems such as HRCT or MRI scans. One specific area in contour reconstruction with a wide amount of interest is the branching problem. This refers to the issues that arise when attempting to reconstruct the branching structures that occur in organs. Some form of contour correspondence has to be achieved in order to generate branching structures in the reconstruction. Contour correspondence and the issue of point correspondence are difficult to test. Often it requires input from a medical practitioner as to whether a reconstruction is accurate or not. Preliminary testing however can be done during development with a synthetically generated model. Generating and testing specific cases such as branching structures may help show flaws or poor performance in contour-based surface reconstruction techniques early. This research aims to generate a test set of ground truth surfaces and sampled contour sets for commonly encountered cases in surface reconstruction. Additionally, it aims to use these test sets to compare existing reconstruction algorithms and introduce improvements where these algorithms show poor reconstruction accuracy. Early testing has been done with Hausdorff distance as a metric for the distance between reconstructed meshes and ground truth surfaces.

Xiran Zhang
Generative Adversarial Networks for Intrusion Detection
Generative adversarial networks (GANs) are a class of deep learning algorithms, implemented by two neural networks contesting with each other in a two-player game framework. GANs have been proved that they can effectively improve the performance of anomaly detection in computer version area in previous researches, which shows that they have high potential in intrusion detection to against growing demand for cyber security. In this paper, we leverage current GANs and its variants models to explore the use of GANs for the intrusion detection.

Cole Dishington
Simulating Flexible Random IP Multiplexing
Simulating Flexible Random IP Multiplexing (FRVM), a recent moving target defence protocol, will provide practical results to compare with pre-existing analytical results. FRVM is an address masking technique that randomly mutates IP addresses of protected hosts to avoid collection of static network configurations. Analytical results make a broad range of assumptions that do not reflect real-world packages, such as OpenFlow and Nmap. Obtaining practical results for security techniques is critical to confirming and increasing confidence in analytical results. Obtaining results involved a creating a simulated network testbed and adding FRVM's functionality to a SDN controller. Performance and security testing results for FRVM include timing extra functions required by FRVM and performing network reconnaissance on a variety of configurable parameters. Preliminary results have identified that TCP connect scan is the fastest scan to be completed against FRVM rather than the TCP SYN scan as would be expected. Scanning has shown to be far less accurate when FRVM is enabled, taking far longer than for a typical network environment with fewer open ports

discovered. The presentation will cover the testbed and implemented controller, testing methodology, and some preliminary results.

Nic Robinson-O'Brien

Application of an algebraic framework to show correctness of Boruvka's minimum spanning tree algorithm

Prior work has described an algebraic framework for proving the correctness of Prim's and Kruskal's minimum spanning tree algorithms. We intend to prove the correctness of an additional minimum spanning tree algorithm, Borůvka's, using the same framework. To this end, our results will be formally verified using the automated deduction capabilities of the Isabelle proof assistant. This work will further demonstrate the suitability of the framework as a sound abstraction for reasoning about weighted graph algorithms.

Rajat Arora

Measuring the Impact of CS Unplugged among New Zealand's Primary and High School Teachers

Various forms of curricula about computer science and programming are now being introduced all around the globe, and have become the part of New Zealand national curriculum since January, 2018. The main objective of this curriculum is to draw students' attention towards digital technology and develop computational thinking (CT) competency. In order to teach students, teachers are required to learn new concepts and techniques relating to introduction of Computational thinking and programming, and how to deliver them effectively in classrooms. Through previous research studies, we have found that teachers attending professional development workshops find "Computer Science Unplugged" activities as a useful tool to foster CT among students. Not only does it capture student interest, but it can have a direct effect on their learning and concept understanding. As teachers are the one delivering these concepts to students, we need to ensure teachers gets familiar with these concepts first, which is being done with the help of PD workshops. The aim of this study is to investigate primary and high school in-service teachers who are attending Professional Development workshops that use unplugged material to introduce them to the new curriculum, and how insights from their experience can be used to help teachers who are new to computational thinking.

Chris Carr

Deep learning based species recognition from thermal images

More accurate estimates of predators in NZ bush are needed to verify effectiveness of eradication efforts. We propose that a convolutional neural network be trained on 3-second-long clips of animals on a GTX1080 using Tensorflow to enable classifying pests (possums, mustelids, hedgehogs, rats, etc) based on both shape and motion. Two separate models are used; one designed to run on previously recorded footage, in the "optimal performance" case, and a second designed to perform real time identification in the field, i.e. a raspberry pi with a thermal camera attached. (In collaboration with industry partner, Cacophony and Matthew Aitcheson.

PhD

Dan Barry
UAV Search Behaviour for Wireless Transmitter Detection
Unmanned aerial vehicles (UAVs) provide exciting opportunities in the problem space of autonomous exploration, particularly for search and rescue (SAR) where an adaptive search method is required for a previously unmapped environment and to integrate new information as it becomes available from limited view sensors. The focus of this work is to explore the problem of wireless signal detection, where transmitter location, number of transmitters, transmitter channel model parameters and location of obstacles - is all unknown to the UAV agents prior to beginning a SAR scenario. The goal of the multi-agent exploration algorithm is to optimize the search time for an unknown number of transmitters and time taken to search the entire environment. The main research direction is to explore how to efficiently have multiple agents form their own cooperative search behaviours without centralized control, with robustness and adaptability being a driving factor. Through the use of a challenging discretized simulation environment, we investigate the practicality of an information-theoretic empowerment-driven search method with problem specific adaptations and assumptions, where we show that our empowerment-driven algorithm has practical potential and lays a foundation for future work in this area.

Simon Yusuf-Enoch
Multi-Objective Security Hardening Optimisation for Dynamic Networks
Hardening the dynamic networks is a very challenging task due to their complexity and dynamicity. Moreover, there may be multi-objectives to satisfy, while containing the solutions within the constraints (e.g., fixed budget, availability of countermeasures, performance degradation, non-patchable vulnerabilities, etc.). So, we propose a systematic approach to optimise the selection of the security hardening options for the dynamic networks given multiple constraints and objectives. To do so, we evaluate potential attack scenarios for a given time period, and then use a multi-objective optimisation based on Genetic Algorithm to find the optimal set of security hardening options. We measure the effectiveness of the options using various security metrics, which is demonstrated through experimental analysis. The results show that our approach can be applied to select the optimal set of security hardening options to be deployed for the dynamic networks given multiple objectives and constraints.

Matthew Young
LiDAR Terrain Mapping with an Autonomous Ground Vehicle
Terrain mapping methods typically have one or more major flaw. They can be time consuming, inaccurate, or (in the case of aerial vehicles) restricted by aviation laws. This can be a problem on industrial sites which need to be periodically re-mapped. Examples include construction sites, mines or stock piles. Mobile robotics can revolutionize an industry by providing a balance of accuracy, speed and repeatability not available using conventional methods. The objective of this research is to develop an autonomous ground vehicle (AGV) for highly accurate, earth-referenced, terrain mapping with an on-board LiDAR unit. The AGV will use a novel interpretation of geospatial surveying practices to maximize the positional accuracy of the output point cloud.

Huyuan Shangguan

3D Human Pose Estimation with a single RGB Camera

This work presents a method to capture the full global 3D skeletal pose of a human in a stable, temporally consistent manner using a single RGB camera. Our method combines a new convolutional neural network (CNN) based pose regressor with kinematic skeleton fitting. Our novel fully-convolutional pose formulation regresses 2D and 3D joint positions jointly and does not require tightly cropped input frames. A real-time kinematic skeleton fitting method uses the CNN output to yield temporally stable 3D global pose reconstructions on the basis of a coherent kinematic skeleton. Our method's accuracy is quantitatively on par with the best offline 3D monocular RGB pose estimation methods. Our results are qualitatively comparable to, and sometimes better than, results from monocular RGB-D approaches, such as the Kinect. However, we show that our approach is more broadly applicable than RGB-D solutions, i.e., it works for outdoor scenes, community videos, and low-quality commodity RGB cameras.

Sam Schofield

Mocap-camera calibration using circle detection

Motion capture (mocap) is commonly used to track the 3D pose of a camera to provide accurate ground-truth data for computer-vision algorithms such as visual odometry, SLAM and object tracking. However, it is challenging to manually align a mocap rigid-body with the optical-frame of a camera. We present a method to calibrate out the misalignment between the rigid-body and the camera's optical frame by detecting the markers in image space. We compare our approach to an existing method and show that it provides a more accurate calibration than the alternative.

Ori Ganoni

Visually Realistic Simulation of Remotely Operated Underwater Vehicles

Remotely Operated Vehicles are being increasingly used in several aerial, land and underwater applications such as inspection, photography, surveillance and recovery. In most cases such as drones and land vehicles, cameras and other vision sensors like depth sensors are attached to the body to provide real-time information, either to a remote operator or to an autonomous system. The need for visually realistic simulation becomes important under those circumstances to provide footage as close as possible to a real environment that could be used in computer vision experiments. The advancement in the game engine industry provides the tools for realistic simulation involving computer vision algorithms. The presentation will cover the latest achievements of our visually realistic simulation of ROVs in the underwater domain based on the "Unreal Engine 4" game engine, and also unique simulation models of an underwater tether and ocean plankton developed for our framework.

Geela Fabic

Supporting Novices and Advanced Students in Acquiring Multiple Coding Skills

In 2015, we started developing PyKinetic, a mobile Python tutor for novices designed for Android smartphones, as a complement to traditional courses. The overall goal of our project is to design programming activities that maximize learning. We present our study on PyKinetic with various activities to target several skills: code tracing, debugging, and code writing. Half of the participants received the exercises in a fixed order (control group), while the other half received problems that were selected adaptively, based on their performance (experimental group). In this presentation, we discuss findings from the study and highlight differences between students with lower pre-existing knowledge (novices) with those who have higher pre-existing knowledge (advanced).

We hypothesized that: 1) novices will benefit more than advanced students, and 2) advanced students in the experimental group will benefit more than those in the control group. The results confirmed our first hypothesis 1), that this version of PyKinetic was more beneficial for novice learners.

Moreover, novices showed evidence of learning multiple skills: code writing, debugging and code tracing. However, we did not have enough evidence for our second hypothesis 2).

Dibash Basukala

Segmentation of Substantia Nigra for the automated characterisation of Parkinson's disease

Segmentation of smaller brainstem nuclei like substantia nigra (SN) is one of the first stage in computer-aided diagnosis to investigate the Parkinson's disease (PD) characteristics and progression. PD patients generally have smaller SN in comparison to healthy individuals. There are very few automated methods proposed for SN segmentation and most of them require quite a few number of reference images for increasing the accuracy. Therefore, we propose an improved algorithm for the segmentation of SN using level set method and dual tree complex wavelet transform (DT-CWT). The proposed level set method uses the local image information and maintains the regularity of the level set function for accurate computation, thus precluding the expensive re-initialization process. DT-CWT is used to solve the problem of over-segmentation, also resulting in holes, and to smooth the jagged outputs generated by the level set method. This presentation describes the materials and methods used in our research and also gives initial experimental results**.**

Bilal Ishfaq

A Network level defence for IoT: a prototype IoT Networks Implementation

Internet of Things (IoT) have become the point of attraction to the industry and the academia recently. In many domains, innovative applications are enabled by IoT. The IoT is becoming popular because of the lesser prices of smart devices and easy availability and can be found at various public places such as airports, pedestrian zones and campuses. Since IoT consist of heterogeneous devices with limited computational and power resources, and dynamically not equipped to respond the abnormalities, eventually exposed to the various attacks. In addition, some devices are not supported by the vendors anymore, leads to non-patchable vulnerabilities. The attackers can easily exploit these vulnerabilities and can launch the attacks. These attacks effect the IoT negatively in terms of normal functionality. Thus, the security of IoT is considered essential although it is difficult and complex task.

To secure the IoT from network attacks, we will design a system model and will implement the reactive and the proactive approaches to the system model with the aid of software defined networking (SDN). The motivation behind the system model design is to protect the IoT by mitigating the network attacks reactively and to enhance the security of IoT network by using proactive defence mechanism. The reactive defence mechanism includes the IoT network topology reconfiguration when the attack happens and proactive defence mechanism includes the decoy systems in addition with moving target defence (MTD).

In our system model design, smart environment will be considered with different attack scenarios. Specifically, the real test bed includes, Ryu controller, Zodiac FX switch and Raspberry Pi. Snort will be use as intrusion detection system (IDS) and we will evaluate our approach using several metrics (e.g. time to compromise, time to reconfigure, etc.).

Faiza Tahir

Extending Worked Examples in ITS: from static to adaptive

Advanced learning technologies particularly intelligent tutoring systems are playing vital role in today's learning environment. These systems incorporate several techniques which are helpful for learners in context of improving performance, improving understand ability of domain concepts, efficient use of time and less cognitive load. Most ITSs support problem solving only. There has been some work on adding worked examples and erroneous examples to ITSs. Previous work done at ICTG provided such additional learning activities based on pre-defined curriculum. Therefore, no freedom was given to learners to choose learning content on their own. The paradigm shift towards self-regulation has opened many directions for giving learners freedom on choosing their learning content

as well as learning strategies. However, not all these strategies are proved successful, and giving learners freedom of choice is still an issue to resolve. We are trying to formulate a model around all these successful and unsuccessful strategies, which will focus on these research questions: 1) When should examples be given to the learner? 2) What type of examples is helpful for the learner at a particular time during learning? The study to answer these questions may include estimation of the learner's knowledge, motivation, mental effort, and affective states. My project will focus on developing adaptive strategies for deciding when to provide alternative learning activities based on the student's cognitive, motivational and affective state.

Sarmad Soomro

In-Vehicle Touchscreens: Reducing Attentional Demands and Improving Performance

Touchscreens are now commonly used in-vehicles; they provide access to a wide range of vehicle functions. However, touchscreens lack several features that are available with physical controls (buttons, knobs, and sliders) such as tangible (haptic) feedback, physical sensation, and grasp-ability. Lacking these features in touchscreen raise two specific problems concerning attention and performance. To address these problems, a research goal is formulated. This primary goal of this research is to develop new methods for interacting with touchscreens in attention-demanding setting, particularly in-vehicle use. First, this research will develop and evaluate haptic augmentation to use with in-vehicles touchscreen that reduces attentional demands and provide eyes-free interaction. Second, this research will develop and evaluate force-sensed touchscreen interaction that enables the user to interact with a touchscreen in vibration/turbulence. This research will propose novel interaction methods for in-vehicle touchscreens.

Amelia Samandari

MAC Protocols for UAV Formations

UAV formations can be used in a variety of areas, from environmental monitoring to entertainment. Using UAV formations is more effective than deployment of a single UAV, because multiple UAVs cooperating to complete a mission are able to perform more complex tasks with greater precision and efficiency.

To our knowledge, there have been no MAC protocol solutions proposed for the case of UAV formation flight that adequately address the issue of packet collisions. We aim to find a general solution for inter-UAV communication to avoid packet collisions in all types of formations, independent of the application the formation is created for.

Ashley Williams

Evaluating the quality and use of grey literature for software engineering research

The disconnect between practitioner and researcher communities has led to practitioner-generated online articles becoming increasingly used as evidence in software engineering research. Systematic grey literature reviews are difficult to conduct using the traditional search dimensions common to systematic literature reviews as the quantity of results retrieved are too large to parse. To address this, we propose 'quality' as an extra dimension for grey literature searches that can lead to manageable grey literature reviews. We measure quality in terms of perceived credibility. Measuring credibility is a difficult concept as it is highly subjective to each individual at each moment in time. In this talk, we present the origins of our chosen credibility criteria and how they map into a semi-automated methodology for measuring credibility which can help researchers conducting grey literature reviews.

Matthew Ruffell

Automating Vulnerability Discovery and Reproducibility in Operating System Kernels with Symbolic Execution

Searching for vulnerabilities in software is a difficult process, normally undertaken by experts. Most vulnerabilities are subtle, and are difficult to discover by reading high level code or assembly representations, since most vulnerabilities arise from bad memory management which enables an attacker to influence the instruction pointer. In recent years, automation of vulnerability discovery has become very popular, using techniques such as fuzzing, symbolic execution or a mixture of the two to search states the program can enter and test for memory safety. There has been a lot of work on analysing and discovering vulnerabilities for standard programs, but what about operating system kernels? Kernels offer unique challenges since they are designed for bare metal, and maintain complex internal structures such as schedulers, page tables, stack and heap memory. My research will talk about enhancements required to explore kernels for vulnerabilities, create reproducers that trigger vulnerabilities and dealing with the challenges behind kernel space memory analysis.

Rosalyn Rough

Datamining of Bloodstain Patterns

Bloodstain Pattern Analysis (BPA) is a discipline of forensic science which is often used at bloodletting crime scenes to assist with the reconstruction of events. BPA uses principles from physics, biology and mathematics to analyse the size, shape and distribution of blood stains to characterise different pattern "types". Classified as a pattern recognition discipline, BPA has received criticism of its subjective nature and seemingly lack of quantitative methods. The purpose of this research is to explore ways computers can assist analysts with more accurately interpreting and classifying patterns by using the power of image processing methodologies, quantitative methods and pattern recognition technology.

Haipeng Li

Applications of multifractal methods in digital mammogram enhancement and micro calcification detection

Medical image analysis algorithms are used in Computer-aided Detection (CADe) and Computer-aided Diagnosis (CADx) systems to help clinicians in better interpretation and diagnosis. In mammogram images, small breast lesions such as micro calcifications and distortion architecture are often difficult to identify because of poor image contrast. Our research focusses on the use of multifractal analysis for enhancing mammogram images and extracting clinically relevant features from the images. Multifractal features are powerful texture descriptors that have recently been applied in medical image analysis applications. In this presentation, we outline our work on breast region segmentation, region of interest enhancement and detection of image segments containing micro calcifications, using different types of multifractal measures and features.

Matthew Edwards

Statistical Distribution of Checkerboard Corner Detection Error

The checkerboard pattern is one of the basic tools of computer vision. Since the late 90s, basically every computer vision researcher has used one for camera intrinsic calibration, and they're widely used for other purposes as well. However, little attention has been paid to their statistical properties. This presentation will go into great detail about the distribution of checkerboard corner detection error.

Andrew Curtis-Black

An Enterprise Policy Description Framework for Software Defined Networking

Computer networks support the day-to-day operation of many modern enterprises by providing access to resources (e.g. the internet, messaging applications, data repositories etc.) Enterprises control access to these resources by creating policies like "don't let students use more than 50GB of data per month". However, existing processes for specifying and implementing policies are complex and error-prone. Our research aims to improve this situation in the context of software defined networking (SDN). SDN is a new paradigm which allows us to program networks the same way we program computers. With SDN, networks can be upgraded like operating systems, and services can be added like smartphone apps. Our work so far has involved a systematic review of existing approaches to policy specification, and a qualitative study of network administrators. Based on this, we propose to improve the process of policy specification and implementation by 1) introducing high-level concepts — intuitive, standardised building blocks for policies — and 2) making them available to network programmers (e.g. via an API).

Caitlin Duncan

Reported Development of Computational Thinking through Computer Science and Programming, and it's benefits for Primary School students

Across the world there has been a paradigm shift in school education as many countries, New Zealand included, have begun incorporating Computer Science (CS), programming, and Computational Thinking (CT), into their K-12 curriculums. Like the majority of countries introducing these topics, NZ faces challenges in preparing teachers for these new subjects, and in successfully implementing a curriculum which achieves its educational goals. This work is based on investigations into incorporating these topics into NZ primary schools. It aims to address the specific questions: How do we teach CT to primary aged students? If they learn CT, does it have the expected positive impacts on students learning? And, what other positive and negative impacts does this have? Analysis of feedback from, and interviews with over 40 teachers, revealed many observations of students developing and exercising CT skills, positive impacts on students general learning, and minimal negative impacts.

Kashif Amanullah

Teaching Computer Programming to Junior and Secondary School Children using Elementary Patterns

Computer science is becoming a prominent part of high school education due to the recent changes in curriculum and shift towards introducing computational thinking in the early years of schooling. This phenomenon poses numerous challenges as many believe that young children are not equipped with cognitive skills to properly understand computer programming. This research explores the idea that we need innovative teaching methodologies to teach computer programming to children. We address this issue in multiple steps. We have identified problems with contemporary block-based programming languages which are the most popular mean to introduce children to programming. These problems are highlighted in the literature and I have confirmed it by analysing over 200,000 projects from Scratch repository. I have proposed elementary patterns as a potential solution to these problems, and an effective way to teach computer programming to children. I am investigating the progression of Scratch users as they develop programs over a period of time to test the involvement and influence of programming patterns. Initial results are promising and an experimental study based on elementary patterns will be carried out with children to confirm the overall effectiveness of the approach.

Oliver Batchelor

Machine Assisted Image Annotation

Supervised machine learning typically requires a significant amount of annotated data, this presents a problem in terms of human labour. I present a simple bootstrapping process involving having a human annotator fix predictions made by a machine learning algorithm. I will discuss where the method is applicable and its strengths and weaknesses and give a demonstration of the idea applied to the problem of annotating images for object detection.

Josh McCulloch

Automated conductor recovery from vehicle mounted LIDAR for dynamic line rating

Traditionally there have been two methods of surveying overhead power lines, those being the expensive airborne LIDAR and the cheaper intern with a laser tape measure. In this research, we use vehicle-mounted LIDAR to achieve the speed and accuracy of helicopter-based surveys at a fraction the cost. However, due to the reduced scan quality of vehicle-mounted LIDAR, traditional automated methods of recovering the overhead infrastructure do not perform well. In this presentation, we will present a family of conductor recovery methods designed to operate under these conditions.

The organisers are grateful for the support of the following sponsors:

Principal Sponsor

Verizon Connect builds solutions and services that put innovation, automation and connected data to work for customers and help them be safer, more efficient and more productive.
With more than 3,500 dedicated employees in 15 countries, we deliver leading mobile technology platforms and solutions.
Verizon Connect offers web-based mobile workforce and fleet management software including GPS tracking, route planning, job management, navigation and compliance.
Commercial fleets and mobile workforces of all sizes use our software to improve the effectiveness and efficiency of their operations – and reduce their carbon footprint.
Verizon Connect began in part a Canterbury success story. Ralph Mason, a founder of one of the companies that came together as Verizon Connect, hails from Christchurch and set up a research and development centre here 14 years ago.
Much of the original technology was developed in Christchurch and has been instrumental in shaping this billion-dollar industry. As a result, Verizon Connect is considered a technology leader and pioneer in the telematics industry.
Verizon Connect has offices in 15 countries around the world including Dublin, London, Sydney, Los Angeles, Chicago, Austin with staff numbers over 3,500.
The company has a large research and development centre based in Christchurch.
Supporting the development of its SaaS software are a range of development and test automation roles requiring capability in C#, JavaScript, C++, REST, SOA, UX, UI, systems administration and database management.
Verizon Connect regularly hires for its Christchurch office with at least 10 graduates each year and five to 10 interns working year-round. Many interns stay on as permanent employees after graduation.
The company is actively looking for software developers and engineers as well as business analysts, support engineers, software test engineers and software development managers.
We look for staff who can embrace change and new ways of thinking – and move quickly
We're a diverse mix of professionals who thrive in an atmosphere that promotes fresh ideas and challenges traditional systems.
Our culture is one that values open communication, and is built on creativity and excellence
Contact us: verizonconnect.com/company/careers
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Allied Telesis: For nearly 30 years, Allied Telesis has been delivering reliable, intelligent connectivity for everything from enterprise organizations to complex, critical infrastructure projects around the globe.
Allied Telesis is recognized for innovating the way in which services and applications are delivered and managed, resulting in increased value and lower operating costs.
Originally part of the DSIR, Allied Telesis Labs - based in Christchurch, New Zealand - joined the international Allied Telesis Group in 1999, and is now the largest research and development centre for the group.
As one of the world's leading producers of computer networking equipment, the group employs more than 3000 people worldwide.
Allied Telesis smart technologies, such as Allied Telesis Management Framework™ (AMF) and Enterprise SDN, drive network evolution, and deliver efficient and secure solutions for people, organizations, and "things".
More than one million customers worldwide have chosen our technology for their networks.
The success of Allied Telesis Labs is built on the skills of our talented employees, who enable the company to compete on an equal footing with the world's largest communications and networking equipment manufacturers.
www.alliedtelesis.co.nz

The **Christchurch City Council** is one of the South Island's largest employers – a progressive local authority, responsible for ensuring the continued successful growth and development of one of New Zealand's greatest cities.
More than 2300 staff works for the Council across 60 locations around the city and Banks Peninsula. These include professional and administrative positions in core infrastructural areas such as water, waste, roading and parks; as well as jobs within the Council's broader activities including its library network, art gallery and recreation facilities.
The Christchurch City Council is an organisation committed to achieving sustainable outcomes for the community, environment and people of Christchurch and Banks Peninsula. By working for the Christchurch City Council you will have an opportunity to work on a wide range of projects providing you with opportunities to further develop your breadth of skills whilst contributing toward the development of our beautiful city and surrounding areas.
www.ccc.govt.nz

Dynamic Controls is a world leading designer and manufacturer of electronic controls for power wheelchairs and scooters. Focusing on innovation and growth in the bio medical engineering sector, Dynamic Controls works to go above and beyond expectations to ensure end users receive the best product possible in order to enhance their quality of life. Dynamic Controls is unique in that we specialize in the medical mobility market. Products range from cost effective controllers to a world leading modular control system that can be customised to suit a wide range of user needs. In addition we have a range of scooter controllers suitable for small, lightweight mini shoppers to rugged outdoor scooters. All our products are renowned for reliability. Dynamic Controls is a global organization which employs over three hundred people, with corporate headquarters in New Zealand and regional offices in the United Kingdom, North America and Asia.

www.dynamiccontrols.com

Tait customers protect communities, power cities, move people, harness resources and save lives all over the world. We create and support their critical communications.

From our strong position as leaders in radio communication technology, we work hard to gain a deep understanding of the issues, problems, and day-to-day working environments our customers' experience. That is how we deliver robust, fit-for-purpose products, exceptional customer service, and world class communication system performance.

Our LMR products and systems are designed and built by our people. We stand by their quality, integrating, testing and perfecting everything we sell. Our specialties include P25 (Phase 1 and Phase 2), DMR (Tier 2 and Tier 3), MPT-1327, Analog Conventional, and software to manage and monitor those radio networks.

We also recognize the increasing importance of business systems like dispatch, AVL, LTE, cellular, voice recorders, SCADA, and many more to come. We integrate these diverse technologies to deliver stronger, simpler, and smarter solutions. Through these efforts, we're redefining critical communications.

Positioning-centric information is changing the way people, businesses and governments work throughout the world. By applying **Trimble**'s advanced positioning solutions, productivity increases and safety improvements are being realized.

Though best known for GPS technology, Trimble integrates a wide range of positioning technologies including GPS, laser, optical and inertial technologies with application software, wireless communications, and services to provide complete commercial solutions. Its integrated solutions allow customers to collect, manage and analyse complex information faster and easier, making them more productive, efficient and profitable.

Trimble products are used in over 141 countries around the world. Employees in more than 30 countries, coupled with a highly capable network of dealers and distribution partners serve and support our customers.

For over 33 years, Trimble has created unique positioning products that help customers grow their business. Our portfolio includes over 1,800 patents and serves as the basis for the broadest positioning offerings in the industry. Trimble augments its organic product development with strategic acquisitions to bring the latest positioning technologies to a wider market.

www.trimble.com

Seequent is a global leader in the development of visual data science software and collaborative technologies. Our solutions enable people to create rich stories and uncover valuable insights from geotechnical data, and ultimately make better decisions about their earth, environment and energy challenges.

Our 3D modelling tools and technology are widely applied across industries and projects, including road and rail tunnel construction, groundwater detection and management, geothermal exploration, resource evaluation and estimation, subterranean storage of spent nuclear fuel, and a whole lot more.

At Seequent, we help transform raw, complex data and give it a form that is easily communicated to stakeholders and collaborated on by remote teams. Having a common picture brings clarity to complexity and empowers everyone with knowledge.

Seequent used to be ARANZ Geo.

Formed in 2004, the company built its flagship 3D geological modelling product 'Leapfrog' based on a pioneering algorithm that enables fast and automated formation of 'surfaces' directly from geological data. Today Leapfrog has thousands of users and is relied on by top mining and exploration firms, major geothermal energy companies, civil construction leaders and environmental science specialists.

Since 2004, we've integrated three unique companies at the top of their game:

QG were brought on to contribute to the geology and geostatistics expertise within Seequent. Their deep experience and market insights solidify our position in the mining industry.

Bloy are one of the world's only product specialists in the grade control field. They develop and support Blockbuster®, a full-featured, off-the-shelf grade control solution.

3Point Science specialise in cloud solutions and geophysics, and in creating highly engaging 3D data visualisation.

We have evolved from a software company developing geological modelling tools and services, into a technology leader offering truly integrated solutions for shared, global challenges. We see the industries we serve in a bigger context and see new possibilities in the areas of earth, the environment and energy.

Seequent is who we are.