



Department of Computer Science and Software Engineering

2021 Postgraduate Conference

September 7 & 8, 2021

Via Zoom

**verizon^v
connect**


**Christchurch
City Council** 

 **Trimble.**

 **Allied Telesis**

dynamicTM 

tait
communications

 **SEQUENT**

Tuesday 7 September

Welcome

Session 1 *Chair: Tim Bell*

Honours (Judges: Tim Bell, Andreas Willig, Fabian Gilson)

10:30 – 10:45	Welcome: Richard Green
10:45 – 11:00	Wikke Nijhof: Texture-Based Nuclei Segmentation for Applications in Computational Pathology
11:00 – 11:15	Juliet Samandari: McEliece Post Quantum Cryptosystem for IoT
11:15 – 11:30	Cameron Stevenson: Contour Splitting for Branching Structures in CT Image Reconstructions
11:30 – 11:45	Jamie Houghton: A Machine Learning Approach to Modelling and Predicting Biomechanical Measures of Strain Across Bone
11:45 – 12:00	Henry Hickman: Measuring the Effectiveness of the Cybersecurity Chapter in the Computer Science Field Guide

12:00 – 13:00	LUNCH at your place
---------------	----------------------------

Session 2 *Chair: Clementine Gritti*

Masters (Judges: Ben Adams, James Atlas, Clementine Gritti)

13:00 – 13:15	Chris Carr: Species Classification of Thermal Video Using a Convolutional Recurrent Neural Network
13:15 – 13:30	Bruce Li: Implementation and Evaluation of Publicly Verifiable Proofs of Data Replication and Retrievability for Cloud Storage
13:30 – 13:45	Zhouyu Qu: A wireless coordination algorithm for overtaking on a drone road
13:45 – 14:00	Lewis White: Modelling of the temporal and spatial variation of outdoor noise propagation
14:00 – 14:15	Shanelle Dyer:

14:15 – 14:30	Short Break
---------------	--------------------

Session 3 *Chair: Walter Guttman*

PhD (Judges: R Mukundan, Andrew Bainbridge-Smith, Tanja Mitrovic)

14:30 – 14:45	Camila Costa Silva: Reusing software engineering knowledge from developer communication
14:45 – 15:00	Andrew Davidson: Machine Learning Segmentation of RNAscope Stained Breast Cancer Tissues Using Whole Slide Images
15:00 – 15:15	Harry Dobbs: Skeletonization and Reconstruction of Trees from Point Clouds
15:15 – 15:30 (11:15 China)	Di Wang: System monitoring to improve bug reproducibility
15:30 – 15:45 (09:00 Sri Lanka)	Priyatharsan Uthayanathan: Secure and Privacy-Preserving Blockchain Technologies in e-Health Systems
15:45 – 16:00 (08:45 Pakistan)	Faiza Tahir: Motivational Strategies of Increasing Learning from ITS

16:00	End of Day 1
-------	---------------------

Wednesday 8 September

Session 4 *Chair: R Mukundan*

10:30 – 10:45	Stewart Dowding: Improving user interaction experience by adapting system pace
10:45 – 11:00	Benjamin McEwen: Predator Tracking and State Estimation
11:00 – 11:15	Timothy McKenzie: Addressing Video Game Development Challenges Using Industry 'Best Practices'
11:15 – 11:30	Pang Suwanaposee: The Influence of Audio Effects and Attention on the Perceived Duration of Interaction
11:30 – 11:45	Bhagya Munasinghe: CS Unplugged and Teachers' Professional Development
11:45 – 12:00	Ja'afaru Musa: Improving Face-to-Face Communication Skills using Active Video Watching

12:00 – 13:00 **LUNCH at your place**

Session 5 *Chair: Tanja Mitrovic*

13:00 – 13:30	Negar Mohammadhassan: Investigating Engagement and Learning Differences between Native and EFL students in Active Video Watching
13:30 – 13:45	Casey Peat: Chicken and the Egg, Training Stereo Neural Networks
13:45 – 14:00	Tim Renson: Towards Automated Species Monitoring and 3D Mapping in Underwater Environments
14:00 – 14:15	Rosalyn Rough: Datamining of Bloodstain Patterns
14:15 – 14:30	Sam Schofield: The Windy Forest Visual Inertial Odometry Dataset
14:30 – 14:45	Matthew Edwards: Experimental Validation of Bias in Checkerboard Corner Detection
14:45 – 15:00	Faiza Tahir: reserve space for Faiza if unable to attend on Day 1

15:00 **End of Day 2**

Abstracts

Honours

Wikke Nijhof

Title: Texture-Based Nuclei Segmentation for Applications in Computational Pathology

Abstract: Nuclei segmentation is an important step in the diagnosis of cancer since tissue and nuclei properties are different in each disease stage. Recent developments in the field of computational pathology has led to the rapid increase in computerised methods for nuclei segmentation and classification. However, one weakness in current segmentation models is that they use only intensity, colour or shape information, and do not consider the texture characteristics of nuclei regions. We perform an investigation of texture descriptors and propose a texture-based nuclei segmentation method for biopsy images using Grey Level Co-Occurrence Matrices and Local Binary Patterns.

Juliet Samandari

Title: McEliece Post Quantum Cryptosystem for IoT

Abstract: Public-Key Infrastructure (PKI) employs public-key cryptosystems as the basis of security for email, communication, and transactions. It is known that solving the hard problems that currently provide the basis of security for standard public-key encryption protocols will no longer be computationally infeasible once large quantum computers are available. Therefore, these protocols will no longer provide security. This necessitates the creation and adoption of a new cryptographic standard that will remain secure even with the possibility of attacks from quantum computers. We have identified the McEliece public-key cryptosystem as a possible option for post-quantum cryptography and have analyzed the underlying cryptographic algorithm providing this cryptosystem's security. We have also assessed its suitability for use by Internet of Things (IoT) devices.

Cameron Stevenson

Title: Contour Splitting for Branching Structures in CT Image Reconstructions

Abstract: Medical imaging modalities, such as HRCT and MRI, produce stacks of images depicting regions of tissue inside the body. These image stacks can be used to reconstruct the 3D structure of internal organs. One such way of reconstruction involves segmentation of contours in each slice, matching contours between slices, and matching points between contours to create a mesh. Under this approach branching structures can be difficult to reconstruct accurately. My project extends prior work with a new approach to tackling branching cases, which I call contour splitting.

Jamie Houghton

Title: A Machine Learning Approach to Modelling and Predicting Biomechanical Measures of Strain Across Bone

Abstract: Accurately determining bone fracture healing requires years of specialty training assessing radiographs, but due to the imaging methodology, this can still result in an incorrect diagnosis which underestimates when the fracture has healed. Providing an ability to track and predict bone strength over time would allow physicians to assess patient recovery more quickly and accurately. The overall problem can be broken down into three subproblems: 1) determining what activity is occurring at a given time, 2) analysing changes to that activity in subsequent occurrences, and 3) correlating those changes with a biomechanical model. A novel microelectronic strain sensor has been developed by Dr Deborah Munro and her team in the mechanical engineering department at the University of Canterbury. The sensor was initially designed to determine the strength and stability of a posterolateral

spinal fusion in sheep with the hypothesis that strain measured by the sensor would decrease as the fusion progressed. Using data acquired from the sensor, a machine learning protocol was developed to recognize simulated sheep movement activity. Building upon this, additional data acquired from a Finite Element Analysis model and a simulated healing setup are being developed for a time series extrinsic regression model to analyse changes in subsequent occurrences of the activity.

Henry Hickman

Title: Measuring the Effectiveness of the Cybersecurity Chapter in the Computer Science Field Guide

Abstract: With the expansion of Achievement Standard 91898 for NCEA in NZ High Schools, allowing students to be examined on cybersecurity, a new chapter in the Computer Science Field Guide (CSFG) has been developed to support teachers and students.

As part of this development, I have been involved in designing and evaluating interactives for this chapter. These are activities and games that aim to reinforce the content provided by the chapter. I aim to evaluate how effective these interactives are, and the chapter as a whole, as a teaching tool. This will involve interviewing teachers across New Zealand to compile their thoughts and feelings on the chapter, allowing us to get an understanding of how effective it is from the ones who will be using it in the classroom.

Masters

Chris Carr

Title: Species Classification of Thermal Video Using a Convolutional Recurrent Neural Network

Abstract: This paper proposes a new approach to species surveying, utilising convolutional recurrent neural networks (CRNNs). By using breakthroughs in neural network architectures and designs, as well as modern hardware, new approaches are possible that have not yet been investigated. Analysing thousands of hours of footage allows for more accurate, timely, and interesting surveying footage, far surpassing current approaches used by conservation programs. Prior to this research, a reliable dataset of thermal images did not exist, much less a dataset that records motion. Further, the data has been labelled, and categorised by location and time. While the creation of this dataset alone is a contribution, the CRNN has a high performance and reliable detection for all trained classes, which increases as more data is gathered. This puts this neural network approach ahead of any other extant method, as those that do exist either use static images, infrared illumination, or perform worse.

The proposed approach is much better at detecting animals than current low tech trap or observation based approaches (by over 3 thousand times), such as trapping lines, transects, dog hunting, or observations. Further, it is more accurate than extant trail cameras for detecting small mammals - being about 10-50 times better in experimental trials.

Hao (Bruce) Li

Title: Implementation and Evaluation of Publicly Verifiable Proofs of Data Replication and Retrieval for Cloud Storage

Abstract: Internet-based cloud services are widely welcomed by individuals and industries, because of their obvious advantages such as convenience, security, and low cost. It can reduce capital expenditures and convert them into operating costs. As a common and important cloud service, cloud storage is also accepted by many parties. Disaster tolerance is one of the standard features to measure the security of cloud storage. Generating cloud file replicas can directly improve its security. The current Proof of Retrievability (POR) can only provide the client with proof that his/her files are stored correctly but the proof does not include the replicas. So Proof of Data Replication and Retrieval (PORR) was proposed

as an extension of POR to include proof of correct replicas storage. It also combines Verifiable Delay Functions (VDF) to prevent a server to generate the replicas on the fly when requested to prove correct storage. VDF allows the client or anyone to verify the server's proof, rather than only the client. Our work is to implement PORR in a real cloud environment, test its performance under a variety of popular network file protocols, and finally compare it with previous similar works for a comprehensive evaluation.

Zhouyu Qu

Title: A wireless coordination algorithm for overtaking on a drone road

Abstract: Unmanned aerial vehicles (UAVs) or drones have strong potential ability to perform complicated tasks, such as goods and parcels delivering, in a conceivable future. A good way to manage those drones is constructing a "drone road", which is a virtual, tube-like area in airspace; drones will prefer to fly in the tube, but can also be out of it when necessary. The scenario we focus on is a straight and finite long tube segment, and all drones fly toward the same direction but with different cruising speed. We intend to implement coordination-based overtaking algorithms to avoid any kinds of collisions in this scenario. OMNET++ (i.e. a modular, component-based C++ simulation library and framework) is used to build a network simulator and then evaluate the performance of our algorithm in the simulation environment. The presentation will cover the system model, baseline algorithms introduction and some preliminary results for those algorithms.

Lewis White

Title: Modelling of the temporal and spatial variation of outdoor noise propagation

Abstract: Anthropogenic noise has a negative impact on our natural environments, modelling this noise is important to the process of minimizing this impact. This project aims to create a user-friendly 4D implementation of a current sound propagation modelling system. Being created with the Department of Conservation in mind, the use of this application in New Zealand's National Parks will provide an upgrade from the GIS-based 2D bird's eye implementation in current use. The identical input data will be converted into an interactive visualisation including a 3D height map and a gradated sound pressure overlay at different points along a flight path. This enhanced environment will allow for better area-specific decisions to be made regarding these modelled spaces.

Shanelle Dyer

Title: *Weddell seal monitoring in McMurdo Sound, Antarctica: a novel approach*

Abstract: The Ross Sea Region Marine Protected Area (MPA) was implemented to understand ecosystem dynamics and ensure that the Antarctic toothfish industry was not impacting key toothfish predators in the Ross Sea, Antarctica. Weddell seals, a named focal species of the MPA, are studied to help understand the impacts this fishing industry may have in the Ross Sea. This highlights the importance of understanding and quantifying Weddell seal population dynamics over space and time. Field camera and ground surveys are among the most common methods employed to monitor long-term populations, with more recent approaches using very-high resolution satellite images to determine population estimates. However, usable satellite images are not taken when most seals are visible on the ice and often only a few are available across a summer season.

To fill these gaps, an understanding of the patterns and timing of Weddell seal haul-outs is required. Here, a novel method is proposed that utilises the spatio-temporal benefits field camera images offer, while greatly enhancing the seal counting process with a semi-automatic image object detector. Results show that the object detection counts were not significantly different from the reference counts manually conducted by experts. For each different survey location, R^2 ranged from 0.889 to 0.997, with no absolute errors showing a strong correlation to the number of seals in each count. This study's

findings suggest that a combined approach of very-high resolution satellite images coupled with object detection and field camera images would provide the best approach for long-term Weddell seal monitoring for Ross Sea Region Marine Protected Area objectives.

PhD

Camila Costa Silva

Title: Reusing software engineering knowledge from developer communication

Abstract:

Software development is a knowledge-intensive activity since it requires different types of knowledge, for example, knowledge about software development processes, practices, techniques and about the domain of an application. On the other hand, throughout the development of software, developers share knowledge via informal communication channels (e.g., instant messaging tools, e-mails, or online forums). Considering that this informal knowledge may be potentially relevant for other developers and given that this knowledge is not necessarily captured and formally documented for reuse, we investigate whether developer communication is a suitable source of reusable software development knowledge. Therefore, we aim to identify software engineering-related discussions from developer communications and evaluate their relevance for reuse in software development activities.

Andrew Davidson

Title: Machine Learning Segmentation of RNAscope Stained Breast Cancer Tissues Using Whole Slide Images

Abstract: The genetic characteristics of breast cancers determine the mechanism that the cancer uses to grow, and therefore, the treatment options that will be effective. RNAscope in situ hybridization allows for the staining of particular RNA sequences in tissue samples, and therefore the quantification of gene expression. However, accurately quantifying the level of RNAscope staining in tumour and non-tumour tissue is extremely time-consuming when done manually. We aim to firstly evaluate existing solutions, and then to create a robust machine learning method to segment important breast cancer tissue structures and quantify the level of RNAscope staining in relation to the different tissue types present. This will save time for pathologists and allow for easier, more objective appraisal of RNAscope stained breast cancer tissues.

Harry Dobbs

Title: Skeletonization and Reconstruction of Trees from Point Clouds

Abstract: Tree models are important for robotics, estimating evapo-transpiration, timber estimates, observing effects trees have on wind patterns, growth modelling, assessing tree health and biological research. Accurate tree model reconstruction from point clouds is a challenging task. The captured data is very noisy, has varying point density as well as having large amounts of missing data due to occlusions from other branches and leaves. Trees also have a large amount of variability in their structure, density and size which has resulted in existing solutions requiring significant parameter tuning and manual intervention. The research being conducted looks to improve current state-of-the-art approaches and develop a pipeline to allow for species classification from the acquired model.

Di Wang

Title: System monitoring to improve bug reproducibility

Abstract: Context and background: More and more modern applications are moved to the web due to accessibility and cross-platform capability. With the wide use of web applications, many critical systems (e.g., financial, business) are also built on the web platform. Therefore, how to make sure the application is of good quality is crucial. However, software system can be broken by functional and non-functional bugs: functional bugs stop application's workflow so user can not finish their job; a non-functional bug, such as performance issues, will make system running at an unacceptable speed until user give up. For most systems, any downtime or performance depreciation can lead to loss of money or even loss of life. For example, in an online trading system such as Alibaba, every second of downtime or performance depreciation can lead to thousands of dollars of lost revenue. Downtime may also lead to a damage to reputation which will impact business growth in the future. Therefore, how to find the problems that cause system's downtime and performance depreciation is important. A prerequisite for diagnostics and performance improvements is a proper and useful application monitoring system.

Problem: There is not many comprehensive studies around the web application's system monitoring. Even though some studies exist, they do not allow end-to-end monitoring. End-to-end monitoring is important because modern-day web applications typically are developed with different modules and the problem may be caused by a single module or several modules of the system. How to monitor web applications and make monitoring data useful for problem diagnostic and performance improvement is the problem we will look into in this research.

Solution approach: In this study, we will focus on the modern web single page application (SPA).

The study will be conducted in two main stages: The first stage focus on a review of the literature. We will conduct a mapping study to find out what monitoring methods are studied in the field and identify the potential gaps. In the second stage, we will conduct empirical action research to develop an improved monitoring framework to help a real-world development team to improve their diagnostic ability and performance improvement.

Expected findings and contributions: The main outcome of the study will be an end-to-end monitoring framework for SPA web applications. This framework should improve the diagnostic process for the software development team and provide relevant information for continuous performance improvement. The side outcomes will include but not limit to 1) a systematic overview of what has been studied so far around web application monitoring. 2) A practical approach to improve monitoring of web applications. 3) A general guide line on how to set up efficient and effective monitoring system for web application.

Priyatharsan Uthayanathan

Title: Secure and Privacy-Preserving Blockchain Technologies in e-Health Systems

Abstract: The impact of blockchain technologies innovating traditional institutional structures and frameworks has garnered global interest. As a result, academics and health industries are increasingly interested in applying blockchain technologies to e-health and its associated sectors. Therefore, it is vital to understand the study area of interest better and expand collaborative networks to progress the research into e-health milestones. This study will analyse the application of blockchain technologies for the secure and privacy-preserving sharing of medical data, emphasising cryptographic techniques in particular. This study will assess global research trends in the domain by examining publication outputs, co-authorships between authors and affiliated nations, co-occurrences of author keywords, types of blockchain used in the existing e-health systems. After the exclusion criteria, a total of 849 journal and conference research papers published between 2016 and 2021 have been retrieved using the Scopus database. Results show that the cumulative total number of published articles doubled and tripled in 2018, 2019 respectively. Around 57% of all global publications were published by scholars from India, China and the United States, outpacing the remaining 80 countries/territories. Research publications covering items related to information security and privacy, and cryptography are very low, with 8% altogether related to other all publications. In conclusion, although research into the use of blockchain

technologies for e-health systems has increased recently, existing systems contain limited studies on applying cryptographic primitives in order to preserve data privacy.

Faiza Tahir

Title: Motivational Strategies of Increasing Learning from ITS

Abstract: Motivation and affect detection are prominent yet challenging areas of research in the field of Intelligent Tutoring Systems (ITS). Devising strategies to engage learners and motivate them to practice regularly are of great interest to researchers. In the learning and education domain, where students use ITSs regularly, motivating them to engage with the system effectively may lead to higher learning outcomes. Therefore, developing an ITS which provides a complete learning experience to students by catering to their cognitive, affective, metacognitive, and motivational needs is an ambitious yet promising area of research. This dissertation is the first step towards this goal in the context of SQL-Tutor, a mature ITS for tutoring SQL.

In this research project, I have conducted a series of studies to detect and evaluate learners' affective states and employed various strategies for increasing motivation and engagement to improve learning from SQL-Tutor. Firstly, I established the reliability of iMotions to correctly identify learners' emotions and found that worked examples alleviated learners' frustration while solving problems with SQL-Tutor. Gamification is introduced as a motivational strategy to persuade learners to practice with the system. Gamification has emerged as a strong engagement and motivation strategy in learning environments for young learners. I evaluated the effects of gamified SQL-Tutor on undergraduate students and found that gamification indirectly improved learning by influencing learners' time on task.

Additionally, prior knowledge, gamification experience, and interest in the topic moderated the effects of gamification. Lastly, self-regulated learning support presented as another strategy to affect learners' internal motivation and skills. The support has been provided in the form of interventions and found evidence of improved learning outcomes. Additionally, the learners' challenging behaviour, problem selection, goal setting and self-reflection have improved with the support without experiencing any negative emotions. This research project contributes to the latest trends of motivation and learning research with ITS.

Stewart Dowding

Title: Improving user interaction experience by adapting system pace

Abstract:

User pace (such as typing rate and speech rate) and system pace (such as animation speeds and timeout durations) both contribute to the overall pace of interaction. Inspired by speech rate convergence, where prosodic features between conversational partners converge towards one another, Cockburn et al. (2021) [1] examined the relationship between interaction pace and user preferences. They found that user preferences for system timeouts are correlated with user pace, such that fast-paced users preferred systems with short timeouts, and slow-paced users preferred longer timeouts.

A natural extension to Cockburn et al. (2021) is to design an interface that dynamically changes settings to coincide with user performance characteristics. This would require a dynamic analysis of the user's interactions with the interface.

This PhD research will investigate issues related to interaction pace, to improving the subjective experience of interaction. To achieve this, the following goals are outlined:

1. Validate the underlying assumption that:
 - a. User's pace can be reliably measured (on various characteristics, including speech rate).
 - b. User's pace characteristics correlate with (or somehow predict) their preferences for system pace.
2. Characterise parameters of system and user pace (for example, investigate the "sweet spots" for system and user pace).

3. Understand means by which systems can/should adapt to user pace.
4. Validate that the adaptations are successful.
5. Investigate system nuances that make the adaptations especially successful. For example, the timing and frequency of adaptation.

Ben McEwen

Title: Predator Tracking and State Estimation

Abstract: Thermal cameras are used to monitor invasive pest populations and inform elimination efforts. These cameras are limited by their resolution, meaning that feature-based classification is often not sufficient. Predictive state estimation of invasive predators is useful for visual classification and the analysis of movement patterns in occluded and noisy environments. These movement patterns aid in the classification of species. Multiple State estimation techniques were tested on a thermal recording dataset. The state estimation techniques were compared using the thermal dataset and it was found that they were able to improve tracking performance in noisy and occluded environments with the Unscented Kalman Filter achieving the best results. It was found that these methods all suffer from similar limitations due to the animal changing state while occluded. A novel state estimation method is proposed that merges traditional state estimations with learnt scene masks to improve tracking results.

Timothy McKenzie

Title: Addressing Video Game Development Challenges Using Industry 'Best Practices'

Abstract: Video games have rapidly become a massive and powerful creative industry that has far surpassed other entertainment industries such as movies and music. However, the video game development (VGD) industry is not without significant development challenges in multidisciplinary team dynamics and communication, work culture, and project management. These issues often stem from video games being a complex and confusing 'marriage' of software engineering and creative production.

There is a lack of agreement in academia and even within the industry itself on 'good' or 'best' VGD practices or processes which unify these competing creative and technical aspects. So, each game studio has its own highly contextualized ad-hoc (and often closely guarded) way of working, which is often misunderstood to be 'agile'. Consequently, the absence of commonly accepted 'good' development practices and the misapplication of agile means both independent studios (especially start-ups) and even AAA studios often struggle to create successful games.

Hence, through interviews, surveys, and case studies with industry studios, this research project will capture the commonly used agile software engineering and creative production practices within VGD, and, investigate the relationships between these practices and the multidisciplinary collaboration challenges studios face. From this analysis a contextualized agile VGD 'best practice' model will be proposed.

Pang Suwanaposee

Title: The Influence of Audio Effects and Attention on the Perceived Duration of Interaction

Abstract: Users often need to wait for computer systems to perform some task (e.g., loading a page or copying a file), and these delays can have substantial negative effects on user experience. However, there is a lack of understanding about what kinds of audio can change people's perception of time and whether audio's effectiveness is consistent across different interaction contexts such as varying attentional demand. We carried out an empirical study investigating how different types of audio effect influence perceived duration across three interaction contexts -- passive waiting with no visual feedback, passive waiting with visual feedback (watching a progress bar), and active completion of a simple game. We tested three different types of audio effect: a series of beeps that changed in tempo (increasing, decreasing, or constant tempo), a series of beeps that changed in pitch (rising, falling, or constant), and variants of a polyphonic Shepard tone (an auditory illusion that seems to continuously rise or fall in pitch); a silent condition was included as a baseline. In the first stage of the experiment, participants experienced a 10.1 second wait period, indicated with a progress bar, accompanied by one of the audio effects, and they were then asked to assess its duration (a *retrospective* assessment). In the second stage, participants were told to consider duration as they experienced a series of conditions that compared two 10.1 second wait periods accompanied by different effects, and then select which one (if either) felt longer (a *prospective* assessment). In settings where users are already considering wait time, our overall results suggest that perceived durations are shorter both with increasing-tempo audio cues and when users have stimuli that occupy their attention. However, this effect may be limited to prospective duration assessments, where users know in advance that they will be assessing the duration of an event.

Bhagya Munasinghe

Title: CS Unplugged and Teachers' Professional Development

Abstract: The incorporation of Computational Thinking (CT) in school curricula worldwide, introducing computing to children as young as 5 years, requires teachers to contend with teaching Computer Science (CS) content in classrooms. CS Unplugged (CSU) is known to be a useful tool to introduce CS concepts and programming to students and is popular among teachers as a teaching tool. Finding effective ways to use CSU to help teachers in teaching CT and to deliver CS, and to use it as an effective professional development tool to reach the teachers with limited computing background, is the main objective of this research. The main experimental focus of my research has been trialling new unplugged activities that focus on introducing basic programming concepts, and studying the usefulness of alternating unplugged activities (both new as well as Classic) with conventional programming teaching practices (i.e. plugged in) when introducing programming to teachers. Findings indicate that alternating unplugged content in introductory programming courses does not hinder the teachers' teaching efficacy and self-efficacy towards computer programming. Moreover, teachers can be equipped with more content within the same time frame as a conventional teaching approach. Observations indicate that CSU content is useful in improving teachers' awareness of common misconceptions, methods for diagnosing them, and interventions to help students develop more robust concepts. Accordingly, our future directions include investigating how CSU can be useful in helping teachers understand the Notional Machine, which research suggests as a prerequisite for effective teaching of computing.

Ja'afaru Musa

Title: Improving Face-to-Face Communication Skills using Active Video Watching

Abstract: Although communication skills are widely recognized as crucial for effective software development teams, many graduates lack such skills, which are difficult to teach. We adopt the active video watching (AVW) approach to teach face-to-face communication skills to second-year software engineering project course. We conducted an experiment with AVW-Space, an online platform which supports video-based learning. The participants watched and comments on tutorial videos first, and later on videos of team meetings. In the last phase, the participants commented on the recording of their own team meeting. We found that students who commented and rated others' comments increased their conceptual understanding of face-to-face communication skills.

Negar Mohammadhassan

Title: Investigating Engagement and Learning Differences between Native and EFL students in Active Video Watching

Abstract: Video-based learning (VBL) requires good listening and reading comprehension skills, which could be challenging for English as a foreign language (EFL) students. We investigated the differences between EFL and Native English speakers in a VBL platform called AVW-Space to identify potential interventions that would be helpful for EFL students. AVW-Space provides note-taking, peer-reviewing, visualisations and personalised nudges to support engagement in VBL. Although previous studies on AVW-Space showed these supports effectively increased engagement, we discovered significant differences in learning outcomes and engagement between EFL/Native students, which stem from different learning strategies, background knowledge and language barriers. This research contributes to using learning analytics to understand better the differences between EFL and Native students and providing more specialised support for EFL students in VBL.

Casey Peat

Title: Chicken and the Egg, Training Stereo Neural Networks.

Abstract: Recent developments in stereo matching using deep learning architectures have allowed for impressive results in the field of depth estimation. Being able learn from a large set of examples allows for these architectures to learn high level semantic cues to aid in making accurate matches, this allows for accurate depth estimation in traditionally challenging domains. Despite this, deep learning stereo is seldom used outside an academic context. We observe that a major reason for this is due to the infeasibility of obtaining adequate depth estimations for training beyond a few specific domains. Ironically, the challenge of obtaining accurate depth estimations is exactly what we aim to solve, hence we are left with something of a chicken and egg problem. Therefore, we have explored 3D reconstruction methods that utilise large quantities of images with the goal of being able to generate the high-quality depth estimates required for training. From this exploration we have found that Nerual Radiance Fields (aka NeRFs) not only achieve a high level of accuracy but can also be used as a form of advanced data augmentation, making this a promising approach to training data generation.

Tim Rensen

Title: Towards Automated Species Monitoring and 3D Mapping in Underwater Environments

Abstract: Scallop fishery SCA7 at the top of the South Island was closed due to stock collapse in 2017, halting commercial and recreational fishing of hundreds of tonnes of scallops, and rahui or restricted access imposed on customary fishing by local maori. Many factors contributed to this stock collapse, including overfishing, sediment and nutrient runoff from land use, and natural events such as once-in-a-hundred-year floods turning productive seabed into sediment muck meters deep, suffocating and starving seabed communities. Scallop dredging involves raking up scallops off shallow seabed where they reside, upturning delicate seafloor, tearing apart microalgal films, resuspending sediment, and permanently changing the topology of the seabed.

For commercial scallop fishing to be more sustainable we need better harvesting and monitoring methods. Autonomous underwater vehicles (or AUVs) make it feasible to scan large areas of seabed consistently. The image data can be processed into 3D reconstructions of habitats, allowing marine scientists to analyse entire benthic habitats with a single 3D model or mosaic image as opposed to frame-by-frame in a video.

I propose an annotation method where scientists can label a reconstructed top-down image of a seabed environment, and these labels propagated to all of the individual image frames. This method requires labelling of unique scallops only once, avoiding having to label the same scallop in multiple frames. Transfer learning will be used to reduce the required amount of data in training a CNN for pixel-wise identification of scallops.

How this will help in monitoring and harvesting of scallops is in development of more efficient methods for analysing the scallop stocks and habitats from AUV video. This same robot can run scallop classification live to locate harvestable scallops and selectively pick them up, eliminating bycatch and minimising habitat damage. The result would be more sustainable scallop fisheries, and increased environmental monitoring, enhancing kaitiakitanga or our stewardship of earth.

Rosalyn Rough

Title: Datamining of Bloodstain Patterns

Abstract: Bloodstain Pattern Analysis is a discipline of forensic science which is often used at scenes of bloodshed to assist with the reconstruction of events. Seen as a pattern recognition discipline, BPA has received criticism of its subjective nature and lack of quantitative techniques. As a result, quantitative classification methods are being explored in this research project. Some bloodstain patterns can consist of thousands of stains, making the task of analysing all of them impossible using current manual methods. A computer vision based application has been developed which analyses all the stains within a pattern and returns useful BPA specific metrics relating to the individual stains and the overall pattern. The tool has been applied to laboratory generated patterns from two classes, impact and cast-off patterns and the data has been mined. Three ML classifiers have been applied to the data in an attempt to determine if the metrics can be used to accurately classify the two pattern types.

Sam Schofield

Title: The Windy Forest Visual Inertial Odometry Dataset

Abstract: This talk presents the Windy Forest dataset - a photorealistic dataset for evaluating visual-inertial odometry in environments containing moving vegetation. The dataset provides fifteen sequences comprised of three trajectories, each with five different wind/scene motion levels - allowing the relationship between scene motion and state-estimation accuracy to be examined. The dataset uses a "semi-synthetic" approach, combining real inertial measurements with synthetic images generated along a real multi-rotor trajectory to provide both realistic data and a highly controllable scene. The dataset is used to assess the effect of scene motion on multiple visual-inertial odometry algorithms in a variety of configurations. The results show that scene motion can worsen visual-inertial odometry performance by a factor of ten.

Matthew Edwards

Title: Experimental Validation of Bias in Checkerboard Corner Detection

Abstract: Detecting “corners”, or interest points, in images is central to many traditional computer vision applications. The sub-pixel corner refinement algorithm in OpenCV is widely used to refine corner location estimates to sub-pixel precision. For example, many researchers use it every time they perform camera intrinsic calibration. However, it produces estimates with significant bias and noise which depend on the sub-pixel location of each corner. Following on from my previous research in which I showed this effect mathematically and in simulation, I used a camera mounted on a precisely controlled slider to demonstrate that the effect is large enough to be noticeable in practice.

The department is grateful for the support of the following sponsors:



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
nicki.graf@verizonconnect.com**



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



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.



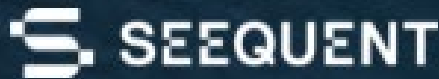
Positioning-centric information is changing the way people, businesses and governments work throughout the world. By applying **Trimble's** advanced positioning solutions, productivity increases and safety improvements are being realized.

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.



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