VICTORIA UNIVERSITY OF WELLINGTON
TE HERENGA WAKA

Wellington Faculty of Engineering
Te Wāhanga Ahunui Pūkaha

2022 DEAN'S LIST PRESENTATIONS

09:20 – 12:00 / 28th October 2022
Alan MacDiarmid Room 102 (AM102), Kelburn
Zoom: https://vuw.zoom.us/my/engr489

09:20	Introduction and Housekeeping **Craig Watterson**
09:30	Welcome & Opening Address **Professor Ehsan Mesbahi** Awarding of Certificates and Prizes
09:45	Dynamic Open Vehicle Routing Problem with Pickup and Delivery **Callum Macaskill**
10:00	Understanding Sickness and Emotional Experiences in VR 360° Motion Simulators (Industry) **Connor de Bruyn**
10:15	Thermographic Drone Inspection of Solar Panel Systems **Daniel Strawbridge**
10:30	***Break***
10:45	Automating Glacier Change Monitoring in the Southern Alps of New Zealand (Industry) **Jackson Jourdain**
11:00	Fingerprinting Bytecode for Better Vulnerability Detection **Emanuel Evans**
11:15	Open-Source Intelligence for Determining Internet Exposure (Industry) **Morgan Hucker**
11:30	***Break***
11:40	An Improved Handover Mechanism for Optimising Video Streaming in Mobile Applications **Oscar Camplin**
11:55	Public Transport Vehicle Speed Mapping (Industry) **Oliver Franklin**
12:10	Concluding Remarks

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ABSTRACT OF PRESENTATIONS

Dynamic Open Vehicle Routing Problem with Pickup and Delivery

Callum Macaskill
Supervisors: Yi Mei and Qi Chen

This project addresses the dispatching and scheduling problem that retail food delivery services experience. Companies that deliver goods from independent restaurants to customers require orders to be assigned to drivers and schedules to be generated for each of them. The dispatching and scheduling outcomes greatly influence the wait times for customers, so making optimal decisions for these tasks is critical. To solve this problem, this project proposes a meta-algorithm to simulate the activity of real-world delivery periods and an algorithm for developing dispatching and scheduling policies with a genetic programming hyper-heuristic. The effectiveness of these developed policies is tested and compared against the performance of baseline dispatching and scheduling methods. The dispatcher developed with the genetic programming hyperheuristic was found to be 25% better than the baseline policy, where performance was measured by the average wait time for customers to receive their orders. Other developed solutions were not as successful as the dispatcher. The results show a clear advantage of using genetic programming to develop effective dispatching policies that are beneficial for businesses and their customers.

Understanding Sickness and Emotional Experiences in VR 360° Motion Simulators (Industry)

Connor de Bruyn
Supervisors: Craig Anslow, Christopher Maymon (*School of Psychology*) and Terry Miller (*Eight360*)

Virtual Reality (VR) has changed the way we approach training personnel, entertainment, work and communication. However, users may still feel disconnected from VR as the motion experienced in the simulation is not translated to their physical environment. Users may also experience cybersickness (CS) which is caused by a disconnection between two or more sensory inputs and produces symptoms of nausea in users. A solution to these problems can be technology such as the NOVA device, which enables users to move in 360-degree motion alongside a VR simulation to reduce the sensory imbalance. This project created a submarine simulation and performed a user study to address if participants experienced less nausea when using the NOVA device. The user study also addressed emotions experienced (such as fear) and suggested improvements to the simulations/devices incorporated.

Thermographic Drone Inspection of Solar Panel Systems

Daniel Strawbridge
Supervisors: Alan Brent and James Hinkley

In recent years proliferating development of the renewable energy sector has been accomplished. Furthermore, significant research to monitor renewable energy systems effectively has been undertaken. One approach to monitoring solar systems and detecting faults uses unmanned aerial vehicles (UAV) equipped with thermal cameras. This approach is effective, but the cost of thermally capable UAVs is often prohibiting for smaller-scale operations. This presentation details the design, implementation and evaluation of a low-cost UAV capable of thermally inspecting small-scale PV systems. This project proved that costs could be reduced by building a UAV only with the necessary components and a thermal camera, rather than purchasing an off-the-self UAV and attaching a thermal camera. The UAV effectively inspected a small PV system installed at a household in Wellington in early 2020, demonstrating its capabilities.

Automating Glacier Change Monitoring in the Southern Alps of New Zealand (Industry)

Jackson Jourdain
Supervisors: Bach Nguyen, Andrew Lensen and Lauren Vargo (*Antarctic Research Centre*)

The response of mountain glaciers to annual climate fluctuations is an important indicator of climate change. A subset of 50 glaciers in the Southern Alps of New Zealand is monitored using aerial imagery, to detect and measure the response of glaciers by identifying the glacier outline. The manual identification of the glacier area and subsequent glacier outline is time consuming. This work aims to design an unsupervised system to automate this process accurately. A system was designed that implements and extends upon an existing unsupervised segmentation method with image processing techniques such as contour identification and image morphology. A well-known U-Net segmentation model is extended using image augmentations and transfer learning, then used to detect the glacier boundary. The performance is compared with the designed unsupervised system. The results showed that the designed unsupervised system was able to improve upon the performance of benchmark unsupervised segmentation techniques, and also outperform the best performing U-Net model by 18.2%.

Fingerprinting Bytecode for Better Vulnerability Detection

Emanuel Evans
Supervisors: Jens Dietrich and Marco Servetto

The use of vulnerable third-party components is among the most pressing issues in modern software development. This is being accentuated by the drastic increase in high-profile incidents associated with vulnerabilities. It is laborious for developers to keep track of whether their applications are affected. For this reason, many software composition analysis tools have been established. Yet, despite their undoubted success, they have blind spots. The goal of this project was to address blind spots related to shaded dependencies, by designing and constructing a tool that recognises them through bytecode representation. This was achieved by creating a digital fingerprint for each component to map shaded classes to their original source. The proposed solution is intended to offer an additional method to detect supply chain vulnerabilities and construct more accurate bills of materials for applications.

Open-Source Intelligence for Determining Internet Exposure (Industry)

Morgan Hucker
Supervisors: Ian Welch, Harith Al-Sahaf and Ethan King (*InPhySec*)

Not understanding what information about your organisation and its employees is openly available on the Internet is a considerable security risk. Attackers frequently gather this information during the reconnaissance phase of an attack to increase the likelihood of a cyber-attack such as phishing being successful. Currently, there is a lack of tools that aim to highlight this Internet exposure in a way that is easily understandable. Organisations commonly use penetration tests to identify technical vulnerabilities; why don't we take a similar approach to find information about employees that can be exploited in social engineering attacks (such as phishing)? Research shows that this is a missed opportunity to increase security awareness among staff members and accurately assess risk. This project has created a software-based tool to automatically assess an organisation's Internet exposure using Open Source Intelligence (OSINT) tools and present information via a graphical interface.

An Improved Handover Mechanism for Optimising Video Streaming Performance in Mobile Applications

Oscar Camplin
Supervisors: Alvin Valera and Winston Seah

Billions of users now regularly use their mobile devices to consume multimedia services online. Ever-increasing customer expectations of streaming quality have placed focus on sources of video quality degradation and fuelled optimisation efforts in recent years. In IEEE 802.11 networks, unintelligent handover decision mechanisms implemented in mobile nodes can significantly degrade user experience. This project proposes and implements a client-based solution for optimising video streaming quality by developing a more intelligent handover mechanism. The mechanism's efficacy is measured in terms of QoS and QoE. Evaluation of the mechanism demonstrated its capability of providing slightly improved overall QoS. QoS results indicated that the mechanism provides greater QoE by reducing rebuffer events and bitrate fluctuations.

Public Transport Vehicle Speed Mapping (Industry)

Oliver Franklin
Supervisors: Jyoti Sahni and Stephen Winch (*Radiola*)

A bus timetable is based on the typical speeds of buses as they travel around a route. However, the speeds of buses can sometimes be inconsistent at different days or times, or due to events such as construction work, protests, or breakdowns. The aim of the project is to develop a solution for the company Radiola which allows a user to identify parts of a bus route where vehicle speeds are slow or inconsistent. This can be used by transport planners at regional councils in New Zealand to improve their bus scheduling.