

IEEE New Zealand Central Section Report

February 2024

PART A - SECTION SUMMARY

A.1 Executive Summary

- **Section Executive Committee Member List in 2023**
 - Chair: Yi Mei
 - Vice Chair: Murray Milner
 - Secretary: Fangfang Zhang
 - Treasurer: Donald Bailey
 - Membership Development: Qi Chen
 - Webmaster: Jordan MacLachlan, Joao Costa, Jesse Wood
 - (Joint) Education Coordinator: Nurul Sarkar
 - Professional Activities Coordinator: Andrew Lensen, Alex Doronin
 - Industry Coordinator: Fanglue Zhang
 - Young Professionals: Bach Nguyen, Andrew Lensen, Fangfang Zhang
 - Women in Engineering: Bing Xue, Qi Chen, Fangfang Zhang
 - Life Member Coordinator: Murray Milner
 - Victoria Student Branch Chair: Kun Huang
 - Massey Student Branch Chair: Yuan Chang
 - Student Counsellor: Mengjie Zhang, Donald Bailey
 - Central CI Chapter Chair: Mengjie Zhang
 - Central Power and Energy Chapter Chair: Daniel Burmester
 - NZ Joint SP/IT Chapter Chair: Yusuke Hioka
 - NZ Joint Communications Chapter Chair: Andrew Austin
 - NZ Joint I&M Chapter Chair: Andrew Taberner
 - NZ Joint Robotics and Automation Chapter Chair: Ho Seok Ahn
 - Other Committee Members: Xiang Gui
- **Section Highlights**
 - We organised a successful Postgraduate Symposium in August 2023, with the most (~40) registrations and attendees over the past few years.
 - We organised a successful Joint Institution Breakfast Event in September 2023. The above two events are our major Section annual events. The first of these events is primarily focused on our student members for membership attraction and retention, while the latter is focused on our industry collaboration. These events were again well received by members. More details on these events are provided below.
 - Our Section successfully sponsored the IVCNZ 2023 and MIGARS 2024 conferences.
 - Our Section has arranged a number of IEEE Distinguished Lectures from around the world. It is these activities which members find most interesting and enable us all to keep at the forefront of research within our fields of interest.
- **Major Events (International, National)**
 - 13 June 2023: Our Section supported the launch event for the Te Whiri Kawe — A Centre for Data Science and Artificial Intelligence at Victoria University of Wellington. The launch invited Prof Yaochu Jin, the IEEE Computational Intelligence Society President-Elect and IEEE Distinguished Lecturer, to give a speech, and attracted 200 attendees, including the NZ Minister of Health and Research, Science and Innovation.
 - 27 June 2023: Our Section supported the Women in Data Science (WiDS) New Zealand 2023, held in Victoria University of Wellington. WiDS New Zealand 2023 is an independent event that is organized by the School of Engineering and Computer Science at Victoria University

Wellington as part of the annual WiDS Worldwide conference organised by Stanford University and an estimated 200+ locations worldwide, which features outstanding women doing outstanding work in the field of data science. The WiDS NZ 2023 event provides an opportunity to hear about the latest data science related research and applications in a number of domains, and connect with others in the field.

- 30 August 2023: The Victoria University of Wellington Student Branch and Massey University Student Branch organised the IEEE Postgraduate Symposium 2023, which was held at Victoria University of Wellington in Kelburn, Wellington. This event involved presentations from over 40 PhD students from Victoria University of Wellington and Massey University (Palmerston North) to present their research work. There were approximately 50 attendees who enjoyed the presentations. The three best presentations were recognised and awarded with prizes.
- 31 October 2023: The Section organised the Joint Institutions Breakfast event, together with EngNZ and IET. This was held as an in-person event at the Wellesley Boutique Hotel (our usual venue). The event had 30+ people in attendance from IEEE, EngNZ, IET and outside. The guest speaker for this event is Professor Emeritus Bob Hodgson, Emeritus Professor, Massey University, Distinguished Fellow Engineering New Zealand. He is a recognized expert in image processing, human factors, and systems engineering. His very full academia career includes a strong record in scholarship, teaching and administration with about forty masters and PhD degrees supervised to completion. He has published widely. Most of his R&D work has been in co-operation with industry. He has made an outstanding contribution to Engineering New Zealand, having served on numerous Boards and committees, Engineering New Zealand and NZQA degree accreditation panels, and six International Washington Accord Panels. He was also a founding member of the New Zealand Council of Engineering Deans. Professor Hodgson is the Technical Director of a start-up science and engineering company, Veritaxa Limited. The company has won worldwide recognition for the Classifynder technology that uses image processing combined with AI to extract information from microscopic images applied to palynology. About twenty systems have been exported.
- 29 Nov – 01 Dec 2023: Our Section successfully sponsored the International Conference on Image and Vision Computing New Zealand. The 38th International Conference on Image and Vision Computing New Zealand (IVCNZ 2023) was held both online and onsite on Nov 29-Dec 1, 2023, at Massey University, Palmerston North, New Zealand. Image and Vision Computing New Zealand is New Zealand's premier academic conference on all aspects of computer vision, image processing, computer graphics, virtual and augmented reality, visualization, and HCI applications related to these fields.
- Our Section technically sponsored the MIGARS conference. MIGARS stands for Machine Intelligence for GeoAnalytics and Remote Sensing, which will be held between 8-10 April 2024 at Shed6, Queens Wharf, Wellington, New Zealand. The broader aim is to bring together professionals and researchers from New Zealand, Australia, and internationally who are the primary users of geospatial data, airborne and satellite-based data in agriculture/horticulture, forestry, geohazards, mining/mineral sector, catchment management, and land and water monitoring. We expect 200-300 participants for this 3-day conference. The website: <https://conferences.co.nz/migars2024/>.

- **Major Chapter Activities**

- IEEE NZ Central Computational Intelligence Society Chapter
 - 20 Jan 2023: Fast Evolutionary Neural Architecture Search with Predictor: A seminar given by A/Prof. Andy Song from RMIT University. This talk introduced their work recently published in GECCO and TEVC. The key contribution is using predictors to speed up Neural architecture search (NAS) as NAS often requires a high computational cost to evaluate candidate networks from the search space. That cost could be mitigated by performance prediction so there is no need to evaluate every candidate network. However, training predictors often require a large number of evaluated architectures which may be difficult to obtain. They address this challenge by proposing a novel evolutionary-based NAS strategy, predictor-assisted evolutionary NAS (PRE-NAS) which can perform well even with an extremely small number of evaluated architectures. PRE-NAS leverages new evolutionary search strategies and integrates high-fidelity weight inheritance over generations. Unlike popular one-shot strategies, which may suffer from bias in the evaluation due to weight sharing, offspring candidates in PRE-NAS are topologically homogeneous. This circumvents bias and leads to more accurate predictions. Extensive experiments

on the NAS-Bench-201 and DARTS search spaces show that PRE-NAS can outperform state-of-the-art NAS methods. PRE-NAS can achieve 2.40% and 24% test error rates on CIFAR-10 and ImageNet respectively. The search cost is only 0.6 days with a single GPU, surpassing most SOTA. In our further work, they developed a novel training-free metrics leveraging active learning, GCN, and a few frontier techniques for the evolutionary NAS. To achieve similar test errors on CIFAR-10 and ImageNet as PRE-NAS, they only need 29 minutes and 37 minutes on a single GPU.

- 17 Mar 2023: How to Prepare a Full PhD Proposal: This talk by Prof. Mengjie Zhang discusses how to prepare a PhD full proposal in science and engineering, particularly in IEEE fields. He provided a number of examples in IEEE CIS outstanding PhD dissertation awards, ACM SigEVO outstanding PhD thesis awards.
- 28 Apr 2023: Hot Trends in EuroGP 2023: This talk from Hengzhe Zhang discussed the hot topics and patterns held in EvoStar 2023, with a focus on genetic programming (EuroGP). This includes main techniques, representations, operators, search, and hybridisation with machine learning, as well as applications of the real-world.
- 09 Jun 2023: Ambulance dispatching with genetic programming: This talk from Jordan MacLachlan discusses the use of genetic programming for the application of emergence management particularly ambulance dispatching. This work has practical value and received runner-up award of the human-competitive competition at GECCO 2023.
- 13 Jun 2023: Data-Driven Evolutionary Optimization of Complex Systems: A Seminar given by Prof. Yaochu Jin, IEEE CIS Society President-elect, IEEE Fellow and Distinguished Lecturer. This talk provides an overview of state-of-the-art algorithms in data-driven evolutionary optimization. On the basis of a brief introduction to the main challenges and methodologies in evolutionary multi-objective optimization, Prof Yaochu Jin focused on presenting recently developed algorithms for handling data paucity and heterogeneity with the help of advanced machine learning algorithms such as ensemble learning, deep learning and transfer learning. Finally, privacy preservation in data-driven optimization was addressed based on federated learning and privacy-preserving techniques before concluding the presentation.
- 16 Jun 2023: On the Similarities Between Geometric Semantic Genetic Programming and Boosting: A seminar given by A/Prof. Grant Dick from University of Otago. Semantic methods in genetic programming attempt to direct search through information garnered from fine-grained details about an individual's behaviour (its semantics). Geometric semantic genetic programming (GSGP) uses search techniques that generate offspring through linear combinations of parent semantics. GSGP frequently outperforms traditional GP variants at the expense of exponential program growth. Closer inspection of GSGP reveals strong overlap with concepts from gradient boosting, and understanding these similarities may allow us to draw on ideas from ensemble learning to produce more effective GSGP variants. Results suggests that these boosting-inspired variants of GSGP are able to perform better than other boosting variants and result in smaller solutions than GSGP.
- 23 Jun 2023: Grammar-Guided Linear Genetic Programming for Dynamic Job Shop Scheduling: This talk from Zhixing Huang discusses grammar representation in linear genetic programming in general and for dynamic job shop scheduling. This work received the best paper award in the GP track for GECCO 2023.
- 26 Jun 2023: Reinforcement Learning Without Explicit External Reward: A seminar given by Prof. Haibo He from the University of Rhode Island. The recent advancements in artificial/computational intelligence (AI/CI) has witnessed tremendous excitements worldwide from academia and industry, which demonstrated the power of AI/CI over complicated tasks. This talk aims to review and discuss the recent research developments in computational intelligence with a focus on the key characteristics of reinforcement learning (RL). Specifically, Prof Haibo He presented a new reinforcement learning and adaptive dynamic programming (RL/ADP) framework for improved decision-making capability. This framework integrates a hierarchical goal generator network to provide a more informative and detailed internal goal representation to guide the decision-making process. Compared to the

existing RL/ADP approaches with a manual or “hand-crafted” reinforcement signal design, this framework can automatically and adaptively develop the internal goal representation over time, without the requirement of an explicit external reward. Detailed learning architecture and associated learning algorithms was discussed in this seminar.

- 30 Jun 2023: Fast and Efficient Local-Search for Genetic Programming Based Loss Function Learning: This talk from Christian Raymond discusses the most recent development on the use of genetic programming for learning loss functions in deep neural networks. The new development focuses on efficient learning with better or at least equivalent results than the state-of-the-art methods. This work received best paper nomination at GECCO 2023 and an extended version was published in IEEE TPAMI.
- 01 Aug 2023: AI/ML/Vision techniques for image analysis in real-world applications: The recent explosion of AI/ML/Vision algorithm accuracy, efficiency and low processing cost has suddenly enabled applications undreamt of even five years ago. Professor Richard Green from University of Canterbury is interested in such real-world applications of challenging research, such as rapid data reduction of petabytes of data from scanning a farm (such as orchards or vineyards) from sub-mm under-canopy/underwater proximal sensing. In this talk, he described his contributions across these research areas, including recent autonomous systems research into drones pruning forests, robots pruning vineyards, autonomous underwater vehicles (AUVs) inspecting mussel lines and wharf pylons to detect invasive biofouling species, AUVs mapping the seabed to locate scallops and even automatic blood spatter analysis.
- 04 Aug 2023: Balancing Different Optimization Difficulty Between Objectives in Multi-Objective Feature Selection: This talk discussed balancing optimisation problem difficulty between different objectives in feature selection. This work has been submitted to IEEE TEVC.
- 18 Aug 2023: YOLO for instance segmentation of individual tree crowns: This talk discusses different versions of YOLO for object detection and segmentation of images. In particular, the experience and lessons of using YOLO for tree crowns were discussed.
- 01 Sep 2023: Building a Dashboard that uses ChatGPT to explain the outputs of GP-NLDR (GP for Nonlinear Dimensionality Reduction): This technical talk discusses the connections between genetic programming and ChatGPT. A key aspect is feature selection, dimensionality reduction.
- 22 Sep 2023: Computer Vision Mussel Farm Long Line Buoyancy Alert System: This talk discusses recent developments for green-shell mussel farm alert system. The key technique is to use AI and Computer vision to automatically detect the line of buoy floats in the mussel farms.
- 13 Oct 2023: CHAI: Computational health and AI: This talk discussed how to use AIML techniques to help health applications. The presenter, Tapabrata Rohan Chakraborty, is from the UK and connect NZ and UK.
- 10 Nov 2023: Recent Development of Intelligent Optimization and Scheduling Research Group: As part of “2023 New Zealand - China Scientist Exchange Program”, Prof. Gaige Wang from Ocean University of China (OUC) introduced his research team at Ocean University of China (OUC) and the significant achievements they have made in various research areas from macro perspectives. Their research group, named the "Intelligent Optimization and Scheduling Research Group," has been actively engaged in several cutting edge research areas over the years, including learning intelligent algorithm, multi-objective optimization, fuzzy scheduling, ENSO (El Niño/Southern Oscillation) prediction, automatic fish classification, dynamic multi-objective optimization, multimodal multi-objective optimization, computer vision, generative adversarial networks, automatic test data generation, distributed scheduling, green scheduling, and feature selection. In each field, he introduced the background, the proposed algorithms, and some representative publications.
- 01 Dec 2023: Rapid determination of bulk composition and quality of marine biomass in mass spectrometry: This talk discusses the use of AIML techniques to help determination of bulk composition and quality of marine biomass in mass spectrometry. This is part of a big Cyber-marine programme.

- 07 Dec 2023: Professor Krauss from the UK gave a seminar on “Data, models, and reality” and discussed the intricate connection of data that informs models which in turn aims at representing and understanding the reality that gives rise to the data. Professor Krauss highlighted common challenges and limitations in the application of data science, which are often based in a mismatch of domain knowledge and technical skills. Moreover, Professor Krauss talked about the significance of collaborative efforts between domain specialists and data scientists.
 - 15 Dec 2023: The final event of the CIS Chapter on 15 Dec 2023 is to celebrate the awards of IEEE Fellows and Engineering NZ Fellows to the CIS key members. Prof Bing Xue from the CIS Chapter at the IEEE NZ Central Section was successfully awarded a Fellowship by IEEE. Prof Bastiaan Kleijn has been an IEEE Fellow and was appointed as a Fellow of Engineering New Zealand. This is a great achievement for our Chapter/Section and also a good recognition of ICT engineering and AI/CI/EC disciplines in NZ. Prof Bing Xue and Prof Bastiaan Kleijn spoke for their main achievements and experience on the applications. Professors Bing Xue and Basitaan Kleijn presented their experience on how to become an IEEE Fellow and Engineering NZ Fellow. This is a combination of Technical and Professional event (professional development).
 - IEEE New Zealand Central Power and Energy Society Chapter
 - Oct-Nov 2023: The PES Chapter successfully organised Power Industry presentation series, consisting of 7 talks in September and October. We had various industry speakers, talking about their experience in the power industry and the problems we have faced, and will face in the future.
 - 05 Oct 2023: Dr. Martin Roeb gave a Guest Lecture. Dr. Martin Roeb holds a diploma in chemistry from the University of Cologne and a doctoral degree in physical chemistry from the same university. Since 1999 he has been working as a scientist, project manager and group leader in DLR’s Solar Research Division in the field of solar high temperature applications. He took over the lead of the team “high temperature solar chemical engineering” in 2010. He has been working as a package leader and coordinator of several domestic and EU projects on solar high temperature processes and in particular on solar fuels. His research interests address processes and materials related to solar thermochemical water and CO₂ splitting, solar upgrading of hydrocarbons, high temperature electrolysis and solar recycling and production processes of chemical commodities. He has been involved in international cooperation in the context of EERA, IEA, the IPHE and SOLARPACES. He used to be the DLR representative in the project HYDROSOL, which has been awarded by the Eco Tech Award Expo 2005, the Technical Achievement Award of the International Partnership for the Hydrogen Economy 2006 and the Descartes Prize 2006 for Scientific Collaborative Research.
 - IEEE Joint NZ Communications Society Chapter
 - 02 Apr 2023: MOTAT STEM Fair is one of the largest annual events held in Auckland (New Zealand) on Sunday April 2, 2023. The day was a huge success with about 1400 visitors and participants engaged with 37 exciting exhibitor stalls showcasing a range of STEM disciplines. We met and greeted school kids (ages 7 to 14 years) and their parents at the centre. We had demonstrations and showcasing on Engineering, Mathematics, and Computer Sciences practical problem solving, live demonstrations, simulation and modelling, and hands-on project trials. I had the opportunity to talk to many kids and their parents about information and communication technologies including Wi-Fi and Bluetooth network modelling. We enjoyed the day as an exhibitor and that the event delivered good outcomes to participants.
 - 05 Apr 2023: 2023 Y12 AUT Campus Experience Day: About 230 students from central Auckland schools visited Auckland University of Technology (AUT) campus on Wednesday 5 April 2023. The tour begun with a morning session where students divided into various groups (about 35 students per group) based on their subject/discipline interest. In this report we describe Computer Science experience. A/Professor Minh Nguyen (HoD, Computer Science and Software Engineering) and Professor Nurul I Sarkar (BCIS Programme Director) offered a workshop covering practical applications of Computer Science and Technology, including artificial intelligence, image processing, networking, software development, and data science.

Students had an opportunity to learn and observe what computer science and software engineering as a discipline would look like at AUT. The session was concluded through a live demonstration of Bluetooth network modelling. About 35 students attended the workshop with a positive outcome.

- 20 May 2023: 11 Jul 2023: STEM Outreach @AUT Orientation: 26 Aug 2023: STEM Outreach @AUT Live: One of the largest pre-university outreach programmes held on 26 August 2023 at Auckland University of Technology, where we volunteered for the day. We met and greeted about 2000+ year thirteen students and their parents on campus. We demonstrated and showcased on emerging network technologies including Wi-Fi, Bluetooth, cyber security projects, robotics, machine learning, and image processing. In addition to the greater Auckland region, students also came from Hamilton and Wellington. Being a programme director (BCIS), Prof Sarkar had an opportunity to talk to many students about study plan/programmes and to answer their queries.
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- 04 Sep 2023: Professor Nurul Sarkar was invited to a Refugee and Migrant careers event (Due Drop Centre, Manukau) attended by 500 year thirteen students accompanied by their parents on Monday 4th September 2023. It was one of the largest career events organised by Ministry of Education this year. AUT student recruitment advisor Eman Ghandour gave an excellent presentation on the day. Being a BCIS programme director, Prof Sarkar had an opportunity to talk to various students about study plan/programmes and to answer their queries. Many students have expressed their interest in coming to AUT for their STEM education.
- IEEE Joint NZ Signal Process / Information Theory Society Chapter
 - 10 March 2023: Concepts and Methods of Blind Source Separation for Speech: An IEEE Distinguished Lecture given by Hiroshi Sawada of NTT Communication Science Laboratories. Humans can naturally separate mixed speeches. Building such a capability into a computer contributes to automatic speech recognition in noisy environments, hearing aids, etc. The task of Blind source separation (BSS) is to separate sound sources from the mixtures with as little prior information as possible. We will have a live demonstration of BSS to separate two simultaneous speeches recorded with a stereo IC recorder. Independent component analysis (ICA) is a primary method for BSS and makes the outputs independent and far from a stationary Gaussian (normal) distribution. However, to separate sounds mixed in a real reverberant environment, we additionally need to solve the so-called permutation problem, which arises from the indeterminacy of the ICA solutions. Independent vector analysis (IVA) is a multivariate extension of ICA that solves the permutation problem by modeling when each speaker starts and stops speaking. Experimental results from various perspectives will be presented to provide an intuitive understanding of the problems and solutions.
 - 13 March 2023: A sophisticated Method of Blind Source Separation for Speech and Music: A seminar given by Hiroshi Sawada of NTT Communication Science

Laboratories. Humans can naturally separate mixed speeches and also musical instruments. Building such a capability into a computer contributes to automatic speech recognition in noisy environments, hearing aids, music analysis, etc. Following on from the talk on March 10th, this talk starts by reviewing the task of Blind source separation (BSS) with a live demonstration and independent component analysis (ICA) as the primary method. To separate not only speech but also musical instruments, we need a richer model than just estimating when each sound starts and stops. Nonnegative matrix factorization (NMF) identifies various frequent sound patterns with a low-rank approximation of a spectrogram and is good at modeling musical instruments. By extending ICA with the NMF source model, we have developed a sophisticated method of BSS for speech and music, called independent low-rank matrix analysis (ILRMA). Various sound examples will be played to provide an intuitive understanding of these BSS methods.

- 21 March 2023: Entropy-based Detection and Classification of Bryde's Whale Vocalizations: An Approach for Understanding and Conserving an Endangered Species: A seminar given by Dr OLUWASEYI P. BABALOLA of Stellenbosch University. Bryde's whales (*Balaenoptera edeni*) are a critically endangered species that inhabits tropical and subtropical waters around the world. Despite their wide distribution, little is known about their population dynamics and behaviour. One of the main challenges in studying these whales is their elusive nature, which makes it difficult to detect and identify them in the wild. In this seminar, we propose an approach for detecting and classifying Bryde's whale vocalizations using entropy-based methods. The proposed method involves using entropy measures to analyse audio recordings of the whales' vocalizations to detect and classify different types of calls. This approach is based on the idea that different types of calls will have different levels of entropy, which can be used to distinguish them from one another. Spectral entropy and temporal entropy are the primary measures used for detection and classification, while approximate entropy and sample entropy are also considered. Machine learning techniques such as decision trees, support vector machines, and hidden Markov model are used to improve the classification performance. The proposed method has the potential to provide valuable information on the presence, distribution, and behaviour of these whales, which will contribute to the conservation and management of this critically endangered species.
- 22 September 2023: Drone Audition: Characterisation, Localization, Enhancement of the Soundfield from Drone-embedded Microphone Array: A seminar given by Wageesha Nilmini Manamperi from Australian National University. The recent emergence of drones across the world enables applications and services mainly in search and rescue missions, wildlife monitoring and video capturing for media and filming industries. Processing of audio signal recordings from drone embedded microphone array on real-world scenes has been referred to as drone audition, whose functionality includes sound source localization, source separation, source tracking, and signal enhancement. However, the audio recordings using the onboard microphones obscure the sound emitted by a source due to drone generated motor and propeller noise, thus leading to an extremely low signal-to-drone noise ratio (*SDNR*). Hence, causes a highly adverse noisy environment and degrades the quality and intelligibility of the recorded audio signals. This talk discusses their work on drone audition using onboard microphone array on the drone for acoustic localization, and audio signal enhancement by exploiting the underlying spatial characteristics of drone noise. They proposed modelling and parameter estimation of the drone-related transfer function (DRTF), an acoustic transfer function from the sound source to a drone-embedded microphones, similar to HRTF. The outcomes of these approaches are (i) enabling 3D position estimation of simultaneously active multiple sound sources, (ii) enhancing the audio signal recordings both speech and bird calls at extremely low *SDNR* level up to -30 dB, and (iii) modelling of a continuous DRTF over space and frequency. They develop these techniques by embedding microphones on to the commercially available drones.
- IEEE Joint NZ Robotics and Automation Society Chapter
 - 13 November 2023: The Chapter organised an IEEE Day event on the New Zealand Robot Soccer Championship 2023.
 - The Chapter organised 8 seminars as follows:

- March 17: Prof Blanca Deusdad Ayala (Universitat Rovira i Virgili, Spain) – Horison Europe SHRI research
- April 12: Mr Jong Yoon Lim (University of Auckland, NZ) – Sentiment understanding
- May 19: Prof. Tauwehe Tamati (University of Auckland, NZ) - Maori Sign Language
- June 16: Mr Peter Cheong (University of Auckland, NZ) - Robot Soccer System
- July 21: Prof Inho Han (Pusan University, Korea) - Digital Healthcare
- October 27: Dr Inkyu Sa (Tencents) - Recent AR/VR systems
- November 17: Edmond Liu (University of Auckland) - Sign language understanding
- November 21: Ruhia King - Maori Sign Language
- IEEE Joint NZ Geo-Remote Sensing Society Chapter
 - 30 Jan 2023: Instrumentation and Future Technology Remote Sensing Summer School: The IEEE GRSS Instrumentation and Future Technologies Technical Committee (IFT) are conducting a Remote Sensing Summer School (IFTR3S) occurring Jan 30-Feb 3, 2023 hosted at the University of Auckland, Auckland, New Zealand. The summer school included mission and sensor design in radar including synthetic aperture radar, bistatic radar and signals of opportunity. Lecturing guests include renowned international experts teaching theory of these technologies combined with hand-on practical exercises.
 - 20 Apr 2023: Sensing Water: The Rongowai airborne remote sensing mission for GNSS-reflectometry across New Zealand: In a unique partnership, the Rongowai mission comprises of a next-generation sensor mounted on a domestic Air New Zealand Q300 aircraft. During the aircrafts' routine scheduled operations, Rongowai autonomously records reflected GNSS signals. Since its first flight in October 2022, Rongowai has obtained data across much of the country, including observing floods in the Auckland and Northland regions in early February 2023. In this talk, we will provide an overview of the mission, outline the current and planned data processing, and present some highlights from data collected to date.
 - 23 Nov 2023: New Zealand GRSS Joint Chapter Annual General Meeting: The chapter had the AGM with 22 eligible voting members.
- **Major Student and Affinity Group Activities**
 - 30 August 2023: The Victoria University of Wellington Student Branch and Massey University Student Branch organised the IEEE Postgraduate Symposium 2023, which was held at Victoria University of Wellington in Kelburn, Wellington. This event involved presentations from over 40 PhD students from Victoria University of Wellington and Massey University (Palmerston North) to present their research work. There were approximately 50 attendees who enjoyed the presentations. The three best presentations were recognised and awarded with prizes.

A.2 Financial Report

Westpac Account 03-0502-0585328-00

Opening Balance	NZ\$ 10,845.38	NZ\$ 10,845.38
Receipts	\$ 8,697.38	
Less 2023 payments	<u>-\$ 9,424.21</u>	
Closing Balance (as at 27/11/2022)	NZ\$ 10,118.55	NZ\$ 10,118.55

Receipts:

Interest	\$ 114.62
Reimbursement of travel for R10 meeting	\$ 1,889.44
AGM Dinner payments	\$ 200.00
IEEE Headquarters	<u>\$ 6,493.32</u>
Total	NZ\$ 8,697.38

Payments:

Bank charges	\$ 19.37
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Student member grants (23)	\$ 1,069.08
R10 Meeting lunch	\$ 95.50
Advance for travel to R10 meeting	\$ 1,889.44
CIS DL meeting	\$ 800.00
Banner	\$ 228.85
PG Symposium	\$ 1,824.46
YP events (4)	\$ 1,505.20
Joint Institutions Breakfast	\$ 469.31
AGM Dinner	<u>\$ 1,523.00</u>
Total	<u>NZ\$ 9,424.21</u>

NEXTGEN Banking

Opening balance (1/1/2023)	US\$ 13,253.18	NZ\$ 20,871.77
(Converted to NZ\$ @ 1.57485)		
Receipts	<u>\$ 431.47</u>	
Closing balance (31/1/2023)	US\$ 13,684.65	NZ\$ 21,635.71
(Converted to NZ\$ @ 1.59102)		

Receipts

Interest	<u>\$ 431.47</u>
Total	<u>US\$ 431.47</u>

Overall position

Current position 31/12/2023	NZ\$ 31,754.26
Position at 1/1/2022	<u>NZ\$ 31,717.15</u>
Net profit (year to date)	NZ\$ 37.10
(including +\$84.43 currency change)	

PART B - ORGANIZATIONAL ACTIVITIES

B.1 Membership Development Activities

- Total number of active members in the past 3 years.
 - 2021: 271
 - 2022: 276
 - 2023: 268
- Summary and evidence of work done to improve the value of membership, which leads to retention and growth of members.
 - In 2023, we have emailed to remind members within the Section who are late to renew their membership for the new year about the benefit of being IEEE member and continue to be a part of the group.
 - We have had an active program of section activities, particularly focused on Chapter activities to encourage more participation by members with specialist interests.
 - We have had a strong program within Victoria University of Wellington and Massey University associated with the section, particularly with postgraduate students. This is reflected in the strong participation with the joint Postgraduate Symposium, which is a whole day event.

B.2 Chapter Activities

- Total number of Chapters in the Section: 6 (Six)
 - Chapter of the Computational Intelligence Society
 - Chapter of the Power and Energy Society
 - Joint Chapter of the IEEE Communications Society (joint with NZ North and NZ South)
 - Joint Chapter of the IEEE Instrumentation and Measurement Society (joint with NZ North and NZ South)
 - Joint Chapter of the Signal Processing and Information Technology Societies (joint with NZ North and NZ South)

- Joint Chapter of the IEEE Geoscience and Remote Sensing Society Chapter (joint with NZ North and NZ South)
- Number of Chapters formed in the current year: 0 (Zero)
- Number of active Chapters (Chapters who have reported required number of meetings during the year)
 - 6 (Six)
- Summary of Chapter activities (Chapter wise with attachment table/information)
 - See above

B.3 Professional and Continuing Education Activities

We have a NZ nationwide Education Coordinator (Nurul Sarkar from AUT) nominated by NZ Central Section, who is also an IEEE STEM Ambassador. Our Education Coordinator has organised a number of education activities as follows:

- 02 Apr 2023: MOTAT STEM Fair is one of the largest annual events held in Auckland (New Zealand) on Sunday April 2, 2023. The day was a huge success with about 1400 visitors and participants engaged with 37 exciting exhibitor stalls showcasing a range of STEM disciplines. We met and greeted school kids (ages 7 to 14 years) and their parents at the centre. We had demonstrations and showcasing on Engineering, Mathematics, and Computer Sciences practical problem solving, live demonstrations, simulation and modelling, and hands-on project trials. I had the opportunity to talk to many kids and their parents about information and communication technologies including Wi-Fi and Bluetooth network modelling. We enjoyed the day as an exhibitor and that the event delivered good outcomes to participants.
- 05 Apr 2023: 2023 Y12 AUT Campus Experience Day: About 230 students from central Auckland schools visited Auckland University of Technology (AUT) campus on Wednesday 5 April 2023. The tour begun with a morning session where students divided into various groups (about 35 students per group) based on their subject/discipline interest. In this report we describe Computer Science experience. A/Professor Minh Nguyen (HoD, Computer Science and Software Engineering) and Professor Nurul I Sarkar (BCIS Programme Director) offered a workshop covering practical applications of Computer Science and Technology, including artificial intelligence, image processing, networking, software development, and data science. Students had an opportunity to learn and observe what computer science and software engineering as a discipline would look like at AUT. The session was concluded through a live demonstration of Bluetooth network modelling. About 35 students attended the workshop with a positive outcome.
- 11 Jul 2023: STEM Outreach @AUT Orientation: 26 Aug 2023: STEM Outreach @AUT Live: One of the largest pre-university outreach programmes held on 26 August 2023 at Auckland University of Technology, where we volunteered for the day. We met and greeted about 2000+ year thirteen students and their parents on campus. We demonstrated and showcased on emerging network technologies including Wi-Fi, Bluetooth, cyber security projects, robotics, machine learning, and image processing. In addition to the greater Auckland region, students also came from Hamilton and Wellington. Being a programme director (BCIS), Prof Sarkar had an opportunity to talk to many students about study plan/programmes and to answer their queries.
- 26 Aug 2023: STEM Outreach @AUT Live: One of the largest pre-university outreach programmes held on 26 August 2023 at Auckland University of Technology, where we volunteered for the day. We met and greeted about 2000+ year thirteen students and their parents on campus. We demonstrated and showcased on emerging network technologies including Wi-Fi, Bluetooth, cyber security projects, robotics, machine learning, and image processing. In addition to the greater Auckland region, students also came from Hamilton and Wellington. Being a programme director (BCIS), Prof Sarkar had an opportunity to talk to many students about study plan/programmes and to answer their queries.
- 13 Sep 2023: YEPN Undergrad Event: Young professionals event that had guest speakers from industry, and discuss the specialisation in Renewable Energy Systems Engineering.

B.4 Students Activities

- Total number of Student Branches in the Section
 - Two – Massey University and Victoria University of Wellington
- Number of new Student Branches formed in the current year
 - None
- Section level student activities (student congress, paper and other contests, awards etc)

- 30 August 2023: The Victoria University of Wellington Student Branch and Massey University Student Branch organised the IEEE Postgraduate Symposium 2023, which was held at Victoria University of Wellington in Kelburn, Wellington. This event involved presentations from over 40 PhD students from Victoria University of Wellington and Massey University (Palmerston North) to present their research work. There were approximately 50 attendees who enjoyed the presentations. The three best presentations were recognised and awarded with prizes.
- Number of active Student Branches (Student Branches who have reported required number of meetings during the year)
 - Two
- Summary of Student Branch activities (Student Branch wise with attachment table/information)
 - As per above.

B.5 Affinity Group Activities

- **Young Professional (YP)**
During 2023, the YP Affinity Group organised a series of 4 employment success workshops for graduates and YP members as follows:
 - 02 Oct 2023: The first workshop is to discover the signature values and signature skills. In this session you will complete a ‘signature values’ exercise and also begin work on articulating your ‘signature skills’.
 - 09 Oct 2023: The second one is to explore career opportunities relating to your degree and learn how to unpack job descriptions. The two most common reasons why job applications are rejected, or candidates fail at interview are not understanding the job description and therefore not addressing the criteria and not realising how important it is to understand the organisation’s overall business i.e. their purpose, values, achievements and the business environment that they operate in. In this session we’ll discover how to learn about different roles and the sectors they fit into and how to talk about them with confidence using the appropriate vocabulary. We’ll also look at how to dissect a job description to ensure that you can present the most compelling evidence of why you are suitable for it.
 - 16 Oct 2023: The third one is to prepare a winning CV and LinkedIn profiles. We’ll use what we’ve covered in the two earlier sessions to look at the content of a winning CV. A winning CV addresses the job description, shows that you are motivated by the insights you have gained regarding this, and finally, shows that you are interested in the organisation and it’s aspirations and values. A good LinkedIn profile can be easily built from a good CV. Three high impact elements of a LinkedIn profile are the Headline (120 characters), the skills you list for endorsement and the organisations that you follow.
 - 30 Oct 2023: The fourth one is to win the selection and interview game. In this session we’ll look at why preparation and practice are key. The more clearly you understand what the employer’s signature skills and values are and what they are looking for in a candidate, the better you are likely to perform. It’s like preparing for an oral exam. You try to anticipate what questions are likely to come up and select and prepare the material you will need to answer each question well. In addition to answering questions well, your audience is weighing up who you really are, and whether you’ll fit into their team.
 - The Group participated in the Joint Institutions Breakfast Seminar (see below).
- **Women In Engineering (WIE)**
In 2023, the WIE group has undertaken the following activities:
 - 27 Jun 2023: The Affinity Group organised the Women in Data Science (WiDS) New Zealand 2023, which features outstanding women doing outstanding work in the field of data science. The workshop went very successful, with 60 IEEE members and 260 guest attendees.
 - The WIE group involved in the organisation of the four YP career workshops together with the YP group.
- **Life Member (LM)**
 - With the great effort of our Life Member Affinity Group Coordinator, Murray Milner, we have successfully established a NZ-wide Life Member Affinity Group. The Group has made some meetings with the Life Members in NZ and is planning for some initiatives to increase the academic and professional visibility of IEEE in NZ.

B.6 Awards & Recognition Activities

- **Award constituted by the Section**
 - The key awards constituted by the Section are those in support of the Postgraduate Symposium. These awards for best presentation are presented each year at the Symposium.
- **Please list all Awards and Recognitions received by the Section, and members in the Section, from R10 and IEEE HQ during the year**
 - None.

B.7 Communication Activities (Newsletter, Home Page, E-mail etc.)

- Newsletter (name and number of issues in the year)
 - Not Applicable
- Home Page of the Section (give the URL and how often it is updated)
 - The Section website is updated regularly with activity information, both as announcements of upcoming events, and reports on the events as they happen. The URL is <https://r10.ieee.org/nzc/>.
 - The website is kept regularly up to date by our very active webmasters Jordan MacLachlan, Joao Costa and Jesse Wood. They ensure that all activities involving the Section are recorded on the website in a timely manner and frequently chase committee members to ensure that reports on recent events are recorded quickly, with photos where possible.
- Other means of contacts with Section members including social media
 - Members are notified of upcoming events through e-Notices.

B.8 Industry Relations

- Membership growth and retention
 - Our Industry Coordinator, Fanglue Zhang, has proposed two industry seminars as follows:
 - 16 Mar 2023: “Neural Style Transfer” by Prof. Paul Rosin, a Professor in Cardiff University, UK. He talked about his research on style transfer based on deep neural networks. This includes an overview of some of his earlier non-photorealistic rendering (NPR) work, and more recent work on neural style transfer. Specifically, the latter methods incorporate additional information: Depth-aware Neural Style Transfer, Neural Style Transfer with Semantic Masks and Neural Style Transfer with Local Models.
 - 31 Mar 2023: “Learning based Visual Content Generation and Editing” by Yu-Kun Lai, a Professor in Cardiff University, UK. He has published over 200 papers in major journals and conferences in these areas, including 90 papers in ACM TOG/IEEE TPAMI/TVCG/TIP/CVPR/ICCV. Visual content is widely used in many applications. Generating high quality visual content can often be time-consuming and require substantial expertise. In this talk, he presented their recent work that aims to automate some visual content generation process while allowing user control for visual content editing, by developing dedicated deep generative models for various types of visual content, namely images, videos, and 3D shapes. He discussed how specific techniques can help address challenges for different media/tasks, along with some directions for future research.
 - Our Young Professional Coordinator, Bach Hoai Nguyen, has also established good relationship with the Engineering New Zealand YP Coordinator from previous YP events.
- Activities for/with industrial members

Our Section has co-organised the following events together with Engineering NZ (ENZ) and/or Institution of Engineering & Technology (IET):

 - 15 Feb 2023: Presentation by Shaun Robinson of NHP on "Internal Arc Fault Mitigation in MV & LV Switchgear". This presentation explored Arc Faults within MV and LV switchgear and what are some of the common causes and the severity of arc faults. It outlined and explored some of the common industry solutions for minimising or mitigating the risks of internal arc faults.
 - 08 Mar 2023: Guidelines for Managing Artificial Intelligence Projects – Hybrid event: Engineers can make important contributions to Artificial Intelligence (AI) and robotic projects. This presentation briefly described the three different types of AI, their limitations and how they can be applied, and especially the need for engineers to review and validate the outcomes provided by AI systems. Case studies of some recent Perth-based projects as well as examples of failures will be presented to provide additional information. Some of the challenges and options for regulating AI were discussed because many AI projects do not explain how outcomes are delivered. Recent developments in “Explainable AI” were presented including creating test plans and verifying or certifying AI projects.

- 12 Apr 2023: Presentation by John Lahiff of GHD on Airfield Ground Lighting (AGL). This presentation introduced airfield ground lighting (AGL) and AGL design. The intention of the presentation is to introduce airfield lighting and provide an understanding of the different components of an AGL 6.6A 5kv series circuit and different technologies used airside.
- 17 May 2023: Presentation: Electrification Challenges for Wellington's Distribution Network. Whanganui-a-Tara, Wellington, isn't known for being particularly sunny and solar uptake hasn't been as rapid as other parts of the country. However, within Wellington there is a real appetite for transport electrification. Wellington Electricity has been busy preparing to supply everything from electric planes to electric cars, electric buses, electric trains and even electric ferries. Each of these new loads presents challenges not only to provide capacity, but to maintain the network's high level of system security.

B.9 Humanitarian Technology Activities

- Humanitarian Technology related activities supported by the Section including collaboration with other OUs.
 - None
- SIGHT Activities
 - None

B.10 Community Activities

- IEEE Social activities (Family day, IEEE day, Engineers Week)"
 - None.

PART C - OTHERS

C.1 Special Events

- The primary Special Event held during 2023 was the Combined Institutions Breakfast Symposium. This event included joint sponsorship from IEEE, IET and ENZ. The event was also jointly funded by the three institutions.

C.2 Relationship with National and International Societies and Non-Government Organizations (NGO)

- Nature of relationship and details of any formal agreement signed
 - Engineering New Zealand (ENZ)
 - Collaboration Agreement signed some years back and needs to be renewed. We have started communicating with ENZ in 2020, but the progress is slow due to the negative effect caused by COVID-19. We will follow up with the process in the new year.
 - Joint events held annually.
 - Considerable overlap in membership
 - Institute of Engineering and Technology (IET)
 - Collaboration Agreement signed some years back and needs to be renewed. We have started the communication with IET, and received a very positive response from IET who have agreed the renewal in principle and are keen to develop closer relationships especially in regard to YP activities. However, again due to COVID-19, the progress is a bit slow. We will follow up with the process on the agreement renewal and closer collaboration with IET in the new year.
 - IEEE NZCS Vice Chair (and Immediate Past Chair) is also an IET Wellington Network Committee member.
 - Considerable overlap in membership
 - Several joint events held annually
- Details of joint activities
 - Primary joint event with ENZ and IET held annually is the Combined Institutions Breakfast event.
 - Other events held on a collaborative basis as appropriate.
- Benefit to IEEE members (for example discounts, access to technical information etc.)

- IEEE members get to access technical seminars and other events which would not be otherwise possible without multiple membership fees
- Benefit to Section (for example help in membership development, venue facilities, cost saving etc.)
 - Greatly increased range of activities for members with less organisational effort
 - Leverage the scale and scope of three organisations for the benefit of members
 - Reduces competition for members between these three organizations

C3. Collaboration with other IEEE Sections

- Support extended to neighboring Sections
 - Many activities are undertaken collaboratively with the New Zealand North and South Sections
 - Several Chapters are Joint with the North and/or South Sections in order to ensure scale and scope of activities.
- Joint activities with any other Section
 - We mainly have joint activities with other New Zealand Sections through the activities organised by our Joint Chapters, as listed above.

C.4 Support extended to Sub-sections & Society Chapters within the Section

- Support extended for organizing technical, educational and professional activities
 - There are no sub-sections within the New Zealand Central Section
 - The NZCS always works to support Society Chapters in a collaborative manner with funding as required.
 - All Chairs of Chapters and Joint Chapters are invited to participate in monthly Section Committee meetings.
- Joint activities for membership development
 - Society Chapter Chairs are involved in all membership development activities undertaken by the Section.
- Support extended for the formation of a Sub-section or transition of a Sub-section into a full Section
 - Not applicable

C.5 Best Practices of your Section (which you would like to share with other Sections for the benefits of members)

- Maintaining regular (monthly) committee meetings.
- We have defined a “Portfolio responsibilities” document, which outlines the roles and responsibilities for the various portfolios on the executive committee.
- Close coordination of activities with those of affiliated groups such as Engineering New Zealand and Institute of Engineering and Technology.
- The New Zealand Central Section has two annual activities which we believe represent best practice. These are:
 - An annual industry breakfast seminar event which is held jointly with the local IET network and the Wellington Branch of Engineering New Zealand. This event is especially targeted at industry members from all three Institutions. It also provides an excellent platform for collaboration with our sister professional institutions operation in our region.
 - The annual Postgraduate Symposium which involves participation across the two postgraduate universities within the NZ Central Region and typically has 30-40 presentations. Prizes are awarded for the best presentations, but the greatest value is derived from the sharing of research activities from across the region. We also provide 1-year free IEEE student membership grant to the presenters to increase our membership retention and visibility of IEEE and our Section in NZ.

C.6 Problems anticipated and suggestions for solutions, if any

- New Zealand like many countries has a national engineering institution which in our case is called Engineering New Zealand. As Engineering becomes increasingly recognised as a critical discipline for the delivery of safe modern facilities, the requirements placed on engineers to ensure Continuous Professional Development and up to date competency in one’s fields of practice increases to the extent

that it becomes a matter of Regulatory Compliance. The Regulatory Compliance aspect is typically associated with membership and competency evaluation through the national engineering institution, which requires membership of Engineering New Zealand. The threat for IEEE is that increasingly engineers must join their national engineering institution to ensure Regulatory Compliance to practice engineering nationally which then puts pressure on funding to also join other institutions such as IEEE. This is becoming an increasing competitive threat to institutions such as IEEE and IET in New Zealand.

- It is highly likely that some form of joint membership will be essential in the future, which enables membership of ENZ and IEEE (say) at a reduced rate relative to joining each institution separately. Our Vice-Chair Murray Milner is a Distinguished Fellow of ENZ, and our Chair (Yi Mei), CIS Chapter Chair (and student councilor) Mengjie Zhang and WIE Coordinator (Bing Xue) are Fellows of ENZ. We will continue to apply for more ENZ Fellowship from the IEEE Committees to increase our engagement and influence on the ENZ decisions and planning.
- Maintaining dynamism within the student branches, especially with a high turnover (students are only with us for a short time). We need to focus on the attraction and retention of members within our two student branches.
- A recent decision from Massey University has made its Engineering discipline and the corresponding staff members redundant, leading to a huge loss of our committee members, memberships, and balance between universities (the membership from Massey has dropped a lot). We need to work harder to increase membership and maintain diversity.

PART D - GOALS AND PLANS

D.1 Continuation of project/activity in progress and their implementation plans

- Ongoing plans for 2024
 - Continue to organise our very successful joint institutions breakfast meeting for industry.
 - Continue with the successful postgraduate presentation event.
 - Continue to encourage Distinguished Lecturers to present to our members.
 - Continue to send introductory letters to all new members within the Central Region.

D.2 Goals and Future Plans

- Goals
 - To increase membership in all disciplines.
 - To encourage members to enhance their membership level.
 - To actively engage with all members within the Central Region.
 - To further encourage YP and WIE activities.
 - Capacity development of future leaders by sending them to the R10 meeting and IEEE Sections Congress as delegates.
- Future Plans
 - To encourage all the coordinators to submit a yearly plan along with a budget at the first committee meeting of the year.
 - To establish our Section social media (e.g., Facebook, Tweeter) to increase our visibility.
 - To establish more awards within the Section to encourage more activity organisation.
 - To invite more committee members from industry.

D.3 Any innovative ideas to make IEEE more creative and value added for sustaining the membership retention and recruitment goals.

- As indicated in Section C6 above, it is becoming increasingly essential to find improved ways to work collaboratively with our national engineering institution, Engineering New Zealand, so that members are not unduly burdened with membership fees for both organizations. We plan to work towards two aspects: (1) engage more with the ENZ activities (e.g., through the YP events with ENZ) to enhance the relationship with them; (2) applying for more Fellowships of ENZ from our Section to increase our influence on ENZ. Then we will find ways to propose ENZ-IEEE joint membership program with the ENZ leadership team.
- We will continue to increase our local visibility through our website, social media and organised activities, to attract more members.

D.4 Business Plan for Sustainable Growth and Financial Stability.

- New Zealand has its summer holidays during December and January and so Business Planning for the New Year will commence in February 2024.
- Hence the Business Plan for 2024 is at an early stage of development for this report.
- It is expected that the Business Plan will continue the work from previous years as follows:
 - Continued support of Chapter seminars and related activities with particular emphasis on Distinguished Lectures,
 - The holding of the annual Combined Institutions Industry Breakfast event,
 - The holding of the Postgraduate Presentation Symposium by the Combined Student Branches,
 - Further increase our visibility through our Section website, social media and activities,
 - A continued emphasis on membership development and retention, noting the challenges identified in C.6 above,
 - Increased focus on Affinity Groups – finding ways to ensure continuity and growth of the Young Professionals Group and the Women in Engineering Group, as well as the newly established NZ-wide Life Member Affinity Group
 - We will continue to apply for more ENZ Fellowship to make more engagement and influence on the ENZ decisions, to make it possible for more deep collaborations (e.g., joint membership) with ENZ.
 - We will establish special funds and awards to encourage people to organise events and provide financial support and sponsorship to them. This way, we expect to increase the visibility and influence of our Section.