ISiUS

THE UNIVERSITY of ADELAIDE

PROGRAMME BOOKLET ICIUS2023

The 19th International Conference on Intelligent Unmanned Systems

Adelaide, South Australia
5-7 July 2023

https://set.adelaide.edu.au/icius2023

Version 3.1 - 7 July 2023

Contents

ICIUS Organisers - Welcome Message

Dear colleagues,

It is our great honour and pleasure, to welcome you to the 19th International Conference on Intelligent Unmanned Systems (ICIUS 2023), to be held in Adelaide, South Australia, from the 5th to the 7th of July 2023. **The conference is being run in hybrid mode - simultaneously onsite and online.**

Our goal is to create an inclusive, respectful conference environment that invites participation regardless of ethnicity, gender, race, religion, age, ability, or sexual orientation. We value diversity in the community, and we are seeking to bring this inclusiveness approach to the conference.

The International Conference on Intelligent Unmanned Systems (ICIUS) is a series of annual international conferences in which the International Society of Intelligent Unmanned Systems (ISIUS) is the primary organiser. ICIUS 2023 is co-organised by the University of Adelaide. The conferences have been successfully run in many countries, and in 2023 it will be held for the first time in Australia.

The aim of the conference is to stimulate interactions among researchers active in the areas pertinent to intelligent unmanned systems. Topics of interests include, but are not limited to the field of unmanned and intelligent systems for ground, underwater, aerial and space applications. This year we also extend the scope to include off-earth exploration, construction and mining as well as Internet of Things and Virtual Reality.

Besides the excellent technical programme, participants will have the opportunity to enjoy their stay in Adelaide, which is consistently voted as one of the most liveable cities in the world with its stunning architecture, vibrant cultural life, historical landmarks, and most importantly its surroundings of beautiful untouched nature.

We welcome you to Adelaide in July 2023. We believe that you will greatly enjoy this major scientific event as well as the Australian culture, cuisine, and hospitality.

Kind regards,

Rini Akmeliawati and David Harvey, The University of Adelaide
ICIUS 2023 Conference Co-Chairs

We acknowledge the Kaurna people, the original custodians of the Adelaide Plains and the land on which the University of Adelaide campuses are built.

ISIUS President - Welcome Message

Distinguished Members, Ladies and Gentlemen,

Welcome to ICIUS 2023. Considering just how busy you all must be, thank you very much for taking your precious time to participate ICIUS 2023 in the University of Adelaide, whatever onsite or online. This is the 1st time ICIUS hosted in Australia.

In particular, I would like to extend my gratitude to all of you and hope that this event will serve as a catalyst for strengthening international cooperation on the transfer of innovative technology and science of intelligent unmanned system. In addition, I am most thankful for the ceaseless efforts of organization committee members in the University of Adelaide Australia and the ICIUS 2023 general co-chair, Prof. Rini Akmeliawati. She is one of the Vice Presidents of ISIUS, and Prof. David Harvey, who is also the ICIUS 2023 general co-chair.

Since 2005, ICIUS annually offers a unique and interesting platform for scientists, engineers and practitioners all over the world. All participants can present and share their most recent research and innovative ideas in the areas of unmanned systems, robotics, automation, intelligent systems, and biomimetics. This conference is believed to represent the highest pedigree, highest quality content and the closest international networking.

On behalf of ISIUS, I sincerely appreciate the generous financial supports from the Office of Naval Research (ONR) of USA, the Sir Ross & Sir Keith Smith Fund in the University of Adelaide, International Society of Mechatronic Engineering (ISME) of Taiwan, and SABRN Tech Pty. Ltd. in South Australia.

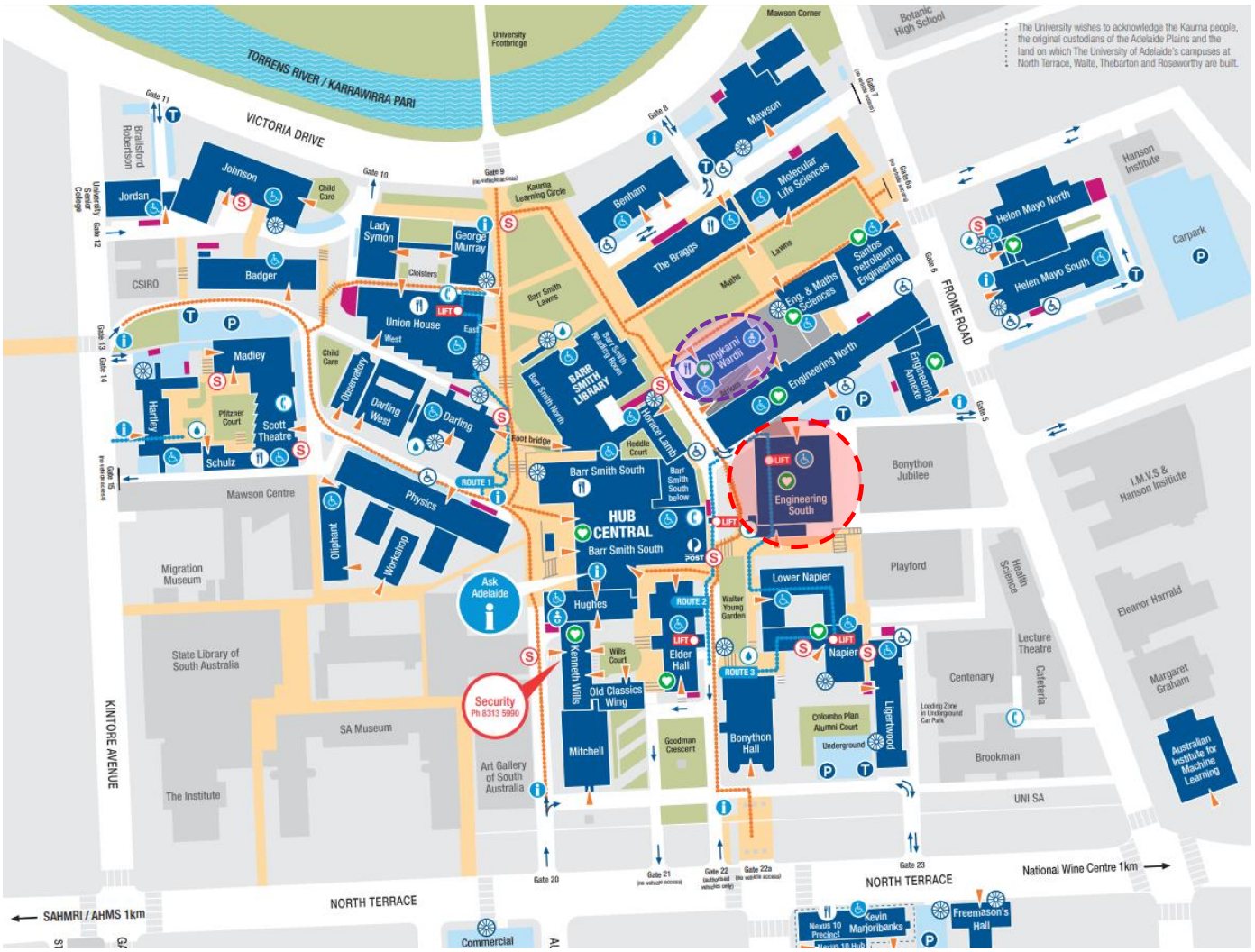
Once again, I am most grateful for your participation, and wish you have a nice stay in Adelaide.

Dear colleagues,

Prof. Lung-Jieh Yang, Tamkang University

President of the International Society of Intelligent Unmanned Systems (ISIUS)

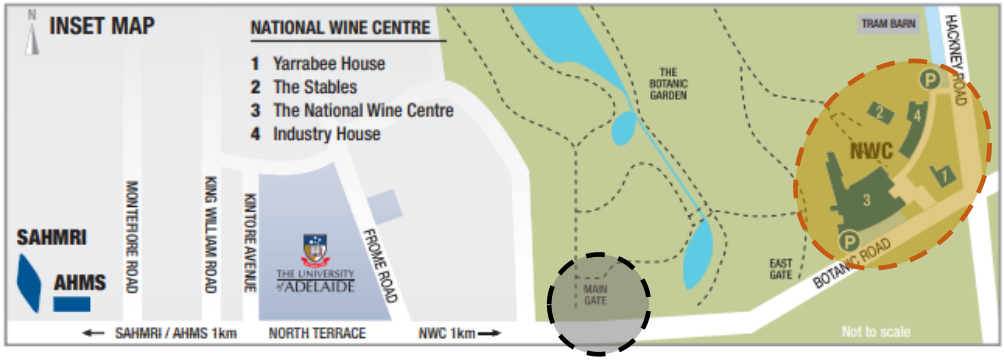
Maps



Legend:

: Conference Venue (Engineering South Building, level 1, rooms S111 and S112)

: Welcome Reception Venue (Ingkarni Wardli Building, level 5, room 5.54)



Legend:

: Banquet Venue (National Wine Centre)

: Tour Venue (Botanic Gardens Main Gate - Resonate Tour)

Conference Committee

General chair and co-chair

- A/Prof. Rini Akmeliawati (University of Adelaide, Australia)
- A/Prof. David Harvey (University of Adelaide, Australia)

Technical programme committee

- Dr. Agus Budiyono (Indonesia Center for Technology Empowerment)
- Dr. Lei Chen (University of Adelaide, Australia)
- A/Prof. Steven Grainger (University of Adelaide, Australia)
- Prof. Wei He (University of Science and Technology Beijing, China)
- Dr. Tien Fu Lu (University of Adelaide, Australia)
- Dr. Noune Melkoumian (University of Adelaide, Australia)
- Dr. Nataliia Sergiienko (University of Adelaide, Australia)
- A/Prof. Sutthiphong Srigrarom (National University of Singapore, Singapore)
- Prof. Lung-Jieh Yang (Tamkang University, Taiwan)

Steering committee

- Dr. Agus Budiyono (Indonesia Center for Technology Empowerment)
- Prof. Park Hoon Cheol (Konkuk University, Korea)
- Prof. Wei He (University of Science and Technology Beijing)
- Prof. Muljowidodo Kartidjo (Institute of Technology Bandung, Indonesia)
- Prof. Masafumi Miwa (Tokushima University, Japan)
- Dr. Thien-Phuc Tran (HCMUT, Vietnam)
- Prof. Lung-Jieh Yang (Tamkang University, Taiwan)
- Prof. Youmin Zhang (Concordia University)

Sponsors

THE SIR ROSS & SIR KEITH SMITH FUND

Schedule Overview

Please note - All times are shown in "Australian Central Standard Time" throughout the programme

Welcome Reception / Public Seminar - Wednesday 5th of July 2023

Time	
3:30pm - 5:00pm	Registration and Opening reception - Ingkarni Wardli IW 5.54 reception area
5:30pm - 6:30pm	Public seminar and panel for invited speakers "Intelligent Unmanned Systems and Flapping Wing Robots" - Engineering South S112

Conference Day #1 - Thursday 6th of July 2023

Time	Room 1 - Engineering South S111	Room 2 - Engineering South S112
8:00am - 10:00am	Registration - Atrium outside Engineering South S112	
9:00am - 9:30am	Opening ceremony (including group photo)	
9:30am - 10:10am	Plenary Presentation #1 Towards Smarter, Safer, More Reliable and More Resilient Intelligent Unmanned Systems *Prof. Youmin Zhang (Concordia University, Canada)*	
10:10am - 10:50am	Plenary Presentation #2 Consensus and Formation Control for Multi-agent Systems *Prof. Peng Shi (University of Adelaide, Australia)*	
10:50am - 11:10am	Coffee break - Engineering South S117	
11:10am - 12:30pm	Parallel Session 1-1 - Flapping wing UAV A	Parallel Session 1-2 - USV / AUV
12:30pm - 1:30pm	Lunch - Engineering South S117	
1:30pm - 2:10pm	Plenary Presentation #3 MEMS Sensors Applied to On-Site Sensing of Unsteady Aerodynamics *Prof. Lung-Jieh Yang (Tamkang University, Taiwan)*	
2:10pm - 3:10pm	Parallel Session 2-1 - Off-Earth robots and control A	Parallel Session 2-2 - Navigation + IoT
3:10pm - 3:30pm	Coffee break - Engineering South S117	
3:30pm - 5:10pm	Parallel Session 3-1 - Flapping wing UAV B	Parallel Session 3-2 - Computer / Machine vision
5:10pm - 6:00pm	Free time	
6:00pm - 8:00pm	Conference tour - Resonate (part of the "Illuminate Adelaide" festival). Meet outside S112 at 5:30pm, ready to walk to the tour site at the Botanic Gardens for a 6pm start.	

Conference Day #2 - Friday 7th of July 2023

Time	Room 1 - Engineering South S111	Room 2 - Engineering South S112
8:00am - 10:00am	Registration - Atrium outside Engineering South S112	
9:00am - 9:40am	Plenary Presentation #4 Conformal Sensors for Non-invasive Monitoring and Health care *Prof. Madhu Bhaskaran (RMIT University, Australia)*	
9:40am - 10:20am	Invited Presentations Will Autonomous Surgery Using Advanced Sensors, Robotics, Augmented Reality and Machine Learning Technologies Be Possible Within the Next Decade? *Dr Abhilash Chandra (Vascular and General Surgeon)* Autonomous Robot Tractor use in Australian and International Viticulture *Simon Nordestgaard (Principal Engineer, The Australian Wine Research Institute)*	
10:20am - 10:40am	Coffee break - Engineering South S117	
10:40am - 12:20pm	Parallel Session 4-1 - Modelling / Control	Parallel Session 4-2 - AI / ML
12:20pm - 1:20pm	Lunch - Engineering South S117	
1:20pm - 2:00pm	Plenary Presentation #5 Magnetic Miniature Robots for Translational Biomedicine: From Individual to Collectives *Prof. Li Zhang (Chinese University of Hong Kong, Hong Kong)*	
2:00pm - 3:00pm	Parallel Session 5-1 - Bio-inspired robots	Parallel Session 5-2 - Off-Earth robots and control
3:00pm - 3:20pm	Coffee break - Engineering South S117	
3:20pm - 4:40pm	Parallel Session 6-1 - AgTech	Parallel Session 6-2 - Communications / Sensors
4:40pm - 4:50pm	Closing remarks	
4:50pm - 6:00pm	Free time / ISIUS meeting	
6:00pm - 10:30pm	Conference Banquet at the Wine Centre and Closing Ceremony	

Schedule Detail

Please note - All times are shown in "Australian Central Standard Time" throughout the programme

Remote delivery is indicated by highlighted presentation

Designated presenters for each paper are underlined in the list of authors

Welcome Reception - Wednesday 5th of July 2023

Time	
3:30pm - 5:00pm	Registration and Opening reception - Ingkarni Wardli IW 5.54 reception area
5:30pm - 6:30pm	Public seminar and panel for invited speakers "Intelligent Unmanned Systems and Flapping Wing Robots" - Engineering South S112

Conference Day #1 - Thursday 6th of July 2023

Time	Room 1 - Engineering South S111	Room 2 - Engineering South S112
8:00am - 10:00am	Registration - Atrium outside Engineering South S112	
9:00am - 9:30am	Opening ceremony *Welcome to country* *Opening remarks: Prof. Nelson Tansu (University of Adelaide, Australia)* *ISIUS President - Prof. Lung-Jieh Yang (Tamkang University, Taiwan)* *A/Prof. Rini Akmeliawati and A/Prof. David Harvey (University of Adelaide, Australia)* *Group photo*	
9:30am - 10:10am	Plenary Presentation #1 Towards Smarter, Safer, More Reliable and More Resilient Intelligent Unmanned Systems *Prof. Youmin Zhang (Concordia University, Canada)* *Chair: A/Prof. Rini Akmeliawati (University of Adelaide, Australia)*	
10:10am - 10:50am	Plenary Presentation #2 Consensus and Formation Control for Multi-agent Systems *Prof. Peng Shi (University of Adelaide, Australia)* *Chair: A/Prof. David Harvey (University of Adelaide, Australia)*	
10:50am - 11:10am	Coffee break - Engineering South S117	
	Parallel Session 1-1 - Flapping wing UAV A *Chair - Prof. Lung-Jieh Yang (Tamkang University, Taiwan)*	Parallel Session 1-2 - USV / AUV *Chair - Prof. Taesam Kang (Konkuk University, Korea)*
11:10am - 11:30am	**Development of Bio-Inspired Perforated Flapping Wings (4619)** *Dharambir Poddar, Ansh Gangwar and Debopam Das*	**Development of Unmanned Surface Vehicle for in-situ Water Quality Measurement Using IoT (2454)** *Surendar Ganesan, Balasubramanian Esakki, Jae Sung Choi, Sridevi S, Sarath Kumar C and Vikram P*
11:30am - 11:50am	**Aerodynamic simulation of a butterfly-inspired flapping-wing robot using ANSYS-FLUENT (5885)** *Tao Niu, Haifeng Huang and Wei He*	**Performance & Evaluation Test Results of Underwater Construction Robots (7486_A)** *Jihoon Kim, Heungchan Kim, Chang Hyeon Seo and Insung Jang*

11:50am - 12:10pm	**Effects on Aerodynamic Forces due to Leading-Edge Twisting in Flapping Wing (2630)** *Vivek Jabaraj Joseph, Lung-Jieh Yang, Saravana Kompala, Paritala Veeranjaneyulu and Wei-Chen Wang*	**Simulation and controller design of an underwater vehicle (9587)** *Sandhya Rani Gumpina, Jungkeun Park, Taesam Kang and Jinyou Kim*
12:10pm - 12:30pm	**Thrust generation by flapping-wings under the low-air density condition (407)** *Gi Heon Ha and Hoon Cheol Park*	**Neuroevolutionary Reinforcement Learning of an Autonomous Underwater Vehicle for Confined Space Inspection (5414)** *Ahmad Faisal Mohamad Ayob, Mohd Rizal Arshad and Aceng Sambas*
12:30pm - 1:30pm	Lunch - Engineering South S117	
1:30pm - 2:10pm	Plenary Presentation #3 MEMS Sensors Applied to On-Site Sensing of Unsteady Aerodynamics *Prof. Lung-Jieh Yang (Tamkang University, Taiwan)* *Chair - Dr. Nataliia Sergiienko (University of Adelaide, Australia)*	
	Parallel Session 2-1 - Off-Earth robots and control A *Chair - Prof. Debopam Das (IIT Kanpur, India)*	Parallel Session 2-2 - Navigation + IoT *Chair - A/Prof. David Harvey (University of Adelaide, Australia)*
2:10pm - 2:30pm	**Nanosatellite Technology Survey with Highlight of AI Empowerment (6593_A)** *Riza Muhida, Meiditomo Sutyarjoko, Adhi Murbini, Agus Budiyono, Ary Setijadi and Agus Sukoco*	**Comparative Analysis of Path Planning Algorithms Based on RRT for 3D Environments (1956)** *Zexuan Hu and Bijan Shirinzadeh*
2:30pm - 2:50pm	**Investigating the use of electrodynamic dust shielding to improve the robustness of a lunar rover drivetrain to regolith (4425)** *Hannah Vine Hall, Oscar Mortier-Spole, Vinh Nguyen, Benjamin Lang, Michael Laden, Mitchell Munn and William Robertson*	**Position Control between GPS and Non-GPS Environments using High Precision IMU (9342)** *Masafumi Miwa, Keiichi Nishikawa, Masataka Shiromaru and Kazunori Araki*
2:50pm - 3:10pm	**Designing a Nature-Inspired Swarm Robot System for Autonomous Production (545_A)** *Joven Tan, Noune Melkoumian, Rini Akmeliawati, David Harvey*	**Review on Vehicle-to-Vehicle (V2V) Communication aspect of Vehicular Ad Hoc Network (VANET) and Handover (6248_A)** *Temitope Joseph Oloke, Abiodun Musa Aibinu, Reuel Zasan Kantiyok, Zainab Oluwawemimo Bakare and Kafayat Oluwatoyin Shobowale*
3:10pm - 3:30pm	Coffee break - Engineering South S117	
	Parallel Session 3-1 - Flapping wing UAV B *Chair - Dr. Nataliia Sergiienko (University of Adelaide, Australia)*	Parallel Session 3-2 - Computer / Machine vision *Chair - Prof. Javaan Chahl (University of South Australia, Australia)*
3:30pm - 3:50pm	**Designing and Manufacturing a Flapping Wing UAV (4106_A)** *Abdelrahman Shaaban, Seyed Hashemi, Abdullah Rasti, Sadok Sassi and Elsadig Saad*	**Effectiveness of Synthetic Image Data in Training Human Action Recognition Models (7317)** *Keith Man and Javaan Chahl*

3:50pm - 4:10pm	**Design of a Remote Controller for flapping MAVs Based on Motions (9903)** *Jeong-Hwan Kim, Sandhya Rani Gumpina, Seungyeon Lee, Taesam Kang and Jungkeun Park*	**FoCLBP+2DGF: Fusion of Complete Local Binary Pattern with 2D Geometry Features for Emotion Recognition through Facial Expressions in Videos (9582)** *Lovejit Singh, Sarbjeet Singh, Naveen Aggarwal and Ranjit Singh*
4:10pm - 4:30pm	**Autonomous Control Design for a Two-Wing Tailless Flapping-Wing Micro Air Vehicle System (3290)** *Christopher Balnaves, Xin Yuan, Peng Shi and Rini Akmeliawati*	**Contactless Vital Signs Monitoring in NICU based on Machine Vision (6020)** *Fatema-Tuz-Zohra Khanam, Asanka G. Perera, Ali Al-Naji, Kim Gibson and Javaan Chahl*
4:30pm - 4:50pm	**Control Board and Motor Driver Board Design for a Directly Motor-driven Flapping MAV (9730)** *Seunghee Jeong, Seungik Choi, Daewook Kim, Sungbin Jang, Jungkeun Park and Taesam Kang*	**A Novel Convolutional Neural Network-Based Insulator Defect Detection Method for High-Voltage Transmission Lines (2551)** *Yulong Zhang, Youmin Zhang, Lingxia Mu, Xianghong Xue, Jing Huang, Xuesong Xie and Jing Xin*
4:50pm - 5:10pm	**Aerodynamics and control of an ornithopter with a bird-like tail (1977)** *Joydeep Bhowmik and Debopam Das*	-
5:10pm - 6:00pm	Free time	
6:00pm - 8:00pm	Conference tour - Resonate (part of the "Illuminate Adelaide" festival). Meet outside S112 at 5:30pm, ready to walk to the tour site at the Botanic Gardens for a 6pm start.	

Conference Day #2 - Friday 7th of July 2023

Time	Room 1 - Engineering South S111	Room 2 - Engineering South S112
8:00am - 10:00am	Registration - Atrium outside Engineering South S112	
9:00am - 9:40am	Plenary Presentation #4 Conformal Sensors for Non-invasive Monitoring and Health care *Prof. Madhu Bhaskaran (RMIT University, Australia)* *Chair: Dr. Tien-Fu Lu (University of Adelaide, Australia)*	
9:40am - 10:20am	Invited Presentations Will Autonomous Surgery Using Advanced Sensors, Robotics, Augmented Reality and Machine Learning Technologies Be Possible Within the Next Decade? *Dr Abhilash Chandra (Vascular and General Surgeon)* *Chair: Dr. Xin Yuan (University of Adelaide, Australia)* Autonomous Robot Tractor use in Australian and International Viticulture *Simon Nordestgaard (Principal Engineer, The Australian Wine Research Institute)* *Chair: Dr. Xin Yuan (University of Adelaide, Australia)*	
10:20am - 10:40am	Coffee break - Engineering South S117	
	Parallel Session 4-1 - Modelling / Control *Chair - A/Prof. Rini Akmeliawati (University of Adelaide, Australia)*	Parallel Session 4-2 - AI / ML *Chair - Prof. Masafumi Miwa (University of Tokushima, Japan)*

10:40am - 11:00am	**Design of Inertial Morphing Prototype using Fusion360 API for attitude dynamics (1126)** *Suraj Aranha and Pavel Trivailo*	**AI Prospective Applications in the Telecommunication Industry (1929_A)** *Ary Setijadi Prihatmanto, Endra Joelianto, Agus Budiyono, Agus Sukoco, Adhi Murbini and Adhi Mahendra*
11:00am - 11:20am	**Finite-time Multi-Surface Sliding Mode Control of Multirotor Slung-Load Systems (3830)** *Clevon Peris, Michael Norton and Sui Yang Khoo*	**A Hybrid-Type Power Transmission Line Inspection Drone and An Anomaly Detection Method Using A Deep Neural Network (9847)** *Fumihiro Hayashi, Masafumi Miwa, Yukinori Misaki, Naoya Iwamoto and Taiga Takechi*
11:20am - 11:40am	**Nonlinear Sliding Mode Controller for Automotive Engine Vibration Isolation With Model Uncertainties (5794)** *Andika Aji Wijaya, Fitri Yakub, Salem Aljazzar, Rini Akmeliawati, Mohd Nazmin Maslan and Akira Kojima*	**Forward Modelling and Inverse Design of Membrane-type Metasurface Absorbers using Neural Networks (7836_A)** *Hamza Baali, Mahmoud Addouche, Abdesselam Bouzerdoum and Abdelkrim Khelif*
11:40am - 12:00pm	**Simulation of Aero-Electro-Mechanical Coupling on HALE UAV Wings for Energy Harvesting (130)** *Mochammad Agoes Moelyadi, Mahesa Akbar, Ema Amalia and Terang Brilian Brantas*	**Automatic Cataract and Cholesterol Detection System based on Recurrent Neural Network (RNN): A Comparison with Artificial Neural Network (ANN) and Siamese Neural Network (SNN) (6628)** *Lie Zener Sukra, Widodo Jatmiko Anindito Farid, Hanesi Isabel Kartika Putri, Moningka Matthew Ryan Norman, Winda Astuti, Yosica Mariana and Rini Akmeliawati*
12:00pm - 12:20pm	**Multi-Objective Optimization of Electromagnetic Railgun based on Improved RVEA-iGNG Algorithm (6474)** *Xiaoyu Li, Ke Guo, Tao Chao and Ping Ma*	**Underwater Survey Capabilities: Prospect for AI Implementation (4121_A)** *Ary Setijadi Prihatmanto, Nico Prayogo, Agus Budiyono, Adhi Mahendra, Agus Sukoco, Vitradisa Pratama and Ach Maulana Habibi Yusuf*
12:20pm - 1:20pm	Lunch - Engineering South S117	
1:20pm - 2:00pm	Plenary Presentation #5 Magnetic Miniature Robots for Translational Biomedicine: From Individual to Collectives *Prof. Li Zhang (Chinese University of Hong Kong, Hong Kong)* *Chair: A/Prof. David Harvey (University of Adelaide, Australia)*	
	Parallel Session 5-1 - Bio-inspired robots *Chair - Prof. Hoon Cheol Park (Konkuk University, Korea)*	Parallel Session 5-2 - Off-Earth robots and control B *Chair - Dr Noune Melkoumian (University of Adelaide, Australia)*
2:00pm - 2:20pm	**Preliminary design of a fish-like fast robot by scaling of the KUFish (2692)** *Khanh Nguyen, Giheon Ha and Hoon Cheol Park*	**Bio-Inspired Legged Robot for Space Exploration (8572)** *Timothy King, Jaxon Craggs and Bailey Coates*
2:20pm - 2:40pm	**CaveX: A low-impact robust cave mapping hexapod (898)** *Lachlan Zilm, Nicholas Verboon, David Harvey and Rini Akmeliawati*	**Bio-Inspired Ventilation System for Off-Earth Geotechnical Structures and Mining (3027_A)** *Ulfa Riani, Noune Melkoumian, Rini Akmeliawati, David Harvey*

2:40pm - 3:00pm	**Roles of hydrodynamic forces generated by tail-beating motion in gliding flight of flying-fish-mimicking robot (7373)** *Khanh Nguyen and Hoon Cheol Park*	**Designing Mining Robot for Swarm Rover Fleet Carrying out Water Extraction on the Moon (3582)** *Gal-Erdene Battsengel, Noune Melkoumian, Rini Akmeliawati and David Harvey*
3:00pm - 3:20pm	Coffee break - Engineering South S117	
	Parallel Session 6-1 - AgTech *Chair - Dr Lei Chen (University of Adelaide, Australia)*	Parallel Session 6-2 - Communications / Sensors *Chair - A/Prof. Steven Grainger (University of Adelaide, Australia)*
3:20pm - 3:40pm	**Autonomous vineyard blade-weeding using Ag robots (8524_A)** *Subrahmanya Chaitanya Aryasomayajula, Lester Cleophas Dsouza, Lakshmi Deepak Ravinuthala and Lei Chen*	**Performance Evaluation of CMOS MEMS Sensor Using a Low-Cost Wireless Data Acquisition System (3628)** *Kunal Gurudath Athikary, Vivek Jabaraj Joseph, Lung-Jieh Yang and Wei-Chen Wang*
3:40pm - 4:00pm	**Low Cost Ground-Vision Based System for Non-invasive Plant Health Monitoring and Vineyard Water Management (2560)** *Shi Zhao, Tien-Fu Lu and Kuan Meng Tan*	**Reliability of Wireless Communication Systems for Drones (8295_A)** *Akitaka Imamura and Masafumi Miwa*
4:00pm - 4:20pm	**Preliminary Design of Agriculture UAV with Hybrid Tilt-Body Configuration (8905)** *Mochammad Agoes Moelyadi, Syahrahman Akhdiyatullah Ginting, Oktavianus Demas Priambudi, Dzikrian Diqnada, Prayoga and Asiah Annur Sarhani*	**In-situ soil sampling system using autonomous farming robotics (823_A)** *Alleigh Melissa Hamnett, Kristen Helen Coles, and Lei Chen*
4:20pm - 4:40pm	**Windrow Perception for Smart Farming Guidance (5925_A)** *Prasanna Kolar*	**Nanosatellite Application for Interference Monitoring (4314_A)** *Meiditomo Sutyarjoko, Riza Muhida, Agus Budiyono, Ary Setijadi and Agus Sukoco*
4:40pm - 4:50pm	Closing remarks	
4:50pm - 6:00pm	Free time / ISIUS meeting	
6:00pm - 10:30pm	Conference Banquet at the Wine Centre and Closing Ceremony	

Schedule with Abstracts

Please note - All times are shown in "Australian Central Standard Time" throughout the programme

Welcome Reception - Wednesday 5th of July 2023

Time	
3:30pm - 5:00pm	Registration and Opening reception - Ingkarni Wardli IW 5.54 reception area
5:30pm - 6:30pm	Public seminar and panel for invited speakers "Intelligent Unmanned Systems and Flapping Wing Robots" - Engineering South S112

Conference Day #1 - Thursday 6th of July 2023

Time	Room 1 - Engineering South S111
8:00am - 10:00am	Registration - Atrium outside Engineering South S112
9:00am - 9:30am	Opening ceremony - See "Room 2 - Engineering South S112"
9:30am - 10:10am	Plenary Presentation #1 - See "Room 2 - Engineering South S112"
10:10am - 10:50am	Plenary Presentation #2 - See "Room 2 - Engineering South S112"
10:50am - 11:10am	Coffee break - Engineering South S117
	Parallel Session 1-1 - Flapping wing UAV A *Chair - Prof. Lung-Jieh Yang (Tamkang University, Taiwan)*
11:10am - 11:30am	**Development of Bio-Inspired Perforated Flapping Wings (4619)** *Dharambir Poddar, Ansh Gangwar and Debopam Das* This study proposes a novel approach to ornithopter wing design that mimics the twisting feather mechanism of birds and insects to increase lift and thrust and reduce negative lift during the upstroke. The proposed design involves creating multiple converging holes on the wings, with a greater hole area on the upper side, and aligning the holes with the direction of flight. Flexible thin strips cover the holes, opening partially during the upstroke to allow flow in a specific direction and closing completely during the downstroke to increase lift and thrust. Experimental results show a significant improvement in lift and thrust generated by the novel wing design compared to existing designs, confirming its effectiveness. This research contributes to the development of more efficient and effective ornithopters with potential applications in various fields.
11:30am - 11:50am	**Aerodynamic simulation of a butterfly-inspired flapping-wing robot using ANSYS-FLUENT (5885)** *Tao Niu, Haifeng Huang and Wei He* Aerodynamic simulation is an effective method to improve the flight performance of flapping-wing robots. In this paper, we use ANSYS FLUENT to simulate the aerodynamic characteristics of a butterfly-inspired flapping-wing robot based on the RNG k-ε turbulence model. First, a simulation model of a butterfly-like flapping-wing robot is constructed based on the same proportion of the actual prototype. Second, different modes of flapping-wing motion of the robot are generated by writing different user-defined functions in the ANSYS FLUENT. Finally, the aerodynamic characteristics of the butterfly-inspired flapping-wing robot are obtained and compared under different flapping-wing frequencies, amplitudes, and phase differences between front and rear wings.

11:50am - 12:10pm	**Effects on Aerodynamic Forces due to Leading-Edge Twisting in Flapping Wing (2630)** *Vivek Jabaraj Joseph, Lung-Jieh Yang, Saravana Kompala, Paritala Veeranjaneyulu and Wei-Chen Wang* This present study is to focus and evaluate the effects on aerodynamic forces due to the leading-edge twisting on a flapping wing. Three flapping mechanisms were fabricated using the Fused deposition modeling (FDM) 3D printing. Type-A1 (Normal servo mechanism) mechanism with simple flapping motion, type-B (servo-bevel gear mechanism) mechanism with flapping and continuous leading edge twisting and type-B1 (servo-bevel gear mechanism with adjustable mechanical stopper) with flapping and restricted leading edge twisting. Lift and net thrust forces were measured using a low speed wind tunnel and averaged. Results revealed that the type-B1 flapping mechanism with restricted leading-edge twisting is having 32.9% better performance than type-A1 simple flapping and 64% better than the type-B flapping mechanism with continuous leading-edge twisting. The leading-edge twisting is enumerated and sketched using a visual motion sensing technique. A high-speed videography was captured for all the flapping mechanisms and Kwon3D software was applied to find the trajectories. Through MATLAB software the trajectories were converted into 3D surfaces and a 2D airfoil cut section was generated at mean aerodynamic chord at different time frame of flapping cycle and the instantaneous angle of attack was found for each instance. The 3D surfaces facilitated to understand the wing surface at each time frame and the corresponding lift force values. Furthermore, a theoretical rigid body dynamics was applied to create the 2D profile and verify the 2D cut sections from MATLAB. The comprehensive study and evaluation of lift and net thrust forces due to leading-edge twisting were conducted for all three flapping mechanisms and 3D printed mechanisms were well suited for this study.
12:10pm - 12:30pm	**Thrust generation by flapping-wings under the low-air density condition (407)** *Gi Heon Ha and Hoon Cheol Park* Since the successful flight of the rotary-wing drone, Ingenuity on Mars in 2021, we have been developing enabling technologies for flapping-wing drones capable of flying in low-air density conditions. To estimate the aerodynamic force generation by flapping-wings under various low-air densities, we first used our one degree-of-freedom (DOF) nonlinear dynamic model and predicted the changes in the flapping frequency and thrust due to the decrease in air density. In the prediction, we used the physical quantities of our insect-like flying robot (KUBeetle-RP). To verify the predictions, we measured the flapping performance under low-air density conditions corresponding to 75%, 50%, 25%, and 10% of the sea-level air density on Earth. Our measurements confirmed that the flapping frequency increased by approximately 11%, and the thrust decreased by approximately 90% when the air density decreased from 100% to 10%. The difference between the predicted and measured flapping frequencies for each low-air density condition was less than about 6%, and the difference between estimated and measured thrusts was less than 5% up to the 25% density conditions and 26% for the 10% density case. These results indicated that our estimation of the flapping frequency and thrust under the low atmospheric conditions is reasonably accurate except the thrust for the 10% density case. We will continue to design and demonstrate a flapping-wing robot capable of flying in low-air density conditions and report our findings in the near future.
12:30pm - 1:30pm	Lunch - Engineering South S117
1:30pm - 2:10pm	Plenary Presentation #3 - See “Room 2 - Engineering South S112”
	Parallel Session 2-1 - Off-Earth robots and control A *Chair - Prof. Debopam Das (IIT Kanpur, India)*
2:10pm - 2:30pm	**Nanosatellite Technology Survey with Highlight of AI Empowerment (6593_A)** *Riza Muhida, Meiditomo Sutyarjoko, Adhi Murbini, Agus Budiyono, Ary Setijad and Agus Sukoco* Nanosatellites have emerged as a disruptive technology in the field of space exploration and satellite communication. These miniaturized spacecraft offer several advantages such as low cost, rapid development cycles, and flexible deployment options. However, due to their limited size, nanosatellites face numerous challenges in terms of computing power, communication bandwidth, and data processing capabilities. In recent years, artificial intelligence (AI) has gained significant attention as a

	transformative technology that can empower nanosatellite-based solutions and enable a wide range of applications. This paper explores the potential of AI application for empowering nanosatellite-based solutions in the context of satellite communication. It presents an overview of the challenges faced by nanosatellites and how AI can address these challenges. The paper discusses various AI techniques, including machine learning, deep learning, and reinforcement learning, and their applicability to enhance different aspects of nanosatellite-based solutions, such as communication systems, data processing, and mission planning. One key area where AI can significantly impact nanosatellite communication is in enhancing data transmission and reception capabilities. AI algorithms can be employed to optimize communication protocols, manage limited bandwidth resources efficiently, and mitigate the effects of noise and interference in the communication channel. Moreover, AI-based algorithms can improve error correction and data compression techniques, enabling more reliable and efficient data transmission. Furthermore, AI can play a crucial role in data processing onboard nanosatellites. By utilizing AI algorithms, nanosatellites can perform real-time data analysis, image recognition, and pattern detection, reducing the need for extensive data downlink and enabling autonomous decision-making capabilities. AI-powered data processing can also facilitate the extraction of valuable information from large datasets collected by nanosatellites, leading to improved scientific research, Earth observation, and remote sensing applications. Additionally, AI can enable intelligent mission planning for nanosatellites, optimizing their operations and resource utilization. By leveraging AI algorithms, nanosatellites can autonomously plan their trajectories, schedule observations, and adapt to changing mission requirements. This autonomy not only reduces the reliance on ground-based control but also enhances the agility and responsiveness of nanosatellite missions. Overall, this paper highlights the transformative potential of AI applications in empowering nanosatellite-based solutions in the field of satellite communication. By leveraging AI techniques, nanosatellites can overcome their inherent limitations and achieve enhanced communication capabilities, efficient data processing, and intelligent mission planning. These advancements open up new possibilities for scientific research, Earth observation, and other applications, further expanding the role of nanosatellites in the space industry.
2:30pm - 2:50pm	**Investigating the use of electrodynamic dust shielding to improve the robustness of a lunar rover drivetrain to regolith (4425)** *Hannah Vine Hall, Oscar Mortier-Spole, Vinh Nguyen, Benjamin Lang, Michael Laden, Mitchell Munn and William Robertson* Purpose. To establish long-term human activities on the Moon, active dust mitigation techniques, such as the EDS, may be used to reduce the volume of regolith incident on any passive dust mitigation and dust tolerant designs used in lunar rover drive systems. Originality. Existing research into using an EDS for lunar regolith removal has primarily focused on flat topologies. This paper will outline how the EDS technology performs as a vertical cylinder wrapped around a conductive vertical shaft, with three phases to control dust flow direction, thus extending the existing body of knowledge on this technology and investigating its use in this new and critical application. This would increase rovers' effectiveness and longevity that would otherwise be decreased by increased dust scattering and wear during rover operations. Methodology. To allow comparison with the existing research, an electrode pitch of 0.6 mm and a width of 0.3 mm was used in the EDS design. Testing was completed with LHS-1 simulant in both flat and vertical wrapped shaft configurations while powering the EDS's electrodes at 1.3 kV and 10 Hz. Findings. Testing found approximately 86.6% removal of simulant by mass (s.d. 9.5%) and a 95.7% reduction in simulant passing through the seal interface for the flat and vertical cylindrical EDS configurations respectively. Although the EDS demonstrates promising simulant mitigation results that aligns with past literature, substantial future work is required to further improve the operational lifetime of the EDS and its viability in lunar mission environments.
2:50pm - 3:10pm	**Designing a Nature-Inspired Swarm Robot System for Autonomous Production (545_A)** *Joven Tan, Noune Melkoumian, Rini Akmeliawati, David Harvey* Swarm robotics has emerged as a promising approach for designing multi-robot systems capable of performing complex tasks in a decentralized and self-organized manner by harnessing nature's design principles. These systems offer significant advantages over traditional robotic systems, including scalability, robustness, and flexibility. In this study, we propose a swarm robotic system for exploration, navigation, localization, task allocation, and haulage, based on three nature-inspired algorithms: bee foraging, firefly light attraction, and ant division of labour. Our objective is to evaluate the performance of the proposed swarm robotic system in terms of harvesting time, robot number, convergence, and failure rate. We conduct simulations and experiments using different numbers of swarm robots and

	various task allocation strategies. The bee-inspired algorithm, inspired by task allocation and specific deployment of a defined number of robots to a given location strategies, which enables the swarm robots to allocate tasks and harvest more quickly. The firefly-inspired algorithm, inspired by bioluminescent light attraction, allows the swarm robots to navigate and locate themselves autonomously within the environment. The ant-inspired algorithm divides tasks among the robots according to their abilities and the system's needs, ensuring that the robots work cohesively as a unit. Our results demonstrate that the proposed swarm robotic system can autonomously perform exploration, navigation and localization, task allocation, and haulage, effectively harvesting the target area in a timely and efficient manner while minimizing the required human intervention. Results from this study provide insight into the feasibility and effectiveness of swarm robotic systems for industrial applications. By developing a swarm robotic system that can autonomously perform exploration, navigation, and localization, task allocation, and haulage, we demonstrate the potential of swarm robotics for improving productivity and efficiency in various industries. The system's adaptability, scalability, and robustness make it a valuable tool for future industrial applications, providing significant advantages over traditional robotic systems.
3:10pm - 3:30pm	Coffee break - Engineering South S117
	Parallel Session 3-1 - Flapping wing UAV B *Chair - Dr. Nataliia Sergiienko* *(University of Adelaide, Australia)*
3:30pm - 3:50pm	**Designing and Manufacturing a Flapping Wing UAV (4106_A)** *Abdelrahman Shaaban, Seyed Hashemi, Abdullah Rasti, Sadok Sassi and Elsadig Saad* Bird strikes became one of the common problems that airplanes face these days. Where the aircraft will experience structural damage or engine malfunction due to the birds hitting the body, the wing, the nose, or the engines. This problem puts many people at risk and costs a lot of heavy losses. Moreover, the most vulnerable times that birds strike occurs are during airplanes takeoff. One of the solutions that the airports are using now is to train a falcon to scare the birds around the airplane's runways. However, it's a bit difficult to control and direct the real falcon exactly in the required way. Therefore, in this project, we are developing a new technology but with the same idea. The idea is to mimic nature to solve a natural problem with the help of the drone's new technology. By designing and manufacturing a flapping wing UAV (Unmanned Aerial Vehicle) that imitates the falcon in its shape and flying style. Flapping wing UAVs use the flapping motion to generate the aerodynamic forces of lift and thrust. We followed the engineering design process through this project. Starting with defining the problem, brainstorming, finding alternate solutions, evaluating them, then designing the final idea implementing the constraint, testing, and repeating when the design doesn't reach the requirements. During the research and progressing, we run many simulations to study the behavior of the system and to find whether it is working and valid or not. The CFD simulations passed through a long process starting with a 2D static airfoil and ending with a 3D dynamic model for the whole system. The results from the simulation were promising. The final method of the 3D motion gave a specific amount of lifting force in newtons not only coefficient as in the case of 2D. Additionally, a test rig was designed, and the experimental results was fairly matching the simulation.
3:50pm - 4:10pm	**Design of a Remote Controller for flapping MAVs Based on Motions (9903)** *Jeong-Hwan Kim, Sandhya Rani Gumpina, Seungyeon Lee, Taesam Kang and Jungkeun Park* Since MAV is small, its motion is very fast and doing test flight is very difficult. Especially when the direction is changed 180 degrees, it is very difficult to control it because the pilot should give opposite operation to obtain same response when it is not rotated. The difficulty of FMAV remote control mainly comes from the fact that the pilot should be able to maneuver several control sticks simultaneously with various 3 dimensional situations, which require the pilot be trained very long time. To overcome the difficulty, we suggest a remote controller based on the motion of the remote controller. I.e., the remote controller gives control command following the attitude, heading, and height of the remote-control board. The remote controller is equipped with a 9-axis MEMS IMU(Inertial Measurement Unit) which includes three axis gyroscopes, three axis accelerometers, and three axis magnetometers for attitude measurement. A barometer and 1-axis laser sensor are also included for measuring height variation of the remote controller. The attitude including the heading is obtained by applying the Kalman filter algorithm using the measurement data from gyroscopes, accelerometers, and

	magnetometers. The altitude is obtained utilizing the barometer and laser sensor measurements. Using the attitude and heading information of the flapping MAV and those of the remote controller, the remote controller always generates command to move the flapping MAV so that it follows the attitude of the remote controller. Thus, we don't need excellent pilot to test the flight of flapping MAVs. The pilot need just to practice maneuvering the attitude and height of the remote controller, and the remote controller generates the proper commands.
4:10pm - 4:30pm	**Autonomous Control Design for a Two-Wing Tailless Flapping-Wing Micro Air Vehicle System (3290)** *Christopher Balnaves, Xin Yuan, Peng Shi and Rini Akmeliawati* Rising global populations and crop demands present an opportunity for flapping-wing micro air vehicles (FW-MAVs) to be used as robotic pollinators, particularly for cross-pollination. Cross-pollination is currently achieved through hand pollination methods, which are highly inefficient. A fleet of autonomous FW-MAVs has the potential to significantly increase the efficiency of artificial cross-pollination. Compared with conventional UAVs, FW-MAVs are more desirable for this task as they have lower power consumption and longer flight times due to the higher lift to wing-size ratio offered by the flapping wing design. Insect-inspired biomimetic features also allow an FW-MAV to interact closely with a crop flower without significant disturbance to the environment. However, these designs have inherent instability due to having only two control surfaces, which are also responsible for providing lift. This work attempts to implement a flight control system (FCS) for a two-wing tailless FW-MAV using linear control techniques. In this paper, a linear FCS using Proportional, Integral and Derivative (PID) control techniques is implemented on a simulated two-wing tailless FW-MAV and simulated based on components of an existing model. The simulation is enabled with a real-world physics engine to emulate the flight characteristics of the physical FW-MAV. Testing and optimisation in the simulation demonstrates the feasibility of the FCS to produce controller gains capable of achieving stable flight in a physical FW-MAV. The stability of the designed FCS has been confirmed by the simulation results, which provides a feasible example before proceeding with the implementation of the system on a physical FW-MAV.
4:30pm - 4:50pm	**Control Board and Motor Driver Board Design for a Directly Motor-driven Flapping MAV (9730)** *Seunghee Jeong, Seungik Choi, Daewook Kim, Sungbin Jang, Jungkeun Park and Taesam Kang* Electronic control boards to drive and manipulate an FWMAV (Flapping Wing Micro Air Vehicle) are proposed in this paper. The flapping wings of the proposed FWMAV are driven directly by two DC motors, and extension springs are used to store and release inertial energy at each flapping direction inverting. To get better energy efficiency, the natural frequency of flapping wings can be adjusted by tuning the spring constant and transmission gear ratio. The control board circuit and motor driver board circuit are designed in customized PCB (Printed Circuit Board). The control board includes an MCU (Micro Controller Unit) as well as an IMU (Inertial Measurement Unit) and voltage regulators. The motor driver board is designed with two small motor driver chips and zener diodes to generate reference voltage levels for the motor driver chips. Flapping wings are controlled individually by independent motor drivers. The synchronization of the two wings is obtained by synchronizing control signals. The offsets, amplitudes, and phases of the two wings are controlled individually to generate control forces for pitch, roll, and yaw respectively. To test the performance of the designed control board and motor driver board, a simple FWMAV is designed and fabricated. Basic functional tests including input scale factor and thrust generation are done using the control board. It is shown that the prototype FWMAV works well as expected to drive with proposed electronic boards.
4:50pm - 5:10pm	**Aerodynamics and control of an ornithopter with a bird-like tail (1977)** *Joydeep Bhowmik and Debopam Das* Ornithopters or bird-like flapping wing aerial vehicles are often equipped with a vertical tail along with the existing horizontal tail or 'V' tail to achieve stability and control during flight. Birds, in contrast, are very proficient in directional control by using their tail in which there is no vertical tail or neither a 'V' tail. The absence of a vertical tail in a conventional aircraft would cause severe control and stability problems. Different types of tails evolved in different birds like graduated, pintail, shallow fork and deep fork shapes. It has been found from other studies that longer tails with a shallow fork are aerodynamically more efficient hence in this paper, we investigate the characteristics of a bird tail with no vertical stabilizer using an experiment and a mathematical model of the bird's tail it can roll and pitch about the body axis. Three different tail models of differing sizes and spans are fabricated and

	fitted on a flapping bird replica in a wind tunnel. The interchangeable tails can be set to a certain orientation while the whole model is mounted on a 6-component dynamic load cell in a wind tunnel to measure the roll, pitch and yaw moments generated due to the tail. The theoretical model predicts the rolling, pitching and yaw moments with the given rotations of the tail during its flying conditions. The nature of the moments from the mathematical model is verified with the wind tunnel measurements. The paper also presents a design criterion for sizing the tail for an ornithopter based on which the control authority is characterized. based on the findings, an ornithopter is fabricated and successfully tested with good handling quality using this natural bird tail.
5:10pm - 6:00pm	Free time
6:00pm - 8:00pm	Conference tour - Resonate (part of the "Illuminate Adelaide" festival). Meet outside S112 at 5:30pm, ready to walk to the tour site at the Botanic Gardens for a 6pm start.

Time	Room 2 - Engineering South S112
8:00am - 10:00am	Registration - Atrium outside Engineering South S112
9:00am - 9:30am	Opening ceremony *Welcome to country* *Opening remarks: Prof. Nelson Tansu (University of Adelaide, Australia)* *ISIUS President - Prof. Lung-Jieh Yang (Tamkang University, Taiwan)* *A/Prof. Rini Akmeliawati and A/Prof. David Harvey (University of Adelaide, Australia)* *Group photo*
9:30am - 10:10am	Plenary Presentation #1 Towards Smarter, Safer, More Reliable and More Resilient Intelligent Unmanned Systems *Prof. Youmin Zhang (Concordia University, Canada)* *Chair: A/Prof. Rini Akmeliawati (University of Adelaide, Australia)* Although the concepts and developments on Fault Detection and Diagnosis (FDD) and Fault-Tolerant Control (FTC) have been progressively and extensively investigated worldwide since the 1970s and 1980s, respectively, the recent catastrophic crashes of two Boeing 737 MAX8 airplanes in 2019 have again highlighted the necessity and urgency for FDD and FTC research & development and their industrial applications. On the other hand, unmanned systems (USs, including Unmanned Aerial Vehicles (UAVs), Unmanned Ground Vehicles (UGVs), Autonomous/Driverless Vehicles (AVs), and other transportation vehicles on the land, on/under the water) are gaining more and more attention and rapid development during the last few years due to their relatively easy and cost-effective uses in various application tasks directly linking to our daily life for better mobility and sustainable development. These new advancements are benefited significantly from technical advances in communication, computation, control, actuators, sensors, networks and new/intelligent designs linked to the rapid development under the framework of Cyber-Physical Systems (CPSs) and widely spread Artificial Intelligence (AI) and Deep Neural Network (DNN) learning technologies. Due to a higher level of size and complexity in systems, in particular the added technical challenges due to the involvement of more electronic devices with both hardware and software and with large-scale and distributed networked systems, artificial cyber-attacks through communication networks, along with physical faults, could occur during systems operation, which will all lead to physical damages of the system and thus critical issues on stability, performance, safety, and security of the normal operations of the above-mentioned USs. In this talk, brief overall view on the challenges and latest developments towards smarter, safer, more reliable and more resilient intelligent unmanned systems in terms of safe and secure controls of these systems by integrating also with Remote Sensing (RS) techniques for applications to forest and environment monitoring and fires/risks/damages detection will be presented first, then some of new developments and current research works being carried out at our group will be introduced as the second part of the presentation. In particular, new developments on autonomous control, FDD, FTC, and Fault/Attack-Tolerant Cooperative Control (FTCC) techniques towards autonomous, safe and secure operation and applications of USs to the forest fire monitoring tasks in the presence of physical faults and cyber-attacks will be presented.

10:10am - 10:50am	Plenary Presentation #2 Consensus and Formation Control for Multi-agent Systems *Prof. Peng Shi (University of Adelaide, Australia)* *Chair: A/Prof. David Harvey (University of Adelaide, Australia)* The key features of Multi-agent Systems (MAS) are communication, coordination, and collaboration, by which the agents can achieve a common (and possibly difficult) goal in a more effective and efficient way. Three main topics within the realm of MAS are consensus, flocking and formation control. Cooperating processes often require agents to reach a consensus, which is the fundamental problem in MAS. Flocking (or swarming) is a self-organizing behavior originated from small-size animals with lower intelligence, which enables the emergence of swarm intelligence to improve the whole system survivability and competitiveness. Formation control generally aims to drive the agents to achieve a desired formation, scalable and/or changeable. In this talk, modeling analysis and design of a variety of distributed schemes for consensus and formation control are introduced. Simulations and experimental examples are provided to demonstrate the potential of the proposed new design techniques.
10:50am - 11:10am	Coffee break - Engineering South S117
	Parallel Session 1-2 - USV / AUV *Chair - Prof. Taesam Kang (Konkuk University, Korea)*
11:10am - 11:30am	**Development of Unmanned Surface Vehicle for in-situ Water Quality Measurement Using IoT (2454)** *Surendar Ganesan, Balasubramanian Esakki, Jae Sung Choi, Sridevi S, Sarath Kumar C and Vikram P* Water pollution is a major concern to human life, and periodic monitoring of water quality parameters across water reservoirs such as lakes, ponds, dams and rivers is necessary to examine the water contaminants. The present work focused on developing an Unmanned Surface Vehicle (USV) to collect water samples in remote water body locations. A solenoid-actuated water sampling system with an automatic cutoff of storage is devised. In addition, an onboard water quality monitoring system consisting of pH, turbidity, electrical conductivity, and dissolved oxygen sensors is integrated with USV. The USV mounted with a water sampler, and sensor unit was tested in a lake near our institute, and 1200ml of water samples from the six polyethene terephthalate (PET) storage containers. The collected water samples were tested in a laboratory, and their contamination levels were estimated. The spatial distribution maps of water contaminants are generated based on the water quality analysis. The in-situ water quality measured using the Internet of Things (IoT) enabled USV will be an efficient choice for online monitoring of water quality parameters. The USV was also tested for its stability on the water surface under various wind loads, and it was able to withstand the wind conditions for effective water sampling and in-situ water quality measurements.
11:30am - 11:50am	**Performance & Evaluation Test Results of Underwater Construction Robots (7486_A)** *Jihoon Kim, Heungchan Kim, Chang Hyeon Seo and Insung Jang* In recent years, the exploitation of various substitute resources has been paid attention to due to the depleting supply of fossil fuels. Hence, we consider getting the resources from the marine environment, which accounts for more than 70 percent of the Earth. In particular, offshore plants and structures are necessary as the demand for marine resources increases. Accordingly, the primary purpose of this project is to develop three kinds of underwater construction robots (URI-L, URI-T, URI-R) independently using our technologies. As a result, those three robots were transferred to a private enterprise company. Then the companies plan to achieve a track record by using underwater construction robots at the outdoor site. In addition, the 2nd stage of the underwater construction robotics R&D center commenced acquiring more test data from the water tank and field test. Mainly, URI-T and R were applied (or operated) to the Yokji Drinking Water Supply Development Project development project in South Korea. Through this construction, we will be able to solve the drinking water shortage on the island in the Republic of Korea. Furthermore, our underwater robotics system is expected to contribute to reducing the rental cost of overseas equipment by more than 10 billion won per year.

11:50am - 12:10pm	**Simulation and controller design of an underwater vehicle (9587)** *Sandhya Rani Gumpina, Jungkeun Park, Taesam Kang and Jinyou Kim* Autonomous Underwater Vehicle (AUVs) have become popular around the world in recent years. They are used for variety of purposes in marine environments, including scientific research, ocean mapping, environment monitoring and military applications. Their Main purpose is to operate the underwater vehicle autonomously without requiring a human pilot, which allows them to collect data in dangerous or difficult-to-reach areas, operate for extended periods of time, and cover large areas of the ocean. In this paper, we constructed a simulation block for underwater vehicles using Matlab Simulink tools. The equations and parameters of the MIT Autolycus are used for simulation and analysis. First the step responses are checked to see the correctness of the model. The obtained results are compared with the Nobel model MIT Autolycus, and it is found that the simulation results are very similar to each other. Simulation model results shows that the maximum velocity obtained on the surge is 0.25m/s. The heave velocity is determined using extra added mass without vertical thrust and it is found that the maximum heave velocity obtained is 0.035m/s. Yaw maneuvers are considered for wide turns and narrow turns and shows that the vehicle can be turned freely. To design a linear feedback controller, a linear model is obtained from the nonlinear model. The frequency responses of the linear model are analyzed for closed loop controller design. The gain and phase margins are checked, and to improve the closed loop responses, simple PID controllers are being tried. The performance results will be included in the final paper.
12:10pm - 12:30pm	**Neuroevolutionary Reinforcement Learning of an Autonomous Underwater Vehicle for Confined Space Inspection (5414)** *Ahmad Faisal Mohamad Ayob, Mohd Rizal Arshad and Aceng Sambas* Purpose: Safety, precision, and predictability of autonomous underwater vehicles (AUVs) are crucial. To ensure the safe functioning of AUVs, it is essential to test the intelligent system under various situations or edge cases. While the application of artificial intelligence in the design of road-based vehicles has advanced to the level of self-driving vehicles, there is still a substantial research gap on AUVs that operate in constrained areas, such as fluid-contained tunnel inspection. This paper will examine several works of literature focusing on robot-assisted inspection. Approach: Provided in this manuscript is a framework for AUV designers on neuroevolutionary reinforcement learning in a concept design phase. The framework comprises a virtual 3D environment modeled in Unity software platform, which represent an AUV model with laser-based distance sensors piloted by an autonomous piloting system based on a gradient-free, population-based, parallelized neuroevolutionary model. The actions, state, reward, and penalty for the reinforcement learning were defined as thruster outputs, sensor readings, checkpoints, and wall-hitting by the agents, respectively. Findings: The results indicate that the resulting autonomous vehicle is capable of negotiating the confined space using three-degree of freedom control method. Contribution: This work contributes a new body of knowledge on integrating neuroevolution to the AUV discipline and hence can be applied to scenario-based planning for the design of such vehicles.
12:30pm - 1:30pm	Lunch - Engineering South S117
1:30pm - 2:10pm	<u>Plenary Presentation #3</u> MEMS Sensors Applied to On-Site Sensing of Unsteady Aerodynamics *Prof. Lung-Jieh Yang (Tamkang University, Taiwan)* *Chair: Chair - Dr. Nataliia Sergiienko (University of Adelaide, Australia)* Microelectromechanical systems (MEMS) and unsteady aerodynamics are two important research areas and possibly interact with each other by their features of small size and high-frequency response. There are 3 parts of works will be addressed in this talk: (1) Design, fabrication and testing of CMOS (complementary metal-oxide-semiconductor) MEMS sensors including flow sensors and pressure sensors; (2) CMOS MEMS sensors applied to the on-site aerodynamic measurement of flapping wings; (3) CMOS MEMS sensors applied to the on-site aerodynamic measurement of wind turbines.
	<u>Parallel Session 2-2 - Navigation + IoT</u> *Chair - A/Prof. David Harvey* *(University of Adelaide, Australia)*

2:10pm - 2:30pm	**Comparative Analysis of Path Planning Algorithms Based on RRT for 3D Environments (1956)** *Zexuan Hu and Bijan Shirinzadeh* UAV path planning, including global planning and local planning, has been widely studied by researchers in recent years. The rapidly-exploring random tree (RRT) algorithm is one of the most popular methods for UAV path planning problems. Various path-planning algorithms have been developed based on RRT in the last two decades, such as RRT*, RRT*-Smart, Informed-RRT*, and connect methods that grow two trees at the same time, which is normally considered to be faster and more efficient than regular RRT, including RRT-Connect, RRT*-Connect, and Informed-RRT*-Connect. All the RRT variants can be used for global path planning in 3D space for UAVs. The performance of each algorithm varies in different environments, and the result of planning in 3D space also differs from the result in 2D space. This paper briefly reviews each RRT variant's features and presents algorithm performance evaluated in different featured environments. Indicators such as convergence time, initial path length, final path length, and path length per iteration are recorded. Multiple tests are conducted, and the average value of the indicators is compared due to the non-consistency performance feature of RRT-based algorithms. the connect methods are not always faster than the regular RRT variants. Each algorithm has its best-performance scenario, and none of the RRT-based algorithms outperforms any other RRT variants in all scenarios. Furthermore, the characteristics and limitations of each algorithm in featured environments are concluded and can help with path-planning algorithm selection in specific application scenarios.
2:30pm - 2:50pm	**Position Control between GPS and Non-GPS Environments using High Precision IMU (9342)** *Masafumi Miwa, Keiichi Nishikawa, Masataka Shiromaru and Kazunori Araki* UAVs such as multicopters use GNSS to obtain position information for position control; when RTK-GNSS is used, the position accuracy is within a few centimeters. However, if a UAV enters an environment where satellite signals cannot be received, such as under a bridge or in a tunnel, position control becomes impossible. To cope with such cases, we propose a system that combines RTK-GNSS and a high-precision IMU. In this study, a multicopter is equipped with RTK-GNSS and an IMU. When the multicopter enters under a bridge or a short tunnel and the RTK-GNSS positioning state becomes RTK-Float, the system switches to inertial navigation using the IMU. It was confirmed that the UAV could fly with high accuracy for about 10 seconds after entering this state. Then, when the RTK-GNSS positioning state returns to RTK-Fixed, it switches to flight using RTK-GNSS positioning information. The effectiveness of the proposal was confirmed through actual flights several meters above the surface of river surface and transport experiments through under multiple bridges.
2:50pm - 3:10pm	**Review on Vehicle-to-Vehicle (V2V) Communication aspect of Vehicular Ad Hoc Network (VANET) and Handover (6248_A)** *Temitope Joseph Oloke, Abiodun Musa Aibinu, Reuel Zasan Kantiyok, Zainab Oluwawemimo Bakare and Kafayat Oluwatoyin Shobowale* Under the "Anywhere, Anytime" paradigm, wireless technologies offer users the promise of constant connection to the network. These wireless technologies can be deployed in vehicular communication to achieve a stable Vehicular Ad hoc Networks (VANET). Stable interaction among vehicles on the road can minimize the occurrence of vehicular collisions, which have proven to be the most challenging aspect of automotive transportation, and resulting into serious life threatening injuries and sometimes loss of many lives. This paper presents a review on various techniques from the existing literature on Vehicular Ad hoc Networks (VANET), focusing on Vehicle to Vehicle (V2V) aspect of VANET. Also in this paper, a review on the existing works on Multiple Operator Enabled SIM (MOES) and Handover parameters are presented. The review for vertical handover reveals that genetic algorithm has been reported to be an effective model for quality of service (QoS) while Hidden Markov model has been reported to be effective for quality of experience (QoE). VANET is the technology created by vehicles equipped with short and medium range wireless communication that aims to increase the safety and comfort of drivers on the road. This review gives an insight into V2V aspect of VANET and provides different approaches where inter-vehicle communication can be achieved. The review on MOES and handover provides various parameters that can be used in order to select the best network among multiple networks.
3:10pm - 3:30pm	Coffee break - Engineering South S117

	Parallel Session 3-2 - Computer / Machine vision *Chair - Prof. Javaan Chahl* *(University of South Australia, Australia)*
3:30pm - 3:50pm	**Effectiveness of Synthetic Image Data in Training Human Action Recognition Models (7317)** *Keith Man and Javaan Chahl* The ever growing need for large amounts of visual data to support the training of computer vision algorithms in applications such as unmanned systems has seen a push towards the use of synthetic image data as an alternative source of data. That said, the use of synthetic data to train machine learning models is not without its caveats. One major caveat is that the effectiveness of synthetic data as a training source, as compared with real data, is difficult to evaluate. Different papers exploring the use of synthetic data have noted varying levels of effectiveness depending on the type of synthetic data tested and the type of model being trained. Outside of a general consensus that synthetic data is likely able to provide similar results to training with real data under specific conditions, there is limited information available on what effect different parameters can have on the effectiveness of synthesised data. The goal of this research is to evaluate the performance of composite synthetic data by training a human pose and action recognition model, investigating the effect different synthesis parameters have on a model trained using synthetic data, and to compare the results to a model trained using real data.
3:50pm - 4:10pm	**FoCLBP+2DGF: Fusion of Complete Local Binary Pattern with 2D Geometry Features for Emotion Recognition through Facial Expressions in Videos (9582)** *Lovejit Singh, Sarbjeet Singh, Naveen Aggarwal and Ranjit Singh* People have different facial attributes in terms of their skin color, shape, and size. This diversity makes a challenge in the development of generalized automatic intelligent system for human's emotions recognition through their facial expressions. Over the decades, researchers have significantly contributed to geometry and texture-based methods to act for facial contents in image/video in the form of feature vector. This paper presents a fusion of texture based complete local binary pattern (CLBP) method with two-dimensional (2D) geometry features (FoCLBP+2DGF) method to represent the facial expressions for emotion recognition in videos. The proposed method better describes the contrast and structural behaviour of facial contents in spatial domain with fusion of CLBP and 2D geometry feature computing. It aggregates the facial expression's behavior in temporal domain by sum normalization method to capture ratio among the features. The constructed final feature vector with proposed method is independent from the duration of video. Further, Bayesian optimization method is used to identify the best hyperparameters of multiclass support vector machines (SVMs) with proposed FoCLBP+2DGF method. Experimental results show that the proposed FoCLBP+2DGF method attained ≈ 88.64 ± 0.38% emotion recognition accuracy with SVMs using Gaussian kernel function in videos of crowd-sourced emotional multimodal actors' dataset (CREMA-D). The proposed method significantly improved accuracy of intelligent system for human emotion recognition in videos over the human accuracy and existing work.
4:10pm - 4:30pm	**Contactless Vital Signs Monitoring in NICU based on Machine Vision (6020)** *Fatema-Tuz-Zohra Khanam, Asanka G. Perera, Ali Al-Naji, Kim Gibson and Javaan Chahl* The monitoring of vital signs plays an important role in both clinical and nonclinical applications. Traditional contact-based vital signs monitoring devices such as electrocardiogram (ECG) or pulse oximeters may cause discomfort, skin damage and infections, especially in neonates with sensitive and fragile skin. Therefore, techniques for contactless measurement of vital signs using camera imaging technologies have been attracting increasing attention. For contactless physiological measurement, machine vision-based methods appear to be an advantageous approach that could be reliable, cost effective , hygienic, and suitable for long-term monitoring. However, there are still limited camera-based studies on neonates in a clinical setting. In this study, the heart rate (HR) and respiratory rate (RR) of five infants at the Neonatal Intensive Care Unit (NICU) were remotely monitored using a digital camera based on color and motion-based computational methods, respectively. Moreover, the region-of-interest (ROI) was automatically selected using a convolutional neural network. Furthermore, to extract both HR and RR different signal processing techniques such as spatial averaging, spectral analysis, band-pass filtering, and peak detection were also used. The experimental results were validated with the ground truth data attained from an ECG monitor and showed a close correlation using the Pearson correlation coefficient, (PCC) 0.9923 and 0.9385 for HR and RR, respectively. A Bland

	Altman analysis of the data also showed a strong correlation between both data sets with a mean bias of 0.13 beats/min and 0.37 breaths/min, and the lower and upper limit of agreement -3.7 to + 4 beats/min and -4.6 to +5.3 breaths/min for both HR and RR, respectively. The RMSE between camera-based data and ECG data for HR and RR were 1.93 beats/min and 2.51 breaths/min, respectively. Therefore, video camera imaging may replace traditional contact-based monitoring in NICU and has prospective applications in other sectors such as home health monitoring.
4:30pm - 4:50pm	**A Novel Convolutional Neural Network-Based Insulator Defect Detection Method for High-Voltage Transmission Lines (2551)** *Yulong Zhang, Youmin Zhang, Lingxia Mu, Xianghong Xue, Jing Huang, Xuesong Xie and Jing Xin* Missing or defect of insulators in high-voltage transmission lines can lead to critical fault of the entire transmission system. The traditional manual patrol method is too inefficient to meet the actual detection needs. Insulator condition monitoring and defect detection of high-voltage transmission lines based on aerial images from unmanned aerial vehicles (UAVs) has been widely investigated. In this paper, an insulator defect detection method based on deep learning technology is proposed using UAVs in high-voltage transmission lines. A staged feature extractor based on the reuse of convolutional feature layers by combining a multiscale feature fusion network is developed. The reuse of convolutional feature layers can reduce the number of channels in the feature map, thus reducing the number of parameters and running faster. Meanwhile, the semantic features can be better extracted by using the features of different receptive fields. The results of training and testing on the Chinese Power Line Insulator Dataset show that our method has higher detection accuracy. The experimental results show that the method proposed in the paper satisfies the insulator defect detection in high-voltage transmission lines, dramatically improves the detection efficiency comparing with existing methods.
5:10pm - 6:00pm	Free time
6:00pm - 8:00pm	Conference tour - Resonate (part of the “Illuminate Adelaide” festival). Meet outside S112 at 5:30pm, ready to walk to the tour site at the Botanic Gardens for a 6pm start.

Conference Day #2 - Friday 7th of July 2023

Time	Room 1 - Engineering South S111
8:00am - 10:00am	Registration - Atrium outside Engineering South S112
9:00am - 9:40am	Plenary Presentation #4 - See "Room 2 - Engineering South S112"
9:40am - 10:20am	Invited Presentations - See "Room 2 - Engineering South S112"
10:20am - 10:40am	Coffee break - Engineering South S117
	Parallel Session 4-1 - Modelling / Control *Chair - A/Prof. Rini Akmeliawati (University of Adelaide, Australia)*
10:40am - 11:00am	**Design of Inertial Morphing Prototype using Fusion360 API for attitude dynamics (1126)** *Suraj Aranha and Pavel Trivailo* Garriott's - Dzhanibekov's effect is the periodic flipping of the body when spun about its intermediate principal moment of inertia axis, but the body does not perform the flipping motion in the other two axes. A novel prototype concept is designed and developed using Autodesk's Fusion360 that can change its inertial properties by moving masses in a scissors like mechanism, where a set of masses are moved in an arc like manner, the procedure is called as Inertial Morphing (IM). IM is the ability of the body to change its inertial properties while on its flight. Autodesk's Fusion360® is a capable cloud-based 3D modelling software, that makes it very easy for collaboration for the development of the prototype. Using the Application Programming Interface, Python programming is explored to analyze the inertial properties of the prototype within the CAD software environment. The paper demonstrates installation of the external Python libraries like Matplotlib, numpy and scipy using PIP to be used on the CAD model. There are loops generated within the scripts that can change the dimensions of the CAD model, to help optimize the mass distribution to perform IM. This paper presents, the periods of flipping motions that are calculated from the CAD model at different angular velocities and the effect of inertial properties with variation in mass, i.e.: the rotating masses versus the total mass of the prototype ratio and its effects on the period of the flipping motion. Analysis is also made on the scissor mechanism and how the distance of masses from the center of gravity affects the period of the flipping motion. Different combinations of weight and dimensional parameters are analyzed to select the optimum shape of the prototype for initial proof of concept mechanism.
11:00am - 11:20am	**Finite-time Multi-Surface Sliding Mode Control of Multirotor Slung-Load Systems (3830)** *Clevon Peris, Michael Norton and Sui Yang Khoo* In the utilisation of drones for applications such as transport of parcels or freight over large distances, the hook used in holding the load rotates around the point of suspension, which adds on to the existing payload rotation dynamics, and hence the suspended load exhibits double pendulum dynamics. In most cases, however, this factor tends to be ignored in order to simplify the control methodology and the associated mathematics involved with it. These expressions are important for the improvement of the quadrotor control, as they reduce the swing effect and increase the overall flight stability. This paper will propose a control method for a slung load carried by a thrust vectored multirotor, where the load is modelled as a double pendulum in the 3D configuration. The dynamics of a multirotor will be cascaded with those of the double pendulum slung load, to form a single dynamic model. A multi-surface Sliding Mode Control will then be used for stabilization of the vehicle's motion together with attenuation of the payload swing. Stability proofs for the controller design will be derived based on the Lyapunov Stability Theory.
11:20am - 11:40am	**Nonlinear Sliding Mode Controller for Automotive Engine Vibration Isolation With Model Uncertainties (5794)** *Andika Aji Wijaya, Fitri Yakub, Salem Aljazzar, Rini Akmeliawati, Mohd Nazmin Maslan and Akira Kojima* One of the primary concerns in the automotive industry is how to improve passenger comfort by attenuating unwanted vibrations. In vehicles, car manufacturers use engine mounts to support the

	engine and isolate vibrations while it is running. Although passive engine mounts have been widely used in many commercial vehicles, they are only effective within a limited range of excitation frequencies. To overcome this limitation, active engine mounts have been introduced. The advantage of the active engine mounting technique is that it can be very stiff at low frequencies and tuned to be very soft at higher frequencies to isolate vibrations. An electromagnetic actuator is generally used in active engine mounts to generate the counterforce that cancels out vibrations. Thus, the dynamic force of the actuator must be designed in such a way as to isolate engine vibration. In this paper, a nonlinear sliding mode control method for active engine vibration isolation is adopted to attenuate vehicle engine vibrations. The proposed controller employs a logarithm-based switching function to create a boundary state that forces the vibration amplitude to be reduced within the maximum amplitude set by the designer. Simulation results show that the proposed logarithm-based sliding mode controller not only performs better in terms of vibration isolation, but also robust in the presence of model uncertainty.
11:40am - 12:00pm	**Simulation of Aero-Electro-Mechanical Coupling on HALE UAV Wings for Energy Harvesting (130)** *Mochammad Agoes Moelyadi, Mahesa Akbar, Ema Amalia and Terang Brilian Brantas* A coupling phenomena between aerodynamics, structure and electro system on high aspect ratio wing of an aircraft become attractive for researchers due to physical complexity and its potential electrical power generation. ITB High Altitude long Endurance (HALE) UAV will be used to study the coupling phenomen. The wings designed as a tandem configuration with a high aspect ratio to obtain higher aerodynamic efficiency. Due to the flexibility structure, the structural rigidity of the wing may reduce and cuase aeroelastic phenomena when it interacts with aerodnynamics. the motion of the flexible wing structure of the HALE UAV due to aerodynamic loads produces amount of higher stress at a certain wing section. Thanks to this mechanical motion of the wing, some electric energy may be harvested using an installed piezoelectric devices at that location and then saved in the battery. Some energy harvesting can be carried out as an addition power for supporting the electrical system of the HALE. The research on the piezoelectric energy harvesting implemented on UAV wing-like structure already conducted by De Marqui Jr (2010). He found that the resulting peak power from self-excitation during cruise is 9 μW for 106 Ω load or equivalent to 9 volts. This electricity energy is sufficient to power the typical UAV's electrical system component such as flight control unit and/or servo actuator. Xiang carried out deep analysis on the piezoelectric for the variation of piezoelectric position in spanwise along the wing spar. The optimization of the installed position of the piezoelectric can generate higher electricity. The study focuses on computational simulation of the coupling phenomena between aerodynamics, structure and electro system on high aspect ratio wing of HALE UAV wings by using COMSOL Multiphysics.
12:00pm - 12:20pm	**Multi-Objective Optimization of Electromagnetic Railgun based on Improved RVEA-iGNG Algorithm (6474)** *Xiaoyu Li, Ke Guo, Tao Chao and Ping Ma* For analyzing the influences of discharge sequence of each pulsed power supply and discharge voltage on the performance of the electromagnetic launch system, intelligent optimization algorithms are carried out based on the simulation model of the electromagnetic launch system. Based on the maximum rail current, projectile exit velocity and energy conversion efficiency, the corresponding multi-objective optimization model is established, and the Pareto front (PF) is acquired in RVEA-iGNG algorithm. The algorithm combines an evolutionary optimization algorithm with the reference vector adaptive adjustment by growing neural gas network. It can handle the multi-objective optimization of the electromagnetic launch system with complex irregular PF and achieve fast convergence. In order to provide decision makers with more diversified solutions, this paper proposes an improved RVEA-iGNG algorithm where the archive maintenance strategy is improved. The simulation results not only show that the RVEA-iGNG algorithm can effectively solve the electromagnetic launch system multi-objective optimization problem, but also show that the improved archive maintenance strategy is significantly better than the archive in the original RVEA-iGNG in terms of enhancing the diversity of solutions.
12:20pm - 1:20pm	Lunch - Engineering South S117

1:20pm - 2:00pm	Plenary Presentation #5 - See "Room 2 - Engineering South S112"
	Parallel Session 5-1 - Bio-inspired robots *Chair - Prof. Hoon Cheol Park* *(Konkuk University, Korea)*
2:00pm - 2:20pm	**Preliminary design of a fish-like fast robot by scaling of the KUFish (2692)** *Khanh Nguyen, Giheon Ha and Hoon Cheol Park* Natural underwater species typically outperform synthetic vehicles in many ways. For example, tuna is a representative fast fish swimming at the maximum speed of 20 m/s. However, that of the fastest swimming robot is much lower than the speed. In this work, to generate a preliminary design for a fish-like robot swimming at 3.6 m/s, we first identified the relationships between thrust, torque, and power generated by tail-beating motion and the tail-beating frequency and tail fin area. Through analyses based on the computational fluid dynamics (CFD) and added mass model, it was found that the thrust is proportional to square of changes in the tail-fin area and tail-beating frequency. The torque is proportional to the 2.5th power of change in the tail-fin area and square of tail-beating frequency. The power consumption is proportional to the 2.5th power of increase in the tail-fin area and cube power of increase in the tail-beating frequency. The relationships are used for determining design parameters of the 1/10 and 1/5 models before we start to design a full-scale robot. The two robot models will be fabricated and evaluated to prove that the preliminary design is appropriate. If proven, the suggested design method can be applicable for real-scale fast-swimming robots.
2:20pm - 2:40pm	**CaveX: A low-impact robust cave mapping hexapod (898)** *Lachlan Zilm, Nicholas Verboon, David Harvey and Rini Akmeliawati* Purpose - In this paper, we present our proposed Cave Exploration (CaveX) robot which is capable of low-impact cave exploration and three-dimensional (3D) mapping to aid scientific research, with continuing project development toward full autonomy. Design/methodology/approach: The CaveX robot is a biologically-inspired hexapod which uses LiDAR (Light Detection And Ranging) sensing to explore and map cave systems while minimising its environmental footprint. A model-based systems engineering approach was employed to establish the robot's desired behaviour through stakeholder interaction, also enabling a rigorous prototype design and construction process. Functional analysis was performed to decompose system attributes into associated subsystems including sensing, control, power, structural and movement, and communications. An onboard computer runs the Robot Operating System (ROS), controlling all movement and LiDAR scanning which is well-suited to low light conditions. An open-source code repository was implemented to control the robot's movement, featuring four walking gaits and closed-loop feedback using the motors' torque load. Six legs, each with three degrees of freedom, were mounted to a carbon fibre chassis to enable agile traversal of the highly variable cave terrain. Digital scan data files collected by the robot have been post-processed using a Simultaneous Localisation and Mapping (SLAM) algorithm, and may be integrated into existing 3D cave models. The current solution system contains a modular testing rig and two prototypes that are both able to walk via remote control. Findings - The robot, as tested in real cave environments, successfully mapped confined areas for up to 30 minutes on various terrain types while operating on a 11.1V LiPo battery. Originality - The proposed robot system aims to facilitate rapid deployment into regions of caves that are inaccessible or hazardous to humans, delivering robust, low-impact mapping capabilities to scientists whilst providing simple interfacing between robot and operator.
2:40pm - 3:00pm	**Roles of hydrodynamic forces generated by tail-beating motion in gliding flight of flying-fish-mimicking robot (7373)** *Khanh Nguyen and Hoon Cheol Park* Flying fish, a marine animal of the family Exocoetidae, can perform amazing unpowered gliding ability. Therefore, understanding the gliding flight of flying fish provides insights for scientists to develop dual-modal robots that can swim and fly together. To begin with, we previously created a robotic fish, called KUFish, which can leap out of water with a speed of 1.5 m/s. In this paper, using the measured tail-beating kinematics, we investigate the hydrodynamic characteristics of the submerged tail-beating motion for different body angles. Through a series of computational fluid dynamics simulations, we found that the hydrodynamic forces by the tail not only support the vertical force to lift up the body, but also generate the thrust to move forward. In addition, we used the measured aerodynamic coefficients from the real flying fish, namely L2 model, as our desired aerodynamic reference data set for the wings of KUFish to explain the tail-beating supported gliding flight. It is revealed that the robotic

	fish can perform the gliding flight without generating pitching moment after the water leaping, when a pair of the wing and body angles are maintained in specific ranges under the head wind speeds of 10.5 m/s. This work can also be used to explain how flying fish perform the water taxiing before take-off, and to develop an actual dual-modal robot that mimics flying fish in the future.
3:00pm - 3:20pm	Coffee break - Engineering South S117
	Parallel Session 6-1 - AgTech *Chair - Dr Lei Chen* *(University of Adelaide, Australia)*
3:20pm - 3:40pm	**Autonomous vineyard blade-weeding using Ag robots (8524_A)** *Subrahmanya Chaitanya Aryasomayajula, Lester Cleophas Dsouza, Lakshmi Deepak Ravinuthala and Lei Chen* To ensure farming crops get adequate water and nutrients for optimal development, weeding is inevitable in agriculture. Mechanical weeding has been one of the most widely used techniques worldwide. Automatic mechanical weeding in farmland is ever increasing due to the global competition. The Minnesota Grape Growers Association (2016) stated, "In larger plantings, tractor cultivation is generally required and may need to be done 4 to 6 times yearly ". The weeds are controlled by physically damaging their crucial parts by cutting leaves and roots or covering the weeds with soil to block the sunlight, or by uprooting the weeds and drying them in the sunlight (Kurstjens 2002). However, the most significant disadvantage of mechanical weeding is the harm it inflicts on the plant's roots. Using an autonomous farming tractor with high-precision GNSS and INS, this paper presents a control system for a hydraulic weeding equipment that helps mitigate the damage it causes to the roots during weeding. A mathematical prediction model which determines the maximum force a root can withstand before failure for a given root diameter is developed. The prediction model is validated through the data obtained from tensile and field pull-out tests. The implementation of the control system on the autonomous farming tractor with experimental results will be analysed in the paper to show the maximum load and the corresponding displacement of the vine root when subjected to pull-out loading in the field.
3:40pm - 4:00pm	**Low Cost Ground-Vision Based System for Non-invasive Plant Health Monitoring and Vineyard Water Management (2560)** *Shi Zhao, Tien-Fu Lu and Kuan Meng Tan* Precision viticulture aims to optimise grape production, reduce operating costs, increase profitability, and improve sustainability of vineyard operations through using the data collected from various sensors. Digital camera is one of such sensors which is able to capture high-resolution images for vineyards. This paper describes a ground-based vision system, Vitibox, that cost-effectively captures geo-tagged imagery under a range of lighting conditions. Compared to existing off-the-shelf image capture systems, Vitibox provides a flexible, low cost (both capital and operating), fast solution that can be tailored to a broad range of image capture missions. The whole device can be powered by a widely available power bank(s) and capture images continuously for more than four hours. Multiple prototypes have been tested intensively in vineyards during different growing seasons. Results proved that the final product can capture high resolution, valuable images that can be converted into key vine health and development indices. These indices can help growers making informed decisions to help more Australian wine growers stay ahead of with the changes in the environment and climate.
4:00pm - 4:20pm	**Preliminary Design of Agriculture UAV with Hybrid Tilt-Body Configuration (8905)** *Mochammad Agoes Moelyadi, Syahrahman Akhdiyatullah Ginting, Oktavianus Demas Priambudi, Dzikrian Diqnada, Prayoga and Asiah Annur Sarhani* This paper focuses the first phase development of VTOL high-speed UAV for precision agriculture. The UAV are developed by step to step design approach to obtain frozen agriculture UAV design. The development is driven by design requirements and objectives (DRO) constituting statements to control design process iteratively. Based on the DRO, a mission profile of the UAV describing whole flight operation is determined including vertical take-off, cruise for spraying mission, manoeuvre and landing. The novelty design configuration is the hybrid tilt-body configuration with diamond shape wings equipped with technologies of low drift spraying technology and obstacle avoidance. The weight estimation for each component of UAV is determined iteratively from the derived equation as a function of Aspect ratio and wing span. Power loading and wing loading for the flight mission are

	evaluated for the design point using matching chart. The designed configuration is then analyzed by aerodynamics, structure, weight and balance, stability, systems and performance. The design results of agriculture UAV show that almost all design requirements are fulfilled.
4:20pm - 4:40pm	**Windrow Perception for Smart Farming Guidance (5925)** *Prasanna Kolar* An important process in forage agriculture is the generation of bales for feed production. The practice of bale production involves various machines that include tractors, tedders, rakers, and balers. As part of the baling process, silage material is placed in windrows to drive over with a baler for easy collection into bales. Windrows are the raked rows of silage material that are allowed to dry prior to bale collection. Modern systems are being developed to improve this process through a fully integrated automated baling vehicle. This system will require advanced perception solutions for precision navigation along the windrow to reduce operator fatigue and improve autonomous capabilities. his research proceeded with incorporating low-cost sensors into an appliqué system and integrating it onto a vehicle; collecting and labeling data to create a database of ground truth for training and evaluation; and finding a neural network (NN) classification architecture that could predict the center of a windrow and refining it into a splined path for autonomous navigation
4:40pm - 4:50pm	Closing remarks - See "Room 2 - Engineering South S112"
4:50pm - 6:00pm	Free time / ISIUS meeting
6:00pm - 10:30pm	Conference Banquet at the Wine Centre and Closing Ceremony

Time	Room 2 - Engineering South S112
8:00am - 10:00am	Registration - Atrium outside Engineering South S112
9:00am - 9:40am	Plenary Presentation #4 Conformal Sensors for Non-invasive Monitoring and Health care *Prof. Madhu Bhaskaran (RMIT University, Australia)* *Chair: Dr. Tien-Fu Lu (University of Adelaide, Australia)* Incorporating electronic materials into flexible or stretchable platforms enables the development of sophisticated and conformal electronic devices. My research has focussed on processes that enable functional stretchable electronics while conducting studies to understand the fundamental mechanisms behind the behaviour of the realized devices. The curvilinear adaptability offers distinct advantage over conventional rigid electronic devices. These devices can adapt seamlessly to the human body, which allows for excellent vital information collection through intimate contact with the skin. This research enables us to push fundamental boundaries - an example of this is demonstration of electronic skin. Electronic artificial skin has components that mimic human skin's responses. These replicate organic skin's ability to react to external stimulus such as pressure or heat and relay a signal to the brain through the nervous system, as well as the brain's decision-making ability allowing an appropriate response to the stimulus to be relayed back. Such breakthroughs are significant steps towards the development of life like prosthetics or incorporating more sensing modalities for robots. There are also numerous practical applications - the presentation will also cover the journey to commercialise technology in collaboration with numerous industry, manufacturing, and design partners. These include nearables for non-invasive monitoring, wearables for healthcare, and point of care diagnostics.
9:40am - 10:20am	Invited Presentations Will Autonomous Surgery Using Advanced Sensors, Robotics, Augmented Reality and Machine Learning Technologies Be Possible Within the Next Decade? *Dr Abhilash Chandra (Vascular and General Surgeon)* *Chair: Dr. Xin Yuan (University of Adelaide, Australia)*

	Autonomous Robot Tractor use in Australian and International Viticulture *Simon Nordestgaard (Principal Engineer, The Australian Wine Research Institute)* *Chair: Dr. Xin Yuan (University of Adelaide, Australia)* Many grape producers around the world are facing labour shortages. This has been exacerbated in some countries by pressure to reduce herbicide use, since mechanical weed control alternatives like cultivation and mowing require more and slower tractor passes. Autonomous vehicles are a means of addressing these challenges. This presentation will review developments in autonomy in Australian and international viticulture. It will cover both standalone robots as well as retrofit kits for existing tractors to make them autonomous.
10:20am - 10:40am	Coffee break - Engineering South S117
	Parallel Session 4-2 - AI / ML *Chair - Prof. Masafumi Miwa* *(University of Tokushima, Japan)*
10:40am - 11:00am	**AI Prospective Applications in the Telecommunication Industry (1929_A)** *Ary Setijadi Prihatmanto, Endra Joelianto, Agus Budiyono, Agus Sukoco, Adhi Murbini and Adhi Mahendra* The rapid advancement of artificial intelligence (AI) has opened up new horizons for various industries, including the telecommunication sector. AI technologies have the potential to revolutionize and enhance numerous aspects of telecommunications, ranging from network optimization and resource management to customer experience and service delivery. This paper explores the prospective applications of AI in the telecommunication industry and highlights their potential benefits and challenges. Firstly, the paper examines how AI can be leveraged to optimize network operations and improve overall efficiency. It discusses the use of AI algorithms and machine learning techniques for network planning, intelligent routing, spectrum management, and predictive maintenance. These applications can lead to enhanced network performance, reduced downtime, and improved resource allocation. Secondly, the paper investigates the role of AI in enhancing customer experience and personalization in telecommunication services. It explores the potential of AI-powered chatbots, virtual assistants, and recommendation systems to provide personalized and interactive customer support, tailored product offerings, and proactive issue resolution. Additionally, the utilization of AI in call centers, sentiment analysis, and customer behavior prediction enables telecommunication companies to deliver more efficient and targeted services. Furthermore, the paper explores the potential applications of AI in security and fraud detection within the telecommunication industry. It discusses the use of AI algorithms to detect and mitigate network vulnerabilities, identify anomalous patterns, and prevent fraudulent activities. By leveraging AI, telecommunication providers can enhance their cybersecurity measures and protect their networks and customers from various threats. Moreover, the paper examines the adoption of AI in the field of network virtualization and software-defined networking (SDN). It explores how AI can optimize virtual network functions, automate network management, and enable dynamic resource allocation. AI-powered SDN can facilitate the deployment of scalable and flexible telecommunication networks, reducing costs and increasing network agility. Finally, the paper discusses the challenges and considerations associated with the adoption of AI in the telecommunication industry. It addresses concerns related to data privacy, ethics, regulatory compliance, and the need for skilled AI professionals. The paper concludes by emphasizing the immense potential of AI in transforming the telecommunication industry and encourages further research and collaboration to fully exploit these prospective applications.
11:00am - 11:20am	**A Hybrid-Type Power Transmission Line Inspection Drone and An Anomaly Detection Method Using A Deep Neural Network (9847)** *Fumihiro Hayashi, Masafumi Miwa, Yukinori Misaki, Naoya Iwamoto and Taiga Takechi* Power transmission lines are a vital infrastructure in our daily lives. These lines can be damaged by natural disasters such as lightning and storms. Therefore, it is important to regularly inspect and maintain them to ensure a stable electricity supply. These inspections also provide valuable information for planning power transmission line replacements, which can save costs. In the past, these inspections have often been performed by human workers hanging on the transmission lines. However, this can be dangerous due to the high risk of accidents since they must work at higher places

	and near the high voltage cables. To improve the safety, accuracy, and efficiency of power transmission line inspections, we have developed a remote-controlled robot that can run on the transmission lines and capture clear images. While this robot can be an improvement over using drones or aircraft, it still requires human workers to carry it up to the transmission lines. To address this issue, we propose a hybrid-type power transmission line inspection drone that can fly to the transmission lines and then run on them. On the other hand, anomaly detections in the images of the power transmission lines are also a difficult task for humans because they have to thoroughly inspect all the captured images. Therefore, we propose an anomaly detection method using deep neural networks to further improve the accuracy and efficiency of the inspections. In this paper, we present the results of field tests that were conducted to verify the basic operation of the hybrid inspection drone and the anomaly detection method.
11:20am - 11:40am	**Forward Modelling and Inverse Design of Membrane-type Metasurface Absorbers using Neural Networks (7836_A)** *Hamza Baali, Mahmoud Addouche, Abdesselam Bouzerdoum and Abdelkrim Khelif* Acoustic metasurfaces can be used to design sound absorbers with sub-wavelength dimensions, which is of significant interest for soundproofing materials. In this study, an effective two-stage data-driven approach is presented for the analysis and design of membrane-type metasurface absorbers with desirable properties. In an initial stage, a forward neural network is trained to map the membrane parameters to the sound absorption spectrum generated. The model resulted in a speed improvement of over four orders of magnitude compared to numerical simulation using finite element methods (FEM) on a personal computer. In the second stage, the weights of the learned forward model are fixed, and the membrane parameters used as inputs to the forward model are derived by minimizing the loss between a desired absorption profile and the output of the forward model. Finally, two devices were fabricated using the estimated membrane parameters. The measured acoustic absorption responses of these devices exhibit good agreement with the desired responses.
11:40am - 12:00pm	**Automatic Cataract and Cholesterol Detection System based on Recurrent Neural Network (RNN): A Comparison with Artificial Neural Network (ANN) and Siamese Neural Network (SNN) (6628)** *Lie Zener Sukra, Widodo Jatmiko Anindito Farid, Hanesi Isabel Kartika Putri, Moningka Matthew Ryan Norman, Winda Astuti, Yosica Mariana and Rini Akmeliawati* In Indonesia, the majority of blindness cases, around 81%, are attributed to cataract, while 35% of the population has higher cholesterol levels than the standard range. However, the lack of specialized medical equipment, such as the slit-lamp biomicroscope, and trained professionals, especially in rural areas, make it difficult to detect these conditions through eye examinations. To address this issue, a supervised machine learning method, the Recurrent Neural Network (RNN), has been employed in creating an iris scanner system to identify cataract and high cholesterol. This system can classify eyes into three categories, i.e., cataract, high cholesterol, and normal iris, with high accuracy. The computer simulations indicate that this technique is more accurate and requires less training time compared to the existing Artificial Neural Network (ANN) and SIAMESE NEURAL NETWORK (SNN)-based method, achieving 100% accuracy.
12:00pm - 12:20pm	**Underwater Survey Capabilities: Prospect for AI Implementation (4121_A)** *Ary Setijadi Prihatmanto, Nico Prayogo, Agus Budiyono, Adhi Mahendra, Agus Sukoco, Vitradisa Pratama and Ach Maulana Habibi Yusuf* Underwater surveys play a crucial role in marine research, environmental monitoring, and exploration. Autonomous Underwater Vehicles (AUVs) equipped with Artificial Intelligence (AI) capabilities have emerged as powerful tools to enhance the efficiency and effectiveness of underwater surveys. This paper presents a comprehensive overview of prospective applications of AI in underwater surveys using AUVs. The paper highlights various ways in which AI empowers underwater surveys, including object detection and recognition, mapping and navigation, path planning and autonomous exploration, anomaly detection and classification, data fusion and decision support, as well as real-time monitoring and adaptive sampling. By leveraging AI algorithms, AUVs can autonomously detect and classify marine life, identify underwater structures and artifacts, create detailed maps of the seafloor, plan optimal survey paths, detect anomalies in environmental data, and provide real-time monitoring and adaptive sampling capabilities. These AI-powered advancements in underwater survey technology enable researchers and operators to efficiently explore and understand the underwater world, make informed decisions based on real-time information, and obtain comprehensive insights into underwater

	ecosystems. The prospective applications of AI in underwater surveys using AUVs present promising opportunities for further advancements in marine research, conservation efforts, and underwater exploration.
12:20pm - 1:20pm	Lunch - Engineering South S117
1:20pm - 2:00pm	Plenary Presentation #5 **Magnetic Miniature Robots for Translational Biomedicine: From Individual to Collectives** *Prof. Li Zhang (Chinese University of Hong Kong, Hong Kong)* *Chair: A/Prof. David Harvey (University of Adelaide, Australia)* Robotics at small scales has attracted considerable research attention both in its fundamental aspects and potential biomedical applications. As the characteristic dimensions of the robots or machines scaling down to the milli-/microscale or even smaller, they are ideally suited to navigating in tiny and tortuous lumens inside the human body which are hard-to-reach by regular medical devices. Although the materials, structural design, and functionalization of micro-/nanorobots have been studied extensively, several key challenges have not yet been adequately investigated for in vivo applications, such as adaptive locomotion in dynamic physiological environments, in vivo localization with clinical imaging modalities, the efficiency of therapeutic intervention, biosafety, and their autonomy for the intervention tasks. In this talk, I will first present our recent research progress on development of magnetic miniature robots, from individual, multiple agents to the microswarms, for rapid endoluminal delivery. Then the key challenges and perspective of using magnetic miniature robots for targeted delivery and clinically relevant applications with a focus on endoluminal procedures will be discussed.
	Parallel Session 5-2 - Off-Earth robots and control B *Chair - Dr Noune Melkoumian* *(University of Adelaide, Australia)*
2:00pm - 2:20pm	**Bio-Inspired Legged Robot for Space Exploration (8572)** *Timothy King, Jaxon Craggs and Bailey Coates* Harsh terrain such as inclined craters, fine regolith and vast canyons inhibits interplanetary exploration by wheeled rovers. Such landscapes could be effectively traversed through the application of unique movement patterns used by animals. This paper presents a hopping robot that imitates the bipedal hopping and pentapedal bounding gaits of a kangaroo for the purpose of interplanetary exploration. The gravitational accelerations of other planetary bodies require the adaptation of traditional locomotive patterns. The hopping motion of a kangaroo is ideal for low gravity conditions as it requires less energy for take-off, offers extended flight times and allows for manoeuvring over large obstacles. In addition to the hopping gait, kangaroos incorporate a pentapedal bound for slow and precise movement during grazing. The design approach focused on rapid prototyping, due to the novel nature of the system, allowing for an iterative testing approach. The components were 3D printed to reduce the manufacturing costs and weight of the design. A lightweight design allows for increased jump height, low power motors and reduced impact stresses. A scaled functional prototype was created to accelerate the development of the system through rapid testing of gait patterns. A variable gravity testing rig was constructed and utilised to simulate a range of gravitational accelerations. An optical tracking system was used to provide precise data on the movement of limbs for analysis. This paper demonstrates the feasibility of bipedal hopping robots for the exploration of lower gravity planets. The bio-inspired legged robots provide a strong foundation for the future development and refinement of these gait patterns.
2:20pm - 2:40pm	**Bio-Inspired Ventilation System for Off-Earth Geotechnical Structures and Mining (3027_A)** *Ulfa Riani, Noune Melkoumian, Rini Akmeliawati, David Harvey* With the increase in mankind's population, the question of whether the Earth can sustain and meet the demand for natural resources of current and future generations continues to emerge. Moon poses an abundance of natural resources, which can help to meet mankind's demand as well as will allow for ISRU (in situ resource utilisation) for long term manned missions to the Moon and other planets. Ventilation, which is a component of the Environmental Control and Life Support System (ECLSS) is an integral part of deep space habitation and one of the keys to the survival of crew members in a completely sealed deep space habitat during the long-term manned mission on the moon by maintaining a comfortable and safe internal environment under micro-gravity conditions. Future deep

	space explorations beyond the low earth orbit will require highly mature and reliable technologies that incorporate the lessons learned from the design, development, testing, and operation of the International Space Station (ISS). However, despite extensive development and continues testing, the currently existing ventilation system operated aboard the ISS still poses multiple major issues such as noise generated by ventilation fans, dust, and carbon dioxide accumulation in some poorly ventilation zones. For future long-term manned missions to the Moon, it is likely that the issues will persist and even become more problematic due to the continuous exposure to challenging conditions of space including the presence of highly abrasive lunar dust. This paper discusses the challenges and issues associated with designing and applying ventilation systems for structures in the lunar environment. Conceptual bio-inspired designs are developed using the methods of biomimicry inspired by various flora and fauna on Earth such as owl, termite, ant, penguin and lotus leaf intended to provide optimizations and improvements of the currently existing ventilation system and solution to some of its associated future challenges. Although the bio-inspired solutions are developed for applications in the lunar environment, they also have the potential to be applied for on-Earth mining, and other geotechnical and civil engineering structures.
2:40pm - 3:00pm	**Designing Mining Robot for Swarm Rover Fleet Carrying out Water Extraction on the Moon (3582)** *Gal-Erdene Battsengel, Noune Melkoumian, Rini Akmeliawati and David Harvey* The NASA Planetary Science Program aims to send long-term manned missions to the Moon and Mars, and for this, the in-situ resource utilisation (ISRU) concept has been proposed which implies extracting and using resources from asteroids, the Moon and other planets. Water is essential for sustaining long-term manned missions and mining activities on the Moon. The unpredictability of space mining requires the careful development of mining methods and strategies since mining methods used on Earth cannot be applied in space mining directly due to heavy machinery and maintenance issues, as well as because of the characteristics of the space environment. The application of swarm mining allows for addressing issues associated with heavy mining machinery. This paper focuses on designing a rover for a mining swarm rover fleet to be used on the Moon for water extraction. Designing the rover involves identifying the best-suited extraction method for the permafrost present in the crates at the poles of the Moon, extracting the maximum amount of water from it, maintaining high manoeuvrability and optimal interaction of rovers in the fleet, evaluating their energy consumption and recharge time, as well as their shipment to the Moon as a fleet for swarm mining. To achieve this design software, and analytical and numerical methods have been applied. Performance optimisation and cost-effectiveness evaluation have been conducted both for the proposed rover and the fleet. Rovers have been equipped with features to maintain high manoeuvrability on normal and permafrost regolith. Cost evaluation has demonstrated the feasibility of using swarm mining on the Moon by employing the proposed rovers. The outcome of this study can be beneficial for on-Earth mining as well and can help to reduce the environmental footprint of mining.
3:00pm - 3:20pm	Coffee break - Engineering South S117
	Parallel Session 6-2 - Communications / Sensors *Chair - A/Prof. Steven Grainger* *(University of Adelaide, Australia)*
3:20pm - 3:40pm	**Performance Evaluation of CMOS MEMS Sensor Using a Low-Cost Wireless Data Acquisition System (3628)** *Kunal Gurudath Athikary, Vivek Jabaraj Joseph, Lung-Jieh Yang and Wei-Chen Wang* This present study is to focus and evaluate the performance of a CMOS MEMS piezoresistive sensor with different pressure ranges under vacuum condition using a self-developed low-cost wireless data acquisition system (WDAQ). The pressure sensor was designed and fabricated using UMC 0.18 µm 1P6M standard CMOS process and MEMS technology. The sensing element of the piezoresistors are polysilicon and it is integrated with CMOS circuits to complete the Wheatstone bridge and sensor system. The testing of pressure sensor was done with a vacuum pressure range of 0-100 kPa. The output signals were extracted using a commercial data acquisition system DAQ970A and compared with a ESP8266 based WDAQ. The results extracted using both the DAQ and WDAQ showed good linearity response over the pressure range with a sensitivity of 6.878 µV/V/psi and the average efficiency of WDAQ was found to be 98.13% compared to the DAQ970A. The proposed WDAQ is a low-cost solution for remote data collection and transmission. The WDAQ system is built using ESP8266

	WIFI module, coupled with an Arduino Nano. Java small object notation (JSON) is used to send data from Arduino nano to ESP8266 using the serial communication protocol, allowing for the transfer of data to Google Sheets using google sheets application programming interface (API). The system is enclosed in a package, making it suitable for wind turbine, flapping wing and harsh environment. The WDAQ will be providing the required operating voltage to the CMOS MEMS sensor which makes it a self-reliant system. The design, implementation, and performance assessment of the WDAQ system are all thoroughly analyzed in this work. The work also concentrates on swarm networks to send data to servers in areas where there is limited network connectivity.
3:40pm - 4:00pm	**Reliability of Wireless Communication Systems for Drones (8295_A)** *Akitaka Imamura and Masafumi Miwa* Recently, UAVs (Unmanned Aerial Vehicles), also known as drones, are becoming increasingly popular due to their lower prices and higher performance. On the other hand, the aviation law and local government regulations have become stricter due to a decline in user morale, and a registration system for aircraft and pilot licenses are being introduced. In addition, there are cases where multiple drones are operated simultaneously, and radio interference from other radio equipment and high-frequency power sources is occurring. As a result, control signals and video signals are disrupted, causing crashes. This paper provides an overview of commercially available wireless communication systems for drones and conducts a survey of actual measurements of drone communication in the 2.4GHz band. Furthermore, the radio propagation characteristics are verified by simulation, and future drone communications are discussed.
4:00pm - 4:20pm	**In-situ soil sampling system using autonomous farming robotics (823_A)** *Alleigh Melissa Hamnett, Kristen Helen Coles, and Lei Chen* The world's future food security hinges on precision agriculture: a farming method applying information technology to minimise resources required and maximise productivity of land. To sustain human development with limited farmland, it is necessary to inform the farmers with accurate soil property information for higher produce with less fertiliser and water. Organic matter, mineral and moisture compositions of soils are essential information for the sustainable management of soils. They also provide farmers insights into improving productivity and maintaining optimal soil health. However, it is difficult to obtain the soil information in real-time to guide farmers. It is presented in this paper that an in-situ soil sampling system based on an autonomous farming tractor with high-precision GNSS and INS. The system encompasses a smart design for a soil corer to collect soil samples to depths of 500 mm. To demonstrate the system's effectiveness, the soil's organic carbon information obtained by an NIR sensor is analysed in real-time. Some on-site testing data will be shown through a customised digital system integrated with the autonomous tractor.
4:20pm - 4:40pm	**Nanosatellite Application for Interference Monitoring (4314_A)** *Meiditomo Sutyarjoko, Riza Muhida, Agus Budiyono, Ary Setijadi and Agus Sukoco* Interference monitoring is a critical task for ensuring the reliable and secure operation of satellite communication systems. Traditional methods for interference monitoring rely on large, complex ground-based systems, which can be expensive to build and maintain. In recent years, advances in nanosatellite technology have opened up new possibilities for interference monitoring in space. In this paper, we present a study of the application of nanosatellites for interference monitoring, focusing on their potential advantages over traditional methods. We discuss the technical challenges and opportunities in the design of nanosatellite-based interference monitoring systems, and present a review of existing research in this area. We also present a case study of a proposed nanosatellite-based interference monitoring system, including a description of its design, simulation results, and potential applications. Our findings suggest that nanosatellite-based interference monitoring systems have the potential to provide a cost-effective and flexible solution for interference monitoring in space.
4:40pm - 4:50pm	Closing remarks
4:50pm - 6:00pm	Free time / ISIUS meeting
6:00pm - 10:30pm	Conference Banquet at the Wine Centre and Closing Ceremony