

Program  
of the  
**2018 IEEE Region Ten Symposium  
(Tensymp)**

Impact of the Internet of Things

4-6 July 2018

Mercure Hotel Sydney NSW Australia



Time	Central Room	James Room	Wynyard Room
<b>Wednesday, July 4</b>			
09:00am-10:40am	PS-1C: <i>PS-1C General 1</i>	PS-1A: <i>PS-1A Artificial Intelligence 1</i>	PS-1B: <i>PS-1B Electronics &amp; Power 1</i>
10:40am-11:00am	B1: <i>Break</i>		
11:00am-11:30am	Opening Ceremony: <i>Opening Ceremony</i>		
11:30am-12:00pm	KN-1: <i>Keynote 1</i>		
12:00pm-12:45pm	LP-1: <i>Lunch</i>		
12:45pm-01:15pm	KN-2: <i>Keynote 2</i>		
01:15pm-02:15pm	PA-1: <i>Panel 1</i>		
02:15pm-02:30pm	B2: <i>Break</i>		
02:30pm-03:30pm	PS-3B: <i>PS-3B Power Engineering 2</i>	PS-2A: <i>PS-2A General 2</i>	PS-2B: <i>PS-2B General 3</i>
03:30pm-04:30pm	PS-2C: <i>PS-2C Software 1</i>	PS-3C: <i>PS-3C WebEx Session</i>	PS-3A: <i>PS-3A Electronics 1</i>
<b>Thursday, July 5</b>			
09:00am-10:40am	PS-4C: <i>PS-4C STEM Papers</i>	PS-4A: <i>PS-4A General 4</i>	PS-4B: <i>PS-4B Power Engineering 3</i>
10:40am-11:00am	B3: <i>Break</i>		
11:00am-11:30am	KN-3: <i>Keynote 3</i>		
11:30am-12:00pm	KN-4: <i>Keynote 4</i>		
12:00pm-12:45pm	LP-2: <i>Lunch and Poster Session</i>		
12:45pm-02:00pm	WS-1: <i>Workshop 1</i>		
02:00pm-03:15pm	PA-2: <i>Panel 2</i>		
03:15pm-03:30pm	B4: <i>Break</i>		
03:30pm-04:30pm	PS-5B: <i>PS-5B Healthcare</i>	PS-5C: <i>PS-5C WebEx Session</i>	PS-5A: <i>PS-5A Electronics 2</i>
06:30pm-10:00pm	Dinner: <i>Conference Dinner Cruise</i>		
<b>Friday, July 6</b>			
09:00am-10:40am	Industry Day: <i>Power - 0 IoT and Asset Management in NSW Health</i>	PS-6A: <i>PS-6A General 5</i>	Industry Day: <i>IoT-1 IoT Workshop</i>
10:40am-11:00am	B5: <i>Break</i>		
11:00am-12:30pm	KN-6: <i>Keynote 6</i>		KN-5: <i>Keynote-5</i>
11:45am-12:30pm	KN-7: <i>Keynote 7</i>		
12:30pm-01:15pm	LP-3: <i>Lunch</i>		
01:15pm-02:45pm	Industry Day: <i>IoT 2</i>		Industry Day: <i>Power 1</i>
02:15pm-03:00pm	K-8N: <i>Keynote 8</i>		Industry Day: <i>Power 2</i>
02:45pm-03:45pm	KN-9: <i>Keynote 9</i>		
03:45pm-04:00pm	B6: <i>Break</i>		
04:00pm-05:00pm	Industry Day: <i>IoT 3</i>	PS-8A: <i>PS-8A WebEx</i>	Industry Day: <i>Power 3</i>
05:00pm-05:25pm	Awards: <i>Best Paper Awards &amp; Closing Ceremony</i>		

## Wednesday, July 4

Wednesday, July 4, 09:00 - 10:40 (Australia/Sydney)

### PS-1A: PS-1A Artificial Intelligence 1

Room: James

Chair: Dapeng Tien

9:00 Computing the relations among three views based on artificial neural network

Ying Kin Yu, Kin Hong Wong and Siu-hang Or

Multiple view geometry plays an important role in the traditional problem on the camera pose estimation from 2-D images. Given only 3 images of the same scene, one may apply the well-known fundamental matrix or trifocal tensor to make a robust computation of the poses among the three camera views. Practically, extracting the pose parameters from them is not straight forward. Multiple solutions arise and the final computed value may deviate from the actual one even if the closest solution is chosen since the process is highly non-linear. In this paper, we are going to investigate the use of a machine learning approach to solve the problem. An artificial neural network is trained with noisy point features from three views to estimate the camera poses among them. It is found that the proposed method is able to compute accurate pose parameters under noisy environment. The effects of applying different amount of noises to the training and testing datasets have also been studied.

pp. 231-235

9:20 An Effective Hexapod Robot Control Design Based on a Fuzzy Neural Network and a Kalman Filter

Hung-Yuan Chung, Yao-Liang Chung and Yi-Jan Hung

This study used a fuzzy neural network and a Kalman filter to control a hexapod robot. The robot could avoid obstacles while walking along a wall. The robot's posture was effectively adjusted, and high stability during movement was achieved. The angle between the robot and the wall was calculated by converting the distance values measured by ultrasonic sensors installed on the sides of the robot. For the fuzzy neural network, the input was the angular position and the output was the swing amplitudes of the robot's legs. The robot's forward movement direction was adjusted based on the difference between the swings of the legs on two sides, which allowed for obstacle avoidance in complex environments. The Kalman filter was used to obtain an accurate tilt angle in the robot by combining the advantages of a triaxial accelerometer and a gyroscope. The tilt angle was then further expressed via the movement direction of each leg. Each leg was adjusted using inverse kinematics, which allowed for the recovery of the robot's postural balance. Furthermore, this study proposes improved gait designs, which provided the robot with more effective responses to different landforms. The empirical results indicated that the proposed method increased the flexibility and mobility of the robot.

pp. 236-241

9:40 Augmented Map based Traffic Density Estimation for Robot Navigation

Baljit Kaur

Most of the work done on robot navigation is focused on map building, localization and obstacle avoidance. In this paper, we particularly focus on intelligent robot navigation based on scene traffic. In this course we initially generate augmented maps using scene traffic flow captured at discrete times of same days, different days and various weather conditions. For facilitating the same, we manually navigate a mobile robot(X80SV) for capturing data(image and sonar map data) across a campus; segmented into zones. Zone specific point cloud maps are then created by merging scene object detection results with sonar map. A Gaussian model is further used for estimating trend for traffic density from the point clouds. This information is later utilized for navigational purposes, to detect the minimum crowded path from a source to destination. Object detection and classification is done using a fine tuned AlexNet. For labelling the training set used for fine tuning, we perform foreground extraction, transfer learning and SVM classification of the scenes. 16 classes of objects including background is used. During realtime navigation, we also perform object detection and classification so that the current traffic trend can be matched with the augmented maps.

pp. 242-247

10:00 Care Robot Transparency Isn't Enough for Trust

A recent study featuring a new kind of care robot indicated that participants expect a robot's ethical decision-making to be transparent to develop trust, even though the same type of introspection isn't expected of a human carer. This might suggest that robot transparency mechanisms are required for users to develop trust in ethical decisions. But, the participants were found to desire transparency only when they didn't know the specifics of a social interaction. Humans trust others without observing their thoughts. So, there must be another method that humans use to determine whether a human carer is trustworthy to make good ethical choices. This paper suggests that the method is social interaction and observation, signifying that trust is a social construct. Moreover, that social determinants, as interpreted through observation and interaction, are the transparent elements of a person's ethics which people place their trust in. Simply, if a person consistently behaves kindly, then people can trust that person to behave kindly always. In a healthcare context, if patients observe that a human carer makes good, ethical care practice choices, then patients can trust that carer to do so always. Thus, the same social determinants may be required of care robots to meet the same level of trust as humans are granted without seeing their thoughts. Another study demonstrates the effectiveness that transparency mechanisms have on improving user understanding of robot decision-making, but it doesn't concern ethical decision-making or trust. The purpose of this paper is to describe why transparency mechanisms may not be effective in helping to develop trust in a care robot's ethical decision-making. Furthermore, how such mechanisms may not be effective at helping someone understand someone else's ethical decision-making processes at all. This paper calls for roboticists to build sociable elements into care robots to help patients to develop trust in the care robot's ethical decision-making.

pp. 248-252

#### 10:20 Study on Training Convolutional Neural Network to Detect Distraction and Drowsiness

Whui Kim, Hyun-Kyun Choi and Byung-Tae Jang

Most critical reason of the crash causal chain were caused by the driver. In other to reduce such human factors, it is necessary to use multiple pieces of information acquired by monitoring driver. In this paper, we propose a method to detect both distraction and drowsiness using a single convolutional neural network, and show that data composition should be different depending on the relationship of two or more class properties. In our experiments, we show driver distraction and drowsiness are reliably classified without decreasing accuracy and frames per seconds.

pp. 253-257

#### **PS-1B: PS-1B Electronics & Power 1**

Room: Wynyard

Chair: Trevor Blackburn

#### 9:00 Distinguishing between Cyber Injection and Faults using Machine Learning Algorithms

B M Ruhul Amin, Adnan Anwar and M. J. Hossain

Cyber Security concern is growing worldwide with the advancement of the smart control and networking in the cyber-physical layer of power systems. Detection of the stealthy False Data Injection Attack (FDIA) is getting more complicated when the system's behavior like the fault is considered. In this paper, a machine learning algorithm based approach is proposed to detect and distinguish between stealthy FDIA in the state estimator and faults in the power system. The detection rate and false positive value obtained by using different state-of-the-art classifiers show that the proposed approach can successfully distinguish between cyber injection and faults in the power systems. Cyber injection and faults are introduced in a state estimator model simulated in MATLAB and an open source machine learning tool, WEKA is utilized to classify the injection and faults from the developed dataset.

pp. 13-18

#### 9:20 Single-Phase Switched-Capacitor Integrated-Boost Five-level Inverter

Md Noman Habib Khan, Yam Siwakoti, Li Li and Mojtaba Forouzes

This paper proposes a novel five-level single-phase inverter topology. The inverter uses eight power switches, two capacitors, one inductor, one diode, and a small LC filter at the output. Compared to other multilevel inverters, the proposed inverter can achieve up to 400% more output voltage for the same DC link voltage. As a result, it requires the only ¼ of the conventional multilevel inverter topology. The operational states are discussed in brief with the theoretical explanation. A comparison table is illustrated to show the importance of proposed topology compared with existing

topologies. The key simulation waveforms and the preliminary experimental results are presented. More explanation of the proposed inverter will be discussed in the final paper.

pp. 19-23

#### 9:40 Fault Protection Technique for ZSI- fed Single-phase Induction Motor Drive

Vivek Sharma

The Z-source inverter (ZSI) is getting popular for induction motor drives as they provide single-stage power conversion with voltage buck-boost ability. Recent surveys have reported that inverters are prone to failure due to internal faults on power semiconductor devices and significantly degrades the overall system's performance. The analysis and diagnosis of faults are significantly important for ensuring reliable operation of drive systems. This paper has rigorously analyzed effects of internal faults on a ZSI-fed single-phase induction motor drive system using Matlab/Simulink. This study proposes a fault protection technique using bidirectional converter to facilitate post fault operation of inverter drives. The simulation circuits with related harmonic spectrum are presented by introducing open circuit fault and short circuit fault in drive system with and without protection circuit. From systematic analyses it is found that fault occurrence leads to harmonic distortions to a significant level in the proposed drive system and therefore, affects the system's efficiency. The proposed fault protection technique proves out to be an effective method to reduce harmonics in the drive system during fault occurrence.

pp. 24-29

#### 10:00 On-chip Transient Detection Circuit for Microelectronic Systems against Electrical Transient Disturbances due to ESD Events

Wen-Chieh Chen and Ming-Dou Ker

An new on-chip transient detection circuit which can detect the electrical disturbances of system-level electrostatic discharge (ESD) is proposed. The circuit is designed with reduced physical area by utilizing dual-latched structure. With hardware/firmware co-design method, auto-recovery procedure can be activated by the detection circuit when microelectronic systems suffering the system-level ESD events. The immunity level of microelectronic products against the electromagnetic interference (EMI) from ESD events can be effectively improved. The proposed on-chip transient detection circuit has been verified in a 0.18-um CMOS process with 1.8-V devices under system-level ESD tests.

pp. 30-33

#### 10:20 A Novel PVDF Thin-film Sensor Design for Multi-axis Measurement of Cutting Force

Yung Ting, Prapto Suprpto and Hsin-Yuan Chen

On-line measurement of cutting force for a CNC machine becomes a fundamental and requisite technique of Internet of Things in industrial manufacturing process. Sensor design is the key component to support the cutting force measurement. To meet with the requirement a new and specific PVDF thin-film sensor for cutting force measurement is developed. Different from the traditional expansive dynamometer implemented on the work piece, the PVDF thin-film sensor is employed on the cutter to directly detect the cutting force. The measured data can be collected and transmitted via wireless communication for subsequent purposes. Moreover, the proposed one-layer PVDF thin-film sensor with multiple electrodes can measure all the required information instead of using many pieces of a regular PVDF thin-film with single electrode or a strain gauge for example so that reducing the effort and difficulty in implementation.

### PS-1C: PS-1C General 1

Room: Central

Chair: Raheel Maqsood Hashmi

#### 9:00 Combating SSDF Reputation Mining and Reset Attacks in Cognitive Radio Networks

Sasa Maric, Sam Reisenfeld and Robert Abbas

The primary deterrent to the implementation of distributed cognitive radios for many years has been their vulnerability to a number of physical layer attacks. In particular, attacks exploiting the spectrum sensing phase of the cognition cycle have been identified as highly susceptible. This paper presents a method to diagnose and neutralise one such attack, the spectrum sensing data falsification (SSDF) attack. We propose a belief propagation based statistical reputation function (BPBSRF). BPBSRF is able to statistically analyse spectrum sensing information from a transmitter and identify the

legitimacy of the data. We introduce a trust factor between pairs of users, which is implemented through a dynamic reputation function. In addition, we define two new types of attack: a data mining attack and a reset attack. We introduce a probation period and a random back off period to combat these attacks. The BPBSRF method is an effective, yet efficient method that was designed to be used in distributed networks where users are limited in power and computational complexity.

pp. 34-38

#### 9:20 Sparsity Representation of Beat Signal in Weather Radar for Compressive Sampling

Rita Purnamasari, Andriyan B. Suksmono, Ian Yosef and Irma Zakia

The beat signal that collected by weather radar in one rotation scanning per minutes are very large. One of method to reduce the volume of beat signal is commonly using compression technique. Since one decade ago, Compressive Sampling (CS) algorithm is begin popular as a new compression technique. CS is a new technique in data acquisition that can reconstruct the signals by take sample less than traditional sampling algorithm. To reach the efficiency, CS requires that the beat signals to be processed have sparsity on a particular base. In this paper we proposed Fast Fourier Transform (FFT) algorithm for transform into sparsity basis and random orthonormal basis as measurement rate. The recovery of beat signals in this paper are reconstructed by convex optimization as the development of minimum  $l_1$  norm reconstruction. The proposed scheme are outperform in accuracy but has long computation which takes about 4.8 minutes.

pp. 39-44

#### 9:40 Design and Development of a Cloud-based Flora Repository System with Geo-Location Mapping for Mt. Hamiguitan Sanctuary Exploration

Jennifer Dela Cruz, Delan Zoe Arenga, Franch Maverick Lorilla and Paul Tangian

Mount Hamiguitan Range Wildlife Sanctuary is the only mountain range heritage site among the six UNESCO World Heritage Sites found in the Philippines. It is the largest pygmy 'bonsai' forest rich with biodiversity of endangered, endemic and rare species of flora that attract not only tourists but also foreign researchers. However, both tourism and research could threaten the sanctuary's conservation if not managed well. Through this study, the Mount Hamiguitan's different flora species, their habitat, and its distribution can be located on the map while doing exploration using a location-based mobile application named as HAGO (Hamiguitan-Go). A mountain explorer who will use the HAGO APP will act as a PS (Participatory Sensing) using his/her smartphone's built-in GPS, internet and camera to geotag the captured plant he/she encountered while hiking. Once verified, the geotagged picture and its information details are stored in an online repository system of plants. The APP users can look into the lists of plants they want to explore and locate on the map using geo-location mapping. The program designed and developed in this study have only undergone simulation testing. Further developments and several on-site experiments must be conducted to achieve a fully-functional cloud-based system.

pp. 45-50

#### 10:00 Fast Bootstrap of Routing Protocol for Low Power and Lossy Networks on Dense Wireless Sensor Networks through Adaptive Trickle Timer Settings

Paul Vincent Alpaño and Jhoanna Rhodette Pedrasa

Wireless Sensor Networks are envisioned to be large-scale and with dense deployments for fine-grain monitoring. Improvements for Routing Protocol for Low Power and Lossy Networks (RPL) are necessary to meet the required outcome. We analyzed through simulations the performance of RPL on dense WSNs as a function of different trickle timer parameters. Our results show that varying the minimum interval, interval doublings and redundancy constant had no effect on the network's PDR and had slight effect on the network's churn rate on uniform topology. However, the startup time significantly changed depending on different minimum interval values. We propose an adaptive algorithm of RPL which varies a node's minimum interval depending on its number of neighbors. We implemented our enhancement on random topologies and showed that our enhancement produced better packet delivery ratio, lower startup time, and lower churn rate compared to networks with fixed minimum intervals.

pp. 51-56

#### 10:20 Formalisation of Problem and Domain Definition for Agent Oriented Smart Factory (AOSF)

Fareed Ud Din, Frans A Henskens, David Paul and Mark Wallis

Industry 4.0 is revolutionising recent industrial setups. Literature has examined the idea of Smart Factory under the umbrella of Industry 4.0 extensively, but further research into the applicability of such frameworks for Small to Medium Size Enterprises (SMEs) is still required. To help address this issue, the Agent-Oriented Smart Factory (AOSF) framework focuses on a multi-agent architecture for end-to-end Supply Chain (SC) in SMEs. This paper presents a Cyber Physical System (CPS) based extension to the general AOSF framework and design heuristics for problem and domain definition of Agent Oriented Storage and Retrieval (AOSR) warehouse system using Multi-Agent Hierarchical Task Networking (MA-HTN) planning formalism.

pp. 282-287

**Wednesday, July 4, 10:40 - 11:00 (Australia/Sydney)**

**B1: Break**

**Wednesday, July 4, 11:00 - 11:30 (Australia/Sydney)**

**Opening Ceremony: Opening Ceremony**

Room: Central

**Wednesday, July 4, 11:30 - 12:00 (Australia/Sydney)**

**KN-1: Keynote 1**

Alex Baitsh

Room: Central

**Wednesday, July 4, 12:00 - 12:45 (Australia/Sydney)**

**LP-1: Lunch**

**Wednesday, July 4, 12:45 - 13:15 (Australia/Sydney)**

**KN-2: Keynote 2**

Wearable Sleep trackers: How do you sleep?

Prof. Chin-Moi Chow

Room: Central

**Wednesday, July 4, 13:15 - 14:15 (Australia/Sydney)**

**PA-1: Panel 1**

Early Career

Pina Dall'Armi-Stokes & Tim Wo

Room: Central

Pannel discussion of strategies for early careere engineers.

**Wednesday, July 4, 14:15 - 14:30 (Australia/Sydney)**

**B2: Break**

**Wednesday, July 4, 14:30 - 15:30 (Australia/Sydney)**

**PS-2A: PS-2A General 2**

Room: James

## 2:30 Dynamic Congestion Control in Information-Centric Networking utilizing Sensors for the IoT

Rungrot Sukjaimuk, Quang Ngoc Nguyen and Takuro Sato

Network congestion control is an important criterion to evaluate the network performance. This is a major research challenge in ICN (Information-Centric Networking), especially in the case of high congestion in a Sensor Network for the IoT (Internet of Things). The reason is that the content producers in ICN need to reply a huge number of content requests from the consumers. In this paper, we propose a hierarchical ICN model for IoT sensor network with dynamic congestion control mechanism. The proposed network system transmits the content with content popularity and priority-based delay time, together with adaptive content lifetime and cache management strategy. The evaluation results using ndnSIM show that the proposed model can provide higher network performance efficiency for the future Internet by achieving higher throughput with lower Interest packet drop rate and higher cache hit rate as we increase the number of IoT sensors in ICN.

pp. 61-66

## 2:50 Research on UWB-Based Indoor Ranging Positioning Technology and a Method to Improve Accuracy

Ding Lei and Tong Zhou

This paper presents a UWB-based indoor location ranging scheme and a method for improving accuracy through error compensation. UWB is widely used in high-precision indoor positioning because of its strong anti-interference performance, high transmission rate, wide bandwidth, low power consumption, and low transmission power. An inverse star location model was established based on the principle of spatial 4-point location. This scheme adopts STM32 to control the DW1000 to realize the UWB signal transceiving on the hardware. The software algorithm uses the TOF principle combined with the spatial 4-point positioning method to determine the position of the target point, uses the error compensation method to correct the data, and improves the accuracy of distance measurement positioning. Finally, the accuracy of the system was tested and corrected by experiments, and the effectiveness of the error compensation method in improving the system accuracy was verified.

pp. 67-71

## 3:10 Performance Evaluation of CoAP Broker and Access Gateway Implementation on Wireless Sensor Network

Aldwin Akbar Hermanudin, Fransiskus Astha Ekadiyanto and Riri Fitri Sari

Currently there are several Application Layer protocols running on Internet of Things system. Protocols such as MQTT, CoAP, XMPP, and DDS have different architectures and performance. Wireless sensor networks operating in low power, low bandwidth and with limited reliability, is more suitable to use CoAP. However, CoAP suffers from scalability issue which make it inferior to MQTT architecture. Therefore this research focuses on CoAP Broker implementation which enables MQTT-like architecture to be implemented in CoAP. This research aims to implement Access Gateway and several scalability scenarios, involving sensor monitoring scenarios and actuator controls on multiple location. This paper shows the success of implementing CoAP Broker along with the mentioned scenarios and performance evaluation results show the latency which has not indicate any congestion when handling 130 requests per second and good error-rate with low value between 0.01% - 0.04%.

pp. 219-224

## PS-2B: PS-2B General 3

Room: Wynyard

## 2:30 Asynchronous MOUSETRAP Implementation of AES-128 encryption using 65nm standard cells

Chris Vincent Densing

Asynchronous pipelines offer advantages of flexibility and modularity over synchronous pipelines. In this work, the AES-128 encryption algorithm was implemented using the MOUSETRAP asynchronous pipelining technique. MOUSETRAP allows easy integration with existing standardcell based design methodologies. Combinational logic blocks were implemented using automatic synthesis tools, while sequential elements of the pipeline were designed by hand. This work was able to achieve a maximum throughput of 312.5 million operations=sec, a latency of 14.374 ns, and average power of 91.38 mW at maximum throughput using 65-nm standard-cell CMOS technology.

pp. 78-82

## 2:50 Proposal of Price Presentation by Smartphone Application for Reducing Food Loss

Yoichi Utsunomiya and Takashi Okuda

In recent years, food disposal and food loss are becoming a social problem. Among them, attention is focused on reducing food loss. Food loss refers to the disposal of the part which was originally able to be eaten among food waste disposal, and it covers residues left behind, excessive removal in the home, expiration date and so on. On the other hand, when disposal due to an expiration of the expiration date at the retail store, it is treated as food disposal. Therefore, we propose price presentation by smartphone application to reduce food loss. The penetration rate of smartphones in Japan is about 65%, which can be appealed to many consumers because it is as high as 80% in the twenties to fifties. In this paper, we confirm the effectiveness of price presentation using smartphone application by simulation.

pp. 117-122

## 3:10 Predictive Analysis of 3D ReRAM-based PUF for Securing the Internet of Things

Jeeson Kim, Hussein Nili, Gina Adam, Nhan Duy Truong, Dmitri Strukov and Omid Kavehei

In recent years, an explosion of IoT devices and its use leads threats to the privacy and security concerns of individual users and merchandises. As one of promising solutions, physical unclonable function (PUF) has been extensively studied. This paper investigates quality of randomness in the first generation of 3D analog ReRAM PUF primitives using measured and gathered data from fabricated ReRAM crossbars. This study is significant as the randomness quality of a PUF directly relates to its resilience against various model-building attacks, including machine learning attack. Experimental results verify near perfect (50%) predictability. It confirms the PUFs potentials for largescale, yet small and power efficient, implementation of hardware intrinsic security primitives.

pp. 57-60

## **PS-3B: PS-3B Power Engineering 2**

Room: Central

## 2:30 Novel High Efficiency H-Bridge Transformerless Inverter for Grid-Connected Single-Phase Photovoltaic Systems

Md Noman Habib Khan, Mojtaba Forouzesh, Yam Siwakoti and Li Li

This paper proposes a new H-bridge type transformerless inverter for grid-connected photovoltaic (PV) application. The proposed H-bridge zero voltage switch controlled rectifier (HB-ZVSCR) inverter uses additional switches and diodes at the AC side with voltage clamping feature to the DC midpoint. Main characteristics of the proposed inverter are the high conversion efficiency and low leakage current, which make it a suitable candidate for grid-connected PV applications. The analysis and operating principles of the proposed inverter are discussed in details. This theoretical findings has been simulated using PLECS software to verify the common mode voltage (CMV) and leakage current behaviors and the results are compared with similar existing midpoint voltage clamping inverter topologies (i.e. HB-ZVR and HB-ZVR-D). Furthermore, power loss and efficiency of the proposed inverter have been evaluated and compared with existing topologies.

pp. 100-104

## 2:50 The Technical, Operational and Energy Policy Issues for Developing Photovoltaic Systems: A Review

Ibrahim Anwar Ibrahim and M. J. Hossain

In recent years, photovoltaic (PV) units are getting popular in different countries, including Australia, as they contribute to reducing emissions of CO<sub>2</sub> and enhancing energy efficiency. However, several technical and economic challenges need to be addressed to ensure maximum benefit from this renewable generation. Moreover, the development of energy policies and regulations also affects the development of such systems. Therefore, this paper aims to review several technical, operational and energy policy issues for developing reliable and efficient PV systems. In addition, this paper summarizes the existing modeling and sizing methods, the maximum power point tracking (MPPT) techniques, and the interface power-electronic devices in this field. Moreover, recommendations for future researchers and investors for developing such systems are provided in this research paper.

pp. 173-178

## 3:10 Performance Analysis of Hybrid Solar-Wind-Microhydro System in Islanded mode

This paper focuses on an integration of photovoltaic (PV), wind energy (WE) and micro-hydro (MH) systems and analyze their performances via simulation. The variation in temperature, solar irradiance and wind speed have been considered for carrying out the analysis. A run-off river MH system with constant power output is considered. The battery energy storage system and MH system, help mitigate the effects of sporadic variation of the hybrid system due to changing weather conditions. An interfacing inverter with LCL filter couples the dc hybrid system to an AC non-linear load. The mathematical modeling of PV system, WE system together with MH system and battery energy storage system is detailed with interfacing AC/DC converters for integrating the system to a DC bus as well as AC non-linear load. A dynamic voltage restorer (DVR) is implemented to compensate the load voltage and current waveform distortion. Islanded hybrid renewable energy (RE) system is best suited for secluded area with low load factor as it eliminates the requirement of grid connection. A model of the hybrid system is developed and applied in the MATLAB/Simulink environment. The simulation results display the electrical parameters of various component of the hybrid system.

pp. 179-184

### **Wednesday, July 4, 15:30 - 16:30 (Australia/Sydney)**

#### **PS-2C: PS-2C Software 1**

Room: Central

Chair: Dapeng Tien

#### **3:30 Developing and Integrating a Semantic Interoperability Testing Tool in F-Interop Platform**

Soumya Kanti Datta, Christian Bonnet, Hamza Baqa, Mengxuan Zhao and Franck Le Gall

The full potential of the Internet of Things (IoT) is challenged by heterogeneous IoT data sources, data formats, and fragmented IoT ecosystems. Semantic interoperability is identified as a key to address these challenges. But majority of the current IoT ecosystems lack any tool to verify if two IoT platforms are semantically interoperable. This paper proposes a semantic interoperability testing tool called SemTest. It performs conformance and interoperability tests to ensure whether two IoT systems under test (SUT) are semantically interoperable. The architecture of each testing methodology is presented along with technical discussion on the tool development. A major contribution of the paper is to integrate the SemTest tool into the F-Interop platform which aims at online conformance, interoperability, and performance tests for IoT. Feedbacks from the semantic web technology experts from IETF and W3C communities highlight that the proposed tool is novel, timely, and will have a strong impact across the IoT ecosystems

pp. 105-110

#### **3:50 VREX: A Framework for Immersive Virtual Reality Experiences**

Vanessa Tan, Ryan Blonna, Mel Stychen Tan, Anna Patricia Mora and Rowel O Atienza

Virtual Reality (VR) is believed to be the future of gaming and even application platforms. However, creating a VR application from scratch takes up a lot of time and research. Virtual Reality frameworks simplify game development by allowing the developer focus on the actual design and system rather than dealing with the core functionalities and interactions of a VR application. In this paper, we present a Virtual Reality framework using Unity3D and the HTC Vive. With this framework, any developer can easily create a VR environment with interactions, scene objectives, player explorations, and many more. This framework is used in the creation of the adventure fantasy game, ELDERVINE, and adapted for the scene creator application, ANEEME. Results of experiments conducted show the framework's usability in creating different VR applications and its capability to make the interactions intuitive and the experience immersive.

pp. 111-116

#### **4:10 On the Necessity of Right Optimizations for Live Migration of Virtual Machines**

Subham Jain, Malayam Parambath Giles, S D Madhu Kumar and Lillykutty Jacob

Virtual machines, while performing the backend computation for new paradigms such as the Internet of Things, enforce their live migrations over bandwidth constrained wide area network. Pre-copy migration is the prevalent live virtual machine migration technique in use. Although work has been done in optimizing the migration time based on the nature of the applications - memory dirtying pattern, extra traffic generated, etc. - none of them rightly pointed out the effect of future dirty bitmap and bandwidth information in deciding the total migration time, downtime, and the extra traffic. In this paper, our objective is to develop an optimal algorithm which will form a baseline for these values and will tell us

the minimum migration time that is possible. We consider two parameters - page dirty behavior of the application and bandwidth availability to develop the optimal algorithm. We simulate our algorithms in CloudSim, and show that a good prediction of the page dirtying pattern and bandwidth can benefit the cloud service providers to save the time and load due to migrations.

pp. 83-88

### **PS-3A: PS-3A Electronics 1**

Room: Wynyard

#### 3:30 Modeling of Errors in a Digital Energy Detector for On-Off Keying Receivers

Christopher Santos and Louis Alarcón

A method in modeling and computing the error probability in a digital energy detection OOK receiver with a moving sum is presented. The model considers samples from both the previous and current bits. Errors for same or different consecutive bits are analyzed separately as ERB(same) and ERB(diff) and can be characterized based on majority vote transitions. Errors were found to have opposite trends with MVth. Thus, optimal thresholds for the smallest bit error rate can be chosen, for a fixed number of samples  $N$ , error probability per sample ERS, and probability of bit transitions. The optimal thresholds for  $N=5, 10, 15,$  and  $20$ , were found to be (2,3), (4,6), (6,9), and (8,12) when the sample error rate is from 0.01 to 0.16 and when the probability of bit transition is 50%. The computed error probabilities have %-errors of -6.91%, -0.40%, and -1.42% for ERB(same), ERB(diff), and ERB when compared with behavioral simulations. ERB was observed to be approximately proportional to  $(ERS)^k$ , where  $k$  is positive, and so improvements in ERS will result in  $k$ -fold improvements in ERB. Estimated  $k$  values are 2.45, 4.78, 6.60, and 8.40 for the  $N$ 's mentioned and are slightly below  $N/2$ .

pp. 123-127

#### 3:50 A Fault Detection Method for IGBT Bond Wires Partial Lift Off Based on Thermal Resistance Assessment

Dan Luo, Minyou Chen, Yi Xiao, Wei Lai and Shengyou Xu

Insulated Gate Bipolar Transistor (IGBT) has become one of the most widely used power electronic devices, hence its reliability has received lots of attention. Bond wires partial lift off is one of the failure mechanisms lead to IGBT open-circuit fault. However it's difficult to detect bond wires partial lift off due to IGBT's package. This paper proposes a new method to detect bond wires partial lift off based on thermal resistance assessment. A Finite Element model based on actual IGBT module is established to analyze how thermal resistance changed by bond wire partial lift off. Simulating results show the validity of this method.

pp. 128-132

#### 4:10 Encoding Multichannel Audio for Ultra HDTV Based on Spatial Audio Coding with Optimization

Ikhwana Elfitri, Doni Nursyam, Fitrilina Fitrilina and Rahmadi Kurnia

Ultra High Definition Television (UHDTV) has been a promising system for future TV broadcasting where 22.2 multi-channel audio is adopted for creating three-dimensional (3D) audio in the home-user listening area. In the development stage, Moving Picture Expert Group (MPEG) Advanced Audio Coding (AAC) standard has been chosen for audio encoding. However, this choice is questionable as its performance deteriorates as the bit-rate decreases. In this paper, Spatial Audio Coding (SAC) with optimization technique is proposed due to its strength on working at lower bit-rates and its backward compatibility to fewer multi-channel configurations. The results of experiments show that the proposed method achieves Objective Difference Grade (ODG) score more than -1, which is rated as excellent score, at bit-rates starting from 1200 kb/s.

pp. 133-137

### **PS-3C: PS-3C WebEx Session**

Room: James

Chair: Bruce Poon

**Thursday, July 5**

**Thursday, July 5, 09:00 - 10:40 (Australia/Sydney)**

**PS-4A: PS-4A General 4**

Room: James

9:00 Super Long Range Small Empty Cavity UHF RFID Tag Antenna Design for a Metal Cart

Byondi Franck Kimetya

This paper presents an UHF(Ultra High Frequency) band small empty cavity structured RFID(Radio Frequency Identification) tag antenna with a super long reading range, designed to apply on metal cart for auto-parts logistics. The size of tag antennas is 140×60×10 in mm, attached on a exporting metal cart, and it can give the information of inventory and logistics of carts. By collecting the exported carts and increasing the recovery rate of missing carts or pallets, the paid import tax can be refunded when the carts are returned back to the manufacture. The tag antenna is made by a PLA plastic cover to prevent damage, and help to make the cavity antenna; the dielectric constant of the cover is considered for the simulation. The copper material is attached on four side of the plastic, the reading range of the tag antenna is almost 21m using LP(Linear Polarization), 10 m with CP(Circular Polarization) reader antennas. This 920 MHz UHF RFID cavity tag ensures the long reading distance of the antenna regardless of the material of the object where it is attached

pp. 138-141

9:20 A Fair Aggregation Scheme in Shared Space Settings

Cheryl Siy and Jhoanna Rhodette Pedrasa

Thermal comfort has been a major problem in shared space environments. The solution is to use an occupant feedback mechanism to enable users to interact with the system and to provide their sensations. However, these systems do not account for false votes. Also, current implementations do not incorporate fairness, which is an important concept in dealing with comfort distributions. In order to address this problem, the integration of a fair comfort maximization scheme in a shared space occupant feedback HVAC control system is formulated. This will be used as the aggregation scheme of the proposed system. This scheme aims to prioritize thermal comfort. Actual data is then used to analyze the proposed scheme compared to top aggregation schemes.

pp. 142-147

9:40 Energy Efficiency in Dynamic Cluster Selection for Cooperative Wireless Sensor Networks

Azlan Abdul Aziz and Hadhrami Ab Ghani

Previous work on energy efficiency in Wireless Sensor Networks (WSN) focuses on one-dimension topology in cluster selection strategy. Here we extend it into two dimension model by including the effect of angle of elevation in the energy modeling and examine the contribution from the sensor mobility in the cooperative WSN. Then, we propose a general framework for energy-efficient routing based on dynamic cluster selection strategy to achieve further improvement. Through numerical analysis, we demonstrate that the proposed model achieves significant energy efficiency if compared to the single hop communication.

pp. 148-152

10:00 Performance Evaluation of ideal Nearest Replica Routing (NRR) against several Forwarding Strategies on Named Data Networking(NDN)

Bambang Susilo, Marion Renaldo Rotinsulu and Riri Fitri Sari

Internet has become the primary need of the world community that led to a new era of sophisticated communication strategy. This enforces service provider to develop a new architecture and boosted wide range distribution of content. Named Data Networking (NDN) offers an alternative solution as the next generation internet architecture. In this paper, We do study the ideal Nearest Replica Routing (NRR) forwarding strategy against multiple forwarding strategies that exist in NDN by evaluating their performance against triple-play service with specific context. This evaluation run on NS3 and ndnSIM 2.0 on Ubuntu 14.04.5. The experiment results show that the ideal Nearest Replica Routing (NRR) strategy provides good performance in different experiment scenarios

pp. 153-158

#### 10:20 A Linearly Polarised Radial Line Slot Array Antenna with Reflection Cancelling Slots

Mst Nishat Yasmin Koli, Muhammad Usman Afzal, Karu Esselle, Raheel Maqsood Hashmi and Md Zahidul Islam

In this paper, a linearly polarised radial line slot array antenna (LP-RLSA) is presented for satellite communication. The antenna makes use of reflection cancelling slots to improve impedance matching. The antenna has highly directive radiation with a peak directivity of 37 dBi at 12.3 GHz. At this directivity, the antenna has very lower side lobe level of -23.1 dB and radiation efficiency greater than 96%. The designed LP-RLSA antenna has successfully overcome the inherent poor return loss performance through reflection cancelling slots.

pp. 159-161

### **PS-4B: PS-4B Power Engineering 3**

Room: Wynyard

Chair: Trevor Blackburn

#### 9:00 Development of a Compact-Sized Biodigester for Pig Manure and Organic Wastes with Raspberry Pi-Based Temperature, Pressure, and pH Level Monitoring

Michael Pacis, Glenn Magwili and Ronald Vincent M. Santiago

Nowadays, biogas is more necessary to use than fossil fuels because it is a renewable energy. To produce biogas, a biomass feedstock should undergo fermentation known as anaerobic digestion. The purpose of this study is to create a raspberry pi-based temperature, pressure and pH level monitoring in a compact sized digester based from pig manure and organic wastes. The outputs of pig manure and a mixture of pig manure and organic materials separately in a compact-sized biogas digester were compared. This project will only use a compact size or small-scale biodigester. The study was conducted by first calibrating the sensors in 100:0 ratio test of pig manure to organic wastes. The procedure was then followed by gathering the measured data from an LCD display in which the parameters were given by the monitoring system. The significance of the test was the temperature condition of the slurry. For all ratios, the temperatures measured are all in a mesophilic condition. This condition ranges from 20 to 45 centigrade. This is the condition where methanogenesis occurs. Based from the data and the presence of biogas, the best ratio of pig manure to organic materials for the first set is 75:25 and 85:15 for the second.

pp. 162-166

#### 9:20 A Classification of Single-Phase Transformerless Inverter Topologies for Photovoltaic Applications

Md Noman Habib Khan, Mojtaba Forouzesh, Yam Siwakoti, Li Li, Tamas Kerekes and Frede Blaabjerg

In Photovoltaic (PV) applications, a transformer is often used to provide galvanic isolation and voltage ratio transformations. However, a transformer based inverter is bulky and has high conduction losses, therefore lead to a reduction in the inverter efficiency. The transformerless inverter topologies are addressed widely to overcome the limitation of transformer based inverter topologies, but the main challenge of a transformerless inverter is common mode issue. This paper has presented a classification of various single-phase transformerless inverter topologies in two groups based on the applied DC input voltage (i.e., single and double PV voltage) to achieve 230 Vac output voltage at 50 Hz grid frequency. Furthermore, five subsections based on common mode behavior, voltage clamping and decoupling techniques have been demonstrated (i.e., common ground, mid-point clamping, AC-decoupling, DC-decoupling and AC+DC decoupling), and the presented topologies have been verified in PLECS software.

pp. 167-172

#### 9:40 Optimal Sizing and Siting of TCSC devices for multi-objective operation of power system using meta-heuristic seeker optimization algorithm

Ghamgeen Izat Rashed, Muhammed Shafik, Ragab A. Elsehiemy and Chen Kun

this research proposes an approach for the problem of thyristor-controlled series compensator (TCSC) equipment optimal allocation in a transmission system. TCSC devices help to increase the controllability of flow over the lines and at the same time enhance the system performance. So the TCSC is incorporated into the multi-objective problem of active power managing problem in addition to active and reactive power losses minimization and enhancing voltage profile while preserving total generation cost of system slightly affected compared to its single objective base case. A meta-

heuristic adaptive seeker optimization (SOA) algorithm is developed to efficiently find a good quality solution. However what extent the TCSC devices can brought out; it highly dependent on the location and parameter sitting of that device. There is no limit of TCSC that may be installed in the system as long as each one justifies its investment cost by a reduction on the overall generation costs and losses. The MATLAB toolbox, MATPOWER, is used to run the necessary routines in order to evaluate the objective function. MATPOWER also have MATLAP interior point solver (MIPS) that runs a linear optimal power flow so it is efficient and trusted tool to be compared with SOA. Also Differential evolution (DE) is compared with SOA in another case study. The proposed algorithm finds optimal solution for selection of the candidate lines for efficient location of TCSC devices that optimize the benefits that TCSC provide to the transmission systems and is tested over a IEEE 9-bus and a 14-bus test system obtaining satisfactory results.

#### 10:00 Optimal Overcurrent Relay Coordination of a Multi-loop Distribution Network with Distributed Generation Using Dual Simplex Algorithm

Michael Pacis, Rogelio Bersano, Jr. and Ronald Vincent M. Santiago

Optimizing the total time of the relay and the proper coordination of the relays on a multiloop power system is at utmost importance. In this paper, the researchers aimed to limit power outages in a power system by optimizing the relay setting. The researchers used the ETAP for the load flow and short circuit analysis. Also, to compute for the optimal relay setting, the Dual-Simplex Method was used and was coded in MATLAB. The incorporation of DG in the IEEE 14-bus system is compared with the results obtained without the DG. Results comparing the different ANSI/IEEE and IEC constants for standard overcurrent relays are performed in this paper. Also, the results shows almost the same results using the Genetic Algorithm and the Matlab toolbox.

pp. 89-93

#### 10:20 Implementation of Maintenance Program to the Generators of the Mindanao Grid using Reliability Centered Maintenance (RCM)

Rogelio Bersano, Jr., Rey Lagrada, Rovick Tarife, Michael Pacis and Ronald Vincent M. Santiago

The implementation of the Reliability-Centered Maintenance (RCM) to the generators of the Mindanao Grid can minimize the cost of maintenance by eliminating unnecessary preventive maintenances, thus can reduce the incidents of blackouts in Mindanao. Based on this ranking list of generator importance created, alternative maintenance schedules were created which considers the reliability of the system. The best alternative maintenance schedule to implement in the Mindanao Grid is determined using the criteria such as EENS and unreliability cost for lowest system risk; maintenance cost for lowest cost. The developed software was applied to six (6) maintenance schedule alternatives; four RCM-based, one Capacity-based and one Reserve-Levelizing approach. Among all alternative schedules, it was determined that the best maintenance schedule was the RCM-based alternative 2. This Alternative 2 schedule is according to the ranking list of generator importance where important generators were scheduled for maintenance annually or once every year in the lowest load levels, while less important generators are maintained tri-annually or once every three years. Maintenance schedule 2 successfully implemented the risk index EENS to reduce the overall total cost while enhancing the reliability of the overall system.

pp. 94-99

### PS-4C: PS-4C STEM Papers

Invited presentations

Room: Central

Chair: Pina Stoks

#### Thursday, July 5, 10:40 - 11:00 (Australia/Sydney)

#### B3: Break

#### Thursday, July 5, 11:00 - 11:30 (Australia/Sydney)

#### KN-3: Keynote 3

Co-clustering Analysis of Multidimensional Big Data

Prof. Hong Yan

Room: Central

**Thursday, July 5, 11:30 - 12:00 (Australia/Sydney)**

**KN-4: Keynote 4**

Building a quantum computer with phosphorus atom qubits in silicon

Sam Gorman

Room: Central

**Thursday, July 5, 12:00 - 12:45 (Australia/Sydney)**

**LP-2: Lunch and Poster Session**

Development of an Adaptive Pipe Inspection Robot with Rust Detection

Argel Bandala, Julianne Alyson I Diaz, Jose Martin Z Maningo and Manuel Ligeralde

In response to addressing the issue of pipe quality checking, the researchers developed an adaptive in-pipe inspection robot that is able to detect rust. The robot is traversed in a pipe network of horizontal, vertical, elbow, and tee type with diameters of 8, 10 and 12 inches for all. Hence, the test features the versatility, adaptability, and robustness of the robot. As for the leg expansion of the robot, it is inspired by the scissors mechanism that is achieved by using of linked, folding supports in a crisscross pattern. In this paper, the traversing of the robot was supported in both simulation and actual testing, wherein it yield a 97.2167% success rate on the site. Likewise, Rust Detection proved to be successful with its high percentage accuracy of 95%. Given the obtained data and results, the researchers were able to go beyond their target objective of 70%.

pp. 258-263

Supervising Vehicle Using Pattern Recognition: Detecting Unusual Behavior Using Machine Learning Algorithms

Mihodi Lushan, Manoshi Bhattacharjee, Tarem Ahmed, Muhammad Abdur Rahman and Supriyo Ahmed

Our lives are becoming busier day by day. We are consequently forced to delegate important activities to other people. In developing countries, the middle class often have paid drivers pick up their children from schools. What if the driver decides to deviate from the usual route into a seedy part of town with the child? What if it speeds and is driving recklessly? What if it gets into an accident? Supervising our vehicles when we are not present in it, and being notified if anyone else using it for any unwanted/illegal intention is of paramount importance. Alarms are annoying, and we want to improvise the system in a smarter way for smarter monitoring. The proposed system is developed by applying Linear Regression models, kth-Nearest-Neighbor and Support Vector Machine classifier to identify a pattern and detect abnormal behavior of the vehicle.

pp. 264-268

A Proposed The Internet of Things (IoT) Framework for Health Sector in Indonesia

Sri Ariyanti and Kautsarina Kautsarina

Today, Ministry of Health of Indonesia has not made a framework for telehealth system. As information technology in health area increased, it is very critical to establish a policy related to telehealth systems in Indonesia. The purpose of this research is to suggest the internet of things (IoT) framework for health sectors in Indonesia. The result of this research shows that IoT for health sectors in Indonesia pointed towards International Telecommunication Union (ITU) framework that consists of the Application layer, Service and Application Support and Layer, Network Layer, and Device Layer. IoT devices for health sectors in Indonesia are suggested to involve: Teleelectrocardiology (TeleECG), Teleultrasonography (TeleUSG), Teleradiology, Teleconsultation, and wearable blood pressure monitor devices for the next five years. Interoperability standard is using HL7 version 3, and DICOM (ISO 12052:2006). IoT sensors must be accordance with Ministerial Regulation of ICT No.34 of 2012 and minimum data rate for network connectivity is 512 kbps. The standard for wearable blood pressure monitoring device refers to IEEE 11073 Personal Health Device standard.

pp. 269-273

Feasibility of a single port flexible antenna array for energy harvesting from ambient sources

In this paper the performance of a single port antenna array is analysed for energy harvesting. Two types of feeds used to feed a flexible patch antenna array are compared. The array consists of 4 rectangular patch antennas made from conductive fabric and PDMS, which are flexible. The proposed array is for energy harvesting for wearable systems. Energy harvesting from ambient energy sources needs an antenna array for collecting a sufficient power level and for wearable applications the array materials must be flexible. For this reason, conductive fabric and PDMS are chosen for conductive and non-conductive parts of the array. However, the array can be fed from a single port signal or individual elements can be fed from simultaneous individual port signals. If the array with a single port has good electromagnetic performance then it is more useful for energy harvesting because it requires single rectifier, which will reduce microwave to dc conversion loss. In this paper these two types of feeding methods are compared with respect to array matching, peak gain and radiation performance. From this comparison we can observe the performance of single port array system for energy harvesting in wearable applications.

pp. 274-277

#### Wastewater Management: An IoT Approach

Adam Drenoyanis

Critical wastewater events such as sewer main blockages or overflows are often not detected until after the fact. These events can be costly, from both an environmental impact and monetary standpoint. By configuring and deploying a complete Low Power Wide Area Network (LPWAN), Shoalhaven Water (SW) now has the opportunity to create "Internet of Things" (IoT) capable devices that offer freedom from the reliance on mobile network providers, whilst avoiding congestion on the existing Supervisory Control and Data Acquisition (SCADA) telemetry backbone. This network infrastructure allows for devices capable of real-time monitoring to alert of any system failures, providing an effective tool to proactively capture the current state of the sewer network between the much larger sewer pumping stations (SPSs). This paper presents a novel solution to improve the current wastewater network management procedures employed by SW. Furthermore, a preliminary end device has been developed to solve associated problems with the current method of testing SPS pump performance, in terms of achieved flow rate, for quality control and quality assurance. Keywords—Wastewater, Internet of Things, LPWAN, LoRaWAN, Communications Survey

pp. 278-279

#### Smart Cold Chain Monitoring and Alert System for Vaccine Carrier

Benny Jackson, Arun Kumar, Darwin Raju, Lovelin P, Jerlin Priya and Padmanesan Narasimhan

This paper proposes a concept to solve the cold chain temperature instability present in a vaccine carrier. Vaccines transported from a healthcare centre are heat and light sensitive. On exposure to variant temperature and light there is a permanent damage to vaccines. In order to avoid the effects of temperature in vaccine, a lab-based real time internet monitoring and alert mechanism were tested. The device updates the temperature of the vaccine carrier through a graphical representation to the healthcare centre and the health care workers over the internet. The Proposed results show that real-time monitoring of vaccine temperatures via internet is feasible. Field based studies are conducted to validate the lab finding.

#### Innovative Design & Manufacturing Techniques for Cost Effective & Superior Performance Power Transformers

Ghulam Ahmad

The critical importance of power transformers in any power system can never be over emphasized. The transformer design and manufacturing techniques have remained more or less the same for almost 150 years. But in recent times continuous efforts to achieve energy efficiency and cost effectiveness without compromising the electrical performance of the system has compelled power engineers to move ahead from conventional transformer design and manufacturing techniques to next generation concepts thus achieving a balance of long term monetary savings and superior performance which was not possible a couple of decades ago. The aim of this research paper is to introduce new design and manufacturing techniques which are evolving to give rise of smarter use of new materials thereby changing the physical construction of traditional transformer. The paper also presents the practical advantages of the emerging designs and manufacturing techniques through theoretical design calculations and practical case studies.

#### Steganographic access protocol for online transactions

Sharon Lucas, Hanna Shaji, Remiya KA and Sheethal Heabel

Extended image Steganography system and Rubik's Cube Principle, a new scheme for online fraud transaction prevention is proposed here. As the user logs in, the system sends the user's details to the bank server for verification. Once the user's details have been verified by the bank an OTP is generated. This OTP which is converted into an image format is then encrypted using Rubik's Cube Principle. Image steganography is done on this encrypted image and it is then divided into two shares. One of these shares is automatically uploaded into the system. The other share is sent directly to the user via mail which the user uploads onto the system. Once this is done the two shares are combined, and de-steganography and decryption is done on it. This regenerates the OTP which is then validated against the original OTP generated. Once the validation is done the transaction is carried out successfully. This system that is combined with encryption based on rubik's cube principle can keep information secret. Secret image can be perfectly hidden in cover image. If somehow secret image is extracted, it would be hard to decrypt secret image due to confusion and diffusion properties of the encryption algorithm.

IoT based security system using PIR sensor and Wi-Fi promiscuous mode

Ravi Kishore Kodali

Having one or the other form of security system is a must as it acts as the first line of defence in case of any break-ins. Houses with no advanced security systems usually have a higher chance of being targeted than those which are installed with sophisticated security systems. The essential part of security is intruder detection system. Till date several solutions have been proposed which make use of PIR sensor and in most of them, the owner is notified every time the sensor detects a motion. This leads to several false alarms as it might not always be an intruder. The solution proposed in this paper aims to reduce this false alarm rate. The proposed solution leverages the human tendency to carry their mobile phones with them wherever ever they go and their habit to use the Internet services while being connected to the home access point rather than mobile data while at home. The security system uses a PIR sensor and is imparted with contextual/environmental awareness, which will let it take better decision as to when to notify the owner and hence reducing the false alarm rate. The contextual awareness of the system is possible due to the promiscuous mode of operation in ESP8266. The system scans for Wi-Fi packets and identifies the origin and destination MAC addresses of the devices communicating. The system then checks for the MAC address of the owner's phone to know his/her presence. Then it decides whether or not to notify the owner in case of any motion. The Instance of intrusion will also be logged in a SQL database.

**Thursday, July 5, 12:45 - 14:00 (Australia/Sydney)**

**WS-1: Workshop 1**

Entrepreneurship

Usman Iftikhar

Room: Central

A workshop for young professionals on how to start-up your own company or start-up

**Thursday, July 5, 14:00 - 15:15 (Australia/Sydney)**

**PA-2: Panel 2**

Trustmarks, Standards and Legislating the IoT

Narelle Clark

Room: Central

**Thursday, July 5, 15:15 - 15:30 (Australia/Sydney)**

**B4: Break**

**Thursday, July 5, 15:30 - 16:30 (Australia/Sydney)**

**PS-5A: PS-5A Electronics 2**

Room: Wynyard

3:30 Performance of SIMO Channel Tracking using Doppler Shift Information in Rician Fading

Irma Zakia

We consider recursive least-squares (RLS) channel tracking using Doppler shift information for single input multiple output (SIMO) systems. The communications is the downlink from a terrestrial or stratospheric platform to a mobile user with an assumed known Doppler shift of the line-of-sight (LOS) channel component. The channel is modeled as time-varying Rician flat fading with elevation dependent Rician factor. We evaluate the system performance in terms of tracking mean square error (MSE) and bit error error (BER). The performance gain of the system using Doppler information is more significant for moderate to high Rician factors or lower elevation angles.

pp. 185-189

### 3:50 Heterogeneous IoT mobility framework for mobile robot agents

Loberi Lopez-Estrada

Across the latest years many technologies have been proposed to sustain and deploy connectivity during the displacement of a robotic agent or device along a physical path, while resiliency and efficiency does not have to be decreased due to instability in the connection or connectivity loss. Technologies like Mobile IP v4 and v6, Hierarchical Mobile IP v6 (MIPv4, MIPv6/HMIPv6) are thought specifically for this matter. However, and after several years they are still maturing and they have not reached a widespread deployment, leaving the Mobility Problem (MP) still as an open research topic. The Internet of Things provide mobile agents or robots with the paradigms to achieve real-time functions; yet the barriers to overcome the MP are still to solve. Thus, this work is meant to offer a simpler, backward compatible solution thought for the present and future needs of mobile robots connected to the Internet. Based on Multipath-TCP over a Low Level Network Framework as our contribution. After experiments performed over a mobile robot under a non-dedicated communication environment (congested) proved efficiency in data delivery, bandwidth increase, an efficient fault tolerance and load balancing obtaining mobility fulfillment across the testing place.

pp. 1-6

### 4:10 Stabilization of Internal Dynamics Using Time Multiplexing of Inversion and Sliding Mode Control for High Boost Converter

Shiv Prakash

In this paper, a new approach to control and stabilize the output voltage and input ripple current of a high boost converter is discussed. This design technique multiplexes the inversion and sliding mode control to generate desired output tracking performance and to stabilize the unstable internal dynamics. The control method is implemented, analyzed and verified on MATLAB. Internal dynamics are stabilized using time division between the two kinds of control techniques i.e. Inversion and sliding mode. By defining appropriate exponential tracking trajectory and error surface, it is shown that even non minimum, non linear systems can also be stabilized by time multiplexing the inversion and sliding mode control.

pp. 190-195

## **PS-5B: PS-5B Healthcare**

Room: Central

Chair: Chris O'Neil

### 3:30 A Customized System to Assess Foot Plantar Pressure: A Case Study on Calloused and Normal Feet

Asanka Rathnayaka, Nipun D Perera, Herath Savindu, Chamara Madarasingha, Sandun Ranasinghe, Anjula C De Silva, Saroj Jayasinghe, Thusitha Kahaduwa, Pujitha Silva, Viduranga Thuduwege and Anuradha Kulathilaka

Foot plantar pressure monitoring is an important tool for biomechanical assessment of posture, foot complications due to callus formation and wounds, and sports applications. The pronounced cost associated with commercial plantar pressure monitoring systems and inflexibility of manipulating data in such systems prompts the development of low cost, versatile systems. This study focuses on development of such a system with high speed data acquisition which provides analysis tools for assessment plantar pressure variation of diabetic patients with calloused feet. The ultimate objective is to evaluate the feasibility of such a system in predicting diabetes related foot ulceration for early clinical intervention. The newly developed system is capable of achieving a frame rate of 155Hz which is ideal for pressure monitoring during walking and running. The system is employed to assess 10 normal subjects and 5 diabetic subjects with calluses on either foot. The results indicate significantly high mechanical stresses on skin beneath callus and postural disorders during standing, in subjects with calluses.

pp. 196-200

### 3:50 Evaluation of single HMM as a Pre-Impact Fall detector based on different input signals

Jie Kai Er and Wei Tech Ang

Accurate near-fall (pre-impact) detection has always been a goal of any fall prevention system. It allows for the early interception before an injury has been sustained by the user. This paper looks at the application of hidden Markov model (HMM) as a near-fall detector with different input signals from multiple IMUs. More input signals and post-processing may increase sensitivity but they also increase computation time and detection latency. This study aims to determine the simplest, fastest and most accurate HMM-based pre-impact fall detection algorithm. 5 IMUs placed at the torso, thighs and shanks are used for data collection. Multiple combinations of acceleration, gyroscope, orientation and quaternion are used as inputs to HMM, without any feature extraction or complex post-processing. Results show that the algorithm is capable of fall detection at about 200ms after fall initiation with 90% sensitivity and 92% precision. The best performing IMU placements are at the torso and thigh. In addition, the computational latency of this algorithm can be as fast as 0.45ms.

pp. 201-206

### 4:10 Posture Alert

Suhan Muppavaram, Nipoon Patel and Muhammad Nadeem

Desk-based office workers typically spend a high amount of time sitting in the chair every day and often in prolonged unbroken bouts. They do not always sit properly as they are not aware of sitting instructions and their sitting posture. Excessive time spent in wrong seating position is a major source of health problem and a leading cause of pathological degeneration of the vertebral disc. In this paper, we present a smart chair solution to remedy these problems by analyzing the sitting posture of the person and keeping him informed about his posture. The chair sends a real-time alert to the user whenever a wrong sitting posture is detected for a prolonged period of time resulting in posture improvement and reducing the risk of repetitive stress injuries (RSI) that introduces back pain. We offer a solution by applying the Internet of Things techniques to create an intelligent decision-making environment. By analyzing the pressure, we recognized different sitting postures. A real-time feedback is provided through an accompanying smart-phone application alerting the users to correct their body balance. The system also generates summaries of postures and the activities over a specified period of time. Finally, We conducted experiments to observe the response of the user's sitting posture to the alerting feedback. The experiments demonstrated a classification accuracy of around 95% and a significant reduction in the time spent in the wrong posture.

pp. 207-212

## PS-5C: PS-5C WebEx Session

Room: James

Chair: Bruce Poon

### 3:30 Talking Gloves: Low-Cost Gesture Recognition System for Sign Language Translation

Hina Shaheen and Tariq Mehmood

Sign language is used by speech and hearing-impaired persons to convey their message to other people. It consists of different sets of movements of fingers and hands. Each motion and bending of fingers has its own meaning. Often this sign language is not understood by everyone, which produces a communication gap. To bridge this gap, Talking Gloves are introduced. The system is based on sensor gloves which convert the sign language to speech. The gloves read the motion and orientation of both hands through Accelerometer and Flex sensors sewed within. All the sensors' data from both hands are multiplexed wirelessly through bluetooth. A respective sound file is played by the audio module upon matching the sensors' values of the gestures. When no sign is made, the system has the capability to switch to its sleeping mode which enables it to save the power. The system design uses a simple algorithm that directly maps gestures via lookup process, thus avoiding complex computations. The aim is to develop a portable, reliable and an inexpensive system. Therefore, the system uses less expensive electronics which are easily available in the local market, making the system affordable for everyone.

pp. 213-218

## Thursday, July 5, 18:30 - 22:00 (Australia/Sydney)

**Dinner: Conference Dinner Cruise**

FUSION dinner cruise  
King Street Wharf Bay 7  
5 July 2018 at 7:10pm

Don't be late. The boat won't wait.

## Friday, July 6

Friday, July 6, 09:00 - 10:40 (Australia/Sydney)

### Industry Day: IoT-1 IoT Workshop

Edward Farell

Room: Wynyard

### Industry Day: Power - 0 IoT and Asset Management in NSW Health

Mr Chris O'Neil

Room: Central

### PS-6A: PS-6A General 5

Room: James

9:00 Coverage Path Planning on Multi-depot, Fuel Constraint UAV Mission for Smart Farm Monitoring

Anton Louise P. De Ocampo, Argel Bandala and Elmer P. Dadios

Monitoring crops using UAVs flying higher than 6m capture telemetric data that provides information on the general condition of the plants in the field. But, in order to obtain specific information on the actual conditions of the plants based on individual morphological aspects, lower altitude monitoring, at most 3 meters, is required. Low-altitude missions cover less than high-altitude and requires UAVs to fly longer to cover more area. In this paper, an algorithm for multi-depot, fuel constrained coverage path planning is discussed. First, target coverage was segmented into smaller regions based on the number of available charging depots. Then, each region was further decomposed into multitude of cells with area equivalent to the camera FOV when UAV is flying at 3 meters above the field. All possible routes were generated and fed into evolutionary optimization in aim to identify the optimal path considering the fuel constraints and availability of recharging depots. The optimization yields a significant improvement in obtaining the route that will provide the minimum distance that the UAV should traverse to cover the entire Area-of-Interest. This approach proved to be useful for crop field monitoring using UAVs.

pp. 7-12

9:20 Potential of IoT System and Cloud Services for Predicting Agricultural Pests and Diseases

Materne Ntihemuka and Masahiro Inoue

Controlling the outbreaks of pests and diseases in agricultural environment, it is still a big challenge to the farmers due to the changing climatic conditions. In this paper we are proposing the alternative method of predicting occurrences of diseases in the plantation, by combining the advantage of IoT farmland monitoring system and Amazon Machine Learning cloud-based services to find hidden patterns into data. Logistic regression algorithm used to train our IoT collected dataset and classify the data with acceptable model quality score, to estimate the diseases forecasting based on sensing technology.

pp. 280-281

9:40 Reversible Data Hiding Based on the Random Distribution of Reference Pixels

Ravi Uyyala and Rajarshi Pal

A novel Prediction Error Expansion (PEE) based reversible data hiding scheme has been proposed in this paper. A set of reference pixels are randomly distributed throughout the image. Number of these reference pixels in a portion in the image is loosely proportional to the roughness of the portion. The prediction of a non-reference pixel is carried out as the weighted median of the reference pixel values within a local neighborhood of the non-reference pixel. The data is embedded in a nonreference pixel using an adaptive embedding strategy based on an estimate of the local complexity and the estimated prediction error. The experimental results show that the proposed method outperforms some of the existing methods in the literature.

pp. 225-230

Keisuke Utsu, Junki Saito and Osamu Uchida

Emoticons are frequently used in online communication. This study, which focuses on front-facing emoticons (Japanese style), proposes an easy method for estimating the sentiment polarity (positive, negative, or neutral) of emoticons by polarity scoring of characters that correspond with features of the emoticon (cheeks, eyes, or mouth). The polarity score is calculated based on the appearance probability of emoticon characters.

pp. 72-77

**Friday, July 6, 10:40 - 11:00 (Australia/Sydney)**

**B5: Break**

**Friday, July 6, 11:00 - 12:30 (Australia/Sydney)**

**KN-5: Keynote-5**

Future Development of the Electricity Supply System in Australia

Dr. Robert Barr

Room: Wynyard

**Friday, July 6, 11:00 - 11:45 (Australia/Sydney)**

**KN-6: Keynote 6**

Standards the Lifeblood of Local Industry and World Trade

Mr Ollencio D'Souza

Room: Central

**Friday, July 6, 11:45 - 12:30 (Australia/Sydney)**

**KN-7: Keynote 7**

IoT + Blockchain: Technologies, Challenges, and Applications

Prof. Ren Ping Liu

Room: Central

**Friday, July 6, 12:30 - 13:15 (Australia/Sydney)**

**LP-3: Lunch**

**Friday, July 6, 13:15 - 14:15 (Australia/Sydney)**

**Industry Day: IoT 2**

IEC61499 & IoT

Dr. John Ypsilantes

Room: Central

**Friday, July 6, 13:15 - 14:45 (Australia/Sydney)**

**Industry Day: Power 1**

Distributed Renewable Power in Microgrid

Prof. John Fletcher

Room: Wynyard

Chair: Trevor Blackburn

**Friday, July 6, 13:15 - 14:15 (Australia/Sydney)**

**PS-7: PS-7**

Room: James

**Friday, July 6, 14:15 - 15:00 (Australia/Sydney)**

**K-8N: Keynote 8**

To Be Advised

Prof. Eleanor Huntington

Room: Central

**Friday, July 6, 14:45 - 15:45 (Australia/Sydney)**

**Industry Day: Power 2**

Distributed Renewable Power Generation in Microgrids

Mr Craig Harrison

Room: Wynyard

**Friday, July 6, 15:00 - 15:45 (Australia/Sydney)**

**KN-9: Keynote 9**

IoT & Smart Audio - A Glimps to Consumer Electronics Industry Developments

Dr. Sharon Peng

Room: Central

**Friday, July 6, 15:45 - 16:00 (Australia/Sydney)**

**B6: Break**

**Friday, July 6, 16:00 - 17:00 (Australia/Sydney)**

**Industry Day: IoT 3**

IoT and Industry 4.0

Mr. Soumya Kanti Datta

Room: Central

**Industry Day: Power 3**

Distributed Renewable Power in Microgrid Part 3

Mr. Shibo Lu & Mr. Sirojan

Room: Wynyard

**PS-8A: PS-8A WebEx**

Room: James

4:00 Demystifying IEC 62368-1: Types of persons

Paul W Robinson

The product safety standard for electronic equipment IEC 62368-1 expands on the concept of various classes of persons to be protected. A new reader familiar with older standards, such as IEC 60950-1 and IEC 60065 which are to be replaced by IEC 62368-1, may not appreciate the distinction between the different classes of persons or how they differ from other standards. This paper introduces the concepts of types of persons described in IEC 62368-1 and expands on what the terms mean and how they apply.

pp. 288-292

**Friday, July 6, 17:00 - 17:25 (Australia/Sydney)**

**Awards: Best Paper Awards & Closing Ceremony**

Room: Central