Program

	Sunday, August 30	Monday, August 31	Tuesday, September 1	Wednesday, September 2
9:00 - 9:15			key-2: *Keynote Speaker 2*	KEY-4: *Keynote Speaker 4*
9:15 - 10:00		Key1: *Keynote Speaker 1*		
10:00 - 10:15				
10:15 - 10:30				
10:30 - 12:30	Tut-1: *Biosignal-driven Models for Improved Control* Tut-3: *Hybrid Microfluidic CMOS Sensing Platforms for Life Science Applications*	AI-2: *Applications of AI in Electrical and Computer Engineering* CN-1: *Communications and Networking* CSE-1: *Computer and Software Engineering* PANEL-1: *Smart Infrastructure and Services: Are We Ready?*	MCV-2: *Machine & Computer Vision* PANEL-3: *NSERC Updates & How to Apply for a Discovery Grant* PEES-2: *Power Electronics & Energy Systems* SE-1: *Sustainable Energy*	PEES-3: *Power Electronics & Energy Systems* S 2-H: *Future Trends and Emerging Technologies*
12:30 - 13:00				
13:00 - 13:30				
13:30 - 14:00				
14:00 - 15:00	AI-1: *Applications of AI in Electrical and Computer Engineering* BBA-1: *Bio engineering & Biomedical Apps* CDS-1: *Circuits, Devices, and Systems*	CN-2: *Communications and Networking* CR-1: *Control and Robotics* CSE-2: *Computer and Software Engineering* PANEL-2: *Technology Leadership Forum*	KEY-3: *Keynote Speaker 3*	P1: *Poster Session 1* P2: *Poster Session 2* P3: *Poster Session 3*
15:00 - 15:15				
15:15			CN-3: *Communications and Networking*	

- 15:30		
15:30 - 16:00		PANEL-4: *IEEE Women in Engineering*
16:00 - 17:00	MCV-1: *Machine & Computer Vision* PEES-1: *Power Electronics & Energy Systems*	S 1-I: *Future Trends and Emerging Technologies* STSP-1: *Signal Theory and Signal Processing*
17:00 - 17:15		

Sunday, August 30

Sunday, August 30 10:00 - 13:00

Tut-1: Biosignal-driven Models for Improved Control

Chair: Ana Luisa Trejos (Western University, Canada)

Tut-3: Hybrid Microfluidic CMOS Sensing Platforms for Life Science Applications

Chair: Sebastian Magierowski (York University, Canada)

Sunday, August 30 13:30 - 15:30

AI-1: Applications of AI in Electrical and Computer Engineering

Chair: Ahmed Shalaby (University of Louisville, USA)

13:30 Hybridizing UFO with Other ML Tools to Locate Faults by Just Knowing Relay Operating Times 

Ali R. Al-Roomi and Mohamed E. El-Hawary (Dalhousie University, Canada)

Universal functions originator (UFO) is a new machine learning (ML) tool that can find relationships between responses and predictors and then automatically formulate them as mathematical equations using the required number of analytic functions and arithmetic operators. Since it was introduced in the literature there is still an urgent question about whether it is worthwhile to hybridize it with other ML tools, such as linear regression (LR), nonlinear regression (NLR), support vector machine (SVM), and artificial neural network (ANN). This study is the first attempt to hybridize UFO, as a universal transformation unit (UTU), with the preceding ML tools. The goal here is to let UTU take care of the non-linearity issue of the dataset before being sent to other ML tools. These new hybrid computing systems are applied to locate three-phase (3ϕ) faults in an electric power network by utilizing the operating times measured from the two-end numerical directional overcurrent relays (DOCRs) of a faulty line. The results show that the hybrid approaches

are viable where their estimations are much better than those obtained by the classical ML tools. This study proves that the strong side of UFO can be integrated with others to have superior computing systems.

Presenter bio: Ali R. Al-Roomi received the B.Sc. degree in process instrumentation and control engineering and the M.Sc. degree (Hons.) in electrical engineering from the University of Bahrain, Sakheer, Bahrain, in 2006 and 2014, respectively. He received the Ph.D. degree (full GPA) in electric power systems engineering in 2020, Dalhousie University, Halifax, NS, Canada. In 2007, he was with Moore Control and Engineering (MCE) Middle East, Manama, Bahrain, as a Project Engineer. Then, he joined Yokogawa Middle East, Nuwaidrat, Bahrain, as a DCS Subsystem and Graphics Engineer. From 2008 to 2012, he was with Aluminum Bahrain B.S.C., Askar, Bahrain, as an Instrumentation and Control Maintenance Engineer in its power stations, in both generation and auxiliary sides. From 2013 to 2015, he was an Instrumentation, Control, and Protection Engineer with Riffa Power Station, Riffa, Bahrain. His current research interests include power operation, power protection, state estimation, smart grid, power system design and analysis, system realization and integration, load forecasting, machine learning, and meta-heuristic optimization algorithms.

pp. 1-6

13:48 EP-FPG Applied to RSSI-Based Wireless Indoor Localization 

Mengze Li and Thiago Eustaquio Alves de Oliveira (Lakehead University, Canada)

Wireless Localization based on Received Signal Strength Indication (WL-RSSI) consists of predicting the localization of a particular device given the radio signals it receives. WL-RSSI methods are suitable for specific scenarios where Global Positioning System (GPS) is unstable or unavailable, such as indoor localization. Developing more efficient WL-RSSI methods is necessary to supplement GPS localization in such applications. Feedforward neural network trained by hybrid Particle swarm optimization and Gravitational search algorithm (FPG) is an optimization strategy that aims at better exploring the network weight-space when compared to methods such as Backpropagation (BP). Feedforward neural network trained by hybrid Particle swarm optimization and Gravitational search algorithm (FPG) is a kind of machine learning model with better exploring ability in the solution search space compared with conventional neural network training methods such as Backpropagation (BP). This article investigates a method to solve the slow convergence problem of conventional FPG and further improve its performance. Extreme Learning Machines (ELMs) are used to pre-train initial particles of the FPG (EP-FPG). This article also presents the application of EP-FPG to classification and regression WL-RSSI problems. Experimental results demonstrate that the proposed EP-FPG performs better on WL-RSSI problems than conventional FPG and BP.

pp. 7-12

14:06 Speech Emotion Recognition Using Convolutional Recurrent Neural Networks and Spectrograms 

Mustafa Qamhan (King Saud University, Saudi Arabia); Ali H. Meftah (King Saud Universty & College of Computer and Information Sciences, Saudi Arabia); Sid-Ahmed Selouani (Université de Moncton, Campus de Shippagan, Canada); Yousef A Alotaibi and Mohammed Zakariah (King Saud University, Saudi Arabia); Yasser M Seddiq (King Abdulaziz City for Science and Technology (KACST) & King Saud University, Saudi Arabia)

In this study, a speech emotion recognition technique based on a deep learning neural network that uses the King Saud University Emotions' Arabic dataset is presented. The convolutional neural

network and long short-term memory (LSTM) are used to design the primary system of the convolutional recurrent neural network (CRNN). This study further investigates the use of linearly spaced spectrograms as inputs to the emotional speech recognizer. The performance of the CRNN system is compared with the results obtained through an experiment evaluating the human capability to perceive the emotion from speech. This human perceptual evaluation is considered as the baseline system. The overall CRNN system achieves 84.55% and 77.51% accuracies for file and segment levels, respectively. These values of accuracy are considerably close to the human emotion perception scores.
Presenter bio: Yousef A. Alotaibi was born on 1965 in Saudi Arabia and received his Ph.D. and MS degrees in computer engineering from Florida Institute of Technology, Melbourne, Florida, USA in 1997 and 1994, respectively. He received the B.Sc. degree in computer engineering from King Saud University in 1988. Currently Alotaibi is a full professor of Computer Engineering Department and the director of the Research Center, College of Computer and Information Sciences, King Saud University, Riyadh, Saudi Arabia. His research interests contain speech recognition, Arabic language processing, Arabic speech processing, artificial neural networks, speech corpora analysis, design, and evaluation, and speaker recognition.
pp. 13-17

14:24 Eucalyptus Volume Estimation for Eucalyptus Clones Trees Using Artificial Neural Networks 

Welington Galvão Rodrigues (Universidade Federal de Goiás, Brazil); Christian D. Cabacinha (Federal University of Minas Gerais, Brazil); Rogerio Salvini (Universidade Federal de Goiás, Brazil); Gabriel Vieira (Federal Institute Goiano, Brazil); Deborah S. A. Fernandes (Universidade Federal de Goias, Brazil); Fabrizzio Soares (Universidade Federal de Goiás, Brazil & Southern Oregon University, USA)
The forest inventory is an instrument of great importance for the healthy management of forest resources. Although It can be used in many applications, for example, to quantify trees or to identify the species of a settlement, the volume is one of the most critical elements for exploration of a specific area. However, it is very challenging to find methods that can accurately calculate the volume of trees without raising costs. Therefore, this study presents an approach with artificial neural networks for the prediction of diameters and calculation of the volume of eucalyptus clones. We proposed models that depend on or not the total height of the tree, which is a measure expensive to obtain in the field. A result shows our proposed methods are up-and-coming to the traditional techniques, besides reduce the total features used for the volume estimation and can support forest inventory automation.
Presenter bio: Associate Professor at Southern Oregon University (SOU) and Informatics Institute at the University of Goiás (UFG). Ph.D. in Electrical Engineering, MSc in Electrical and Computing Engineering, Graduated two programs: Computer Science and Data Processing. He works with Machine Learning, Image Processing, Computer Vision, Human-Computer Interaction, and Applied Computing. Nowadays, he is Computer Science Chair at SOU and advises Ph.D., Mastering, and Undergrad Students at UFG.
pp. 18-22

14:42 Computational Intelligence Platform for Hydrothermal Power System Auction Models 

Fabiano S Carvalho (Universidade Federal de Goiás, Brazil); Juliana Félix (Universidade Federal

de Goiás, USA); Gelson Cruz Jr. (Universidade Federal de Goiás, Brazil); Fabrizzio Soares (Universidade Federal de Goiás, Brazil & Southern Oregon University, USA)
This paper describes the elaboration of a computational environment that allows the comparison between the centralized model of planning and auction models for the operation of hydrothermal power systems. This environment will be used to add computational intelligence methods to the strategies of the agents (hydroelectric, thermoelectric, distributors) in the auction environment and later enable the verification of market behavior regarding energy price and the risk of deficit in periods low river inflow.
pp. 23-28

15:00 Parkinson's Tremor Onset Detection and Active Tremor Classification Using a Multilayer Perceptron 

Anas Ibrahim and Yue Zhou (Western University, Canada); Mary Jenkins (London Health Sciences Centre, Canada); Michael D Naish and Ana Luisa Trejos (Western University, Canada)
The study of the characteristics and behaviour of tremor for people suffering from Parkinson's disease (PD) is an important first step in developing a new method to predict future tremor signals, their onset and the active tremor instances. The current approaches to detect tremor are limited to tremor estimators that rely on simple tremor models, or on deep brain probing that is invasive in nature. Thus, a new method that is noninvasive and that can capture tremor complexity to predict when tremor is active is needed. In this work, a new approach is presented using neural networks (NNs) and inertial measurement units (IMUs) to predict tremor onset and classify the active tremor instances in the wrist and metacarpophalangeal (MCP) joints of the index finger and thumb. The developed model showed an accuracy of 92.9% in predicting and detecting tremor onset, and therefore can be considered a reliable tool that has the potential to be integrated with wearable assistive devices for suppressing tremor.
pp. 29-32

15:18 Gaussian Process Regression Based Model for Prediction of Discharge Voltage of Air Gaps Under Positive Polarity Lightning Impulse Voltages 

Vidya M S and Sunitha K. (National Institute of Technology Calicut, India); Deepa Kumar (College of Engineering Trivandrum & Powergrid Corporation of India Ltd, India); Deepak Mishra (IIST, India); Ashok S (NIT Calicut, Kerala, India)
Discharge voltage of insulation is pivotal in the design of High Voltage systems. In this work, a machine learning algorithm is used to develop a model to predict the discharge characteristics of air. Finite Element Method (FEM) simulations have been performed to extract different electric field and energy features of air gaps in the range 5mm-40mm under lightning impulses of positive polarity. While developing the model, these features along with gap lengths are considered. The features have been used for training a machine learning algorithm based on Gaussian Process Regression (GPR) to develop the model. The results obtained from the model are validated with measured experimental data. A good comparison between the predicted data and the measured data establishes the accuracy of the predicted model. The proposed methodology is compared using different kernel functions.
pp. 33-38

15:36 Predicting the Demand in Bitcoin Using Data Charts: A Convolutional Neural Networks

Prediction Model 

Ahmed Fakhri Ibrahim (University of Waterloo, Canada); Liam Corrigan (IVEY Business School & Pharmacy Diagnostics and Care Inc, Canada); Rasha Kashef (Ryerson University, Canada)

Traditional time series modeling techniques emphasize on predicting cryptocurrencies using classically structured data representation as numerical features to present the time-series datasets. In this paper, a novel approach to analyze time-series data charts using a modified Convolutional Neural Networks (CNNs) is proposed. The CNNs have been adopted to recognize subtle and undetectable patterns within images of timeseries data charts. Our approach has been proven to achieve significant results, suggesting a need for further research into this new method for time series modeling, especially for Bitcoin.

pp. 39-42

BBA-1: Bio engineering & Biomedical Apps

Chair: Fahmi Khalifa (University of Louisville, USA)

13:30 Agent-Based Model of Cell Signaling in Cancer 

Youcef Derbal (Ryerson University, Canada)

Cancer is a genetic disease whose growth and proliferation is driven by the dysregulation of cell signaling and an aberrant metabolism. A better understanding of signaling dysregulation dynamics in cancer cells would inform the development of more effective therapies. In this respect, an agent-based model of cellular pathways is developed to study the dynamics of the cell signaling circuit in closed loop with cell metabolism. The model focuses on signaling pathways that involve frequently altered cancer genes. This would support explorations of therapeutic strategies aimed at derailing cancer proliferation through disruptions of major oncogenic pathways.

pp. 43-46

13:48 Extraction of Fetal ECG Signal with Ectopic Beats Using Blind Source Separation Based Null Space Approach 

Luay Yassin Taha (University of Windsor & Electrical and Computer Engineering, Canada); Esam Abdel-Raheem (University of Windsor, Canada)

The aim of this paper is to apply blind source separation (BSS) to extract fetal electrocardiogram (FECG) signal with ectopic beat. We use a novel deterministic BSS algorithm type null space transformation matrix (NSITM). The ECG signals are used to compute the ITM. Then, the FECG signal and maternal ECG (MECG) signals are extracted from the null space of the ITM. Results from Physionet synthesized ECG data show considerable improvement in extraction performance (quality signal-to-noise ratio qSNR and correlation r) over other algorithms used in this work, when the fetal-to-maternal signal-to-noise ratio (fmSNR) increases from $-$30 dB to 0 dB. Using the NSITM algorithm, the maximum values of qSNR and r are 5.95 dB and 0.871, respectively, when fmSNR is equal to 0 dB. The minimum values of qSNR and r are 2.27 dB and 0.726, respectively, when fmSNR is equal to $-$30 dB. The study demonstrates that the BSS type NSITM is a feasible algorithm for extracting FECG signals for subjects with ectopic beats.

Presenter bio: Esam Abdel-Raheem received his Ph.D. degree from the University of Victoria, Canada in 1995, in Electrical Engineering. Since 2003, he has been with the ECE Dept. at the

University of Windsor, Ontario, Canada, where he is currently a Professor. Dr. Abdel-Raheem's research fields of interests are in Spectrum Signal for Cognitive Radio Retworks, Biomedical Signal processing, Digital Signal/Image Processing, Signal Processing for Communications, and VLSI Signal Processing. He has authored and co-authored more than 100 refereed journal and conference papers, and one published U.S./world patent. He is a senior member of the IEEE and a member of the Association of Professional Engineers of Ontario.
pp. 47-50

14:06 Automatic QRS Detection and Segmentation Using Short Time Fourier Transform and Feature Fusion

Abdullah Biran (McMasterUniversity, Canada & King Faisal University, Saudi Arabia); Aleksandar Jeremic (McMaster University, Canada)
QRS detection from an electrocardiogram (ECG) is potentially useful tool in many applications such as diagnosing cardiac diseases, bio-identification, bio-encryption, etc. In this paper, we present an automated algorithm for detecting QRS waves and segmenting ECG signal into separate beats using short time Fourier transform (STFT) and multi-channel ECG feature-based classification. We test the performance of our algorithm using ECG signals of 62 subjects from the ECG ID public database. The results show that our method is capable of extracting QRS waves with 99.45% average QRS segmentation accuracy.
pp. 51-54

14:24 Explainable Deep Learning for Referable Diabetic Retinopathy

Mohamed Chetoui and Andy Couturier (Université de Moncton, Canada); Moulay A. Akhloufi (University of Moncton & University Laval, Canada)
Diabetic Retinopathy (DR) is a retinal lesion due to diabetes. Through blood leaks and excess glucose in the blood vessels, pathological lesions including hemorrhages, exudates and microaneurysms (HM, EX, MA) develop in the eye, which may lead to blindness if not timely treated. In this paper, we propose a deep Convolutional Neural Network (CNN) architecture trained to identify Referable Diabetic Retinopathy (RDR) lesions from retinal fundus images. The model uses a pre-trained network with fine-tuned layers, cosine learning rate decay, and warm up. The efficiency of the proposed architecture has been evaluated on eight public datasets. The results show that the proposed architecture obtains state-of-the-art performance using only publicly available datasets. An explainability algorithm was also developed to show the efficiency of the model in detecting RDR signs.
Presenter bio: Andy Couturier received a B.Sc.A. degree in computer science in 2015, a B.Sc. in mathematics in 2017, and a M.Sc. in computer science in 2019 from Université de Moncton, Canada. He is currently a Ph.D. candidate in applied science at Université de Moncton, Canada. His interests include computer vision, deep learning, unmanned aerial vehicles, and computationally efficient algorithm for robotic applications.
pp. 55-58

14:42 Determination of SWIR Features for Noninvasive Glucose Monitoring Using Machine Learning

Khoa H. D. Nguyen, Anh Dinh and Francis M. Bui (University of Saskatchewan, Canada)

The use of infrared (IR) light for noninvasive glucose monitoring is a potential solution to reduce infection-related mortality rate for diabetic patients. However, IR spans a wide band and the relevant wavelengths need to be chosen. This paper presents an automated and computationally efficient model, capable of examining a large number of wavelengths, to determine the suitable ones for monitoring, based on feature selection and other machine learning techniques. The study examined wavelengths from 1300-2600nm which cover the majority of short-wave infrared (SWIR) band. For reliable ground truth, two datasets, D1 and D2, were used with 100 observations and 1000 observations respectively. In term of optimal performance with limited time and computational resources, Sequential Forward Floating Selection (SFFS) technique was chosen as a core feature selection algorithm due to its high accuracy and reasonable speed. Classifiers based on Support Vector Machine (SVM) were used to evaluate the performance of selected wavelengths. Principal Component Analysis (PCA) was used to enhance the accuracy. Pipeline and nested cross-validation techniques were adopted to prevent information leakage and biased results. The proposed approach managed to reduce the number of wavelengths by 65% for D1 and 58% for D2 while achieving accuracy and f1 score above 90%, which are 10% higher compared to other work in the literature. The feature selection results also suggest that suitable wavelengths fall in the range 1600-2600 nm.
pp. 59-62

15:00 General Framework for Multi-Classification of EEG Signals Based on Multi-Scale Properties 

Salim Lahmiri (Concordia University, Canada)
Numerous computer automated diagnosis (CAD) systems have been proposed to detect epilepsy in electroencephalogram (EEG) signals. The aim of this paper is to look at multi-scaling properties obtained by multi-scale analysis (MSA) as main distinctive features to simultaneously distinguish between all categories of EEG signals that compose the popular database hosted by the department of epileptology, University of Bonn, Germany. Particularly, multi-scale analysis is employed to capture long-range properties of the EEG signal at different scales used to represent its short and long variations. Then, the obtained multi-scale properties are used to train four different classifiers; namely, k-nearest neighbor (k-NN), linear discriminant analysis (LDA), naïve Bayes (NB), and the support vector machine (SVM). Experimental results based on ten-fold cross-validation method show that each single classifier achieves 100% accuracy. In this respect, multi-scale properties are found to be effective as they outperformed existing works on the same database by achieving perfect accuracy to distinguish between all five distinct EEG categories. Overall, the obtained results are promising.
pp. 63-66

15:18 Explainable AI in Decision Support Systems A Case Study: Predicting Hospital Readmission Within 30 Days of Discharge 

Alexander Vucenovic (Erie St. Clair Local Health Integration Network, Canada); Osama Ali (University of Western Ontario, Canada); Clifford Ekwempe and Ozgur Eren (Erie St. Clair Local Health Integration Network, Canada)
Explainable models are a critical requirement for predictive analytics applications in the healthcare domain. In this work we develop a hypothetical clinical decision support system for the classification task of predicting hospital readmission within 30 days of discharge. We compare a baseline logistic regression model with an implementation of the coordinate descent algorithm

known as lasso. We choose lasso because it inherently performs variable selection during optimization which leads to an explainable model. Using model evaluation data we achieve an area under the ROC curve score of 0.795 improving on the baseline score of 0.683 without inflating the feature space.
pp. 67-70

CDS-1: Circuits, Devices, and Systems

Chair: Ebrahim Ghafar- Zadeh (York university, Canada)

13:30 Stagger Tuning for BW Extension in Transimpedance Amplifiers
Omidreza Ghasemi (Concordia University, Canada)
This article explains Stagger tuning of two stage TIA. The method reduces effect of capacitances of the transistor. The process of stagger tuning has been shown using zero-pole analysis. The feasibility of the method is confirmed using CMOS technology (i.e. 90nm). 3-dB bandwidths of 40GHz when using 50fF PD capacitance and 5fF load with consumption of 4.4mW can be achieved.
pp. 71-74

13:48 Placement with Sequence-Pair-Driven TCG for Advanced Analog Constraints
Lian He and Zhenxin Zhao (Memorial University, Canada); Yuanzhu Chen and Lihong Zhang (Memorial University of Newfoundland, Canada)
Although demand for analog integrated circuits (ICs) keeps increasing in a broad range of emerging IoT applications along with technology advancement, analog layout automation still largely lags behind the modern digital counterpart due to high complexity in analog design. In this paper, we propose a sequence-pair (SP) driven transitive-closure-graph (TCG) method to effectively and efficiently deal with analog placement, which is an indispensable stage in the analog IC layout design. Besides discussing the promising advantages of the proposed method in handling advanced analog constraints, this paper is mainly focused on the algorithmic complexity reduction while satisfying symmetry constraints. Our theoretical analysis and experimental results demonstrate the efficacy of the proposed method.
pp. 75-78

14:06 An Energy Harvesting Solution for IoT Devices in 5G Networks
Maryam Eshaghi and Rashid Rashidzadeh (University of Windsor, Canada)
Internet of Things (IoT) and IoT applications will experience significant growth as the fifth-generation (5G) of wireless technology matures and becomes more widely adopted. How to power on billions of low power wireless IoT devices has initiated a new interest in energy harvesting. The 5G technology will open new opportunities to design circuits to efficiently extract energy from millimeter waves to power on IoT devices. In this paper, an energy harvesting circuit is designed and simulated using Advanced Design System (ADS) which is compatible with 5G technology. A microstrip patch antenna with -17.35 dB return loss at 11.02 GHz is designed and implemented. A rectifier using a Schottky diode is also designed to operate at high frequencies. Simulation results indicate that the proposed solution can extract energy from incoming waves at 11.02 GHz and generate 1.18 V across an IoT sensor with an efficiency of 87%.

pp. 79-82

14:24 Performance Analysis of Squarely Packed Dimorphic MWCNT Bundle for High Speed VLSI Interconnect

Abu Bony Amin (Florida Polytechnic University, USA); Muhammad Sana Ullah (Florida Polytechnic University & University of Missouri-Kansas City, USA)

According to the demand of present era, carbon nanotubes are getting closer attention as VLSI high speed interconnects. This consequence drives us to conduct our research on the performance evaluation of different configurations of MWCNT bundle as interconnect based on the propagation delay estimation. Throughout this paper, we are going to introduce a new configuration model, named Squarely packed Dimorphic MWCNT, develop mathematical model for different circuit elements i.e. Resistance, Capacitance and Inductance. Finally, we divulge the squarely packed bundle of dimorphic MWCNT configuration as the most thriving one in terms of propagation delay for intermediate and global level interconnect length by simulating different configurations and different interconnect materials using MATLAB for 16 nm, 22 nm and 32 nm technology nodes.

pp. 83-88

14:42 Learning-Based Reconfigurable Cache for Heterogeneous Chip Multiprocessors

Furat Al-Obaidy, Arghavan Asad and Farah Mohammadi (Ryerson University, Canada)

In this work, a new energy-efficient reconfigurable cache architecture for chip multiprocessors is proposed. We formulate the reconfiguration problem based on using a machine learning technique. The proposed approach predicts the latency of the last-level cache in the next interval and then detects the type of it at runtime. This work provides a new approach that uses a neural network algorithm to reconfigure cache components. Experimental results show that the proposed design improves energy consumption of a three-dimensional chip multiprocessor with 16 cores by about 45% and performance by about 13% in compared to non-reconfigurable baselines.

pp. 89-93

15:00 Low Power Data Acquisition System for Noise Pollution Monitoring

Mark Lipski, Matthew D James, Petros Spachos and Stefano Gregori (University of Guelph, Canada)

Low-power data-acquisition systems are instrumental in meeting the growing demand for Internet-of-things applications. Activity-aware wake-up circuits reduce power consumption by detecting activity in the analog domain and intelligently feeding that information to digital control systems. This paper investigates implementations of low-power audio systems with activity-aware wake-up and discrete components. Experiments are run to demonstrate the functionality of the wake-up function and estimate the power savings.

pp. 94-97

Sunday, August 30 16:00 - 17:00

MCV-1: Machine & Computer Vision

Chair: Radwa Sultan (Manhattan College, USA)

16:00 Real-time Road Cracks Detection Based on Improved Deep Convolutional Neural Network

Syed Ali Hassan, SeungHeon Han and Soo Young Shin (Kumoh National Institute of Technology, Korea (South))

This paper presents road cracks detection implementation to help the road inspectors to easily identify damages on the road. Sometimes due to earthquake cracks appears on the road and identification of damages on the road is required. Identifying road cracks manually during the inspection is a tedious and difficult task. The formation of own data set is a time-consuming and laborious task. Own created data set is labelled with the improvements in the YOLOv3 tiny is finished and compared to better detect the cracks on the road. Both models performance is benchmarked in respect of accuracy and MAP (mean average precision). It is observed in testing phase, the improved tiny version of YOLO performed better in terms of MAP and accuracy. This road cracks detection system can be implemented in UAV or vehicle to detect road cracks using camera vision in Real-Time for the inspection of road.

Presenter bio: I am a student of Msc I.T(Convergence Engineering) studying in Kumoh National Institute of Technology South Korea. I have completed my graduation BS (Software Engineering) from Mohammad Ali Jinnah University Pakistan on December 2016 and i have two years of working experience as an Augmented reality mobile application Developer.

pp. 98-101

16:18 Multimodality Weight and Score Fusion for SLAM

Thangarajah Akilan (University of Windsor, Canada); Edna Johnson, Gaurav Taluja, Japneet Sandhu and Ritika Chadha (University of Lakehead, Canada)

Simultaneous localization and mapping (SLAM) is used to predict the trajectory by the Autonomous Navigation Robots (ANR), for instance a Self-Driving Cars (SDC). It computes the trajectory by sensing the surroundings, like visual perception of the environment. This work focuses on the performance improvements of a SLAM model using multimodal learning: (i). early fusion via layer weight enhancement of feature extractor, and (ii). late fusion via score refinement of the trajectory (pose) regressor. The comparative analysis on Apolloscape dataset shows that the proposed fusion strategies improve the localization performance significantly. This work also evaluates applicability of various Deep Convolutional Neural Networks (DCNNs) for SLAM.

pp. 102-105

16:36 Implementation Simple Fitting System Using Image Recognition for Portable Device

Hsin-Yu Huang, Yong-Yi Fanjiang, Ting Hsuan Lee, Chia An Lee, Tzu Min Zhang and Wei De Li (Fu Jen Catholic University, Taiwan)

Most fitting systems have to rebuild the 2D or 3D clothes or human body models, but only few manufacturers spend time and cost to re-draw these virtual models. And most fitting systems also deployed base on PC. This study proposes to implement simple fitting system for portable device that deployed in an embedded system with a touch panel, light and a build-in camera. Users can search to their favorite websites to select the desired clothes, and use the built-in camera to take portrait photo or to select the preset user image that has been stored inside the system. In the system processes images without need for an external processing unit based on embedded system. The requirements of image capturing, target detection, allocate target position, and implementing based as embedded system on the programming language with image recognition library. User can

immediately see the image of the selected clothes worn on them. This makes it easily to view the dressing photo of favorite the clothes from the website, so that users can choose clothes quickly and easily.
pp. 106-110

16:54 CloudMach: Cloud Computing Application Performance Improvement Through Machine Learning 

Mohamed Abu Sharkh, Yong Xu and Eric Leyder (Ferris State University, USA)
Cloud computing is rapidly becoming the standard through which enterprises of all sizes fulfill their computing infrastructure demands. This work aims at exploring the impact that Machine Learning algorithms can have on Cloud application behavior profiling and prediction. Although Classic machine learning algorithms have been used in Cloud Computing context before, cutting-edge algorithms like deep learning (DL) and reinforcement learning (RL) are yet to be convincingly exploited for this specific problem. Despite being a revelation with fields like image processing and speech recognition, these algorithms (deep neural networks for instance) face adoption challenges outside certain topics. There is a high demand for timely research work that dissects these algorithms and develops novel techniques to facilitate seamless adoption for Cloud providers and clients. In this work, we will evaluate the efficiency of machine learning algorithms in the Cloud context by applying them to a large scale application resource utilization dataset (TU Delft Bitbrains traces). The objective is to design a Cloud application behavior prediction technique based on machine learning predictors. Any improvement on prediction precision has direct impact on key performance indicators for both Cloud providers and Cloud tenants/clients. Experimental results show the potential of our approach to improve Cloud resource scheduling in a Cloud data center.
pp. 111-116

17:12 A Cloud-Based Architecture for Automated Grading of Computer-Aided Design Student Work Using Deep Learning 

Maysa Faroun Khaleel (Jordan University of Science and Technology, Jordan); Mohamed Abu Sharkh (Ferris State University, USA); Mohamad Kalil (IBM, Canada)
The practical benefits of deep convolutional networks are increasingly proven by successful implementations of deep learning models in various image processing applications. A model is proposed to evaluate the realize the benefits of Deep Convolutional Neural Networks to grade computer aided student drawings. Such model would assist in full automating the educators task or serving as a decision support system. Given the shared fundamental skills at least for fundamental drawing skills, the model has the potential to be used as Cloud service to be utilized by various distributed users. This would only serve to support and improve the model's performance given the additional training it could provide. A cloud Software as a service (SaaS) architecture is introduced. The Machine learning neural network model for the image recognition problem is introduced and evaluated. Experimental results using student drawings prove the potential this model has to solve the problem and automatically generate accurate grades for the computer aided designs.
pp. 117-121

PEES-1: Power Electronics & Energy Systems

Chair: Adeel Sabir (Western University, Canada)

16:00 Fault Detection and Localization in a Ring Bus DC Microgrid Using Current Derivatives

Yunfei Bai and Athula Rajapakse (University of Manitoba, Canada)

To provide more clean energy and satisfy the increasing power demand, microgrids using renewable energy sources (RES) are designed as additional power supplies. Recently, DC microgrids (DCMGs) have gained the attention for their higher power efficiency and simpler configuration compared to AC microgrids (ACMGs). Although DCMGs seem better than ACMGs, lack of protection standard is a critical problem when operating DCMGs. Since DC fault response is completely different as AC fault, AC protection methods cannot be used for DCMGs. In this paper, a ring bus DCMG model is simulated using computer software PSCAD. A combined protection scheme based on cable current derivatives is introduced. This protection scheme not only detects and localizes low resistance DC faults very fast, but also accurately handles high resistance DC faults. The reliability of this scheme is proved by the simulation results.

pp. 122-127

16:18 Grid-Connected Low-Voltage Power Supply to Equipment on Transmission Line Structures

Hamed Ahmadi (BC Hydro & University of British Columbia, Canada); Mazana Armstrong (Powertech Labs Inc, Canada)

Electrical equipment installed on high-voltage (HV) transmission structures may require low-voltage (LV) electrical supply from the distribution network. For example, cell sites for communication antennas and warning lights are the most common applications in BC Hydro's system. Bringing the LV supply to the HV structures introduces a number of electrical concerns. The first concern is the transfer of ground potential rise (GPR) from the HV system to the LV system during a ground fault on the transmission structure. The second concern is the induction in the LV system due to the proximity to the HV transmission line. In addition, there could be system impacts that require special attention, such as reduction in circuit-to-circuit separation in multiple-circuit corridors, pole fire on the LV wood poles, etc. This paper discusses technical solutions to mitigate the identified concerns and system impacts. Amongst the possible recommendations, addition of appropriately rated isolation transformers to the LV feeder and improving the electrical grounding on the HV transmission structure are shown to be the most effective methods for preventing the transfer of hazardous potentials to the customers connected to the same LV feeder. The proposed isolation circuit has been tested in a HV laboratory to confirm its effectiveness.

pp. 128-134

16:36 Artificial Neural Network Based Improved Modulation Strategy for GaN-based Inverter in EV

Soumava Bhattacharjee, Sukanta Halder and Animesh Kundu (University of Windsor, Canada); Lakshmi Varaha Iyer (Magna International Inc., USA); Narayan Kar (University of Windsor, Canada)

Wide-bandgap (WBG) device based high-frequency inverters using Gallium Nitride (GaN) switches

are gaining significant research attention in the field of electric vehicles (EVs) due to their potential to operate at higher switching frequencies with improved efficiency as compared to the available power devices. However, the computation time of the control algorithm plays a significant role in the effective control and operation of such high-frequency converters. This paper presents an advanced artificial neural network (ANN) based improved space vector pulse width modulation (SVPWM) control for Gallium Nitride based inverter in EV application. The proposed neural-network (NN) based control technique has two core objectives: the first objective is to overcome the processing speed of the complex algorithm during high switching frequency operation and hence reduce the computation time which is the major challenge in WBG device-based inverter control. The second objective is to minimize the GaN inverter switching losses and to improve the overall performance of the inverter. The NN based SVPWM is trained using the reference voltage to get the modulated signal for pulse generation, thereby reducing the computation time and improving the performance of the inverter. The proposed ANN-based improved switching strategy has been validated experimentally using a GaN inverter and a comparative performance analysis with a conventional SVPWM technique is presented in this paper.
pp. 135-138

16:54 Understanding Cyber-physical Resilience from A Power System Perspective
Nancy Mohamed and Magdy Salama (University of Waterloo, Canada)
Resilience, as a concept, has been recently become a strategic objective for power grids. However, there are still some conceptual unclarities. Resilience is often mistakenly used as a synonym for reliability. A power system can be reliable but not resilient. This paper clarifies this misconception. It discusses resilience definitions, cycle, and states to better understand resilience aspects. It also discusses power grids' new vulnerabilities and sheds the light on both cyber-physical resilience and cyber contingency concepts. Finally, it reviews the strategies used to enhance grid resilience.
pp. 139-143

Monday, August 31

Monday, August 31 9:15 - 10:15

Key1: Keynote Speaker 1

Monday, August 31 10:30 - 12:30

AI-2: Applications of AI in Electrical and Computer Engineering

Chair: Fahmi Khalifa (University of Louisville, USA)

10:30 A New Statistical Method for Anomaly Detection in Distributed Systems
Bamdad Vafaie (UOIT, Canada); Mahbobe Shamsi (Supervisor, Iran); Morteza Javan (Amirkabir University of Technology, Iran); Khalil El-Khatib (University of Ontario Institute of Technology, Canada)
Distributed computing systems are increasing in popularity and being widely used as a new way of large-scale data processing. However, to achieve a reliable and efficient performance in a

distributed environment, it is important to deal with system anomalies as soon as they are encountered. In this paper, two novel anomaly detection algorithms will be introduced as well as compared with previous anomaly detection algorithms. These introduced algorithms are devised based on data summarization and error prediction in comparison with previously extracted data. The result of our experiments show that the proposed methods exhibit higher performance in terms of precision and accuracy.
pp. 144-147

10:48 ANN-Supervised Interface System for Microturbine Distributed Generator 

M. Hamouda (University of Waterloo, Canada); Mostafa I. Marei (Ain Shams University & Faculty of Engineering, Egypt); Mohmmed Nassar and Magdy Salama (University of Waterloo, Canada)
Distributed generators based on Micro-turbine Generators (MTGs) are used widely for their proven advantages e.g. flexibility, Compatibility, low emissions…etc. This paper presents a novel interface system based on an artificial neural network (ANN) for the MTGs. The proposed interface system can identify and adapt itself to the operation mode of the system i.e. grid-connected, islanded, or fault modes. The ANN system is integrated with a back-to-back voltage source converter (VSC) interface to control MTGs in different operation modes.
pp. 148-152

11:06 Self-learning for Day-night Mode Energy Strategy for Solar Powered Environmental WSN Nodes 

Michal Prauzek (VSB - Technical Universty of Ostrava, Czech Republic); Jaromir Konecny and Jakub Hlavica (VSB - Technical University of Ostrava, Czech Republic); Petr Musilek (University of Alberta, Canada)
Environmental data is in many cases acquired in remote locations that are are difficult to access for sensor maintenance. Therefore, efficient use of available energy is key, particularly in systems that feature energy harvesting subsystems, such as solar panels. This study presents energy strategy implemented in an environmental wireless sensor network (EWSN) controller which employs model-free Q-learning algorithm at day times and linear energy discharging at night times. Three-component Q-learning reward signal along with 7 actions and 11 energy states are designed for the system to achieve optimal operation in terms of data sensing and transmission cycles and to minimize amount of failures due to depleted energy storage.
pp. 153-157

11:24 Ensemble-based Feature Selection and Classification Model for DNS Typo-squatting Detection 

Abdallah Moubayed (University of Western Ontario, Canada); Emad Ali Aqeeli (Yanbu University College & Royal Commission in Yanbu, Saudi Arabia); Abdallah Shami (Western University, Canada)
Domain Name System (DNS) plays in important role in the current IP-based Internet architecture. This is because it performs the domain name to IP resolution. However, the DNS protocol has several security vulnerabilities due to the lack of data integrity and origin authentication within it. This paper focuses on one particular security vulnerability, namely typo-squatting. Typo-squatting refers to the registration of a domain name that is extremely similar to that of an existing popular

brand with the goal of redirecting users to malicious/suspicious websites. The danger of typo-squatting is that it can lead to information threat, corporate secret leakage, and can facilitate fraud. This paper builds on our previous work in [1], which only proposed majority-voting based classifier, by proposing an ensemble-based feature selection and bagging classification model to detect DNS typo-squatting attack. Experimental results show that the proposed framework achieves high accuracy and precision in identifying the malicious/suspicious typo-squatting domains (a loss of at most 1.5% in accuracy and 5% in precision when compared to the model that used the complete feature set) while having a lower computational complexity due to the smaller feature set (a reduction of more than 50% in feature set size).
pp. 158-163

11:42 A Deep Learning Approach to Predict Weather Data Using Cascaded LSTM Network

Zarif Al Sadeque and Francis M. Bui (University of Saskatchewan, Canada)
Weather prediction is a challenging research problem although the revolutionary advancement in Deep learning along with the availability of big data made this much easier than before. However, in terms of robustness and computational cost, this problem has interested many researchers to develop numerous models and still going on. This paper proposes a lightweight yet powerful model for weather forecasting that can outperform some of the existing well-known models. The proposed architecture mainly uses the LSTM layers in a stacked fashion with a different number of units in each layer. It takes in multiple weather variables as input features for a given time sequence to forecast the same weather parameters in multi-input multi-output (MIMO) structure. The proposed models are tested to predict the wind speed, relative humidity, dew point and temperature in this study and experimented with different hyper-parameters consisting a number of LSTM layers, a variable learning rate, number of LSTM units. Two models have been built cascading the basic 1hour-ahead model which predicts the weather parameters for the 2 hours and 3 hours ahead. It shows the cascaded models perform significantly better than the standard LSTM or 1D convolution networks in shorter period prediction.
pp. 164-168

12:00 Low-Power Low-Cost Audio Front-End for Keyword Spotting

Daljit Josh, John-Anthony Elenis, Heman Muresan, Petros Spachos and Stefano Gregori (University of Guelph, Canada)
This paper presents a low power audio front end for keyword spotting. A multi-stage approach is used to reduce the power consumption of the system by only using different stages when they are required. A working prototype was created and tested to verify its functionality. The effectiveness of the multi-stage approach is shown by comparing the power consumption of the system in its idle state to the systems active state. The prototype has a power consumption of 4.1 mW in the idle state that can be reduced below 3 mW with a keyword detection accuracy of 87%.
pp. 169-172

12:18 Partially Observable Markov Decision Processes for Fault Management in Autonomous Underwater Vehicles

Kathleen A Svendsen (Dalhousie University & Lloyd's Register ATG, Canada); Mae Seto

(Dalhousie University, Canada)
This paper reports on a novel solution for fault detection, identification, and recovery for autonomous underwater vehicles using partially observable Markov decision processes (POMDP). It explains the reasoning behind using -POMDP model-based fault manager over traditional static look-up tables. A generic long-endurance AUV was simulated with selected sub-systems as a proof-of-concept. The simulation test bed design that was used is described. The results from simulations were performed using both generated and sample bathymetry data and were very encouraging.
pp. 173-179

12:36 Novel Casestudy and Benchmarking of AlexNet for Edge AI: From CPU and GPU to FPGA

Firas Al-Ali (Senior Lecturer, Manukau Institute of Technology, New Zealand); Thilina Gamage and Hewa Nanayakkara (Student, Manukau Institute of Technology, New Zealand); Farhad Mehdipour (Otago Polytechnic - Auckland International Campus, New Zealand); Sayan Kumar Ray (Manukau Institute of Technology, New Zealand)
Convolutional Neural Networks (CNNs) require massive parallelism due to the high-precision floating-point arithmetic operations they perform. So, demand of processing power in them is significantly higher than what a standard CPU can offer. This has traditionally made CNNs more suited for running on a Graphics Processing Unit (GPU). However, GPUs consume much more power than CPUs, rendering the former impractical for implementing CNNs in Edge AI (Artificial Intelligence), where restraining power consumption is paramount. On the other hand, FPGAs (Field Programmable Gate Arrays) are more suited for AI computing at the edge as they consume much lesser power than GPUs and even CPUs. Additionally, GPUs and CPUs are not suited for real-time AI applications, which require both high throughput and low latency at the same time and FPGAs excel at all these requirements. The purpose of this paper is to provide a study of the performance of FPGA as the most suitable platform for AI-based computing at the edge. To achieve this, we chose AlexNet, a popular CNN image classifier, for which we present a case study on four different platforms: CPU, GPU, embedded RISC core, and FPGA fabric. Then, we quantitatively measure and compare the performance in terms of inference time (time needed to classify an image) on all these platforms. Inference time using FPGA is reduced by almost 64, 1.6, and 1.1 times compared to a dual-core ARM, an i5-6400 CPU, and an Nvidia GPU, respectively.
pp. 180-183

CN-1: Communications and Networking

Chair: Amr El-Wakeel (Queen's University, Canada)

10:30 Dynamic Satisfactory Power Allocation for Multi-Class Ultra Dense 5G and Beyond

Sami Abdelaaziz Nadif (Hassan I University of Settat, Morocco); Halima Elbiaze (University of Quebec at Montreal, Canada); Essaid Sabir (ENSEM, Hassan II University of Casablanca, Morocco); Abdelkrim Haqiq (Hassan 1st University, Settat, Morocco)
Power control is originally used in wireless networks, to compute optimal transmit power and deal with undesired interference. It is also a flexible mechanism that can provide Quality of Service (QoS) and strategically allow to meet the user requirements. This paper introduces a QoS-aware Satisfactory Power Allocation (SPA) for ultra dense networks, using a mean field perspective. In this setting, the user devices are partitioned into several classes based on their throughput

requirements. Now, instead of seeking to maximize their QoS, the user devices from each class only aims to meet their respective throughput demands. Yet, by leveraging stochastic geometry analysis and mean field approximation, we investigate the uplink power control problem in a large scale ultra dense network that guarantees a satisfactory performance per class. Next, we formulate the problem as a mean field optimal control where the optimality conditions are derived using Lagrangian dual formulation. Finally, the effectiveness of the SPA policies is illustrated via extensive numerical analysis, and many insightful discussions are presented.
pp. 184-190

10:48 A Cooperative Spectrum Sensing Architecture and Algorithm for Cloud- And Big Data-based Cognitive Radio Networks 

Victor Balogun (University of Winnipeg, Canada); Oluwafemi Sarumi (The Federal University of Technology Akure, Nigeria & University of Manitoba, Canada)
Cognitive Radio Network (CRN) was designed to lessen the shortage of radio resources. The Secondary Users (SUs) can opportunistically utilize any available spectrum when the Primary Users (PUs) are inactive. Some of the challenges of CRN include the service interruption loss, complexity of processing and exchange of large amount of data, limited available memory to SUs and the non-real-time exchange of spectrum sensing data. These challenges can lead to significant degradation in the performance of a CRN. Therefore, there is a need to seek solutions that will alleviate these problems. The Cloud system incorporated with Big Data Analytics algorithm can be a potential solution. In this paper, we propose a Cloud-based Cooperative Spectrum Sensing model for CRN that allows the SUs to aggregate their individual spectrum sensing data into a cloud environment, where it can be analyzed using a proposed expanded Apache Spark algorithm incorporated with the hybridization of three machine learning methods-ensemble classifier approach that can effectively and efficiently analyze the spectrum sensing data for easy access, real-time analysis, deep insight and on-demand decision support for the SUs. In addition, the two-layer Fusion Center design proposed introduces redundancy by using the cloud as a secondary Fusion Center while still maintaining a primary land-based Fusion Center.
pp. 191-195

11:06 Content Delivery Networks - Q-Learning Approach for Optimization of the Network Cost and the Cache Hit Ratio 

Diego Felix de Almeida and Jason Yen (British Columbia Institute of Technology, Canada); Michal Aibin (British Columbia Institute of Technology, Canada & Northeastern University, USA)
With an increasing demand for web content delivery, it is necessary to optimize the CAPEX and OPEX costs of the Content Delivery Networks. Ideally, all web content to be requested should be stored in local cache nodes at all times. However, the content demand varies across space and time. In this paper, we propose a Content Delivery Network model that allows us to choose the best trade-off between costs and cache hit ratio.
Presenter bio: Dr. Michal Aibin was born in 1989 in Poland. He began his doctoral studies at the Department of Systems and Computer Networks at the Wroclaw University of Technology in 2012, where he was twice awarded the Dean Award and a scholarship to the best Ph.D. students. He received his doctoral degree in June 2017 by defending the thesis: "Dynamic Routing Algorithms for Cloud-Ready Elastic Optical Networks." He currently upholds his first academic position, at the British Columbia University of Technology, Vancouver, Canada, in the Department of Computing, where he was awarded the Employee Excellence Award in the Applied Research category.

pp. 196-200

11:24 Combined Latency-Aware and Resource-Effective Virtual Network Function Placement

Wissal Attaoui (Hassan II University of Casablanca, Morocco); Essaid Sabir (ENSEM, Hassan II University of Casablanca, Morocco); Halima Elbiaze (University of Quebec at Montreal, Canada)
With the emergence of network function virtualization (NFV) and Software-Defined Networking (SDN) technologies, virtual network functions (VNF) can be interconnected to deliver different mobile services in 5G communication networks. Our primary purpose is to find the optimal VNF placement reducing resource consumption while providing specific latency and throughput for slicing services. We consider VNFs as M/M/1/C queues chained together to serve customer requests. The problem relies on finding an efficient orchestration and placement of VNFs. In this context, we propose a decision algorithm based two-procedures, the first one, named orchestration phase, aims to manage the reuse of VNFs having the same required functions through a dynamic logit method, and the second one is related to the new placement of VNFs. In this paper, we focus on a simple scenario of delivering video streaming service traversing a standard chain of four VNFs. Simulation results prove the performance of our proposed algorithm in terms of End-to-End delay and dropping probability compared to greedy and affinity algorithms.
pp. 201-207

11:42 EEDOR: An Energy Efficient Depth-Based Opportunistic Routing Protocol for UWSNs

Rogaia Mhemed (Dalhousie University, Canada); Frank D Comeau (St. Francis Xavier University, Canada); William Phillips (Dalhousie University, Canada); Nauman Aslam (Northumbria University, United Kingdom (Great Britain))
In this paper, we present an Energy Efficient Depth-Based Opportunistic Routing protocol (EEDOR) that enhances the network lifetime of underwater wireless sensor networks. We implement EEDOR using an opportunistic routing approach, where a source node and its neighbors use wireless broadcast when exchanging their information to form the forwarding set. A novel holding time formula is used for each forwarding node based on its depth difference with the source and its priority in the forwarding set. We compare our proposed EEDOR protocol with the well-known DBR and EEDBR protocols. Our extensive simulation results show that our technique is energy efficient, reduces retransmissions and increases network stability. Our simulation results also show that EEDOR outperforms the EECOR and FLCOR protocols.
Presenter bio: Frank Comeau received the B.Eng. (Electrical) degree and the M.A.Sc. (Eng.) from the Department of Electrical Engineering from the Technical University of Nova Scotia (now Dalhousie University), Halifax, NS, Canada, in 1989 and 1996 respectively. He received the Ph.D. from Dalhousie University in 2008. He is currently an assistant professor at St. Francis Xavier University, Antigonish, NS. Mr. Comeau is a member of the Association of Professional Engineers of Nova Scotia and a member of the IEEE.
pp. 208-213

12:00 Supporting Delay-Sensitive IoT Applications: A Machine Learning Approach

Ali Alnoman (Sheridan College, Canada)

In this paper, a supervised machine learning approach, namely, the decision tree is used to classify a variety of Internet of Things (IoT) applications according to their delaysensitivity status. The decision-tree is trained and tested to classify tasks into delay-sensitive and delay-insensitive based on the application features such as type and location. Delay-sensitive tasks are generally related to applications such as medical, manufacturing, and connected vehicles that require high service quality and short response time. Once delay-sensitive tasks are recognized, a prioritized scheduling mechanism is implemented at the edge device to reduce the undesired queueing delays. To this end, a two-class priority queueing system is used to model the scheduling mechanism at the edge device. Results show the effectiveness of machine learning in classifying IoT tasks, and how delay-sensitive tasks can enjoy short queueing delay which is a big step towards enabling high quality edge computing services.
pp. 214-217

12:18 Scalable Path Computation Element (SPCE) 

Hamid Hajaje (University Mohammed V, Morocco); Zine elabidine Guennoun (Mohamed V University, Morocco); Junaid Israr and Mouhcine Guennoun (University of Ottawa, Canada)
Current Path Computation Elements (PCE) are limited to scaling only hundreds to a few thousand nodes, depending on the underlying path computation algorithm. This is because the entire network is considered one domain when applying the path computation algorithm. It takes approximately three seconds to compute all the paths between all pairs of vertices in a 1k graph, measured with Floyd-Warshall and Dijkstra algorithms, which allows us to apply the benefits of distribution and precomputation to optimize the path computation element. The objective of this proposal is to increase the scale of the PCE from hundreds to hundreds of thousands of nodes. In this paper, we provide a two-layer architecture with proven capability, based on simulations, to scale a relatively large network.
pp. 218-221

12:36 Deploying an OFDM Physical Layer Security with High Rate Data for 5G Wireless Networks 

Saeed Komeylian (Sharif University, Iran); Somayeh Komeylian (Ryerson University, Canada)
Open nature of wireless networks leads to being sensitive to eavesdropping. Hence, a tremendous growth of literature has carried out challenges in privacy and security in wireless networks. Conventional techniques would be highly susceptible to technological imperfections, over-exposed to eavesdroppers and dependent on complicated mathematics, leading to failure for deploying secure transmission wireless channels. In this study, we have significantly boosted the performance of the physical layer security in the 5G downlink transmission system by implementing the Orthogonal Frequency Division Multiplexing (OFDM) technique twice in the wiretap channel. We have fully compared the performance of exploiting the OFDM technique twice in the wiretap channel with its counterpart available approach with the one OFDM technique. This study has a major contribution to compare the performance of the two aforementioned techniques in terms of the secrecy capacity, the success rate of an eavesdropper, and the OFDM-modulation efficiency. The simulation results have verified that an extreme security rate and a very low success rate for the eavesdropper in the proposed technique. In addition, we have confirmed that the OFDM-64-QAM3/4 technique shows the ultimate performance in terms of a smaller number of errors, less value of BERs, and high rate modulation compared to the other modulation techniques. In the following, we have represented the simulation results of the active user throughput for the further evaluation of

the proposed channel model.
pp. 222-228

12:54 Deep Reinforcement Learning Algorithm for Smart Data Compression Under NOMA Uplink Protocol 

Mohamed Elsayed (Qatar University, Qatar); Ahmed Badawy (Politecnico di Torino, Italy); Ahmed El Shafie (Qualcomm Inc., USA); Amr Mohamed and Tamer Khattab (Qatar University, Qatar)
One of the highly promising radio access strate-gies for enhancing performance in the next generation cellularcommunications is non-orthogonal multiple access (NOMA).NOMA offers a number of advantages including better spec-trum efficiency. This paper focuses primarily on proposing anenergy efficient system for transmitting medical data, such aselectroencephalogram (EEG), collected from patients for thesake of continuous monitoring. The framework proposes theuse of deep reinforcement learning (DRL) to provide smartdata compression in uplink-NOMA protocol. DRL enforces thedata compression ratios for the nodes in order to avoid outageconstraints at any sensor node. Jointly, it optimizes the powerconsumption of these sensor nodes. The data compression forsuch sensor network is vital in order to minimize the power everysensor consumes to maximize its service lifetime. We minimizethe expected distortion under practical channel realization andoutage probability constraints using NOMA-uplink protocol.Meanwhile, we optimize the power efficiency of the user node inorder to increase the battery lifetime.
pp. 229-234

CSE-1: Computer and Software Engineering

Chair: Ahmed Elbery (Queen's University, Canada)

10:30 Smart Home Networks: Security Perspective and ML-based DDoS Detection 

Yaser Al Mtawa (University of Western Ontario, Canada); Harsimranjit Singh (Western University, Canada); Anwar Haque (Western Ontario, Canada); Ahmed Refaey (Manhattan College, USA & Western University, Canada)
Internet of Things (IoT) allows households to have real-time access to various services such as IP cameras for monitoring home security, automatic climate controls, doors and window access for family members including pets, mood-based home lighting, or automatic refrigerators that tell what item is going to expire at what time, etc. However, IoT has often been considered a single-domain facility that provides services to consumers, but security and privacy issues pertaining to households and residential infrastructure have not been studied thoroughly. The security of IoT-based systems requires a critical engineering infrastructure when dealing with home security. Any proposed home security framework should establish an automatic access monitoring and regular updates of the system software and firmware according to the ongoing threats. In this paper, we provide an insightful short review of security issues in smart home systems. We highlight several popular IoT protocols and provide critical analysis of their performance against various security threats. Mitigation strategies are also presented to reduce the impact of cyberattacks on smart home systems. Furthermore, our analysis shows that DDoS is one of the most common threats to smart home systems. Therefore, we developed an ML-based model to detect DDoS attacks. We employed unique characteristics of IoT traffic to engineer features that enable ML algorithms to accurately classify DDoS traffic from normal/benign traffic.
pp. 235-242

10:48 Design and Implementation of an Intelligent System to Translate Arabic Text into Arabic Sign Language

Tariq Jamil (Sultan Qaboos University, Oman)

Sign Language is a widely known medium of communication used by the deaf, hard of hearing individuals, and those who are unable to speak physically because of any reason. There is no common or universal version of sign language. This is especially true for Arabic Sign Language (ArSL) which has various versions depending on the Arab country where it is being used. In this paper, we have designed an intelligent system which can parse Arabic text, keeping in mind the context of the text, and then translate the text into Arabic Sign Language. Preliminary testing of the system has shown an overall accuracy of 85% in correctly translating Arabic words into the Arabic Sign Language.

Presenter bio: Dr. Tariq Jamil has been teaching and doing research in the areas of computer architecture, parallel processing, computer arithmetic, and cryptography, for over 20 years and is currently associated with the Department of Electrical and Computer Engineering at Sultan Qaboos University (SQU, Oman). He holds a B.Sc. (Honors) degree in electrical engineering from the NWFP University of Engineering and Technology (Pakistan) and M.S./Ph.D. degrees in computer engineering from the Florida Institute of Technology (USA). He has authored three books, co-authored another book on speech recognition for Arabic language, holds an Australian Innovation Patent on Complex Binary Associative Dataflow Processor, and has written over fifty research papers in refereed international conferences and journals. He has been a recipient of research grants from the Australian Research Council and Sultan Qaboos University, and has given invited lectures/ tutorials in Finland, Thailand, Pakistan, Oman, the United Kingdom, and the United States of America. On account of his outstanding academic achievements and for contributions to activities related to the computing discipline, he was awarded the IEEE Computer Society (USA)/Upsilon Pi Epsilon Honor Society (USA) Award for Academic Excellence in 1996. Dr. Jamil has served as a distinguished speaker in the IEEE Computer Society (USA) Distinguished Visitors Program (DVP) during 2005-2007 and his biography has been published in such renowned directories as Marquis's Who's Who in the World (USA), Who's Who in Science and Engineering (USA), and Dictionary of International Biography (UK). He is a Fellow of the IEEEP, a senior member of IEEE (USA), member of the IET (UK), a Chartered Engineer (UK), and a registered Professional Engineer.

pp. 243-246

11:06 Dynamic Group Trip Planning Queries in Spatial Databases

Farhana Aklam and Wendy K Osborn (University of Lethbridge, Canada)

Trip planning queries are considered an integral part of Location Based Services. In this paper, we investigated Sequential Group Trip Planning (SGTP) queries. Given a set of starting and destination locations and an ordered sequence of Categories of Interests (COIs) for a group of users, a SGTP query returns the route for each user from their respective start and destination locations that minimizes the overall travel distance. We propose two approaches: Dynamic Group Trip Planning (DGTP) and Modified Dynamic Group Trip Planning (M-DGTP). The proposed DGTP approach enables users to plan a group trip in a more flexible manner and the M-DGTP approach optimizes the total travel distance of the group. We compare the results of our proposed strategies with an existing strategy called N-DGTP through experimental evaluation.

pp. 247-252

11:24 Software Effort Estimation from Use Case Diagrams Using Nonlinear Regression Analysis

Ali Bou Nassif and Manar AbuTalib (University of Sharjah, United Arab Emirates); Luiz F. Capretz (University of Western Ontario, Canada)

Software effort estimation in the early stages of the software life cycle is one of the most essential and daunting tasks for project managers. Recently, conducting software estimation from UML use case diagrams has become significant since use case diagrams are drawn in the Requirements stage of the software life cycle. In this research, a new model based on non-linear regression analysis is proposed to predict software effort from use case diagrams. It is concluded that, where software size is classified from small to very large, one linear or non-linear equation for effort estimation cannot be applied. Our model with three different non-linear regression equations can incorporate the different ranges in software size.

pp. 253-256

11:42 Integrated Control of Multiple Data Centre Cooling Units 

Shirin Mozaffari, Ghada Badawy and Douglas Down (McMaster University, Canada)

Energy management is one of the biggest challenges in today's fast growing world of technology. While data centres play a critical role as a facility for storage and IT operations, they also consume a significant amount of energy to operate, especially for cooling. Efficient cooling of data centres involves meeting temperature constraints while minimizing power consumption. We first demonstrate the applicability of a zonal model for a modular data centre. We then leverage this zonal model to demonstrate that a joint workload assignment and cooling control problem has a simple solution: equally load the servers and maximize the setpoints of the cooling units to meet redline temperature constraints.

pp. 257-260

12:00 Improved Asymmetric Time-Varying Coefficients of Particle Swarm Optimization 

Mohammad AlShabi, Chaouki Ghenai and Maamar Bettayeb (University of Sharjah, United Arab Emirates)

In this work, a modified version of the newly-developed algorithm Improved Particle Swarm Optimization (PSOI) is proposed. PSOI is a type of a PSO algorithm that uses time-varying social coefficients to train the particles. It shows a better performance compared to the conventional PSO, and this inspires this work. The proposed method uses asymmetric polynomial curves, and hence, it is referred to as the Improved Asymmetric PSO (PSOAI). In this work, PSOAI is tested using several benchmarks and compared to several PSO versions including the PSOI. The results are promising compared to several versions of PSO.

Presenter bio: Mohammad Al-Shabi is currently serving as an assistant professor in the mechanical department at University of Sharjah/UAE. He obtained his BSc and MSc in Mechanical Engineering from Jordan University for Science and Technology/Jordan. He obtained his PhD in Mechanical Engineering/Mechatronics from McMaster University/Canada in 2011.

pp. 261-264

PANEL-1: Smart Infrastructure and Services: Are We Ready?

Chair: Anwar Haque (Western Ontario, Canada)

Monday, August 31 14:00 - 16:00

CN-2: Communications and Networking

Chair: Ahmed Elbery (Queen's University, Canada)

14:00 Real-world Applications of Mobile Learning Tools in Engineering: Prospects, Hindrances and Accessibility in Conjunction with Scholastic Views

Samuel Eneje (Lancaster University, Canada & Technology Enhanced Learning, United Kingdom (Great Britain))

This desk-based study uses a qualitative approach to explore the range of affordances that mobile technology-enhanced learning can avail to engineering education. It took documented outcomes and experience of mobile users who participated in engineering experiments. The secondary data are from eleven examined articles that are used in text data analysis. This study produces a scholar`s view through empirical studies of real-world uses of mobile technologies in implementing learning. This study highlights the features and issues associated with mobile devices used in investigated studies. The summary of the study will provide insight for a prospective integration of elements of mobile technology in the area of engineering learning. It will be useful to learners and instructors for aligning choices of instruments suitable for supplementing 'real' laboratories. The array of descriptions in this study ingresses and anticipates the relevance of this study to be helpful to anyone who intends to advise a mobile application pathway for learning, especially for engineering program.

Presenter bio: A Nigerian-Canadian, Formerly, Head of Electrical and electronic engineering department, Federal University, Oye-Ekiti, Nigeria. Had a stint as a doctoral fellow/researcher at Tshwane University of Technology, South Africa. Presently, a doctoral scholar at Lancaster University, United Kingdom. Working on Learning networks, Learning Analytics, management of virtual learning, Human-computer interactions, and interactive media for learning.

pp. 265-272

14:18 Towards Smart Trust Management of VANETs

Rasha Atwah, Paola Flocchini and Amiya Nayak (University of Ottawa, Canada)

The challenge to meet the demands from both communication and computation is increasing in the ever-advancing field of vehicular applications. The cost of additional infrastructure deployments such as roadside units (RSUs), cellular networks, and mobile cloud computing is an obstacle towards the enhancement of the quality of the traffic provided services. The idea of partial reliance on fog computing to support the existing infrastructure is proposed in few research papers. In this paper, we conceive the idea of involving fog nodes in the trust evaluation process. By integrating fog nodes as coordinator resources in Vehicle Ad hoc Networks (VANETs), the quality of services and applications can be significantly enhanced. Possible services fog nodes can perform to reduce the burden on agents include event detection, cluster head selection, and misbehaviour detection. Also, we propose a novel task-based trust experience that evaluates the trustworthiness of a vehicle according to the type of task demanded by examining its historical records. The proposed framework reduces communication demand between the agents by leveraging a vehicle's historical records. Also, the proposed model enables the cluster head to employ not only the most trusted vehicle, but also the most competent vehicle for a specific task. Finally, we discuss our model in terms of the challenges and conclude the work.

pp. 273-277

14:36 Machine Learning-Based Task Clustering for Enhanced Virtual Machine Utilization in Edge Computing 

Ali Alnoman (Sheridan College, Canada)

Edge devices provide cloud-like services at the network edge near mobile users. Due to the prosperity of smart applications that involve computing-intensive tasks, edge devices are intended to provide sufficient amounts of resources in order to accommodate the increasing computing demands. On the other hand, computing resources could also suffer being underutilized which leads to both resource and energy wastage. In this paper, we consider heterogeneous virtual machines (VMs) in edge computing such that VMs enjoy different processing capabilities in order to adapt the available resources with the actual task demands. To this end, an unsupervised machine learning technique, namely, the K-means is used to classify the incoming tasks into three different categories according to their processing requirements. Afterwards, the classified tasks are served using three different types of VMs in the edge device to better utilize computing resources. Results show the effectiveness of the proposed machine learning scheme in classifying the incoming tasks, and the importance of adopting different VM types for improving resource utilization in edge computing.

pp. 278-281

14:54 Energy Consumption Reduction of the Spectrally-Spatially Flexible Optical Networks Based on the Energy Savings Algorithm 

Joseph Gotengco, Justin Tran, Jason Soukchamroeun and Diego Felix de Almeida (British Columbia Institute of Technology, Canada); Michal Aibin (British Columbia Institute of Technology, Canada & Northeastern University, USA)

Energy reduction and conservation is gaining interest in our society rapidly in the last decade. In this paper, we design an energy-efficient algorithm for the problem of Routing, Modulation, Core and Spectrum Assignment in Spectrally-Spatially Flexible Optical Networks (SS-FON). We then evaluate our approach using existing, real-life networks in the simulation testbed. Two primary metrics of the evaluation are energy usage, which directly relates to the operational cost of the networks, as well as bandwidth blocking probability, which affects how many customers network operators can serve. Our algorithm achieves similar efficiency for routing as the ones in the literature with the average double reduction of the energy consumption.

Presenter bio: Dr. Michal Aibin was born in 1989 in Poland. He began his doctoral studies at the Department of Systems and Computer Networks at the Wroclaw University of Technology in 2012, where he was twice awarded the Dean Award and a scholarship to the best Ph.D. students. He received his doctoral degree in June 2017 by defending the thesis: "Dynamic Routing Algorithms for Cloud-Ready Elastic Optical Networks." He currently upholds his first academic position, at the British Columbia University of Technology, Vancouver, Canada, in the Department of Computing, where he was awarded the Employee Excellence Award in the Applied Research category.

pp. 282-286

15:12 Wireless Positioning Network Location Prediction Based on Machine Learning Techniques 

Furat Al-Obaidy, Najmeh Razfar and Farah Mohammadi (Ryerson University, Canada); Peyman Moeini (Peytec Inc., Canada)

Developing wireless communication technology as well as the extensive usage of wireless networks

imply that location applications have been made rendered necessary. Notably, this position denotes the functionality and events to estimate a node of interest's location. This study compares different machine learning (ML) approaches to locate the accurate localization of a moving tag based on wireless sensor network (WSN) as the wireless propagation medium to improve the prediction of positions. Our experimental recommends using neural networks method to design an appropriate intelligent WSN networks and seek an optimal position with high precisions. The results show the proposed method provides a prediction accuracy about 94% based on neural network approach.
pp. 287-291

15:30 User Association in Coexisting RF and TeraHertz Networks in 6G 

Noha Hassan (Ryerson University, Canada); Md Tanvir Hossan and Hina Tabassum (York University, Canada)

While fifth generation (5G) networks are ready for deployment, discussions over sixth generation (6G) networks are down the road. Since high frequencies like terahertz (THz) will be central to 6G, in this paper, we propose two user association (UE) algorithms considering a coexisting RF and THz network that balances the traffic load across the network by minimizing the standard deviation of the network traffic load. Our algorithms capture the heterogeneity observed at RF and THz frequencies such as transmission bandwidth, molecular absorption, transmit powers, etc. Unlike typical unsupervised clustering algorithms (e.g. k-means, k-medoid, etc.) that search for appropriate cluster centers' locations, our algorithms identify the appropriate UEs to be associated to a certain BS such that the overall network load standard deviation (STD) can be minimized subject to users' rate constraints. In particular, our algorithms cluster UEs to every base station (BS) such that the traffic load across the network can be balanced, i.e., by minimizing the STD of network traffic load. Numerical results show that the proposed algorithms outperform the classical user association algorithms in terms of data rate, traffic load balancing, and user's fairness.
pp. 292-296

CR-1: Control and Robotics

Chair: Mahsa Bataghva Shahbaz (Western University/Robarts Research Institute, Canada)

14:00 ManitobaSat-1: Space Systems Engineering for Student Training 

Jaime Campos (University of Manitoba, Canada); Philip A Ferguson (University of Manitoba & NSERC / CSA / Magellan Aerospace Industrial Research Chair in Satellite Engineering, Canada)

ManitobaSat-1 is a CubeSat project implementing project management approaches found in other industries that enable efficient system engineering practices. One of the major roles of a systems engineer is to control requirements that dictate product specifications, functions, and related tasks. These functions provide engineers a metric that better reflects the technical progress of a project compared to Earned Value management. This project management approach combines the roles of systems engineer with project manager by using requirements verification activities to capture the technical progress of a project, providing managers with a meaningful metric to monitor the health of the project.
pp. 297-300

14:18 Tracking Control of Force, Position, and Contour for an Excavator with Co-simulation

Niraj Reginald, Jaho Seo and Abdullah Rasul (OntarioTech University, Canada)
An integrative control approach of mutually associated factors for successful autonomous excavation is described in this paper. The control strategy integrates Force, Position and Contour Control requires for ground contact tasks of an excavator. As part of the position control strategy a non-linear PI controller was utilized to control the each hydraulic cylinder strokes to control the end effector tool position which is the bucket tip. In order to compensate for the ground resistive forces in contact space an impedance controller is used. To generate an optimal path for the bucket tip for ground leveling tasks a contour compensation was introduced. Simulation results provide that designed control scheme provides good tracking results in terms of force and position along with contour profile compensation
Presenter bio: Master of Applied Science candidate in Mechanical Engineering at Ontario Tech University, Oshawa, Canada
pp. 301-305

14:36 Discussion on Accuracy of Approximation with Smooth Fuzzy Models 

Ebrahim Navid Sadjadi (Carlos III of Madrid & Tehran Polytechnic University, Spain); Maryam Ebrahimi (Shahid Beheshti, Iran); Zahra Gachloo (Damghan University, Iran)
The structure of fuzzy model impacts how well it approximates the nonlinear function, and how many rules are required to gain the desired accuracy. The most of the earlier works rely on diminishing the higher derivation of the fuzzy model in front of the higher derivatives of the real system. However, the smooth compositions are m-time differentiable and will not diminish. This has motivated to derive the relation of required fuzzy rules with the arbitrary accuracy for function approximation through the smooth fuzzy model. The originality of the work is that the approximation error and the number of required fuzzy rules in this paper, rely on the structure of the fuzzy model and the involved s-t compositions, beside the nonlinear properties of the real plant, through a reliable mathematical formulation. Hence, we have presented a prediction-correction algorithm to include all the main factors. It is proved that number of the required rules are lower than those of the earlier works to gain the same level of model accuracy.
pp. 306-311

14:54 Robotic Sanding of Wooden Bowls with Hybrid Force/Position Impedance Control

Srijith Sudhagar, Brian Surgenor and Keyvan Hashtrudi-Zaad (Queen's University, Canada)
This paper addresses the question as to whether a serial robot could be used to sand a wooden bowl, in order to free a human operator from what is considered a hazardous task. The process of sanding wood is similar to the polishing of metal, both set out to eliminate scratches. There are robot-based commercial systems available for the polishing of aluminum. However, unlike aluminum, wood is a non-homogeneous material. In the case of wooden bowls, each has a unique geometry, and to a degree, unique material properties. A hybrid force/position impedance controller was implemented and four different force control configurations were tested. The best performance was obtained with a FO filter for force control and PD action for position control.
pp. 312-317

15:12 Stability Analysis of Smooth Positive Fuzzy Systems 

Ebrahim Navid Sadjadi (Carlos III of Madrid & Tehran Polytechnic University, Spain); Mohammad Bagher Menhaj (Amir Kabir University of Technology, Iran); Danial Sadrian Zadeh (University of Tehran, Iran); Behzad Moshiri (University of Tehran & University of Waterloo, Iran)

The paper addresses the stability problem of positive systems represented by smooth fuzzy models. It provides the sufficient conditions of stability for such systems through the Banach Contraction Theorem. The Illustrative example shows that through the employment of the smooth compositions, the fuzzy model will have higher tolerance to the noises and disturbances for returning back to the stability, rather than the classical fuzzy models.

pp. 318-323

15:30 Hand Gesture-Based Control of a Front-End Loader 

Johann von Tiesenhausen, Unal Artan, Joshua Marshall and Qingguo Li (Queen's University, Canada)

In this paper, we present the design and use of an instrumented glove consisting of a 9-DOF inertial measurement unit (IMU) and resistive flex sensors. The glove is used as a unique human-machine interface to control a Kubota R520s front-end loader, through input gestures, for the excavation of a fragmented rock pile. Raw sensor data from the glove is recorded and transmitted to a computer for recognition. Recognized gestures are then used to command the loader to switch between dig states and control the excavation process. The system allows an operator to observe the entire process from beside the loader, providing them with valuable information about interactions between the loader bucket and rock pile not usually available when seated in the vehicle's cab. Preliminary experiments show that a novice operator was able to improve their performance using the proposed system, evaluated based on metrics of total and dig completion times, as well as payload.

pp. 324-327

CSE-2: Computer and Software Engineering

Chair: Ahmed Shalaby (University of Louisville, USA)

14:00 PMTRU: An Efficient and Resistant Variant of the NTRU Public Key Cryptosystem 

Hamid Hajaje (University Mohammed V, Morocco); Zine elabidine Guennoun (Mohamed V University, Morocco); Mouhcine Guennoun (University of Ottawa, Canada)

This paper proposes a novel cryptosystem (PMTRU) that is a variant of the NTRU public key cryptosystem. PMTRU combines the advantages of the NTRU and its other variant, MATRU. We prove analytically that our cryptosystem improves the speed of encryption and decryption procedures, and significantly increases the security level of the private key. Compared to NTRU and MATRU, PMTRU greatly improves resistance against brute-force and lattice-based attacks, while decreasing the memory space required to register the public key and ciphertexts.

pp. 328-335

14:18 ES2ISL: An Advancement in Speech to Sign Language Translation Using 3D Avatar Animator 

Bhavinkumar Patel and Harshit Balvantrai Patel (Lakehead Univ, Canada); Manthan Khanvilkar (Lakehead University, Canada); Nidhi Rajendrakumar Patel (Lakehead Univ, Canada); Thangarajah Akilan (University of Windsor, Canada)

This work proposes a model and an initial implementation of a robust system, which converts English Speech into Indian Sign Language (ES2ISL) animations. Such system may considerably enhance the lives of hearing-impaired people, especially in interaction and information exchange between concerned parties. The core purpose of the system is to bridge the communication gap between hearing-impaired people in India and others. It exploits and integrates the semantics of the Natural Language Processing (NLP), Google cloud speech recognizer API, and a predefined sign language database. The experimental results show that the proposed system outperforms existing models with an average accuracy of 77%. Hence, it overshadows the existing systems in terms of processing time by taking about 0.85s.

pp. 336-340

14:36 Geo-Spatial Data Visualization and Critical Metrics Predictions for Canadian Elections 

Mohammad Abdul Hadi and Fatemeh Fard (University of British Columbia, Canada); Irene Vrbik (University of British Columbia Okanagan, Canada)

Open data published by various organizations is meant to make the data available to the public. A huge number of open databases containing a lot of facts and numbers are maintained by numerous organizations all over the world. However, most of them do not offer a concise and insightful data interpretation or visualization tool which can help users to process all of the information in a consistently comparable way. Canadian Federal and Provincial Elections is an example of these databases. This information exists in numerous websites, as separate tables that a user should traverse through a tree structure on the website, and the comparison is left to the user, without providing proper tools or visualizations. In this paper, we provide technical details of addressing this problem, by using the Canadian Elections data (since 1867) as a specific case study as it has numerous technical challenges. We hope that the methodology used here can help in developing similar tools to achieve some of the goals of publicly available datasets. The developed tool contains data visualization, trend analysis, and prediction components. The visualization enables the users to interact with the data through various techniques including Geo-spatial visualization. To reproduce the results, the tool is published open-sourced.

Presenter bio: I am a graduate student (MS in Computer Science) at the University of British Columbia.

pp. 341-347

14:54 FPGA-Based Evaluation and Implementation of an Automotive RADAR Signal Processing System Using High-Level Synthesis 

Mohammed Khalid (University of Windsor, Canada)

HLS enables the design of optimized hardware from behavioral specifications using HLL such as C, C++, and SystemC. Hardware designs were traditionally developed using HDLs such as Verilog, VHDL etc. at the Register Transfer Level. Recently HLS has been gaining popularity due to

increasingly better QoR, high productivity and lower development times. HLS gives software developers the ability to implement their designs on FPGAs without requiring detailed knowledge of RTL technologies and HDL. A high-level model for HLS of an automotive RADAR signal processing system has been investigated for the purpose of comparison between hardware design using HLS model and an existing HDL model. A synthesized design of an automotive RADAR signal processing system using Xilinx Vivado HLS-based design methodology is presented in this paper which can be depicted as a mid to high complexity, real world application. Various HLS techniques have been used to optimize the design for both speed and resource utilization while providing a much shorter development time. The FPGA resource utilization increased but it was well under 5% of the total resources available on the FPGA chip, achieving a speed up of 2x when compared to the RTL-based design for the RADAR system while at the same time reducing the development time by 60%.
Presenter bio: Dr. Mohammed A. S. Khalid received the Ph.D. degree in Computer Engineering from the University of Toronto in 1999. He has over 25 years of experience in teaching, research and development in academia and industry. Before joining the University of Windsor in August 2003, he worked for 4 years as a Senior Member of Technical Staff in the Verification Acceleration R & D Group (formerly Quickturn), of Cadence Design Systems, based in San Jose, California. His research and development interests are in architecture and CAD for field programmable chips and systems, reconfigurable computing and embedded system design. He has published several papers in these areas and holds a U.S. Patent in the area of architecture of reconfigurable systems.
pp. 348-353

15:12 Accelerated Hardware Implementation of BLAKE2 Cryptographic Hash for Blockchain

Sumaia Mustafa Mohamed Atiwa and Yunus Dawji (York University, Canada); Ahmed Refaey (Manhattan College, USA & Western University, Canada); Sebastian Magierowski (York University, Canada)
Interest in the efficient implementations of hashing algorithms has received even more attention recently due to the growing application-space for blockchain technology. Consequently, a pressing need has arisen to develop high-performance hashing techniques to support these developments. In this paper, an architecture and VLSI implementation of the newest hashing standard, BLAKE2, is presented. The Equihash algorithm serves as a use case for BLAKE2 in Blockchain. An FPGA-based custom computing machine (FCCM) approach is used. This approach is producing an accelerated Equihash hashing-core system which is 5x faster than an ARM Cortex-A9 based system on a ZC706 SoC chip for 0.27 W. Indeed, this is the first BLAKE2 implementation allowing fast execution, and effective substitution of any previous hash families implementations.
pp. 354-359

PANEL-2: Technology Leadership Forum

Chair: Kexing Liu (Mira Connections, Canada)

Tuesday, September 1

Tuesday, September 1 9:00 - 10:00

key-2: Keynote Speaker 2

Chair: Abdallah Shami (Western University, Canada)

Tuesday, September 1 10:30 - 12:30

MCV-2: Machine & Computer Vision

Chair: Wafa M Elmannai (Manhattan College, USA)

10:30 Application of Saliency Methods for Extracting Tree Features in Outdoor Scenes

Gabriel Vieira (Federal Institute Goiano, Brazil); Naiane Sousa (Universidade Federal de Goias, Brazil); Juliana Félix (Universidade Federal de Goiás, USA); Junio Lima (Instituto Federal Goiano, Brazil); Fabrizzio Soares (Universidade Federal de Goiás, Brazil & Southern Oregon University, USA)

The growing demand for accurate results in agricultural environments consolidates the so-called precision agriculture in which saliency analysis has brought possibilities for the effective application of computer vision techniques. The saliency measured by computer algorithms follows a logic of attention similar to the human visual system in which the protuberant regions are identified due to some feature that makes them more evident and prone to draw more attention. Thus, the salient features are preserved in such a way that the most evocative scene components are highlighted to emphasize the relevant areas. In this paper, we compare saliency estimation approaches in the context of tree detection in order to analyze their performance concerning the tree areas detected and the number of segment portions correctly labeled as a tree. We discuss their performance in detecting correctly tree regions to point out the most robust ones in this task, as well as addressing their responsive capabilities for external application. We compared fourteen saliency methods using an annotated database of manually segmented images that were collected in different scenarios where trees are emphasized in the foreground.

Presenter bio: Juliana Félix is an Assistant Professor of Computer Science at Informatics Institute, Federal University of Goiás (INF/UFG). She is a Ph.D. candidate in Computer Science at UFG and holds a Master of Science degree in Computer Science (2018) and a Bachelor's degree in Computer Science (2015), both from Federal University of Goiás (UFG), Brazil. From 2013 to 2015, she was a visiting student at the University of Manitoba (UofM), Canada, where she has also worked on a summer project at the Faculty of Science. Her research interests include Machine Learning, Internet of Things, and Theoretical Computer Science.

pp. 383-386

10:48 Performance Evaluation of Pre-Trained CNN Models for Visual Saliency Prediction

Bashir Muftah Ghariba (Memorial University of Newfoundland, Canada & Faculty of Engineering, Elemergib University, Khoms, Libya); Mohamed S Shehata (University of British Columbia & Memorial University, Canada); Peter McGuire (C-Core, Canada)

Human Visual System (HVS) has the ability to focus on specific parts of the scene, rather than the whole image. This phenomenon is one of the most active research topics in the computer vision and neuroscience fields. Recently, deep learning models have been used for visual saliency prediction. In this paper, we investigate the performance of five state-of-the-art deep neural networks (VGG-16, ResNet-50, Xception, InceptionResNet-v2, and MobileNet-v2) for the task of visual saliency prediction. In this paper, we train five deep learning models over the SALICON dataset and then use the trained models to predict visual saliency maps using four standard datasets, namely: TORONTO, MIT300, MIT1003, and DUT-OMRON. The results indicate that the ResNet-50 model outperforms the other four and provides a visual saliency map that is very close to human performance.
Presenter bio: Bashir Ghariba received the B.Eng in Electrical and Computer Engineering from Elmergib University, Libya in 1998 and M.Eng from Libyan Academy in April, 2010. He became a lecturer in the Faculty of Engineering, Elmergib University, Khoms, Libya in December 2011. He is currently working toward the Ph.D. degree in Computer Engineering at Memorial University of Newfoundland, St. John's, Canada. His research interests include Computer vision and machine learning, especially for Visual attention predication.
pp. 387-390

11:06 Conditional Probabilistic Relative Visual Localization for Unmanned Aerial Vehicles

Andy Couturier (Université de Moncton, Canada); Moulay A. Akhloufi (University of Moncton & University Laval, Canada)
Unmanned aerial vehicles (UAV) are now used for a large number of applications in everyday life. These applications require autonomous navigation which is enabled by the self-localization solution integrated to the UAV. To perform self-localization, most UAVs are relying on a series of sensors combined with a global navigation satellite system (GNSS) in a sensor fusion framework. However, GNSS are using radio signals which are subjected to a large range of outages and interferences. This paper presents a relative visual localization (RVL) approach for GPS-denied environments using a down-facing 2D monocular camera and an inertial measurement unit (IMU). The solution is embedded in an adapted particle filter and use feature points to match images and estimate the localization of the UAV. A new conditional RVL measure is developed in order to leverage spare computation resources available during the data collection when the UAV is still receiving a GNSS signal. An evaluation of six feature point extraction methods is performed using real-world data while varying the number of feature points extracted. The results are promising and the approach has shown to be more efficient and to have fewer limitations than similar approaches in the literature.
Presenter bio: Andy Couturier received a B.Sc.A. degree in computer science in 2015, a B.Sc. in mathematics in 2017, and a M.Sc. in computer science in 2019 from Université de Moncton, Canada. He is currently a Ph.D. candidate in applied science at Université de Moncton, Canada. His interests include computer vision, deep learning, unmanned aerial vehicles, and computationally efficient algorithm for robotic applications.
pp. 391-394

11:24 MODSiam: Moving Object Detection Using Siamese Networks

Islam I Osman (University of British Columbia, Canada); Mohamed S Shehata (University of British Columbia & Memorial University, Canada)

Moving object detection is a challenging task in computer vision. A class agnostic model is learned to detect moving objects in a video despite their category. This is done using the proposed MODSiam that takes a single background image of the scene and the current frame as input, then the model extracts features from both inputs and merges then to output the foreground objects. A comparison of using this model with three different backbone convolutional neural networks is presented. The evaluation is done using the metrics precision, recall, F1-measure, false-positive rate, false-negative rate, specificity, accuracy, and the number of frames per second. All models are tested on the benchmark dataset CDNet, which is a dataset of videos for moving objects under different conditions like low frame rate, shadows, and dynamic background. The results show that using ResNet as a backbone produced promising results compared to other models with respect to most of evaluation metrics.
pp. 395-400

11:42 Machine Learning Towards Enabling Spectrum-As-a-Service Dynamic Sharing

Abdallah Moubayed (University of Western Ontario, Canada); Tanveer Ahmed (Nordicity, Canada); Anwar Haque (Western Ontario, Canada); Abdallah Shami (Western University, Canada)

The growth in wireless broadband users, devices, and novel applications has led to a significant increase in the demand for new radio frequency spectrum. This is expected to grow even further given the projection that the global traffic per year will reach 4.8 zettabytes by 2022. Moreover, it is projected that the number of Internet users will reach 4.8 billion and the number of connected devices will be close 28.5 billion devices. However, due to the spectrum being mostly allocated and divided, providing more spectrum to expand existing services or offer new ones has become more challenging. To address this, spectrum sharing has been proposed as a potential solution to improve spectrum utilization efficiency. Adopting effective and efficient spectrum sharing mechanisms is in itself a challenging task given the multitude of levels and techniques that can be integrated to enable it. To that end, this paper provides an overview of the different spectrum sharing levels and techniques that have been proposed in the literature. Moreover, it discusses the potential of adopting dynamic sharing mechanisms by offering Spectrumas-a-Service architecture. Furthermore, it describes the potential role of machine learning models in facilitating the automated and efficient dynamic sharing of the spectrum and offering Spectrumas-a-Service.
pp. 401-406

PANEL-3: NSERC Updates & How to Apply for a Discovery Grant

Chair: Firouz Badrkhani Ajaei (Western University, Canada)

PEES-2: Power Electronics & Energy Systems

Chair: Syed Ahmed Raza Naqvi (University of Western Ontario, Canada)

10:30 M-Model: A New Precise Medium-Length Transmission Line Model

Ali R. Al-Roomi and Mohamed E. El-Hawary (Dalhousie University, Canada)

Real transmission lines are translated into mathematical models using either the lumped parameter approach or the distributed parameter approach. The first one is used for short- and medium-length transmission lines, while the other is used for long-length transmission lines where the accuracy and precision are required. For medium transmission lines, the lumped parameter approach can be

applied using one of four popular circuit representations known as gamma (Γ), oppositegamma (Γ), tee (T), and pi (Π). This study presents a new circuit representation called em (M). This model is inspired by the sagging phenomenon where, at the sag point, the distributed series impedance of the Π-model is divided into two equal/unequal parts and the distributed shunt admittance at the center is bigger than that at both ends. For some numerical experiments, the M-model shows a stunning performance in estimating transmission line readings. It wins in most cases and, for the few remaining cases, the M-model shows very competitive results.
Presenter bio: Ali R. Al-Roomi received the B.Sc. degree in process instrumentation and control engineering and the M.Sc. degree (Hons.) in electrical engineering from the University of Bahrain, Sakheer, Bahrain, in 2006 and 2014, respectively. He received the Ph.D. degree (full GPA) in electric power systems engineering in 2020, Dalhousie University, Halifax, NS, Canada. In 2007, he was with Moore Control and Engineering (MCE) Middle East, Manama, Bahrain, as a Project Engineer. Then, he joined Yokogawa Middle East, Nuwaidrat, Bahrain, as a DCS Subsystem and Graphics Engineer. From 2008 to 2012, he was with Aluminum Bahrain B.S.C., Askar, Bahrain, as an Instrumentation and Control Maintenance Engineer in its power stations, in both generation and auxiliary sides. From 2013 to 2015, he was an Instrumentation, Control, and Protection Engineer with Riffa Power Station, Riffa, Bahrain. His current research interests include power operation, power protection, state estimation, smart grid, power system design and analysis, system realization and integration, load forecasting, machine learning, and meta-heuristic optimization algorithms.
pp. 407-412

10:48 Induction Motor Fault Diagnosis Using Graph-Based Semi-Supervised Learning

Shafi Md Kawsar Zaman (Memorial University of Newfoundland, Canada); Xiaodong Liang (University of Saskatchewan, Canada); Lihong Zhang (Memorial University of Newfoundland, Canada)

In this paper, a graph-based semi-supervised learning (GSSL) method is proposed for fault diagnosis of direct online induction motors using stator current and vibration signals. A 0.25 HP induction motor under healthy, single- and multi-fault conditions is tested in the lab. Three-phase stator currents and three-dimensional vibration signals of the motor are recorded simultaneously under steady-state operation in each test. Features for machine learning are extracted from the raw experimental stator current and vibration data using the discrete wavelet transform (DWT). Three GSSL algorithms, local and global consistency (LGC), Gaussian field and harmonic function (GFHF), and greedy-gradient max cut (GGMC), are used in the paper. It is found that both stator current and vibration signals perform well for one individual fault diagnosis using GSSL algorithms, but for classification of a combination of five different faults, the stator current outperforms the vibration signal significantly. Among the three GSSL algorithms, GGMC shows better classification results over LGC and GFHF for both stator current and vibration signals.
pp. 413-417

11:06 A DFFT and Coherence Analysis-Based Fault Diagnosis Approach for Induction Motors Fed by Variable Frequency Drives

Md Nasmus Sakib Khan Shabbir (Memorial University of Newfoundland, Canada); Xiaodong Liang (University of Saskatchewan, Canada)

For faults diagnosis in a Variable Frequency Drive (VFD) fed induction motor, a Discrete Fast Fourier Transform (DFFT) and coherence analysis-based approach is proposed in this paper. To identify signature harmonics that maintain a strong correlation between a healthy and a faulty cases

and are present under various conditions, a coherence analysis is conducted. After signature harmonics are identified, fault diagnosis can be carried out by comparing magnitudes of the fundamental and signature harmonics under various healthy and faulty conditions. Magnitudes of the fundamental voltage and the third harmonic voltage can serve as parameters to detect the five types of faults. The fifth harmonic current can effectively detect the occurrence of a fault although it cannot distinguish the fault types. The combination of the fundamental voltage and the third harmonic voltage from the stator voltage and the fifth harmonic current from the stator current can lead to effective fault diagnosis. The proposed approach is verified using two motor loading conditions.
pp. 418-422

11:24 Mathematical Schemes to Linearize Operating Times of Overcurrent Relays by Sequentially Fixing Plug Settings and Time Multiplier Settings 

Ali R. Al-Roomi and Mohamed E. El-Hawary (Dalhousie University, Canada)
Nowadays, many studies have been presented in the literature to solve various optimal relay coordination (ORC) problems. These highly constrained nonlinear nonconvex optimization problems are commonly solved using evolutionary algorithms (EAs). For online applications, where the processing speed is very crucial, some studies suggest using different types of linear programming (LP), including simplex and interior-point methods, while others suggest hybridizing both EAs and LPs. For these approaches, the ANSI/IEEE and IEC/BS standard models used to calculate the operating times of overcurrent relays (OCRs) are linearized by just fixing their plug settings (PS) and varying time multiplier settings (TMS). This study presents another way to linearize these models by doing the opposite where TMS are fixed and PS are varied for both standard models. These linearized models can be used to effectively tune the objective functions of ORC problems to achieve both performance criteria; the solution quality and the processing speed.
Presenter bio: Ali R. Al-Roomi received the B.Sc. degree in process instrumentation and control engineering and the M.Sc. degree (Hons.) in electrical engineering from the University of Bahrain, Sakheer, Bahrain, in 2006 and 2014, respectively. He received the Ph.D. degree (full GPA) in electric power systems engineering in 2020, Dalhousie University, Halifax, NS, Canada. In 2007, he was with Moore Control and Engineering (MCE) Middle East, Manama, Bahrain, as a Project Engineer. Then, he joined Yokogawa Middle East, Nuwaidrat, Bahrain, as a DCS Subsystem and Graphics Engineer. From 2008 to 2012, he was with Aluminum Bahrain B.S.C., Askar, Bahrain, as an Instrumentation and Control Maintenance Engineer in its power stations, in both generation and auxiliary sides. From 2013 to 2015, he was an Instrumentation, Control, and Protection Engineer with Riffa Power Station, Riffa, Bahrain. His current research interests include power operation, power protection, state estimation, smart grid, power system design and analysis, system realization and integration, load forecasting, machine learning, and meta-heuristic optimization algorithms.
pp. 423-428

11:42 Using a Low Power MCU to Control Operation Frequency to Increase DC-DC Buck Converter Efficiency in the Light Load 

Y. W. Bai and Shu-Jung Lin (Fu Jen Catholic University, Taiwan)
Step-down DC-to-DC power converters are widely used in electronic modules such as motherboards, Video Graphics Array cards, server power supplies, car chargers, etc. The main purpose of these power converters is to convert high voltage buck into a variety of different voltages for those modules requiring different voltage levels. In this design, the microprocessor

control unit (MCU) is used to sense the converter output current and then the MCU is used to control the duty cycle of the pulse width modulation (PWM) operating frequency of the converter. This design can adjust the PWM operating frequency with the magnitude of the output current in order to both reduce any power loss of the converter and to improve the power conversion efficiency. The experiments show that the conversion efficiency control can reduce the electronic module's temperature.

Presenter bio: Ying-Wen Bai is a professor in the Department of Electronic Engineering at Fu-Jen Catholic University, Taiwan. His research focuses on mobile computing and microcomputer system design. Ying-Wen Bai obtained his M.S. and Ph.D. degrees in electrical engineering from Columbia University, New York, in 1991 and 1993, respectively. Between 1993 and 1995, he worked at the Institute for Information Industry, Taiwan.

pp. 429-434

12:00 Demand Charges Minimization for Ontario Class-A Customers Based on the Optimization of Energy Storage System

Abdeslem Kadri and Farah Mohammadi (Ryerson University, Canada)

emand charges (DC) is one of the major utility charges especially in the case of large electricity customers. The Energy Storage System (ESS) can be optimized to minimize these charges. For instance, a large consumer can minimize his DC by incorporating an ESS that charges during his low-consuming hours and discharges during his high-consuming hours. In other words, the ESS can shave the high peak powers of the customer's load profile to ensure lower DC. In this way, the large electricity customer will be able to save a big portion of his/her energy bill of which the DC is a part. This paper presents an optimization formulation for the sizing and scheduling of the ESS to minimize the energy monthly bill through the minimization of DC. Based on the market regulations of Ontario (Canada), this study investigates the potential of using the ESS for DC minimization based on real data for a large class-A Canadian electricity customer in Ontario. The results demonstrate the effectiveness of the proposed ESS deployment algorithm in minimizing the overall energy bills of the class-A customer.

pp. 435-438

12:18 Primary Frequency Control in Islanded Microgrids Using a Novel Smart Load

Javad Khodabakhsh and Ebrahim Mohammadi (Western University, Canada); Gerry Moschopoulos (University of Western Ontario, Canada)

Islanded microgrids are an inexpensive way to supply electricity to consumers in remote areas. They consist of synchronous diesel generators, distributed generators (DGs) that use renewable energy resources, energy storage systems (ESSs), and loads. The low inertia of the DGs; however, interfaces increase the complexity of frequency control in islanded microgrids and increases the possibility of system instability. In this paper, a new frequency control framework that is based on using single-stage AC-DC converters as virtual synchronous machine (VSM) smart loads to emulate the behavior of a synchronous machine (SM) is proposed to increase system inertia and reduce frequency oscillations. The AC-DC converter is based on a new topology that has been proposed by the authors. In this paper, the topology and the control system are explained and an IEEE 37 bus test feeder with the smart loads is simulated as an islanded microgrid. It is shown that using the proposed smart load results in frequency fluctuations being damped considerably faster.

pp. 439-442

SE-1: Sustainable Energy

Chair: Hamed Aly (Dalhousie University, Canada)

10:30 Effect of Varying Threshold Voltage on Efficiency of CMOS Rectifiers for Piezoelectric Energy Harvesting Applications

Xingwen Li (University of Toronto, Canada); Seyed Nabavi and Lihong Zhang (Memorial University of Newfoundland, Canada)

In this paper, the efficiency of a conventional cross-coupled gate CMOS bridge rectifier used in MEMS (microelectromechanical system) piezoelectric energy harvesters is investigated. The MOSFET threshold voltage is varied between 10 mV and 800 mV to evaluate the performance of the circuit for various threshold voltage levels. The circuit is simulated using the 130 nm CMOS technology process for each MOSFET to generate performance metrics for the rectifier. The results are evaluated for optimal load resistance, and it is confirmed that a lower threshold voltage results in significant improvements to the efficiency of the rectifier at lower input voltage amplitudes, with up to 62% at 0.5 V input amplitude when a smoothing capacitor is placed across the load.

pp. 443-446

10:48 DC and AC Voltage Investigation in Isolated and Grid-connected Hybrid Microgrid

Mouhamadou Thiam (Ecole Polytechnique de Thiès); Sengthavy Phommixay (Université du Québec à Trois-Rivières, Canada); Moustapha Diop ('Ecole Normale Supérieure d'Enseignement Technique et Professionnel); Mamadou Lamine Doumbia (Université du Québec à Trois-Rivières); Mamadou Wade (Ecole Polytechnique de Thiès, Senegal)

This article investigates the grid connection impact on the DC and AC bus voltage of a microgrid composed of a photovoltaic generator (PV), a battery storage system (BESS), a diesel power generator (DPG). This microgrid is connectable to the local distribution grid. A conductance increment algorithm is implemented for the maximum power point tracking (MPPT) of the PV modules. Proportional-integral (PI) control is used for MPPT and DC bus voltage regulation through the bidirectional battery connected converter. A three-level inverter controlled by space vector pulse width modulation (SVPWM) is proposed and is connected through the LC filter to interface with the AC bus, diesel generator, and grid. Two scenarios are investigated: isolated and grid-connected operation modes.

pp. 447-452

11:06 A Study on the Performance of PV Modules in Snowy Conditions Considering Orientation of Modules

Ebrahim Mohammadi and Javad Khodabakhsh (Western University, Canada); Gerry Moschopoulos (University of Western Ontario, Canada); Roohollah Fadaeinedjad (Gaduate University of Advanced Technology, Iran)

The performance of a photovoltaic (PV) system is significantly affected in snowy conditions. Snow accumulation on a PV module causes the shadow on the module and as a result the irradiance level received by the module and its generated power are reduced. During the snow removal and snow sliding on a PV module, its performance can be different considering the module landscape or portrait orientations, the number and location of bypass diodes, used in the module. In the present study, a snowcovered PV module is modeled using MATLAB/Simulink software considering the

snow sliding as the snow removal process. A commercial PV module with three bypass diodes is modeled and its performance is investigated in snowy conditions considering portrait and landscape orientations. The result of the study shows how the module orientation and bypass diodes affect the performance of the PV system in snowy conditions. The results of the study can be considered as practical guidelines for installing different PV modules in snowy conditions.
pp. 453-456

11:24 Data Driven Approach for Reduced Value at Risk Forecasts in Renewable Power Supply Systems 

Behrouz Banitalebi, Srimantoorao Appadoo and Aerambamoorthy Thavaneswaran (University of Manitoba, Canada)
Electricity production from renewable resources such as wind and solar has increased uncertainty in the electricity supply chains. This uncertainty fluctuates the electricity price and consequently causes a highly volatile electricity market which eventually increases the value at risk (VaR) of electricity price. Therefore, production managers need to have an accurate forecast of electricity price as well as VaR before making any plan for further production. In this work, performance of exponentially weighted moving average (EWMA) and recently introduced generalized-EWMA (G-EWMA) have been evaluated for VaR forecasting. Both methods have been applied to electricity price dataset of different Canadian provinces. The results of our real data analysis show that G-EWMA perform more accurately than EWMA. In addition, it is revealed that Ontario has the highest electricity VaR among other Canadian provinces and it might be the consequence of participation of wind and solar power plants in electricity production system. Electricity market, that is responsible for scheduling electricity buyers and sellers, should also use forecasting tools for matching supply and demand to avoid any sudden change in electricity price. Double exponential smoothing (DES) and triple exponential smoothing (TES) forecasting methods, have been used for electricity supply and demand forecast. Our analysis show that, DES forecast of supply/demand outperformed more accurately than TES.
pp. 457-462

11:42 Optimal Demand Control of Electric Water Heaters to Accommodate the Integration of Plug-in Electric Vehicles in Residential Distribution Networks 

Majid Moradzadeh and Morad Abdelaziz (University of British Columbia, Canada)
The large-scale adoption of PEVs can result in an increased peak demand of the residential distribution network and in an increased distribution transformer loss of life. This study investigates the potential use of household electric water heaters (EWHs) to eliminate such adverse impacts. To this end, we propose optimizing the thermostat set-points of the EWHs in residential houses with the objective of minimizing the energy cost associated with the residential houses having PEVs. The problem is formulated as a mixed integer linear programming (MILP) problem. The proposed MILP problem considers the random behavior of the PEVs charging demand as well as the uncertainty associated with the hot water consumption rate of the EWHs. The developed MILP model was built in GAMS environment solved using CPLEX solver.
pp. 463-468

12:00 Site Selection Criteria for Battery Energy Storage in Power Systems 

Zeenat Hameed and Seyedmostafa Hashemi (Technical University Denmark, Denmark); Chresten Træholt (Denmark)

Battery energy storage systems (BESSs) have gained potential recognition for the grid services they can offer to power systems. Choosing an appropriate BESS location plays a key role in maximizing benefits from those services. This paper aims at analyzing the significance of site selection for placement of BESS in a power grid by providing a techno-economic evaluation with respect to specific grid services it can deliver, and benefits that can be extracted from those services in the form of revenue streams. The Focus of the previous studies extended in this direction has been limited to the optimization techniques and software tools being used for BESS siting. However, questions around the benefits that stakeholders can derive from BESSs located at different levels of power network still remain unanswered. This paper handles those questions by drawing a link between technical considerations essential for BESS placement and their economic evaluations.

Presenter bio: Zeenat Hameed is a first year Ph.D. student at Technical University Denmark in the Department of Electrical Engineering. Her research work is focussed on grid-connected battery storage systems. She has a keen interest in renewable energy technologies and has previously completed her master's in Renewable and Sustainable Energy from Monash University, Australia.

pp. 469-475

12:18 Voltage Stability Constrained Low-Carbon Generation & Transmission Expansion Planning 

Vahid Asgharian (The University of British Columbia, Canada); Morad Abdelaziz (University of British Columbia, Canada)

Environmental concerns and limits on CO2 emissions entail expanding the capacity of renewable generation units. However, the increase in the renewable generation capacity can significantly impact the hosting power system voltage stability. Therefore, the consideration of voltage stability in the expansion planning problem is of an increasing importance. In this paper, we present a multi-stage low carbon voltage stability constrained generation and transmission expansion planning (G&TEP) model. The developed G&TEP model accounts for the investment and operation costs of generation units and transmission lines, as well as the load and wind curtailment costs, and determines the optimal installation year and location for transmission lines and generation units to meet the anticipated load demand increase. The voltage collapse proximity indicator (VCPI), which is a line voltage stability index based technique, is used to account for the voltage stability of the developed expansion plans. To this end, the VCPI is incorporated in the G&TEP model to guarantee an acceptable level of voltage stability for the developed expansion plans over the planning horizon. The effectiveness of the proposed framework is validated using numerical cases studies on the IEEE 24-bus RTS test system developed in General Algebraic Modeling System (GAMS) environment.

Presenter bio: Vahid Asgharian (Student member, IEEE) was born in Maragheh, Iran, in April 1989. He received the B.Sc. and M.Sc. degrees in electrical engineering from power and water university of technology (PWUT), Iran, in 2012 and Istanbul Technical University (ITU), Turkey, in 2016, respectively. He is currently working toward the Ph.D. degree in electrical engineering with University of British Columbia (UBC). His research interests include generation and transmission expansion planning and investment, power system decarbonization and operation, power market, distribution systems, and optimization methods.

pp. 476-480

Tuesday, September 1 14:00 - 15:00

KEY-3: Keynote Speaker 3

Chair: Abdallah Shami (Western University, Canada)

Tuesday, September 1 15:15 - 17:15

CN-3: Communications and Networking

Chair: Amr El-Wakeel (Queen's University, Canada)

15:15 Management Emulation of Advanced Network Backbones in Africa: 2019 Topology

Jose-Ignacio Castillo-Velazquez and Luis-Carlos Revilla-Melo (Autonomous University of Mexico City, Mexico)

AFRICACONNECT is formed by three advanced networks in Africa: UBUNTUNET, WACREN and ASREN connecting National Research and Education Networks in 29 countries in Africa. Each backbone infrastructure has been evolving and updating, adding bandwidth and backbones router´s capability till today. IPv6 Connectivity and management assessment emulation were developed using the AFRICACONNECT´s 2019 backbone topology. Results showed GNS3 emulator capabilities when using high performance backbone networks, but it also offers a top-down view which could support strategic decisions for the evolution of this kind of networks

Presenter bio: José-Ignacio Castillo-Velázquez [M´02, SM´10] has been working for 23 years in computer and telecommunication industries and universities involved in 90 national & international projects. He authored 39 international journal and conference papers, 3 books, 16 industry articles & tech reports and 100 popular Sci. & Tech. articles. Referee for Springer and IEEE Journals and Conferences. He is Professor & Researcher in Telecommunications at Mexico City A. University (UACM), where he is head of Advanced Networking Laboratory. Also, he is a Datacenter Dynamics consultant. He received his B.Sc. & MSc. degrees in Electronics, with honors, from the B. Autonomous University of Puebla, Mexico. IEEE Computer Socciety Distinguished Lecturer (´15-´17), he received the IEEE CS Golden Core Member Award (´12). Some voluntering positions: IEEE Computer Soc. DVP Com. member (´18-´19), IEEE ComSoc LA Secretary & Mem. Dev. (´16-´17), IEEE Computer Soc. Board of Governors mem. & Audit Chair (´11-´14). General Chair for LASCCDC&N (´12). Editor in Chief for NoticIEEEro (´08-´11).

pp. 481-484

15:33 Dynamic Frame-Slotted Aloha in RFID Using Received Signal Strength Information

Gan Luan (Beijing University of Posts and Telecommunications, China); Norman C Beaulieu (Beijing University of Posts and Telecommunications BUPT, China)

Received signal strength information based dynamic frame-slotted Aloha (RSSI-DFSA) RFID is proposed to replace random slot access where idle and collided slots lead to low system efficiency. Tag coordinates are calculated from received signal strength information, and the slot is chosen based on the coordinates. Simulations show that RSSI-DFSA system efficiencies are 14.9%, 2.4%, and 2.1% higher, and the time efficiencies are 8.3%, 2.5%, and 1.8% higher than those of existing algorithms, when the path loss exponent is 4 and the standard deviations of the shadowing are 1, 2, and 3 dB.

pp. 485-489

15:51 GNS3 Limitations When Emulating Connectivity and Management for Backbone Networks: A Case Study of CANARIE

Jose-Ignacio Castillo-Velazquez and Alonso Delgado-Villegas (Autonomous University of Mexico City, Mexico)

Advanced networks born after commercial Internet, becoming national research and education networks around the world, as the internet version 2 for each country. Backbone internet infrastructure is so expensive that just few internet service providers in a country can invest and deliver those advanced networks. So, when academics wish to explore management in those backbone internet networks simulator or emulator must be used and GNS3 was chosen because this emulator supports backbone routers and Gbps links. Advanced networks have been evolving and updating its backbone´s infrastructure till Gbps and using backbone routers. In this work a connectivity and management emulation for the backbone topology of different advanced networks in the globe, emulator´s capabilities and limitations are shown when approaching to real backbone´s infrastructure but CANARIE is chosen the case.

Presenter bio: José-Ignacio Castillo-Velázquez [M´02, SM´10] has been working for 23 years in computer and telecommunication industries and universities involved in 90 national & international projects. He authored 39 international journal and conference papers, 3 books, 16 industry articles & tech reports and 100 popular Sci. & Tech. articles. Referee for Springer and IEEE Journals and Conferences. He is Professor & Researcher in Telecommunications at Mexico City A. University (UACM), where he is head of Advanced Networking Laboratory. Also, he is a Datacenter Dynamics consultant. He received his B.Sc. & MSc. degrees in Electronics, with honors, from the B. Autonomous University of Puebla, Mexico. IEEE Computer Socciety Distinguished Lecturer (´15-´17), he received the IEEE CS Golden Core Member Award (´12). Some voluntering positions: IEEE Computer Soc. DVP Com. member (´18-´19), IEEE ComSoc LA Secretary & Mem. Dev. (´16-´17), IEEE Computer Soc. Board of Governors mem. & Audit Chair (´11-´14). General Chair for LASCCDC&N (´12). Editor in Chief for NoticIEEEro (´08-´11).

pp. 490-493

16:09 Measurement and Analysis of Small Cell Splitting in a Real-world LTE-A HetNet

Haijun Gao, Japjot Bawa and Raman Paranjape (University of Regina, Canada)

Network densification is an important topic which has been studied during the past decades in the 4G heterogeneous networks (HetNets). Deployment of small cells and cell-splitting technique are aimed to increase network capacity, cell coverage, and total cell throughput in HetNets. However, most published literature is about theoretical analysis. In this paper, extensive measurements are conducted in a real-world LTE-A HetNet environment. The cell-splitting strategy is applied in a real-world LTE-A HetNet. Four directional antennas operate as one cell and two cells respectively in an indoor gymnasium in the University of Regina. Optimization technique such as ABS (Almost Blank Subframe) is utilized to mitigate interference and increase UE (user equipment) SINR inside the gymnasium. User's (both static users and moving users) average SINR and system cell throughput are used to evaluate the performance of the tests. Our results show that operating the small cells from one cell to three cells for the whole building, the SINR inside the gymnasium decreased from 29 dB to 5 dB ，and cell throughput decreased from 140 Mbps to 88Mbps. Even though the throughput performance of cells inside the gymnasium is slightly lowered, but overall network capacity of the building is enhanced.

pp. 494-499

16:27 A Fairness Guaranteed Dynamic PF Scheduler in LTE-A Networks 

Haijun Gao, Japjot Bawa and Raman Paranjape (University of Regina, Canada)

Resource allocation is always an essential and important task in LTE-A networks. The maximum gain will be achieved by properly allocating resource blocks (RBs) to users. In this paper, a new scheduler is developed by using the control theory and PF (proportional fair) scheduler. The fairness of user data rate is dynamically adjusted by setting a threshold in the new scheduler. A PI (proportional integral) controller is added on the generalized PF scheduler so that a closed-loop feedback system is formulated. In addition, the scheduler is verified using measured data with SINR of static users and moving users from a real-world LTE-A network environment. Comparisons are made among the results of the new scheduler, the PF scheduler, and measured data. The simulation results show that our scheduler can adjust the fairness and cell throughput properly according to the requirements from the designer's perspective. This lightweight and flexible scheduler will help base stations better allocate the resource blocks.

pp. 500-505

16:45 Honeybee Algorithm for Content Delivery Networks 

Rama Ferguson, Brody Voth, Zachary di Giovanni and Diego Felix de Almeida (British Columbia Institute of Technology, Canada); Michal Aibin (British Columbia Institute of Technology, Canada & Northeastern University, USA)

The rapid changes and increase of modern and cloud-ready services "on-demand" increase the utilization of Content Delivery Networks (CDNs) to deliver service and content to end-users efficiently. In order to minimize the communication cost and the average waiting time, it is necessary to send the end-users' requests to the best available servers. In this paper, we design and implement a Honeybee algorithm that adapts quickly to possible servers' downtime to avoid communication delays. We then compare it to other algorithms available in the literature. Finally, the evaluation is performed using various scenarios with networking issues, such as single server failures or natural disasters consisting of multiple server issues.

Presenter bio: Dr. Michal Aibin was born in 1989 in Poland. He began his doctoral studies at the Department of Systems and Computer Networks at the Wroclaw University of Technology in 2012, where he was twice awarded the Dean Award and a scholarship to the best Ph.D. students. He received his doctoral degree in June 2017 by defending the thesis: "Dynamic Routing Algorithms for Cloud-Ready Elastic Optical Networks." He currently upholds his first academic position, at the British Columbia University of Technology, Vancouver, Canada, in the Department of Computing, where he was awarded the Employee Excellence Award in the Applied Research category.

pp. 506-509

17:03 Safely Engineering Egress Traffic Changes 

Greg Sidebottom (Juniper Networks, Canada); Md Rashed Iqbal Nekvi (Western University & Juniper Networks Inc., Canada); Anwar Haque (Western Ontario, Canada)

Automation of Egress Peer Engineering (EPE) is an important topic for today's large-scale Internet service and content providers. Automatically applying large scale traffic changes is beneficial but also risky. In this paper, we formulate a model for EPE network traffic changes and their risks and

benefits. Using this model, we devise a heuristic algorithm that can automatically apply large scale traffic changes to efficiently obtain the benefit in a safe way.
Presenter bio: MD Rashed Iqbal Nekvi, PhD Research Assistant Dept of Computer Science Western University, Canada
pp. 510-516

PANEL-4: IEEE Women in Engineering

Chair: Mahsa Bataghva Shahbaz (Western University/Robarts Research Institute, Canada)

S 1-I: Future Trends and Emerging Technologies

Chair: Ayman Al-khazraji (University of Bahrain, Bahrain)

15:15 Multi-Agent Reinforcement Learning for the Energy Optimization of Cyber-Physical Production Systems 

Jupiter Bakakeu (Friedrich-Alexander-University of Erlangen- Nuremberg, Germany); Dominik Kisskalt (Friedrich-Alexander-Universitaet Erlangen-Nuernberg, Germany); Joerg Franke (FAPS, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany); Schirin Baer, Hans-Henning Klos and Joern Peschke (Siemens AG, Germany)
The paper proposes an artificial intelligence-based solution for the efficient operation of a heterogeneous cluster of flexible manufacturing machines with energy generation and storage capabilities in an electricity micro-grid featuring high volatility of electricity prices. The problem of finding the optimal control policy is first formulated as a game-theoretic sequential decision-making problem under uncertainty, where at every time step the uncertainty is characterized by future weather-dependent energy prices, high demand fluctuation, as well as random unexpected disturbances on the factory floor. Because of the parallel interaction of the machines with the grid, the local viewpoints of an agent are non-stationary and non-Markovian. Therefore, traditional methods such as standard reinforcement learning approaches that learn a specialized policy for a single machine are not applicable. To address this problem, we propose a multi-agent actor-critic method that takes into account the policies of other participants to achieve explicit coordination between a large numbers of actors. We show the strength of our approach in mixed cooperative and competitive scenarios where different production machines were able to discover different coordination strategies in order to increase the energy efficiency of the whole factory floor.
pp. 517-524

15:33 Light Weight and Low Power Multispectral MIPI Camera for Agronomy 

Aref Bakhtazad, Nicholas Mitchell and Jayshri Sabarinathan (University of Western Ontario, Canada)
A new multi-spectral camera configuration based on multiple sensors with multiple filters using CMOS sensors and MIPI protocol in a mobile processing technology platform is described. We introduce two schemes using the camera either in video mode or in trigger mode of operation. We show how accurate time management makes it possible to multiplex MIPI coded image data and achieve fast imaging. We compare the schemes. As system simplicity and low power consumption were our goals, we have no image buffer memory and our scheme is asynchronous in nature. However we will discuss means to decrease intra frame latency.

pp. 525-528

15:51 Customized Shape Detection Algorithms for Radiometric Calibration of Multispectral Imagers for Precision Agriculture Application

Nicholas Mitchell, Aref Bakhtazad and Jayshri Sabarinathan (University of Western Ontario, Canada)

Dual panel relative radiometric calibration is an important tool for multispectral imagers mounted on UAV's for small farm precision agriculture. A customized dual panel detection technique integrated into the multispectral calibration routine is developed in this work. Otsu segmentation was the most precise method to find square reflectance panels with a controlled background. Canny edge detection proved less noisy than Laplacian of Gaussian filters and more robust to environmental changes than Otsu's method. More post processing on the images was required inside of edge detection algorithms, as the zero crossing edge detection methods amplified noise inside the image. Both hole filling algorithms and morphological filters were employed to reduce the noise. Morphological erosion filters caused under segmented images. This resulted in the desired low false positive rates, and negative volume similarity metrics for the regions of interest. A fast and reliable dual reflection panel detection technique was implemented for radiometric calibration for small farm monitoring where time is of the essence.

pp. 529-532

16:09 Rapid Design Method for Generating Power System Stability Databases in SPS for Machine Learning

Teukam Dabou Raoult (Laval University, Canada); Innocent Kamwa (Hydro-Québec/IREQ, Canada)

Today, the electrical networks are subjected to various internal or external disturbances that are likely to affect their stability. In view of their complexities and sizes, it is important to understand and rapidly predict the behavior of power grids in reaction to these disturbances during their operations. Big data presents itself as an alternative for the fast and efficient prediction of the stable or unstable state of electrical networks. In this work, we will be presenting a simple and fast technic for generating a large amount of data stability on Matlab/Simscape Power System (SPS) for deep learning. This is to facilitate the use of machine learning in the power system, which is necessary for the extraction and classification of stability criteria. By performing a simulation from the pseudo code of i fault on each j lines of the IEEE 68 bus, we obtain large matrices of n time response signals per generator, for each of the p generation-load patterns in our database.

pp. 533-538

16:27 Measuring Electric Fields Produced by MRI Gradient Coils Using a Patch Antenna Probe

Arjama Halder (Research Assistant, Canada); Ali Attaran (Research Scientist, Canada); William Handler (Reasearch Scientist, Canada); Blaine Chronik (xMR Director, Canada)

As a part of this work a small patch antenna probe was developed to measure the variation in the electric field produced by gradient coils within an MRI in the presence of any active implantable medical devices (AIMDs). This probe was designed, fabricated, and tested within a gradient coil mimicking dB/dt exposure platform. A 2×1 cm small patch antenna followed by an

instrumentational amplifier was chosen to measure the electric fields. Probes were fabricated using a 4-layer PCB. The fabricated probe was used to monitor the electric fields within the coil. To verify the observed behavior of the probe a simulation study was performed using Sim4Life. This study aims to assess the performance of this probe in a tissue mimicking environment within the coil.
pp. 539-542

16:45 Data-Driven Performance Prediction Using Gas Turbine Sensory Signals 

Thambirajah Ravichandran (University of Waterloo & Tecsis Corporation, Canada); Yuan Liu, Amar Kumar and Alka Srivastava (Tecsis Corporation, Canada); Houman Hanachi (Algonquin College of Applied Arts and Technology, Canada); Glenn Heppler (University of Waterloo, Canada)
Performance of gas turbine engine (GTE) deteriorates with degradation and aging. Availability of the operating data from GTE and capability to perform data analysis provides an opportunity to identify short-term and long-term performance deterioration and relate to more difficult to detect components degradation. In this work, a data-driven and machine learning based predictive modeling framework has been developed for performing combined input and model selection towards generating easily interpretable, parsimonious and accurate regression models intended for gas turbine engine performance analysis. The proposed multistage predictive modeling framework incorporates the orthogonal least squares (OLS) learning and multi-criteria decision-making approach for selecting inputs and model structures in a computationally efficient manner while optimizing multiple objectives. The regression models obtained from this framework for predicting power and exhaust gas temperature (EGT) outputs using GTE operational data collected over a three year period have demonstrated short-term and long-term performance deterioration patterns for the GTE.
pp. 543-548

STSP-1: Signal Theory and Signal Processing

Chair: Radwa Sultan (Manhattan College, USA)

15:15 Assessment of Neuroplasticity Using EEG Signal in Rehabilitation of Brain Stem Stroke Patients 

Maryam Butt (The University of Wollongong, Australia); Golshah Naghdy, Fazel Naghdy, Geoffrey Murray and Haiping Du (University of Wollongong, Australia)
Robot-assisted motor training provides an efficient alternative to conventional rehabilitation methods used for poststroke patients. The re-learning of lost motor functions happens through neuroplasticity in the brain. Electroencephalogram (EEG) provides an effective method for assessing neuroplasticity. Movement-related cortical potential (MRCP), an EEG-derived time-domain pattern, indicates changes due to motor skills gained as a result of the training. This study aims to perform a two-stage robot-assisted rehabilitation program on brain stem stroke patients consisting of a total of 24 training sessions and to assess whether significant motor recovery and neuroplasticity induction are achieved after the first stage or after completing both stages of the designed rehabilitation program. Three brain stem stroke patients were recruited for hand motor training on AMADEO rehabilitation robot for 8 weeks consisting of two stages of 4 weeks each. Three assessments methods which include standard clinical tests, hand strength and range of movement measurements using AMADEO assessment tool, as well as EEG signal acquisition, were

performed at the beginning of all the training sessions (week 0), after completion of the first stage of rehabilitation (week 4) and after completion of both stages of the training sessions (week 8). The experimental results demonstrate that all brain stem stroke patients show significant functional hand motor recovery, as indicated by clinical tests, hand strength, and range of movement measurements, after completing 8 weeks of the training. Moreover, MRCP signal negative peak showed a significant decrease in its amplitude when the patients completed two phases of rehabilitation training, indicating neuroplasticity induction.
Presenter bio: I am a Ph.D. student at UOW, Australia. My research interest is to understand the effect of motor training on the brain signals acquired from stroke patient. I am working on EEG signal analysis during the robot-assisted rehabilitation training of post-stroke patients.
pp. 549-552

15:33 Modified ESTOI for Improving Speech Intelligibility Prediction 

Ahmed Alghamdi and Wai-Yip Geoffrey Chan (Queen's University, Canada)
Objective measures of speech intelligibility are commonly used as a practical alternative to expensive and laborious listening tests. The extended short-time objective intelligibility (ESTOI) measure has demonstrated high accuracy in predicting the intelligibility of speech corrupted by many types of degradation. In this paper we propose a modified version of ESTOI that is based on the glimpse model of speech perception in noise. Performance assessment against subjective data reveals that the modified ESTOI is equivalent to ESTOI on three data sets and slightly better than ESTOI on two data sets.
pp. 553-557

15:51 Average Plain Gradient Based Indirect Frequency Estimation Using Adaptive Notch Filter


Yue Yuan (China University of Petroleum-Beijing, China); Meiyi Qing (China University of Petroleum-Beijing & University of Calgary, Canada); Hua-qing Liang (China University of Petroleum, China)
The existing Adaptive Notch Filter (ANF)-based frequency estimation methods have problems of slow convergence speed, unstable error and limited selection of iterative initial values. In this paper, a frequency estimation method based on the indirect average plain gradient algorithm is proposed. It uses a new error function applied to the second-order adaptive Infinite Impulse Response (IIR) notch filter. The proposed error function is the mean value of the weighted average of the squares of the two signals outputted by Finite Impulse Response (FIR) and IIR sections of the ANF. It has better gradient characteristics, and arbitrary initial value can be selected for the following iterative calculation. The theory and simulation show that the proposed algorithm, compared with other indirect gradient algorithm, improves the convergence speed and estimation accuracy with little addition of the computation, while it is superior in varying-frequency signal tracking performance.
pp. 558-562

16:09 Turbo Receiver for Polar Coded OFDM Systems with Unknown CSI 

Siyu Zhang and Behnam Shahrrava (University of Windsor, Canada)
In this paper, a turbo receiver for polar-coded orthogonal frequency division multiplexing (OFDM) systems for frequency-selective fading channels with unknown channel state information (CSI) is

proposed. The receiver iteratively exchanges soft information between an expectation-maximization (EM) symbol detector and a soft polar decoder that is based on the belief propagation (BP) algorithm. By utilizing such receiver, the error-correcting performance of the system can be significantly improved even with unknown CSI. Simulation results show that by using the proposed turbo receiver, around 5dB coding gain at a bit-error rate of \(5 \times 10^{-2}/) can be obtained compared to the receiver that detects symbols and implements decoding separately with unknown CSI.

Presenter bio: Si-yu Zhang received his B.A.Sc. degree from Jilin University, China, in 2014 and his M.A.Sc. degree in electrical engineering from the University of Windsor, Ontario, Canada, in 2016. He is now pursuing the Ph.D. degree at the University of Windsor. His current research interests include PAPR reduction in OFDM systems, coding and information theory, especially the design of polar decoders for 5G wireless networks.

pp. 563-566

16:27 State-Space Randles Cell Model for Instrument Calibration 

Aaron J Fonseca and Roger Green (North Dakota State University, USA)

It is desirable to calibrate electrochemical impedance spectroscopy (EIS) instrumentation using a Randles circuit. This presents a challenge as realistic loads, simulated by this circuit, contain theoretical components (Warburg elements) that are difficult to model. This paper proposes a state-space solution to this problem that facilitates digital realizations of high accuracy Randles circuit approximations for the purposes of verifying and calibrating instrumentation. Using Valsa, Dvorak, and Friedl's network approximation of a Warburg element, a collection of state space relations describing the impedance of a Randles circuit are derived.

pp. 567-572

16:45 Implementation and Evaluation of LS-SVM Optimization Methods for Estimating DoAs

Somayeh Komeylian (Ryerson University, Canada)

Important technological advancement in designing smart array antennas has been encouraged many researchers to concentrate their work on the two main concepts of the direction of arrival (DoA) and beamforming techniques. The preliminary objective of beamforming techniques includes, electronically, the mainbeam in the direction of interest at a certain time and measuring the output power. In this scenario, the main practical challenge resides in achieving maximum output power in which the direction of steered mainbeam coincides with the direction of arrivals. Since the involved problems in most DoA estimation optimizations consist of a lot of unknown parameters including direction of arrivals, SNRs, signal waveforms and samples of noises in the array output, it may become impossible to build a large enough training dataset for covering the distributions for all the aforementioned test data. An alternative way to overcome this constraint which we aim at stressing in this work involves employing support vector machine algorithms for separating unknown components of the actual input in the higher dimensional feature space. In this work, we have implemented the decision directed acyclic graph (DDAG) and Vapnik-Chervonenkis (VC) methods for the least squares support vector machine (LS-SVM) algorithms for estimating DoAs. We have rigorously verified that DoAs are very much affected the antenna array geometries. In addition, we have investigated the quality of the communication channel by the concept of bit error rate (BER).

pp. 573-580

17:03 Evaluation of Path-Loss Models for THz Propagation in Indoor Environments 

Nagma Elburki (Université du Québec, Canada); Souheib Ben Amor and Sofiene Affes (INRS-EMT, Canada)

In this paper, we evaluate the path-loss models that can be adopted for indoor communications in the TeraHertz (THz) frequency band. Three different models are investigated versus distance; namely, the ITU, the log-distance (LD), and the multi-wall COST 231 models. The latter exhibits much higher path-loss than the other two because it is able to account more accurately for the interior obstacles of indoor environments.

Presenter bio: Nagma Elburki is currently pursuing PhD. (Telecommunication Engineering) in Wireless lab headed by Dr. Sofiène Affes. She has completed her Masters in Physics from University of Benghazi, Libya

pp. 581-585

Wednesday, September 2

Wednesday, September 2 9:00 - 10:00

KEY-4: Keynote Speaker 4

Wednesday, September 2 10:30 - 12:30

PEES-3: Power Electronics & Energy Systems

Chair: Javad Khodabakhsh (Western University, Canada)

10:30 Diagnosing Fuel Pumps, Power Transducers, CTs, and PTs via Fuel-Power Function and 2Oo3 Voting 

Ali R. Al-Roomi and Mohamed E. El-Hawary (Dalhousie University, Canada)

In power system operation, the actual operating cost of thermal generating units can be estimated by employing what is called a fuel-cost function. This function can be expressed as a linear, quadratic, or cubic equation. The unit operating cost is the dependent variable, while the independent variable can be the active or reactive power generated by that unit. The mathematical expression of this fuel-cost function is modeled by fitting a curve to match the actual unit readings. In regression analysis, it is known that if there is a relation between two variables, a transposed relation can also be created by making the predictor the subject of the formula instead of the response. In other words, the independent variable is taken as a dependent variable. This study aims to benefit from the fuel-cost function in estimating the unit power output. This means that a fuel-power function can be designed from the fuel-cost function. To validate this claim, a numerical experiment is carried out based on data collected from a real gas turbine (GT). A novel diagnosing system is proposed to check the status of fuel pumps, power transducers, current transformers, and potential transformers by merging the areas of power system automation, control, operation, and protection through a 2 out of 3 (2oo3) voting logic system.

Presenter bio: Ali R. Al-Roomi received the B.Sc. degree in process instrumentation and control engineering and the M.Sc. degree (Hons.) in electrical engineering from the University of Bahrain, Sakheer, Bahrain, in 2006 and 2014, respectively. He received the Ph.D. degree (full GPA) in

electric power systems engineering in 2020, Dalhousie University, Halifax, NS, Canada. In 2007, he was with Moore Control and Engineering (MCE) Middle East, Manama, Bahrain, as a Project Engineer. Then, he joined Yokogawa Middle East, Nuwaidrat, Bahrain, as a DCS Subsystem and Graphics Engineer. From 2008 to 2012, he was with Aluminum Bahrain B.S.C., Askar, Bahrain, as an Instrumentation and Control Maintenance Engineer in its power stations, in both generation and auxiliary sides. From 2013 to 2015, he was an Instrumentation, Control, and Protection Engineer with Riffa Power Station, Riffa, Bahrain. His current research interests include power operation, power protection, state estimation, smart grid, power system design and analysis, system realization and integration, load forecasting, machine learning, and meta-heuristic optimization algorithms.
pp. 586-591

10:48 A Moving Target Approach for Securing Secondary Frequency Control in Microgrids

Shichao Liu and Rahul Kosuru (Carleton University, Canada); Chuma Francis Mugombozi (IREQ/ Hydro-Québec, Canada)
Microgrids' dependency on communication links exposes the control systems to cyber attack threats. In this work, instead of designing reactive defense approaches, a proacitve moving target defense mechanism is proposed for securing microgrid secondary frequency control from denial of service (DoS) attack. The sensor data is transmitted by following a Markov process, not in a deterministic way. This uncertainty will increase the difficulty for attacker's decision making and thus significantly reduce the attack space. As the system parameters are constantly changing, a gain scheduling based secondary frequency controller is designed to sustain the system performance. Case studies of a microgrid with four inverter-based DGs show the proposed moving target mechanism can enhance the resiliency of the microgrid control systems against DoS attacks.
Presenter bio: Shichao Liu received the Ph.D. degree from the Carleton University, Ottawa, ON, Canada, in 2014. He is currently an Assistant Professor with the Department of Electronics, Carleton University. He is an Associate Editor of the IEEE Access and an Editorial Board Member of Smart Cities. His current research interests include analysis and resilient control of cyber-physical energy systems and reinforcement learning based microgrid control.
pp. 592-597

11:06 Stall Control and MPPT for a Wind Turbine, Using a Buck Converter in a Battery Storage System

Ali Yazhari Kermani (Graduate University of Advanced Technology, Iran); Roohollah Fadaeinedjad (Gaduate University of Advanced Technology, Iran); Alireza Maheri (University of Aberdeen, United Kingdom (Great Britain)); Ebrahim Mohammadi (Western University, Canada); Gerry Moschopoulos (University of Western Ontario, Canada)
This paper presents modeling and analysis of a stand-alone small-scale induction-generator based wind turbine, connected to a buck converter in order to achieve maximum power point tracking in variable wind speed conditions and charge a battery and feed a DC load. Also, this converter is responsible for stalling the turbine in conditions where wind speed exceeds the nominal value for the turbine. Several investigations have been carried out comprising different wind conditions, battery charging, and discharging.
Presenter bio: Master student at the graduate university of advanced technology, Kerman,Iran. Studying Electrical power systems engineering with the main focus on wind energy conversion systems and their power electronics.

pp. 598-601

11:24 Battery Storage System Optimization for Multiple Revenue Streams and Savings

Abdeslem Kadri and Farah Mohammadi (Ryerson University, Canada)

Battery storage systems (BSSs) can be employed for a variety of energy services. Saving in utility charges is one of the revenue streams that can be achieved using a BSS. Demand charges (DC)-one of the major utility charges, especially for large electricity customers-can be reduced using BSSs. Furthermore, a BSS can gain revenues from other services such as demand response (DR) and energy arbitrage (EA). This paper presents an optimization formulation for the sizing and scheduling of the BSS to minimize the monthly energy bill through minimization of DC. Moreover, it counts for EA's revenue as well as the participation in winter and summer DR programs. Based on the market regulations of Ontario (Canada), this study investigates the potential of using BSSs for DC minimization and profit maximization from both EA and DR using real data for a large class-A Canadian electricity customer in Ontario. The results demonstrate the effectiveness of the proposed BSS deployment algorithm in minimizing the overall energy bills of the class-A customers.

pp. 602-606

11:42 Elements of Networked Protection Systems for Distribution Networks and Microgrids: A Cyber-Security Perspective

Younes Seyedi (Polytechnique Montreal, Canada); Houshang Karimi (Ecole Polytechnique de Montreal, Canada); Santiago Grijalva (Georgia Institute of Technology, USA); Brunilde Sansò (Ecole Polytechnique de Montreal, Canada)

Networked protection systems use information, communication and computation technologies to collect and process sensor data from spatially distributed sensors, and launch protective and control actions by sending commands to local devices. Such protection systems are also capable of supporting specialized tasks including asset control and backup protection in case of traditional relaying failures. This paper explains the structure and the fundamental elements of the networked protection systems in distribution systems and microgrids. The overall system is divided into three subsystems which are interconnected by communication systems. Different types of cyber-attacks on the subsystems and their impacts are discussed from the vantage point of protection. False and delayed tripping, non-detection, cascading failures, and unstable operation of distributed energy resources (DERs) are discussed as the critical issues that can be related to cyber-attacks.

pp. 607-610

12:00 Analyzing the Resiliency of Microgrid Control Algorithms Against Malicious Input

Christopher Neal and Ranwa Al Mallah (Polytechnique Montreal, Canada); José M. Fernandez (Ecole Polytechnique de Montreal, Canada); Andrea Lodi (Polytechnique Montreal, Canada)

Microgrids (MGs) have been proposed to meet some of our electricity needs by incorporating renewable energy sources and energy storage systems into isolated portions of the electrical distribution network. The coordination of these MG devices is performed by a centralized controller which can act in an unanticipated manner when faced with falsified input caused by a cyberattack. MG security research generally focuses on characterizing or preventing attacks on MG devices and communication infrastructure. We instead investigate security concerns in MG control logic and

analyze how the underlying control algorithm may be exploited. This paper demonstrates a framework for uncovering vulnerabilities in MG controller algorithms that could be exploited by a cyber-capable adversary. Experimental results using a simulated MG developed in Matlab/Simulink show the controller is less performant when faced with various False Data Injection (FDI) attack scenarios.
pp. 611-616

S 2-H: Future Trends and Emerging Technologies

Chair: Ahmed Farouk (Wilfrid Laurier University, Canada)

10:30 A Deep Manifold Representation for Information Discovery 

Lei Gao and Ling Guan (Ryerson University, Canada)
Information discovery plays a vital role in the success of various machine learning and data-driven tasks. In essence, it is a process of exploring useful knowledge from input data sources. In this paper, a deep manifold representation method is proposed for information discovery, consisting of multistage manifold filters, a hashing transform and a histogram operation. Specifically, a manifold method, locality preserving projections (LPP) is utilized for constructing multistage filter banks in different layers, followed by a hashing transform and a histogram operation to generate the final manifold representation. In the proposed method, not only is the intrinsic local structure revealed by LPP, but also the abstract representation from different levels is explored by multistage filters, leading to better data representation for information discovery. To demonstrate the effectiveness of the proposed strategy, we conduct experiments on two visual analysis and recognition tasks. Experimental results show that the proposed method is superior to the related methods.
pp. 617-620

10:48 Dynamics Targeting Through Cell Membrane: MD Simulation Approach in CNT-Based Drug Delivery Application 

Nafiseh Sohrabi (York University, Canada); Maysam Zamani Pedram (University of Calgary & KN Toosi University, Canada); Ebrahim Ghafar-Zadeh and Sebastian Magierowski (York University, Canada)
Nowadays, a carbon nano (CN) structure is used in a variety of biomedical applications, including cancer disease diagnostics and subsequent treatments. Among the various types of CN, carbon nanotube (CNTs) has been implemented by many research groups for an array of life science applications. Because of the microstructure shape of Nanotube they can be widely used in carrier and separation applications. Conjugation of CNTs with proteins, drugs and magnetic nanoparticles provides the chance of targeting and trajectory manipulation. Moreover, the force needed for crossing through a specific area such as cell membrane or tissue is essential for successful targeting. In this paper, we studied functionalized CNTs' controlled delivery crossing through the cell membrane. All interaction effects have been carried out by MD (Molecular Dynamics Simulation). Mathematical modelling of the cell membrane and proposed delivery system as an input-output (velocity-force) system has been considered. Dynamics equations of CNTs were defined in the time and frequency domain using control theory methods. This system dynamic helps the researcher to analyze the movement dynamics of an accurate model during the time. Data are collected from MD simulation and a linear model is estimated. This model has been calculated by the identification method based on the MATLAB toolbox.

pp. 621-624

11:06 A Non-Invasive Wireless Respiratory Monitoring System for Animals' Behavioural Studies

Kuanghua Qiao, Amanda Nickerson, Suzanne MacDonald and Ebrahim Ghafar-Zadeh (York University, Canada)

This paper presents a novel non-invasive wireless device for animal breathing measurement. The flexible sensor is used to convert the berthing rate into a parodic resistive change. An interface circuit is designed to accurately measure the resistive signal, detect the breathing rate and transfer it to the computer wirelessly. We demonstrated and discussed the functionality of the proposed system on a dog. Based on this result, the proposed system can reliably be used for animal behavioral studies.

pp. 625-628

11:24 A New Capacitive MEMS Flow Sensor for Industrial Gas Transport Monitoring Applications

Abbas Panahi (York University, Canada); Pouya Ghasemi (Iran University of Science and Technology, Iran); Sebastian Magierowski and Ebrahim Ghafar-Zadeh (York University, Canada)

This paper introduces a new MEMS microcantilever chip for mass flow rate and flow velocity measurement in a harsh environment where combustible gas flows are the working fluid. In such a condition, using thermal flow sensors is hazardous and may threaten a staggering amount of investment and human lives by igniting the gas flow which might lead to an explosion. To overcome these drawback mechanical sensors are more desirables for such environments. Here we have designed a MEMS chip consist of 74 polysilicon microcantilevers that are operating based on a capacitive detection mode. There are microcantilevers with 50, 100, 250 and 400 µm in length and same thickness and wideness, 2µm and 50µm, respectively. This sensor is capable of measuring moderate flows up to 200 m/s in a 10 cm diameter pipes based on the current design for bypass. According to experimental results, the sensor output capacitance varied from 3.3445 pF to 3.350 pF for a range of flow between 0 to 30 m/s. We have shown that MEMS flow sensor can meet large size flow measurements in the industry.

pp. 629-632

11:42 Training a Neural Network for Lane Demarcation Detection in the Infrared Spectrum

Taufiq Rahman (National Research Council, Canada)

The retro-reflective characteristics of lane demarcations on roadways can potentially provide robust detection in the infrared spectrum even in poor lighting and weather conditions. This paper explores this idea by training a convolutional neural network using Darknet with YOLO to detect 9 classes of road lines from the Berkeley Deep Drive Dataset (BDD). Although BDD is composed of conventional colour images, they were converted to greyscale prior to training as a solution to the scarcity of datasets in the infrared spectrum. The trained model was evaluated on road scenes acquired by the infrared sensor of an Intel-Realsense camera. From the experimental results, it is concluded that object detection techniques primarily developed for localization and classification of objects in the form of bounding boxes are inherently unsuitable for detecting line shaped objects such roadway lane demarcations. In addition, despite the sub-optimal training and detection

approach, the performance showed potential for robust lane detection using infrared images.
pp. 633-636

12:00 Worker Safety Considerations for Deployment of Mobile Disconnect Switches on Transmission Lines 

Jahangir Khan and Mazana Armstrong (Powertech Labs Inc, Canada); Ali Moshref (BBA Inc., Canada)
Mobile disconnect switches allow electrical isolation on high voltage transmission lines where stationary switches are not available, or special switching is required. In particular, dropping/ picking part of a line and loop switching are two key applications of mobile switches. These switches are used in live-line environment. Therefore, several worker safety considerations must be taken into account prior to their deployment. Electrical clearance, grounding design, switch duty calculation and switching sequence - all needs to be assessed. This article provides a set of simplified methods for initial calculations, and an example of real-world deployment where many of these issues are addressed.
pp. 637-641

Wednesday, September 2 14:00 - 16:00

P1: Poster Session 1

Chair: Radwa Sultan (Manhattan College, USA)

14:00 Optimal Integration of DG for Improvement of Economy and Voltage in Distribution Network

Navdeep Kaur (Thapar Institute of Engineering and Technology Patiala, India); Sanjay Jain (Thapar University, India)
In this work, the optimal integration Dispersed Generators (DGs) is accomplished using both single as well as multi-objective optimization for single and multiple locations. The voltage deviation and overall economy indices are considered as objectives for the optimization. The multi-objective optimization is realized through fuzzy decision approach in which, fuzzy memberships are assigned to these indices and a multi-objective function (MOF) is formulated for optimization. In addition to this, multi-objective optimization is also attained through True Pareto based optimization. The formulations are executed by utilizing Particle Swarm Optimization (PSO) to achieve the optimum location and capacity of DGs. The numbers of DGs are limited by formulating clusters of buses based on base-case load flow. The suggested methodology is investigated on 69-bus radial distribution network (RDN) for optimal integration of single and multiple DGs.
pp. 642-646

14:18 Textile Design Generation Using GANs 

Raja Asim Fayyaz (FAST NUCES, Pakistan); Muaz Maqbool (National University of Computer and Emerging Sciences, Pakistan); Muhammad Hanif (FAST NUCES, Pakistan)
In this work, we propose a novel method for automated textile design patterns generation using generative models. We first improve the accuracy of state-of-the-art results in classification of textile design patterns by 2% through data cleaning and pseudo labeling. Then a new dataset which is an improvement of existing dataset is also proposed. On this new dataset we compare the performance of image generative models like Wasserstein Generative Adversarial Networks

Gradient Penalty (WGANs GP), Deep Convolutional GANs (DCGANs) and Convolutional Variational Autoencoders (CVAEs) for all classes separately and have evaluated the models using the inception score. We further use a style transfer model to combine multiple designs generated by WGANs GP, due to its better results among all three approaches and form more complex and appealing textile designs. Moreover we present results of unsupervised clustering of different patterns in the latent space captured by a CVAE.
pp. 647-651

14:36 Resource Allocation in CAT-M and LTE-A Coexistence: A Joint Contention Bandwidth Optimization Scheme

Radwa Sultan (Manhattan College, USA); Ahmed Refaey (Manhattan College, USA & Western University, Canada); Walaa Hamouda (Concordia University, Canada)
There are high expectations for IoT devices and networks concerning reliability, performance, quality, and long-term availability. Indeed, wireless connectivity is the most critical success factor for the IoT era. Recently, the cellular technologies focused on introducing new releases, like LTE Cat-M1, to provide global coverage and mobility for the IoT applications. However, the cellular spectrum is already congested, and adding new services will defiant the existing ones. Herein, the network key performance indicator (KPI) should be considered to enhance the resource management for LTE and LTE CAT M1 users. Tackling the coexistence between the aforementioned in the 1.4 Mhz band, three coexistence optimization problems are formulated. The first and the second coexistence optimization problems are formulated assuming higher IoT-traffic priority, and higher LTE-traffic priority, respectively. On the other hand, the third problem is formulated assuming that both the IoT-traffic and the LTE-traffic have the same priority. Afterward, a scheduling optimization solution algorithm is proposed using the interior point method. Finally, the performance of the proposed scheduling algorithm is evaluated via numerical analysis
pp. 652-657

14:54 A Highly Secure Platform That Supports Smart Locks

Wafa M Elmannai, Paige Isaiah, Rei Rexha and Marcia Rivera (Manhattan College, USA)
Nowadays, the demand of replacing traditional door locks with deadbolts that is controlled by electronic devices such as cell phones via Bluetooth or over WI-FI has increased. Although there are variety of smart locks on market, most of these devices are expensive and vulnerable due to security attackers such as network attackers and malware. In addition, these existing smart locks are limited in their capabilities. Therefore, we are proposing a reliable, secure and economical accessible platform that supports smart locks based on peer to peer communication. The enhanced secured communication will be provided through the designed application. In addition, Host Card Emulation (HCE) was adopted to create a virtual secure element. Three main components are used to test the proposed system that are Beaglebone Blue, NFC module and designed lock emulation circuit.
Presenter bio: Wafa M. Elmannai is an assistant professor. She received her Ph.D. in Computer Science & Engineering Department at the University of Bridgeport. Elmannai received $20,000 fellowship award of one year from AAUW for her Ph.D. research project, 2015. Wafa has been selected by the Connecticut Technology Council (CTC) for its 2015 Women of Innovation awards program. Wafa is a member of the technical program committees of many international conferences. As a leader, Wafa has been elected as the President of the Honor society of Upsilon Pi Epsilon chapter of the University of Bridgeport for 2015 term after she served as Vice President since 2012. She published more than 10 research papers in the most prestigious national / international conferences and journals. Wafa has research interests in the areas of WSNs, mobile communications, network security, quantum computing.

pp. 658-663

15:12 Trusted Boot for Embedded Systems Using Hypothesis Testing Benchmark

Sara Zimmo (The University of Western Ontario, Canada); Ahmed Refaey (Manhattan College, USA & Western University, Canada); Abdallah Shami (Western University, Canada)

Security has become a crucial consideration and is one of the most important design goals for an embedded system. This paper examines the type of boot sequence, and more specifically a trusted boot which utilizes the method of chain of trust. After defining these terms, this paper will examine the limitations of the existing safe boot, and finally propose the method of trusted boot based on hypothesis testing benchmark and the cost it takes to perform this method.

pp. 664-665

15:30 Unsupervised Manifold Alignment for Wifi RSSI Indoor Localization

Zain Khaliq and Paul Mirdita (Manhattan College, USA); Ahmed Refaey (Manhattan College, USA & Western University, Canada); Xianbin Wang (Western University, Canada)

There is a wealth of analysis techniques that researchers across the world are implementing for better indoor localization. The RSSI fingerprinting is one of many techniques used for indoor and outdoor localization. In addition, other fingerprints are used to assist in the localization collected from several sources such as camera, radar, and Lidar. Ideally, a combination of these sources is used to locate the same object. Precisely, these sources are collecting the same data using different dimensions ultimately building upon one big system. Due to different dimensions set by these sources, it often becomes difficult to train the overall system to achieve the task of localization. In this paper, we propose a technique that can be used to incorporate training multiple datasets from different dimensions (e.g. Lidar, camera, and radar) into one global dataset, then train it all at once. This technique is known as the Manifold Alignment. Our proposed manifold alignment algorithm bridges the gap, allowing the inclusion of multiple datasets in our application whilst constraining the computational time and storage that would be required for the system. We assume that our technique is embedded into our system and localization is achieved through either computing our proposed Manifold Alignment algorithm over a local device, edge server, or cloud. Results in this paper show how well the Manifold Alignment Algorithm is beneficial for a localization problem where it is implemented inside a machine learning model that computes the manifold of these datasets.

pp. 666-672

15:48 Lighting Protection of VSC-HVDC Transmission Systems Using ZnO Surge Arresters

Matheus Ataka, Lucas Bacci, Thiago Lima and Ronaldo Pereira (University of São Paulo, Brazil); Eduardo Costa (Universidade de Sao Paulo, Brazil); Luisa H. B. Liboni (Institute of Education, Science, and Technology of São Paulo, Brazil)

This paper proposes an analysis of the lightning performance of High Voltage Direct Current - HVDC transmission systems with Voltage Source Converters - VSCs. The lightning protection is composed of AC metal-oxide surge arresters at the sending and receiving ends of an HVDC transmission line. These lightning protection devices are projected to operate under AC power signal; nevertheless, there are several applications in which conventional AC surge arresters have been used in HVDC transmission systems with Line Commuted Converters - LCCs. In this context, this paper investigates the performance of this same lightning protection apparatus when applied to a VSC-HVDC transmission systems

pp. 673-677

16:06 ANN Daily Peak Forecast for Peak Demand Charges Management

Abdeslem Kadri and Farah Mohammadi (Ryerson University, Canada)

Demand charges (DC) is one of the major utility charges that represents a considerable portion of the electricity bill, especially in the case of large electricity consumers. Predicting the monthly peak of the facility helps manage peak demand charges (PDC). Forecasting of the monthly peak demand value of the facility is required to manage the PDC component of the energy bill. The monthly peak of a given class-A facility is a very specific and unique problem that requires an individual forecasting module for each facility because each facility is unique in its pattern of operation, energy consumption, and load profile. This paper proposes a methodology based on artificial neural networks (ANN) to forecast the daily peak demand of a given class-A facility to help manage its PDC. Based on the market regulations of Ontario (Canada), and the use of battery storage systems (BSSs) and real data for a large class-A Canadian electricity consumer in Ontario, the simulation results demonstrate the effectiveness of the proposed forecasting module in minimizing the DC cost of the class-A electricity customer. Using real class-A electricity consumer demand data, we show that our algorithm module is more consistent from day to day and provides a solution to peak demand problems.
pp. 678-682

16:24 Electromagnetic Noise and Vibration in PMSM and Their Sources: An Overview

Niccolo' Remus (University of Windsor, Canada); Mohammad Sedigh Toulabi (Fiat Chrysler Automobiles (FCA) US LLC, USA); Shruthi Mukundan and Himavarsha Dhulipati (University of Windsor, Canada); Wenlong Li (University of Windsor, unknown); Colin Novak and Narayan Kar (University of Windsor, Canada)

Due to the recent electrification trend in automotive industry, electric traction motors, specially permanent magnets synchronous motors (PMSMs) , have gained significant attention from the scientific community. One of the critical aspects of powertrain is noise and vibration generation. In this paper, an overview on the different sources of noise and vibration in PMSMs is presented, with specific attention and details about the mechanisms of noise generation related to the electromagnetic parameters of the machine, along with the most commonly used methods of analysis for noise and vibration. Noise is split into different categories depending on the nature of its source, and several phenomena affecting electromagnetic-generated vibrations are listed and analyzed, as this type of vibration is recognized to be the most critical type in PMSMs used in vehicle applications.
pp. 683-686

16:42 EMC Testing at Temperatures Other than Ambient

John Makaran (Fanshawe College, Canada)

The following paper proposes a method for performing all facets of EMC Testing at temperatures other than ambient. An examination of operational requirements of electronic assemblies is presented through an examination of operating temperature requirements for electronic assemblies from different industrial sectors. This is followed by examination of the requirements of EMC specifications, followed by a proposal of the specifications required for an ideal device to perform EMC testing at temperatures other than ambient.
pp. 687-691

17:00 Navigation and Obstacle Avoidance System in Unknown Environment

Jaspreet Singh (Manhattan College, USA); Ahmed Refaey (Manhattan College, USA & Western University, Canada); Aiman Erbad (Hamad Bin Khalifa University, Qatar); Amr Mohamed and Mohsen Guizani (Qatar University, Qatar)

Recently, drones have been used in many different applications such as search and rescue operations, extinguishing fires, and environment mapPing. As the number of moving drones

increases in the sky, the collisions risk increases. In this paper, we present a system model, prototype, and preliminary evaluation for UAV obstacle avoidance. The obstacle avoidance system prototype uses ultrasonic sensors for obstance detection, S-BUS communication protocol for drone control, and Savitzky-Golay filter for data smoothing.
pp. 692-695

17:18 Proposed Approach for the Rapid Detection of Corona Virus Using Quantum Dots 

Kazi Naziba Tahsin (University of Western Ontario, London, Ontario, Canada); Amin Rizkalla and Paul Charpentier (Western University, Canada)

A significant need exists for determining both the presence of the COVID-19 virus and the concentration (viral load). High performance size exclusion chromatography (HP-SEC) is an automated high throughput method for measuring macromolecules in the viral size range (~100nm) and can be used for detecting cultures. This paper proposes a detection method carried out by attaching ZnS Quantum Dots (QDs) with controlled surface chemistry to either antibodies or the COVID protein components and calibrating for detection using a multi-detector system including photoluminescence. This detection scheme can help identify each virus serotype by controlling the QD composition and surface ligand chemistry.

Presenter bio: A current challenge is the rapid need for new robust and accurate diagnostic methodologies for determining both the presence of the Covid-19 virus and the concentration (viral load). Such a methodology must be high throughput, low cost and targeted for the ~200nm diameter of the COVID virus. Polymer chemists and the global polymer industry have long relied on size exclusion chromatography (SEC or GPC) for measuring large molecules in the viral size range (20-200nm). Also, metal-based nanomaterials termed quantum dots (QDs) will be explored which can be targeted for specific attachment to COVID protein. By attaching the QDs to either antibodies or the COVID components, we can learn to detect and measure the virus particle size and concentration on-line using high performance SEC.

P2: Poster Session 2

Chair: Ahmed Elbery (Queen's University, Canada)

14:00 Engagement in a Virtual Learning on Two Social Networks of an Engineering Course Using the Social Network Analysis- an Approach Using a Case Study 

Samuel Eneje (Lancaster University, Canada & Technology Enhanced Learning, United Kingdom (Great Britain)); Shereefdeen Sanni (Federal University Oye Ekiti, Nigeria); Claudio Fagundes Pereira (Brazil)

This study aims to investigate learning engagements in two social networks-blog and Facebook, used for engineering course as a scale-up handle to examine the students 'participation in learning. The research question it used is finding the extent of student`s engagement on the formal and the informal virtual learning sites. Engineering students' class` social network sites were used for the class activity and dataset was built from their interactions which further provides the social network analysis and statistical tool data to analyze metrics and properties. Collaborated groups were created by social network analysis. It investigated the connections of participants and unveiled network structure of participants` interactions. It found that a structured network such as Facebook are better suitable for learning interactions than a slapdash structured social network site. The study also found that students are more inclined to the former than the blog. The results provide an enlightenment and prior step to choosing appropriate sites should learning be situated on social

network sites supplement to laboratory`s introductory.
Presenter bio: A Nigerian-Canadian, Formerly, Head of Electrical and electronic engineering department, Federal University, Oye-Ekiti, Nigeria. Had a stint as a doctoral fellow/researcher at Tshwane University of Technology, South Africa. Presently, a doctoral scholar at Lancaster University, United Kingdom. Working on Learning networks, Learning Analytics, management of virtual learning, Human-computer interactions, and interactive media for learning.
pp. 696-701

14:18 Vehicle Damage Classification and Fraudulent Image Detection Including Moiré Effect Using Deep Learning

Umer Waqas (Aithe, Korea (South)); Nimra Akram (Fatima Jinnah University, Pakistan); Soo Hwa Kim, Donghun Lee and Jeon Jihoon (AIthe, Korea (South))

Image-based vehicle insurance processing and loan management has large scope for automation in automotive industry. In this paper we consider the problem of car damage classification, where categories include medium damage, huge damage and no damage. Based on deep learning techniques, MobileNet model is proposed with transfer learning for classification. Moreover, moving towards automation also comes with diverse hurdles; users can upload fake images like screenshots or taking pictures from computer screens, etc. To tackle this problem a hybrid approach is proposed to provide only authentic images to algorithm for damage classification as input. In this regard, moiré effect detection and metadata analysis is performed to detect fraudulent images. For damage classification 95% and for moiré effect detection 99% accuracy is achieved.
pp. 702-706

14:36 Toward Versatile CMOS Capacitive Sensors for Cellular Monitoring

Hamed Osouli Tabrizi, Sebastian Magierowski and Ebrahim Ghafar-Zadeh (York University, Canada)

CMOS capacitive sensors have shown to be efficient label-free alternatives for optical methods in life-science applications. Their applicability to cellular monitoring for drug discovery has recently gained attraction. Solutions in the literature are typically customized for and tested by specific types of cells. This paper presents circuits and preliminary results to achieve a versatile CMOS capacitive sensor for cellular monitoring. A new circuit and testbench is demonstrated that enjoys high linearity and achieves more than two times higher dynamic range compared to the state-of-the-art. In addition, adjustable sensitivity allows achieving higher sensitivity than reported in the literature. Results are obtained based on the implementation of the circuits in TSMC 0.18 µm technology.
pp. 707-710

14:54 Live RF Image Transmission Using OFDM with RPi and PlutoSDR

Jay C Patel and Mae Seto (Dalhousie University, Canada)

Orthogonal Frequency Division Multiplexing (OFDM) is a multi-carrier digital communication technique which solves most of the digital communication problems such as inter-symbol interference (ISI), lower data rate, inter-carrier interference (ICI). It adds up an excessive amount of low data rate carriers to assemble high data rate communication system. Each low data rate carrier provides enough long symbol periods, which results in eliminating ISI. Orthogonality enables excellent feature providing each carrier a way to be closed spaced, although overlapped without ICI. The main contribution of this research is to demonstrate the OFDM concept in real time RF Communication while investigating its critical performance analysis. This framework integrates more than one embedded platforms such as RPi, Analog PlutoSDR and MATLAB. This may be an efficient way to transmit live images/video feed from one place to another for surveillance purposes. This research is more focused on transmitting live image taken with constant rate from

Rpi video-camera to Analog Pluto, which transmit image over Radio channel and receive the same with different PlutoSDR at remote location.
Presenter bio: Even before I knew that there exists a discipline called engineering, in my sophomore year I read an article on “Engineering has more impact on the world than any other profession.” which aroused my interest in engineering. This interest developed further during my industrial training program as I witnessed on more than one occasion the lack of appreciation for each other’s challenges between the technical & non-technical personnel even though both had common organizational targets. I was assistant professor in Parul University for year. Given my desire to be an all-rounded professional and build a bridge between innovation and technology, I had completed my masters degree from GTU in ECE and currently pursuing my PhD in Electrical and Computer Engineering in Dalhousie University. I completed my undergraduate degree in Electronics & Communications Engineering from Parul Campus (GTU). An experience that chiseled my analytical abilities. My work experience in the form of part-time roles, internships and co-ops at major firms like Bombardier Transportation, Alstom and in other firms like Hub Hopper, VTalent Global, in the areas of Advisory Services, RF Designing, Market Research and Business Development has vested in me the versatility and capability to contribute to any enterprise that I am a part of. My professional objective is to join a value driven organization, with the potential for career mobility and opportunities to make an impact. I am currently looking for roles in the fields of RF Designing, Technical Services, Advisory Services or Technology Consulting. I strongly believe that I have the necessary skills, determination, team player attitude and optimistic state-of-mind to live my passion. Please get in touch with me at jay.patel.in@ieee.org or patel.jay@dal.ca and I will be happy to discuss opportunities for internships, full-time employment as well as any academic or volunteer projects that can leverage my capabilities.
pp. 711-715

15:12 A Bedsheet for Baby Monitoring at Night: Measurement and Characterization Results

Samal Munidasa (York University, Canada); Parastoo Baghaei (University of Waterloo, Canada); Edward Shim and Olivia Lin (Studio 1 Labs, Canada); Ebrahim Ghafar-Zadeh (York University, Canada)
This paper presents the characterization of a smart bedsheet developed by Studio 1 Labs, which could be used to monitor the movement of an infant at night in order to detect and prevent sleep-related disorders. This smart bedsheet consists of an array of conductive fabrics to be used as pressure sensors to track the baby's movement. Electrical impedance spectroscopy (EIS) has been performed using the Metrohm Autolab potentiostat on a single and two-fabric interface. The results of this study will provide the information required to develop a sensitive and reliable smart bedsheet.
pp. 716-719

15:30 Image Saliency Analysis in Agricultural Environments: A Survey

Naiane Sousa (Universidade Federal de Goias, Brazil); Gabriel Vieira (Federal Institute Goiano, Brazil); Juliana Félix (Universidade Federal de Goiás, USA); Junio Lima (Instituto Federal Goiano, Brazil); Fabrizzio Soares (Universidade Federal de Goiás, Brazil & Southern Oregon University, USA)
Salience methods can contribute to the development of precision agriculture as they are based on non-invasive image analysis. Relevant data can be detected to support agricultural applications in

performing low-level tasks, such as highlighting areas of interest for processing in computer vision, inference, and decision making. In this study, we report a systematic review of the literature that presents and discusses computational saliency methods applied to the context of agriculture fields. We describe thirteen salience techniques and the primary purposes of them to solve agricultural problems. Our work is prone to contribute to future studies by pointing out research opportunities that can be investigated in harvesting, inspection, and crop monitoring processes.
Presenter bio: Associate Professor at Southern Oregon University (SOU) and Informatics Institute at the University of Goiás (UFG). Ph.D. in Electrical Engineering, MSc in Electrical and Computing Engineering, Graduated two programs: Computer Science and Data Processing. He works with Machine Learning, Image Processing, Computer Vision, Human-Computer Interaction, and Applied Computing. Nowadays, he is Computer Science Chair at SOU and advises Ph.D., Mastering, and Undergrad Students at UFG.
pp. 720-723

15:48 Evaluation and Detection of Gaps in Curved Sugarcane Planting Lines in Aerial Images

Bruno Rocha (Universidade Federal de Goias, Brazil); Gabriel Vieira (Federal Institute Goiano, Brazil); Afonso Ueslei Fonseca (Universidade Federal de Goiás, Brazil); Helio Pedrini (Institute of Computing, University of Campinas, Brazil); Naiane Sousa (Universidade Federal de Goias, Brazil); Fabrizzio Soares (Universidade Federal de Goiás, Brazil & Southern Oregon University, USA)
Sugarcane is one of the main crops in the world due to the economic value it promotes by selling its derivatives. A diversity of technologies has been developed to optimize agricultural activities and maximize the productivity of sugarcane crops. In this sense, our primary goal is to contribute to this research area by detecting planting lines and measuring their faults, including the evaluation of curved lines that substantially limit numerous solutions in practical applications. An automatic method that identifies and measures sugarcane planting lines through digital image processing techniques and machine learning algorithms is presented. The proposal is evaluated using a database of real scene images that was prepared with the support of a small unmanned aerial vehicle (UAV). Experimental tests show a low relative error of approximately 1.65\% compared to manual mapping in the planting regions. It means that our proposal can identify and measure planting lines accurately, which enables automated inspections with high precision measurements. In future work, we intend to continue developing the proposed method and use it as a management and decision support tool to sugarcane crops, as well as in growing other products such as corn and coffee.
Presenter bio: Associate Professor at Southern Oregon University (SOU) and Informatics Institute at the University of Goiás (UFG). Ph.D. in Electrical Engineering, MSc in Electrical and Computing Engineering, Graduated two programs: Computer Science and Data Processing. He works with Machine Learning, Image Processing, Computer Vision, Human-Computer Interaction, and Applied Computing. Nowadays, he is Computer Science Chair at SOU and advises Ph.D., Mastering, and Undergrad Students at UFG.
pp. 724-727

16:06 Visual Detection of Productive Crop and Pasture Fields from Aerial Image Analysis

Gabriel Vieira (Federal Institute Goiano, Brazil); Bruno Rocha (Universidade Federal de Goias, Brazil); Helio Pedrini (Institute of Computing, University of Campinas, Brazil); Naiane Sousa

(Universidade Federal de Goias, Brazil); Junio Lima (Instituto Federal Goiano, Brazil); Ronaldo Costa (University of Goiás, Brazil); Fabrizzio Soares (Universidade Federal de Goiás, Brazil & Southern Oregon University, USA)

The use of unmanned aerial vehicles (UAV) is expanding rapidly throughout the world. Nowadays, it is not hard to find some useful applications that use them in both urban and rural environments. Especially in the second case, the UAV is promoting significant changes in traditional agricultural activities. Thus, current technologies have been incorporated into inspection, surveillance, and agricultural management. In this study, we investigated some practical uses of aerial images in rural areas. A new method to allow a UAV to understand and interpret visual information from static imagery is presented. Tree detection and shadow segmentation are essential requirements for navigation and visual examination purposes. Therefore, our method deals with these tasks to be a starting point to enable a machine to perform visual inspections in production fields. The proposed method uses computer vision techniques as visual color enhancement, morphological operations, and segmentation approaches. We performed an evaluation of our system based on a dataset with different types of crop areas and pasture lands. Moreover, we assessed our approach to verifying tree canopy and shadow detection. We also verified delineating agricultural fields, and segmentation of sunlight exposed vegetation, as well as vegetation areas covered by shadows. A result shows that our approach provides an exciting and robust approach to be adopted in the field.

Presenter bio: Associate Professor at Southern Oregon University (SOU) and Informatics Institute at the University of Goiás (UFG). Ph.D. in Electrical Engineering, MSc in Electrical and Computing Engineering, Graduated two programs: Computer Science and Data Processing. He works with Machine Learning, Image Processing, Computer Vision, Human-Computer Interaction, and Applied Computing. Nowadays, he is Computer Science Chair at SOU and advises Ph.D., Mastering, and Undergrad Students at UFG.

pp. 728-731

16:24 Stereo Matching Optimization with Multi-baseline Trinocular Camera Model

Jie Wang, Chenglei Peng, Sidan Du and Yang Li (Nanjing University, China)

In this paper, we focused on accelerating the stereo matching by using multi-baseline trinocular camera model. To optimize matching cost calculation and cost aggregation steps, we designed a special scheme called the trinocular dynamic disparity range (T-DDR) by narrowing disparity searching range. Based on that, we proposed the T-DDR-SGM for trinocular stereo matching. Evaluation results showed that T-DDR-SGM could significantly reduce the computational complexity with slightly improving the accuracy. We proved that the proposed optimization methods for the trinocular stereo matching are effective and the trinocular stereo matching is useful for reducing computational complexity.

pp. 732-735

16:42 A Study of Jacobi-Fourier Moments via Image Reconstruction

Yubing Liang and Simon X. Liao (University of Winnipeg, Canada)

In this paper, we have discussed the computational aspects regarding to Jacobi-Fourier moments. A k×k numerical scheme has been applied to improve the computing accuracy of Jacobi-Fourier moments. To verify our proposed method, image reconstructions of the higher orders of Jacobi-Fourier moments have been carried out. The experimental results of reconstructing a testing image sized at 512 × 512 are highly satisfied. We have also conducted a study on image reconstructions from uneven order pairs of Jacobi-Fourier moments, {n,m}, and concluded that the order n and repetition m preserve the circular and radial pattern information of image, respectively.

pp. 736-741

17:00 A D-Type Flip-Flop with Enhanced Timing Using Low Supply Voltage 

Osama Naser Bondoq (PSUT, Jordan); Khaldoon Abugharbieh and Abdullah Hasan (Princess Sumaya University for Technology, Jordan)

This work proposes a novel master-slave latch D-type Flip-Flop. It consists of a reset-set slave latch and an asymmetrical single data input master latch. By reducing the number of stages and removing signal conditioning circuitry in the master latch, setup time has been significantly reduced and power consumption has improved. The proposed flip-flop is competitive to other state of the art low power flip-flops in addition to the conventional Transmission Gate Flip-flop (TGFF) in terms of performance, power consumption and area. In simulations, the proposed flip-flop has achieved up to 71.5% improvement in setup time, 36.5% improvement in D-Q delay time and up to 56.5% less power delay product (PDP) with 10% data activity compared to Topologically Compressed Flip-Flop (TCFF), which is a low power flip-flop. Further, it has achieved 11% smaller circuit area compared with TGFF. This work includes the proposed flip-flop's circuit schematic, layout design and simulations using Hspice tool with 28nm CMOS technology and a 1V supply voltage at 1 GHz clock (CLK).

pp. 742-745

17:18 A Low-Power 25GS/Sec Sample and Hold Circuit with Active-Load Inductors 

Abdullah Hasan, Khaldoon Abugharbieh, Muntaser Al-Mousely and Waseem Al-Akel (Princess Sumaya University for Technology, Jordan)

This work presents a novel design of a sample and hold circuit which operates at 25GS/s. The circuit consists of three main stages. The first stage is the input buffer which provides a high frequency boost using an active-load inductor instead of the commonly used passive inductor. The second stage is the switch stage which is responsible for sampling the input signal with high linearity. Finally, the output buffer is used to recover the high frequency component of the signal. The circuit is designed in 28nm CMOS technology used in digital circuits and uses a 1V supply. It is simulated using a 3GHz input signal that has a differential peak to peak voltage amplitude of 0.4V and a 25GHz sampling clock signal. The proposed circuit consumes a total power of 2.47mW and occupies an area of 0.005mm2. The achieved Effective Number Of Bits (ENOB) is 5 bits and the Total Harmonic Distortion, THD, is -40dB. The sampled signal has a droop rate of 0.35mV/psec.

pp. 746-749

P3: Poster Session 3

Chair: Mahsa Bataghva Shahbaz (Western University/Robarts Research Institute, Canada)

14:00 A 0.3V 15.6MHz 7T SRAM with Boosted Write and Read Worldlines 

Mohammad AL-Fayyad (Princess Sumaya University for Technology, Amman, Jordan); Khaldoon Abugharbieh (Princess Sumaya University for Technology, Jordan)

An ultra-low power 7T-based SRAM system is proposed. The seven-transistor cells are used with write and read wordlines boost assist circuits: WWLB and RWLB. A low power switching PMOS sense amplifier (SPSA) is also presented. The read and write assist circuits utilize charge pumps that generate voltages above VDD and below ground to improve speed of operation. The proposed

system works properly at a very low supply voltage equal to 0.3 V. For a 32 Kb system, typical power and energy consumption are 0.147 mW and 3.82 pJ, respectively. The operating frequency is 15.6 MHz and the static noise margin, SNM, is 55mV. All circuits were simulated in Hspice using 28nm CMOS technology devices.
pp. 750-753

14:18 A Non-Magnetic RF Balun Designed at 128 MHz Centre Frequency for 3 T MRI Scanners
Ali Dianat (University of Windsor, Canada); Ali Attaran (Research Scientist, Canada); Roberto Muscedere (University of Windsor, Canada); Blaine Chronik (xMR Director, Canada)
In this work, a non-magnetic RF balun is implemented for 3 T magnetic resonance imaging (MRI) scanners operating at 128 MHz to transform a balanced input signal from a dipole or loop antenna into an unbalanced output signal. It is fabricated on a low-cost, copper cladded four-layer printed circuit board (PCB), FR4 with a thickness of 1.57 mm and a copper thickness of 35 μm, with overall footprint of 11.6 mm × 12.2 mm. A comparison among the ADS RF momentum simulations and the measured results indicates a good agreement with the measured insertion and return losses of better than -1 dB and -13 dB, respectively, in a 50 Ω termination setting.
pp. 754-757

14:36 Dual-Modality Cardiac Data Real-Time Rendering and Synchronization in Web Browsers
Qi Zhang (Illinois State University, USA)
Multimodality medical data visualization can convey a significant amount of complementary image information from various sources into a single and meaningful display. Even though there have been publications on integrating multiple medical images into a unique 3D representation, there are no researches on rendering registered multiple medical data in web browsers and synchronizing the rendering results over Internet, especially in cardiac applications. Web-based multimodality medical data display is hampered by the large size of the dataset that makes the rendering and information streaming too slow to be applied in clinical diagnosis and treatment. In this paper, we introduce new algorithms and a software platform to address this issue. The presented research results take advantages of bidirectional network connection and hardware accelerated graphics shader processing to real-time fuse and display inner organ structures in web browsers and stream the rendering results over Internet, which will provide medical users with intuitive feedback in collaborative cardiac diagnosis and image-guided remote therapy.
Presenter bio: Dr. Zhang is an Assistant Professor in the School of Information Technology at the Illinois State University, and an adjunct faculty of the Western University. He obtained his Ph.D. degree from the Western University and Master's degree from the University of Waterloo with research focuses on computer graphics, medical visualization, virtual reality, data science, computer vision, networking, and information technology. He has been awarded various research grants and published more than 20 academic papers in peer-reviewed journals and conferences, a book chapter, and several industrial research publications.
pp. 758-762

14:54 Fuzzy Adaptive Control of a Knee-Joint Orthosis for the Smooth Tracking
Ebrahim Navid Sadjadi (Carlos III of Madrid & Tehran Polytechnic University, Spain); Behzad Moshiri (University of Tehran & University of Waterloo, Iran); Danial Sadrian Zadeh (University of Tehran, Iran)
The control problem for a knee orthosis of the human has been discussed in this paper. The goal is to achieve the best performance of the system (shank-orthosis) for tracking the recommended trajectory of a doctor, with the lowest level of variation in the tracking errors. Hence, a fuzzy adaptive control law has been designed to enhance the accuracy of the system tracking while

upholding the stability of the whole structure. We could demonstrate the superior performance and more accurate tracking of the proposed control strategy through several comparative simulations.
pp. 763-768

15:12 Foreign Artifacts Detection on Pediatric Chest X-Ray

Afonso Ueslei Fonseca (Universidade Federal de Goiás, Brazil); Leandro Luis de Oliveira (Federal University of Goias, Brazil); Jaline Mombach (University of Goiás, Brazil); Deborah S. A. Fernandes (Universidade Federal de Goias, Brazil); Rogerio Salvini (Universidade Federal de Goiás, Brazil); Fabrizzio Soares (Universidade Federal de Goiás, Brazil & Southern Oregon University, USA)

Chest radiography is one of the recommended imaging tests by the World Health Organization for childhood pneumonia diagnosis. In computer-aided diagnostic systems where radiography is the main input, its quality is crucial. The presence of foreign artifacts can, therefore, compromise the performance of these systems. In the radiography exam, foreign artifacts are very common, especially in children, due to the ingestion of objects and the need for immobilization of these patients by third parties. Identification tags, shirt buttons, catheters, tubes and in conventional scanned radiographs, fingerprints, tags, noise and inadequate brightness are some of the artifacts present. In this study, we present an efficient and very simple method for detecting and removing artifacts based on common digital image processing operations such as channel subtraction, edge detection, and morphological operations. We describe the proposed method and evaluate its performance in a database of 200 images. We show that it is robust to identify different types of artifacts regardless of their positions on the radiography. A visual inspection was used to measure the errors and the experimental results showed an accuracy of 0.98 and a processing time of about 375ms per image. As a result of this, the method demonstrates to be a very promising pre-processing tool.

Presenter bio: Associate Professor at Southern Oregon University (SOU) and Informatics Institute at the University of Goiás (UFG). Ph.D. in Electrical Engineering, MSc in Electrical and Computing Engineering, Graduated two programs: Computer Science and Data Processing. He works with Machine Learning, Image Processing, Computer Vision, Human-Computer Interaction, and Applied Computing. Nowadays, he is Computer Science Chair at SOU and advises Ph.D., Mastering, and Undergrad Students at UFG.

pp. 769-772

15:30 Feasibility Analysis of a Solar Water Pumping System in Pakistani Conditions: A Case Study

Usman Ashraf and Mohammad Tariq Iqbal (Memorial University of Newfoundland, Canada)

In this paper, a feasibility and cost analysis of a PV based solar water pumping system is conducted for Pakistani conditions. A site was selected (Mustafa Research Farm) which is located at Wasti Jiuan Shah Sadiqabad, Rahim Yar Khan Pakistan. It is around 96.97 hectares, which is watered by 5 pumping systems. For this area, an optimized system was designed using HOMER Software, load for one of the pumping system was found to be 7.412kW. After simulation, the system requirement came out to be 56.8kW capacity for PV panels, a power converter requirement of 8.34kW and 270, 12V 105Ah batteries. Overall, initial capital cost of the proposed system was found to be $129,920. At the end of the paper, the proposed feasible system details and possible future work are discussed.

pp. 773-776

15:48 A Novel Approach for Seasonality and Trend Detection Using Fast Fourier Transform in Box-Jenkins Algorithm

Hmeda Musbah (Canada, Canada); Hamed Aly and Timothy Little (Dalhousie University, Canada)

Forecasting is the first step to deal with the new generation of renewable energy systems. The accuracy of the forecasting techniques is very important. Time series technique is one of the powerful tools used for forecasting, but it works well with stationary data. In addition, non-stationary time series can cause unexpected behaviors or create a non-existing relationship between two variables. This work was motivated by the need of detecting the seasonality and trend for a given data. The trend and seasonality components are very important in dealing with forecasting. Based on the trend and seasonality we could use clustered regions and feed the clustered regions to a forecasting technique like ANN, WNN or Kalman Filtering. Then aggregating the forecasted data back again for a better performance. In this paper we use Fast Fourier Transform (FFT) in Box-Jenkins approach instead of Autocorrelation Function (ACF) for the seasonality and trend detection. The present study is validated using visual inspection, statistical tests and time series decomposition in identifying the trend and the seasonality by applying them to wind speed time series. The results of FFT technique and ACF are compared to the results of the most well-known techniques. The results show that some methods have minor limitations in determining either the trend or the seasonality compared to FFT.

pp. 777-781

16:06 Automation of Thermal Energy Storage in Homes Using Artificial Neural Networks

Balaji Venkatesh (University of Toronto, Canada)

About 60% of the energy consumed by homes in North America is for air conditioning. With about 78% of electric energy is generated by from fossil fuels in the US, this energy use contributes to greenhouse gas emissions and global warming. Residential solar energy is now becoming cost effective and is as cost effective electric energy from the electric grid. However, solar energy availability and energy required for air conditioning are mismatched with respect to time. This mismatch in availability and need necessitates the use of energy storage. In previous works, storage of energy in thermal air mass of homes has been proposed. However, the thermostat required for such application is very complex. In this work, an artificial-neural-network-based thermostat is proposed. A method to train the model for an average home is demonstrated with an example, and the method is shown to be effective.

pp. 782-787

16:24 Toward Smart Internet of Things (IoT) Devices: Exploring the Regions of Interest for Recognition of Facial Expressions Using Eye-gaze Tracking

Abdallah S. Abdallah (Penn State University, USA); Lisa Elliott (Penn State Erie - The Behrend College, Canada); Daniel Donley (Penn State Erie - The Behrend College, USA)

A significant portion of the internet of things (IoT) devices will become reliable products in our daily life if and only if they are equipped with strong human computer interaction (HCI) technologies, specifically visual interaction with users through affective computing. One of the major challenges faced in affective computing is recognizing facial expressions and the true emotions behind them. Despite numerous studies performed, current detection systems are ineffective at correctly identifying facial expressions with reliable accuracy, especially in case of negative expressions. Several research projects attempted to extract the recognition process that humans follow to identify facial expressions in order to replicate in smart machines without a significant success. This paper describes our interdisciplinary project whose goal is to extract and define the recognition process that humans follow when identifying the facial expressions of others. We monitor this process by identifying and analyzing the regions of interest participants look at

when they are shown static emotions samples under a specific experimental setup. This paper reports the current status of data collection, experimental setup, and initial data visualization.
pp. 788-791

16:42 Next Generation of Network Reference Architecture in K-12 Education Sector 

Mirza Kamaludeen (ig2 Group, Canada); Salam Ismaeel (Ryerson University, Canada); Sarah Asiri (ig2 Group, Canada)

In this paper, a new reference architecture serves as a guideline for the design, build and operation of K-12 School Districts computing network. It focuses predominately on the broadband wide area network and its protection from cyber threats. When fully implemented, it establishes the base of K-12 school connectivity to the Internet and partners and its cyber protection. The proposed reference architecture maintains the broadband centric secure SD-WAN. The main changes and enhancements are a) The extension of some security function to the cloud, with added security features and capacity; b) the upgrade of the SD-WAN appliance to an edge appliance, with SD-WAN and wireless LAN additions; c) a path towards integration of LAN and WAN (Singularity) and workload-driven design with user identification and authentication. The system and technology model follows the same path of current School Districts' network architecture; however, the component model has been updated, which leverages important technology and industry development.

Presenter bio: Salam Ismaeel is a Senior Data Scientist at Ontario Gov. and a researcher in the Computer Science Department/Ryerson University, Toronto, Canada. He served in academic positions and researcher for more than 15 years at the University of Technology, University of Baghdad and Future University. He has authored and co-authored over 35 refereed manuscripts and supervised over 20 students. He received his 1st Ph.D. in Computer Eng. from Al-Nahrain Uni. in 2003. He is in the process to have 2nd PhD in Computer Science by the end of 2019. His research interests span various topics in the areas of Cloud Computing, Energy-Aware Computing, and Data-Driven techniques and innovation in modeling and prediction. He has served as a reviewer and editor for several international journals and conferences. He regularly acts as a consultant to industry on various projects and is on several steering or advisory boards. He is a member of the IEEE and IEEE International Humanitarian Technology committee.

pp. 792-797