كلية الهندسة
College of Engineering
QATAR UNIVERSITY جامعة قطر

ELECTRICAL ENGINEERING DEPARTMENT NEWSLETTER

EED NEWSLETTER

VOLUME 3 ISSUE 1

INSIDE THIS ISSUE:

Message from the Head of the Department

2019 has been an year of accomplishments despite the numerous challenges.. I feel very proud and delighted of the department great achievements. Indeed, during this year, the Department prepared and submitted two proposals for new programs namely Mechatronics Program and Telecommunications Engineering Program. The new Mechatronics program proposal successfully passed the different processing steps of reviews and has reached the last step of approval by the University higher administration. The Telecommunications Engineering proposal has been submitted recently to the dean office and it is going through the first step of the review process.

In regards to the department intellectual and scholarship contributions to Qatar University, local society and the profession, the department successfully published considerable number of peer reviewed and highly indexed contributions 135 Journal papers and 96 conference papers in addition to 5 patents and 13 books and book chapters in 2019. Besides, the Department maintained its quality assurance process by assessing its Students' Outcomes according to its assessment plan and new ABET accreditation requirements.

Nevertheless, to cope with the digital transformation that the country and the word is witnessing, the department started gradually providing digitized courses and labs. Such as, Embedded Systems, Computer Networks, and Probabilities and Statistics, etc.

I congratulate all the faculty, staff and students in the department for their great achievements wishing them a good continuation.

I hope that you will enjoy reading this new issue of our newsletter.

Dr. Nasser Al-Emadi

Head of the Department

EE faculties and IEEE Qatar Section Election

Three members from EE department have been elected in IEEE Qatar section board. Dr. Ridha Hamila was elected as the new chair of IEEE Qatar Section and Dr. Atif Iqbal as vice-chair. Eng. Amith khandakar has been elected for the second time as the section secretary .

Dr. Ridha Hamila

New Chair

Dr. Atif Iqbal

New Vice-Chair

Eng. Amith Khandakar

New Secretary

IEEE QATAR SECTION

Editorial Team:

- Prof. Adel Gastli
- Prof. Atif Iqbal
- Dr. Muhammad Chowdhury
- Eng. Mohamed Elsayed

Faculty Achievements & Activities

Dr.Farid Touati

**Professor
Electrical Engineering
Department at Qatar
University**

Dr. Faycal Bensaali

**Associate Professor
Electrical Engineering
Department at Qatar
University**

Prof. Serkan Kiranyaz

**Professor
Electrical Engineering
Department at Qatar
University**

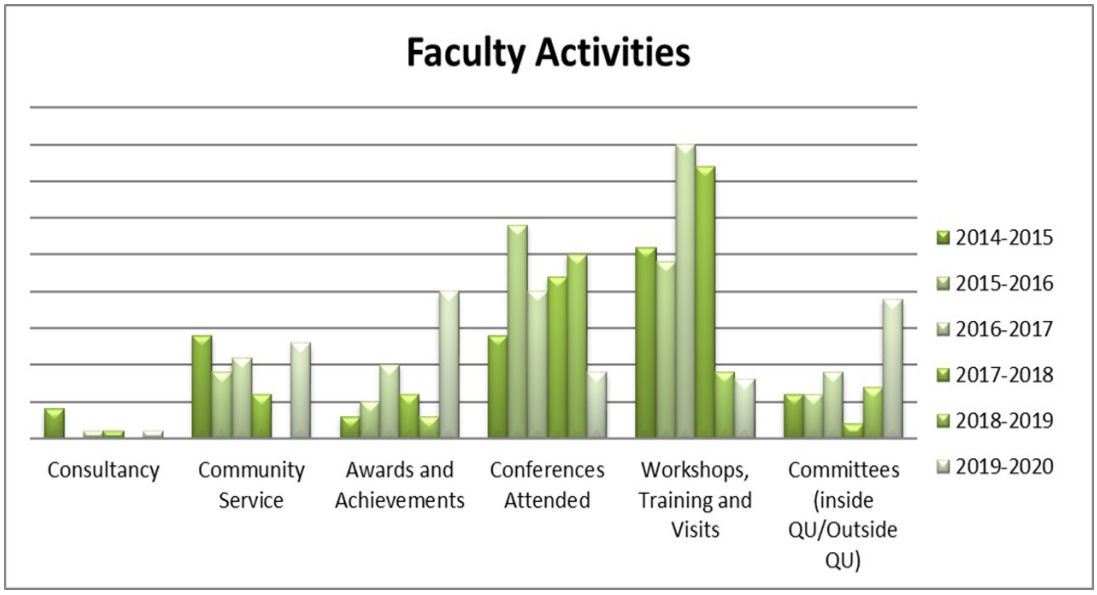
Seminars/Talks

Workshops

1) A workshop on Crowd Sensing and Management for Public Safety was organized on the 17th March 2019 at the EE department, with invited speakers from Industry, the traffic department and two guests from Canada.

Awards/Achievements

1) "Real-time vibration-based structural damage detection using one-dimensional convolutional neural networks," by Dr. Serkan Kiranyaz became the top most-cited paper in Journal of Sound and Vibration (Elsevier) among all papers published during 2016-2019.
2) Dr. Serkan Kiranyaz won the Research Excellence Award of Qatar University.
3) Dr. Serkan Kiranyaz won the Merit Award of Qatar University, September 2019.
4) Dr. Serkan Kiranyaz won the "1st Place Prize in the 2019 IEEE Engineering in Medicine and Biology Prize Paper Award" in November, 2019.
5) "Portable System for Monitoring and Controlling Driver Behavior and the Use of a Mobile Phone While Driving" by Amith Khandakar and Muhammad Chowdhury featured in a US Magazine titled "Veterans Weekly".
6) Dr. Faycal's undergraduate students secured 1st place in the Annual Undergraduate Research Experience Program (UREP) Competition held by Qatar Foundation in April, 2019.
7) Best Oral Presentation Award at the 17th IEEE Student Conference on Research and Development, awarded to Dr. Faycal Bensaali, October 2019.
8) Dr. Faycal Bensaali was awarded the Excellence in Teaching by the College of Engineering, May 2019.
9) Dr. Farid Touati was awarded a patent on "MULTI-PARAMETRIC ENVIRONMENTAL DIAGNOSTICS AND MONITORING SENSOR NODE", Patent No.: US10,429,367 B2, Date of Patent publication: Oct.1, 2019.
10) Dr. Tamer Khattab won best paper awards at the IEEE International Wireless Communications and Mobile Computing (IWCMC) 2019 conference in Morocco.




جامعة قطر
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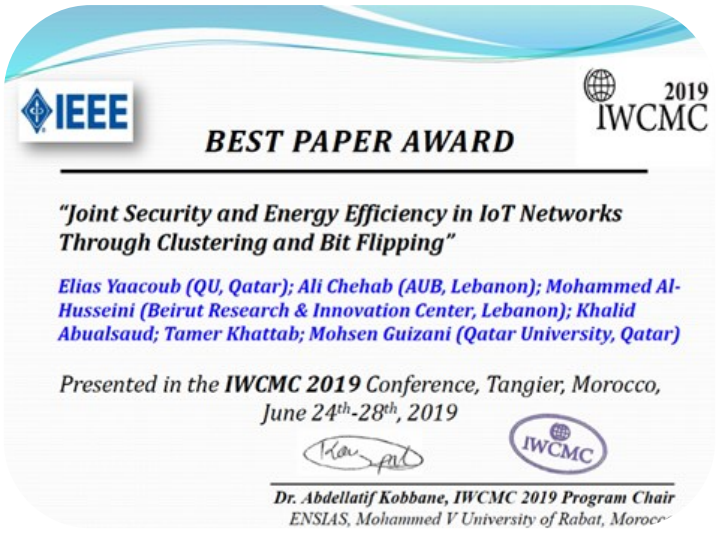
Annual Research
Forum & Exhibition
2019
Qatar University is pleased to present the 2019
RESEARCH EXCELLENCE AWARD
in
Science and Engineering
To:
Prof. Mustafa Serkan Kiranyaz
24 April 2019
in recognition of the outstanding research
contributions and sustained research excellence,
leading to regional and global visibility of Qatar
University as an institution committed to advancing
innovative scholarly works for human welfare.


Qatar National Research Fund
Member of Qatar Foundation
1st PLACE
شهادة تقدير
CERTIFICATE OF APPRECIATION
Qatar National Research Fund and
Qatar Shell Research and Technology
Centre award this certificate to
يمنح الصندوق القطري لرعاية البحث العلمي
ومركز شل قطر للبحوث والتكنولوجيا
هذه الشهادة إلى
Dr. Faycal Bensaali
for their outstanding research
project in the 11th Annual Undergraduate
Research Experience Program
Competition held on 31 March 2019
تقديراً للمشروع المتميز في المسابقة السنوية
الحادية عشرة لبرنامج خبرة الأبحاث
للطلبة الجامعيين الذي عقد
في ٣١ مارس ٢٠١٩
Dr. Abdul Sattar Al-Taie
Executive Director
Qatar National Research Fund
الدكتور عبد الستار الطائي
المدير التنفيذي
الصندوق القطري لرعاية البحث العلمي


IEEE
2019
IWCMC
BEST PAPER AWARD
"Joint Security and Energy Efficiency in IoT Networks
Through Clustering and Bit Flipping"
Elias Yaacoub (QU, Qatar); Ali Chehab (AUB, Lebanon); Mohammed Al-
Husseini (Beirut Research & Innovation Center, Lebanon); Khalid
Abualsaud; Tamer Khattab; Mohsen Guizani (Qatar University, Qatar)
Presented in the IWCMC 2019 Conference, Tangier, Morocco,
June 24th-28th, 2019
IWCMC
Dr. Abdellatif Kobbane, IWCMC 2019 Program Chair
ENSIAS, Mohammed V University of Rabat, Moroc

Faculty Achievements & Activities

Dr. Faycal Bensaali

**Associate Professor
Electrical Engineering
Department at Qatar
University**

Qatar's First ECMO Simulator: When High-Fidelity Meets High Affordability

Extracorporeal Membrane Oxygenation (ECMO) is a lifesaving procedure developed for the care of patients with short-term respiratory and/or circulatory issues. ECMO was originally established as a standard therapy for newborns suffering from acute respiratory or circulatory failure, but was later extended to be used on adults. Since its development, ECMO has been estimated to help treat over 53,000 patients for life threatening diseases with survival rates up to 75%. The technique involves circulating the patient's blood through an external tubing circuit with a pump used to push the blood through a filter, which provides lung-like oxygenation and carbon dioxide extraction. The blood is then returned to the patient. ECMO implementations have been used to improve survival rate, however, the technology can potentially result in numerous health complications for patients. Moreover, pump failures, oxygenator failures, and tube ruptures are common hardware complications that decrease the patient-survival rates by 40%. Monitoring those complications requires an ECMO trained multi-disciplinary team as well as an ECMO nursing staff member. Figure 1 shows a simplified representation of an ECMO setup.

ECMO is not a widely adopted technology due to its high cost and high risk nature. An ECMO machine costs approximately $130,000 and its corresponding oxygenation unit cost around $5,000-$10,000. Simulations, although expensive to perform, increase communication skills, impulse responses, and procedural emergency management, which are essential qualities for ECMO patient management. There are a several hardware ECMO simulators that have been developed for the purpose of training ECMO staff. All existing ECMO simulators rely on real deoxygenators, and the use of animal blood.

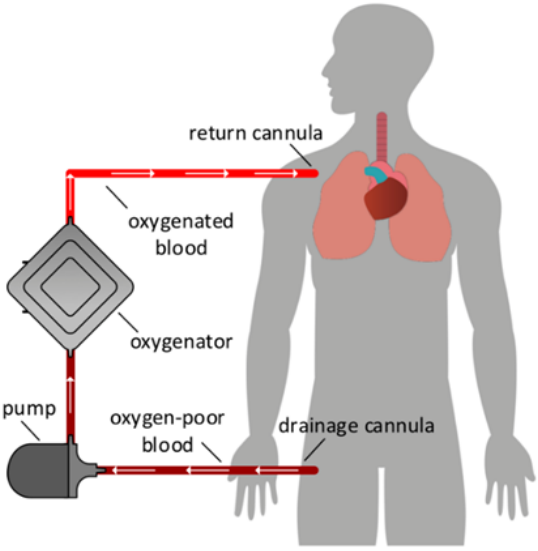


Figure 1. Simplified Illustration of Venous-Venous ECMO Circuit.

Henceforth, this project tackles the aforementioned issues by building a simulator of the ECMO

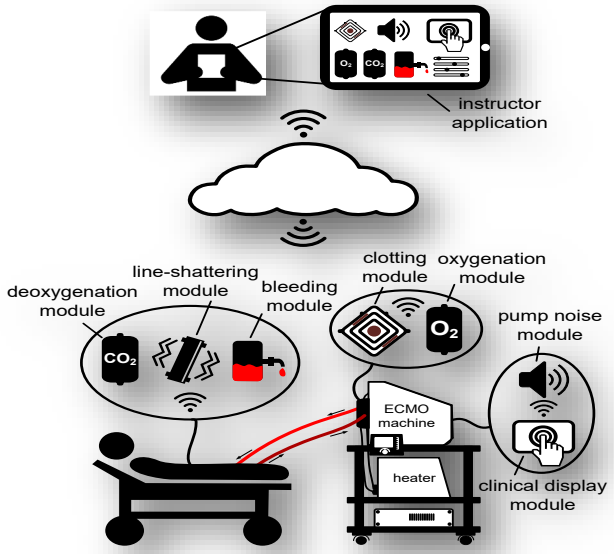


Figure 2. Block Diagram of the Proposed System.

machine with Hamad Medical Cooperation (HMC). The replicated machine will externally look similar to the real one but will internally contain different hardware components that will be used to simulate the functionalities and emergency scenarios. In addition, the simulated ECMO machine will be fully controllable via an ECMO instructor tablet application for manual control and the creation of custom training scenarios. Figure 2 illustrates the structure of the simulator. On the other hand, costly animal blood can be replaced with thermochromic ink which has the ability to change its color based on temperature adjustment (Figure 3). Thus, blood circulation, oxygenation and deoxygenation can be replaced by a mixture of inks. The research team invented (US non-provisional patent and PCT applications) a brand-new blood color simulation technology which is the core of cost-effective ECMO simulation workflow.

The proposed design consists of four units-the ECMO unit, patient unit, heater unit and the mock oxygenator. The ECMO unit consists of a replicated ECMO, containing a single-board computer, driving a touch screen that displays a mock ECMO screen remotely controlled by an instructor tablet application, and all necessary knobs and buttons for the leaner to be able to "control" the circuit. A concealed patient unit will include the circulation pump, thermochromic mixture tank, modules that generate physical cues created by ECMO emergencies (e.g. line shattering and patient bleeding) and a cooling unit to simulate deoxygenated blood. The mock oxygenator will be a look-alike empty shell of the MAQUET HLS oxygenator and will act as a hidden bypass allowing thermochromic mixture to flow back and forth from the heater unit. The heater unit will be responsible for thermochromic mixture heating; shifting it to oxygen-rich color, containing a module to disable heating and simulating hypoxemia. Figures 4 and 5 depict the simulator prototype.

Advantages of an ECMO independent simulator are reduced deployment and maintenance cost, customizability, expandability and full system control. The simulated blood color change circuit components (excluding the heater-cooler) costs 300 USD to build and can be used indefinitely, (or until a component is damaged) since components are non-consumable. Our thermochromic recipe costs 40 USD/L. Moreover, our in-house design facilitates ease of use and control since the system electronics are programmable to the user's preference and can be wirelessly enabled to receive remote commands to perform simulation actions. Figure 6 shows the printed circuit boards of the system.

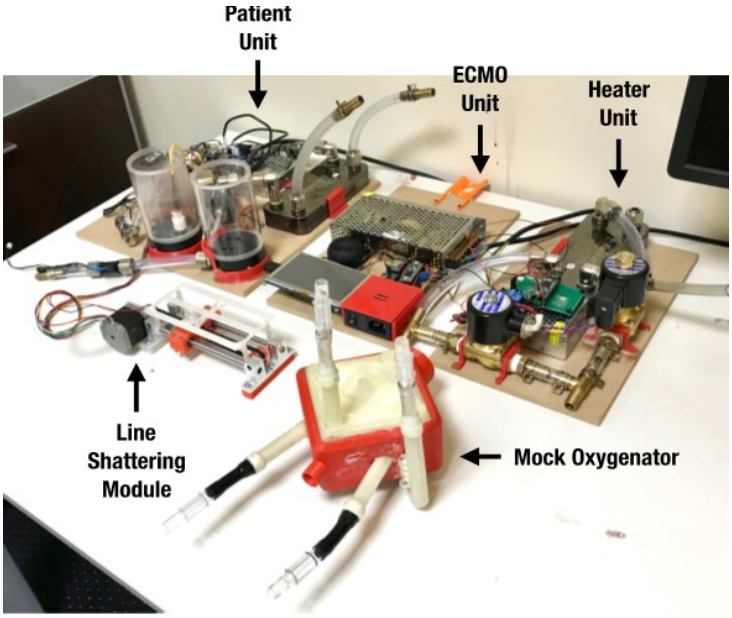


Figure 4. Simulator Prototype Panels.

In the grand scheme of regional medical simulation, the current state of the simulator is a successful case study of engineering integrating with medicine towards revolutionizing simulations in a high-fidelity and cost-effective manner. Once the simulator's educational efficacy is validated, our product will be directly deployed at HMC ICU for future ECMO training courses. Following successful local training runs, HMC is planning to hold regional ECMO courses in Qatar using our simulator as the core SBT tool, paving the path towards a regional training facility enabled by technology made in Qatar.

The project gained local and international recognition. The team was awarded several reputable awards including 4th Annual Conference of the South and West Asia Chapter of Extracorporeal Life Support Organization (ELSO-SWAC

Dr. Faycal Bensaali

Associate Professor Electrical Engineering Department at Qatar University

Faculty Achievements & Activities (Cont.)

2017) along with best oral presentation and best poster presentation awards. The team was also awarded 1st place in Senior Design Project Contest 2017 in the College of Engineering at Qatar University and the first place for Best Project in Qatar University Honors Program Project Fair 2017. Moreover, among all QNRF Undergraduate Research Experience Program (UREP) grantees, the project has been awarded first place at the eleventh iteration of the national competition. Figure 7 exhibits a sample of the research team recognitions in various events.

From the large expanse of exposure the project earned through conferences, there is an increasing international demand from ECMO centers in the US, the Netherlands, Korea, Hong Kong and more. Moreover, the Extracorporeal Life Support Organization (ELSO) has expressed interest in purchasing the simulator following completion of the evaluation study. In conclusion, the modular ECMO simulator is revolutionizing medical training in Qatar and building global reach with prospective clients including Sidra, ELSO and hospitals in the US, the Netherlands and Hong Kong.

العرب
العدد 11172
الأحد 7 جمادى الأولى 1440هـ | 13 يناير 2019م

نجح عدد من طلاب قسم الهندسة الكهربائية بكلية الهندسة - جامعة قطر، وهم (عبدالله علاء السالمي - محمد صبحي الديسي - يحيى الحمصي) بإنجاز مشروع تخرج بعنوان «تدريب الاعتناء بالمرضى باستخدام محاكاة للأكسجة الغشائية خارج الجسم في مؤسسة حمد الطبية»، تحت إشراف كل من أ. د. عباس عميرة -العميد المساعد للبحث العلمي والدراسات العليا بكلية الهندسة، والدكتور فيصل بن سي علي- أستاذ مشارك بكلية الهندسة.

بتمويل من الصندوق القطري لرعاية البحث العلمي

طلاب بجامعة قطر يحصلون على براءة اختراع أميركي لجهاز يخدم القطاع الطبي

الدوحة - هبة فتحي

تقوم فكرة المشروع حول تصميم وتنفيذ جهاز محاكاة لعملية الغشاء الصناعي المزود للأكسجين للجسم (أي ما يشابه الرئة الصناعية خارج الجسم)، ولكن بتكلفة منخفضة في التصنيع والصيانة، وقابل للاستعمال لعدة مرات، كما يمكن تعديله وتطويره بشكل فعال وسهل، حيث تم تنفيذ المشروع بالتعاون بين جامعة قطر ومؤسسة حمد الطبية.

من جهته، قال الدكتور عباس عميرة - العميد المساعد للبحث العلمي والدراسات العليا بكلية الهندسة، إن عملية الأكسجة الغشائية خارج الجسم هي عملية من عمليات العناية المركزة، حيث يتم سحب الدم من المريض ثم تتم إضافة الأكسجين ثم إعادته إلى جسم المريض، وتتصف هذه العملية بحساسيتها وتتطلب من مؤديها الدقة وسرعة الاستجابة

■ د. فيصل بن سي علي ■ د. عباس عميرة ■ الطالب عبد الله علاء السالمي

■ الطالب يحيى الحمصي ■ الطالب محمد صبحي الديسي

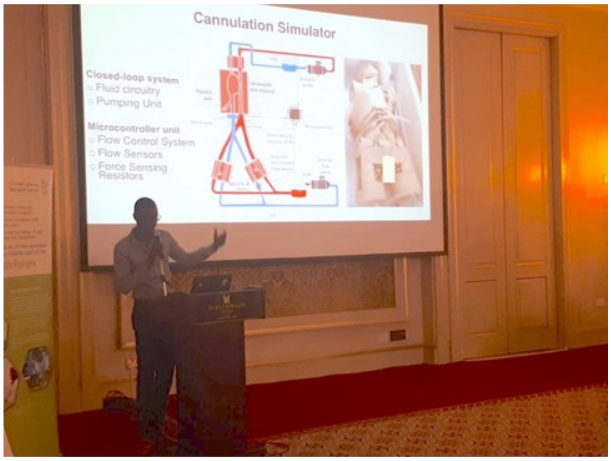
لأي طارئ.

واعتبر أن الميزة الأساسية التي تم تصميم هذا الجهاز عليها هي ميزة التخصيص، ما يمنح الجهاز سعر تكلفة منخفض ويسمح للاخصائيين إضافة ميزات له بشكل بسيط وسهل، ليصبح الجهاز أكثر واقعية وبلائم احتياجات المستشفى، مؤكداً أن الجهاز يتمتع بميزة تكنولوجية فريدة من نوعها في المحاكاة الطبية وتم استخدامها لأول مرة في هذا المجال، وهي تكنولوجيا الحبر المتغير لونه


Extracorporeal Membrane Oxygenation
Simulator for Patient Management
Training at HMC
Research Mentor
Students


Senior Design Contest
Amount
5000 QR
Senior Design Contest 2017
First Place


BRINGING ECMO TO LIFE
SIMULATION
4th Annual
ELSO-SWAC


Cannulation Simulator
Closed-loop system
Fluid circuitry
Pumping Unit
Microcontroller unit
Flow Control System
Flow Sensors
Force Sensing Resistors

Faculty Achievements & Activities (Cont.)

Dr. Nizar Zorba

**Professor
Electrical Engineering
Department at Qatar
University**

Crowd Management

Prof. Nizar Zorba published an editorial paper in the IEEE Communications Magazine (IF: 10.36) with the title: Crowd Management, in April 2019.

In its 2018 Revision of the World Urbanization Prospects, the United Nations projects that 68 percent of the world's population is expected to be living in urban spaces by 2050, compared to the current 54 percent and 30 percent in 1950. The main drive for urbanization has been economic, with the general population seeking better employment opportunities accompanied by improved lifestyles. Such increased urbanization rates put significant pressure on city infrastructure networks and challenges existing methods for various aspects of governance, including crowd and traffic management. In particular, phenomena such as rush hours and special events carry significant challenges and risks. Environmental impacts due to massive urbanization are also on the rise. These and other indicators call for new management mechanisms for crowds, especially those exploiting recent advances in technology, e.g., the Internet of Things (IoT) and big data.

Recently, the ubiquitous use of smartphones has motivated great interest in utilizing them for various sensing applications. In addition to its powerful communication and computing capabilities, the typical smartphone possesses a wide array of sensing capabilities (camera, microphone, gyroscope, accelerator, GPS, thermometer, barometer, etc.) that enable its use in a wide range of applications. These advances in smartphone technology coupled with their ubiquity have paved the way for an exciting new paradigm for accomplishing large-scale sensing, known in the literature as crowd sensing (CS). The key idea behind CS is to empower ordinary citizens to collect and share sensed data from their surrounding environments using their smartphones.

An equally important area of research is analyzing and making sense of this crowd-sensed data to extract information that is useful for managing the movement of crowds, known as crowd management (CM). CM is of huge importance as it translates sensed values into tangible actions and predictions. For example, the use of CM has been investigated and implemented in both the pedestrian and vehicular environments, as well as in recognizing various levels of crowd activity.

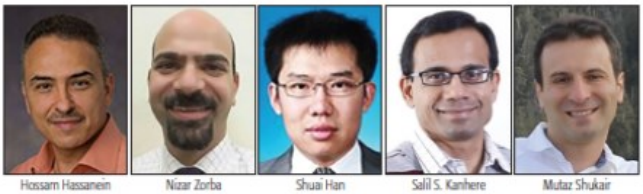
A major component that impacts the whole process of CM is the sensing infrastructure and its level of smartness. Such smart infrastructures for CM are a hot topic under consideration in recent research due to their impact on the broad disciplines of IoT, big data, CS, CM, and so on. Some characteristics of the infrastructure and its level of smartness would require long-term analysis that is mainly achieved through offline inferences. The objective of this Feature Topic is to understand the impact of smart infrastructures on CM mechanisms. A main concern is how to achieve scalability, while also ensuring the ability to deal with different kinds of crowds (e.g., pedestrians, bikers, cars, autonomous cars, emergency vehicles) and scenarios (e.g., residential buildings, governmental buildings, service buildings, roads, parks). At the core of the smart infrastructure realization is a closed-loop sense-process-act cycle. This core relies heavily on state-of-the-art advances in sensing, computing, and telecommunications/ networking, and proceeds with considerations for both evolutionary setups (i.e., smartening up traditional infrastructures) as well as new infrastructure implementations.

How the research culture has been evolved in Qatar and how it is helping in the nation building and achieving the 2030 Qatar vision of transforming gas

based economy to knowledge based economy was discussed. The ranking and visibility of higher education institutions in Qatar especially focusing on Qatar University achievements was highlighted. The UREP and the internal grants provided by Qatar University to develop research culture was presented. The blockade has forced the researchers and students in Qatar to focus more on innovation and applied research with product development in order to move towards the self-sustained society with long term benefit. The support provided by the govt. of Qatar and Qatar University was praised. The food security issue was also in the discussion and soil-less technology of agriculture was further discussed. It was highlighted that the blockade has impacted positively on the research culture in Qatar.

GUEST EDITORIAL

CROWD MANAGEMENT



Hossam Hassanein Nizar Zorba Shuai Han Salil S. Kanhere Mutaz Shukair

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A major component that impacts the whole process of CM is the sensing infrastructure and its level of smartness. Such smart infrastructures for CM are a hot topic under consideration in recent research due to their impact on the broad disciplines of IoT, big data, CS, CM, and so on. Some characteristics of the infrastructure and its level of smartness would require long-term analysis that is mainly achieved through offline inferences. The objective of this Feature Topic is to understand the impact of smart infrastructures on CM mechanisms. A main concern is how to achieve scalability, while also ensuring the ability to deal with different kinds of crowds (e.g., pedestrians, bikers, cars, autonomous cars, emergency vehicles) and scenarios (e.g., residential buildings, governmental buildings, service buildings, roads, parks). At the core of the smart infrastructure realization is a closed-loop sense-process-act cycle. This core relies heavily on state-of-the-art advances in sensing, computing, and telecommunications/networking, and proceeds with considerations for both evolutionary setups (i.e., smartening up traditional infrastructures) as well as new infrastructure implementations.

The scope of this Feature Topic falls within recent efforts of both engineering and research communities to realize a smart city, which takes advantage of its communication infrastructure and computing/sensing capabilities to sense, filter, process, infer, and react, in order to enhance the city's sectors of traffic management, health and air quality, weather, business, and education, among others. The contributions in this Feature Topic are divided into three parts. Part one focuses on data analytics and management, and comprises five very interesting articles giving insights to the reader about CM and its usage in practical systems. The second part contains two articles discussing consideration of the crowd-sensed values in CM for emergency situations, which is a very vital concept for smart cities. The last part is composed of four articles focusing on the social and data sharing challenge that arises when collecting information from the crowd to achieve the objective of CM, and also the influence of smart infrastructure on such data sharing.

The first part opens with the article "Crowd Management: A New Challenge for Urban Big Data Analytics" by Celes *et al.*, which explains how the pervasive availability of urban data provides unprecedented opportunities for analyzing several situations in cities The authors analyze the types of crowd situations, describe the major categories of urban data, and highlight their strengths and weaknesses. Moreover, through case studies, the authors explain how to apply urban data for spatial, temporal, and semantic observations of crowd situations.

This is followed by the article "Monitoring a Crowd's Affective State: Status Quo and Future Outlook" by Taha *et al.*, which focuses on evaluating the effects of crowd monitoring by reviewing the recent advances and enabling technologies in affective sensing at both the individual and crowd levels. Further, this article also remarks on deployment considerations in affective sensing architectures and discusses the area's current key outstanding challenges.

A knowledge mining model is presented in the article "Self-

Faculty Achievements & Activities (Cont.)

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**Lecturer
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Dr. Nasser Al Emadi

**Head of Department
Electrical Engineering
Department at Qatar
University**

Portable System for Monitoring and Controlling Driver Behavior and the Use of a Mobile Phone While Driving

There is an utmost requirement for technology to control a driver's phone while driving, which will prevent the driver from being distracted and thus saving the driver's and passenger's lives. Information from recent studies has shown that 70% of the young and aware drivers are used to texting while driving. There are many different technologies used to control mobile phones while driving, including electronic device control, global positioning system (GPS), on-board diagnostics (OBD)-II-based devices, mobile phone applications or apps, etc. These devices acquire the vehicle information such as the car speed and use the information to control the driver's phone such as preventing them from making or receiving calls at specific speed limits. The information from the devices is interfaced via Bluetooth and can later be used to control mobile phone applications. The main aim of this paper is to propose the design of a portable system for monitoring the use of a mobile phone while driving and for controlling a driver's mobile phone, if necessary, when the vehicle reaches a specific speed limit (>10 km/h). A paper-based self-reported questionnaire survey was carried out among 600 teenage drivers from different nationalities to see the driving behavior of young drivers in Qatar. Finally, a mobile application was developed to monitor the mobile usage of a driver and an OBD-II module-based portable system was designed to acquire data from the vehicle to identify drivers' behavior with respect to phone usage, sudden lane changes, and abrupt breaking/sharp speeding. This information was used in a mobile application to control the driver's mobile usage as well as to report the driving behavior while driving. The application of such a system can significantly improve drivers' behavior all over the world.

A complete block diagram of the prototype is shown in Figure 1. Any vehicle manufactured after 1996 is equipped with an on-board diagnostics (OBD) II system, which allows access to the vehicle's real-time information from its electrical control unit (ECU). The vehicle information from the OBD-II module was sent to a controller unit (microcontroller) and stored in the secure data (SD) card and transmitted via Bluetooth to the mobile phone. The hardware module was powered by the OBD-II module, which took power from the OBD-II port. Therefore, the system only ran while the vehicle was running and it did not drain the vehicle's battery. There was a three-degree-of-freedom (DOF) accelerometer module interfaced with the controller to keep track of the acceleration in the x-, y-, and z -directions. In the mobile phone, an in-house developed smartphone application made decisions based on the information received from the controller.

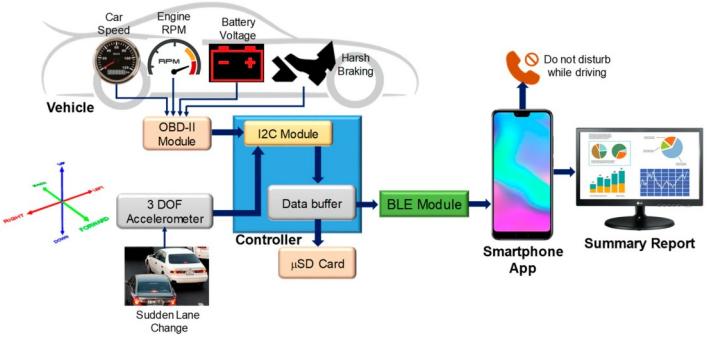


Figure 1: Complete system block diagram.

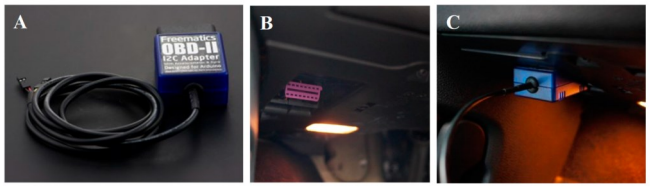


Figure 2: (A) On-board diagnostics (OBD)-II module, (B) OBD-II port, and (C) OBD-II module connected to the car's OBD-II port.

BD-II Module: The OBD-II adapter as displayed in Figure 2 was plugged into the OBD port of the vehicle to access various data from the car (car speed, engine rpm, battery voltage, etc.). The data were merged to measure the frequency of sudden breaking-like driving behavior. The connection of the OBD-II module to the OBD port is shown in Figure 3.

Controller Module: The OBD-II module was interfaced to an Arduino Nano microcontroller to gather the information from it. This information was packaged with 3-DOF accelerometer data and sent to the mobile phone via Bluetooth. The microcontroller and the modules were powered by the car battery through the OBD-II module. The inter-integrated circuit (I2C) interface was used for connecting the OBD-II and 3-DOF modules to the microcontroller, whereas the serial peripheral interface (SPI) was used for connecting the Micro SD card module to the microcontroller.

3-DOF Accelerometer Module: A 3-DOF accelerometer module (MMA7455) was used to collect x- (forward-backward), y- (left-right) and z-axis (up-down) acceleration of the vehicle. This was used to identify normal left-right turning, sudden right-left turning, and U-turn. The MMA7455 module was connected with the Arduino Nano using the I2C interface.

A tracking application in the Android platform was developed to read the data from the hardware wirelessly, log the data locally for 24 h, and identify the driver's behavior based on the logged data and pre-set threshold. The application was designed to monitor car speed and control the driver's mo-

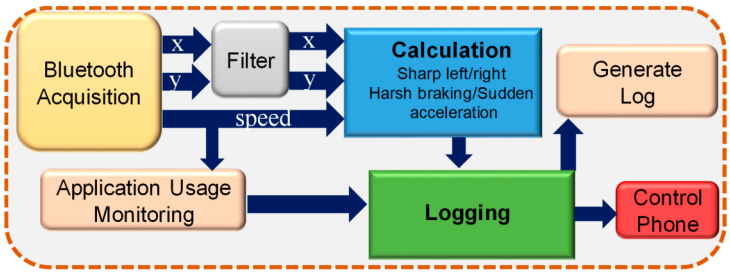
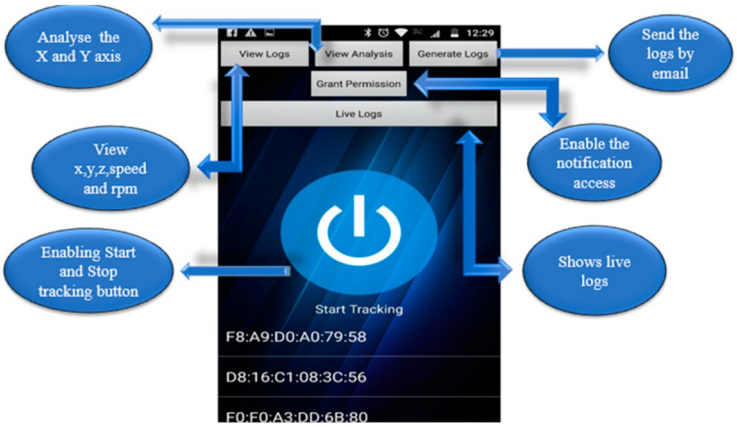


Figure 5. Block diagram showing the application's operation.



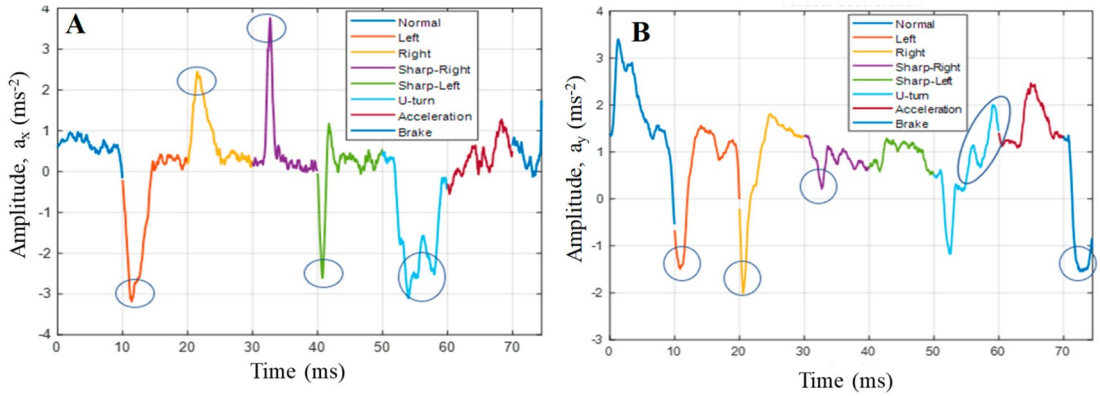


Figure 11. Flowchart of the mobile application's decision stages.

Faculty Achievements & Activities (Cont.)

Dr.Farid Touati
Professor
Electrical Engineering Department at Qatar University

Achievements of NPRP8-1781-2-725 and NPRP10-0102-170094, 2019

Research year 2018-2019 was a congenial patch in the timeline for EE, full of discoveries, innovations and intellectually impactful in the science and technology calendar of EE. We have plenty to share with you about our NPRP8-1781-2-725 (Structure Health Monitoring; SHM) and NPRP10-0102-170094 (Air Quality Monitoring; AQM). Our accomplishments in multi-variable IoT systems design and development for SHM and AQM marched up the productivity benchmarks. The encouragement of awarding as top 3 in ARC18 boosted our courage and motivation that enabled us to deliver three versions of our SHM proof-of-concept system presented below with site deployments. The CANopen based bi-axial accelerometers closed band to inclinometers using ADXL203 nodes interfaced with STM32F10RBT6 (ARM® 32-bit Cortex®-M3 CPU Core). The SN65HVD257 was used as a line driver to accomplish body area networks for SHM applications.

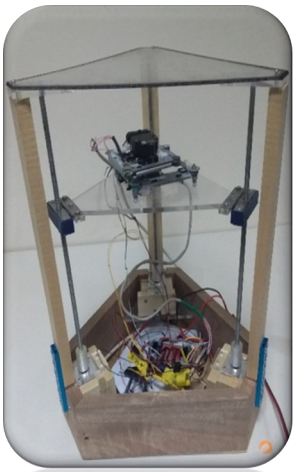
QU Early Childhood Center Deployment | QU B09-Lab106A Deployment

Air Quality Monitoring units

In the annual Qatar University Annual Research Forum 2019, we presented a full-fledged demonstration of our SHM system to national and international stakeholders exhibited below. The opensource Ginkgo VTG202A CAN2USB converter was coupled with Raspberry Pi 3 to constitute an out-surface board presented in our published journals as a network of 5, 10 and 12 CANopen nodes. Banana Pi R1 was transformed into SHM gateway using Ubuntu 16 Xenial Xerus and customization of the ThingSpeak IoT platform for private cloud. Furthermore, a real-time 50ms response rate dashboard using highcharts was implemented on the gateway as well for early warning.

On April 23, 2019, our team gave a complete demonstration to the guests from Ashghal, MoTC, and MME. Our AQM developments were running in parallel and deployed in 4 locations in QU as recommended by our ESC Expert collaboator for improvements and demonstration as shown below.

The presented system was based on a customization of the ATMega328P board interfaced with FT232RL, LMP91000 for AFE EC Gas Sensors, SHT21, MPL3115A2, GP2Y1010AU0F, and IAQ_Core to constitute a heterogeneous sensing system. The QuecTel-M10 was used for GPRS and PA6H for GPS was used to ensure outdoor air quality mapping.

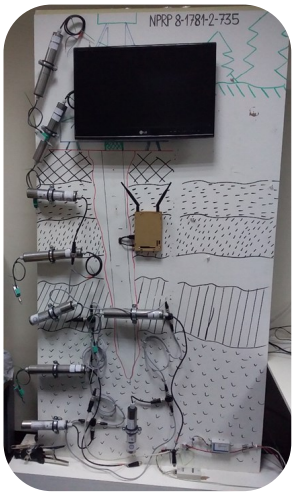


Ground Motions Simulation Platform

In the later events like Research Collaboration Symposium 2019, an improved demonstration was delivered using all the modules developed in NPRP8 including the ground motions simulation platform .

The Annual Research Symposium 2019 was the second biggest event in the year where our NPRP8 and NPRP10 systems were selected and appreciated by all the visitors, especially for MME, Ashghal and MoTC.

Our SHM system is at TRL7 and AQM at TRL6 that entrusted stakeholders for fertile collaboration with us in future endeavors.



SHM System for Early Warning Demonstration

The overall biggest event in 2019 was the SHM workshop on Oct 4, 2019; that was based on the final outcomes and of NPRP8 .

A patent by Dr. Atif Iqbal, M. Meraj, S. Rahman and Dr. L. Ben-Brahim ""Passive Component-Less Dimmable LED Driver For DC Distributed Lighting System

Increasing energy demand is driving the research to build energy efficient systems to fulfill the needs with reduced energy utilization. Renewable energy like photovoltaic, wind generation, fuel cell, and tidal energy started sharing a significant percentage of load demand. Based on end user/load requirement and load demand different concepts like standalone renewable systems and hybrid power systems for AC grid and DC distributed systems (DCDS) were proposed. Among these DC grid distributed systems are gaining popularity because most of the office buildings, commercial spaces, sports complexes and conference halls are mostly using a large number of DC loads like LED lighting, computers and printers. DCDS show significant improvement in energy efficiency, reliability, and economic savings leaving far behind AC grid, especially, when integrating renewable energy sources to the distribution systems.

It is known that the lighting load shares a considerable portion of total energy and in particular applications like sports complex, IT parks, commercial buildings (CB). CB uses more than 50% of lighting loads. For energy efficient LED lighting, energy saving is about six folds than incandescent, florescent and CFL's and also long-lasting than conventional light sources. Solid state lighting (LED lighting) is future of illuminating technology for the whole world because of no environmental side effects like poisonous gases and no radiations. Unlike conventional light sources LED's work on DC power supplies. DC power supplies are invariably obtained from an AC-DC converter which makes use of extra electronic circuitry, increases component count, power loss and harmonic distortions in the grid. So a typical DC distribution system is shown in Fig. 1, to power the DC loads and Integration of renewables and battery systems.

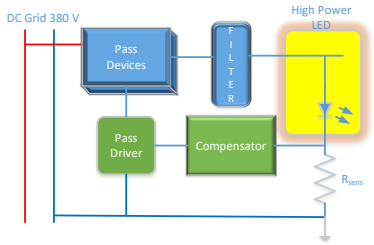


Fig. 1. LED Driver Block Diagram

DC regulated grid voltage can be centralized controller which prioritize the solar PV panel (renewable energy) or battery by DC-DC converter and a centralized AC-DC rectifier. The DC grid voltage level will be regulated according to end load or application. In the literature 48V, 220V, 380V, 400V and 540 V DC grids are mentioned but here we are discussing lighting loads and IT loads so 220V DC grid is suitable and for HVAC loads 380V/400V is more appropriate. 48V DC voltage for the grid (lower voltages <220) are not suitable because of current requirement of the loads will be high which results in thick wiring cords leads some power losses and also generate heat, in overall it is not economic. Last but not least, DC loads does not have reactive power demand so the current rating will go down in delivering the same amount of power.

In present day LED drivers are based on AC-DC then switched mode DC-DC for every light fixture and the same fixture cannot operate at different power levels (dimmable). These LED fixtures generates the harmonics in the supply system and two levels of converters reduce the efficiency of the overall driver. These also lead to utilization of the capacitors, inductors, drivers for MOSFETs and current controller IC's which leads to a higher size of the driver and high cost. Hence a linear regulator based LED driver is proposed in this invention. In DC power distribution systems, conditioning unit (controller) regulates the output voltage with 1-2% regulation of nominal voltage, which leads to design a simpler electronic circuit to regulate

Novelty:

- Inductor and capacitor less LED driver for high power and high voltage applications
- Remote control operation for dimming the light output
- Compact and low cost
- No harmonics in the supply system
- Ground leakage current is very low of the order of 100 µA
- Can be used for wide range of LED ratings

Application:

- Green buildings and Net Zero Energy Buildings (NZEB) etc
- Commercial buildings with energy efficiency lighting and HVAC systems etc
- Sport complex or stadiums etc
- Dimming and remote control features of LED fixtures helpful in efficient presentation of speakers in Conference halls, meeting rooms, seminar halls and auditoriums etc
- Decorative, sign boards and hoarding systems etc
- Street lighting systems
- Ground current is very less hence well suited for battery powered applications or stand-alone applicationsNo harmonics in the supply system
- Ground leakage current is very low of the order of 100 µA
- Can be used for wide range of LED ratings

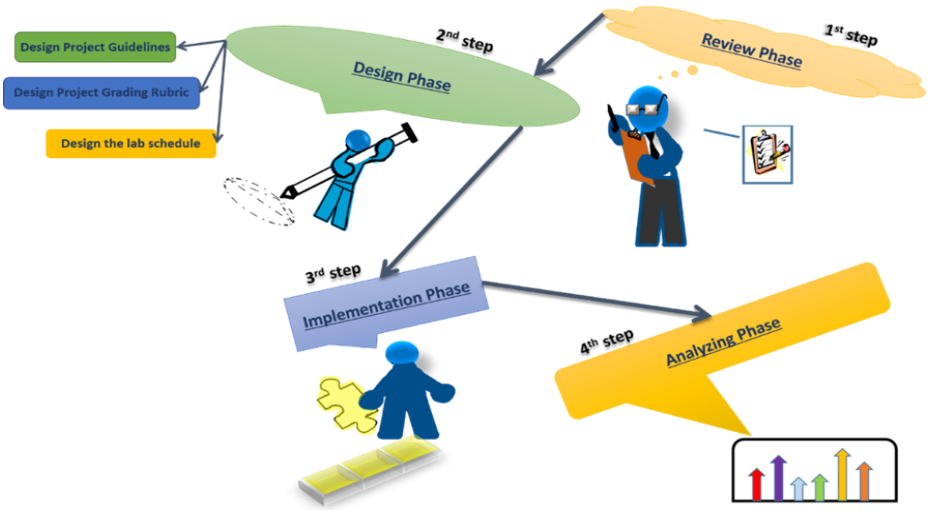
Faculty Achievements & Activities (Cont.)

Case Study to Analyze the Impact of Multi-Course Project -Based Learning Approach on Engineering Education for Sustainable Development

Amith Khandakar 1, Muhammad Enamul Hoque Chowdhury 1, Antonio Jr. San Pedro Gonzales 1, Farid Touati 1, Nasser Al Emadi 1 and Mohamed Arselene Ayari

Available online: Sustainability 12(2):480, DOI: 10.3390/su12020480

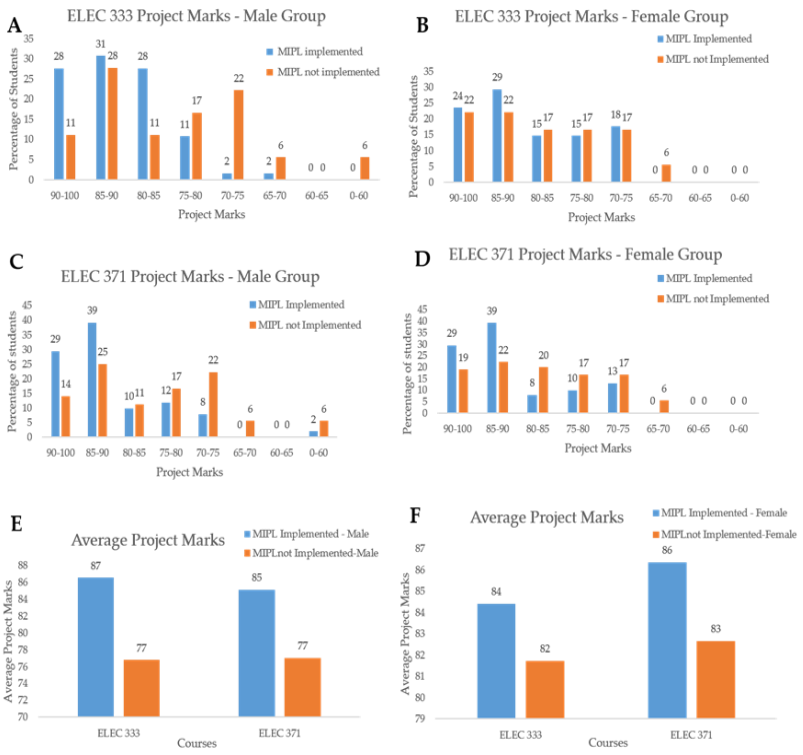
The faculties of the Department of Electrical Engineering (EE) of the College of Engineering of Qatar University consisting of Engr. Amith Khandakar, Dr. Muhammad Chowdhury, Engr. Antonio Gonzales, Dr. Farid Touati and Dr. Nasser Al Emadi have published an innovative teaching approach implemented in EE courses showing the impact on technical, cognitive, and soft skills learning necessary for preparing fresh engineers for Sustainable Development on the verge of the 4th Industrial Revolution. This work presented a multi-course project-based learning (MPL) approach implemented using two EE intra-level undergraduate courses. It revealed that implementing an MPL approach helps in the development of critical thinking and collaborative decision-making skills. The attainment of these skills should be the outcome of Education for Sustainable Development (ESD); the skills help students acquire the knowledge, attitudes, and values necessary to shape a sustainable future. The participating students worked on a design project, which was used to assess the fulfillment of a set of student learning outcomes (SLOs), focusing on engineering soft skills and project management skills. The skills include the ability to communicate effectively, to work collaboratively in a team, to think both critically and creatively, and to manage projects efficiently with realistic constraints and standards, which is at the heart of engineering practice. The challenges of implementing the MPL method are the organization of pedagogical activities that are planned for each of the courses involved, the coordination of the materials delivered by each course, and the supervision of around 90 students per year performing the MPL method. The experience of MPL deployment in the EE program was assessed using student surveys. It was assumed that the MPL approach would be beneficial to the students based on the instructors' and students' feedback from the same courses in previous years. This was verified using chi-square statistics of the survey results. The implementation of the MPL also helped in increasing the average marks scored by the students in the design project. Some interesting feedback, statistical analyses, and improvement ac-



tions are reported for future upgrades. Nonetheless, this work also contributes to the MPL pragmatic body of knowledge by exploring a successful initiative and its outcomes, which can help in attaining the skills needed for ESD

The paper provided the step by step approach on how such an approach can be implemented starting with the: Review Phase, Design Phase, Implementation Phase and Analyzing Phase.

The work has provided a detailed description of the implementation of MPL study for junior-level electrical engineering courses at Qatar University. An MPL study is imperative for incorporating competencies that are required for sustainable development, such as creative and critical thinking. This would prepare students for global market competitiveness and sustainable development. The authors have tried to provide systematic instructions on how such an approach could be implemented for electrical engineering programs adopting ABET accreditation, where the forementioned skills are the main required student learning outcomes. The results conducted at the end of the semester provided positive feedback on this approach. Suggestions that are useful for improving the approach are also provided. The approach has been useful in advocating the fundamental principles of PBL. The implementation results of the MPL model enable students to mesh various engineering principles and concepts in a complex system exposing them to practical challenges that foster creativity and team spirit under a positive learning environment. This case study would be useful yet inspiring for incepting new approaches for engineering education.



Faculty Achievements & Activities (Cont.)

Dr. Tamer Khattab

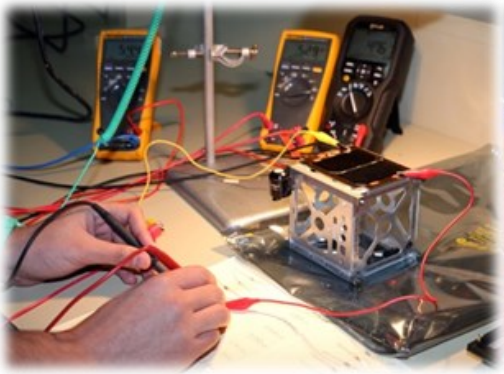
Associate Professor Electrical Engineering Department at Qatar University

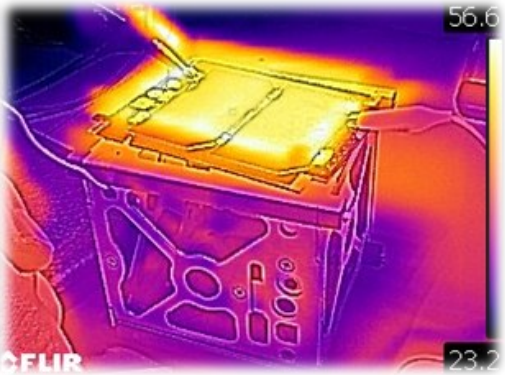
Qatar University built cuBeSat (QUBSat-I)

Space exploration and space technology have always been the driver to many scientific and technological discoveries that push the boundaries of advancements in diverse fields. Thanks to the CubeSat initiative, access to space technology turned from a farfetched dream into a conceivable reality to many research and academic institutions around the world. A team from the Department of Electrical Engineering lead by Dr. Tamer Khattab and composed of faculty, engineers, graduate students and undergraduate students, has decided to put Qatar University on the prestigious league of ambitious institutions in the quest for space technology through the CubeSat initiative, which started at the Department of Electrical Engineering. QU will be among the leading institutions in the Region and the first in Qatar to design, build, launch and operate a pico-satellite. The objective of the new initiative is to conceive a multidisciplinary students' based mega project focused on building, launching and operating a miniaturized pico-satellite system and a satellite ground station according to the CubeSat (http://www.cubesat.org) standardized project. The project will expand in the future in collaboration with colleagues from the Department of Mechanical Engineering to include an experimental rocket launching facility. The first QU built CubeSat satellite is called QUBSat-I.

More than 70% of the require human resources, expertise as well as labs and facilities are already available at Qatar University. The remaining required resources and expertise are covered through strong partnerships with world renowned partner universities as well as local and international industries. As part of the project umbrella, QU will also establish an Experimental Rocket Launching initiative by the Department of Mechanical Engineering. The overarching aim of the CubeSat and Rocket Launching project is to establish the QU Spacecraft Design Lab, which will act as a nucleus towards two more strategic objectives; namely, establishing Qatar's first Aerospace Engineering Program at QU and establishing Qatar's Space Agency at the national level.

The project idea, initiated by Dr. Tamer Khattab, an Associate Professor at the Department of Electrical Engineering, will position Qatar University as a technology and educational leader in the region. It will also position the State of Qatar on the map of space exploring nations. The technological and knowledge base outcomes from the project and the human skills development provided by the project are well aligned with Qatar vision for

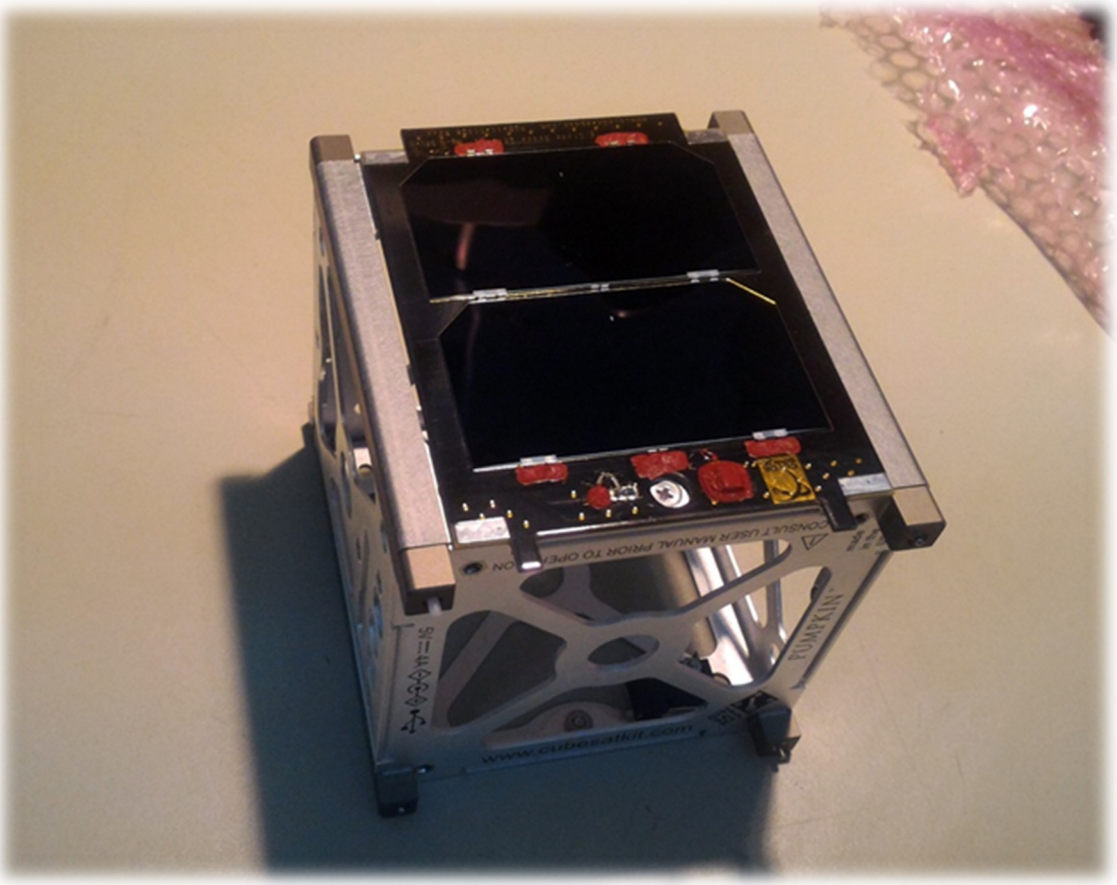




2030.

CubeSat is a standardized design for pico-satellite systems, which allows economically efficient implementation and launching of small-scale satellites with specific predefined missions. The system standardizes the different satellite subsystems' components as well as its dimensions and shapes. The former, enables the use of commercial off-the-shelf (COTS) components to implement the desired satellite system. Thus, enabling simpler and more cost effective implementations. The latter, enables batch launching of several satellite systems in one launching vehicle. Thus significantly reducing the launching cost per satellite system and making it more feasible for experimental purposes.

The design and implementation of a CubeSat system requires multi-disciplinary work at least between electrical, computer, and mechanical engineering programs (other disciplines can be involved based on the mission). Due to its affordability, scale and multidisciplinary nature, a CubeSat system design and implementation requirements fulfill the objectives of a mega multidisciplinary capstone design project for engineering students. Moreover, the project is also a key enabling vehicle for project based learning, integration of research activities into undergraduate curriculum, and pursuing advanced graduate research work at the masters and doctoral degree levels.



Faculty Achievements & Activities (Cont.)

Dr.Ridha Hamila
Professor
Electrical Engineering
Department at Qatar University

Two US Patents for Dr. Ridha Hamila

Dr Ridha Hamila, professor of electrical engineering at QU published two US patients in communication engineering.

1) Method and apparatus for implementing sparse finite-impulse-response equalizers

US Patent: US10382101B2, granted 2019-08-13

Abstract

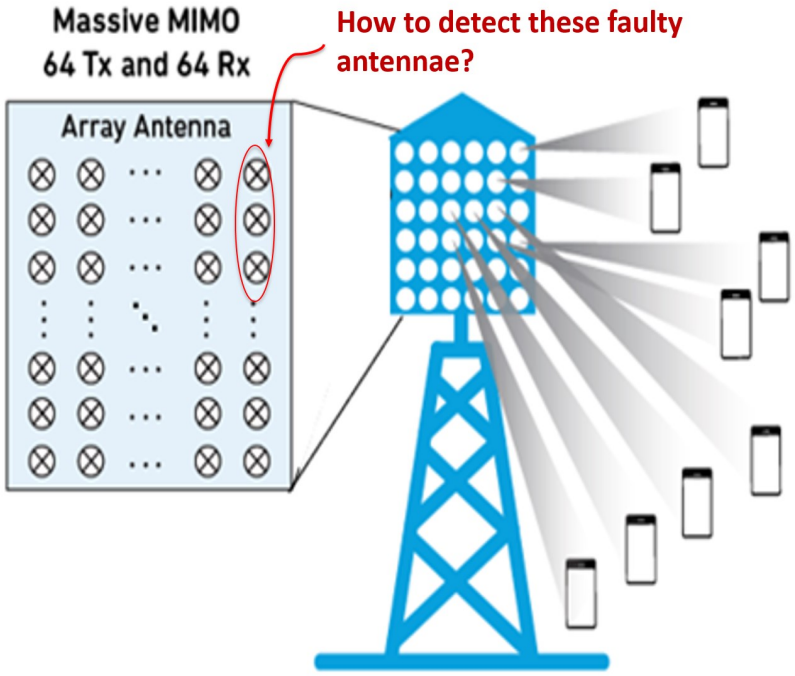
A method and apparatus may include receiving a transmission. The method can also include determining a sparsifying dictionary that sparsely approximates a data vector of the transmission. The determining the sparsifying dictionary includes performing a fast Fourier transform and/or an inverse fast Fourier transform. The method also includes configuring a filter based on the determined sparsifying dictionary.

2) Method of identifying faulty antenna elements in massive uniform linear antenna arrays

US Patent: US10135551B2, Granted 2018-11-20

Abstract

The method of identifying faulty antenna elements in massive uniform linear antenna arrays is a compressive sensing-based method that takes advantage of the reduction of the measurement matrix for a uniform linear antenna array to a partial discrete Fourier transform (DTF) matrix, whose rows correspond to the measurements' locations. Particularly, the method of identifying faulty antenna elements in massive uniform linear antenna arrays allows the measurements to be taken to reduce the measurement matrix's worst-case coherence, a factor which affects the detection probability of the defective antenna elements. The method constructs a measurement matrix with fewer distinct inner product values to reduce the worst-case coherence. In an alternative embodiment, the method focuses on bounding the inner product between any pair of measurement matrix columns.



Three US Patents Granted for the IIPL Research Group of Electrical Engineering

A research team at the *Intelligent Information Processing Lab* (IIPL) research group at the Department of Electrical Engineering has received three granted US patents in 2019. The group is lead by Dr. Tamer Khattab and includes Dr. Ahmed Badawy (Previously a Ph.D. student with Dr. Khattab and a postdoctoral fellow at Electrical Engineering and currently with Ericsson Canada Inc.). The work was in collaboration with colleagues from the Department of Computer Science and Engineering at Qatar University and colleagues from Politecnico di Torino in Italy. The three patents are in the area of advanced efficient and secure wireless communication systems. The work was featured on Qatar University's social media and annual research magazine as well as Qatari newspapers such as Al-Raya newspaper.

Patent title: Method and Apparatus for Simple Angle of Arrival Estimation

Inventors from Qatar University: Ahmed Badawy, Tamer Khattab, Tarek Elfouly, and Amr Mohamed

US Patent #: 10386447

Summary:

The method and apparatus for angle of arrival estimation are used for estimating the angle of arrival of a received signal by a switched beam antenna array and a single receiver. The switched beam antenna array first collects an omnidirectional signal to be used as a reference signal. A main beam thereof is then switched to scan an angular region of interest. The collected signals from the switched beams are cross-correlated with the reference signal. The cross-correlation coefficient is the highest at the true angle of arrival and relatively negligible otherwise


من مكتب البراءات والعلاقات التجارية الأمريكي

تسجيل 27 براءة اختراع باسم الجامعة

مفتاح سري للاتصالات اللاسلكية المشفرة

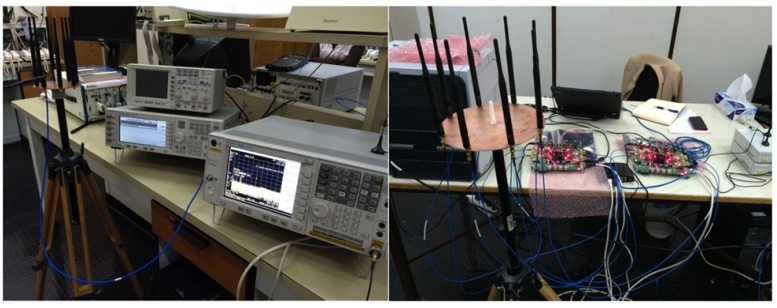
Patent title: Method for Generating a Secret Key for Encrypted Wireless Communications

Inventors from Qatar University: Ahmed Badawy, Tamer Khattab, Tarek Elfouly, and Amr Mohamed

US Patent #: 10404457

Summary:

The invention is regarding a new method for generating a secret key for encrypting wireless communications at the physical layer, exploiting wireless channel randomness between two nodes. The importance of such the new method comes from the significant improvement on the efficiency of generating such keys, which will have enormous implications on communication systems that require source of randomness to generate secret keys with high level of secrecy, and exclusiveness amongst communicating nodes. The method may also be used for other applications such as cloud storage, and radio frequency fingerprinting.



Faculty Achievements & Activities (Cont.)

The method is based on reference signals exchanged by the two nodes, which are used to form a channel estimate, including gain and phase. The gain and phase estimates are then compared to respective threshold values, and locations (i.e., x-axis points or time stamps) where gain and phase exceeding the threshold values are stored in vectors. The moving differences between gain locations and phase locations at adjacent sampling times define secondary random processes. The moving difference values are quantized and converted to bit streams, which are then concatenated to generate the secret key. Measures are provided to reduce parity errors, thereby reducing the bit mismatch rate (BMR).

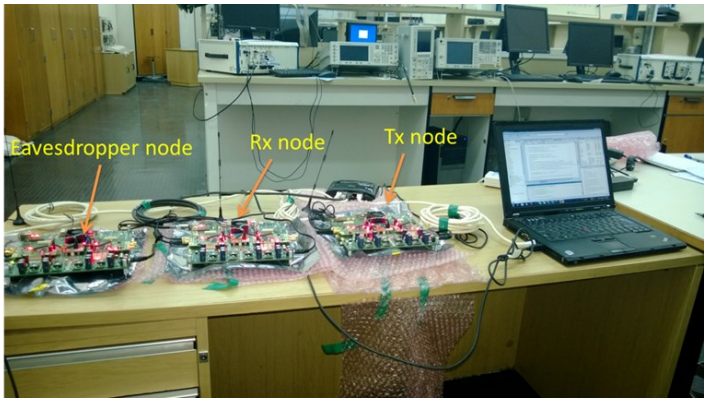
Patent title: Non-coherent Ultra-wideband Receiver

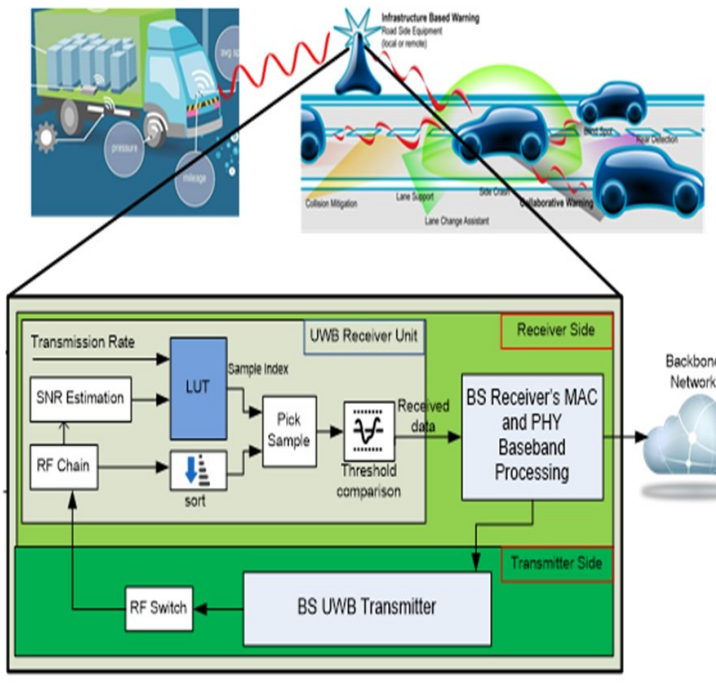
Inventors from Qatar University: Ahmed Badawy, Tarek Elfouly, Tamer Khattab

US Patent #: 10396849

Summary:

The non-coherent ultra-wideband receiver receives an ultra-wideband (UWB) signal, consisting of pulses (or "symbols") and uses on-off keying (OOK) modulation so that when a binary "0" is transmitted, the receiver collects noise-only samples. The receiver collects samples during the symbol (pulse) duration and sorts the samples by magnitude of voltage or energy. The receiver uses the known transmission rate and the estimated signal-to-noise ratio to retrieve a sample index from a look-up table. The receiver then compares the signal sample at the index value with a predetermined threshold voltage (or energy). If the selected sample exceeds the threshold, then it is assumed that all succeeding samples also exceed the threshold (assuming the sort is in ascending magnitude) and the pulse is present and binary "1". Otherwise, the pulse is absent in the sampling period, and binary "0". The process is repeated for the signal duration.





Faculty News

Prof. Mazen Hasna

Promoted to Professor

Prof.Ahmed Massoud

Promoted to Professor and appointed as Associate Dean for Research and Graduate Studies

Prof. Atif Iqbal

Promoted to Professor

Prof. Nizar Zorba

Promoted to Professor

Dr. Mohammed Hitmi

Promoted to Associate Professor

Eng. Ahmed Al-Shafei

Joined the department as Teaching Assistant

Eng.Anton Jugalbot

Joined the department as Lab Engineer

Ms.Haya Hassan AL-Shahwani

Joined the department as Administrative Coordinator

Students' Activities

Field trip to Kahramaa-Siemens Sub-station

On Monday 18th of Feb 2019, QUIEEESB organized a field trip to Kahramaa-Siemens, where the students get in contact with the state-of-the-art deployment Kahramaa is performing for Ras Abu Aboud stadium, one of the World Cup 2022 stadiums, with the assistance of Siemens. Students received information on the different kind of technologies used in delivering and regulating power from

Arduino workshop

QUIEEESB organized a workshop on the 20 October 2019 about the fundamentals of Arduino for the male students at college of engineering. The workshop discussed the basics of the Arduino board and the fundamental Arduino programming concepts.

QU Student Clubs Forum

The QU-IEEE-SB participated in Qatar university Clubs and Organizations Forums 2019, which was held between 23rd and 25th of September 2019; introducing the club vision and events to the new engineering students. IEEE booth in this event attracted a good number of students, especially fresh undergraduate students from electrical engineering department and other engineering departments as well.

School visit

QU-IEEE-SB branch prepared a visit to Newton British School in Doha. Our team met the school students. We discussed with the students why engineering is important and what is role of engineers in the world. Our consular, Prof. Nizar Zorba gave a small presentation about the electrical engineering department at QU and what EE students are doing during their academic study. Also, he mentioned what are the opportunities that EE students could have after the graduation.

Es'hailSat Talk

QUIEEESB hosted a talk by Dr. Majid Mubarak Al-Naimi, Executive Director of Network Operations at Es'hailSat, who presented an interesting talk about the Es'hailSat 2 satellite.

Students' Activities (Cont.)

Trip to GE Qatar

QU-IEEE-SB had a fruitful trip to GE Qatar. They attended a workshop about Digital Energy Solutions. The workshop program included: A tour of GE Digital Energy's training and simulations facility at QSTP. An introduction to grid architecture, with a closer look at selected core technologies and systems. A review of sample job functions within the grid technology ecosystem. Interaction with GE engineering, telecom, software, and project management professionals from the regional operations team for perspectives from the field.

Field trip to Es'hailSat

The IEEE student branch at Qatar University has organized a wonderful field trip to Es'hailsat (Qatar Satellite Company). It was a great opportunity for the electrical engineering students to attend the presentation given by Eng. Yassin, which was talking about the satellite system operated by Es'hailsat. Also, the student had a chance to visit the monitoring room which is controlling the TV broadcasting and the channel qualities, and all the other communication system parameters for the satellite system.

Undergraduate Students' Achievements

3rd prize in the Annual Innovation and Entrepreneurship contest 2019

Undergraduate students Hadeel Abed and Nada Abdou won the 3rd prize for their idea Cooling Leakage Detection Drones under the supervision of Prof. Nizar Zorba in the 7th Annual Innovation and Entrepreneurship contest 2019 .

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Certificate of Winning

This is to certify that

Hadeel Abed and Nada Abdou

are hereby recognized for winning the third place for their idea ***Cooling Leakage Detection Drones*** under the supervision of Prof. Nizar Zorba from the Electrical Engineering Department in the Seventh Annual Innovation and Entrepreneurship Contest 2019.

Eatidal Al Qatami
Training Manager, Center for Entrepreneurship

Best paper Presentation award

Mr. Abdulrahman Mahmoud won the best paper presentation award in recognition of an outstanding presentation paper "Preliminary Implementation of the next generation cannulation simulation" under supervision of Dr. Faycal Bensaali at 17th IEEE Student conference on research and development. The conference was hold during Oct 15-17, 2019 at Universiti Teknologi PETRONAS, Malaysia.

SCOReD

In cooperation with
IEEE MALAYSIA SECTION & IEEE UTP STUDENT BRANCH

IEEE
Advancing Technology for Humanity

Best Paper Presentation Award

This certificate is awarded to

Abdulrahman Mahmoud

in recognition of an outstanding presentation of the paper

Preliminary Implementation of the Next Generation Cannulation Simulator

at the 17th IEEE Student Conference on Research and Development (IEEE SCOReD)

held during Oct 15-17, 2019 at Universiti Teknologi PETRONAS, Malaysia

Fawnizu Azmadi Hussin
General Chair, 2019 17th SCOReD

Irraivan Elamvazuthi
Conference Chair, 2019 17th SCOReD

Undergraduate Students' Achievements

Best Presentation award

Undergraduate students Abdulrahman Mahmoud, Uzair Khurshid, Amin Abducarim, Sakib Mahmud, Omrane Abdallah, Elshaikh Mohamed, Abdullah Alsalmi won the best free paper presentation award under supervision of Dr. Faycal Bensaali Dr. Abbes Amira for the abstract entitled "Toward Next Generation Cannulation Simulation" on Oct 31, 2019 at Sheraton Grand Resort & Convention Hotel.

Qatar Critical Care Conference 2019
MONDAY-THURSDAY, 28 - 31 OCTOBER

مؤسسة حمد الطبية
Hamad Medical Corporation

CERTIFICATE OF ACHIEVEMENT

The 1st Best Free Paper Presentation award is presented to

Abdulrahman Mahmoud, Uzair Khurshid, Aiman Abducarim, Sakib Mahmud, Omrane Abdallah, Elshaikh Mohamed, Abdullah Alsalemi, Faycal Bensaali, Abbes Amira, Ali Ait Hssain, Guillaume Alinier, Ibrahim Hassan

for the abstract entitled

Towards Next Generation Cannulation Simulators

On the 31th of October 2019 at Sheraton Grand Resort & Convention Hotel
Doha, Qatar

Dr. Ibrahim Mohamed Fawzy Hassan
Chairman, QCCC 2019 & Qatar Critical Care Society

Prof. Guillaume Alinier
Director of Research, Hamad Medical Corporation

Undergraduate Students' Publications

- A. Al-Kababji, L. Shidqi, I. Boukhennoufa, A. Amira, F. Bensaali, M. S. Gastli, A. Jarouf, W. Aboueata and A. Abdalla, "IoT-Based Fall and ECG Monitoring System: Wireless Communication System Based on Firebase Realtime Database," presented at The 16th IEEE International Conference on Advanced and Trusted Computing (ATC 2019), Leicester, United Kingdom, 2019.
- A. Jarouf, A. Al-Kababji, L. Shidqi, M.S. Gastli, W. Aboueata, A. Sakr, F. Bensaali, A. Amira, "Internet-of-Things-based Fall and ECG Monitoring System: Signals Comparative Analysis and Classification" presented at the Third International Computational Science & Engineering Conference, October 2019. [Abstract]
- L. Shidqi, M.S. Gastli, W. Aboueata, A. Al-Kababji, A. Jarouf, A. Sakr, F. Bensaali, A. Amira, "Internet-of-Things-based Fall and ECG Monitoring System: Signal Compression and Reconstruction Through Compressive Sensing", presented at the Third International Computational Science & Engineering Conference, October 2019. [Abstract]
- Khurshid, U., Mahmoud, A., Abducarim, A., Mahmud, S., Abdallah, O., Mohamed, E., Bensaali, F., Amira, A., Alsalemi, A., Ait Hssain, A., Alinier, G., and Hassan, I.: 'Towards the design and implementation of a human circulatory system for Extracorporeal Membrane Oxygenation simulation', The Egyptian Journal of Critical Care Medicine, , vol. 6, no. 3, pp. 87-89, 2019.
- Mahmoud A, Khurshid U, Abducarim A, Mahmud S, Abdallah O, Mohamed E, et al. Towards Next Generation Cannulation Simulators. Qatar Med J. 2019;
- A. Mahmoud, U. Khurshid, A. Abducarim, S. Mahmud, O. Abdallah, E. Mohamed, F. Bensaali, A. Amira, A. Alsalemi, A. Ait Hssain, G. Alinier, I. Hassan "Human Circulatory System for Extracorporeal Membrane Oxygenation Simulation", in 10th IEEE-GCC Conference & Exhibition, Kuwait, 2019(in press).
- Mahmoud A, Khurshid U, Abducarim A, Mahmud S, Abdallah O, Mohamed E, et al. Preliminary Implementation of the Next Generation Cannulation Simulator. In: IEEE SCOReD. 2019.
- Mahmoud A, Alsalemi A, Bensaali F, Amira A, Hssain AA, Alinier G, et al. A Leap Towards the Next Generation Cannulation Simulator. In: 30th Annual ELSO Conference. 2019. [Abstract]
- Khandakar, A., Chowdhury, E.H.M., Ahmed, R., Dhib, A., Mohammed, M., Al-Emadi, A.N., and Michelson, D.: 'Portable System for Monitoring and Controlling Driver Behavior and the Use of a Mobile Phone While Driving', Sensors, 2019, 19, (7)
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- Chowdhury, E.H.M., Khandakar, A., Alzoubi, K., Mansoor, S., M. Tahir, A., Reaz, B.M., and Al-Emadi, N.: 'Real-Time Smart-Digital Stethoscope System for Heart Diseases Monitoring', Sensors, 2019, 19, (12)
- M. Chowdhury, A. Khandakar, B. Hossain and R. Abouhasera, "Corrigendum to "A Low-Cost Closed-Loop Solar Tracking System Based on the Sun Position Algorithm"", Journal of Sensors, vol. 2019, pp. 1-11, 2019.
- A. Al-Zawqari, O. Hommos, A. Al-Qahtani, A. Farhat, F. Bensaali, X. Zhai and A. Amira, "HD number plate localization and character segmentation on the Zynq heterogeneous SoC", Journal of Real-Time Image Processing, vol. 16, Issue 6, pp. 2351-2365, December 2019.
- M. Al Disi, A. Alsalemi, Y. Alhomsi, F. Bensaali, A. Amira and G. Alinier, "Extracorporeal Membrane Oxygenation Simulation-based Training: Methods, Drawbacks and a Novel Solution", Perfusion, vol. 34, Issue 3, pp. 183-194, April 2019.
- M. Al Disi, A. Alsalemi, Y. Alhomsi, F. Bensaali, A. Amira and G. Alinier, "Using Thermochromism to Simulate Blood Oxygenation in Extracorporeal Membrane Oxygenation", Perfusion, vol. 34, Issue 2, pp. 106-115, March

Senior Design Contest May 2019 Winners Recognition ceremony

The college of Engineering organized Senior Design Contest Winners Recognition ceremony in May 2019 in Ibn Khaldoon hall. Three top groups were selected by the department of Electrical Engineering to show case their projects during the event. Three juries from industry were nominated to evaluate the submitted reports and the presentations (20 mins). Students were highly motivated and enthusiastic to show their work. The jury praised and appreciated the students' effort and the quality of work done. Top three projects were finally chosen for the awards based on the score obtained. The list of the winning teams is given below:

Project Title	Students	Rank
RF based Anti-Drone System	- Abdulrahman Hasan Abunada - Ahmed Yousif Osman	1st
Design and Implementation of Capacitive Electrodes for Electrocardiogram (cECG) Signal Acquisition	- Shaikha J. Al-Naimi - Wafaa Salman - Al-dana Al-Obaidli	2nd
Human Circulatory System Simulation for Extracorporeal Membrane Oxygenation Simulation	- Abdulrahman Mahmoud - Aiman Abducarim - Uzair Khurshid	3rd


كلية الهندسة
College of Engineering
Winners: Senior Design Contest 2019
First Place


كلية الهندسة
College of Engineering
Winners: Senior Design Contest 2019
Second Place
Amount:
4000 QR


كلية الهندسة
College of Engineering
Winners: Senior Design Contest 2019
Third Place
Amount:
3000 QR

MSc Graduates

Mariam Elnour

Mariam Elnour received the B.Sc. and M.Sc. degrees from Qatar University, Doha, Qatar, in 2015 and 2019, respectively. From September 2016 to January 2018, she was a Graduate Assistant at Qatar University, where she is currently a Research Assistant. Her research interests include machine learning, signal processing, and fault diagnosis.

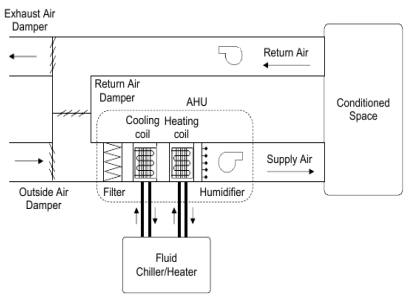
Thesis Title: Fault Diagnosis Of Sensor and Actuator Faults In Multi-Zone HVAC Systems

Supervisors: Dr. Nader Meskin and Dr. Mohammed Al-Naemi

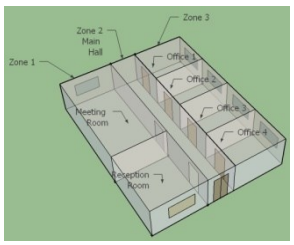
The buildings sector accounts for 30% of the energy consumption and more than 55% of the electricity demand. The Heating, Ventilation, and Air Conditioning (HVAC) system is the most extensively operated component that is used to provide healthy and comfortable indoor conditions and it is responsible alone for 40% of the final building energy usage. HVAC systems include a considerable number of sensors, controlled actuators, and other components. They are at risk of malfunctioning or failure resulting in reduced efficiency, potential interference with the execution of supervision schemes, and equipment deterioration.

Two neural network-based methods are proposed for sensor and actuator faults for a 3-zone HVAC system. For sensor faults, an online semi-supervised sensor data validation and fault diagnosis method using an Auto-Associative Neural Network (AANN) is developed.

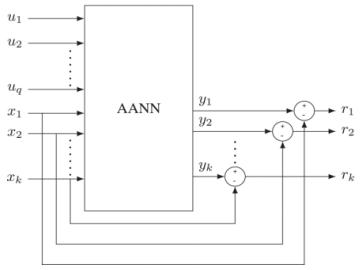
The method is based on the implementation of Nonlinear Principal Component Analysis (NPCA) using a Back-Propagation Neural Network (BPNN) and it demonstrates notable capability in sensor fault and inaccuracy correction, measurement noise reduction, sensor data replacement, and in both single and multiple sensor faults diagnosis. A novel on-line supervised multi-model approach for actuator fault diagnosis using Convolutional Neural Networks (CNNs) is developed for single actuator faults. It is based on a novel data transformation technique in which the 1-dimensional data are configured into a 2-dimensional representation without the use of advanced signal processing techniques. The CNN -based actuator fault diagnosis approach demonstrates improved performance capability compared with the commonly used Machine Learning-based algorithms.



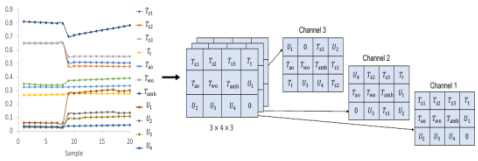
A Typical HVAC system



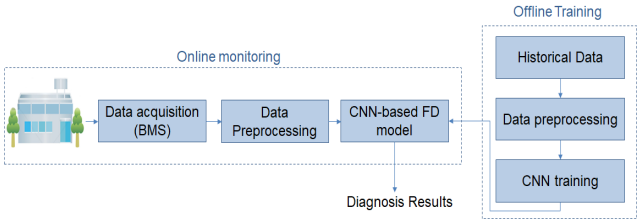
The 3-zone building



The sensor fault diagnosis scheme

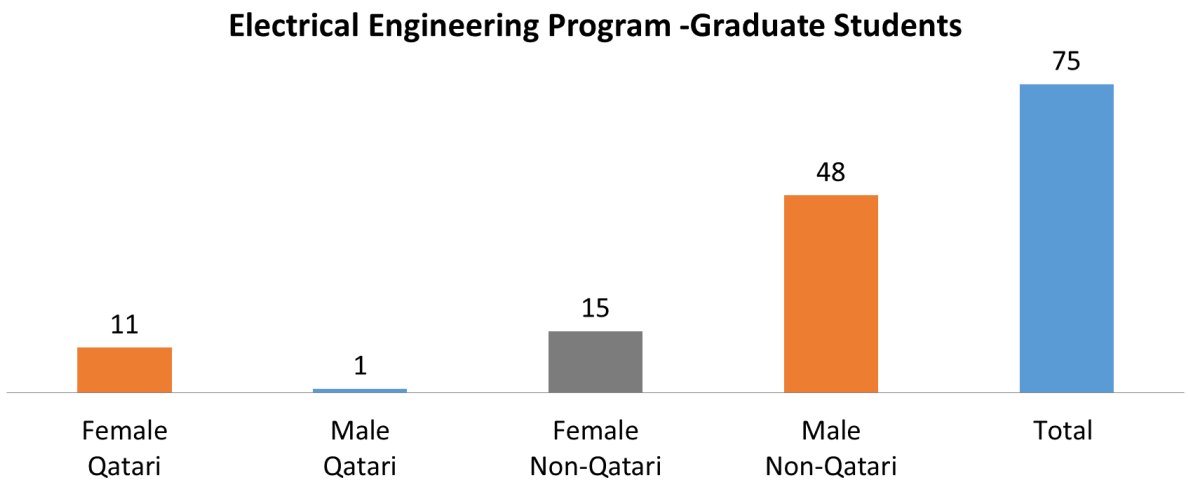


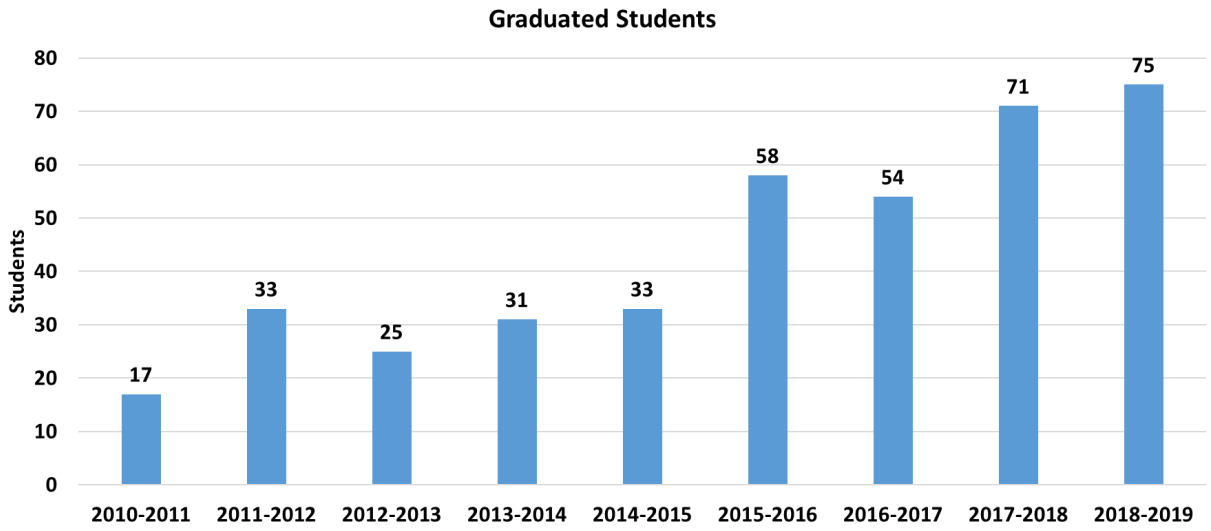
The 1D to 2D data transformation technique



The actuator fault diagnosis scheme

Graduate Program Facts





PhD Graduates

Dr. Lutfi Samara

Lutfi Samara received the B.Sc. degree in electrical engineering from Qatar University, Doha, Qatar, and the M.Sc. degree (with distinction) in information technology from the Tampere University of Technology, Tampere, Finland, in 2011 and 2013, respectively. In 2019, he received his Ph.D. degree (with distinction) in Electrical Engineering from Qatar University, Doha, Qatar, under the supervision of Prof. Ridha Hamila. Currently, he is a Post-doctoral researcher at the electrical engineering department in Qatar University. His current research interests include the modeling and compensation of radio frequency impairments in radio transceivers, cooperative communications, and physical layer security.

Thesis Title: Advanced DSP Algorithms for modern wireless communication transceivers

Supervisors: Dr. Ridha Hamila

Since the beginning of the new millennium, there has been an ever-increasing demand on wireless communication based applications. In order to cope with this growing demand, an obligation is imposed on the academic and industrial circles to put forward novel technologies that aim at increasing the capacity of wireless communication networks. The work presented in my thesis proposes several novel signal processing techniques at the physical layer (PHY) that enhance the performance of wireless communication systems. The proposed methods not only address the problem of increasing the data rate, but also tackle several technical aspects related to the energy efficiency and reliability of wireless communication links. Such considerations are valuable in the development of wireless communication systems that are suitable to be adopted in emerging wireless communication standards such as the fifth generation (5G) wireless communication standard and beyond. The thesis covers the analysis of the performance of a full-duplex (FD) transceiver under the constraint of imperfect self-interference (SI) cancellation. In particular, we derive a closed-form expression of the average residual SI power in FD orthogonal frequency multiplexing (OFDM) transceivers, and we show its functional dependency on IQI and PN levels. For instance, the residual SI power is plotted versus the digital domain cancellation parameter d in Fig. 1. The figure further demonstrates the effect of phase noise and IQI, which are quantified by the 3-dB bandwidth (β) and the image rejection ratio (IRR) metrics, respectively. The depicted results show a perfect match between the derived closed form expression for the residual SI power and the numerical simulations. Moreover, increasing β and the IRR result in a higher floor even when the digital-domain cancellation error is relatively small.

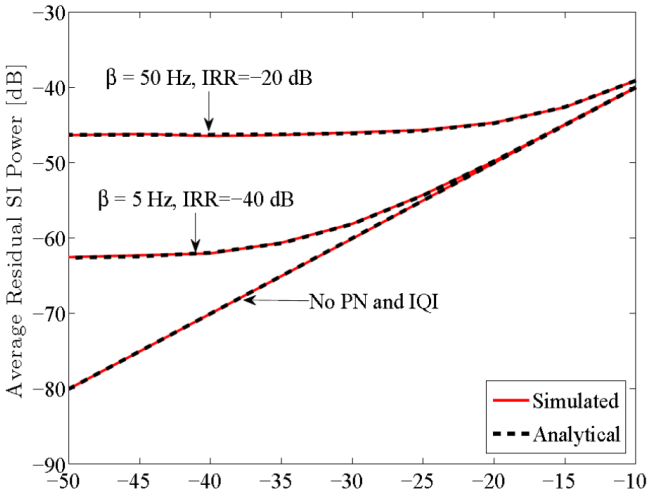


Figure 1: : Average residual SI power versus d.

It is worth noting that the reason why residual SI power is critical to evaluate is that in the event that it is completely cancelled, it can yield a doubling in the spectral efficiency of a wireless communication link, thus increasing the capacity of a wireless network. The thesis also contains the evaluation of the residual SI power when a FD transceiver is deployed in a relay adopting the amplify-and-forward (AF) protocol. Moreover, several algorithms that aim at performing multiple relay selection and beamforming in a dual-hop AF relay network were proposed. The relays were assumed to operate using FD transceivers, and the selection and beamforming algorithms were designed to consider different types of constraints.

If N represents the number of OFDM subcarriers in an OFDM waveform, realizing it would have the complexity in the order of N3 since it requires the inversion of a matrix. However, the OMP algorithm yields a sparse equalizer in the order of N2, thus significantly reducing the equalization complexity. Moreover, while performing the equalization process, the developed

sparse equalizer requires less complex multiplications to equalize the received signal, hence increasing the efficiency at the receiver. Fig. 2 depicts the proposed sparse equalizer. As shown in the block diagram in Fig. 2, the equalizer further contains a decision feedback chain to suppress the ISI.

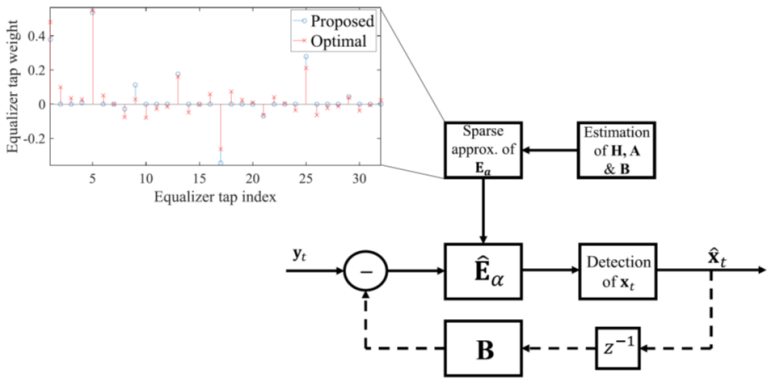


Figure 2: A block diagram depicting our proposed equalization scheme

Fig. 3 depicts the data rate of an OFDM symbol when the CP length in samples (v) is varied.

The OMP algorithm is applied to the MMSE-decision feedback equalizer (DFE) case since, as it will be shown in the results, the MMSE-DFE equalizer performs the closest to the Sufficient CP based design, and our aim is to perform as close as possible to the Sufficient CP based design while reducing the complexity of realizing the equalizer.

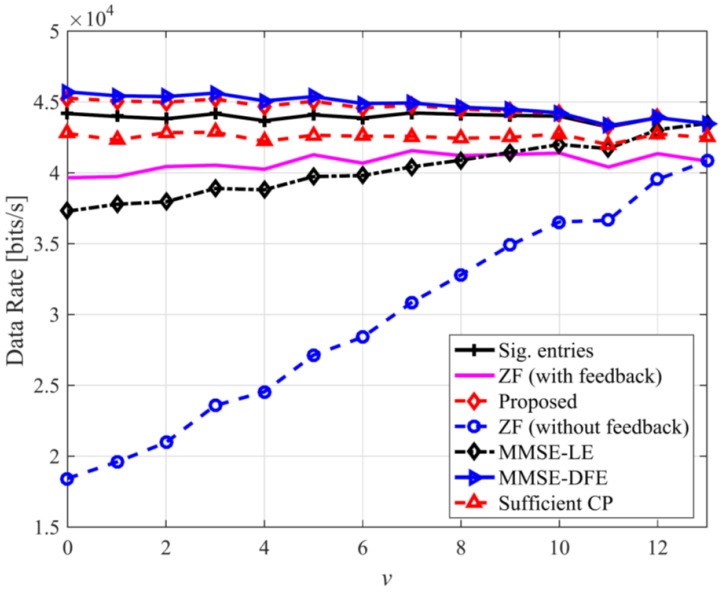


Figure 3: Data rate vs. v (CP length) for various equalizer implementations when the received SNR is equal to 20 dB and a sparsity level is at 50%.

It can be seen from the depicted results that reducing the length of the CP length will increase the data rate as more useful data is transmitted. In the simulations, we set the CP length for the Sufficient CP case to be equal to 16, totally eliminating the ISI effect. Since the CP length for the Sufficient CP case is set to 16 samples, our proposed equalizer always results in a higher data rate even when only 50% of its entries are being active.

The same sparse equalizer design approach was performed in the context of OFDM signals affected by phase noise. Phase noise has detrimental effects on OFDM signals and causes ICI, hence efficient sparse equalizers were designed following a similar approach as that of the case of the insertion of insufficient CP.

Publications:

Samara, L., Mokhtar, M., Özdemir, Ö., Hamila, R., & Khattab, T. (2016). Residual self-interference analysis for full-duplex OFDM transceivers under phase noise and I/Q imbalance. IEEE Communications Letters, 21(2), 314-317.

Samara, L., Gouissem, A., & Hamila, R. (2018). Hybrid full-duplex and alternate multiple relay selection and beamforming in AF cooperative networks. IEEE Access, 6, 28467-28477.

Samara, L., Alabassi, A. O., Hamila, R., & Al-Dhahir, N. (2018). Sparse equalizers for OFDM signals with insufficient cyclic prefix. IEEE Access, 6, 11076-11085.

Samara, L., Al-Abbasi, A. O., Hamila, R., & Al-Dhahir, N. (2018). Reduced-complexity sparsity-aware joint phase noise mitigation and channel equalization in OFDM receivers. Physical Communication, 30, 50-57.

Samara, L., Gouissem, A., Hamila, R., Hasna, M. O., Al-Dhahir, N. (2019). Full-Duplex AF Relaying Under IQ Imbalance, IEEE Transactions on Vehicular Technology. (returned with major revision, reviews submitted).

PhD Graduates

Dr. MISHRA ARTI

Thesis Title: Thesis Title: Perovskite Solar Cell Development and Characterization for Printable Techniques

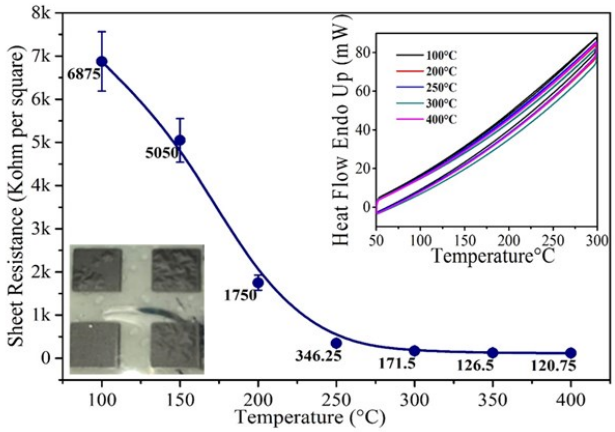
Supervisors: Dr. Farid Touati (EE) and Dr. Zubair Ahmad (CAM)

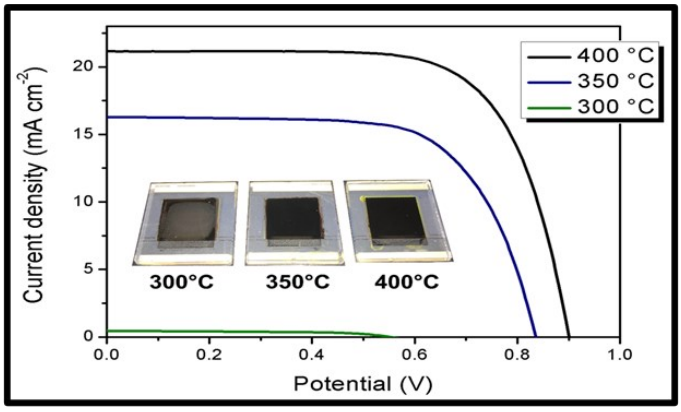
PSCs have become a significant performer in 3rd generation photovoltaics with power conversion efficiency, greater than 22% for active areas less than 1 cm2. However, with efficiency improvement, concerns regarding the operational stability and industrial production firstly resolved to grow into commercially viable PSCs. To address these issues most stable, yet efficient Monolithic PSCs (mPSCs) are structured. The mPSCs are having compact TiO2, mesoporous TiO2, mesoporous ZrO2, and mesoporous carbon electrode layers in optimal thicknesses on the FTO substrate. Fabrication protocol for all the layers which is easily acceptable for large area mPSCs manufacturing and top carbon electrode materials those are stable and behaves as protective casing to make PSCs stable has been highly desired. Hence, in this project our aim is to optimize top carbon layer and study photophysical processes inside the mPSCs. This research work is mainly divided into three parts.

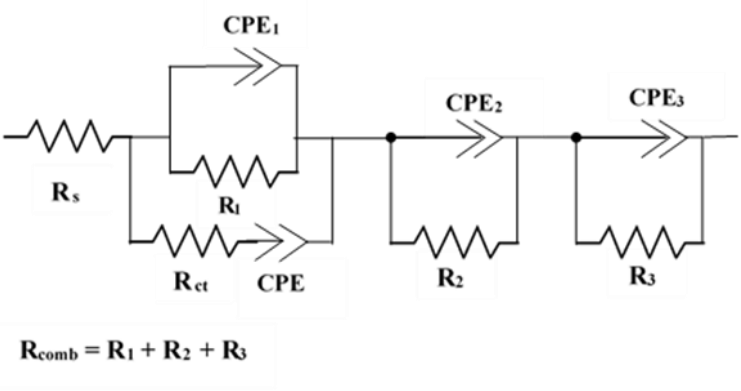
The first part of the dissertation described carbon film fabrication by screen printing technique and their investigation at different annealing temperature. Influence of annealing temperatures on the electrical, morphological and structural properties of the carbon film has been discussed. It is shown that a low annealing temperature is good for better adherence of the conductive carbon films, however, temperatures higher than 300°C are required to produce efficient mPSCs. A sintering temperature of 400°C showed the highest device efficiency of 13.2%.

It is important to correlate all the physical properties/ processes taking place in the mPSCs to gain a deeper understanding of mPSCs operation: What is the role of the contacts? What limits the efficiency of existing perovskite solar cells? How many charge carriers are there in the cell under operating condition. Hence, in 2nd part, Electrochemical Impedance spectroscopy (EIS) spectrum has been described, which is performed on the mPSCs having highest efficiency during previous experiments. The EIS spectrum of mPSCs quantitatively explains the role of contacts, layers, charge generation, drift and diffusion of charge carriers and recombination. This would further provide insight into the performance-limiting physical processes of mPSCs.

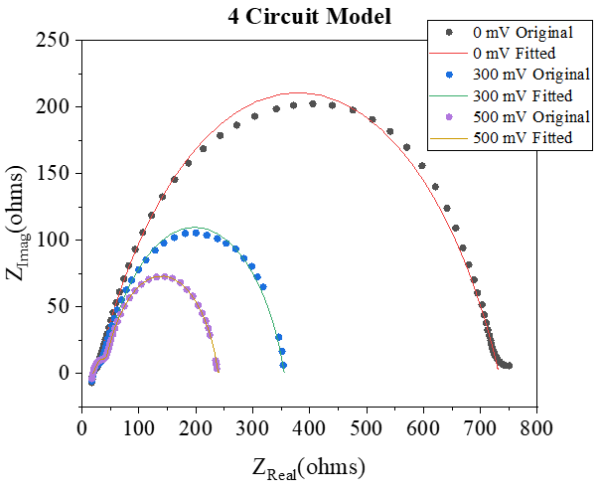
The microstructure or morphology of the perovskite crystals inside mesoporous TiO2 and mesoporous ZrO2 have significant effect on the mPSCs performance and stability. Therefore, to achieve

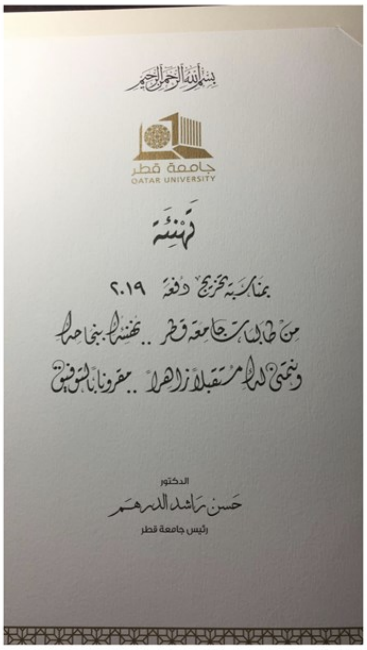






higher mPSCs device performance, one-dimensional microrods (4mm-5mm) of PbI2 and CH3NH3PbI3 (MAPbI3) is fabricated in the 3rd part. These microrods consist of unique structural and morphological properties which are grown at room temperature. The analyses confirm the existence of strong interactions between different stable groups in the crystals. The morphological studies approve crack free morphology of PbI2 and MAPbI3 micro-rods. The above results are expected to have a big effect on solar cell and photo-detection industry by fostering improvement of thin-film opto-electronic devices. Best Thesis Award: Qatar University Outstanding Thesis Award and Outstanding Dissertation Award.





Students & Alumni Success Stories

Engr. Mohammad Sadok Gastli

Graduate Student's Journey

I graduated from Qatar University in June of 2019, and was looking to expand my horizons and step the next big step. That step culminated into pursuing a Master's of Applied Science at the University of Waterloo. The university is considered one of the top engineering and artificial intelligence universities in Canada.

Now in University of Waterloo, I specialize in Pattern Analysis and Machine Intelligence, my current research is involved in investigating the use of machine learning with images in real-life applications alongside industrial partners. My current work relies heavily on great knowledge and skills in programming which I built my basis on during my undergraduate in QU.

Doing my undergraduate degree in Electrical Engineering at Qatar University provided me with the necessary experience; both academic and personal. The faculty at QU has contributed immensely to my academic knowledge and experience and propelled me to always thrive for the best. In addition, the ABET accredited engineering program in QU helped me obtain a strong basis in electrical engineering and provided me with the means to tackle multidisciplinary problems, which is crucial in a world where different fields grow more interconnected every day.

Some of the difficulties I faced were with the shift into the different field of Artificial Intelligence as I had to work on building a better foundation for that. Moreover, the difference between the pace and workload of a bachelor's degree and a master's degree is very notable. However, Experiencing new professors and different teaching styles, I now know that professors at QU are on-par with other leading universities. Furthermore, living in the multicultural society of Qatar made it much easier for me to adapt to a new location with many international students.

So far my journey has been wonderful, and I am looking forward to all of the new experiences and opportunities that will come my way. With the bitter and the sweet, my experience at QU helped pave this path for me.

Engr. Yazan Qiblawey

Graduate Student's Journey

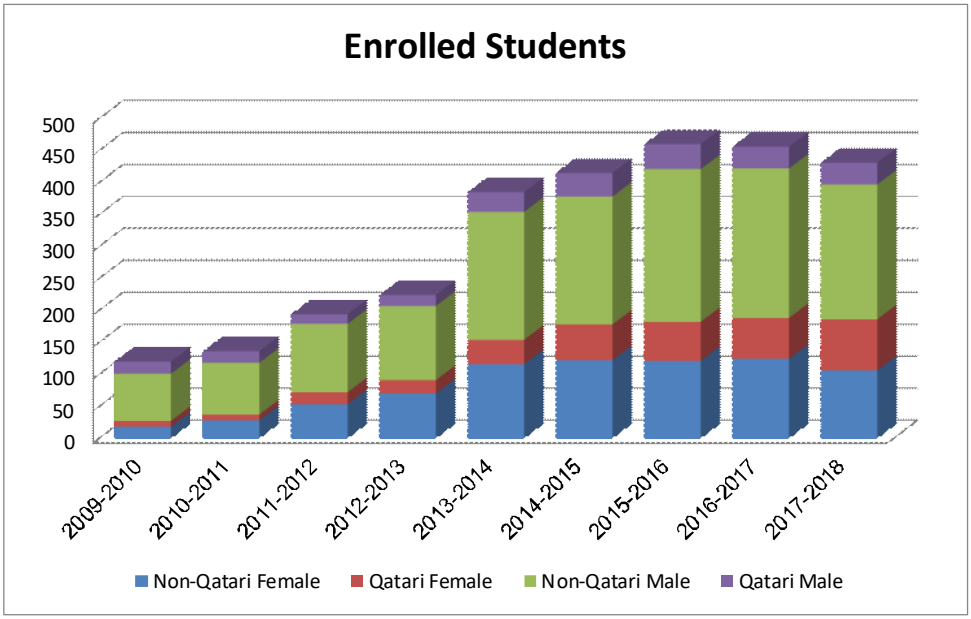
Since I graduated from QU in January 2018, I had a plan to take a further step in my career, I aimed to pursue my graduate studies. I got accepted to do my Master of Science in University of Nottingham (UoN), the United Kingdom in electrical engineering in 2019. UoN is considered one of the top universities in the UK in electrical engineering and top 100 universities worldwide. Also, many university faculties and alumni won noble prices in physiology or medicine and economics.

My master studies focused on signal processing and control systems. My thesis is about the detection of series arc faults in DC systems in the presence of power electronic loads. In particular, electric aircraft using signal processing techniques based on Wavelet analysis. During my time in UoN, I got chance to participate in Sir William Siemens Challenge, where top postgraduate students across the UK are challenged to deliver smart and high-quality solutions for daily life that can be combined with Siemens products. Moreover, I got the chance to explore new areas of electrical engineering and their associated applications that can help my career by conducting my experiments in Energy Technologies Research Institute (ETRI) and visiting several industrial sites.

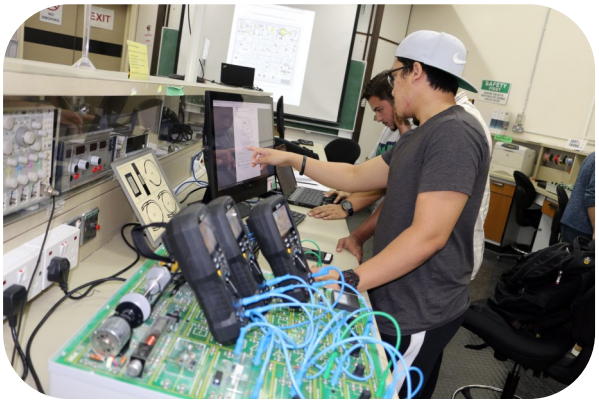
Completing my undergraduate study in QU gave me a strong fundamental knowledge and skills in electrical engineering which are necessary to complete my postgraduate study despite the workload difference between undergraduate and postgraduate in terms of projects and assignments. In terms of teaching, the teaching method and techniques in QU are used worldwide. Qatar University provided faculties with the most recent technology for teaching in classrooms and labs. Also, professors and teaching assistants are doing their best to transfer knowledge to students, which I really appreciate and acknowledge. Therefore, I would like to acknowledge them for their efforts.

Studying abroad can be difficult for many people. However, living in a multicultural society like Qatar, it helped to narrow down the gap. In addition, working and dealing with students from different counties and backgrounds added to my personal skills and let me create a friendship with people from around the world.

Undergraduate Students' Statistics



Undergraduate Students' Lab sessions



Editorials from EE Faculty

A Faculty's Reflection on Distance Learning Experience

Dr.Tamer Khattab
Associate Professor

A prologue

Since the start of the COVID -19 pandemic event many aspects of our lives globally have been changing rapidly. Education was no exception to these changes. With its central role in modern civilization, continuity of education through the safety measures and social distancing constraints had to be maintained. Globally and at almost all level from K-12 to College, the shift to distance learning using modern information technology tools seemed the only viable solution to maintain learning ongoing. The idea seemed viable everywhere and the initial thought was "Well, everyone was talking about it before as the future of education and it has been happening here and there, so for sure it can be easily done!" However, as the actual implementation started on large scale, the tiny little details started to pop up till they became major issues that needs to be addressed.

In this article, I will try to provide a faculty's perspective on this new experience as well as provide some tips and tricks, which I believe, other colleagues may find useful. I have used online tools before this period within my classes in the Department of Electrical Engineering at Qatar University. I have used lecture video recordings as well as flipped classroom techniques for graduate, undergraduate, major core, major elective and general engineering course levels. I have experienced teaching for small classrooms as well as large classrooms. I have even delivered some of my lectures remotely when I was on business travel to avoid class interruptions. Therefore, I saw the main differences between using technology tools to augment face-to-face class learning setup as opposed to fully distance learning setup.

The shift and the feelings

To start with, in our current setup, we have to respect two aspects that have drastic effects on the whole experience. These two aspects stem from the fact that the current situation is not a typical distance learning experience. The two aspects are the sudden shift that happened in the middle of a semester that started as a classical face-to-face learning experience as well as the reality that the extra measures related to safety and social distancing have their effects on both educators and learners. This means that the experience that I will describe in the following might not completely fit the classical distance learning situation, which is setup from the beginning where both parties come to it willingly and prepared (or even prefer it).

The challenges

The most common challenges facing the faculty and students related to the current shift to distance learning can be summarized in the following paragraphs:

- The appearance of synchronized peak load that overwhelms the existing infrastructure. Everyone whether in college or schools wants to teach classes in their original scheduling to avoid disrupting students and classes times. This results in overloading the network infrastructure. To add to the dilemma, the utilized tools are less than a handful set of tools, which puts another bottleneck, namely the tool application server.
- The challenge of examinations in terms of methods

to guarantee fairness to students and exam integrity. The fairness issue comes as a consequence of online exam nature which tends to have binary results (correct/ incorrect) as opposed to typical paper and pencil exam where students have the chance to show steps and get partial marks. Moreover, using an essay/written answer exam, while having the exam at home, requires a take-home type of exam which is typically open ended and more challenging to the average student to compensate for the lack of invigilation. On the other hand, the integrity of online unmonitored exams are highly doubtful even when using the lock-down respondus browser since the student is not monitored and can easily get external help easily by talking to others physically around or electronically through another device as well as have access to all resources on the Internet.

- Lack of access to labs and physical resources of the university due to the closure process to maintain the required safe social distancing is particularly challenging to engineering and other science disciplines. This has its most drastic effect on the capstone graduation (senior design) projects. Addressing the experimental labs and capstone projects is out of the scope of this article and needs to be addressed in another article.

Methods, tips and tricks

Capitalizing on the experience I was blessed with through using some techniques of online tools in my regular classes, I am suggesting in the following some methods/ tips for carrying the new mandatory distance learning mode of operation with minimal impact on learners as well as educators. The proposal includes the methods I am using and why I am using them as well as some brief analysis of the expected disadvantages.

In order to overcome the issue of peak load, I am using pre-recording of lectures on videos that I post to students on Youtube ahead of time; then I hold an online problem solving and Q&A session for each module (typically 2-3 videos). The pre-recording has the advantage of allowing students to look at the topic before interacting. The live interactive session ensures continuous real-time interaction with students. However, it might happen that students do not watch the videos before the session; therefore, they will not be ready for the session. To address this issue, I use some flash video quizzes (very short direct questions) on the material of the videos before holding the online session. Moreover, I highlight the main concepts of the module at the start of the interactive session before solving the examples. One hint is to make sure that the total time spent by students in this model is similar to the time they should spend in typical class teaching times. So, the videos and the sessions have to be each shorter than a regular lecture.

On the assessment side, I have opted for reducing the weights on exams to avoid the dilemma of exam integrity versus fairness. I have moved to dependency on mini projects, take home open ended assignments and short oral assessments. Moreover, major exams such as midterm or final are broken into mini exams each focusing on a separate module of the course to increase students' chances as well as avoid higher possibility of technical issues with longer time online exams. The issue of exam integrity is still a challenge though. To address this issue, the exam's general nature is changed to be more geared towards a thought and outcome oriented assessment rather than a knowledge and memory oriented one. Moreover, questions randomization to minimize the possibility that two students will get the same exam as well as one question at a time with no go back options are setup to minimize the chances of cheating.

The tools

In my approach, I diversify the tools as much as possible to enhance the quality, increase the interaction with students and minimize the possibilities of hitting a bottleneck. Lecture recordings are saved on Youtube and made public to allow easy access for students, avoid

Editorials from EE Faculty

A Faculty's Reflection on Distance Learning Experience (cont.)

Dr.Tamer Khattab
Associate Professor

the Blackboard jam and increase the benefits beyond Qatar University community. I am diversifying the tools I use to deliver online live interaction sessions between Blackboard Collaborate, Webex and Zoom. The first two are Qatar University based tools and may encounter higher load during peak hours. However, Zoom is a public tool and I find it in general less loaded and more flexible. When using zoom it is advised to login twice (using same ID or 2 different IDs from two different devices) to have access to students' text chat while sharing your screen. I present my work in interactive sessions using my iPad with a program called Explain Everything. It allows me to use prepared slides and annotate (handwrite) on them as well as write on white screen. The same setup can be done on any tablet. In terms of online exams and quizzes, Blackboard and Socrative are great tools in addition to some publishers based tools (Pearson, McGraw Hill, Wiley). I also use Skype for short texting with students in addition to email. Skype enables an almost instantaneous continuous direct interaction with students to address short requests and inquiries without sharing phone numbers (might not be preferred by students/faculty) as needed in other tools such as Whatsapp or other chat applications. I am using Twitter as a tool of broadcast to students in addition to Blackboard. I have created a Twitter account for the course and

asked students to follow it to receive announcements. Last but not least social media (Twitter, Facebook, Instagram) can also be used as a tool for online lecture delivery through live broadcast in case other tools get crowded with the disadvantage that they allow only text interaction with audience.

An epilogue

The current situation is challenging to learners as much as it is challenging to educators. Stress from the safety measures and the uncertainty about the future is affecting everyone. It is our duty as college educators to take every measure to support our students during these tough times. We have to understand that no solution is perfect and that knowledge and assessment are not the only important pieces of education. Students' learn from the actions, characters and behaviours of their professors/instructors as they learn from the course syllabus contents. We have to be willing to accept that some students may take advantage of the situation, but this does not matter as much as making sure we take the majority of our students safely and successfully though the journey of this semester. Being flexible, providing alternatives and working with the students to try to evaluate them based on their best performance indicators are all crucial to be able to carry them through successfully. An important aspect that is worth mentioning is that the initial direct physical interaction with students due to the classical start of the semester is a great asset that establishes a human bond between the instructor and the students. This bond enables a level of trust and motivation that is essential for students to carry through the course work successfully. Therefore, I recommend that in any distance learning model, some arrangements for a couple of person-to-person physical interaction need to be planned early on. There will be lots of lessons learned from the current experience concerning distance learning and the possibility of achieving quality education without personal physical interaction. However, this can be the topic of another article after we go through the whole experience.

Electrical Engineering responding to Online Exams using Blackboard

Engr. Amith Khandakar, Teaching Assistant, Electrical Engineering Department at Qatar University

The shift to the online education due to the COVID-19 pandemic happened globally. It was initiated comparatively earlier by Qatar University thanks to the excellent leadership. Electrical Engineering Department had taken the initiative and developed a set of online videos for its faculties in creating online tests/exams using the Blackboard Learning Management System.

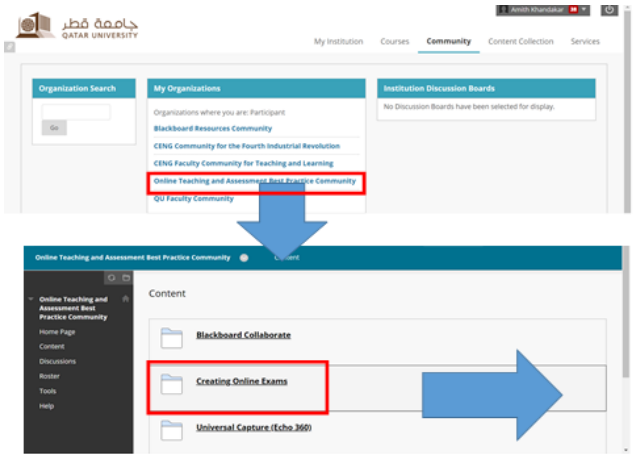
The videos shows step by step instructions on how to create online tests using the features of Blackboard and also from the experience of its experienced faculties.

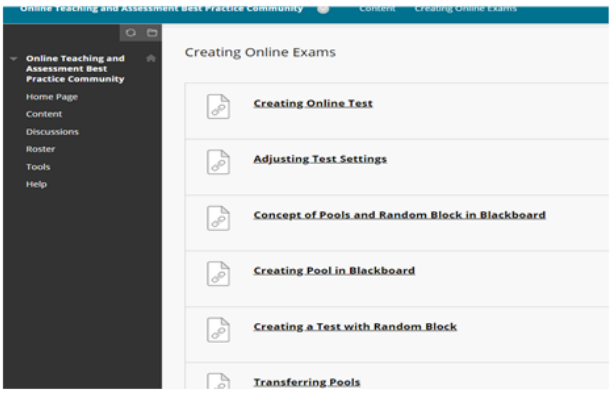
These videos have also been shared on the Blackboard under Community----Online Teaching and Assessment Best Practice Community ---Creating Online Exams. The videos are very handy and useful for the faculties of the department in creating online tests/exams during this period.

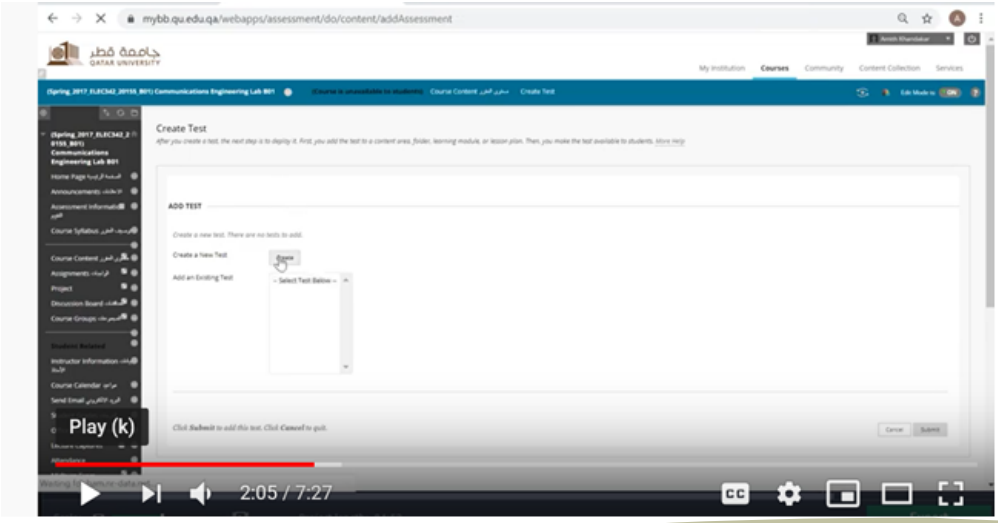
The online videos could be accessed using the links below:

1. Creating Test Online
2. Adjusting Test Settings
3. Concept of Pools and Random Block in Blackboard
4. Creating Pool in Blackboard
5. Creating a Test with Random Block
6. Transferring Pools

Snapshots of one of such videos:







Editorials from EE Faculty

Dr. Atif Iqbal
Professor

A novel approach towards improved power extraction, highly efficient and fault-tolerant grid integration of solar power to the utility grid

Research Summary:

Dr. Atif Iqbal and his research team in the Dept. of Electrical Engineering, Qatar University have worked on addressing the key challenges related to solar power deployment in the region of Qatar. As a part of NPRP – EP project X-033-2-007, innovative solutions have been developed related to effect and remedy of partial shading, efficient grid integration converters and automation control.

Innovative solution for partial shading in Solar PV modules:

The team here utilized a new circuit termed as quasi Z Source Inverter (qZSI) consisting of only four Power electronic switches when compared to the conventional configuration of five switches (boost converter + H – Bridge inverter). To achieve high power, several units of this novel circuits are connected in series and termed as a multilevel inverter (MLI) as shown in Fig. 1. In conventional system also, connecting circuits in series yields higher power. When these circuits are powered with solar PV panels, each circuit must be controlled to extract maximum power from the solar PV panel. Control of novel qZSI also allows extraction of maximum possible power. However, due to clouding or dust accumulation, solar irradiation received by the solar panels decreases resulting in reduction of power produced by PV panel. This problem is highly concerning in multilevel inverter system. Here, due to partial shading of one circuit, other series-connected circuits (which are receiving 100% solar irradiation), also experiences this effect and the resultant power extraction further reduces.

To address this concern, the research team developed novel technique to improve power extraction from solar PV panels. During partial shading condition, power extraction of healthy modules is improved, and partially shaded modules are clamped the possible outputs to respective solar irradiation level. Along with this, additional benefits of high efficiency and smaller size are also obtained, in addition to the modularity of the solution. In case of failure or damage of one or more units, the identical unit(s) can be easily and conveniently replaced.

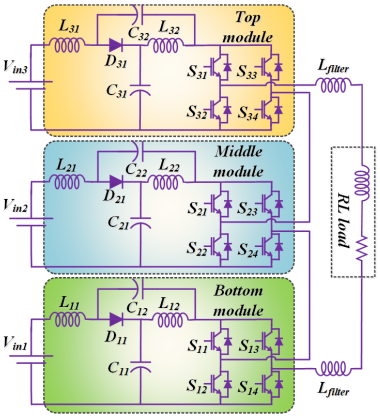


Fig. 1 – Multilevel Quasi Z Source Inverter connected to RL load.

Results showing the improvement of the proposed method are illustrated in Fig. 2. When

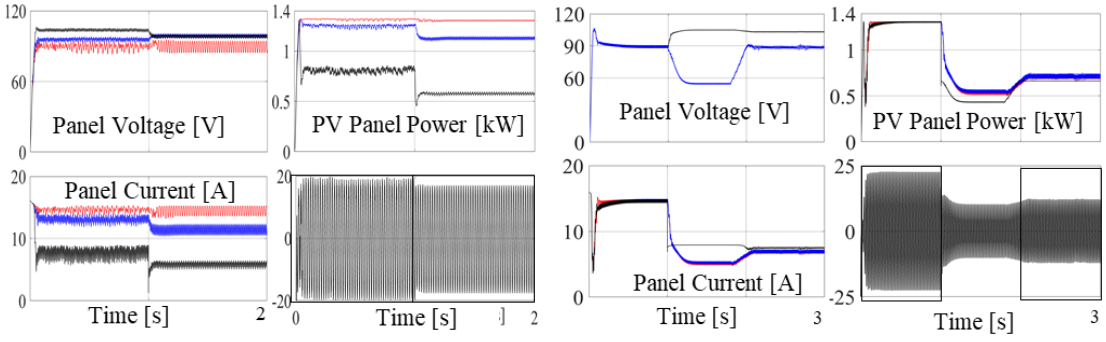


Fig. 2 – Grid current injection with (a) Conventional method and (b) Proposed method for multilevel qZSI.

partial shading occurs at t=1sec, in conventional system, power extracted is reduced by 65%. With the proposed method, power extracted is increased to 97% of the rated capacity as shown in Fig. 2(b). *Thus, it can be concluded that 32% improvement in the extracted power is observed with proposed control technique*. This is a major milestone achieved in the project. Research papers are published on this finding.

Novel control algorithm to achieve fault-tolerant operation of grid-connected multilevel qZSI:

In conventional systems, due to switches/diodes fault, the entire circuit must be isolated from the multilevel operation. Due to this isolation, the performance of grid-connected power converter circuit experiences reduction in output power. In conventional system consisting of cascaded H Bridge inverter, only reduction/buck of input voltage is possible. However, with qZSI, buck/boost operation is possible. Utilization this feature, performance during post–fault operation can be significantly improved in both grid-connected powering multilevel qZSI circuit.

Although, boosting of input voltage is possible with qZSI, there are several constraints related to it. Increasing boosting alone may disturb the steady-state performance of the circuit. Coupling of these constraints is shown in Fig. 3. To address this concern, the two-step control algorithm is developed. This algorithm must function during partial shading whose characteristics are shown in Fig. 4.

Simulation results of the system are shown in Fig. 5. At t = 1sec, module

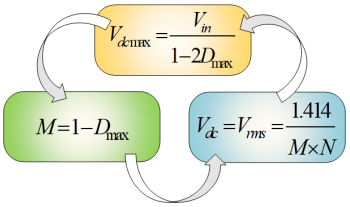
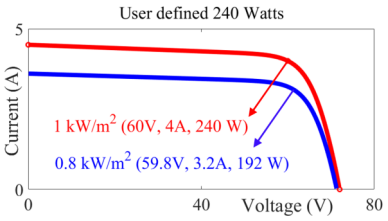


Fig. 3 – Triangle of coupled constraints

fault is emulated in the system. In the first step of correction algorithm during post-fault operation, the output voltage is restored to pre-fault value thereby helping in sustained grid connection. In the second step implemented at 2sec, phase shift is restored in accordance with multilevel operation thereby improving THD content resulting in enhanced post-fault operation. To test the suitability for solar application, variation of solar irradiation is also introduced, and the desired performance is achieved thereby verifying the robustness of the proposed control.



Fig, 4 - Rating of PV panel at different solar irradiations

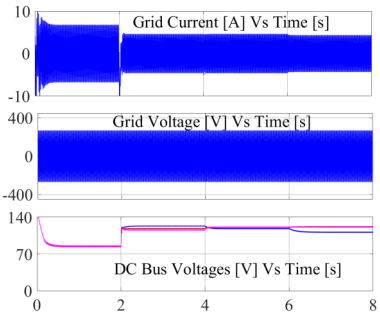


Fig. 5 – Results showing improved fault – tolerant performance.

Optimized implementation of FPGA based control algorithm of Multilevel qZSI System:

Operation of multilevel inverter systems at high frequency is advantageous as it results in high efficiency and low converter size. To achieve this, the control algorithm of the proposed system is implemented with Field Programmable Gate Arrays (FPGA) processor operating at 100 MHz. With single FPGA control board, a complex 12 modules of qZSI are controlled thereby eliminating resource and software redundancy. This is another milestone achieved in the project that can help practicing engineers to implement such solutions in their system. Fig. 6 shows control algorithm of multilevel qZSI. Fig. 7 shows the hardware prototype developed for validation. Experimental results obtained are shown in Fig. 8 – 11. For further reading, references are mentioned at the below

Acknowledgment: This article was made possible by NPRP grant # [X-033-2-007] from the Qatar National Research Fund (a

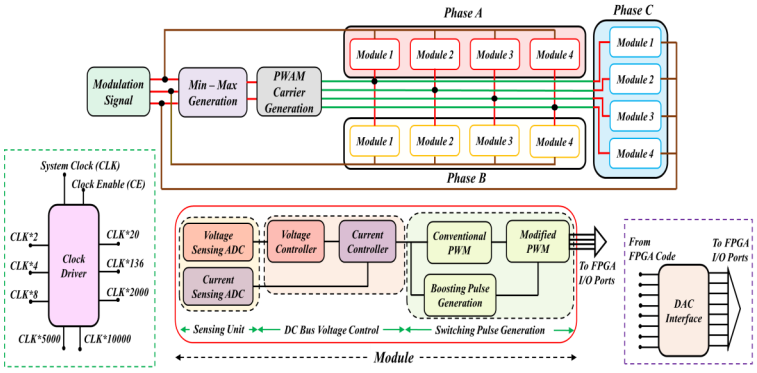


Fig. 6 – FGPA based control algorithm for multilevel system

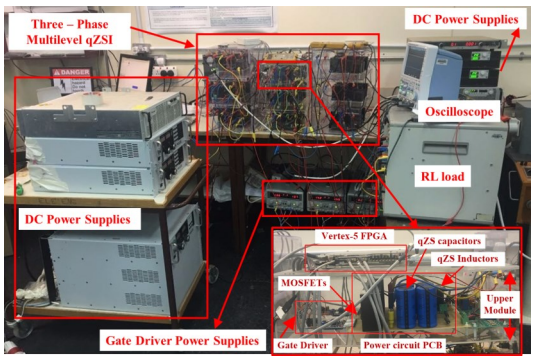


Fig. 7 – Hardware prototype of multilevel system

Editorials from EE Faculty (Cont.)

Dr. Atif Iqbal
Associate Professor

A novel approach towards improved power extraction, highly efficient and fault-tolerant grid integration of solar power to the utility grid (Continued)

member of Qatar Foundation). The statements made herein are solely the responsibility of the authors

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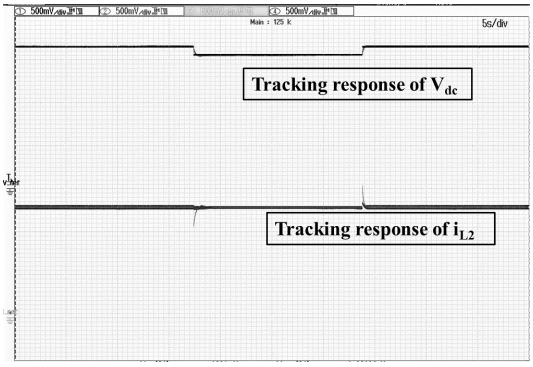

Fig. 8 – Control algorithm tracking performance of qZSI module

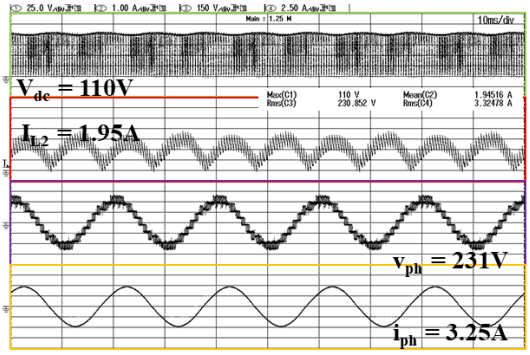

Fig. 9 – Voltage boosting and output parameters for qZSI module

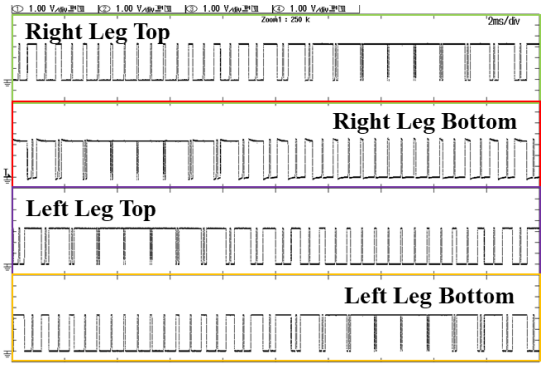

Fig. 10 – Switching pulses for qZSI module switches

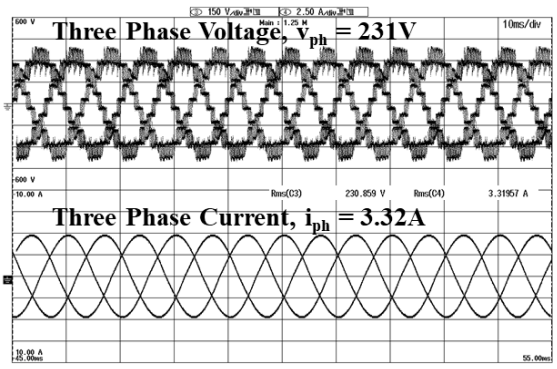

Fig. 11 – Three phase line voltage and line current of qZSI system

EE Faculties Gatherings

Editorials from EE Faculty

QU-High-Impact Grant-Advanced Reconfigurable Multiphase Motor Drive System for Electric Vehicle Applications-[QUHI-CENG-19/20-2]

Dr. Atif Iqbal
Professor

Dr. Prathap Reddy

The major aim of this project is to develop a multiphase motor drive system for gearless electric vehicle. The developed multiphase motor is capable of running with different phase as well as pole number to achieve required speed and torque of the electric vehicle. With this, the proposed multiphase machine will deliver the equivalent speed torque characteristics of conventional fossil fuel driven IC engines. The proposed machine is capable to run at 1:3 and 1:3:5 and 1:3:5:9:15 rations, which results in the gear less operation of EV.

According to a statistic, new registration of EV (cars) in 2016 has reached a record number of about 750,000 worldwide. Norway is among the leading country of adopting EV with a market share of roughly 30% of the Worldwide market. The second in the major country is Netherlands, whose market share has reached about 6.5% followed by Sweden with a share of 3.4%. China, UK and France all have EV market shares of about 1.5%. The market in China has seen an exponential growth in EV cars accounting for higher than 40% of the total electric cars sold in the world which is more than double the number of cars sold in the United States. The global EV electric car stock crossed 2 million mark in 2016 [Global EV Outlook 2017]. High amount of R&D is deployed in this sector and the mass production of EV has strong potential of rapidly declining the fixed and running costs. There is a continuous improvement in motor drives, control algorithms, embedded controllers, energy storage devices and ICT in EVs. This will soon lead to narrowing the cost competitiveness gap between EVs and ICEs. It is expected that the EV stock will be reaching 9 to 20 million by year 2020 and between 40 to 70 million by 2025 [Global EV Outlook 2017].

Qatar has some major research priorities targeting; reducing carbon footprints, developing smart cities and smart grids and these demands high deployment of Electric Cars in near future. Qatar is highly progressive country adopting to the new evolving technology at fast pace. This project is aimed at the development of a robust, highly reliable, efficient and wide speed range multiphase motor drive system that falls within the right context of the current research priorities of the Qatar University and the state of Qatar.

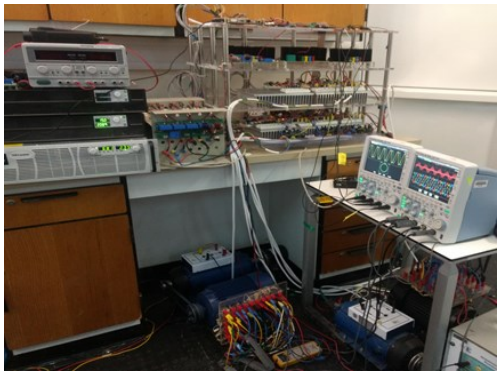

Fig.1. Laboratory prototype of 9-phase PPMIM drive.

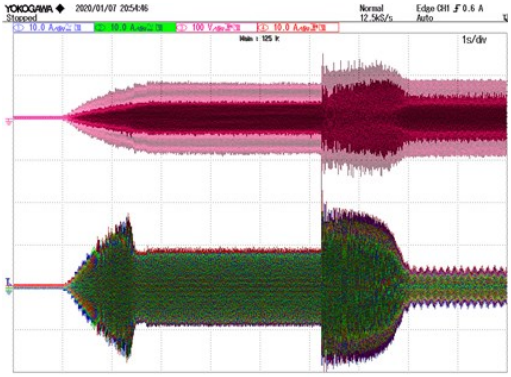

Fig.2. Experimental results under open loop V/f=constant control.

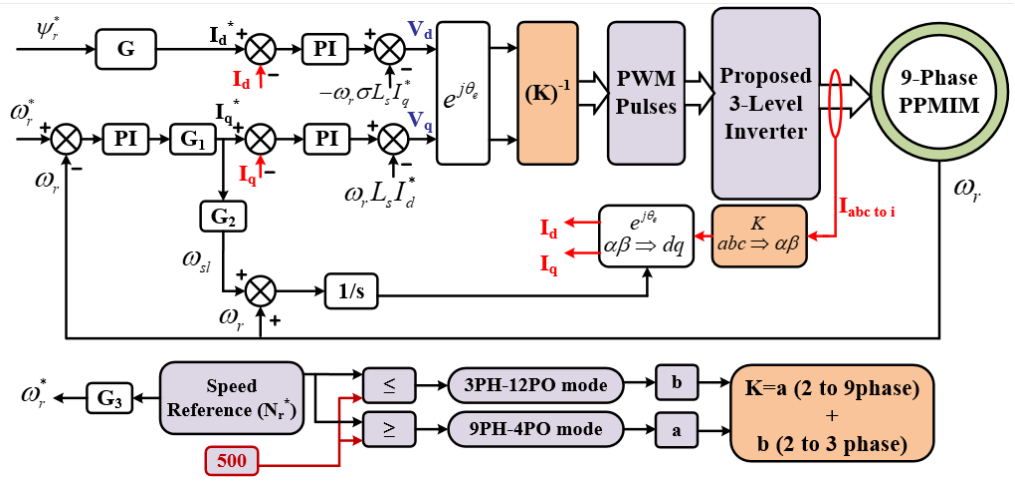

Fig.3. Voltage-controlled IFOC block diagram of the 9-Phase PPMIM drive.

Wider speed and torque range are the major requirements of a drive for applications like ship propulsion, more electric aircraft and high power traction. Regular motors need to be oversized to have wider speed and torque range which in turn increases the volume and cost of the drive. The pole changing techniques are adopted for achieving an extended range of speed-torque characteristics of the IM without Pole amplitude modulation (PAM), Pole-phase modulation (PPM) and multiple stator windings.

In late 1960s, mechanical switches are used for changing the number of poles of the IM. Due to the enhancement in the power semiconductor technology and microcontrollers, the pole-changing techniques are becoming a cost-effective and efficient solution for achieving a wider range of speed and torque. The power electronic switches are substitute for the mechanical switches, which are controlled by microcontrollers. The continuous changing the number of poles is possible by varying the supply voltage excitation to respective windings with the help of the power electronic converters called as Pole-Phase Modulation (PPM). The PPM drives delivers a high torque for hill climbing and faster acceleration in high pole and less phase operation. Whereas in high phase and low pole mode the drive delivers high speed with constant power for steady run operation. Theoretical, simulation and experimental investigation is carried out successfully. The Experimental results of the pole phase induction motor (PPMIM) drive as well as the experimental setup developed in the laboratory are shown in Fig. 1 to Fig.4.

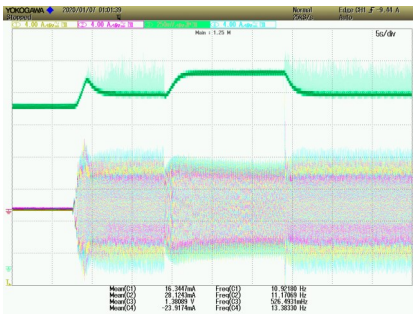

Fig. 4 .(a) Experimental results under IFOC vector control.

The design details of the 9-phase IM are; rating: 5hp (squirrel cage type), coil pitch:9, stator/rotor slots: 36/49, airgap diameter: 160mm, length of core: 130mm, airgap length: 1mm. The propo -sed inverter is realized with the 6 three-phase silicon carbide IGBT modules along with gate drives and one DC power supply. The FPGA Vertix-5, XC5VLX50T is used to generate the SVPWM based switching pulses for controlling the proposed MLI.

The vector control block diagram of indirect field-oriented control (IFOC) for PPMIM drives is presented in Fig. 4. The 9-phase PPMIM drive requires nine 40^0 phase displaced voltages in 9PH-4PO mode and 3 sets of three 120^0 phase displaced voltages in 3PH-12PO mode. In this vector control, the mode of operation is selected based on the speed reference (N_r^*), i.e., if the speed <500 rpm gives the 3PH-12PO operation (i.e., a=0 and b=1) and speed >500 rpm gives the 9PH-4PO operation (i.e., a=1 and b=0), here *a* and *b* are two variables that are representing mode of operation. The transformation matrix (K) is modelled as a combination of both 9 to 2 transformation in 9PH-4PO mode and 3 to 2 transformation (with three sets of 3 phase windings) in 3PH-12PO mode respectively, i.e., K= a*(9 to 2 transformation) + b*(3 to 2 transformation) as clearly shown in Fig. 3.

Firstly, the phase currents of 9-phase PPMIM drive are transformed into αβ domain by using the transformation matrix K in the stationary reference frame. With the help of the rotational

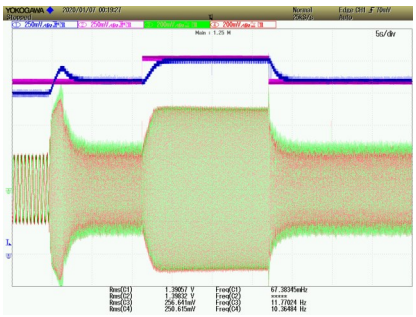

Fig4.(b)speed and currents plot

Editorials from EE Faculty (Cont.)

Dr. Atif Iqbal
Professor

QU-High-Impact Grant-Advanced Reconfigurable Multiphase Motor Drive System for Electric Vehicle Applications-[QUHI-CENG-19/20-2](Continued)

transformation matrix given in [1], the αβ components are transfor-med into dq domain where the angle θ is calculated w.r.t mode of operation. The V_d and V_q vectors are attained from the flux component and speed error respectively, which are transfor-med into actual modulating vectors of PPMIM drive by taking the inverse transformation of the K matrix. By using the carrier-based SVPWM the pulses for PPMIM drive are generated according to the mode of op-eration.

An outcome seminar was or-ganized on Thursday, 10/24/2019. Time: 11:00-12:00

Faculty from QU, Industry personnel, Graduate and un-dergraduate students from Qatar University attended the seminar. Some of the pictures from the outcome seminars are given here .

Dr. Prathap Reddy

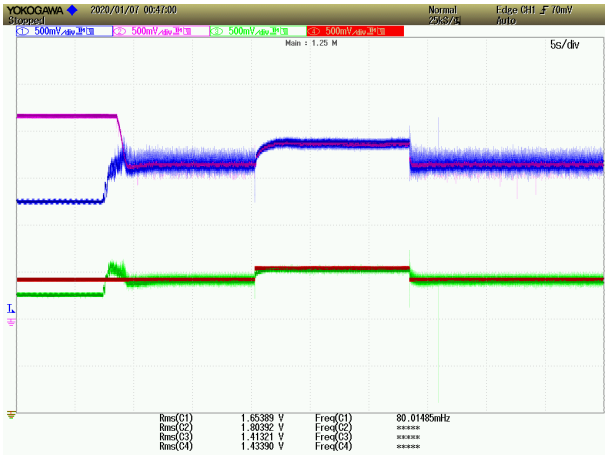

Fig4.(c) I_d and I_q actual and reference currents.

Fig. 5. Project outcome seminar pictures of the project

EE department 12th International Invention Fair of the Middle East (IIFME)

EE department won 3 medals in 12th International Invention Fair of the Middle East (IIFME) in Kuwait. **Dr. Ridha Hamila**, Professor of Electrical Engineering, has earned the silver medal for his invention of a "Measurement Method for Detecting the Defective Antenna Elements in Massive MIMO Antenna Arrays".

Eng. Mohammed Mearag, PhD student in Electrical Engineering has earned the silver medal for the invention of "Linear Regulated Dimmable Light Emitting Iodide", representing the research team headed by **Prof. Atif Iqbal**. **Dr. Nasser Al Emadi**, Head of Electrical Engineering Department, has acquired the bronze medal, on behalf of the late **Dr. Moheiddine Benammar**, for the invention of "Apparatus & Method for Monitoring the Volume & Rate of Air Drained from a Body" by Dr. Benammar.

Prof. Moheiddine Benammar

Editorials from EE Faculty

Dr. Atif Iqbal
Professor

A Multiple Output Contactless Inductive Power Transfer System for Electric Vehicle Battery Charging Station

The major aim of this project is to develop an inductive Wireless Power Transfer (WPT) rapid charging system for Electric Vehicle (EV). With the proposed system, three different EV (low, medium and high) will be simultaneously charged in a span of about 30 min. The proposed charging system consists of a quasi Z-source converter (required to boost the input voltage) followed by a high-frequency inverter and an inductive coil with series-series capacitive compensation. At the receiver end, a buck converter is placed which is controlled in Constant Current (CC) and Constant Voltage (CV) charging modes depending upon the State Of Charge (SOC) of batteries. Both CC and CV are achieved by two separate PI controllers.

The carbon footprint is one of the highest in Qatar due to its booming economy. The greenhouse gasses are emitted from the industries and transportation system (which is mainly gasoline based vehicles). The increasing workforce in Qatar due to huge infrastructural development is leading to increasing use of private cars, busses and trucks. A worldwide study shows that highway vehicles release about 1.7 billion tons of greenhouse gases (mostly CO2) yearly that are contributing to severe global climatic changes. As a rule of thumb each gallon of gasoline burnt in a vehicle generates about 20 pounds of greenhouse gasses. The solution to the growing environmental problem due to use of gasoline is the development of EV and Hybrid Electric vehicle (HEV). Qatar also is also investing to find solutions to reduce its carbon footprint. Introduction of EV/HEV in Qatar and development of related technology is the need of hour. EVs/HEVs can limit the dependence on Oil & Gas and reduce carbon emission. The proposed project will not only reduce the greenhouse effects but will also have enormous effects on Qatar utility network in terms of power quality, active and reactive power demand and regulation policies. The proposed project will be step forward in moving towards smart gird infrastructure development. Time of use tariff may be implemented. The proposed project which is on the development of advanced solutions for contactless power transfer for battery charging of EVs is completely aligned with the research theme set forth by Qatar University and aligned with 2030 Qatar Vision.

The future cities will see a surge of EVs and the refueling stations will be completely replaced by the battery recharging stations. In most of the advanced countries, the transition from gasoline based vehicle to electric based vehicle has already begun. In the other grand challenges of sustainable urbanization and Doha

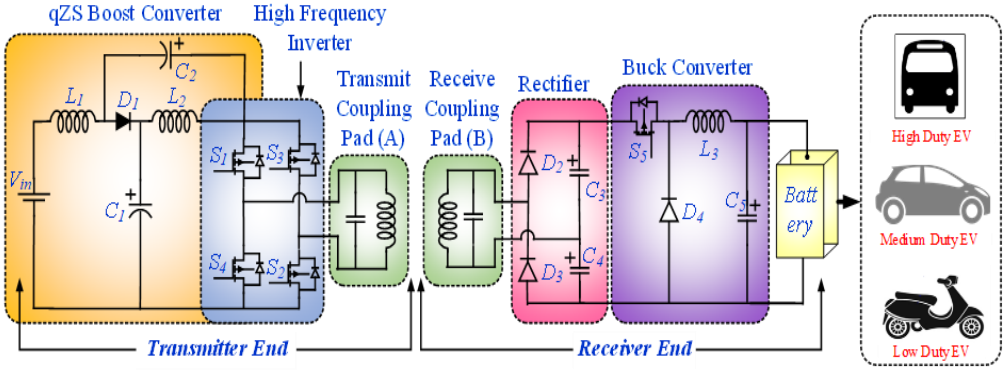

Fig.1. Block diagram of proposed inductive WPT for EV.

Dr. Mohammed Al-Hitmi
Assistant Professor

Mr. Kiran Maroti Pandav

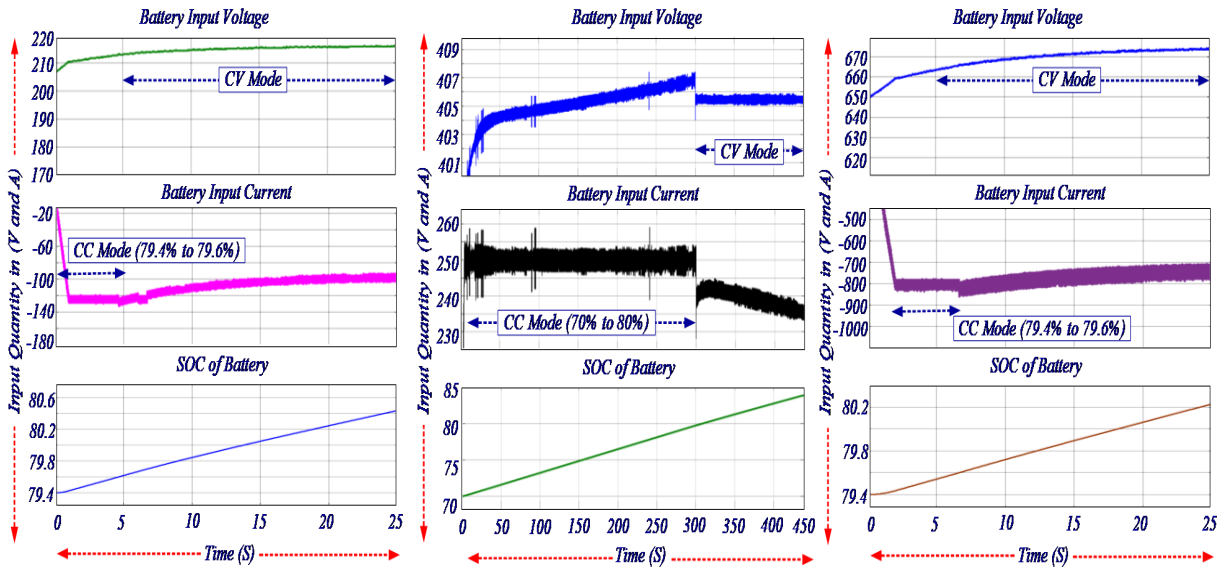

Fig.2. Simulation results battery charging voltage, current and SOC level during inductive WPT for (a) low, (b) medium and (c) high duty EV.

being a smart city, the present project will play an important, crucial and pivotal role in this transformation.

This project is aimed at development of qZS based WPT fast charger to charge different duty EV (individually or simultaneously) in 30 min by CC-CV charging profile. This project scheme increases the availability of charging facilities with little incremental cost and reduces waiting time for charging for a population with a large number of EV. Presently most technologies developed or under development are targeted at single vehicle charging rom the same source.

Fig. 1 shows the schematic diagram of the proposed inductive WPT charging scheme with LC resonant compensating circuit. In that the transmitter mode consisting of dedicated qZS boost converter, high-frequency inverter and transmitting inductive coil-A. The qZSI is utilized (instead of conventional DC-DC converter) followed by the full-bridge inverter to boost the input voltage and invert it to high-frequency AC signal. The proposed structure reduces the number of components and control complexity. However, the shoot-through state of the qZS converter is achieved in the zero state of H bridge inverter. The receiver mode of the proposed system consisting of high-frequency half-bridge rectifier and DC-DC buck converter. The received high-frequency AC voltage and current is compensated through capacitive compensative circuit. The half-bridge rectifier and split capacitor arrangement reduces the components of the system and doubles the voltage. Capacitors C3 and C4 stores the energy in the alternate cycle of the supply and deliver the energy in series to the buck converter. The buck converter is utilized to control charging current of the battery.

EV vehicle rapid charging operation must consist of both CC and CV charging modes. To select the charging mode of operation, present value of SOC is sensed into the system and compared with threshold value of SOC (SOCthr typically set at 80%). If the value of present SOC is lower than SOCthr, then CC mode of operation is selected else CV mode of operation is selected. The FPGA Vertix-5, XC5VLX50T is used to generate the high frequency switching pulses for controlling the proposed qZSI. Fig. 2 shows the simulation results of battery charging voltage, current ad SOC level during inductive WPT for low, medium and high duty EV. Fig. 3. Shows the experimental results of medium duty EV prototype model.

An outcome seminar was organized on Thursday, 11/26/2019.

Time: 11:00-12:00

Faculty from QU, Industry personnel, Graduate and undergraduate students from Qatar University attended the seminar. Some of the pictures from the outcome seminars are given here.

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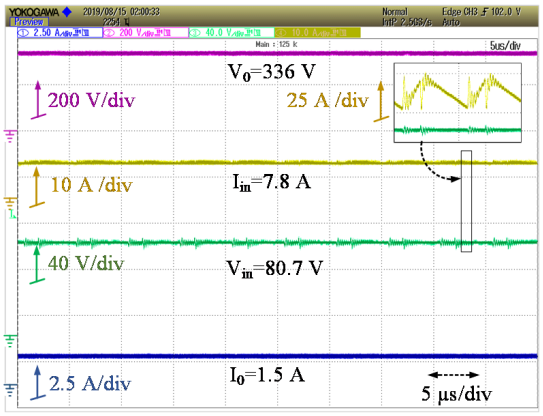
Editorials from EE Faculty (Cont.)

A Multiple Output Contactless Inductive Power Transfer System for Electric Vehicle Battery Charging Station (Continued)

Dr. Atif Iqbal
Professor

Dr. Mohammed Al-Hitmi
Assistant Professor

Mr. Kiran Maroti Pandav



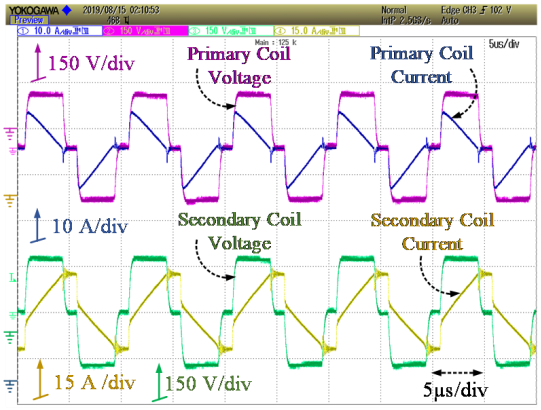


Fig. 3. Experimental results of prototype (a) input and output voltage current and (b) voltage and current of primary and secondary side of inductive coil.

Fig. 4. Project outcome seminar pictures of the project

External Advisory Board (EAB)

The Electrical Engineering External Advisory Board (EAB) is composed of respected members from industry and government affiliates. The EAB works with the Department to increase the level of collaborative engagement from industries and provide input, advice and assistance in various areas. The EAB mainly helps in the following areas:

- Participate in the review the EE Program's Educational Objectives (PEOs).
- Provide feedback related to the EE program and Review curriculum modifications
- Help in the placement of students in the Practical training course
- Advising on developing new programs.

Needs of industry.

The EAB meets annually for review and assessment of the Electrical Engineering program and to get updates on the activities of the department.

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Vision:

The Department of Electrical Engineering will be the recognized national leader in electrical engineering education and research at the local and regional levels; its program will be the preferred electrical engineering program in Qatar, and its graduates will be the top choice for local employment.

Mission:

The Department of Electrical Engineering supports the mission of the College of Engineering and that of Qatar University through high quality teaching, research, and services that benefit the Electrical Engineering students and the State of Qatar. The department produces graduates with strong engineering skills necessary for contemporary areas of electrical engineering and who are well prepared for successful engineering careers or for pursuing graduate studies.

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More information about EED faculty and staff can be found at: http://www.qu.edu.qa/engineering/electrical/directory.php