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2022 International Mobile and Embedded Technology Conference (MECON)

10^{th} – 11^{th} March 2022

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Amity School of Engineering and Technology, Noida,

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Preface

2022 International Mobile and Embedded Technology Conference (MECON) technically co-sponsored by IEEE U.P.Section. The conference held during 10th to 11th March 2022 organized by the Amity Innovation and Design Center, Amity School of Engineering & Technology, Amity University Uttar Pradesh.

The conference started with lighting of lamp in the inaugural session on 10th March. The Head of the Department Dr. Sujata Pandey introduced the theme of the conference. The joint Head ASET, Dr. M.K. Pandey gave the welcome address. Dr. Abhay Bansal joint Head ASET, Dr, K,M, Soni, Dy. Dean, Engineering & Technology and Dr. W. Selvamurthy, President- Amity Science Technology and Innovation Foundation, Director General-Amity Directorate of Science and Innovation, Chancellor- Amity University, Chhattisgarh also addressed the gathering. The Chief Guest speeches were delivered by Dr. Saffur Rahman, President IEEE Elect 2022.

In this conference, 356 papers were submitted. For reviewing the papers, a strong panel of Technical Program Committee was formed. After review process only 176 accepted and 139 papers were finally registered for presentation.

Over the period of two days on 10th and 11th March, there were 24 technical sessions and 20 keynote talks with Industry Session mostly from reputed Universities and Industry.

The technical sessions were chaired by professors from different universities and institutions like IIT, NIT Jalandhar, Punjab University, etc.

The keynote addresses were delivered by Prof. Mohammad Obaidat, University of Sharjah, UAE, Dr. Meena Jha, Central Queensland University, Australia, Prof. Kazuya Kobayashi, Chuo University, Japan, Dr. Amlan Chatterjee, California State University, USA, Dr. Siddhartha Bhattacharyya, Rajnagar Mahavidyala, India, Prof. Yogesh Chauhan, IIT Kanpur, India, Dr. Kaibin

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On day 1, in all 72 papers were presented in the areas of Embedded System, Image Processing, Cloud Computing, control system, power electronics renewable energy and other emerging areas of science and technology.

Day 2, started with technical sessions in which 67 research papers were presented in the areas of soft computing, control system technology, IoT and applications and Electrical, Electronic and Mechanical systems.

General Chair

MECON 2022

KEYNOTE TALKS OF MECON 2022

Prof. Mohammad Obaidat

Fellow of IEEE, Fellow of SCS and Fellow of AAIA

University of Sharjah, UAE

A Novel Learning Automaton-Based Controller Placement Scheme for Software-Defined Network Systems

Abstract:

Software-defined networking (SDN) basically moves the control plane of network devices like switches and routers to the controller. The latter is responsible for managing the whole network using application programming interfaces (APIs). Fault tolerance in these networks can be handled by providing multiple controllers. Insertion controllers in an SDN network can be seen as facility location problem which is an NP-hard problem. In this keynote, we devise a heuristic algorithm for controller placement in SDN networks using a learning automaton (LA) scheme. The proposed scheme can places the controllers based on a predefined propagation latency between the controllers and the switches while minimizing the overall propagation latency. We conduct several simulations experiments, from the available topologies of ToplogyZoo, and the results show the superiority of the proposed algorithm when compared to competing current recent algorithms in terms of propagation latency.

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Dr Meena Jha

Central Queensland University, Australia

Artificial Intelligence: Changing the landscape we live today

Abstract:

The power of Artificial Intelligence (AI) is being accepted undeniably in all fields. John McCarthy invented the term Artificial Intelligence in the year 1950. Technology is changing rapidly, and this rapid change is influencing the entire world. AI is used in almost all fields, such as education, manufacturing, processing, and healthcare to name a few. The advancement of artificial intelligence, machine learning algorithms, deep learning, and convolution neural network happening very fast, at a much higher speed then it was predicted. With Moore's Law still valid, and new ways to measure processing power, AI will bring massive impact to this world in another 30 years, that is not easy to imagine. AI solves a myriad of problems throughout society, these advancements do not come without some concerns. This talk will present the impact of AI on society and its changing landscape.

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Prof. Kazuya Kobayashi

Professor, Faculty of Science and Engineering
Chuo University, Japan

Radar Cross Section Analysis of a Finite Parallel-Plate Waveguide with Material Loading: A Rigorous Wiener-Hopf Approach

Abstract:

The analysis of electromagnetic scattering by open-ended metallic waveguide cavities is an important subject in the prediction and reduction of the radar cross section (RCS) of a target. This problem serves as a simple model of duct structures such as jet engine intakes of aircrafts and cracks occurring on surfaces of general complicated bodies. Some of the diffraction problems involving two- and three-dimensional cavities have been analyzed thus far based on high-frequency techniques and numerical methods. It appears, however, that the solutions due to these approaches are not uniformly valid for arbitrary dimensions of the cavity. Therefore it is desirable to overcome the drawbacks of the previous works to obtain solutions which are uniformly valid in arbitrary cavity dimensions. The Wiener-Hopf technique is known as a powerful, rigorous approach for analyzing scattering and diffraction problems involving canonical geometries. In this lecture, we shall consider a finite parallel-plate waveguide with four-layer material loading as a geometry that can form cavities, and analyze the plane wave diffraction rigorously using the Wiener-Hopf technique. Both E and H polarizations are considered.

Introducing the Fourier transform of the scattered field and applying boundary conditions in the transform domain, the problem is formulated in terms of the simultaneous Wiener-Hopf equations. The Wiener-Hopf equations are solved via the factorization and decomposition procedure leading to the exact solution. However, this solution is formal since infinite series with unknown coefficients and infinite branch-cut integrals with unknown integrands are involved. For the infinite series with unknown coefficients, we shall derive approximate expressions by taking into account the edge condition. For the branch-cut integrals with unknown integrands, we assume that the

waveguide length is large compared with the wavelength and apply a rigorous asymptotics. This procedure yields high-frequency asymptotic expressions of the branch-cut integrals. Based on these results, an approximate solution of the Wiener-Hopf equations, efficient for numerical computation, is explicitly derived, which involves a numerical solution of appropriate matrix equations. The scattered field in the real space is evaluated by taking the inverse Fourier transform and applying the saddle point method. Representative numerical examples of the RCS are shown for various physical parameters, and the far field scattering characteristics of the waveguide are discussed in detail. The results presented here are valid over a broad frequency range and can be used as a reference solution for validating other analysis methods such as high-frequency techniques and numerical methods.

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Dr. Naseemuddin

Senior Scientist - III
Institute for Infocomm Research, A-STAR

Metasurface-based circularly polarized antennas for wideband wireless systems

Abstract:

Different metasurface/metamaterial structures have been used as an artificial antenna ground or partial ground to enhance the performance of the single feed based circularly polarized (CP) planar antennas, which include reactive impedance surface (RIS), electromagnetic bandgap (EBG), high impedance surface (HIS), artificial magnetic conductor (AMC). Furthermore, these metamaterial surfaces can be used as a radiator or stacked radiator or parasitic radiator as well, various metasurface-based antennas were designed and demonstrated for a wideband CP radiation. In recent years, the demands of large-capacity and high-speed wireless communication have increased drastically, so that the wideband antennas technology is playing a key role in next generation wireless communication, satellite systems, and connectivity systems. An antenna performance plays an important role in the satellite systems and wireless system. These systems need a small CP antenna to establish a reliable connection between the satellite and wireless mobile devices. To concurrently support several satellite systems where the operating bands are very close, the multi-band/wideband CP antennas are required. Also, the CP antenna with one CP rotation sense considerations the characteristic that can reject the signal of opposite CP sense, which is effective for multi-path interferences suppression.

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Dr. Amlan Chatterjee

Associate Professor
California State University, USA

Identifying and mitigating the spread of misinformation on social media

Abstract:

With the growth in the use of social media to share personal and shared information, there is a concern of spread of misinformation using the available platforms. Significant number of users on social media view the available information like news and data from conventional sources, sometimes without checking the correctness of the information. There are multiple methods available to identify and flag such information and mitigate the negative effects of false information. This talk focuses on the different techniques to identify misinformation and mitigate it, with a focus on the underlying ethics of doing such work.

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Dr. Siddhartha Bhattacharyya

Principal
Rajnagar Mahavidyalaya, India

Understanding Quantum Backpropagation

Abstract:

Backpropagation techniques are widely used in neural networks for the purpose of weight adjustment and system error compensation. The lecture discusses the basics of the backpropagation algorithm with reference to a multilayer neural network. In addition, quantum backpropagation is introduced with reference to quantum mechanical principles. Applications of the quantum backpropagation technique are also demonstrated.

The key topics to be discussed in this lecture include Fundamentals of Multilayer Neural Networks, Backpropagation Algorithm, Quantum Computing Fundamentals, Quantum backpropagation.

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Dr. Atif Shamim

Associate Professor

King Abdullah University of Science and Technology, UAE

Flexible, Wearable, Disposable Wireless Communication and Sensing Systems Through Additive Manufacturing

Abstract:

With the advent of wearable sensors and internet of things (IoT), there is a new focus on electronics which can be bent so that they can be worn or mounted on non-planar objects. Due to large volume (billions of devices), there is a requirement that the cost is extremely low, to the extent that they become disposable. The flexible and low-cost aspects can be addressed through additive manufacturing technologies such as inkjet and screen printing. This talk introduces additive manufacturing as an emerging technique to realize low cost, flexible and wearable wireless communication and sensing systems. The ability to print electronics on unconventional mediums such as plastics, papers, and textiles has opened up a plethora of new applications. In this talk, various innovative antenna and sensor designs will be shown which have been realized through additive manufacturing. A multilayer process will be presented where dielectrics are also printed in addition to the metallic parts, thus demonstrating fully printed components. Many new functional inks and their use in tunable and reconfigurable components will be shown. In the end, many system level examples of wireless sensing applications will be shown. The promising results of these designs indicate that the day when electronics can be printed like newspapers and magazines through roll-to-roll printing is not far away.

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Prof. Yogesh Chauhan

Assistant Professor

IIT Kanpur, India

Negative Capacitance Transistors - Modeling, Simulation and Circuit Performance

Abstract:

The ongoing scaling of CMOS technology is now reaching its limit, due to supply voltage reduction being restricted by the subthreshold swing (SS) of 60mV/decade achievable at room temperature owing to Boltzmann transport of the charge carriers. Concept of negative capacitance proposed to achieve a sub-60mV/decade SS is currently seen as one of the potential solutions to the problem. A "negative capacitance transistor (NCFET)" employs a ferroelectric material in the gate stack of a FET providing a negative capacitance and thereby an "internal voltage amplification" at the gate of the internal FET which helps in reducing SS. Several experiments have successfully demonstrated an improved SS with the bulk MOSFET, FinFET, and 2D FETs. The improvement in subthreshold characteristics is also accompanied with the advantage of an increased ON current relative to the reference FET as has been observed both in simulation studies and experiments. In this talk, I will discuss the physics and modeling of various NCFET structures and impact of this new transistor on circuits including processors.

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Dr. Kaibin Huang

Associate Professor, Dept. of EEE
The University of Hong Kong, Hong Kong

6G Intelligent Edge: Shannon Meets Turing

Abstract:

The popularity of mobile devices and densification of wireless networks result in the availability of enormous data and computational resources distributed at the network edge. To leverage the data and resources, machine-learning is deployed at the network edge to train AI models by exploiting the distributed mobile data while preserving their privacy. While computing speeds are advancing rapidly, the communication latency is becoming the bottleneck of fast edge learning. Attempts to overcome the bottleneck have led to the emergence of a new paradigm in wireless communication, "communication efficient edge learning", which departs from the classic principle of "rate-maximization" and focuses on "fast intelligence acquisition". In this talk, I will overview new design challenges in the area and highlight some recent advancements in different directions including resource allocation, gradient quantization, feature transmission, wireless data labelling, active data acquisition, and over-the-air computation.

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Prof. Slawomir Nowaczyk

Professor, Center for Applied Intelligent Systems Research
Halmstad University, Sweden

Progress and Challenges in Explainable Artificial Intelligence exemplified by Predictive Maintenance

Abstract:

One of the key areas of AI research today concern explainability. In other words, how can humans "make sense" of the predictions made by artificial intelligence and machine learning systems. In the talk I will motivate and give examples of recent XAI techniques, using the field of predictive maintenance as an example. Predictive maintenance is a fast-growing area of application, where AI/ML techniques are used to monitor condition of equipment, and optimise maintenance needs. From the methodological perspective it is uniquely interesting in highlighting several key challenges.

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Dr. Kinde Anlay Fante

Associate Professor, Faculty of Electrical and Computer Engineering
Jimma University, Ethiopia

Deep Learning Acceleration Techniques for Embedded and Mobile Visual Applications

Abstract:

Malaria is one of the deadly tropical and subtropical diseases in the world, especially in the developing countries of Africa, Asia, and Latin America continents. It is transmitted by infected female Anopheles mosquitoes. Early diagnosis of malaria can reduce the mortality rate and its harmful consequences. The gold standard and widely used method of malaria diagnosis is the manual examination of blood smears using light microscopy. However, this method is subjective, time-consuming, and error-prone. The diagnosis result highly depends on the level of technical expertise and experience of the laboratory technicians. To improve the reliability and accuracy of this diagnosis method, automated computer-aided diagnosis (CADx) systems were proposed as a viable option. The CADx systems are used to detect the malarial parasites in the microscopic images and quantify the level of infection. The methods proposed for detecting and classifying malarial parasites in blood smear microscopic images can be divided into two broad categories. The first category of these methods employs traditional image processing and classical machine learning algorithms. The second category of the methods employs deep learning methods for the detection and classification of malarial parasites. The focus of this talk is on a comprehensive review of different methods for malarial parasite detection and classification in blood smear microscopic images. A methodological review of the recent deep learning techniques is given more emphasis. The technical progress attained so far and the future research directions will be discussed.

Prof. Emil Björnson

Professor of Wireless Communication
KTH Royal Institute of Technology, Sweden

Multi-Mode MIMO Communications Beyond Beamforming

Abstract:

Traditional wireless receivers operate in the far-field of the transmitter and the channels only involve a few angular directions. Under these conditions, the main role of antenna arrays is beamforming: to focus the transmitted signals in the strong angular directions and focus the reception correspondingly. This feature can be realized using classical phased-array technology. Several research developments towards 6G will change the status quo. Firstly, the carrier frequency is increasing towards the THz range, which proportionally increases the far-field limit. Secondly, the antenna array dimensionalities are increasing, particularly at the base stations, which further extends the far-field limit. Thirdly, the network densification shortens the propagation distances and increases the number of impactful propagation paths. These three factors will fundamentally change how point-to-point MIMO (multiple-input multiple-output) links must be designed in the future. We need to go beyond traditional phased-array-inspired far-field beamforming and consider the near-field focusing regime, where multiple parallel spatial layers can be transmitted using different spatial modes, even in line-of-sight scenarios with only a single angular path.

In this keynote, we will revisit the fundamentals of point-to-point MIMO communications and explore the new features that arise when operating in the radiative near-field. The relation between spatial modes, spherical wavefronts, and array geometries will be described and illustrated. The hardware requirements for exploiting spatial modes will be analyzed. Are the spatial modes the next untapped signal dimensions that can sustain the capacity growth in future networks?

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Prof. Amitabha Bhattacharya

Associate professor, Electronics & Electrical Communication engineering
IIT Kharagpur, India

Ground Penetrating Radar as a futuristic sub-surface sensor

Abstract:

Modern communication is migrating to internet of things. So, many sensors are needed in ocean, air and earth. One such sensor for sub-surface sensing is ground penetrating radar. The technology of ground penetrating radar will be discussed and the open research areas will be highlighted.

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Prof. Rafael Caldeirinha

Fellow IET, Senior Member IEEE, Senior Member URSI
Polytechnic of Leiria, Portugal

Smart Radio Environments for 6G

Abstract:

This talk addresses a promising new research direction on intelligent reflecting surfaces for the sixth generation (6G) of communication networks, which are also known as software-controlled meta-surfaces and reconfigurable intelligent surfaces (RIS). These are semi-passive surfaces consisting of an array of meta-atoms with reconfigurable properties that can be controlled to reflect an incoming wave in a controllable way. While only the transmitter and receiver can be optimised in conventional wireless communication systems, the addition of intelligent reflecting surfaces enables optimization also of the propagation channels and, thus, the creation of smart radio environments. The main challenges to physical prototype of smart radio environments using RIS, as well as solutions to the challenges, will be addressed.

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Dr. Timothy O Farrell

Chair Professor of Wireless Communications

University of Sheffield, UK

The Impact of ADC Resolution on Concurrent, Multiband Direct RF Sampling Receivers for 5G New Radio

Abstract:

Connectivity using interband frequencies in 5G radio access networks incurs high receiver complexity and power consumption when implemented using multiple radio units. Employing concurrent, multiband, direct RF sampling in a single radio chain architecture reduces the RF component count, leading to lower receiver complexity and power consumption. For this architecture, as the composite signal from multiple concurrent bands is digitised by a common analogue-to-digital converter (ADC), the bit resolution critically affects system performance. In this talk, the effect of ADC resolution on the error vector magnitude (EVM) and Block Error Rate (BLER) performance of a concurrent, multiband, direct RF sampling receiver for 5G New Radio is investigated. Simulation and hardware measurement of a tri-band receiver supporting three simultaneously active channels is evaluated when reducing the ADC resolution from 8 to 3 bits. Interband interference measurements demonstrate that the multiband, direct RF sampling, wideband receiver remains 3GPP compliant at 4-bit ADC resolution.

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Prof. Nuno Borges Carvalho

Full Professor and a Senior Research Scientist

Universidade de Aveiro, Portugal

Simultaneous Wireless Information and Power Transmission – from IoT to Space Exploration

Abstract:

The energy needs for wireless systems limit the evolution of most IoT and Space future approaches. An overview of the energy problem in IoT wireless communication systems will be presented in this talk. The main objective is to discuss future wireless paradigms that will be changing soon, those include the issue of battery-less wireless devices, combining wireless power transmission and backscatter communications. The talk starts with a general overview of the energy needs for future XG networks and then presents the design of batteryless wireless sensor networks. Issues like the characterization and design of passive backscatter sensors will be discussed.

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Dr. Mahesh P Abegaonkar

Associate Professor

IIT Delhi, India

Recent trends in applications of Metasurfaces

Abstract:

Metasurface is a topic of great research interest and is used in numerous applications because their ability to manipulate electromagnetic waves at microwave and optical frequencies. These engineered materials have subwavelength thicknesses and are usually composed of metallic patches of various shapes both in planar or multi-layer configurations. They are light weight, easy to fabricate, and have ability to control wave propagation on the surface as well as elsewhere. In this talk, recent progress in the field of metasurfaces will be discussed based on their applications. The applications discussed will include surface wave absorbers, surface waveguides, beam shaping, leaky wave antennas, cloaking, and polarizers, etc.

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Dr. Karun Rawat

Associate Professor, Department of Electronics & Communication
IIT Roorkee, India

Efficiency and Linearity Improvement in Wireless Radio Frequency Transmitters for cellular Applications

Abstract:

This talk discusses various techniques to improve efficiency as well linearity of radio frequency wireless transmitters. The power amplifier being a key component in RF transmitters, requires high efficiency to reduce the operating cost of the radio access network. At the same time, it must be linear in order to meet the spectrum efficiency requirements of the modern wireless communication standards.

This talk discusses the advancement over conventional schemes where load modulation based power amplifier (PA) (Doherty PA or Chireix Outphasing PA etc.) for handling high crest factor signals with good power efficiency are combined with linearization schemes such as digital predistortion. New schemes such as delta-sigma modulation-based transmitters will also be discussed which can exhibit good performance in terms of error vector magnitude (EVM), where high-efficiency switch-mode PAs can be used along with RF filters for suppressing out-of-band quantization noise.

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Dr. C. J. Reddy

Vice President Business Development
Electromagnetics Altair, USA

Advanced Electromagnetic Simulation Tools for Automotive Radar Integration and Virtual Drive Tests

Abstract:

Automotive OEMs are moving towards the inclusion of several safety systems, which are covered by several sensors. Many new functions are being added to assist the driver to avoid accidents that might be caused by different road scenarios. The new ADAS (Advanced Driver Assistance Systems) systems are mainly: lane change assistants (LCA), blind spot detection (BSD), pedestrian recognition, collision avoidance and pre-crash functions, cross traffic alerts and parking assistance. Automotive Collision Avoidance Radars operate at 77GHz band. Radar design and integration at such high frequencies is very challenging. As a result, electromagnetic (EM) simulation is applied to avoid time consuming and expensive prototyping cycles for the radar manufacturer and a complex radar integration behind a car‘s bumper for automotive OEMs. In this talk, a detailed design process for automotive radar design and integration will be presented using Altair’s advanced EM simulation solutions. Also, this talk will present simulations of radar channel and the environment for better understanding of the functioning of the radar in real driving scenarios using virtual drive test simulations using Altair’s advanced simulation solutions.

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Dr. Xavier Fernando

Professor, Dept of Electrical and Computer Engineering
Ryerson University, Canada

Sustainable Internet of Things

Abstract:

The Internet of Things (IoT) has been changing the way we live. It plays a key role in transforming society to create an interconnected globe. The world is increasingly populated with sensors and connected devices that automatically communicate, make decisions and perform complex tasks. IoT nodes could be sophisticated servers like autonomous vehicles that fuse information from a multitude of sensors plus 5G++ wireless networks and perform control operations in seconds. On the other hand, they could also be simple sensing devices like smart meters or roadside cameras. Nevertheless, their contribution is valuable. Artificial Intelligence and Machine Learning algorithms play a vital role in analyzing the humongous amount of data to draw meaningful conclusions.

Currently an estimated 50 Billion IoT nodes exist and this number could double in 2-3 three years. There are a few issues in realizing a sustainable IoT system. Mainly, in the realms of spectrum availability and energy sustainability. It is interesting to note, compared to the energy consumed by IoT, energy saved by the deployment of intelligent IoT solutions in other areas is huge. In this presentation a few approaches to address the spectrum crunch, namely the Cognitive Radio approach and Optical-Wireless, especially Visible Light Communication (VLC) approach will be discussed. Also, energy saving and harvesting approaches to reduce the carbon footprint IoT ecosystem will be highlighted.

Dr. Manos Tentzeris

Professor in Flexible Electronics, School of ECE

Georgia Institute of Technology, USA

Inkjet-/3D-/4D-Printed "Zero-Power" RFID-enabled Wireless Ultrabroadband Modules for IoT, SmartAg and Smart Cities Applications

Abstract:

In this talk, inkjet-/3D-printed antennas, interconnects, "smart" encapsulation and packages, RF electronics, RFIDs microfluidics and sensors fabricated on glass, PET, paper and other flexible substrates are introduced as a system-level solution for ultra-low-cost mass production of Millimeter-Wave Modules for Communication, Energy Harvesting and Sensing applications. Prof. Tentzeris will touch up the state-of-the-art area of fully-integrated printable broadband wireless modules covering characterization of 3D printed materials up to E-band, novel printable "ramp" interconnects and cavities for IC embedding as well as printable structures for self-diagnostic and anti-counterfeiting packages as well as tile-by-tike massively scalable reconfigurable intelligent surfaces. The presented approach could potentially set the foundation for the truly convergent wireless sensor ad-hoc networks of the future with enhanced cognitive intelligence and "rugged" packaging. Prof. Tentzeris will discuss issues concerning the power sources of "near-perpetual" RF modules, including flexible miniaturized batteries as well as power-scavenging approaches involving thermal, EM, vibration and solar energy forms and examples of 5G-enabled wireless grid through the use of printed Rotman lenses. The final step of the presentation will involve examples from shape-changing 4D-printed (origami) packages, reflectarrays and mmW wearable (e.g. biomonitoring) antennas and RF modules. Special attention will be paid on the integration of ultrabroadband (Gb/sec) inkjet-printed nanotechnology-based backscattering communication modules as well as miniaturized printable wireless (e.g.CNT) sensors for Internet of Things (IoT), 5G and smart agriculture/biomonitoring applications. It has to be noted that the talk will review and

present challenges for inkjet-printed organic active and nonlinear devices as well as future directions in the area of environmentally-friendly ("green") RF electronics and "smart-skin' conformal sensors as well as massively scalable “tile-by-tile” RFID-enabled reconfigurable intelligent surfaces.

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Prof. Zeljko Zilic

Professor, Dept of Electrical and Computer Engineering
Mc Gill University, Canada

IoT: Towards the Great Convergence of Technologies

Abstract:

Internet of Things is enabling massive changes towards automation, greater convenience and better products and services in wide areas of industrial, consumer, medical etc. areas. The underlying areas of networking, computing, sensing and powering have both matured and are pliable for rapid improvements as required by IoT applications. In this talk, we discuss on how this great convergence of technologies will create even greater synergy in the next generation of IoT applications, especially with greater acceptability of blockchain. The challenges in the security, privacy and safety will be discussed.

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Prof. Mohamed-Slim Alouini

Professor and Associate Dean, Electrical Engineering
King Abdullah University of Sciences and Technology, UAE

Towards connecting the remaining 3+ billion

Abstract:

It goes without saying that we suffer from severe gaps in global internet connectivity. We tend indeed to forget that we still have about half of the world population (or about 4 billion people) without broadband connectivity. And it is expected that 5G (in it current initial deployment stages) will further accentuate this connectivity divide. Actually, the Covid 19 pandemic also showed that the connectivity divide is in a way becoming one of the modern faces of inequality, deepening the economic and social unbalances between the 'Haves' and 'Have Nots' in a digital context. To achieve digital inclusiveness, we need to develop and deploy new technological solutions that help connecting the unconnected/under-connected in an affordable fashion. In this context, this talk aims to (i) provide an envisioned picture of 6G, (ii) serve as a research guideline in the beyond 5G era, and (iii) go over the recently proposed solutions to provide high-speed connectivity in under-covered areas in order to serve and contribute to the development of far-flung regions.

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Prof. Sharad Sharma

Professor in the Department of Computer Science
Bowie State University, USA

Mobile Augmented Reality and Virtual Reality Applications for Situational Awareness and Emergency Response

Abstract:

During emergencies such active shooter events or fire and smoke, the ability of security personnel to respond appropriately to the situation is driven by pre-existing knowledge and skills, but also depends upon their state of mind and familiarity with similar scenarios. Human behavior becomes unpredictable when it comes to making a decision in emergency situations. The cost and risk of determining these human behavior characteristics in emergency situations is very high. Emergency response in indoor building evacuation is essential for effective rescue and safety management. First responders often lack the situational awareness capability to quickly assess the layout of a building upon initial entry. One of the challenges is to provide user-specific personalized evacuation routes in real-time. In multilevel building environments, the complexity of the architecture creates problems for both visual and mental representation of the 3D spaces. Augmented reality (AR) and Virtual Reality (VR) are increasingly being sought after as a teaching and training tool because they offer visualization and interaction capability that captures the learner's attention and enhances the learner's capacity to retain what was learned. Utilizing the visualization and interaction capability that AR offers and the need for emergency evacuation training, this talk explores mobile AR application (MARA) constructed to help users evacuate a building in the event of an emergency such as a building fire, active shooter, earthquake, and similar circumstances. This talk also describes the augmented reality application to leverage the Microsoft HoloLens for emergency response during a building evacuation. This talk also presents an immersive collaborative virtual reality (VR) environment for performing virtual building evacuation drills for active shooter training scenarios using Oculus Rift head-mounted displays. The immersive collaborative VR

environment also offers a unique method for training in emergencies for emergency response and decision making. The participant can enter the collaborative VR environment setup on the cloud and participate in the active shooter response training environment, which leads to considerable cost advantages over large-scale real-life exercises.

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Prof. Afaq Ahmad

Professor, Department of Electrical and Computer Engineering
Sultan Qaboos University, Oman

Current Status on Digital Circuit Testing and Scope of Scan Circuitry on FPGA

Abstract:

The tremendous increase in complexity of digital systems has put increasingly more attention on reliable design of hardware systems. In the computer industry, digital circuit testing and testability is a common and an easy approach to meet the goals of reliable design requirements. However, the gap between technological advancements in design and advancements in test technologies has created a testing crisis in the electronics industry. The more advanced IC fabrication technologies, and new packaging techniques make it increasingly difficult to physically access test nodes. Modern testing techniques and methodologies are to be provided as per specific need and requirement for the generation to generation of design developments of electronic industries. Some of the standards and guidelines of test techniques are gaining popularity include Design for Testability (DFT), Built-In Self-Test (BIST), Automatic Test Signal Generation (ATSG) and Output Response Compression (OCR). This talk will provide an overview and status in the field of test technology. The talk will also highlight about the scope of employing FPGA based test circuitry in scenarios of edge computing provisions and unmanned devices.

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Dr. Ashok Agarwala

Professor in the Department of Computer Science,
Harvard University USA

Information Dynamics - Integrating information and systems

Abstract:

The field of information technology is impacting all aspects of our lives these days with new and innovative applications and usage getting introduced daily. However, we rarely look at the basic nature of information. In this talk we examine the fundamental aspects of information and its relationship to the systems that we build.

The starting observation is that there is a clear difference between information and its representations. In the physical world we can only use representations as a substitute for the information that we want to deal with, which only human beings can do. This observation has far-reaching consequences for us. The ultimate user of all manipulations carried out by IT equipment is a human user who has to derive information, with meaning and semantic content, from the data (representations) presented. Only those manipulations of representations which have meaning at the information are useful. We present a systematic study of the implications of the distinction between the information and its representations and how it impacts the systems.

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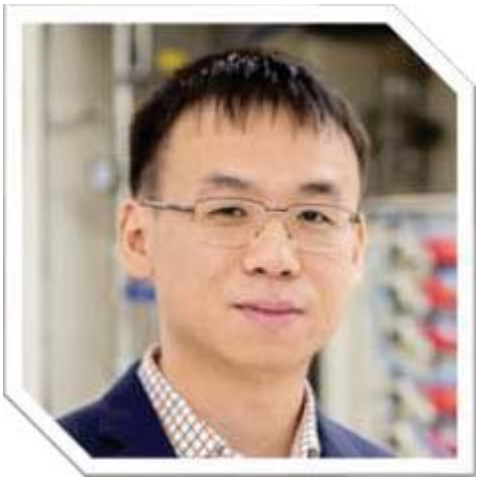

Dr. Xiaohang Li

Assistant Professor

King Abdullah University of Science and Technology, UAE

UWBG semiconductor materials and devices

Abstract:

Ultrawide bandgap (UWBG) semiconductors including AlN, Ga2O3, c-BN, diamond have recently attracted enormous interests. They offer markedly larger figures of merits for power electronics and RF electronics than known semiconductors. Additionally, they are promising platforms for quantum information and enable deep-far UV optoelectronics. Hence, the UWBG device and circuit technologies could lead to revolutions in many crucial areas in the decades to come, including electric vehicles, wireless communication, healthcare, pandemic prevention, quantum computing, space exploration. Thus they have been regarded as the 4th generation of semiconductors after the consequential Si, III-V, and wide bandgap materials. This seminar will cover latest research on UWBG AlN and Ga2O3 based materials and devices, including power devices and CMOS.

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Prof. Sardar M. N. Islam

Professor and Director of Decision Sciences and Modelling Program

Victoria University, Australia

Embedded Multi-agent systems and Artificial Intelligence "Game Theory Modeling Machine Learning and Application"

Abstract:

No Abstract.

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Dr. Shankar Parikriya

Professor, Dept. of Electrical Engineering
IIT Delhi, India

NOMA and massive Machine Type Communication (mMTC)

Abstract:

In this talk we discuss the use of non-orthogonal multiple access (NOMA) to increase spectrum utilisation efficiency and to provide access to a large number of users. Research on NOMA and grant-free access has intensified in view of the increased importance of massive machine type communications (mMTC). We start with a brief review of wireless communications, and underlay cognitive radio communications. After an introduction to various NOMA protocols in uplink and downlink, we discuss cooperative NOMA and relayed NOMA. Grant-free access and semi grant-free access protocols are discussed, and a semi-grant scheme is suggested. We then discuss coordinated direct and relay transmission protocols. In underlay communications, where the transmit power is constrained and use of NOMA appears to be counter-intuitive, we how that by use of clever mode switching and user selection, large performance gains can accrue. NOMA is critical for mMTC and to increase spectral efficiency, and will play a significant role in years to come.

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Dr Ramani Kannan

Senior Lecturer, Department of Electrical and Electronics Engineering
Universiti Teknologi PETRONAS, Malaysia

Role of Power Converters in Inductive Power Transfer System for Public Transport

Abstract:

IPT (Inductive power transfer) charging is a highly flexible concept whereby it allows charging at any possible opportunity and is highly versatile for vehicles of all sizes. IPT wireless charging technology employs high power inductive energy transfer between the components embedded into streets and the receiving equipment mounted below the vehicle. When the vehicle moves over the charging point, the contactless charging process is initiated between the components and the vehicle. In this keynote talk, the role of power converter topologies in IPT systems are studied for Electric Vehicle (EV) charging applications. The contingency in misalignment, loading and frequency shift are discussed for various converter topologies. The tolerance in misalignment poses serious challenges wireless chargers in EVs. Therefore, designing a symmetric IPT system with multiple decoupled receiving coils is the need of the hour. The significance of power inverter topologies for achieving resonance as well as the generation of high frequency supply is studied in detail.

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Dr. Aaron R. Rababaah

Associate Professor of Computer Science, College of Engineering and Applied Sciences, American University of Kuwait, Kuwait

Simple Imperative-Model Programming Language for Education

Abstract:

This work presents the development of a new small programming language named SIMPLE, "Simple Imperative-Model Programming Language for Education". The motivations for the development of this new language stems from the lack of literature for practical efforts and guidelines to develop programming languages bottom-up from scratch. We believe that exposing students to the process of creating a programming language carries significant educational benefits and real experience in a serious project. We discuss the language grammar and demonstrate its main elements and features. SIMPLE is procedural compiled high-level language that implements a significant set of programming language's elements and features including: variables (local and global), standard i/o, file i/o, arrays, operators (arithmetic, logical, bit_logical, relational, bit_shift), expressions, if-statement, if-else, switch, for loop, while loop, do loop, break statement, macros, procedures and functions. A compiler was designed to translate SIMPLE code to x86 machine code. Primary highlights if the new language include: the programmer need not to get bugged by library imports as all necessary i/o features are included; i/o operations are simplified using two operators that work for both standard and file i/o; as language is intended for simplified programing environment, no variable types are used; SIMPLE provides a new keyword "loop" that substitutes all three types of loops: for, while and do; new loop forms are introduced: loop(const), loop(var) and loop(var:begin, end, inc); the language minimized number of keywords to one per each structure as in: loop: instead of do-while, n case in switch, no return in functions; a new construct "swif" is introduced because switch cannot handle ranges and If-else is messy so "swif" combines both structures in a more elegant easy to use structure; the language has new operators in expressions: ^, !, ~: power, factorial and xor; to remove the confusion in equality operator "==", it was replaced by

“?=“’; the new language enabled code reuse by introducing the keyword “use” to allow programs link to previous code. We believe that SIMPLE is a good tool for programing language education at different levels of Computing classes such as: introduction to programming, assembly language, concepts of programming languages and compilers. The new language has been tested extensively using 60+ programs designed to evaluate all elements of the language and found to be reliable and promising for educational purposes. As a future work for this project, we intend to make the new language available for our students and examine it effectiveness through another study and survey students’ feedbacks. The study could involve different class levels as mentioned earlier to cover introduction to programming, assembly language, concept of programming languages and compilers.

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Prof. Keshav Singh

Assistant Professor, Institute of Communications Engineering
National Sun Yat-sen University, Taiwan

Signal Processing for 5G and Beyond Communications

Abstract:

Wireless spectrum is a scarce commodity in the today's connected and data-hungry world, where demand for higher data rates is increasing exponentially on a daily basis. To tackle this, efficient spectrum utilization techniques, such as spectrum sharing (SS), and full-duplex (FD) transmission have been considered. While SS can substantially increase the spectrum utilization efficiency by allowing licensed/unlicensed users to share the spectrum with other licensed users, FD radios have the potential to double the spectrum efficiency of current half-duplex systems by transmitting and receiving at the same time and frequency resources. Furthermore, both SS and FD can be implemented in conjunction with each other, whereby FD SS nodes will be able to transmit and sense the transmission of other nodes at the same spectrum resources. Accordingly, this talk will center around 1) various interference cancellation techniques, which are obligatory for the realization of FD radios, and 2) detailed discussion on Radar-LTE co-existence based on Licensed/Authorized Shared Access. In particular, we will focus on the amalgamation of the above two points by conversing about transceiver design techniques to facilitate spectrum sharing in FD communication systems (such as cellular systems, IoT, etc.) from the perspective of spectrum efficiency.

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Dr. Eng Hock Lim

Professor, Electrical and Electronic Engineering Department,
University Tunku Abdul Rahman, Malaysia

Application of Ionic Polymer-Metal Composite (IPMC) for Antenna Design

Abstract:

The Ionic Polymer-Metal Composite (IPMC) is a promising soft actuator, and it has received attention due to its remarkable high-strain electromechanical performance under low stimulated voltage and ability to operate in aqueous environment. Two projects will be shared in this webinar to demonstrate the application of IPMC for antenna design. First, the IPMC actuator has been integrated with an UHF RFID tag antenna for frequency tuning and reconfiguration. Here, the IPMC actuator itself is forming a movable flap that can be used for reconfiguring the resonant frequency of the tag antenna effectively. The IPMC flap can be easily deflected in two directions, either up or down, enabling a two-degree of frequency tuning. The IPMC actuator requires very low power as the deformation of the IPMC will stay even after the DC bias is removed. Simulations and experiments have been conducted to verify the design concept. The functionalities of the fabricated prototype were also tested inside an anechoic chamber as well as using a portable commercial RFID reader. Apart from the RFID application, this webinar will further explore the possibility of powering the IPMC actuator in a wireless manner for implantable drug delivery device. The IPMC actuator can be activated through magnetic resonant coupling when the frequency of an external field is tuned to match with the resonant frequency of the antenna of the planar receiver. Under wireless activation, the IPMC actuator unseals the reservoir to initiate drug releases from the developed drug delivery device to the aqueous surrounding. Experimental results show a successful release of the fluorescein dye from the 0.072 ml reservoir by wirelessly activating the actuator with the RF power of 0.65 W. In vitro study was further performed by wireless releases of tetracycline hydrochloride to an Escherichia-coli (E. coli) suspension. The reduction of E. coli colony formation from 89 × 106 CFU ml-1 to 35 × 106 CFU ml-1 shows that proof of concept on wireless drug delivery was successfully demonstrated.

Prof. Oliver Amft

Professor

Friedrich-Alexander Universität Erlangen-Nürnberg (FAU) Germany

Co-design of wearables and implants with human digital twins

Abstract:

The notion of digital twins is well-established for technical systems, in particular mechanical devices. Yet our understanding of the merits and use of human digital twins is still very limited. In this talk, I will give an overview on our efforts in co-designing and utilising wearable and implantable technology and artificial intelligence (AI) algorithms with and against human and technical digital twins for medical applications. The talk will start with a practical example on the relevance and impact of wearables observed in the German “RKI Corona Datenspende” initiative, a citizen data donation effort to monitor the COVID-19 development at regional and federal levels. The initiative is by far the largest data donation project worldwide that exploits wearable device data to fight SARS-CoV-2. The data is used to create physiological population models, which - as a side product - could serve as basis for human digital twins. Subsequently, the talk will highlight how wearable and implantable system design and AI algorithms can be selected and optimised in co-simulations with human digital human twins with examples from movement rehabilitation, dietary monitoring, and other areas. But the reverse approach has potential too, i.e. to inform digital twins from body-worn device data. I will show how we add realism to human digital twin models to maximise system design insight and create advanced decision support systems, e.g. to support healthy behaviour choice of obese patients.In scaling up the concept of human digital twins, I will show how we recently modelled individual daily life behaviour in an agent-based model and integrate it into mass behaviour, which was then applied to analyse human proximity, interaction, and SARS-CoV-2 virus spread under different interventions, including contact tracing, test-to-release, and quarantine. The modelling developed for the behaviour simulations has been inspired by the human digital twin idea and exploits the vast design space given by virtual worlds in which we expose the created individuals.

Dr. Korhan Cengiz

Assistant Professor, College of Information Technology
University of Fujairah, UAE

Novel Wireless Sensor Network Protocols

Abstract:

The reduction of energy consumption has become a key research area for the information and communication technology (ICT) industry, due to economic, environmental, and marketing reasons. While the environmental direction aims at minimization of greenhouse gas emissions by enforcing the usage of renewable energy in the ICT industry, economical and marketing directions lead researchers to design low-power components or develop and enhance energy-saving protocols without an impact on the level of the performance. With the steady increase in the cost of energy, the expanding number of energy-hungry components and widespread usage of ICT industry, most of the protocols that have become an integral part of our lives but are yet developed without any energy constraints in mind in the past will need to be restructured or developed again. For this reason, researchers are studying on all layers of the Internet protocol stack to develop energy-efficient protocols and algorithms. This keynote lecture reviews recent approaches for energy efficiency studies for each layer in the Internet protocol stack from the physical layer to the application layer and also especially for WSNs. It is expected that with the deployment of current research output, the studies performed at each layer will result in significant energy savings for the ICT industry which in turn will have a positive impact on our lives for their economic and environmental results.

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Dr. Anthony Ghiotto

Associate professor

Bordeaux Institute of Technology, France

Honey, I shrunk the RF system

Abstract:

Introduced in the early 2000s, the substrate integrated waveguide (SIW) technology, has trigged a huge interest from academia to industry with the focus on the design and development of low-loss, compact, integrated, self-packaged and low-cost microwave and millimeter-wave circuits, antennas and systems. However, the classical metallic waveguide technology, which offers better performances such as lower insertion loss and higher power handling, has still been used in the design of microwave and millimeter-wave systems, despite its higher cost and bulky structure. To offer a highly integrated, further loss-reduced, low-cost alternative to the conventional waveguide and also to allow a wide-spread use of the millimeter-wave spectrum, a new SIW structure called Air-Filled SIW (AFSIW) has been introduced. This new structure has been theoretically and experimentally studied in details with a substantial amount of results. At millimeter wave frequencies, compared to the SIW topologies, the proposed AFSIW scheme exhibits a substantially lower insertion loss (three times at Ka-band, for example) and a much higher average power handling capability (four times, at Ka-band for example). Numerous AFSIW passive components have been investigated designed and demonstrated, which take advantages of the well-established multilayer printed circuit board (PCB) fabrication process. Couplers, phase shifters, power dividers, antennas and filters have been modeled, designed, prototyped and measured based on the introduced technology. Their performances have theoretically and experimentally been compared with their SIW counterparts to demonstrate and validate the benefits of the proposed technology.

Dr. Lajos Hanzo

Professor, School of Electronics and Computer Science
University of Southampton, U.K.

Integrated Ground-Air-Space Networking Just Utopia or A Next-Generation Challenge?

Abstract:

Thanks to the spectacular advances in signal processing and nano-technology, five wireless generations have been conceived over tha past five decades. Indeed, near-capacity operation at an infinitesimally low error-rate has become feasible and flawless multimedia communications is supported in areas of high traffic-density, but how do we fill the huge coverage holes existing across the globe? As a promising system-architecture, an integrated terrestrial, UAV-aided, airplane-assisted as well as satellitebased global coverage-solution will be highlighted to pave

the way for seamless next-generation service provision. However, these links exhibit strongly heterogeneous properties, hence requiring different enabling techniques. The joint optimization of the associated conflicting performance metrics of throughput, transmit power, latency, error probability, hand-over probability and link-lifetime poses an extremely challenging problem. Explicitly, sophisticated multi-component system optimization is required for finding the Pareto-front of all optimal solutions, where none of the above-mentioned metric can be improved without degrading at least one of the others.

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Prof. Giulio Antonini

Associate Professor, Department of Electrical Engineering
University of L'Aquila, Italy

The Partial Element Equivalent Circuit Method

Abstract:

The Partial Element Equivalent circuit (PEEC) method is a recognized integral equation method, which has been widely used for solving mixed electromagnetic (EM)/circuit problems across various application fields. It is based on the mixed potential integral equation (MPIE) and the current continuity equation. A pertinent choice of electrical quantities and basis functions allow solving the electric field integral equation (EFIE) along with the continuity equations as an equivalent circuit in which ohmic losses and magnetic and electric field couplings are described in terms of partial elements, namely resistances, partial inductances, and coefficients of potential. The resulting equivalent circuit can be directly analyzed by SPICE-like circuit solvers in both the time and frequency domains. The aim of the talk is to give a brief introduction to the PEEC method trying to highlight its applicability to different mixed circuit/electromagnetic problems.

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Dr. Eng. Daniele Romano

Postdoctoral Researcher, Dept. of Industrial and Information Engineering and Economics
University of L'Aquila, Italy

Circuit synthesis from measurements or simulation data

Abstract:

This talk aims to review the state-of-the-art of the most important circuit synthesis techniques of rational approximation of electromagnetic multiport systems in order to incorporate them into a circuit simulator. In particular, by starting from measurements or simulated data, the Vector Fitting is applied to obtain their pole/residue or state-space impedances, admittances, and scattering parameters (S, Y, Z) representation. Then, it will be shown how it is possible to generate an equivalent circuit from these representations and how it is possible to migrate from a state-space (S, Y, Z) representation to another one by applying different matrix transformations. It is important to underline that the resulting reduced equivalent circuits can then be connected to linear/non-linear devices or lumped elements in a Spice-like framework allowing to analyze mixed electromagnetic/circuit problems. Finally, the validity of all the presented equivalent circuits and state-space transformations is tested through pertinent numerical examples.

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