ECE PhD Qualifying Exams

Presentation Schedule

Spring 2023

ECE QE Presentation Schedule Spring 2023

Slide Number	Last Name	First Name	Date	Time	Venue	Title	PhD Advisor
5	Ahmed	Sabrina	04/14/2023	11:00 AM – 12:00 PM	Microsoft Teams	Dynamic Allocation of Cryptographic Security Encryption in IoT Network	Mohammed Zamshed Ali Hlaing Minn
6	Ahmad	Obaid Ullah	03/31/2023	12:00 PM – 01:00PM	ECSW 3.375	Network Controllability with Applications in Machine Learning	Waseem Abbas
7	Awais	Muhammad	04/07/2023	02:00 PM – 3:00 PM	ECSS 3.910	Design of Electronic Beam-steering Reflectarray for THz Application	Kenneth O
8	Aziz	Arian	04/6/2023	12:00 PM – 1:00 PM	Microsoft Teams	Optimal Design of High Power Density MVDC Cables for Wide Body All Electric Aircraft	Mona Ghassemi
9	Dhole	Sameer Raju	04/20/2023	09:00 AM – 10:00 AM	Microsoft Teams	Overview of Amplitude Modulating HW Trojans	Aria Nosratinia
10	Ghaderi	Mohammad Hasan	04/25/2023	10:30AM - 11:30AM	ECSN 4.728	On the Stability of Cascaded DC-DC Converters	Poras Balsara
11	Haider	Muhammad Luqman	04/19/2023	12:00 PM -01:00 PM	RL 3.204	High Performance Ultra-sensitive Crack Based Sensor	Jeong-Bong Lee
12	Hamidieh	Mohammad	03/31/2023	12:00 PM 01:00 PM	Microsoft Teams	Numerical Study on Negative Corona Discharges in Air	Mona Ghassemi
13	Jena	Sritam	04/21/2023	11:30 AM – 12:30 PM	ECSN 4.728	Design of a Current Source Inverter fed Air-Core PMSM drive	Bilal Akin
14	Jessie	Benjamin	04/06/2023	10:00 AM – 11:00 AM	ECSN 4.702	Neural Network Transient and Steady State Modeling of Buck Converter	Babak Fahimi
15	Kakaraparty	Karthikeya	03/20/2023	01:00 PM – 02:30 PM	ECSN 4.702	DESIGN OF HIGHLY COMPACT, LOW-PROFILE, WIDE-BAND, CIRCULARLY POLARIZED ANTENNA ARRAYS AND MONOLITHIC MICROWAVE INTEGRATED CIRCUITS (MMICS) BASED FRONT-END FOR MILLIMETER-WAVE (mmW) APPLICATIONS	Ifana Mahbub
16	Lin	Jia-Cong	04/17/2023	11:00 AM – 12:00 PM	Microsoft Teams	Modeling and Design of Electronically Tunable Reflectarrays	Rashaunda Henderson
17	Liu	XI	04/17/2023	04:00 PM – 05:00 PM	ECSN 2.704	Nerual homomorphic based monaural speech enhancement	John Hansen

ECE QE Presentation Schedule Spring 2023

Slide Number	Last Name	First Name	Date	Time	Venue	Title	PhD Advisor
18	Mahin	Rafsan	04/17/2023	01:00 PM – 2:00 PM	ECSN 4.728	Distributed Phased Array Antenna System (DPAAS) Analysis with Integrated Radio Frequency Circuit Designs for Developing the Next Generation of Far-Field Wireless Power Transfer Network	Ifana Mahbub
19	Malickal	Pranutha	04/14/2023	12:25 PM – 01:25 PM	ECSN 4.728	Impact of in-band and adjacent band interference in terrestrial and satellite communication technologies on network applications	Ravi Prakash
20	Mansoori	Shoaib	04/26/2023	11:00 AM – 12:30 PM	Microsoft Teams	Theoretical Study of Electronic Transport in Monolayer and Bilayer Transition Metal Dichalcogenides.	Massimo Fischetti
21	Martinez Lucas	Luz	04/26/2023	02:00 PM – 03:00 PM	ECSN 4.728	Emotion Recognition in Conversation and Sequence-to-Sequence Modeling	Carlos Busso
22	Mosammam	Behnam	04/07/2023	03:00 PM – 04:00 PM	ECSN 4.702	Global Optimization of Reluctance machines using evolutionary methods	Babak Fahimi
23	Mote	Pravin Chandrakant	04/26/2023	04:00 PM – 05:00 PM	ECSN 4.728	Domain Adaptation for Speech Emotion Recognition by Semi-Supervised Learning	Carlos Busso
24	Naini	Abinay Reddy	04/26/2023	03:00 PM – 04:00 PM	ECSN 4.728	Ordinal speech emotion recognition	Carlos Busso
25	Okei	Samuel	04/25/2023	02:00 PM – 03:00 PM	Microsoft Teams	CCi-FACE: Audio-Visual Speech Augmentation for Improvement in Experience for Cochlear Implant Users	John Hansen
26	Parchamdar	Baharealsadat	03/22/2023	12:00 PM -01 :00 PM	ECSN 4.702	Smart Wearable system for real-time arrhythmia detection using TinyML and TinyFPGA	Tooraj Nikoubin Lakshman Tamil
27	Patwary	Adnan Basir	04/05/2023	01:00 PM – 02:00 PM	ECSN 4.728	Development of UWB Beam Steering Antenna and Impulse Radio Ultrawideband (IR-UWB) Transmitter for Wireless Power Transfer (WPT) Application	Ifana Mahbub
28	Rastegar	Mohammad	04/07/2023	10:00 AM – 11:00 AM	ECSN 4.728	A DWPT system with maximum efficiency under varying load and alignment conditions	Babak Fahimi
29	Reza	Sakib	04/24/2023	01:00 PM – 02:00 PM	ECSN 4.728	Ultrawideband Reconfigurable Integrated Intelligent Conformal Surface (RI2CS) for the Next-generation of Full-duplex Joint Radar Communications and Implantable Sensors	Ifana Mahbub
30	Saha	Nabanita	04/25/2023	03:00 PM – 05:00 PM	ECSN 4.728	Design of Dual-polarized and Circularly polarized Phased-Array antenna and Automatic Beam Alignment System for Wireless Power Transfer Application	Ifana Mahbub

ECE QE Presentation Schedule

Spring 2023

Slide Number	Last Name	First Name	Date	Time	Venue	Title	PhD Advisor
31	Usih	Ebenezer	03/24/2023	02:00 PM – 03:00PM	ECSN 4.702	Experimental Demonstration of Bayesian Inference in the Stochastic Computing Paradigm Using Muller C-Element	Joseph Friedman
32	Westergaard	Thor	04/24/2023	11:00AM-12:00PM	ECSN 4.728	Design of Digital Twin for DC-DC Converter	Babak Fahimi
33	Tayeb Naimi	Shideh	04/03/2023	11:00AM-1:00PM	ECSN 4.702	On the Investigation of Autocorrelation-Based Vector Doppler Method with Plane Wave Imaging	Kamran Kiasaleh

Sabrina Ahmed

Dynamic Allocation of Cryptographic Security in IoT Networks

04/14/2023 11:00AM - 12:00 PM

Abstract:

The launch of 5G telecommunication comes with great advantages for IoT industry in terms of faster communication, latency, scalability, reliability, and so on. However, it raises big concerns in security for communications between IoT device and network routing devices. 5G edge computing allows more communication capability to end devices that is why the data is most vulnerable during transmission from IoT device to 5G network. Although some popularly used security mechanism like SDEC (Software Defined Edge Computing) is in effect for SDN routers in 5G network, currently not enough security mechanism is in place to protect the data from 3rd party attacks before being transmitted to the router from IoT edge devices. In order to address this vulnerability, implementing a cryptographic solution initiated right at IoT device provides end-to-end security. As of now, healthcare device data has been encrypted using two layer protection along with an identifier flag for the 5G network to identify the data source. The goal is to build a dynamic security mechanism that will support not just healthcare but also other applications such as government secret services, financial applications, utilities, HVACs, and many others where the encryption layer will be decided based on the application privacy requirement.

PhD Advisor: Dr. Hlaing Minn & Mohammed Zamshed Ali

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

+1 469 297-6880, 868671187# united States, Dallas (Toll)
Microsoft Teams Meeting: Conference ID 868 671 187#

Obaid Ullah Ahmed

Network Controllability with Application in Machine Learning

03/31/2023 12:00PM - 01:00 PM ECSW 3.375

Abstract:

The challenge of effectively representing graph-structured data for machine learning tasks, such as network classification and link prediction, is currently limited by existing approaches that rely on fixed attributes or computationally expensive algorithms. We propose a unique approach using networked control system theory to design expressive, stable, scale-invariant, and accurate graph representations. We can utilize the well-established network control theory approach to obtain insights regarding the network topologies. The approach also includes a network probing mechanism to explore network structures that are missing from all the approaches in the current literature. We can use this theory to distinguish graphs based on their dynamic and controllability properties. The proposed building blocks include a control-based framework, mechanisms to integrate network topology and node features, and techniques for dynamically changing networks. These suggested methods will be evaluated for their accuracy in learning tasks and for their applications in control and optimization problems. This presentation will delve into a novel concept of network controllability backbone, which refers to the set of connections among network agents that can maintain controllability properties. Due to the computational complexity of identifying the controllability backbone, which is possibly NP-Hard, we employ two methodologies based on zero-forcing set and vertex distances to preserve the lower bounds of controllability. We design algorithms to find the controllability backbone for a network using these two approaches and further analyze them to provide theoretical guarantees on the size of the backbone.

PhD Advisor: Dr. Waseem Abbas

Muhammad Awais

Design of Electronic Beam-streering Reflectarray for THz Application

04/07/2023 2:00 PM – 3:00 PM ECSS 3.910

Abstract:

The design of a CMOS-based reflectarray for terahertz (THz) applications is a challenging task due to the limited availability of active and passive components that can operate in the THz frequency range. However, CMOS technology offers a promising solution for the design of reflectarray elements, as it provides a large number of transistors and passive components on a single chip. This leads to a compact and low-cost design. The basic building block of a CMOS-based reflectarray is a unit cell, which consists of a patch antenna and a reconfigurable phase shifter. The patch antenna receives or transmits the THz signals, while the reconfigurable phase shifter adjusts the phase of the reflected signal. The phase shifter can be implemented using a varactor diode, MOS switch, or PIN diode. The design of the patch antenna is critical to the performance of the reflectarray, as it affects the gain and efficiency of the system. The resonant frequency of the patch antenna should match the THz frequency range, and it should have low loss for maximum transmission and reception of the THz signals. The size and shape of the patch antenna, substrate material, and the dielectric constant of the surrounding medium also play a crucial role in its performance. The reconfigurable phase shifter can be designed using a varactor diode, MOS switch, or PIN diode, depending on the specific requirements of the application, such as phase range, switching speed, and power consumption. It can operate in a voltage-controlled or current-controlled mode. In short, the design of a CMOS-based reflectarray for THz applications requires careful consideration of various factors, such as patch antenna design, reconfigurable phase shifter, and substrate material and dielectric constant. By optimizing these factors, a compact, low-cost, and high-performance CMOS-based reflectarray for THz applications can be achieved.

PhD Advisor: Dr. Kenneth O

Arian Azizi

Design of High Power Density MVDC Cables for All Electric Aircraft

04/06/2023 12:00 PM – 1:00 PM

Abstract:

Aircraft electrification yields the next generation of aircraft such as more electric aircraft (MEA) and all electric aircraft (AEA). These aircraft require electric power systems (EPS) with high-power-density and low-system-mass specifications. Increasing the voltage of the system to the range of a few kV is a reasonable approach to achieving high-power-density and low-system-mass EPSs for aircraft applications. Nevertheless, the difficulties of designing aviation cables, such as arc and arc tracking, partial discharges (PD), and thermal management, are exacerbated by using medium voltage (MV) EPSs for airplanes. Due to the reduced air pressure at the cruising altitudes of wide-body aircraft, the heat transfer by convection reduces severely. In our research, we have shown that severely limited heat transfer by convection results in reducing the maximum permissible current flowing a cable at a lower pressure of 18.8 kPa compared to the atmospheric pressure. Also, by using multi-layer multi-functional electrical insulation (MMEI) systems, multiple designs were proposed to tackle the challenges in designing aircraft cables. The proposed cables are thermally and electrically analyzed and compared to cable systems designed based on available standards. The results show that besides benefiting from more multi-functionalities to face aircraft cables' challenges, the overall diameter and weight of the designed cables are lower than designs based on AS22759 and IEC 60502 standards. In our research, a precise Finite Element Method (FEM) model containing conductive, convective, and radiative heat transfers is developed in COMSOL Multiphysics coupled with computational fluid dynamics (CFD), and electrical physics to calculate the thermal, electrical, and geometrical characteristics of the examined cable systems.

PhD Advisor: Dr. Mona Ghassemi

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

+1 469 297-6880, 784138895# united States, Dallas (Toll)
Microsoft Teams Meeting: Conference ID 233 225 652 00#

Sameer Raju Dhole

Overview of Amplitude Modulating HW Trojans

04/20/2023 09:00 AM – 10:00 AM

Abstract:

Hardware trojans introduce a dangerous dimension for compromising the security and privacy of wireless networks. These are malicious modifications introduced into a manufactured integrated circuit, which can be exploited by a knowledgeable adversary to steal sensitive data. In this overview, I will conduct a comparison and analysis of two amplitude-based hardware trojans. The focus will be on exploring their similarities and differences, performance, and fundamental detectability.

PhD Advisor: Dr. Aria Nosratinia

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

+1 469 297-6880, 900884220# united States, Dallas (Toll)
Microsoft Teams Meeting: Conference ID 281 977 763 570#

Mohammad Hasan Ghaderi

On the Stability of Cascaded DC-DC Converters

04/25/2023 10:30 AM – 11:30 AM ECSN 4.728

Abstract:

A cascaded dc–dc converter is the main component of a dc distributed power system. Interactions among dc-dc converters in a cascaded system can introduce system instability and power quality issues. Typically, dc-dc converters are all carefully designed to be inherently stable, but the cascaded power converters composed of different converters may be unstable. Cascaded dc-dc converters using different switching frequencies, and inter-converter coupling can lead to nonlinear phenomena such as chaos in such systems. This nonlinear behavior mainly occurs in the form of switching ripples and instability. As a result, coupling between dc-dc converters significantly affects the dynamic characteristics of cascaded power converters. This research aims to analyze the interaction dynamics of dc-dc converters, specifically with different switching frequencies in cascaded systems. In this regard, an improved model for studying the stability of cascaded dc–dc converters will be determined. This model will then be used to employ frequency domain strategies to analyze the coupling effect of the dc-dc converters on the stability of cascaded system. Next, appropriate control methods will be investigated to handle the nonlinear phenomena and therefore instabilities. Finally, some simulations are provided to verify effectiveness of the theoretical analysis.

PhD Advisor: Dr. Poras Balsara

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

Mohammad Luqman Haider

High Performance Ultra-Sensitive Crack Based Sensor

04/19/2023 12:00 PM – 1:00 PM RL 3.204

Abstract:

Wearable electronics have been gaining much research attention in recent years, specifically in healthcare, IoT, and human-machine interface systems. For skin-mountable wearable electronics flexibility, sensitivity, linearity, and mechanical flexibility are the important factors for sensor selection. Conventionally, flexible strain sensors based on nanomaterials such as nanowires, graphene, carbon nanotube, and silver nanoparticle are used due to their excellent electrical and mechanical properties and thermal stability. Typically, these materials exploit the piezoresistive or piezo capacitive properties of the material by applying stain. However, sensitivity and stretchability to small physiological changes have been the main challenge for these materials. A relatively new approach such as introducing cracks in the sensing layer to change the conductivity against strain is utilized to achieve ultra-high sensitivity. However, the lower sensing range for such sensors has been the main concern. This QE presentation will be focused on a comprehensive literature survey and discuss the feasibility of novel strategies devised to improve the sensing range for crack-based sensors.

PhD Advisor: Dr. Jeong-Bong Lee

Mohammad Hamidieh

Numerical Study on Negative Corona Discharge in Air

03/31/2023 12:00 PM – 1:00 PM

Abstract:

Comprehensive computer simulations provide a deeper understanding of non-thermal plasma in air-based systems and can help prevent undesirable electrical breakdowns caused by sudden occurrences of such discharge plasmas in an insulation system. Our study presents a mathematical model, computer simulation, and analysis of non-thermal plasma discharges in the air under negative DC high voltage. A needle-plane electrode system leading to a strongly non-uniform electric field is used to represent any sharp conductor and a flat grounded object in front of it. The study uses a hydrodynamic drift-diffusion model to represent phenomena mathematically and investigates the effect of operating conditions on the discharge plasma. Analyses are performed mainly on the variations of the generation and loss rates of the charged species, their concentration evolution, and corresponding electric field distribution alterations. Simulations are carried out as a two-dimensional, axisymmetric model using COMSOL Multiphysics software, and the study identifies computational challenges that require stabilization methods to obtain reliable simulation results.

PhD Advisor: Dr. Mona Ghassemi

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

+1 469 297-6880, 575653237# united States, Dallas (Toll)
Microsoft Teams Meeting: Conference ID 575 653 237#

Sritam Jena

Design of a Current Source Inverter fed Air-Core PMSM drive

04/21/2023 11:30 AM – 12:30 PM ECSN 4.728

Abstract:

Electrification of transportation and “more electric” systems is a promising solution to mitigate climate change, and the development of advanced electrical machines and drives is essential to achieve this goal. This research focuses on designing a machine drive for a customer to drive their state-of-the-art air-core permanent magnet synchronous machine (PMSM), which is significantly more efficient, lighter, and smaller in size than equivalent induction machines. Traditional voltage source inverter (VSI) drives are unable to run it due to the machine's more than 100x smaller stator inductance. In this work, a buck-type current source inverter (CSI) prototype is designed, which operates at 1MHz and uses wide bandgap-based silicon carbide (SiC) devices. Position sensorless speed control with square-wave current is implemented to drive the machine, and an I-f start-up method, an online commutation error compensation method and a hybrid speed control method are proposed to overcome the challenges in controlling the machine. Such a sensorless CSI drive has the advantage of inherent shoot-through protection, no-bulky capacitor, and low system cost due to sensorless control. The results demonstrate the feasibility of the proposed design, and it has the potential to be an effective means of achieving high power density, high efficiency, sustainable, reliable, and affordable electrical drives for more electric systems.

PhD Advisor: Dr. Bilal Akin

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

Benjamin Jessie

Neural Network Transient and Steady State Modeling of DC-DC Switched Mode Converters

04/06/2023 10:00 AM – 11:00 PM ECSN 4.702

Abstract:

DC-DC switched mode converters are utilized in a wide array of industrial applications for stepping up or stepping down voltage levels. Accurate modeling of the converter's operation is crucial for design and eventual implementation into physical systems. Current modeling tools such as LTSpice, Simulink, and PSIM allow for simulating under ideal and nonideal conditions. However, the growing presence of automated intelligence in industry and academic research has raised questions about the ability to accurately model converters via deep learning neural networks. This work uses a buck converter as a case study to investigate the possibility of creating and training an artificial neural network using the MATLAB Machine Learning Toolbox. The buck converter's input voltage, switching frequency, duty cycle, and circuit component values will be used as inputs to a neural network to predict and model the corresponding transient and steady state output voltage. A comparison of hidden layer size, 3-10, and training methods, Levenberg-Marquardt and Bayesian Regularization, will be conducted to determine the network that most accurately models buck converter operation.

PhD Advisor: Dr. Babak Fahimi

Karthikeya Kakaraparty

DESIGN OF HIGHLY COMPACT, LOW-PROFILE, WIDE-BAND, CIRCULARLY POLARIZED ANTENNA ARRAYS AND MONOLITHIC MICROWAVE INTEGRATED CIRCUITS (MMICS) BASED FRONT-END FOR MILLIMETER-WAVE (mmW) APPLICATIONS

03/20/2023 1:00 PM – 2:30 PM ECSN 4.702

Abstract:

A global effort to deliver an efficient on-the-move connectivity-based communication strategy to onboard mobile platforms using satellites and other high-altitude drone-to-drone (D2D) platforms has been nudged by surging demand and reliance on bandwidth-hungry wireless devices and components. The crucial part of this communication strategy is an extremely spectrum-efficient antenna and system design that can achieve high-gain, broadband operation with a focused radiating beam along the line of sight. Also, the antenna design should be suitable for low-cost mass production to serve a variety of mass markets. Even though several recent prior works contributed antenna array designs for various high-frequency applications, only a few works optimized the design parameters and integrated them with monolithic microwave integrated circuits (MMIC) front-end circuits to achieve a high gain, broad operational bandwidth, and beam steerability. In addition, the atmospheric absorption is extremely high at these millimeter wave frequency bands, which results in high signal attenuations. Additionally, antennas intended for deployment on drones are needed to conformal to curved apertures and should have a narrow radiation beamwidth (<40°) and a high gain (>30 dB) to implement precise D2D tracking. The specific research gaps lie in the efficient integration of the designed antenna arrays with an ultra-compact MMIC-based front-end that includes amplifiers and phase shifters to enhance the potential of the whole integrated system in terms of gain and beam steerability. Also, there is a special need to investigate metamaterial antenna designs that are capable to manipulate the overall nature of the designed antenna array to reduce the signal degradation brought on by the environment. The first part of this research presentation focuses on the optimal mmWave antenna array designs with high gain (> 30 dB) and broadband operation with a minimum of 20% fractional bandwidth (FBW) to mitigate the losses associated with the atmospheric attenuations at millimeter wave regimes. This would also include the discussion on various state-of-the-art compact GaAs/GaN-based MMIC frontend circuit designs to address the issues. The second part of this research investigates the optimal design of metasurface antennas for mmW applications. Metamaterial-based surfaces (MMBS) are synthetically engineered surfaces that can control incident electromagnetic waves in novel ways. MMBS have the potential to manipulate the overall nature of the designed antenna array to reduce the signal degradation brought on by the environment. Finally, the discussion on conformal antenna designs with the highly focused radiation beam intended for millimeter-wave-based D2D tracking applications will be presented. To sum it up, the research outcomes include efficient mmW antenna designs and corresponding MMIC front-end counterparts integrated systems for efficient communication and D2D tracking in the mmW regime.

PhD Advisor: Dr. Ifana Mahbub

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

Jia-Cong Lin

Modeling and Design of Electronically Tunable Reflectarrays

04/17/2023 11:00 AM – 12:00 PM

Abstract:

Reconfigurable intelligent surfaces (RISs) are being proposed for 6G applications due to their ability to shape electromagnetic radiated waves by using controllers to reconfigure metamaterial elements. Metasurfaces have grown out of the original work on frequency selective surfaces and reflectarray antenna theory. In an effort to provide a complete understanding of the electromagnetic and circuit modeling capability of tunable reflectarrays, this presentation will focus on a seminal reference paper that modeled an electronically tunable patch reflectarray at 5.8 GHz. The research work is focused on the multi-bit unit cell design for RIS demonstration at millimeter wave frequencies.

PhD Advisor: Dr. Rashaunda Henderson

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

+1 469 297-6880, 427585385# united States, Dallas (Toll)
Microsoft Teams Meeting: Conference ID 233 327 383 287#

Xi Liu

Nerual homomorphic based monaural speech enhancement

04/17/2023 4:00 AM – 5:00 PM ECSN 2.704

Abstract:

With the development of Deep Neural Networks(DNN), DNN based speech enhancement methods have been extensively explored and showed superior performance compared with traditional approaches. Most of main stream DNN based methods directly aim to estimate clean spectrums and waveforms, little work has been done to study speech model in cepstrum domain. In this work, we proposed a neural network based homomorphic filtering approach to map clean speech cepstrum. We test our model on Deep Noise Suppression(DNS) challenge public test sets to compare with other state-of-the art methods.

PhD Advisor: Dr. John H. L. Hansen

Rafsan Mahin

Distributed Phased Array Antenna System (DPAAS) Analysis with Integrated Radio Frequency Circuit Designs for Developing the Next Generation of Far-Field Wireless Power Transfer Network

04/17/2023 1:00 PM –2 :00 PM ECSN 4.728

Abstract:

A revolutionary direction in the development of the next generation of far-field wireless power transfer (WPT) network points to an approach where, instead of the use of conventional single-phased array antenna transmission, multiple-phased array antennas are used to transmit radio frequency signals from each of the individual phased array antennas such that the signals combine coherently at the receiver. Compared to single antenna transmission, this technique referred to as distributed phased array antenna system (DPAAS) transmission yields increased range, increased power transfer efficiency, and precise directional beamforming. Although a vast amount of recent prior works has utilized different phase and frequency synchronization protocols to achieve optimal distributed beamforming across all the antennas in the DPAAS, none of the prior works have developed a study as to how these synchronization techniques improve the overall performance of the distributed antenna system. So, the specific research gap still lies in identifying the controlling factors that define the performance of the DPAAS. Hence, to determine the governing parameters that impact the performance of the DPAAS in the WPT network this research presentation focuses on developing a model of the distributed antenna system that can analyze the overall radiation pattern, gain, effective aperture area, beam steering range, beam collection area and the power density parameters of the DPAAS in the WPT network. The model would then provide the optimum local design parameters of the TX phased array antennas along with the optimum number, placement, position, and spacing of the TX phased array antennas to realize which combination of the variable parameters results in the optimal global system level performance. To establish the far-field WPT network, it is important to design an efficient power amplifier (PA) for the transmitter system as that is typically the governing block to determine the transmitter efficiency (ηTX). Prior works have shown that the PA performance is limited by their ability to provide a wide bandwidth and a high gain. The research gap lies in the optimum impedance matching of the device and designing the input and output matching networks accordingly so that the output power, bandwidth, and power added efficiency can be maximized. This presentation focuses on providing an analysis into how the impedances varies due to the changes in the frequency and the harmonics of the transistor device and thus, demonstrates an analytical approach to minimize those impedance variations to achieve a high gain, PAE and output power across a wide range of frequency points. In addition to the PA circuitry, the design of a high-power conversion efficiency (PCE) rectifier circuit at the receiver side is equally important to ensure all the incoming RF power from the receiving antenna is harvested efficiently and converted to a DC power. Prior works have shown that the main challenge in the design of a rectifier circuit is identifying the optimum diode parameters since the diode is the main source of power loss in the rectifier circuit. Hence, it is important develop a relationship between the diode model parameters and the power conversion efficiency so that the optimum conditions can be determined. This presentation focuses on discussing an analytical approach to obtaining the optimum diode parameters that would yield the highest PCE and bandwidth performance of the rectifier circuit in comparison to the current state-of-the-art-works. Prior works have also shown that different rectifier topologies yield different output voltages and PCE performances. So, this work also presents an analytical derivation of the output voltage and power conversion efficiency of different rectifier topologies so that the optimum rectifier architecture can be identified that would yield the highest output voltage and PCE performance.

PhD Advisor: Dr. Ifana Mahbub

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

Pranutha Malickal

Impact of in-band and adjacent band interference in terrestrial and satellite communication technologies on network applications

04/14/2023 12:25 PM – 1:25 PM ECSN 4.728

Abstract:

The exponential increase in mobile data traffic has created a demand for better coverage and capacity. Meeting the need for high-quality wireless video streaming services while ensuring Quality of Experience (QoE) is challenging due to bandwidth and time constraints. To address these challenges and effectively use limited spectrum resources, researchers are exploring heterogeneous networks that can improve spectrum utilization, exploit multiple access paths, and improve service quality. Multipath connections to a mobile device from multiple networks can improve session stability and user QoE by providing higher aggregate bandwidth. However, in-band and adjacent signal interference remains a significant challenge. Furthermore, current transport protocols used for network applications, especially real-time video streaming, inadequately address critical challenges related to network heterogeneity. Efficient coexistence of heterogeneous networks, including both terrestrial and satellite communication technologies, is crucial for functional and inhibitive coexistence. In this context, coexistence refers to the ability of multiple wireless communication technologies to operate concurrently without causing harmful interference. To address these issues, we aim to analyze the interaction of various technologies in terms of spectrum sharing, interference management, and their impact on network applications. We examine the advantages and challenges in using multipath wireless communication while considering key scheduling functions and an end-to-end perspective.

PhD Advisor: Dr. Ravi Prakash

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

Shoaib Mansoori

Theoretical Study of Electronic Transport in Monolayer and Bilayer Transition Metal Dichalcogenides.

03/30/2023 11:00 AM – 12:30 PM

Abstract:

As devices shrink, silicon-based technology faces short-channel effects that can limit performance. Two dimensional (2D) transition metal dichalcogenides (TMDs) have garnered significant attention over the past decade due to their unique electronic, optical, and mechanical properties, making them promising candidates for next-generation electronic devices. Being atomically thin, they offer better gate control, higher carrier mobility, and less susceptibility to short-channel effects. The aim of this research project is to study the electronic and transport properties of TMDs in both the monolayer and bilayer configurations using full-band Monte Carlo simulation. The insights gained from this study can be used to optimize the design and performance of TMD-based electronic devices.

PhD Advisor: Dr. Massimo Fischetti

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

+1 469 297-6880, 876812165# united States, Dallas (Toll)
Microsoft Teams Meeting: Conference ID 876 812 165#

Luz Martinez Lucas

Emotion Recognition in Conversation and Sequence-to-Sequence Modling

04/26/2023 02:00 PM – 03:00 PM ECSN 4.728

Abstract:

The field of emotion recognition has often focused on predicting emotional states from a single utterance or facial expression. However, emotional states and outbursts are rarely isolated. Emotions are affected by the contextual information surrounding the person externalizing the emotions. In the field of speech emotion recognition in conversation (SERC), this contextual information includes the surrounding speech and the other speakers. Modeling the effect of other speakers on the current speech can be done by following the work done in the field of emotion recognition in conversation (ERC), which focuses on emotion recognition using textual information. Current ERC models often consist of recurrent neural networks (RNNs) and graph neural networks (GNNs), with the RNNs encoding the temporal context and GNNs encoding the inter-speaker information. However, many of those models focus on the emotions of a single sentence or utterance, not considering any changes in emotion during the utterance. To further model the dynamic nature of emotion, especially natural externalizations of emotion, we can predict the trace of emotion over a full conversation. Predicting these traces requires sequence-to-sequence models that are context aware. These types of models are often RNNs or Transformers, which have often been used in natural language processing (NLP) for sequences of text. The neural process (NP) family of models can also be used for sequence-to-sequence modeling. The advantage of the NP family is that such models predict a full sequence from a space of sequences with a dynamically encoded prior. This aspect differs from classical approaches where sequences are predicted based on a static prior generated during training. Combining an ERC model modified for SER and a sequence-to-sequence model would allow us to effectively predict the emotional traces of conversations. This presentation reviews the current literature in the fields of ERC and sequence-to-sequence modeling. It also introduces a plan for combining the models in these fields for Dynamic SERC as well as some preliminary results.

PhD Advisor: Dr. Carlos Busso

Behnam Mosammam

Global Optimization of Reluctance machines using evolutionary methods

04/07/2023 3:00 PM – 4:00 PM ECSN 4.702

Abstract:

Electric machines are prevalent in high impact applications such as electric propulsion for land and air vehicles. Torque density and efficiency are among the most important performances that will determine the ultimate success of electrification of transportation industry. Conventional electric machines are subject to limitations such as symmetry in design, uniform distribution of material, and old manufacturing mechanism. Advances in 3-D printing, new generation of material, and advanced computational facilities over the past few years has introduced new opportunities that calls for an overhaul in design and optimization practices. In this project, using an on/off assignment of material to a partitioned rotor structure, a global optimization of the geometry and distribution of material in the rotor of a reluctance machine is performed. Evolutionary methods such as genetic algorithms and swarm optimization will be used to find the best rotor geometry in terms of torque density, torque pulsation and efficiency.

PhD Advisor: Dr. Babak Fahimi

Pravin Chandrakant Mote

Domain Adaptation for Speech Emotion Recognition by Semi-Supervised Learning

04/26/2023 4:00 PM – 5:00 PM ECSN 4.728

Abstract:

A realistic scenario for using affective computing solutions is to apply emotion recognition models trained on one domain (i.e., source domain) in an application where the data is collected on a different domain (i.e., target domain). In a general scenario, it is only expected to have unlabeled data from the target domain. The generalization of emotion recognition systems on unlabeled data is a challenging problem due to differences in data distributions. An emotion classifier trained on a source domain does not perform well when tested on a target domain if the data distribution of the source and target domains are dissimilar. The differences in domains are caused by variability in speech signals, including recording conditions, bias in emotional content, and personal traits of the speaker. Effective generalization of machine-learning models can be achieved through adaptation techniques that can learn and bridge the mismatches between domains. A few of the well-known methods are domain adversarial training, encoder-decoder reconstruction, and transfer learning. A ladder network adaptation is an example of an encoder-decoder method. It formulates the problem as a multitask learning problem, where the primary task is to classify the emotion and the auxiliary task is to learn the common representation of both the source and target domains. The auxiliary task does not need emotional labels. Hence, this semi-supervised method is an effective technique to adapt a model using unlabeled recordings. Common approaches have considered all the samples in the target domain to adapt the models. We hypothesize that some samples in the target domain are more important than others for robust adaptation. Some target samples that are not well represented in the feature representation created with the source data may even negatively affect the performance of the system. Therefore, we propose to implement the ladder network approach with a curriculum learning formulation. Curriculum learning has successfully improved performance in various areas of machine learning. With curriculum learning, a ladder network is first trained by providing easier samples at the beginning of the training. Then, the training data is increased to include more difficult samples while reducing the learning rate. The curriculum policy proposed in this study sorts the samples in the target domain according to their proximity in the feature space to samples in the source domains. Therefore, target samples that are close to the source samples are selected early in the training process. The proposed domain adaptation solution has the potential to increase the robustness of emotion recognition systems when used for real-life applications. We focus our study on speech emotion recognition.

PhD Advisor: Dr. Carlos Busso

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

Abinay Reddy Naini

Ordinal Speech emotion recognition

04/26/2023 3:00 PM – 4:00 PM ECSN 4.728

Abstract:

Recognizing emotions play an important role in developing advanced interface systems, which enhance human-computer interactions. In recent times, many real-world applications in health care, education, and security and surveillance use automatic Speech Emotion Recognition (SER). Extensive research has been done to improve SER systems, where the task is to predict emotional attributes with models trained with labels derived from subjective evaluation from multiple annotators. However, achieving annotations with high inter-evaluator agreement is difficult due to the differences in perceiving emotions across people. One of the promising approaches is to rank emotional behaviors using preference learning strategies. It is also shown in the literature that annotators tend to agree better on the relative trends, creating better labels to train preference learning models. Furthermore, a preference learning framework is proved to be more appropriate for retrieval tasks, providing the ideal tool for several applications where massive amount of data needs to be screened. However, there are very few studies focusing on preference learning for SER. Our aim is to develop preference learning framework with good performance for SER tasks in new domains. SER models that generalize across different domains are important for real-world applications, since the performance of most current SER systems significantly drops when tested in different domain conditions. As a result, there is a need for making retrieval tasks robust to different domain conditions. This presentations will describe existing methods in this area, describing our preliminary results using a novel combination of unsupervised strategies. Our preliminary experiments showed a promising gain in performance compared to the existing methods in the literature.

PhD Advisor: Dr. Carlos Busso

Samuel Okei

CCi-FACE: Audio-Visual Speech Augmentation for Improvement in Experience for Cochlear Implant Users

04/25/2023 2:00 PM – 3:00 PM

Abstract:

Cochlear implants (CI) help to restore hearing to individuals with severe-to-profound sensorineural hearing loss. While these solutions have aided the hearing impaired, cochlear implants do not restore the normal hearing mechanisms to CI users due to a number of potential neurological factors. One way to improve the performance of cochlear implant devices is to incorporate visual aspects of speech in addition to audio. As part of the research efforts conducted by the UT-Dallas CRSS-CILab, we aim to develop a real-time system to evaluate potential benefits of audio-visual speech engagement for CI users by providing human facial cues. The proposed system employs an audio driven animation generation that mimics a speaker's facial cues in real-time and operates within the current human perceptual limits to ensure that lag and processing delay do not interfere with speech understanding and effective communication. Results show that CCi-FACE is comparable to available lip-sync technology.

PhD Advisor: Dr. John Hansen

Baharealsadat Parchamdar

Smart Wearable system for Real-time arrhythmia detection using TinyML and TinyFPGA

03/22/2023 12:00 PM – 1:00 PM ECSN 4.702

Abstract:

Smart Wearable system for Real-time arrhythmia detection using TinyML and TinyFPGA Baharealsadat Parchamdar Advisors: Prof. Tooraj Nikoubin and Prof. Lakshman Tamil Quality of life is the most valued component of human life. One of the most important factors of quality of human life is the healthcare. Tiny Wearable healthcare devices can help to detect abnormality in human health situations and can prevent dangerous health occurrences. Electrocardiography produces an electrocardiogram (ECG), a recording of the heart's electrical activity [1]. It is an electrogram of the heart, which is a graph of voltage versus time of the electrical activity of the heart [2] using electrodes placed on the skin [3]. Some key design parameters of wearable ECG systems are energy efficiency for battery lifetime, device size, flexibility, suitable physical shape to eliminate the risk of injury to the body, real-time operation, accuracy, and reliability. In the last decade, many advancements in Machine Learning (ML) algorithms have happened, and it accelerated automated reasoning in a wide range of applications, including healthcare. Machine Learning algorithms normally require powerful processors to train as well as to deploy. TinyML, which is the intersection of ML, hardware, and software is a new idea and a solution for making machine learning algorithms run in less powerful processors. Some cardiac arrhythmia detection algorithms have been coded into hardware chips that can be placed in a wearable device for real-time cardiac monitoring that would help to ensure early diagnosis of certain kind of cardiac abnormalities [4]. TinyFPGA boards are very small size FPGA boards that could be more suitable for developing wearable systems. A combination of TinyML and TinyFPGA, along with sensors, can define a new generation of smart wearable healthcare devices. In my doctoral research, I am planning to design a Real-time wearable arrhythmia detector using TinyML and TinyFPGA. References: 1. Bunce, Nicholas H.; Ray, Robin; Patel, Hitesh (2020). "30. Cardiology". In Feather, Adam; Randall, David; Waterhouse, Mona (eds.). Kumar and Clark's Clinical Medicine (10th ed.). Elsevier. pp. 1033–1038. ISBN 978-0-7020-7870-5. 2. Lilly, Leonard S. (2016). Pathophysiology of Heart Disease: A Collaborative Project of Medical Students and Faculty, 6th Edition. Lippincott Williams & Wilkins. pp. 70–78. ISBN 978-1-4698-9758-5. OCLC 1229852550 3. https://en.wikipedia.org/wiki/Electrocardiography 4. R. Ghosh and L. S. Tamil, “Computation-efficient and Compact FPGA Design for a Realtime Wearable Arrhythmia-Detector,” Biomed. Engrg. Advances, vol.2, 100019, Oct. 2021, web. https://www.sciencedirect.com/science/article/pii/S2667099221000190

PhD Advisor: Dr. Tooraj Nikoubin & Lakshman Tamil

Adnan Basir Patwary

Development of UWB Beam Steering Antenna and Impulse Radio Ultrawideband (IR-UWB) Transmitter for Wireless Power Transfer (WPT) Application

04/05/2023 1:00 PM – 2:00 PM ECSN 4.728

Abstract:

Wireless power transfer (WPT) is undoubtedly a concept of the future, but compared to most technologies, it has had a long history, beginning with renowned scientist Nikola Tesla. Wired power supply and batteries remain the main way to provide power to electronic devices. Current techniques of wireless power charging, which are mainly based on the principle of electromagnetic inductive coupling, are essentially near-field techniques that are not sufficient to power constantly moving electronic devices such as unmanned aerial vehicles (UAVs). Radiative far field based WPT is a more viable alternative to produce longer distance wireless power transfer. When done efficiently, far field based WPT can reduce the need for batteries in the UAVs whilst reducing the power required to stay in the air. In order to increase the efficiency, careful design of the RF power transfer link, consisting of nonlinear subsystems and radiating elements, is required to assure that their characteristics are carefully optimized for such particular scenario. In order to improve the efficiency of the WPT system for UAVs, a directive narrow beam far-field-based system can be implemented which has selective tracking capability to track the moving UAVs. Recent works related to far-field based WPT propose systems with beam scanning capability using electrically steered phased array antennas. The antennas proposed in these systems have a maximum scanning range of ±60◦ along the azimuth/elevation plane only which increases the number of transmitters needed to provide constant power to a UAV as it moves out of range. A research gap lies here as there lacks an array antenna system which has a larger scanning range and can steer the far-field beam along both azimuth and elevation plane. These systems also implement two separate antennas for WPT and object tracking which makes the system more complex and bulkier. There is a scope for further advancement by designing a single antenna with dual polarization which can handle both WPT and communications. Also the WPT systems proposed in recent works implement conventional continuous wave transmitters to transmit wireless power which have low efficiency (<10%) due to the RF path loss and large DC power consumption by the transmitters. As very few works have mentioned any method to increase the efficiency at the transmitter end, another research gap lies in the implementation of waveform engineering at the transmitter end to improve the overall efficiency of the WPT system. This research focuses on developing a WPT transmitter front end system that addresses the following research gaps: (1) Implementation of Impulse radio ultrawideband (IR-UWB) technology to reduce the power consumption and increase the overall PAE (>40%) of the system. IR-UWB technology uses short pulses in the time domain with their energy spread over a wide bandwidth in the frequency domain. IR-UWB has low design complexity, low power consumption, and low average transmitted power with a high peak to average power ratio (PAPR) which in turn can increase the overall power conversion efficiency (PCE) of the rectifier compared to continuous signals. (2) Design of high gain UWB phased array antenna with high fractional bandwidth (FBW>110%), narrow beam (<30◦), high gain (>35 dBi), and electrical beam steering capability to facilitate the IR-UWB technology, increase the radiation efficiency, and reduce the path loss. And (3) implementation of mechanical movement of the array elements along with the electrical steering to induce electro-mechanical steering to increase the far-field beam scanning range (±90◦) and introduce scanning in both elevation and azimuth plane.

PhD Advisor: Dr. Ifana Mahbub

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

Mohammad Rasegar

A DWPT system with maximum efficiency under varying load and alignment conditions

04/07/2023 10:00 AM – 11:00 AM ECSN 4.728

Abstract:

About 28% of total U.S. energy consumption in 2021 was for the transportation industry. This causes the emission of harmful gases into the environment. Therefore, the electrification of vehicles has been a key remedy to tackle this problem. However, the electrification industry faces a major challenge, which is a cost-effective and reliable energy storage system and also the needed time to charge a bulky onboard battery storage system. To address this challenge, dynamic wireless power transfer (DWPT) has recently opened a new area of research and provided the electrification industry with an efficient solution. In fact, dynamic wireless charging is a concept which provides the electrification industry with practical solutions to problems that have not been solved for so many years hence attracting many scientists. From the power electronics vantage point, presenting an efficient DWPT system is very important. To get maximum efficiency in the wireless power transfer while a car is in motion, various factors should be taken into the consideration. Therefore, designing a DWPT system with the maximum efficiency for a car while it is in the motion and under varying loading and alignment condition is the goal of this research. This seminar offers the fundamental building blocks and control strategies that are integral parts of the electrified transportation industry of the future.

PhD Advisor: Dr. Babak Fahimi

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

Sakib Reza

Ultrawideband Reconfigurable Integrated Intelligent Conformal Surface (RI2CS) for the Next-generation of Full-duplex Joint Radar Communications and Implantable Sensors

04/24/2023 1:00 PM – 2:00 PM ECSN 4.728

Abstract:

Recently, reconfigurable intelligent surface (RIS) has attracted continuous attention in wireless communications. In the traditional wireless communications, the transmitted radio waves interact uncontrollably with the surrounding objects, thus resulting in quality degradation in the received signal. The deployment of RISs enables the network operators to improve the signal quality at the receivers by optimizing the reflection, refraction, and scattering of the radio waves to decrease the multipath fading with low-cost hardware and low power consumption. One of the design challenges in designing RIS is to model the angular sensitivity of the incident and reflected waves on the performance of such RIS as the normal incidence condition of electromagnetic waves cannot always be satisfied in practical applications. In particular, the impact of incident and reflected angles on scattering parameters through which the optimum receiver position can be determined has not been evaluated yet. Another important application of RIS is to power implantable medical devices (IMDs) through wireless power transfer (WPT) schemes which avoids invasive surgeries and ensures human safety. To power the IMDs wirelessly, compared to the traditional beamforming array antenna, the metasurface can eliminate the complex feed network, decrease the complexity and fabrication cost, and reduce the profile of the transmitting antenna. In particular, phase gradient metasurface lens (PGMSL) is a convenient, low-cost, lightweight, easier to fabricate and simple solution for high-gain applications. However, the impact of PGMSL, specifically conformal PGMSL (CPGMSL) on designing different aspects of WPT system for IMDs has not been well addressed. The specific research gaps lie in the development of a complete theoretical model which is more advantageous for the time cost and optimization complexity incorporating the reflection coefficient as a function of frequency as well as incident angle to determine the optimum receiver position for arbitrary incident angles. Also, there is a special need to assess CPGMSL based WPT system for radiative near-field IMDs to boost the transmission strength as well as the power transfer efficiency while WPT is the sole solution to power the IMDs. First part of this research presentation focuses on the development of a complete theoretical model based on microwave network theory to compute the accurate reflection coefficient of RISs elements under the illumination of incident waves from arbitrary directions. This would also include the discussion on various state-of-the-art impedance modelling method to assess the angular sensitivity of the incident and reflected waves on the performance of RIS. The second part of this research validates the theoretical model by designing a dual polarized unit cell followed by designing the complete array through the assessment of tuning parameters including coupling between neighboring unit cells, coupling between adjacent layers, size of the array etc. Finally, an optimal design of WPT system based on CPGMSL with an enhancement of transmission efficiency by 15 dB and power transfer efficiency by 20 percent will be presented through the analysis of the performance of the proposed system with respect to the various practical situations, such as rotation, flexibility, misalignment, and focus depth variation of the receiver element.

PhD Advisor: Dr. Ifana Mahbub

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

Nabanita Saha

Design of Dual-polarized and Circularly polarized Phased-Array antenna and Automatic Beam Alignment System for Wireless Power Transfer Application

04/25/2023 3:00 PM – 5:00 PM ECSN 4.728

Abstract:

With the recent advancement and progress in the field of wireless power transfer systems, there is an expanding demand for accomplishing maximum beam collection efficiency (BCE) and high-power transfer efficiency (PTE). Conventional wireless power transfer systems can transfer power in only one direction which causes power loss while transferring power to a dynamic receiver. The crucial part of wireless power transfer applications is determining the location of the dynamic receiver and transferring continuous power toward the receiver to reduce the power loss due to misalignment between the transmitter (TX) and receiver (RX) antennas. The phased-array antenna-based wirelessly powered system can meet the challenge to supply continuous power to the dynamic receivers (e.g. freely moving animals, unmanned aerial vehicles etc.) by steering the focused beam in different directions. To achieve the maximum BCE, the beam coverage area of the TX antenna needs to be the same as the aperture of the receiver. Even though several recent prior works contributed antenna array designs for wireless power transfer systems, only a few works optimized the design parameters of the phased array antenna based on the aperture of the receiver. For neuromodulation applications, the receiver needs to be fully implantable to enable sophisticated optogenetic manipulation of the neurons of freely moving animals. The specific research gap that will be highlighted in the presentation is related to the optimization of the design parameters of the phased-array antenna to identify a method to implement an efficient tradeoff between the receiver aperture, BCE and the beam scanning range. Also, the design of a fully implantable receiver with high efficiency is another important task to be done, which will be discussed in detail. The alignment of the TX beam toward the receiver is also a critical problem in wireless power transfer applications. The integration of the beam alignment system with the WPT system to transfer the power precisely and accurately is another research gap that will be presented in this talk. In summary, the first part of this research presentation investigates the optimal dual-polarized and circularly polarized phased array antenna design (with PTE>88%) based on the receiver aperture to mitigate the misalignment problem and reduce power loss. The second part of this research focuses on the design of a fully-implantable and electrically small receiver antenna design with a volume<5mm3 for neuromodulation applications. Finally, the integration of an automatic beam alignment system with the complete WPT system will be presented. The future research outcomes would include an efficient phased array antenna-based WPT system design that is integrated with an automatic and efficient beam-tracking system.

PhD Advisor: Dr. Ifana Mahbub

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

Ebenezer Usih

Experimental Demonstration of Bayesian Inference in the Stochastic Computing Paradigm Using Muller C-Element

03/24/2023 2:00 PM – 3:00 PM ECSN 4.702

Abstract:

Bayesian inference is a statistical method of arriving at informed decisions by considering the probabilities of different events. This tool has various applications such as pattern recognition, e-mail spam filtering, developing cancer risk models, etc. However, as traditional general-purpose computers were not designed with tackling Bayesian inference problems in mind, they are not optimized for solving these kinds of problems. In this work, by employing stochastic computing principles, we have designed, fabricated, and experimentally tested a chip to efficiently perform Bayesian inference. We implement it using both synchronous and asynchronous designs to make comparisons on which might yield a better performance. From power measurements, our chip consumes about 240µW. This direct implementation of Bayesian inference on stochastic hardware opens the door to a new method of efficient decision-making circuits in applications ranging from engineering to medicine.

PhD Advisor: Dr. Joseph Friedman

Thor Westergaard

Digital Twin of DC-DC Converter

04/24/2023 11:00 AM – 12:00 PM ECSN 4.728

Abstract:

Understanding the reliability of DC-DC converters is vital for optimizing safety, maintenance, and cost. The presentation compares the approaches of other state of the art digital twins to a novel method. This novel method creates a digital twin which evaluates the reliability of a buck converter based on physics and data driven modeling techniques while only using non-invasive data acquisition.

PhD Advisor: Dr. Babak Fahimi

Shideh Tayeb Naimi

On the Investigation of Autocorrelation-Based Vector Doppler Method with Plane Wave Imaging

04/03/2023 11:00 PM – 1:00 PM ECSN 4.702

Abstract:

Color flow imaging is one of the doppler method applications which can only estimate the velocity of a moving target along the direction of ultrasonic propagation, that is, the axial velocity. In order to overcome this limitation, high-frame-rate plane wave imaging is utilized by emitting plane waves in multiple directions and estimating the blood flow velocity vectors. In the vector Doppler method based on plane wave imaging, the axial velocity is typically using the autocorrelation method by estimating the mean frequency based on the change in the phase of an echo signal during its sampling interval. The proposed method estimates the wavenumbers of the received signal in lateral and vertical directions to estimate the wavenumber in the axial direction, from which the center frequency as well as beam steering angle was estimated. Finally, to validate the result of this method, absolute bias error (ABE) and root-mean squared error (RMSE) is investigated.

PhD Advisor: Dr. Kamran Kiasaleh

THE UNIVERSITY OF TEXAS AT DALLAS
Erik Jonsson School of Engineering and Computer Science

Thank You!