ECE PhD Qualifying Exams

Presentation Schedule

Spring 2022

ECE QE Presentation Schedule

Spring 2022

Slide Number	Last Name	First Name	Date	Time	Venue	Title	PhD Advisor
4	Alam	Lamia	04/19/2022	1.30 PM	MS Teams	Literature Review of Die Attach and Wire Bond Defect Detection in Integrated Circuit Manufacturing	Nasser Kehtarnavaz
5	Aljohani	Mousa	03/11/2022	11:00 AM	MS Teams	Abstractions for Network Update	Jorge Cobb
6	Badakhshan	Sobhan	04/01/2022	11:00AM	MS Teams	Dynamic modeling of ship-to-grid to enhance the resiliency of coastline power grids	Jie Zhang
7	Xie	Jiamin	4/8/2022	11:00 AM	MS Teams	Automatic Speech Recognition: Challenges for Naturalistic Telephony Data	John Hanson
8	Daryanavardan	Negar	3/31/2022	9:00AM	MS Teams	Cascaded Channel Estimation for Reconfigurable Intelligent Surface Assisted MIMO Systems	ARIA NOSRATINIA
9	Deshmukh	Akshay Vijayrao	03/03/2022	3:00PM	MS Teams	Self-commissioning, fault diagnostics and control of AC motor drives	Bilal Akin
10	Duraisamy Swamikannan	Lena	04/11/2022	2:00pm	MS Teams	Oral Cancer Detection using Machine Learning Algorithms	Lakshman Tamil
11	Hossain Bhuiyan	Md Emran	03/28/2022	11:00 AM	MS Teams	Micromachined acoustic transducers	Siavash Pourkamali
12	Kong	Zelun	03/09/2022	10:00 AM	MS Teams	TZ-DFL: Enhancing Embedded System data confidentiality with Dynamic Function Loading based on TrustZone	Chung Hwan Kim
13	Marri	Sai Kumar	04/18/2022	10.00AM	MS Teams	Design and Optimization of Context-aware Behavioral Artificial Neural Networks	Benjamin Carrion Schaefer
14	Parvez	Mohammad Salman	04/07/2022	10:00 am	MS Teams	Surface Acoustic Wave (SAW) on Lithium Niobate (LiNbO3) for microfluidic applications	Jeong-Bong Lee
15	PATEL	DHRUVI DHAIRYA	03/04/2022	10:00 AM	MS Teams	Comparative study of adjustable speed drives for electric propulsion	Babak Fahimi
16	Sonawane	Akshay Bhagwan	04/11/2022	10:00am	MS Teams	Privacy-Preserving Federated Learning	Lakshman Tamil
17	Yang	Mu	04/08/2022	10:00AM	MS Teams	Self-supervised Pre-training and Semi-supervised Learning for Mis-pronunciation Detection in non-native speech	John Hansen
18	ZAHEDI		02/28/2022		MS Teams	Exact Recovery Threshold via Semidefinite Programming	ARIA NOSRATINIA

ECE QE Presentation Schedule

Spring 2022

Slide Number	Last Name	First Name	Date	Time	Venue	Title	PhD Advisor
19	Zhao	Guangwei	4/5/2022	2:00PM	MS Teams	Applying Modern Machine Learning Techniques to Hardware Security Challenges	Kaveh Shamsi
20							
21							
22							
23							

Lamia Alam

Literature Review of Die Attach and Wire Bond Defect Detection in Integrated Circuit Manufacturing

04/19/2022 1:30 PM

Abstract:

Defect detection plays a vital role in the integrated circuit (IC) manufacturing process. The focus of this presentation will be placed on die attach and wire bond defects. A comprehensive literature review of these defects will be conducted covering different non-destructive testing (NDT) sensing approaches that have been utilized for this purpose.

The major sensing approaches used include visual NDT, scanning acoustic microscopy (SAM), infrared thermography (IRT), magnetic current imaging (MCI), and surface acoustic waves (SAW). The review discusses an examination of both conventional and deep learning methods based on images generated by the above sensing approaches.

A comparison of the methods in terms of their effectiveness for the detection of die attach and wired bond defects will also be presented.

PhD Advisor: Nasser Kehtarnavaz

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Mousa Aljohani

Abstractions for Network Update

03/11/2022 11:00 AM

Abstract: Configuration changes are a common source of instability in networks, leading to outages, performance disruptions, and security vulnerabilities. Even when the initial and final configurations are correct, the update process itself often steps through intermediate configurations that exhibit incorrect behaviors. This paper introduces the notion of consistent network updates—updates that are guaranteed to preserve well-defined behaviors when transitioning between configurations.

We identify two distinct consistency levels, per-packet and per-flow, and we present general mechanisms for implementing them in Software-Defined Networks using switch APIs like OpenFlow. We develop a formal model of OpenFlow networks, and prove that consistent updates preserve a large class of properties. We describe our prototype implementation, including several optimizations that reduce the overhead required to perform consistent updates. We present a verification tool that leverages consistent updates to significantly reduce the complexity of checking the correctness of network control software. Finally, we describe the results of some simple experiments demonstrating the effectiveness of these optimizations on example applications.

PhD Advisor: Dr. Jorge Cobb

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Sobhan Badakhshan

Dynamic modeling of ship-to-grid to enhance the resiliency of coastline power grids

04/01/2022 11:00 AM

Abstract: The concept of ship-to-grid has been explored in recent years, which allows electric ships to supply a part of power demand in the terrestrial electric grid during normal operations or extreme conditions under disruptive events. While this could potentially enhance the resiliency of the power grid during extreme events.
This research discusses a resilience operational framework based on control of power assets to strengthen the operational resilience of interconnected ships to grids. In the proposed resilience framework, the real-power flexibility of ship grid generators is evaluated and aggregated to obtain the overall adaptive capacity of a shipboard power system to respond to either an increase or decrease in demand. To better evaluate the dynamic feasibility of ship-to-grid interconnection, different operation times of shipboard power systems are simulated to meet instantaneous generation–demand balance in the ship grid, and their impacts on the shipboard power system are analyzed. The proposed strategy has been verified by a case study on an MVDC 4-zone shipboard power system and various shoreline grids with different characteristics and loads. The dynamic simulations are conducted with the PSS@E and PSS@NETOMAC software.

PhD Advisor: Jie Zhang

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Jiamin Xie

Automatic Speech Recognition: Challenges for Naturalistic Telephony Data

04/08/2022 11:00 AM

Abstract:
Recently, deep learning has enabled much progress for automatic speech recognition (ASR) on natural conversational data, claiming human parity on benchmark datasets such as Switchboard. However, such state-of-the-art methods often benefit from an ensemble of several models, which are difficult to gather and provide few insights on how the problem is solved.

A few challenges remain due to the characteristics of naturalistic telephony data: 1) recognition of filler words and stop words, such as ‘eh’, ‘a’, and ‘the’ against other non-speech events, 2) correct transcription of multi-syllable words, and 3) telephone channel effects. In this presentation, we will focus on the first two issues identified in the Switchboard telephony corpus and provide analysis. We will introduce a novel method of using deformable convolution neural networks in end-to-end ASR and show a recognition performance boost through asymmetric pattern discovery in naturalistic speech.

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Negar Daryanavardan

Cascaded Channel Estimation for Reconfigurable Intelligent Surface Assisted MIMO Systems

9:00 AM 03/31/2022

Abstract:

Reconfigurable intelligent surfaces (RIS) have emerged as a novel technology that can configure the wireless environment in a favorable manner by properly tuning the phase shifts of a large number of passive and low-cost reflecting elements.

Different from traditional multiple-input multiple-output (MIMO) systems, the design of channel estimation in systems utilizing this technology is challenging, since the RIS can only passively reflect the incident signals by certain phase shifts and does not have any signal processing capability.

To deal with this issue, in this presentation a general framework for the estimation of the transmitter-RIS and RIS-receiver cascaded channel is introduced, and a two-stage algorithm including the bilinear generalized message passing algorithm for sparse matrix factorization and the Riemannian manifold gradient-based algorithm for matrix completion is presented

PhD Advisor: Dr. Aria Nosratinia

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Akshay Vijayrao Deshmukh

Self-commissioning, fault diagnostics and control of AC motor drives

03/03/2022 3:00PM

Abstract:

AC motors, specifically Permanent Magnet Synchronous motors (PMSM) have gained popularity in Industrial applications due to their very high reliability and efficiency. With permanent magnet rotor, they also have higher torque with smaller frame size and no rotor current. The high power-to-size ratio of PMSMs, makes design smaller without the loss of torque. However, due to non-ideal factors such as uncertainties in in motor parameters, periodic torque ripples due to harmonics of flux and dead time of inverter, Inter-turn short circuit (ITSC) faults etc. can disrupt the smooth sensor-less speed control of AC motor.

To ensure safety and reliability of operation in safety critical application, continuous health conditioning monitoring and parameter estimation and fault diagnostics of AC motors is essential. Currently the research focusses on the problem of minimizing the torque ripple due to spatial harmonics. proportional–integral–resonant (PIR) and Revised Repetitive Controller (RRC) control strategies are implemented to eliminate the ripples in torque. Further, the research will focus on online estimation of motor parameter as a part of self-commissioning of AC motors, a sensor-less smooth control operation of PMSM motor and finally the conditioning monitoring of ITSC faults and sensor-less control of motor with ITSC faults will be discussed.

PhD Advisor: Bilal Akin

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Lena Duraisamy Swamikannan

Oral Cancer Detection using Machine Learning Algorithms

04/11/2022 2:00pm

Abstract: Oral Cancer is the eleventh deadliest cancer in the world. The biggest challenge is that, in early stages the cancer can go unnoticed until it reaches the most advanced, difficult to treat stages. Though 90% of survival rate is assured when diagnosed earlier, expensive periodic checkup is mandatory for early-stage detection.

As this cancer is more prevalent in low resource settings, there is a need to develop cost effective Oral cancer Detector (OCD). Hence, AI oriented approach is a promising platform for fast screening, efficacy assessment and early detection of oral cancer. The goal is to develop machine learning model driven mobile application that captures the real time image of the mouth using camera, followed by analyzing the probability of the image being cancer or normal image using deep learning model. Also, the developed OCD mobile application collects metadata (Demography details, Health parameters, Personal Habits), which is stored in the cloud along with the analyzed image.

In this study, two deep learning-based computer vision approaches were assessed for the automatic detection and classification of oral image for the early detection of cancer. To achieve accurate results, clinical experts have been provided with Computer Vision annotation tool (CVAT) to provide rich labels and these annotated images are used for training the model. The developed OCD model is evaluated using F1 score that demonstrates the predictive performance of the model.

PhD Advisor: Dr. Lakshman Tamil

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Md Emran Hossain Bhuiyan

Micromachined acoustic transducers

03/28/2022 11:00 AM

Abstract:
Micromachined acoustic transducers have a wide variety of applications including range finding and proximity sensors, non-destructive testing, fluid flow measuring sensors, and microphones and micro speakers. To generate a strong acoustic signal, high output pressure per surface area is required. When a transducer vibrates with a large vibrational amplitude, it can generate high output pressure per surface area even at a lower frequency. Currently, available piezoelectric or electrostatic micromachined transducers have design and fabrication limitations to vibrate with a large vibrational amplitude.
This work explores novel electrostatic micromachined acoustic transducers that can be used to generate high output pressure per surface area even at a lower frequency. A certain percentage of the area of the transducer along the four edges is covered by micrometer size capacitors cells. The cell-covered area is comprised of a flexible silicon skeleton (mesh) with a network of trench refilling polysilicon electrodes electrically insulated and separated from the silicon walls by submicron airgaps.
The array architecture of the cell-covered area provides flexibility and large displacement by adding displacements from individual cells, while submicron gaps lead to relatively large actuation forces. Such arrangement of micro-scale actuator cells, allows the addition of displacement of a large number of cells, leading to vibrational amplitude in the tens of microns range. This presentation will focus mainly on the merits of the proposed design and perform a comparison with the literature to clearly understand the impact and importance of the proposed design in acoustic transducers applications.

PhD Advisor: Dr. Siavash Pourkamali

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Zelun Kong

TZ-DFL: Enhancing Embedded System data confidentiality with Dynamic Function Loading based on TrustZone

03/09/2022 10:00AM

Abstract: Protecting the confidentiality and integrity of data on microcontroller-based systems (MCUS) deployed in security-critical environments is important: leakage or tampering of sensor data and control instructions can lead to serious personal privacy breaches or industrial production disasters since MCUS are often a part of a larger system, vulnerabilities may jeopardize not only the MCUS itself but other subsystems.

For example, data leakage of health-related IoT devices may lead to illegal personal health status disclosure. In this presentation, we propose TZ-DFL, a dynamic function Loading mechanism based on ARM's TrustZone technology, which will protect critical data by dynamically loading the related subprocedures into secure world protected by TrustZone. TZ-DFL does not require re-develop of existing code.

To achieve this, TZ-DFL utilizes LLVM-based static analysis approaches and LLVM Passes to automatically select subprocedures that need to be run in the secure world according to user-selected critical data.

PhD Advisor: Chung Hwan Kim

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Sai Kumar Marri

Design and Optimization of Context-aware Behavioral Artificial Neural Networks

04/18/2022 10:00AM

Abstract: Artificial Neural Networks (ANNs) are used for a wide range of applications ranging from simple text recognition to high end image-based object recognition. Different types of ANNs require different configurations (e.g., different number of hidden layers) which in turn leads to the need to use different amount and type of hardware resources. Currently, most of these ANNS are trained in software using one of the popular ANN domain specific languages or libraries (e.g., TensorFlow, Keras), but then manually optimized in hardware.

This leads to unnecessary long development times. Moreover, these ANNs design flows do not consider the complete hardware platform where they will used. Most HW ANNs are instantiated as HW accelerators in complex System-on-Chips (SoC). This requires to consider how the ANN interfaces with the rest of the components in the SoC including the embedded processor, other accelerators as well as how the trained weights and biases are read into the ANN. To address this, in this work we propose to design and optimize the ANNs using synthesizable behavioral descriptions, e.g., ANSI-C/C++ or SystemC and optimize them considering the entire SoC and not the individual ANN isolated from the rest of the systems' components.

This requires to build the entire SoC using the same synthesizable behavioral description such that the effect of different configurations can easily be measured in terms of area, performance and power. Because the search space is large and it might take long time to evaluate unique configurations, this work will investigate the use of machine learning techniques to speed up the optimization phase.

PhD Advisor: Carrion Schaefer, Benjamin

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Mohammad Salman Parvez

Surface Acoustic Wave (SAW) on Lithium Niobate (LiNbO3) for microfluidic applications

04/07/2022 10:00 AM

Abstract:

In the field of microfluidics and lab-on-a-chip devices (LOC), actuation of microfluid is needed for manipulation of particles, micro pumping through micro channels and mixing of different fluids. Over the past few years, various techniques have been used for pumping, guiding and mixing microfluids such as: AC & DC electroosmosis process, AC electrothermal process (ACET), pneumatic membrane pumping, and acoustic force-based actuation, etc. Among various acoustic force-based actuation, surface acoustic wave (SAW) has also been studied for microfluidics. (SAW is mechanical wave which propagates along the surfaces of piezoelectric materials. The speed of propagation depends on acoustic velocity of that piezoelectric material. Generally, there are two types of surface acoustic waves: shear-horizontal SAW (SH-SAW) & Rayleigh SAW (RSAW). Most common type is RSAW (named after Lord Rayleigh) which is a combination of transverse and longitudinal waves. SAW is generated by applying high-frequency AC-signal on comb shaped interdigitated electrodes (IDTs) which are formed along the direction of the propagation axis of the piezoelectric material.

The applied frequency of the signal is a function of the acoustic velocity of the piezoelectric material and the gaps and widths of the IDTs. The most common use of SAW has been witnessed in the industry of telecommunication for operating telecommunication devices at radio frequencies. Alongside, SAW-based active mixing technique has been reported to have low propagation loss, low power consumption and ease of fabrication. It has been introduced to create vortices in different shapes of microfluidic channels. In fact, the most used electrokinetic and mechanical actuation and pumping devices are at the verge of replacement by the SAW pumping and actuation methodology due to its high flow rate and portability. Some other salient features of SAW pumps are non-contact application and operating capability in a completely closed loop system. The reason why it is becoming ubiquitous is that it is independent from the choice of the type of fluid such as: Newtonian or non-Newtonian, conductive or non-conductive and regardless of fluid concentration & properties.

PhD Advisor: Dr. J.B. Lee

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DHRUVI DHAIRYA PATEL

Comparative study of adjustable speed drives for electric propulsion

03/04/2022 10:00 AM

Abstract:

In electrified powertrains, selection of the proper electric traction drive is an important step in design and performance optimization. Due to the use of high energy magnets, permanent magnet synchronous machines (PMSM) have been the primary choice in the electric traction motor market. However, due to unstable cost and limited availability of rare-earth metals and fault tolerance issues related to the constant permanent magnet excitation, manufacturers are very interested to find a permanent magnet-free alternative as a substitute option.

Here, a new comprehensive review of electric motor drives that includes Double Stator switched reluctance machine (DSSRM) drive, Permeant Magnet Synchronous motor drive (PMSM), induction motor drive (IM), synchronous reluctance motor drive (SynRel), and PM-assisted SynRel (PMSynRel) drive is presented. By comparing the performances of all above-mentioned drive systems in terms of power density, efficiency, torque ripple, vibration and noise, and fault tolerance. These systematic examinations prove that recently proposed magnetic configurations such as double-stator switched reluctance machine can be a reasonable substitute for permanent magnet machines in electric traction applications.

PhD Advisor: DR. BABAK FAHIMI

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Akshay Bhagwan Sonawane

Privacy-Preserving Federated Learning

04/11/2022 10:00am

Abstract:
With the rapid development of Machine Learning based applications and services, data privacy is becoming an increasing challenge. On the one hand, we are experiencing demanding and more stringent regulations with extensive administrative procedures on data usage, such as the California Consumer Privacy Act (CCPA) and EU General Data Protection Regulation (GDPR). And on the other hand, conventional centralized machine learning approaches are vulnerable to personal data leakage, misuse, and abuse. Thus, Federated Learning comes to the rescue to some extent.

It allows the decentralized training of a machine learning model to the server without sharing the private data from the clients. But recent studies show that Federated Learning alone is not a safe learning approach. One of the reasons is the confidential information leakage from the client's model updates sent after every training epoch to the server. Therefore, we saw a fall in the gap of integrating the privacy-preserving techniques to the Federated Learning systems. In this session, we will study the privacy attacks in the Federated Learning systems and explore the proposed privacy-preserving solutions in the literature. In addition to this, we will discuss the possible challenges of employing these privacy-preserving techniques and future research direction.

PhD Advisor: Dr. Lakshman Tamil

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Javad Zahedi Moghaddam

Exact Recovery Threshold via Semidefinite Programming

10:30 AM 02/28/2022

Abstract:

A random graph with n vertices is partitioned into two clusters using a binary stochastic block model. This model connects independently two nodes with probability p within clusters and q across clusters.

The community detection problem is formalized by a maximum likelihood estimator, however, solving this problem is NP-hard. Applying some relaxations on the maximum likelihood estimator, it was shown that the equivalent semidefinite programming estimator reaches the optimal exact recovery threshold.

In addition, it is proven semidefinite programming relaxation can achieve the optimal recovery threshold for a single cluster of size proportional to n in a planted dense subgraph model.

PhD Advisor: Aria Nosratinia

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Yang Mu

Self-supervised Pre-training and Semi-supervised Learning for Mis-pronunciation Detection in non-native speech

04/08/2022 10:00AM

Abstract:

Mis-pronunciation Detection (MPD) is a fundamental task for Computer-aided Pronunciation Training (CAPT). An MPD system aims to do phoneme recognition on foreign language learners' non-native speech to provide pronunciation diagnosis and feedback. However, due to the sparsity of annotated datasets, directly training a Deep Neural Network (DNN)-based MPD model in a supervised learning manner is sub-optimal. Recently, pre-training strategies have been proposed to enable a DNN model to leverage large-scale unlabeled data for robust representation learning.

We approach the low-resource setting in the MPD task using the pre-trained speech encoders (e.g. Wav2vec 2.0). We propose both feature-based and finetune-based approaches to utilize the encoders. Our empirical results show that with only 3 hours of labeled accented speech, speech representations from the pre-trained speech encoders significantly improve Phoneme Error Rate (PER) over conventional Mel Filter Banks representations. In addition, we propose to use several semi-supervised learning methods to enhance the MPD performance by using unlabeled accented speech data.

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Guangwei Zhao

Applying Modern Machine Learning Techniques to Hardware Security Challenges

04/05/2022 2:00 pm

Abstract:
Many chip design companies have gone fabless in recent years as a result of the globalization of the semiconductor supply chain, which has raised security concerns, including Hardware Trojan insertion, IP theft, and IC Reverse Engineering. Other hardware vulnerabilities such as side-channel attacks remain a major issue. Various circuit-based algorithms and techniques such as Logic Locking, IC Camouflage, Split manufacturing, and Masking have been proposed and are still being developed to hamper these threats.

In recent years modern machine learning techniques primarily deep, neural networks have been replacing traditional algorithms in many fields. Circuit-based hardware security techniques should be no exception to this. In my research, I have been applying modern machine learning techniques primarily Graph-Neural-Networks (GNNs) to improve different hardware security algorithms. In this presentation, I will showcase their application to the problem of benign circuit reverse engineering, and the security analysis of logic locking.

PhD Advisor: **Kaveh Shamsi**

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Thank You!