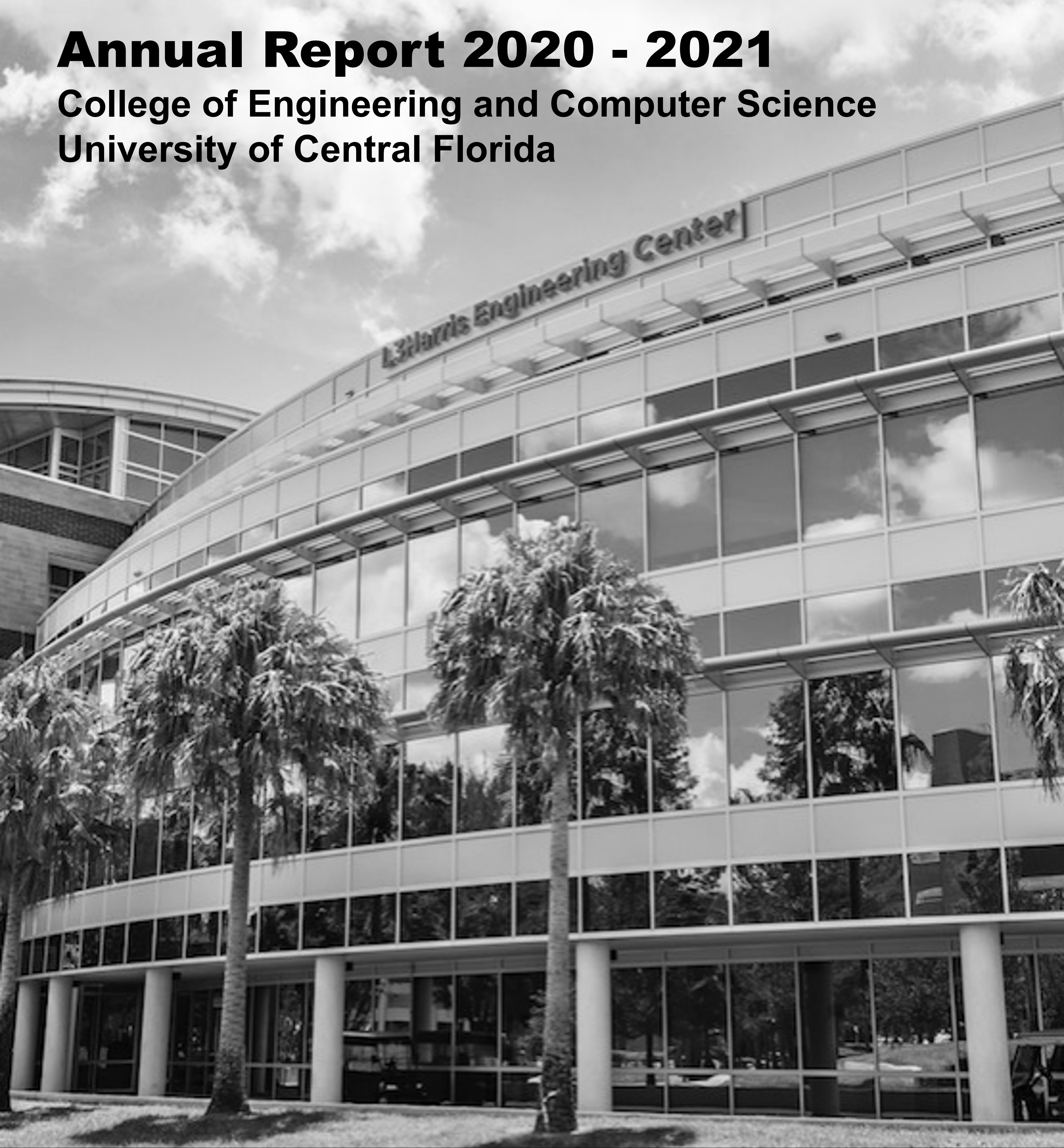
Electrical and Computer Engineering

UCF

Annual Report 2020 - 2021

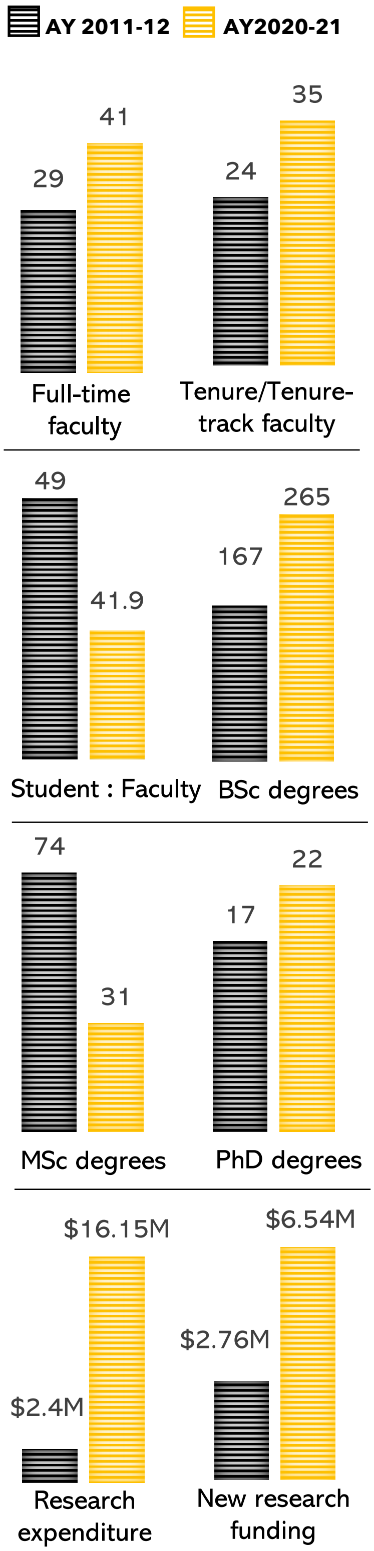
College of Engineering and Computer Science
University of Central Florida



Message from the Interim Chair
Dr. Murat Yuksel

Email: murat.yuksel@ucf.edu

This edition of ECE annual report features our two new faculty members, contains samples of collaborative research projects, and includes the statistics on standard metrics. With the invaluable support from our alumni and friends, the ECE faculty, students and staff will continue to serve our society and always strive for excellence.



The academic year of 2020-2021 was one of its kind! Having a mostly online year and the prepping to transition back to normal operation were extraordinary challenges for the faculty, students, and staff. The social distancing constraints and the urge to protect everyone's health and safety led to several innovations in teaching and research. Among other things, the classes and exams became hybrid or online, contact tracing of COVID was implemented, the lab sessions were made portable, the research experimentation was split to multiple stages, and a massive vaccination campaign took place. Under these never-seen-before difficulties, the Department of Electrical and Computer Engineering (ECE) continued to lead in excellence by striving for the highest quality instruction and research.

Even though COVID changed our lives for good, it brought new problems to solve and provided new opportunities for our profession to serve humanity with more due diligence. ECE fields played a crucial role in enabling our society to function through the pandemic. The well-needed ECE job market is better than ever. ECE-related industrial innovations are moving at full speed. Although the academic year of 2020-2021 was unique, ECE continues to strive for serving the needs of our society and the fast-changing job market as the graphs compare our continuing efforts over the last ten years.

USNWR ranking in 2022

Electrical Engineering

#58

#66 in AY2012

Computer Engineering

#51

#54 in AY2012

Best Engineering Schools

(2022 Graduate School Rankings)

#71

ECE Fast Facts

AY 2020-2021
ENROLLMENT

1,717

total undergraduate enrollment

807 EE
910 CpE

228

total graduate enrollment

57 EE MS
28 CpE MS
99 EE PhD
44 CpE PhD

AY 2020-2021
DEGREES

265

total undergraduate degrees awarded

128 EE
137 CpE

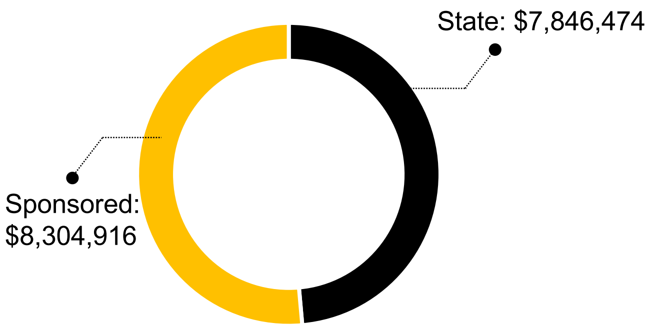
53

total graduate degrees awarded

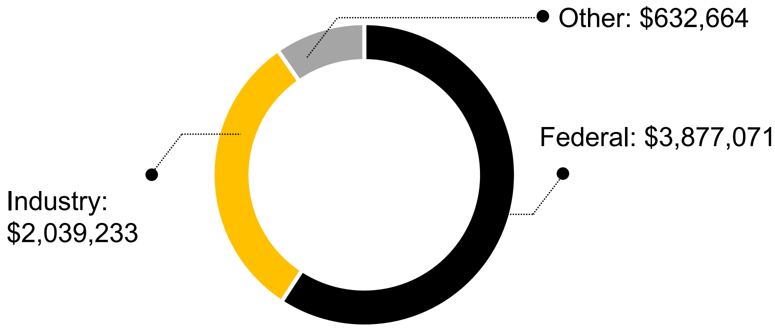
14 EE MS
17 CpE MS
13 EE PhD
9 CpE PhD

Finances

Expenditures
$16,151,390



Sponsored Awards
$6,548,968



ECE Welcomes New Additions

Dr. Hao Zheng is an Assistant Professor in the Department of Electrical and Computer Engineering at the University of Central Florida. His research interests are in the areas of computer architecture and parallel computing, with emphasis on Network-on-Chips, energy-efficient manycore architectures, and machine learning for efficient computing. Prior to joining UCF, Dr. Zheng received his Ph.D. in computer engineering at George Washington University in 2021. His research has been published in the leading computer architecture and EDA venues.

Dr. Ying Ma is a Visiting Assistant Professor in the Department of Electrical and Computer Engineering at the University of Central Florida. She received her Ph.D. from the University of Florida with the Department of Electronic and Computer Engineering, under supervision of Prof. Jose Principe in 2021. She was a Summer research Intern at Apple Siri understanding in 2019 and Google in 2020 and 2021. Her current research interests include machine learning and deep learning, especially reinforcement learning and continual learning.

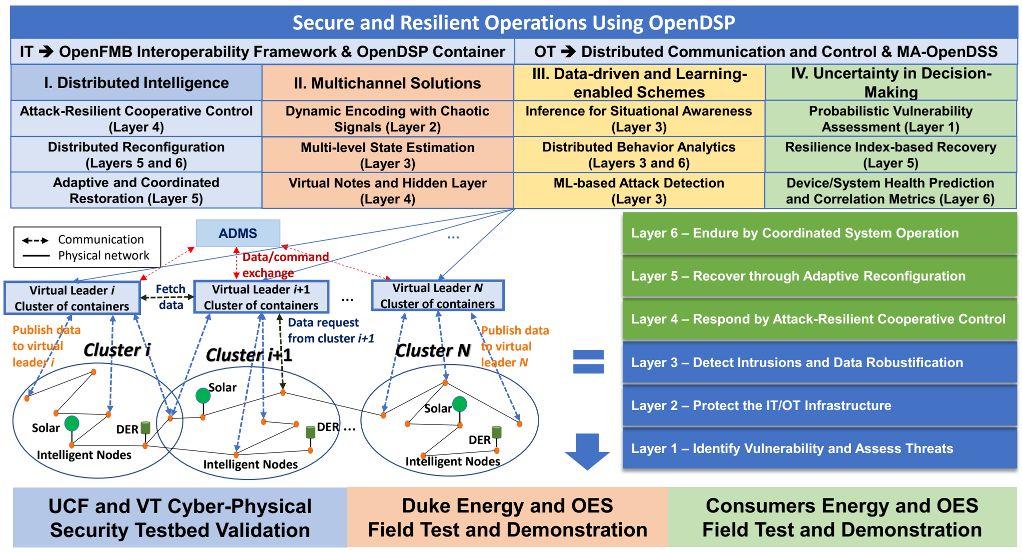
Research Highlights

Dr. Wei Sun along with fellow ECE faculty and the UCF RISES Research Center members, Drs. Zhihua Qu and Aleksandar Dimitrovski, and external partners, Virginia Tech, Duke Energy, Consumers Energy, and Open Energy Solutions, received a $4.75 million award from the U.S. Department of Energy for their project: "Secure and Resilient Operations Using Open-Source Distributed Systems Platform (OpenDSP)".

In modern power grid, increasing grid-edge devices and distributed energy resources (DERs) are being deployed steadily across distribution networks. Ranging from solar panels to batteries and smart air conditioners, DERs are equipped with advanced connectivity, computational and control capabilities to enable better sustainability and efficiency. However, they also expose the overall electricity infrastructure to new cyber vulnerabilities.

The goal of this project is to identify and address cybersecurity gaps by developing a multi-layer multi-channel cyber-physical defense and survival mechanism for operating distribution networks with high penetration of solar and DERs. The proposed security enhancements are built upon the distributed framework and solution architecture for both information technology (IT) and operational technology (OT) systems. The technical solutions consist of two composite functionalities and six layers: proactive defense (vulnerability assessment, communication protection, and attack detection, as layers 1-3), and adaptive self-healing (attack-resilient control, adaptive recovery, and resilient survival, as layers 4-6). Dr. Sun and his team will develop, validate, and field test the technical solutions using university testbed, open-source software, and testing facilities at two utility members.

"We need to understand how to control these DERs at the grid edge,' says Dr. Sun. "This project will develop critical distributed and interoperable technologies to address the emerging cybersecurity issues and enhance relevant operational platforms for DER service providers and utilities."



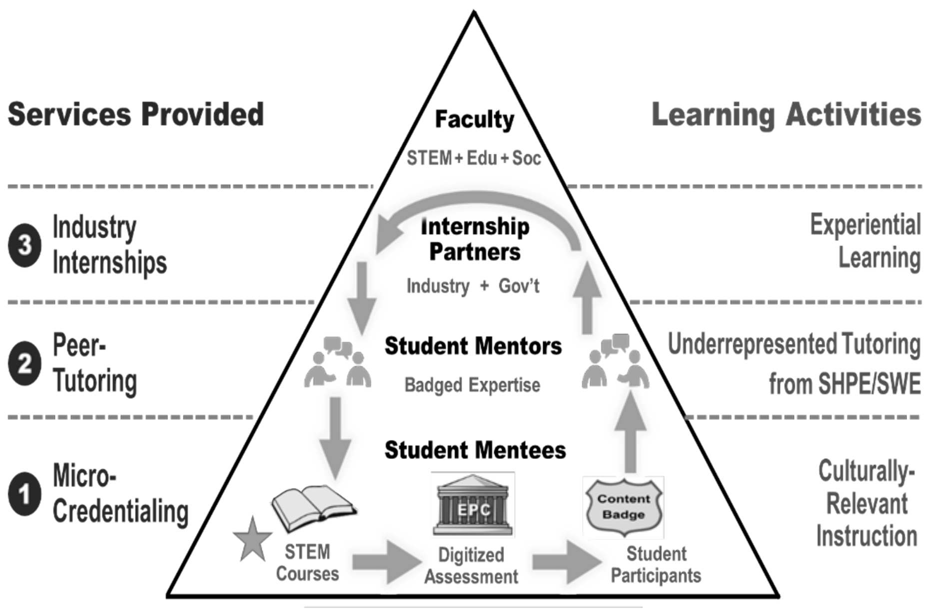
Research Highlights

Dr. Ron Demara (ECE) along with fellow UCF faculty members, Drs. Laurie O. Campbell and Florencio Eloy Hernandez, and co-investigator Dr. Alex Mejia of UTSA received an NSF improving undergraduate STEM education (IUSE) Hispanic Serving Institution (HSI) program grant ($1,83M).

The four-year project, entitled "Building Undergraduate Capacity in STEM at a Hispanic Serving Institution utilizing Culturally-Relevant Instruction with Micro-Credentialing," is advancing engineering and science education simultaneously with inclusive participation within UCF's ECE, College of Engineering and Computer Science (CECS), College of Sciences (COS), and also its propagation nationwide to STEM programs at other HSI institutions. There are four objectives that are pursued to achieve the project goals:

- **training higher-education STEM faculty and graduate teaching assistants in culturally-relevant instructional approaches while increasing peer-tutoring with or without a dedicated Evaluation and Proficiency Center (EPC) facility for interwoven remediation**
- **developing micro-credentialing by data-mining STEM assessments and enabling industry internships**
- **transporting the developed pedagogy through technical and instructional exchange activities including a summer training workshop conducted annually.**

A Transportable Micro-Credentialing Framework is being prototyped by mining digitized student assessment submissions which undergoes thresholding algorithms to determine the applicable micro-credentials earned. This framework extends data mining in new directions for STEM using the Canvas Learning Management Systems (LMSs). As depicted in the graphic, this grant benefits those students who seek to pursue their professional aspirations within STEM career fields. Thus, it advances degree programs and experiences that prepare students to thrive in- and outside of the classroom via innovative pedagogy supported with innovated instructional technology and infrastructures.

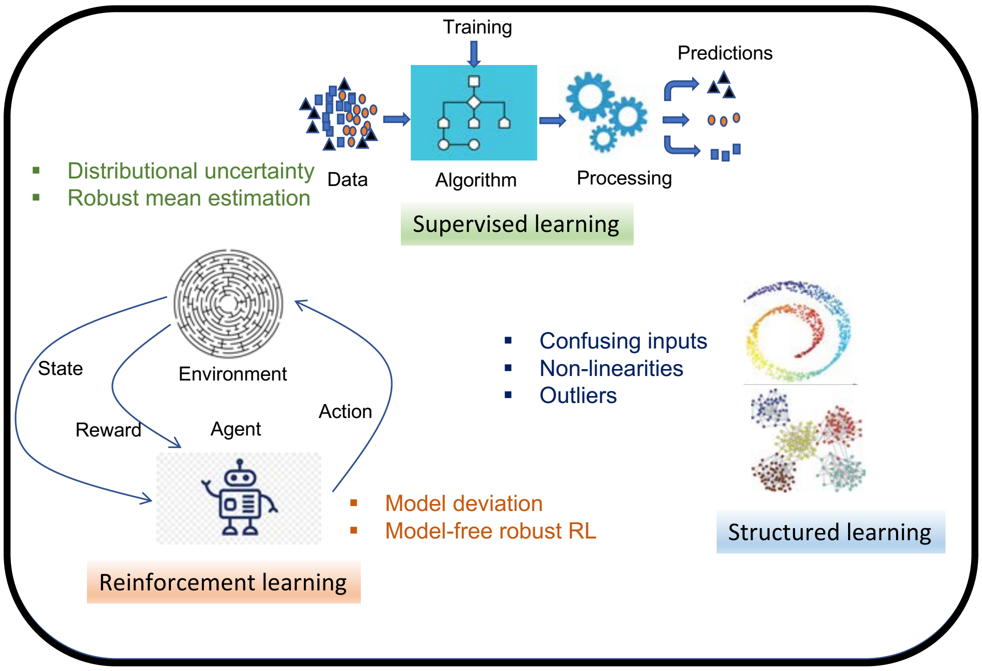


Research Highlights

Dr. George Atia (ECE) has received an award from the Division of Computing and Communication Foundations (CCF) of the National Science Foundation (NSF) in the amount of $1.2M in collaboration with Dr. Veeravalli from the University of Illinois at Urbana Champaign and Dr. Zou from the University at Buffalo on “Emerging Directions in Robust Learning and Inference”.

Future applications of national importance, such as healthcare, critical infrastructure, transportation systems, and smart cities, are expected to increasingly rely on machine-learning methods, including structured learning, supervised learning, and reinforcement learning. In many of these applications, the probabilistic distribution governing the data may undergo variations with time and location, and data could be corrupted by faulty or malicious agents/sensors. Such model deviation and data corruption could result in significant performance degradation.

The goal in this project is to explore new ways to design learning and inference methods that are robust to distributional uncertainty and data corruption. Several directions will be investigated including robust sketch-based learning, robust mean estimation, synthesis of confusing inputs to machine learning models, robustness to distributional uncertainty at inference time, and robust model-free reinforcement learning. This project is bridging and further advancing research in areas of statistical learning, optimization, control theory, network science, reinforcement learning, statistical signal processing and information theory. The investigators are co-organizing special sessions at conferences, workshops and symposia on robust learning and inference to disseminate the research outcomes of this project, formalize far-reaching research directions, identify new challenges in this emerging area, stimulate the development of original research ideas, and foster interdisciplinary collaborations.



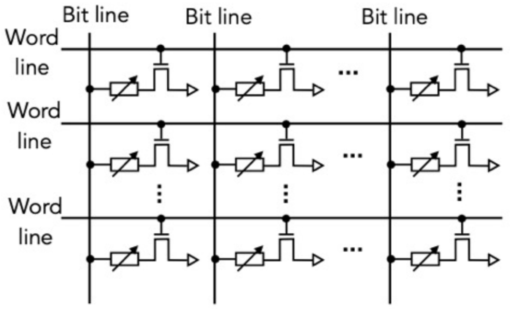
Research Highlights

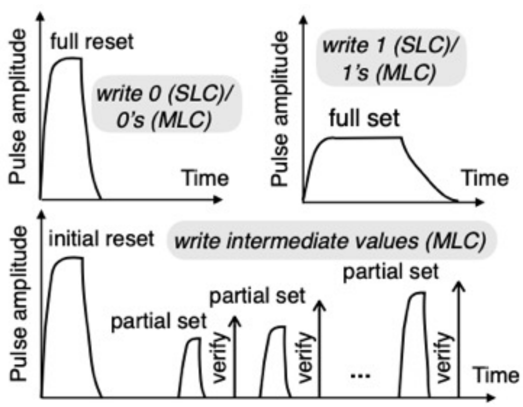
Dr. Fan Yao along with fellow ECE faculty members, Drs. Rickard Ewetz and Amro Awad, received a $500K grant from the National Science Foundation (NSF) for their projected entitled "Towards Secure-By-Design Integration of Emerging Non-Volatile Memory in Future Systems".

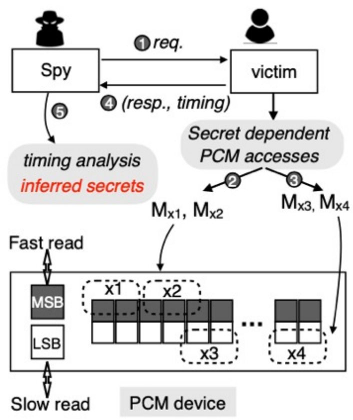
As traditional DRAM technology faces severe scalability and power issues, non-volatile memories (NVMs) that promise high capacity, superior power economy and persistent storage are expected to be mass produced. It is projected that the global non-volatile memory market would reach to the 100-billion dollars value in the next 5 years. While NVM technologies bring tremendous performance and cost-efficiency, information security of NVM devices have not been widely investigated. The recent advances in hardware-based attacks such as Spectre and Meltdown have shown evidence that understanding the security implication of the underlying hardware design (e.g., side channels), especially relating to performance optimizations is imperative when integrating new technologies to computer systems. Particularly, security of future systems should be modeled *during the design phase* instead of considered as an afterthought of system breaches. This is especially critical for NVM integration as today's users rely on remote services such as the cloud to store tremendous amount of private and potentially sensitive data.

This project focuses on understanding the security vulnerabilities in terms of side and covert channels in emerging systems where NVMs are integrated at various levels and devising efficient defensive techniques to mitigate futuristic adversaries exploiting them. The project will innovatively investigate a set of timing channel vulnerabilities as NVMs are deployed in the whole computing storage stack including main memories, secondary memories and storage drives. The PIs aim to understand the exploitation mechanisms behind these newly discovered information leakage attacks. This project would also produce architecture, system and software-level mitigation mechanism to eliminate such leakage possibility.

"Computer architecture and hardware design are at the core of computing system security" says Dr. Fan Yao. "We hope this project will set the steppingstones for secure-by-design implementations that involve integration of NVM in future systems."







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UNIVERSITY OF CENTRAL FLORIDA

Dept. of Electrical & Computer Engineering
L3 Harris Corp. Engineering Center
4328 Scorpius Street | Orlando, FL 32816-2362
Phone: (407) 823-3327 | Fax: (407) 823-1488
For more information, visit ece.ucf.edu
Connect with us on social media

@ECEUCF
UCFDEPARTMENTOFECE