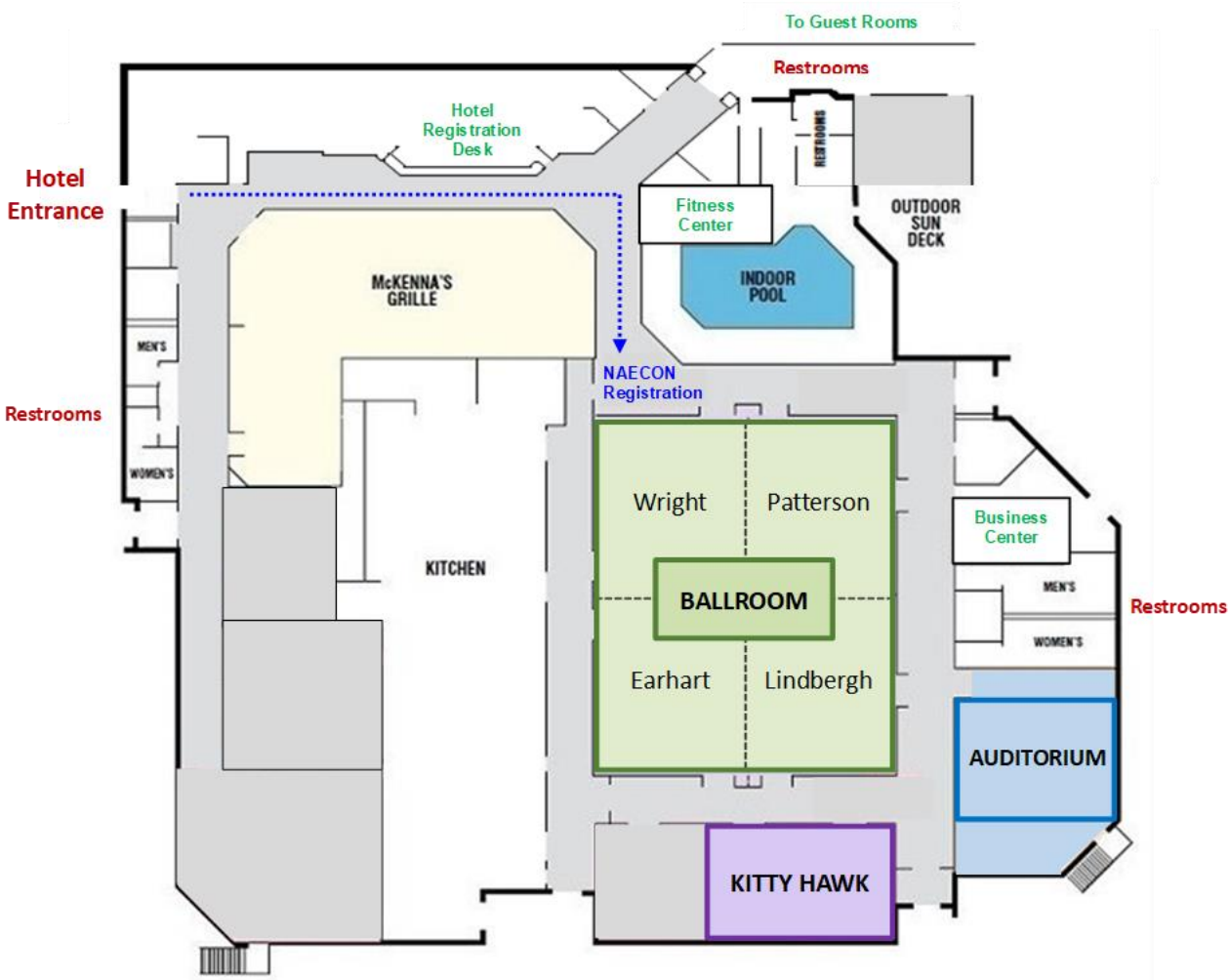
IEEE NATIONAL AEROSPACE AND ELECTRONICS CONFERENCE (NAECON 2024)

DAYTON, OH
DAYTON
EST. 1943
THE CENTER OF AEROSPACE INNOVATION

PROGRAM CONTENTS

Conference Website: https://attend.ieee.org/naecon-2024/

Holiday Inn Dayton/Fairborn I-675 Venue Floorplan



WIFI ACCESS CODE (Holiday Inn): FBNPD

CHAIR'S MESSAGE

Welcome to the 76th Annual
IEEE National Aerospace and Electronics Conference

NAECON 2024

Whether this is your first NAECON, or you are a long-time attendee of NAECON, we welcome your full and active participation in this year's in-person event. In 1948, a then 5-year-old Dayton Section made a bold decision to inaugurate the National Aerospace and Electronics Conference, promoting the technical innovation centered in the Miami Valley and its impact to the region, the US and around the world. Now 76 years later, the inspiration of that first NAECON is captured by this year's theme "**Machine Learning/Artificial Intelligence for DoD System/Sensor Collaboration**". The 2024 NAECON agenda includes 10 technical tracks aligned towards Aerospace Electronic Systems (AES), Circuits and Systems (CAS), tutorials on High Temperature Electronics and Artificial Intelligence, a Special Session for Microwave Theory and Technology, 7 Keynote speakers, and the return of two poster sessions. In addition, our panel session will discuss the increasing importance of the microelectronics commons ecosystem and will be emphasized with our Banquet Keynote speaker Ms. Jackie Janning-Lask.

Respectfully Submitted,

Dr. Charles Cerny, AFRL/RYMP, NAECON ExComm

SPONSORS

IEEE

SILVER Sponsor

KBR

KEYSIGHT

Parallax ADVANCED RESEARCH

BRONZE Sponsor

MTT-S MHz to THz Community

MTT-S
IEEE MICROWAVE THEORY & TECHNOLOGY SOCIETY

The IEEE Microwave Theory and Technology Society (formerly the IEEE Microwave Theory and Techniques Society) (MTT-S) is a transnational society with more than 13,000 members and 200 chapters worldwide. Our society promotes the advancement of microwave theory and its applications, including RF, microwave, millimeter-wave, and terahertz technologies.

Established in 1952, for more than 70 years, the MTT-S has worked to advance the professional standing of its members and enhance the quality of life for all people through the development and application of microwave technology. As we enter into an exciting future, our mission is to continue to understand and influence microwave technology and to provide a forum for all microwave engineers. The MTT-S will continue to be the global focus for the promotion of the RF and microwave engineering profession, by advancing and distributing knowledge and supporting professional development.

This is an all-volunteer society, driven to excellence by its leadership and with the active participation of all its world-wide members. The activities sponsored by the MTT-S include a broad spectrum of conferences, workshops, tutorials, technical committees, chapter meetings, publications and professional education programs. Our principal publications and conferences are world class, peer-reviewed and recognized as top of the class. Our professional venues provide a great opportunity for networking with experienced innovators, experts, and practitioners. Our volunteer programs provide for the development of critical, non-technical skills that enable you to be more effective professionally.

Agenda DAY 1

Monday July 15, 2024

Time	Event	Location
12:00 PM – 5:00 PM	REGISTRATION	BALLROOM FOYER
1:00 PM – 4:00 PM	CONCURRENT TUTORIAL SESSIONS	
1:00 PM – 3:45 PM	**TUTORIAL A:** High Temperature Electronics Workshop	BALLROOM
1:00 PM – 3:30 PM	**TUTORIAL B:** Enhancing Assured PNT: Alternative, Collaborative and AI/ML Methods, Open Standards and Interoperability	AUDITORIUM
1:00 PM – 3:00 PM	**TUTORIAL C:** Exploring Federated Learning: Improving Efficiency and Security in Decentralized and Collaborative Machine Learning	KITTY HAWK

WIFI ACCESS CODE (Holiday Inn): FBNPD

Ballroom

Tutorial A

High Temperature Electronics Workshop

Organized by: **Dr. Ahmad Islam (AFRL/RYDD)**

1:00 PM – 1:45 PM

Invited Speaker

Development of a GaN MMIC Fabrication Process for Extreme Temperature Operation

Presenter: **Dr. Darren Brock**, Lockheed Martin Corporation

Abstract: Operation of traditional MMIC technology within extreme temperature environments (> 300°C) is typically impractical due to the cost and complexity of thermal management. In this talk, we outline the development of a Gallium Nitride (GaN) fabrication process flow and RF devices specifically designed to survive and operate at high temperatures.

Speaker Bio: Darren K. Brock (S'87-M'97-SM'21) received his B.S., M.S., and Ph.D. in Electrical Engineering from the University of Rochester. Since August 2008, he has been working at Lockheed Martin in Billerica, MA where he currently holds the position of Technical Fellow.

2:00 PM – 2:45 PM

Invited Speaker

Nitride Ferroelectric Materials and Device for Computing in Extreme Environments

Presenter: **Dr. Deep Jariwala**, University of Pennsylvania

Abstract: This presentation summarizes recent work on memory devices from emerging wurtzite structure ferroelectric nitride materials, namely aluminum scandium nitride (AlScN). A brief overview of nitride ferroelectric materials and their properties, as well as recent work on Ferroelectric Diode (FeD) devices is provided. FeDs provide a unique advantage in compute-in-memory (CIM) architectures for efficient storage and search, as well as hardware implementation of neural networks. AlScN FeDs can be operated in extreme environments and integrated with SiC substrates.

Speaker Bio: Deep Jariwala is an Associate Professor in Electrical and Systems Engineering at the University of Pennsylvania (Penn). Deep completed his Ph.D. in Materials Science and Engineering from Northwestern University in 2015. Deep was then a Postdoctoral Fellow in Applied Physics and Materials Science at Caltech before joining Penn in 2018.

Ballroom

Tutorial A (continued)

High Temperature Electronics Workshop

Organized by: **Dr. Ahmad Islam (AFRL/RYDD)**

2:45 PM – 3:00 PM	COFFEE BREAK

3:00 PM – 3:45 PM

Invited Speaker

Technology Development for an Integrated AlScN/SiC Dynamic Pressure Sensor

Presenter: **Dr. Mark Sheplak**, University of Florida

Abstract: Accurate dynamic pressure measurements at elevated temperatures are crucial in the design of hypersonic flight vehicles. Existing silicon-based sensing technology is insufficient due to inherent material limitations. This talk will provide an overview of the technology development towards monolithically-integrated pressure sensors for operation in high-temperature environments up to 800 C.

Speaker Bio: Mark Sheplak is a Professor holding joint appointments in the Departments of Mechanical & Aerospace Engineering and Electrical & Computer Engineering at the University of Florida. Prior to joining UF in 1998, he was a postdoc at MIT's (95-98). He received a BS, MS, and Ph.D. degrees from Syracuse University.

Auditorium

Tutorial B

Enhancing Assured PNT: Alternative, Collaborative and AI/ML Methods, Open Standards and Interoperability

Organized by: **Dr. Robert Ewing (AFRL/RYMS)**

1:00 PM – 3:30 PM

Invited Speaker

Enhancing Assured PNT: Alternative, Collaborative and AI/ML Methods, Open Standards and Interoperability

Presenter: **Dr. Charles Barry**, Luminous Cyber Corp.

Abstract: A New Age of Position, Navigation, and Timing (PNT) is emerging, with GPS as the worldwide gold standard for PNT. Civilian, commercial, and defense navigation across air, land, and sea; personal devices; financial transactions; critical infrastructure; and billions of people rely on GPS and related Global Navigation Satellite Systems (GNSS). However, GPS/GNSS services are vulnerable to electromagnetic interference and denial, with space-based threats of increasing concern. This has led to a surge in R&D for Assured and Alternative PNT technologies. Advances in semiconductor and quantum timing, navigation sensors, increased computational power, Low Earth Orbit satellites, diverse Signals of Opportunity/Intent, and AI/ML are driving growth in this field. The U.S. is heavily invested, evidenced by the SpaceWERX Alt-PNT Challenge promoting resilient PNT technologies. This tutorial introduces Assured and Alternative PNT concepts, emphasizing the need for open standards and interoperability, such as Modular Open Systems Approaches (MOSA) and Sensor Open System Architecture (SOSA).

Speaker Bio: Dr. Charles Barry, is a serial entrepreneur with deep expertise in networking, network synchronization, and analytics. Dr. Barry currently leads Luminous Cyber Corp and its AFWERX/USAF and SpaceWERX/USSF sponsored PNT efforts. Dr. Barry co-founded 4 prior startups resulting in an IPO and successful exits to companies like Juniper Networks, Cisco and Adtran. His companies have delivered carrier-class telecommunications products deployed by telecommunications providers worldwide, including network synchronization for Vodafone, and real-time network performance analytics for McDonalds' worldwide operations. Dr. Barry patents are in the area of networking, analytics, AI/ML, and PNT. S.B Physics, MIT; MSEE, PhDEE, Stanford.

2:45 PM – 3:00 PM	**COFFEE BREAK**

Kitty Hawk

Tutorial C

Artificial Intelligence & Machine Learning

Organized by: **Dr. Anca Ralescu** (University of Cincinnati)

Presenter:

1:00 PM – 3:00 PM

Invited Speaker

(OWL)

Exploring Federated Learning: Improving Efficiency and Security in Decentralized and Collaborative Machine Learning

Presenter: **Dr. Chong Yu**, University of Cincinnati.

Abstract: Data generated at the network edge is experiencing explosive growth. Transferring such a large volume of data to a server for centralized machine learning (ML) is impractical due to privacy concerns and the strain on communication and computational resources. As edge devices become more powerful in computing and integrate ML capabilities, data processing can be shifted to local devices instead of relying solely on a central server. Federated Learning (FL), a distributed ML paradigm, allows each individual client to train their models locally and facilitates collaboration among clients by sharing model parameters, thereby preventing the exposure of sensitive information. Nonetheless, FL still faces challenges in efficiency and security due to data heterogeneity, resource constraints, and cyber vulnerabilities. This talk will present the latest findings from our research aimed at addressing these FL challenges, including communication-efficient hybrid federated learning for diverse data distribution and secure approaches against model poisoning attacks.

Speaker Bio: Chong Yu is an assistant professor in the Department of Computer Science at the University of Cincinnati. She received her Ph.D. degree in Computer System Structure from Northeastern University, Shenyang, China, and another Ph.D. degree in Electrical and Computer Engineering from the University of Nebraska-Lincoln, Lincoln, USA. Her research interests include distributed computing, machine learning, and cybersecurity, with a broad range of applications, including data analytics, edge-based artificial intelligence, and the Internet of Things.

Ballroom

KEYNOTE PRESENTATION

Tuesday July 16, 2024

8:15 AM – 9:00 AM

Opening Keynote
(Keynote 1)

Robust Radar Signal Processing Using α-Divergence

Presenter: **Prof. Karim Seghouane**, University of Melbourne, Australia

Abstract: The maximum likelihood estimator is a well-established tool for radar signal processing. However, it can be very sensitive to small model misspecifications caused by outliers. Motivated by the link between maximum likelihood estimation and Kullback-Leibler divergence minimization, we present a new framework for robust radar signal processing based on α-divergence.

Speaker Bio: Abd-Krim Seghouane is a faculty member in the School of Mathematics and Statistics, the University of Melbourne, Australia. Prior to this, he was a Senior Lecturer in the Department of Electrical and Electronic Engineering within the same University. His research focuses on theoretical and applied statistical signal and image processing.

WIFI ACCESS CODE (Holiday Inn): FBNPD

Tuesday July 16, 2024

MORNING TECHNICAL SESSIONS (9:00 AM – 11:15 AM)

Cyber Systems and Security I & II
(BALLROOM)

TRACK CHAIRS:	**Dr. Mark Reith** (AFIT/ENG) **Dr. Frank Wolff** (KBR)

Cyber Systems and Security I **(BALLROOM)**

9:00 AM - 9:20 AM
Paper 8013

An Empirical Study of Software Sanitization Locality

Authors: Boland Christian, Junjie Zhang, Daniel Chong, Rui Dai

Abstract: This work introduces the concept of software sanitization locality and conducts empirical measurements. We define software sanitization locality as the property wherein the sanitization operation, if present, remains proximate to its protected API. To quantify this property, we have introduced a range of metrics. We have also gathered and labeled a dataset of programs containing security patches to conduct empirical measurements. The findings conclusively illustrate that the analyzed samples do exhibit the hypothesized sanitization locality.

9:25 AM – 9:45 AM
Paper 8015

Path-Safe: Enabling Dynamic Mandatory Access Controls Using Security Tokens

Authors: James MacLennan, Junjie Zhang

Abstract: Deploying Mandatory Access Controls (MAC) is a promising way to provide host protection against malware. Unfortunately, current implementations lack the flexibility to adapt to emergent malware threats and are known for being difficult to configure. To address this limitation, we have devised a MAC method that leverages using encrypted security tokens to allow for redeploying policy configurations in real-time without the need to stop a running process. This work also develops Path-Safe, a MAC security system that focuses on protecting filesystem access from unauthorized processes and malware. We show that our security system can mitigate real-world malware threats with low overhead and high accuracy.

9:50 AM – 10:10 AM
Paper 8032

A DWT Robust Blind and Cyber Secure Digital Watermarking and Information Hiding Scheme with Carrier Partial Capacity Utilization for Image Authentication, Tampering Localization and Recovery

Authors: Swapnil Chaughule, Dalila Megherbi

Abstract: The secure digital exchange of private image information is in increasing demand in many applications, such as distributed networked collaborative systems and intelligent multi-sensor-monitoring information, due to the rise in connectivity between digital devices. In this paper, we present a blind watermarking technique and information hiding, and

	authentication based on our prior work where the carrier image, for added cyber security, is arbitrary and known only at the sending end but unavailable on the Internet, including at the receiving end. The proposed scheme has redundancy in the watermark and hidden images while offering the flexibility to utilize only the partial (not full) capacity of the carrier images, leaving the rest of the carrier's capacities to be used for other applicable needs. We present the blind image embedding and extraction schemes alongside watermarking, information hiding, tampering localization, and self-recovery. We show the robustness of the proposed carrier-partial-capacity information hiding and authentication scheme to unauthorized tampering localization and recovery, including blurring, noise, pixel tampering, data compression, and image encryption.
10:15 AM – 10:30 AM	**COFFEE BREAK**
Cyber Systems and Security II	**(BALLROOM)**
10:30 AM – 10:50 AM **Paper 8078**	**Temporal Semantic Parsing for Insider Threat Activity Modeling and Detection** *Authors:* Muhanned AlSlaiman, Christopher Wang, Mohammed Salman, Ahmad Asiri **Abstract:** Insider attacks are a growing concern for organizations due to their frequency and difficulty to detect. This work presents an innovative approach using Kernel Density Estimation, Cumulative Distribution Function, and Deep Learning techniques like Convolutional Neural Network, Long Short-Term Memory, and Dense layers to model insider activities effectively. The system has been evaluated using log files from the CMU CERT r4.2 insiders' dataset, showing promising results in detecting insider threats with different KDE kernel functions and datasets of various sizes.
10:55 AM – 11:15 AM **Paper 8091**	**IIoT Security Using Industrial Identity Management System** *Authors:* Khaled Alrawashdeh, Qasem Abu Al-Haija **Abstract:** The rapid proliferation of Internet of Things (IoT) devices in industrial settings has revolutionized business operations, and enhanced efficiency and automation. However, this increased connectivity also introduces significant security challenges. This paper explores the critical importance of IoT security within industrial identity management frameworks. The paper examines emerging security threats targeting industrial IoT deployments. It emphasizes the importance of proactive threat intelligence, anomaly detection, and continuous monitoring to detect and mitigate security breaches in real time. The paper proposes a robust authentication mechanism, authorization policies, and centralized identity repositories to effectively control device and user interactions. The proposed approach makes use of the OAuth 2.0 authorization protocol to provide an efficient Identity and Access management approach. The paper validates the proposed fundamental principles of identity management in industrial IoT ecosystems using the MIMIC IoT Simulator. The simulation shows that the design can work in principle and analyze the potential pitfalls.
11:15 AM – 12:30 PM	**LUNCH BUFFET OPEN**

Tuesday July 16, 2024

MORNING TECHNCIAL SESSIONS (9:00 AM – 11:15 AM)

Deep Learning & Artificial Intelligence I & II
(AUDITORIUM)

TRACK CHAIRS:	**Dr. Tem Kebede** (AFRL/RYWA) **Dr. Daniel Koranek** (AFRL/RYWA)

Deep Learning & Artificial Intelligence I (AUDITORIUM)

9:00 AM - 9:20 AM
Paper 8007

Optimizing Radar Parameter Values with Language and Genetic Algorithms

Authors: Jackson Zaunegger, Paul Singerman, Ram Narayanan, Muralidhar Rangaswamy

Abstract: Cognitive radar systems are radar systems that are capable of adjusting their operating parameters in response to perceived changes in their environment. The development of these systems requires them to detect these changes, and possess the knowledge to use this information to adjust their operating characteristics. The system must understand the task it is trying to complete so it may determine the best way to accomplish it. These goals may be stated to the computational system in the form of textual inputs. We have previously shown that Natural Language Processing (NLP) models can be used to extract radar parameters, values, and units from text. We have also shown that these models may be used to extend the capabilities of Language Based Cost Functions (LBCFs). In this work, we show how these NLP models and LBCFs may be used to develop a fitness function for a Genetic Algorithm (GA), and to find the optimal set of radar parameter values to achieve a given task. This fitness function may also be used to train Reinforcement Learning (RL) based systems.

9:25 AM – 9:45 AM
Paper 8037

3D Flash LiDAR Object Detection and Tracking on Edge Hardware

Authors: Riccardo Consolo, Abhijit Bhattacharjee, Art Lompado, Daniel Carvalho, Jarrod Brown

Abstract: We developed a real-time vehicle detection system combining YOLOX and Kalman filter tracking, optimized for 3D Light detection and ranging (LiDAR) data. Using a TigerCub Flash LiDAR camera, our method eliminates color variability, enhancing detection accuracy. The machine learning models were deployed on an NVIDIA Jetson Orin Nano, achieving over 95% precision in real-time at 30 frames-per-second.

9:50 AM – 10:10 AM **Paper 8058**	**Deep Learning and Semantic Segmentation for the Detection and Mapping of Glacial Lakes** *Authors:* Alison Hardie, Umesh Haritashya, Russell Hardie **Abstract:** Glacial lakes provide insight into the melting rates of glaciers; thus, the ability to automatically detect and map them opens possibilities for improved monitoring of the changing size of glacial lakes. An accurate automated method for glacial lake segmentation would provide the means to perform constant monitoring without the need for tedious manual labeling. This work utilizes a deep learning approach using semantic segmentation in MATLAB with convolutional neural networks (CNNs) to automatically detect and map glacial lakes. This work can be used to produce quick estimates of lake area in order to monitor changes in their size. The CNN used is DeepLab v3+ with a Resnet 18 backbone. The algorithm correctly identified 93.322% of lake pixels and has a mean BF score of 0.98652, meaning that the generated boundaries closely match the truth. These results show that this is a viable method for the detection and mapping of glacial lakes.
10:15 AM – 10:30 AM	**COFFEE BREAK**
Deep Learning & Artificial Intelligence II	**(AUDITORIUM)**
10:30 AM – 11:15 AM **Paper 8051**	**Empirical Analysis of Learnable Image Resizer for Large-Scale Medical Image Classification and Segmentation** *Authors:* Shaifur Rahman, Zahangir Alom, Simon Khan, Tarek Taha **Abstract:** Deep Convolutional Neural Networks (DCNN) demonstrate state-of-the-art performance in computer vision and medical imaging tasks. Learning with large-scale images is still a challenging task. This study proposes two DCNN models for classification and segmentation tasks. The performance of the proposed models is evaluated for the Diabetic Retinopathy (DR) analysis and skin cancer segmentation tasks. The proposed model outperformed existing methods for both classification and segmentation tasks. For classification, the proposed architectures achieved a 5.34% and 7.39% improvement in accuracy compared to the base model for two different input resolutions. The segmentation model yielded around 0.62% accuracy over the base model and 0.28% in Intersection-over-Union (IoU) from state-of-the-art performance. The proposed model enhances the capability of the existing R2U-Net for medical image segmentation tasks. Moreover, it enables a significant advantage in learning better with a comparatively lower number of training examples. The experimental results reveal that the proposed models are better than the current approaches.
10:55 AM – 11:15 AM **Paper 8046**	**Feature Activation Regression for Image-to-Image Feature Generation** *Authors:* Patrick Hafner, Safwan Altwargi, Anna Carollo, Mohammed Alsheri, Theus Aspiras, Vijayan Asari **Abstract:** With the need for explainable AI, several visualization methods have been developed to explore neural networks. Our proposed work seeks to isolate and generate image features of input data using any neural network. We employed a modified gradient ascent algorithm with a smoothed gradient loss function for image-to-image feature generation.
11:15 AM – 12:30 PM	**LUNCH BUFFET OPEN**

Tuesday July 16, 2024

MORNING TECHNICAL SESSIONS (9:00 AM – 11:15 AM)

Autonomous Systems
and
Signal/Image Processing & Sensor Data Fusion I
(KITTY HAWK)

TRACK CHAIRS:	**Autonomous Systems** **Dr. Theus Aspiras** (University of Dayton)	**Signal/Image Processing & Sensor Data Fusion** **Dr. Ken Hopkinson** (AFIT/ENGC) **Dr. Barath Narayanan** (UDRI) **Dr. Bradley Ratliff** (Univ. of Dayton) **Dr. Brian Rigling** (Univ. of Dayton) **Dr. John Malas** (Univ. of Dayton)

Autonomous Systems **(KITTY HAWK)**

9:00 AM - 9:20 AM
Paper 8006

Minimum Time Escape from a Circular Region of a Dubins Car

Authors: Isaac Weintraub, Alexander Von Moll, Meir Pachter

Abstract: A turn-constrained evader strives to escape a circular region in minimum time.

9:25 AM – 9:45 AM
Paper 8028

Artificial Intelligence-Driven Unmanned Aerial Vehicle Base Station Placement: Current Advances, Challenges, and Use Case

Authors: Yaser Jararweh, Sharief Abdel-Razeq, Haythem Bany Salameh, Ayate Al-Khdouer

Abstract: In recent years, there has been a lot of interest in using drones as aerial base stations (BSs), namely drone base stations (DBS), to help with ground connection under unique situations. Despite the apparent benefits of DBSs, they present some significant obstacles that must be solved in order to provide a robust drone-assisted wireless network service. Optimal placement of DBSs in the air and their movement to ensure optimum coverage is one of the most crucial difficulties. In this paper, we provide an overview of DBSs and their challenges, focusing on the main challenge, the placement, and how artificial intelligence (AI) can be utilized to solve such a challenge effectively. Finally, we present a use case in which we propose an AI-based approach for distributing multiple DBSs to serve zones within a network while allowing for dynamic behavior in user demand and services over time. This problem is solved using the RL approach based on the SARSA algorithm for exploration and continuously learns and adapts DBS allocation strategies in response to environmental interactions. The simulation results show an increase in operator profit compared to equal policy dispatch.

9:50 AM – 10:10 AM **Paper 8050**	**Ensemble Methodology for Automated Machine Predictive Maintenance Classification** *Authors*: Corwin Fister, Isaiah Hill, Timothy Marshall, Aidan Picard, Theus Aspiras **Abstract:** Machine predictive maintenance is important for low-cost maintenance of manufacturing machines. Current methodologies use different classification models for predicting machine maintenance and failures. We propose an ensemble model that utilizes current state-of-the-art classification models for predictive maintenance: random forest, sequential neural network, XGBoost, decision tree, and support vector machine models.
10:15 AM – 10:30 AM	**COFFEE BREAK**
Signal/Image Processing & Sensor Data Fusion I	**(KITTY HAWK)**
10:30 AM – 10:50 AM **Paper 8025**	**Multi-Sensor Adaptive Birth for Autonomous Driving Labeled RFS Filters Using Doppler Measurements** *Authors*: Terell Dale, Dimitri Cugini, Tod Schuck, Ram Narayanan **Abstract:** Alternative proposal distributions for Monte Carlo importance sampling-based, multi-sensor, measurement adaptive track initiation unrestricted to invertible measurement functions have been established to achieve scalable track initialization for labeled random finite set filters. Such proposal distributions provide an efficient means to expand the observable state space in track initialization by way of uninvertible measurements of relative object velocity. This paper proposes an augmented proposal distribution for Monte Carlo importance sampling-based, multisensory measurement adaptive track initiation that improves joint measurement pseudolikelihood approximation using augmented measurements of object velocity. The solution for a Doppler only measurement function is provided and autonomous driving simulation results are shown to verify the resultant tracking performance increase.
10:55 AM – 11:15 AM **Paper 8068**	**Spectral Decision Support for Multifunction Phased Array Systems with Multiobjective Optimization** *Authors*: Richard Pooler, Edwin Lee, Michael Parker, Jason Hodkin **Abstract:** Arrays of antenna elements orchestrated to act as a single antenna aperture offer a flexible platform for active electronic sensors and communication systems. Given the cost and complexity of these systems, there is a desire to increase the functionality of a single array to satisfy the needs of multiple functions including communications, radar, and EW functions. While the RF front-ends are becoming simultaneously integrated, reconfigurable, and capable of wideband sampling, multifunction arrays are absorbing the concepts of dynamic spectrum access. The implementation of mechanisms in the domain of machine learning are more attractive now than ever. This case study addresses the need to articulate the trade-offs associated with a reward function encountered in reinforcement learning (RL) strategies applied to a multifunction phased array. The criteria considered include signal-to-interference plus noise, signal bandwidth, and electromagnetic compatibility. This study uses a multiobjective optimization genetic algorithm to estimate the Pareto frontier followed by multicriteria decision analysis to rank the solutions, specifically for the radar application.
11:15 AM – 12:30 PM	**LUNCH BUFFET OPEN**

Ballroom

KEYNOTE PRESENTATION

Tuesday July 16, 2024

12:00 PM – 12.45 PM **Position, Navigation, and Timing (PNT) for Next Generation Avionics**

Luncheon Keynote
(Keynote 2)

Presenter: **Dr. Charles Barry**, Luminous Cyber Corp.

Abstract: A New Age of Position, Navigation, and Timing (PNT) is emerging. Fueled by growing threats to GPS, increased investment in Assured and Alternative PNT is driving advances in semiconductor and quantum timing, sensors, software-defined systems, LEO PNT, diversity, and AI/ML. Dr. Barry, a five-time startup founder, provides insights into emerging PNT technology and entrepreneurial opportunities.

Speaker Bio: Dr. Charles Barry, is a serial entrepreneur with deep expertise in networking, network synchronization, and analytics. Dr. Barry currently leads Luminous Cyber Corp and its AFWERX/USAF and SpaceWERX/USSF sponsored PNT efforts. Dr. Barry co-founded four prior startups resulting in an IPO and successful exits to companies like Juniper Networks, Cisco and Adtran. His companies have delivered carrier-class telecommunications products deployed by telecommunications providers worldwide, including network synchronization for Vodafone, and real-time network performance analytics for McDonalds' worldwide operations. Dr. Barry patents are in the area of networking, analytics, AI/ML, and PNT. S.B Physics, MIT; MSEE, PhDEE, Stanford.

Tuesday July 16, 2024

AFTERNOON TECHNICAL SESSIONS (1:00 PM – 5:00 PM)

Quantum Computing, Communication and Sensing I & II
(BALLROOM)

TRACK CHAIRS:	**Dr. Charles Cerny** (AFRL/RYMP) **Dr. Leleia Hsia** (AFIT/CLE)

Quantum Computing, Communication & Sensing I (BALLROOM)

1:00 PM – 1:20 PM
Paper 8012

From Atom-Based RF Metrology to Quantum RF Receivers and Emitters

Authors: Damir Latypov

Abstract: Recent research in Rydberg atom-based RF metrology and RF receivers is briefly summarized. While Rydberg atom-based emitters have not yet been reported, they hold significant promise. Quantum emitters offer well-known advantages, including a high degree of coherence, super radiance, and single photon sources. A particularly intriguing possibility is a low-frequency Rydberg atom-based emitter, which could overcome the Chu-Hurrington limit on the Q-factor of electrically small RF antennas. A compact very low frequency (VLF) quantum emitter could have diverse applications ranging from establishing RF links between submerged submarines and air platforms to probing the ionosphere and magnetosphere at VLF frequencies. Additionally, it could play a role in controlling the population of relativistic electrons in radiation belts, ensuring the safety of space assets during space weather events. Naturally occurring in space low-frequency Rydberg atom-based emitters manifest themselves through phenomena like radio recombination lines (RRL) and astrophysical masers.

1:25 PM – 1:45 PM
Paper 8018

Physically Unclonable Characteristics for High Optical Access Trapped Ion Quantum Processors

Authors: Karli Wallace, Michael Roberts, Leleia Hsia, Laurence Merkle

Abstract: At the forefront of quantum technology, trapped ion quantum computing offers unparalleled prospects for computation and data processing. This paper proposes securing trapped ion computing technology with physically unclonable characteristics (PUCs), which leverage device variations occurring during fabrication. We provide an overview of high optical access trap processors and propose potential characteristics for evaluation as PUCs for the trap. Additionally, we present the experimental methodology and preliminary results for the use of calibration data (T1 and T2 coherence times, SPAM error, and 1Q and 2Q errors.) and benchmarking algorithms (Single Qubit State Fidelity and Hadamard Quantum Walks) as PUCs. This introduction of PUCs into trapped ion quantum computing holds promise for enhancing security and reliability in quantum technologies.

1:50 PM – 2:10 PM **Paper 8033**	**Density-Oriented Quantum Simulator Using Block-Encoding Variational Eigensolvers** *Authors*: Advait Vagerwal, Zhenhua Jiang **Abstract:** This paper presents the methods and initial results about a reconfigurable density-oriented quantum simulator, using a new block-encoding variational quantum eigensolver (BE-VQE), which is well suited to new materials and drug discovery. We first propose a modification to the traditional Variational Quantum Eigensolver (VQE), which uses block-encoded matrices instead of Pauli stings in situations where the Pauli decomposition is not readily available, or the Hamiltonian is not unitary. This process can reduce the number of quantum circuits to be executed when evaluating an operator's expectation value, but may lead to a longer operation time, which could be constrained by the quantum decoherence. The procedure to estimate the expectation value of a Hamiltonian operator (or matrix) using block-encodings is discussed in the paper. Then, we utilize the expectation values in a block-encoding-based VQE and apply the solver to the Kohn-Sham Density Functional Theory (KS-DFT) formulation in a 3-dimensional discretized grid space. Also, case studies are presented to illustrate the design and implementation options (including a variational quantum deflation VQD algorithm) with different Hamiltonian formations and demonstrate potential capabilities of the reconfigurable quantum simulator. Finally, the paper is concluded and a plan for future work is identified.
2:15 PM – 2:30 PM	**COFFEE BREAK**
Quantum Computing, Communication & Sensing II	**(BALLROOM)**
2:30 PM – 2:50 PM **Paper 8035**	**QuProbLeM – A Novel Quantum Probabilistic Learning Machine: Software Architecture** *Author*: Zhenhua Jiang, Linh Nguyen **Abstract:** This paper presents a novel Quantum Probabilistic Learning Machine (QuProbLeM) paradigm that is fully based on Bayesian inference and well suited to directly learning the patterns or correlations inherent in dynamic processes from operation data by using a probabilistic neural network. In the QuProbLeM, the respective probability distributions of the weights capturing the input-to-output relationships are learnable parameters that can be learned from data samples. This revolutionary machine learning (ML) paradigm is inspired by the philosophy of Parts and the Total (e.g., each data sample in a closed system affects the total in such a way that the whole system will thereafter influence every single part) and can be effectively implemented on a quantum computing system that may also share the same philosophy. The QuProbLeM can take as its input a set of quantum-encoded data samples comprising pairs of cause-effect variables, and its output may include the updated probability distributions of the model's parameters (i.e., weights) and the predicted effect (output) variables and their distributions when given new cause (input) variables or their distributions.
2:55 PM – 3:15 PM **Paper 8086**	**An Initial Survey on Quantum Enhanced RF Signal Extraction in Cluttered Environments** *Authors*: Vatsa Patel, Zhenhua Jiang **Abstract:** RF (radio frequency) signals are commonly used in modern communication systems, e.g., radio broadcasting, mobile electronic devices, smart meters, satellite transmission, etc., but often face significant challenges such as signal interference. To gain a deep understanding about signal extraction, in this paper, we perform an initial survey on the existing methods and general trends in extracting signals of interest from the received signals

with mixed components, including emerging quantum enhanced signal processing algorithms. We then study a specific method that employs a Bayesian neural network (BNN) as an encoder, combined with a decoder based on a deep neural network (DNN), or a long short-term memory (LSTM) network, or a BNN. Case studies are performed to compare different auto-encoder neural network models and initial testing results show that the BNN's probabilistic parameters can handle the input signal uncertainty well and may significantly enhance signal clarity. Future research will explore quantum computing methods to enhance RF signal extraction in cluttered environments, and some potential quantum algorithms are identified in the paper.

3:20 PM – 3:40 PM

Paper 8029

Scalable Room-Temperature Quantum Processors for Probabilistic Machine Learning and Decision

Authors: Roberto Di Salvo, Zhenhua Jiang

Abstract: This paper presents a modular hardware / software architecture for scalable, configurable quantum processors based upon room-temperature quantum materials and control devices. We propose to apply this architecture to potential implementation of a quantum learning machine as well as a quantum probabilistic decision engine, both of which are well suited to learning unknown dynamics in uncertain dynamic processes/systems from operation data and supporting decision-making under uncertainty. As an example, two case studies are presented to illustrate the design and implementation options and demonstrate the potential of quantum processor. A plan for future work is also identified.

Setup for Poster Session I **(BALLROOM)**

3:45 PM – 5:00 PM

Poster Presenters:

Please report to the easel corresponding to the Poster number assigned on **Page 29** of this program.

Tuesday July 16, 2024

AFTERNOON TECHNICAL SESSIONS (1:00 PM – 5:00 PM)

Deep Learning & Artificial Intelligence III & IV

and

Industry Sponsor Technical Presentations

(AUDITORIUM)

TRACK CHAIRS:	**Deep Learning & Artificial Intelligence** **Dr. Tem Kebede** (AFRL/RYWA) **Dr. Daniel Koranek** (AFRL/RYWA)	**Industry Sponsor Technical Presentations** **Mr. Bill McQuay** (KBR)

Deep Learning & Artificial Intelligence III **(AUDITORIUM)**

1:00 PM – 1:20 PM
Paper 8092

Automated Synthesis of Hardware Designs Using Neuro Symbolic Reasoning and LLMs

Authors: Sumit Kumar Jha, Susmit Jha, Rickard Ewetz, Alvaro Velasquez

Abstract: Large language models (LLMs) are capable of creating small programs including those in hardware description languages. However, there are no guarantees on the correctness of such generated programs. Our approach seeks to create correct-by-construction hardware designs using LLMs by employing formal verification to verify the designs and by using counterexamples to guide the synthesis of such hardware designs in a counterexample-guided refinement loop. We demonstrate the capability of our automated synthesis approach by generating n-bit multipliers using LLMs and their assurance artifacts using model checking. Our approach provides a step in the direction of high-assurance synthesis of hardware artifacts using LLMs and formal methods.

1:25 PM – 1:45 PM
Paper 8060

Implementing SNOOP-AI in CoModIDE

Authors: Alexis Ellis, Brandon Dave, Hugh Salehi, Subhashini Ganapathy, Cogan Shimizu

Abstract: Artificial Intelligence (AI) has surged to the forefront of many major research interests in many different domains. Since research in AI is constantly evolving and is becoming more complex, it can be difficult to understand and explain what many of these systems are doing internally. The push to develop a way to represent, communicate, and explain AI systems is becoming more prevalent as the field continues to expand. This paper builds upon current research with a focus on explainable AI taking from our developed framework of EASY-AI and integrating it into a more applicable way with CoModIDE.

1:50 PM – 2:10 PM

Paper 8102

Insights into Heterogeneous Sensor Fusion and Passive RF Feature Extraction for xAI

Authors: Asad Vakil, Robert Ewing, Erik Blasch, Jia Li

Abstract: In this study, we implement a Convolutional Neural Network (CNN) for the fusion of Passive RF (P-RF) and Electro-Optical (EO) data to gain insights into how P-RF data can be utilized for target detection. The P-RF data first undergoes feature extraction via Short-Time Fourier Transform (STFT), Continuous Wavelet Transform (CWT), Wigner-Villle Distribution (WVD) and Constant-Q Gabor Transform (CQT). Prior experimentation with both Greedy Algorithms and Saliency Maps indicated that the fusion of P-RF and EO data still heavily focuses on the EO data, if possible, only relying on the P-RF data if it was necessary to detect the target. While P-RF has seen more use in vehicle detection for both autonomous driving and drone applications in recent years, its impact on sensor fusion based decision making is still under investigation. By expanding on the available P-RF data, this paper compares different features of P-RF data and their impact in the fusion using diverse counterfactual explanations (DiCE), as well as potentially increasing the reliability of the P-RF data for target detection.

2:15 PM – 2:30 PM | **COFFEE BREAK**

Deep Learning & Artificial Intelligence IV (AUDITORIUM)

2:30 PM – 2:50 PM

Paper 8098

Sparse Feature-Persistent Hierarchical Classification

Authors: Ashley Diehl, Joshua Ash

Abstract: Hierarchical methods that divide target classes into nested sets of progressive generality are increasingly important in large-scale classification tasks. Additionally, large-scale classification over many classes typically requires a large number of features, which necessitates larger amounts of training data. In this work, we leverage class hierarchies to mitigate data paucity in large-scale problems. We combine sparse classification methods with a hidden Markov tree model to identify and exploit feature saliency across different levels in a class taxonomy. By modeling the hierarchical persistence of salient features, the proposed method is designed to improve classification performance in scenarios where training data is limited and high dimensional. Examples demonstrate efficacy of the approach on several measured datasets.

2:55 PM – 3:15 PM

Paper 8100

A Learnable, Super Resolution-Based Framework for Enhancing Compressed Images

Authors: David Essig, Matthew Gnacek, David Fan, Marc Hoffman, Stefan Westberg, Bradley Ratliff

Abstract: Image compression is an important topic in remote sensing applications such as in memory-constrained or low-bandwidth environments. An evaluation of a machine learning compression framework jointly paired with a super resolution network, to restore compressed images, is performed. Image quality and compression metrics are analyzed against existing techniques.

Industry Sponsor Technical Presentations	(AUDITORIUM)
3:30 PM – 4:00 PM	**KBR (Silver Sponsor)** *Presenter:* Mr. Robert Henning
4:00 PM – 4:30 PM	**Parallax (Silver Sponsor)** *Presenter:* Dr. Viktoria Greanya
4:30 PM – 5:00 PM	**Keysight Technologies (Silver Sponsor)** *Presenter:* TBD

Tuesday July 16, 2024

AFTERNOON TECHNICAL SESSIONS (1:00 PM – 5:00 PM)

Signal/Image Processing & Sensor Data Fusion II & III

and

Advantages of IEEE Membership

(KITTY HAWK)

TRACK CHAIRS:	**Signal/Image Processing & Sensor Data Fusion** **Dr. Ken Hopkinson** (AFIT/ENGC) **Dr. Barath Narayanan** (UDRI) **Dr. Bradley Ratliff** (Univ. of Dayton)	**Advantages of IEEE Membership** **Dr. Charles Cerny** (AFRL/RYMP)

Signal/Image Processing & Sensor Data Fusion II **(AUDITORIUM)**

1:00 PM – 1:20 PM

Paper 8005

Large Scale Multispectral Image Dataset Change Detection Based on Self-Supervised Learning with Novel Evaluation Metric

Authors: Youngmin Kim, Ram Narayanan, Muralidhar Rangaswamy

Abstract: Change detection is an important topic in remote sensing to study the effects of climate change, natural disasters, urbanization, etc. However, the need for labeled data has posed significant challenges. In this paper, we introduce a self-supervised learning model to overcome this problem. To evaluate our model performance, we propose a novel evaluation metric called recall-based operational reliability. In our study, we used a large-scale multispectral image dataset called DynamicEarthNet.

1:25 PM – 1:45 PM

Paper 8043

Benefits of HLS for DoD ASIC Development

Authors: Edwin Lee, Michael Parker, Kirk Ober

Abstract: Once conceptualized as futuristic, HLS (High Level Synthesis) tools are now mainstream for ASIC and FPGA design in development of commercial applications, relegating hand-coded RTL (Register Transfer Language) to the past. Our paper details our experience bringing lessons learned from the commercial domain into defense applications using HLS to design an ASIC with large scalability and high complexity data path design, comparing this with efforts to replicate the same design using Verilog and VHDL. We provide area, power and development time metrics of both flows, supporting our conclusion that HLS tools surpass RTL hand coding in virtually all cases. The perception that HLS tools are too risky to adopt because of their novelty and abstraction of design control is overcome by dramatic improvements in development efficiency, and this gap will grow with anticipated acceleration using generative AI technologies in tandem with HLS. This paper focuses on use of the Cadence® Stratus™ High-Level Synthesis (HLS) tool for ASIC development using the GF12LP+ process. The basic circuit functionality will be described but not the application and algorithm.

1:50 PM – 2:10 PM **Paper 8049**	**Navigation Solution Based on Reconfigurable Intelligent Surfaces for GNNS-Degraded/Denied Scenarios** *Authors*: Alan Becerra, Aly El-Osery **Abstract:** This paper presents a navigation solution tailored for global navigation satellite system (GNSS)-degraded/denied environments, crucial for scenarios like search and rescue (SAR) operations. The proposed system employs a swarm of unmanned aerial vehicles (UAVs) integrated with reconfigurable intelligent surface (RIS) technology to facilitate position estimation. By redirecting signals from a mobile base station to a ground target via the RIS on the UAVs, the system enables appropiate positioning for SAR tasks. The study investigates various parameters affecting system performance, including swarm formation, ground speed, and flight altitude, providing valuable insights for optimizing navigation solutions in GNSS-degraded/denied scenarios.
2:15 PM – 2:30 PM	**COFFEE BREAK**
Signal/Image Processing & Sensor Data Fusion III	**(AUDITORIUM)**
2:30 PM – 2:50 PM **Paper 8055**	**Leveraging Docker Containers for Scalable Wireless Communication Applications** *Authors*: Varun Kowndinya, Shankar Prasad, Venkataramani Kumar **Abstract:** Virtualization, despite bringing about a paradigm shift in the utilization of resources, suffers from multiple draw- backs such as the need to possess the entire copy of the operating system by the virtual machines, and other necessary drivers and softwares. Such requirements resulted in adding on to the computational complexity, and significantly higher consumption of resources. However, Containers alleviated the above men- tioned challenges by providing encapsulating all the requisite dependencies into a light-weight, and standalone package. In this work we intend to extract the Container services to address the challenges in wireless communication applications such as inefficient resource utilization, delay in testing, and compatibility issues pertaining to different testbed environments. A real-time case-study of a wireless communication application is taken to illustrate the significance of Containers.
2:55 PM – 3:15 PM **Paper 8094**	**A Strategic Approach to Enhancing INL Performance in 10-Bit MOS-Based R-2R DACs through Area Allocation** *Authors:* Emmanuel Amankrah, Patricia Tutuani, Randall Geiger **Abstract:** This paper presents an approach to improving the Integral Non-Linearity (INL) performance of a 10-bit digital to analog converter (DAC) by strategically allocating area. We propose a methodology that improves matching performance by allocating varying areas to cells in the DAC structure based on their individual impact on the INL metric. Simulation results conducted in a TSMC 180nm process validate the effectiveness of our area allocation strategy, as a 10-bit DAC achieve 15.3% and 16.7% improvement in the INL when 18µm^2 and 27µm^2 area is reduced from LSB and allocated to MSB respectively. The DNL and ENOB also improved by 6.9% and 3.5% respectively.

3:20 PM – 3:40 PM **Paper 8061**	**Automatic Waveform Recognition from Complex RF Data with Filter-Based Deep Learning** *Authors*: Bruce Hicks, Sabyasachi Biswas, Ajaya Dahal, Victor Gonzalez, Ali Gurbuz **Abstract:** Radar-based technologies, vital in both civilian and military sectors, face challenges such as spectrum congestion and signal interference. Accurate and rapid radar waveform recognition is essential, yet traditional methods reliant on transforming raw RF data into alternate feature spaces are limited by low feature fidelity and high computational costs. To address these issues, we propose a filter-based deep learning framework that learns directly from raw RF data. This model incorporates parameterized filters with learnable cutoff frequencies, allowing the network to learn high-level features with clear physical meanings. Initial validation with Sinc and Gabor filters on synthetic RF waveform data achieved a peak state-of-the-art accuracy of 97.4%, without extensive preprocessing.
Advantages of IEEE Membership	**(KITTY HAWK)**
3:45 PM – 5:00 PM	**IEEE Membership Benefits** *Presenter*: Charles Cerny **Abstract:** IEEE is the world's largest technical professional organization celebrating 140 years of “Advancing Technology for Humanity”. There are currently 460,000 members in over 190 countries and more than 66 percent of whom are from outside the United States. IEEE members are engineers, scientists, and allied professionals whose technical interests are rooted in electrical and computer sciences, engineering, and related disciplines. IEEE offers a number of ways to get involved with technical and local communities. These communities are active participants in research and authorship, conferences, and important conversations about today's most relevant technical topics. Membership benefits will be described along with an array of professional and technical career development opportunities.

Tuesday July 16, 2024

EVENING TECHNICAL SESSION (5:00 PM – 6:30 PM)

NAECON RECEPTION & POSTER SESSION I

(BALLROOM/FOYER)

TRACK CHAIRS:	**Dr. Akshay Kulkarni** (University of Florida) **Dr. Fathi Amsaad** (Wright State University)

Poster Session I: 5:00 PM – 6:30 PM

Poster Number	Paper Number	Track	Title	Author(s)
Poster 1	8039	1.2	Escape from an Orbiting Pursuer with a Nonzero Capture Radius	Braulio Mora, Alexander Von Moll, Isaac Weintraub, David Casbeer, Animesh Chakravarthy
Poster 2	8002	1.4	Improved Sampling Model for the Nyquist Folding Receiver	Peter Swartz, Saiyu Ren, Shuxia Sun
Poster 3	8011	1.4	Synthetic Aperture Radar	Jiajia Chen
Poster 4	8056	2.2	Noise Analysis of Memristors: Single Device and Crossbar Array	Muana Kasongo, Maher Rizkalla, Trond Ytterdal, Mukesh Kumar, John Lee
Poster 5	8008	2.3	Tracking a Plane Wave Direction Using Sparse Arrays with an Extended Kalman Filter	Showrov Rahman, Kaushallya Adhikari
Poster 6	8021	2.3	No-Reference Image Quality Assessment for Intelligent Sensing Applications	Zhuobin Yuan, Ademola Ikusan, Rui Dai, Junjie Zhang
Poster 7	8024	2.4	Human Fatality Estimation in Aircraft Accidents	Vishal Pramanik, Maisha Maliha, Sumit Kumar Jha
Poster 8	8034	2.4	Aviation Passenger Segmentation through GANs Integrating K-Means Clustering: Innovating Airline Optimization	Maisha Maliha, Dean Hougen
Poster 9	8042	2.4	kNN Classification of Malware Data Dependency Graph Features	John Musgrave, Anca Ralescu
Poster 10	8048	2.4	RF-Based Drone Type Prediction via Advanced Feature Extraction and Sigmoid Calibration	Yaser Jararweh, Mustafa Daraghmeh, Anjali Agarwa

Wednesday July 17, 2024

MORNING SESSIONS (8:00 AM – 11:00 AM)

Electronics for Extreme Environments/WBG Semiconductors I & II

(BALLROOM)

TRACK CHAIRS:	**Dr. Ahmad Islam** (AFRL/RYDD) **Dr. William Kennedy** (AFRL/RXEE)

Electronics for Extreme Environments/WBG Semiconductors I **(BALLROOM)**

8:00 AM – 8:30 AM

Invited Speaker

(EEE-01)

Extending the Limits: Computing and Advanced Electronics at High Temperature

Presenter: **Dr. A. Matt Francis**, President and CEO
Ozark Integrated Circuits, Inc.

Abstract: Aerospace systems provide a challenging environment for electronics; vibration, shock and wide temperature operation leave system designers with a delicate balance between performance and reliability. Recent advances in advanced packaging coupled with silicon and silicon-carbide semiconductors will be presented, offering new system tradeoffs in the range of 200 to 800oC.

Speaker Bio: A. Matt Francis, PhD (S'99-GS'03-M'09-SM'16) received the BS, BSEE, Physics and PhD degrees from the University of Arkansas. He is founder, President and CEO of Ozark Integrated Circuits (Fayetteville, AR), a leading provider of high temperature electronics and single board computers since 2011. Dr. Francis is Director, Region 5.

8:35 AM – 9:05 AM

Invited Speaker

(EEE-02)

Silicon Carbide Technology Development for General-Purpose Electronics in Extreme Environment Applications

Presenter: **Dr. Zeynep Dilli**, CoolCAD Electronics

Abstract: Silicon carbide is a wide-bandgap semiconductor. Thanks to its material properties, it can operate at much higher temperatures than silicon. Here, we will present the development path and CoolCAD's demonstrated capabilities towards having a wide variety of devices and circuits built using SiC, operating at high temperature conditions.

Speaker Bio: Zeynep Dilli (B.Sc.'98-M.Sc.'01-Ph.D'07) received her B.Sc in Electrical Engineering from Bilkent University, Ankara, Turkey, and her M.Sc and Ph.D. from University of Maryland, College Park, USA. She has been with CoolCAD Electronics since 2014, where she runs R&D and productization programs on SiC high-temperature CMOS technology and SiC UV sensors.

9:10 AM – 9:30 AM

Paper 8064

RF Performance Evaluation of AlGaN/GaN 140 nm T-Gate HEMTs at High Temperatures

Author: Biddut Sarker, Ahmad Islam, Antonio Crespo, Gary Hughes, Nicholas Sepelak, Dennis Walker, Karen Nishimura, Andrew Green

Abstract: This manuscript presents our recent findings from small signal RF measurements of AlGaN/GaN high-electron-mobility transistors (HEMTs) at different temperatures. We will discuss the temperature-dependent variations of key RF device performance parameters, including extrinsic cutoff frequency (fT), maximum gain frequency (fmax), unilateral power gain (UPG), and maximum stable gain (MSG).

9:30 AM – 9:45 AM	COFFEE BREAK

Electronics for Extreme Environments/WBG Semiconductors II **(BALLROOM)**

9:45 AM – 10:15 AM

Invited Speaker

(EEE-03)

Switching-Voltage Dependence of Remnant Polarization and Its Effects on the On/Off Ratio in AlScN Ferrocapacitive Memory Devices at High Temperatures

Presenter: **Dr. Joshua Kennedy**

Co-Authors: David Moore, Spencer Ware, Nick Glavin, Deep Jariwala, Troy Olsson

Abstract: We report a systematic investigation of variations in the on/off ratio of AlScN memory devices as a function of switching field and temperature up to 500 C. Our results show a clear distinction between the wake-up effect in these devices, cycle fatigue, and the evolution of an imprint field that depends on the maximum switching voltage employed.

Speaker Bio: Dr. Kennedy leads the Agile Electronics Materials and Processes Research Team at AFRL where he studies emerging materials for electronic and optoelectronic devices.

10:20 AM – 10:40 AM

Paper 8090

Electrical Characterization of AlScN Ferroelectrics

Authors: Gregory Muha, Guillermo Salcedo, Stefan Nikodemski, Michael Harrington, Vladimir Vasilyev, John Cetnar, Rashmi Jha, Ahmad Islam

Abstract: Aluminum Scandium Nitride (AlScN) is a III-V compound ferroelectric material, making it promising in various applications, such as sensing, RF circuits, and memory applications. Additionally, its high temperature stability as well as large remnant polarization and coercive field make it an ideal choice for extreme operating environments. In this work, we characterize an AlScN sample and report its standard ferroelectric properties. Additionally, we report on a well-defined relationship between coercive field and measurement frequency.

10:45 AM – 11:05 AM **Paper 8062**	**Ferroelectric Characteristics of Hafnium Zirconium Oxide Studied Using X-Ray Photoelectron Spectroscopy** *Authors*: Guillermo Salcedo, Ahmad Islam, Tyson Back, Kevin Leedy, Timothy Wolfe **Abstract:** The ferroelectric (FE) properties of hafnium zirconium oxide (HZO), a material of importance for many electronic applications, are heavily dependent on the zirconium content (x). Here we report that in some cases, samples with the same x display different FE character, and these variations can be explained by changes in the location of X-ray photoelectron spectroscopy (XPS) peaks in the zirconium (Zr) 3d and oxygen (O) 1s spectra, suggesting that these FE character variations could be related to lattice strain in the Zr-O bonds.
11:00 AM – 12:15 PM	**LUNCH BUFFET OPEN**

Wednesday July 17, 2024

MORNING SESSIONS (8:00 AM – 11:00 AM)

Machine Learning, Guidance, and Control I & II
(AUDITORIUM)

TRACK CHAIRS:	**Dr. Trevor Bihl** (AFRL/RYAR) **Dr. Anca Ralescu** (University of Cincinnati)

Machine Learning, Guidance, and Control I (AUDITORIUM)

8:00 AM – 8:20 AM
Paper 8022

Improving Condition-Based Maintenance Transparency Through Causal Explanations: An Aircraft Maintenance Scheduling Case Study

Authors: Huong Dang, KC Chang, Genshe Chen, Hua-Mei Chen, Simon Khan, Milvio Franco, Erik Blasch

Abstract: In our latest study, we introduced an eXplainable Deep Reinforcement Learning based strategy to address an aircraft maintenance scheduling problem, which shed light on the agent's prioritized objectives. In this paper, we present a structural causal model that improved the transparency of the existing scheduling framework by generating causal explanations.

8:25 AM – 8:45 AM
Paper 8004

A Novel Multi-Sensor Fusion System with a Machine Learning-Based Human-Machine Interface for Automating Industrial Robots

Authors: Yasmeen Behbehani, Temesguen Messay-Kebede

Abstract: This paper presents a novel method to control an industrial robotic arm using multiple sensors. This system consists of a hybrid brain activity and vision sensors that convey a human being's intention and visual perception. We fuse and analyze the data from those sensors using a machine learning-based approach to automatically guide the manipulator to a designated location. We believe that this Brain–Machine–Interface (BMI) can greatly alleviate the burdensome traditional method used to program a robot (greatly aids the end–user). We explore various machine learning and pattern recognition techniques as well as existing feature selection methods. Our experimental results show that the subject can control the robot to a destination of interest using BMI. We attain accuracy in the order of 99.4% when it comes to the desired motion and 100% for the case of deducing the desired/targeted object. In this work, we implemented and demoed our approach using a simple pick–and–place test case, a foundation for an underlying system that can be used to benefit people with restricted abilities and allow them to perform complex and robotics-related duties in an industrial setting.

8:50 AM – 9:10 AM **Paper 8047**	**Improved RF-Based Drone Detection via Advanced Feature Extraction and Sigmoid Calibration** *Authors*: Yaser Jararweh, Mustafa Daraghmeh, Anjali Agarwal **Abstract:** This paper proposes an RF-based drone detection approach utilizing advanced feature extraction and sigmoid calibration applied to binary classification models. The proposed methodology improves detection precision and effectively distinguishes drone signals from noise. The study evaluates the effectiveness of advanced feature extraction and model calibration in improving drone detection accuracy.
9:30 AM – 9:45 AM	**COFFEE BREAK**
Machine Learning, Guidance, and Control II	**(AUDITORIUM)**
9:45 AM – 10:05 AM **Paper 8053**	**Adaptive Lifelong Safe Learning Based Intelligent Tracking Control for Nonlinear System Under Unstructured Environment with Non-Stationary Tasks** *Authors*: Shawon Dey, Hao Xu **Abstract:** A novel adaptive lifelong safe learning algorithm is designed for real-time cost-effective tracking control in unstructured environments with non-stationary tasks. Learning sequential tasks while retaining memory of previous tasks in real-time control is challenging due to the computational complexity. To address this, we design a dynamic task selection-based adaptive lifelong learning algorithm for safe optimal tracking control. This includes a real-time adaptive lifelong learning-based actor-critic mechanism. Compared with conventional actor-critic reinforcement learning, the critic neural network in this paper is modified with an adaptive lifelong learning strategy. Specifically, a hybrid offline-online learning framework is developed, where the probability distributions of offline-trained weights for sequential dynamic tasks are utilized in online training to select the most relevant previous tasks. The developed learning framework also includes a fairness term to avoid repeatedly selecting specific tasks. The selected previous tasks are then integrated with a weight consolidation scheme in the designed critic weight update law to achieve adaptive lifelong safe learning.
10:10 AM – 10:30 AM **Paper 8076**	**Boosting Race Car Performance through Reinforcement Learning from AI Feedback (RLAIF)** *Authors*: Danny Nagura, Trevor Bihl, Jundong Liu **Abstract:** In this paper, we present a novel application of reinforcement learning with artificial intelligence frameworks (RLAIF) to enhance race car motion planning. Leveraging Proximal Policy Optimization (PPO) as the foundational algo- rithm, we develop two distinct artificial intelligence systems built on Convolutional Neural Networks (CNNs). These systems are designed with specific objectives: the first aims to maintain the race car's position in the center of the road, while the second encourages the adoption of shorter, more efficient paths. To integrate these objectives into a coherent learning process, we devise a reward modeling strategy that translates the out- comes of the CNN-based classifications into meaningful reward signals. Experimental results demonstrate the effectiveness of our approach, showcasing significant improvements in race car motion planning.

10:35 AM – 10:55 AM **Paper 8063**	**Hybrid Efficient Unsupervised Anomaly Detection for Early Pandemic Case Identification** *Authors*: Ghazal Ghajari, Mithun Kumar PK, Fathi Amsaad **Abstract:** Unsupervised anomaly detection is a promising technique for identifying unusual patterns in data without the need for labeled training examples. This approach is particularly valuable for early case detection in epidemic management, especially when early-stage data are scarce. This research introduces a novel hybrid method for anomaly detection that combines distance and density measures, enhancing its applicability across various infectious diseases. Our method is especially relevant in pandemic situations, as demonstrated during the COVID-19 crisis, where traditional supervised classification methods fall short due to limited data. The efficacy of our method is evaluated using COVID-19 chest X-ray data, where it significantly outperforms established unsupervised techniques. It achieves an average AUC of 77.43%, surpassing the AUC of Isolation Forest at 73.66% and KNN at 52.93%. These results highlight the potential of our hybrid anomaly detection method to improve early detection capabilities in diverse epidemic scenarios, thereby facilitating more effective and timely responses.
11:00 AM – 12:15 PM	**LUNCH BUFFET OPEN**

WIFI ACCESS CODE (Holiday Inn): FBNPD

Wednesday July 17, 2024

MORNING SESSIONS (8:00 AM – 11:00AM)

Novel Sensors & Integration

and

Trusted Microelectronic Systems I: CHEST Session

(KITTY HAWK)

	Novel Sensors & Integration	Trusted Microelectronic Systems - CHEST
TRACK CHAIRS:	**Dr. Stefan Westberg** (AFRL/RYDR) **Dr. Vamsy Chodavarapu** (Univ. of Dayton) **Dr. Elliot Brown** (Wright State Univ.) **Dr. Marc Hoffman** (AFRL/RYDR) **Dr. Amy Neidhard-Doll** (Univ. of Dayton) **Dr. Mike Saville** (AFIT/ENG)	**Mr. Luis Concha** (Univ. of Cincinnati)

Novel Sensors & Integration **(KITTY HAWK)**

8:00 AM – 8:20 AM

Paper 8041

Scalable Compute Platform for Sensor Processing

Authors: Ian Land, Michael Parker

Abstract: DoD systems like sensor arrays must continue to push the state-of-the-art (SOTA) size, weight, and power (SWaP) while advancing system performance processing of the individual sensors. A scalable Vector Processor (VP) based compute platform can deliver ASIC-like performance/power while incorporating FPGA-like flexibility and latency. This paper presents a study of key processors and assesses the strengths and challenges where a vector-engine based platform can deliver capabilities beyond the traditional methods that leverage FPGAs, while adding in AI acceleration and consideration of multiple sensors, sensor fusion, and strategic applications. The described scalable compute platform technology provides the programmability of the FPGAs with the power profile of fixed function ASICs. It is ideal for modern sensor processing, such as Electronic Warfare (EW) and Intelligence, Surveillance, and Reconnaissance (ISR). Reprogrammable Vector Processor (VP) based ASICs can offer lower power as well as pipelined algorithm swaps in as little as a single clock cycle. The scalable processing system can expand from small, battery-powered autonomous systems to large ground radar installations.

8:25 AM – 8:45 AM

Paper 8014

Superconducting Ring Array Pattern Modeling, Characterization, and Propagation for Microwave through Terahertz Frequencies

Authors: Nathan Lehman, Thomas Bullard, Kyle Frische, Timothy Wolfe, Timothy Haugan, Anil Patnaik, Michael Dexter

Abstract: In recent work, we have demonstrated the capability of directional beam forming using superconducting ring arrays across frequencies from microwave to expected terahertz

(THz), triggered by an ultra-fast laser pulse. This paper will extend these developments by presenting comprehensive simulations covering the entire 4pi steradian sphere and outlining an experimental plan for detailed characterization. The existing experimental data will be compared with the simulations conducted in this study. Preliminary designs and modeling are also presented for arrays optimized for the THz regime, providing a possible pathway for future THz generation.

8:50 AM – 9:10 AM

Paper 8103

B-VOSS: Biohybrid Volatile Organic Compound Sensing System

Author: Elisabeth Steel, Zachary Brooks, Maegan Kornexl, Nikhil Vijai, Angela Dixon, Mark Willis, Steve Kim

Abstract: Currently fieldable instruments for gas analysis are large, expensive, and slow. Hand-held devices are limited to identification of specific targets such as nitrogen oxide, oxygen, and carbon dioxide or generalized estimated concentration of total VOCs. There are no commercially available devices harnessing the rapid, selective, sensitive capabilities of olfaction systems due to challenges in the bioelectronic interfacing necessary for maintaining long-term stability of olfactory signaling elements. Our biohybrid sensor approach integrates live Manduca sexta moth antenna with a 32-channel silicon microelectrode array for high resolution recording of voltage responses generated by olfactory sensory neurons (OSN) when exposed to volatile organic compounds (VOC). The innovative current capabilities include: (1) High resolution spatial mapping of OSN activity in response to VOC exposure, (2) a 3-D printed platform that maintains antennal organ function for up to two weeks, and (3) light-weight neural decoding for VOC identification using a Support Vector Machine (SVM). Our biohybrid system supports extended biosensor viability and accurately identifies 8 individual VOCs.

9:30 AM – 9:45 AM | **COFFEE BREAK**

Trusted Microelectronic Systems I: CHEST Session (KITTY HAWK)

9:45 AM – 10:05 AM

Paper 8065

FaultArm: Detecting Fault Injection Vulnerabilities in Arm Assembly

Author: Prateek Kharangate, Guillermo Rached, Harris Musungu, Nan Niu, Boyang Wang

Abstract: Fault injection attacks can flip bits by changing voltage, temperature or EM radiation on a target (e.g., a microcontroller), and therefore, modify program execution on the target, such as bypassing secure boot. However, there are limited tools to automatically detect these vulnerabilities in source code at the development stage. In this paper, we develop a new tool, named FaultArm, which can automatically detection four types of vulnerable code under fault injection attacks in Arm assembly. Our approach includes (1) parsing and (2) token matching. Specifically, we design a customized parser for Arm assembly and design specific token matching rules. We create a dataset of 32 Arm assembly files with 8,493 lines across three optimization levels, including O0, O1 and O2. Our evaluation show that our tool is effective and efficient. Specifically, our tool can achieve 100% precision and 98% recall in O0, 98.6% precision and 90.9% recall in O1, and 96.5% precision and 88.2% recall in O2.

10:10 AM – 10:30 AM

Paper 8066

(OWL)

Power Side-Channel Verification in Hardware Designs

Authors: Khitam Alatoun, Ranga Vemuri

Abstract: The security of hardware designs is seriously threatened by power side-channel attacks, wherein the adversary can expose confidential information by analyzing the power consumption in the design. This paper introduces a methodology for formal verification of the power side-channel leakage. Our model analyzes gate-level side-channel dynamic power and

	uses JasperGold for formal verification. Multiple SystemVerilog Assertions (SVA) are devised to capture various properties relevant to the power-side channel analysis. The verification process is executed on four distinct hardware designs. The outcomes demonstrate the efficacy of our approach in accurately detecting power-side channels in hardware. Additionally, an analysis of SVA failures enables the quantification of the leaked power.
10:35 AM – 10:55 AM **Paper 8085**	**Impact of CMOS BEOL and Heterogenous Packaging Process Conditions on the Performance of On-Chip Antenna Arrays for EM Radiation Monitoring** *Presenter*: Manoj Yasaswi Vutukuru, Andrew Muha, Ramesh Srinivasan, Rashmi Jha **Abstract**: This study investigates the impact of CMOS Back-End-Of-Line (BEOL) and heterogeneous packaging process conditions on the performance of on-chip antenna arrays designed for electromagnetic (EM) radiation monitoring in integrated circuits (ICs). On-chip antennas can be crucial for detecting aging and electromigration for enhancing IC reliability. We analyze how BEOL conditions, including high temperature anneals and varied annealing durations, as well as metal thickness, affect the return loss and coupling of on-chip antennas.
11:00 AM – 12:15 PM	**LUNCH BUFFET OPEN**

Ballroom

KEYNOTE PRESENTATION

Wednesday July 17, 2024

11:30 AM – 12:15 PM **Artificial Intelligence – Support to Acquisition**

Luncheon Keynote
(Keynote 3)

Presenter: **Mr. Joseph Oder**, SES, DAF
Executive Director, Air Force Nuclear Weapons Center

Abstract: The Department of Defense (DoD) recognizes the growing importance of data analytics and artificial intelligence (AI) as critical enablers of decision-making, operational effectiveness, and competitive advantage. The strategy also includes the creation of an ethical framework for AI use, which will guide the development of AI-enabled systems and ensure that they are used in a manner that aligns with DoD's values and principles. We recognize that AI adoption is a long-term endeavor that will require sustained investment and commitment.

Speaker Bio: Joseph M. Oder, a member of the Senior Executive Service, is the Executive Director, Air Force Nuclear Weapons Center, Kirtland Air Force Base, New Mexico. Mr. Oder advises the AFNWC commander in managing all aspects of the center's mission to acquire, sustain and modernize our nuclear arsenal to maintain an effective nuclear deterrent that safeguards the United States, assures allies and deters adversaries. The center is responsible for the lifecycle management of nuclear weapons systems supporting two legs of the nation's nuclear triad, including intercontinental ballistic missiles; air-launched cruise missiles; gravity bombs; and nuclear command-and-control communication systems.

Mr. Oder entered the Air Force in May 1989 after graduating from the U.S. Air Force Academy and has more than 25 years of experience in nuclear weapons and counterproliferation with the U.S. Air Force and the Department of Energy's National Nuclear Security Administration. He was awarded his missile operations badge in July 1990 and is a senior missileer with more than 200 combat alerts in Minuteman II ICBMs. After obtaining a master's degree in nuclear engineering, he took over as the Program Manager for ICBM Nuclear Survivability and later became the ICBM Systems Program Office executive officer. In 2000, he participated in the two-year Nuclear Technologies Fellowship Program at Sandia National Laboratories, where he focused on the technical aspects of current and retired nuclear weapons. He then served as the Deputy Chief for Counterproliferation at the Air Force Nuclear Weapons and Counterproliferation Agency. Assigned to the NNSA headquarters in 2004, Mr. Oder began as a program engineer in the Nuclear Bombs Division but was quickly elevated to Deputy Director for the Office of Nuclear Weapons Stockpile. In 2007, he became the acting Director and led the $1 billion-per-year nuclear stockpile program. He retired from active duty in the Air Force in 2009. Mr. Oder began his civilian government service when NNSA selected him as its permanent Director, a position that became an SES in 2012, where he provided executive leadership, management, and vision for five divisions and an operating budget of $1.4 billion. Prior to his current assignment, Mr. Oder was the Deputy Assistant Deputy Administrator for Major Modernization Programs, ensuring the viability of the nuclear weapon stockpile by planning, executing and evaluating all modernization programs related to nuclear weapons.

Mr. Oder holds a BS in Engineering Physics from the US Air Force Academy, a MS in Engineering Management from West Coast University, a MS in Nuclear Engineering from the Air Force Institute of Technology, and a MS in Military Operational Art and Science from Air University, Maxwell AFB.

Ballroom

KEYNOTE PRESENTATION

Wednesday July 17, 2024

12:15 PM – 1:00 PM **Trusted and Assured Microelectronics (T&AM) Overview**

T&AM Keynote
(Keynote 4)

Presenter: **Dr. Matthew Kay**, OSD T&AM, Naval Surface Warfare Center, Crane Division

Abstract: Dr. Matthew Kay, Distinguished Scientist for Trusted Microelectronics, will provide an overview of the Trusted & Assured Microelectronics (T&AM) Program. Dr. Kay is detailed to OUSD R&E and serves as the T&AM Program Director. T&AM program's technical objective is to transition demonstrated assured microelectronics prototypes for productization in support of Department of Defense's modernization priorities to include but not limited to hypersonics, C4SIR, electronic warfare, advance communications and sensing, secure computation, space operations, and the nuclear deterrent.

Speaker Bio: Dr. Kay currently provides technical and programmatic oversight as the Program Manager of the Trusted and Assured Microelectronics (T&AM) Program, a multi-billion dollar initiative over the future years defense program that addresses access and assurance of microelectronics for the Department of Defense (DoD). In his over 15 years with the Navy, Dr. Kay has led in numerous roles for the Navy and at the Department level. Dr. Kay has served as the Navy Representative to the Defense Microelectronics Cross-Functional Team, the lead for DoD Unique Needs and the later-Radiation Hardened Technical Execution Area for the T&AM Program, and the Executive Secretariat for the Office of the Under Secretary of Defense for Research and Engineering in support of the Strategic Radiation-Hardened Electronics Council. In April 2023, Dr. Kay was appointed the Distinguished Scientist for Trusted Microelectronics at the Naval Surface Warfare Center in Crane, Indiana.

He has served as a subject matter expert in the area of trusted radiation-hardened microelectronics with a focus on memory technology for various services, agencies, and working groups across the United States Government. Some of the services and agencies he supports and collaborates with include the Navy Strategic Systems Program, Air Force Nuclear Weapons Center, Office of the Deputy Assistant Secretary of Defense for Nuclear Matters, Defense Advanced Research Projects Agency, National Aeronautical and Space Agency, Los Alamos National Labs, Naval Research Lab, as well as T&AM and the Joint Federated Assurance Center, a joint, Department-wide federation of capabilities to support the trusted defense system needs of the Department.

A native of Big Rapids, Michigan, Dr. Kay graduated in 2003 from Wabash College with a bachelor's of arts with a major in Physics. He received his M.S and Ph.D. in Physics from Purdue University's Physics and Astronomy Department.

Wednesday July 17, 2024

SPECIAL AFTERNOON INDUSTRY SESSION (1:00 PM – 2:15 PM)

Microelectronics Commons Ecosystem Panel

(BALLROOM)

TRACK CHAIRS:	**Mr. Bill McQuay** (KBR) **Dr. Charles Cerny** (AFRL/RYMP)

Panelists:

Invited Speaker

Dr. Matthew Kay

Panelist Bio: Dr. Matthew Kay, Distinguished Scientist for Trusted Microelectronics (SSTM), Detailed to OUSD(R&E) DCTO(CT), Trusted & Assured Microelectronics Program Manager, Naval Surface Warfare Center, Crane Division, (NSWC Crane), Crane, Indiana. In his over 15 years with the Navy, Dr. Kay has led in numerous roles for the Navy and at the Department level. Dr. Kay has served as the Navy Representative to the Defense Microelectronics Cross-Functional Team, the lead for DoD Unique Needs and the later-Radiation Hardened Technical Execution Area for the T&AM Program, and the Executive Secretariat for the Office of the Under Secretary of Defense for Research and Engineering in support of the Strategic Radiation-Hardened Electronics Council. In April 2023, Dr. Kay was appointed the Distinguished Scientist for Trusted Microelectronics at the Naval Surface Warfare Center in Crane, Indiana. A native of Big Rapids, Michigan, Dr. Kay graduated in 2003 from Wabash College with a Bachelor's of Arts with a major in Physics. He received his M.S and Ph.D. in Physics from Purdue University's Physics and Astronomy Department.

Wednesday July 17, 2024

Microelectronics Commons Ecosystem Panel

(BALLROOM)

Panelists (continued):

Dr. Matt Casto

Panelist Bio: Dr. Matt Casto currently serves as Chief Technology Officer of The Midwest Microelectronics Consortium (MMEC) where he is responsible for the mission focused technological direction of the MMEC, leading product research and development from the laboratory to commercialization. Dr. Casto is a standing Senior Member of the Institute of Electrical and Electronics Engineers, holding B.S. and M.S. degrees in Electrical Engineering from Wright State University, and a Ph.D. in Electrical and Computer Engineering from The Ohio State University.

Dr. Casto joined MMEC in 2023, previously serving 20 years in numerous Department of Defense (DoD) technical leadership positions including roles at the Pentagon in the Office of the Secretary of Defense as Director for the DoD Trusted and Assured Microelectronics (T&AM) Program and in the Office of the Assistant Secretary of the Air Force as the Department of Air Force Senior Strategic Advisor for Microelectronics Innovation. As Chief for the Air Force Research Laboratory's Aerospace Components and Subsystems Division at Wright Patterson Air Force Base, Dr. Casto led the discovery, development, and integration of affordable sensor and countermeasure technologies for Air and Space Force warfighters. In addition to his DoD experience, Dr. Casto has proven expertise in driving commercial product innovation. From 2021 to 2023 he successfully led high volume intelligent secure access control operations as CTO and Senior Vice President of Manufacturing and Engineering R&D at The Genie Company. Dr. Casto has authored more than 50 publications, patents, and invited talks on advanced, secure, and reliable semiconductor and electronics technology and is a 2020 inductee and member of the IEEE Hardware Oriented Security and Trust (HOST) Hall of Fame.

Dr. Frank Wolff

Panelist Bio: Francis G. Wolff received a Ph.D. from Case Western Reserve University, Cleveland, OH, USA. He is an IEEE Senior member and an ACM Senior member. He is Adjunct Associate Professor in the EECS department at Case Western Reserve University, and also working at KBR as a senior digital design engineer. His research interests are in IC chip custom ASIC and FPGA design, hardware chip trust and assurance, explainable AI and semiconductor reliability.

Wednesday July 17, 2024

AFTERNOON TECHNICAL SESSIONS (2:30 PM – 5:00 PM)

Electronics for Extreme Environments/WBG Semiconductors III
(BALLROOM)

TRACK CHAIRS:	**Dr. Ahmad Islam** (AFRL/RYDD) **Dr. William Kennedy** (AFRL/RXEE)

Electronics for Extreme Environments/WBG Semiconductors III **(BALLROOM)**

2:30 PM – 3:00 PM
Invited Speaker
(EEE-04)

Radiation Effects Prediction through Experimentally Validated Simulation of Gallium Nitride

Presenter: **Dr. Rongming Chu**, Pennsylvania State University

Abstract: Predicting radiation effects of GaN electronics requires a fundamental understanding of defect formation and properties, in the context of device operation in radiation environments. Penn State is leading a MURI team to gain this understanding, through a multi-physics and multi-scale simulation framework, validated by experiments. This talk will update our learnings on defect formation, device spectroscopy, and heavy-ion single-event effects.

Speaker Bio: Rongming Chu earned his Ph.D. in 2008 from UC-Santa Barbara. From 2008 to 2010, he spent two years at Transphorm, Inc., contributing to the first GaN power switch prototype. From 2010 to 2018, Rongming Chu was with HRL Laboratories LLC, leading GaN power electronics R&D. He is presently a Professor of Electrical Engineering at The Pennsylvania State University.

3:05 PM – 3:35 PM
Invited Speaker
(EEE-05)

Neutron Radiation Single Event Effect Characterization of Wide Bandgap Power Electronics

Presenter: **Dr. Moinuddin Ahmed**, Argonne National Laboratory

Abstract: This work is focused on the in-situ single event effect (Failure-in-time) characterization of wideband gap (WBG) SiC and GaN power transistors due to terrestrial neutron radiation. Wide bandgap SiC and GaN power transistors are attractive candidates for aerospace and satellite communication which offer smaller footprint, lower weight, higher-temperature operation, lower power losses, and higher operating frequency.

Speaker Bio: Moinuddin Ahmed is leading Power Electronics Research at Argonne National Laboratory. He finished his Ph.D. from the University of Texas in 2014 and B.S. from Bangladesh University of Engineering & Technology. Before joining Argonne in 2017, he worked at the University of Texas as a Postdoctoral Fellow.

3:40 PM – 4:10 PM

Invited Speaker

(EEE-06)

Impact of Radiation on Wide and Ultrawide Bandgap Materials and Devices

Presenter: **Dr. Joe McGlone**, The Ohio State University

Abstract: Wide and ultrawide bandgap materials are promising for harsh radiation environments from their wide bandgap and the high required energy to displace atoms within the crystal. This talk will overview radiation damage at the material level and how those radiation induced defects impact device level performance.

Speaker Bio: Joe McGlone received his BS from Rochester Institute of Technology in Microelectronic Engineering and then went on to get his MS and PhD in Electrical and Computer Engineering at Ohio State University. Since January 2022, he has been working at Ohio State University in the Institute for Materials and Manufacturing Research as a Research Scientist in the Wide and Ultrawide Bandgap semiconductor device area.

4:15 PM – 4:35 PM

Paper 8069

III-Nitrides for Sensing at High Temperatures

Authors: Goutam Koley, Makhluk Hossain Prio, Ferhat Bayram, Durga Gajula

Abstract: There is a significant need for high temperature pressure sensors for applications in aerospace, automotive, chemical processing, nuclear power and petroleum industries. While Si based piezoresistive pressure sensors are one of the most prevalent pressure sensors, due to degradation in their electrical properties related to the generation of thermal carriers and high leakage currents, they are not suitable for applications above 150 ˚C. Higher band-gap materials, including III-Nitrides, are therefore, of interest to address the application gap at higher temperatures due to their excellent thermal stability and inert nature. To perform both steady state and dynamic pressure measurements, piezoresistive sensors utilizing the two-dimensional electron gas (2DEG) formed at the interface of AlGaN/GaN heterojunction, can be utilized. The 2DEG will have both its density and mobility modulated as a function of strain, resulting in exceptional deflection sensitivity, much higher than Si piezoresistors, where only the carrier mobility is affected by strain. We will discuss potential applications of III-Nitride HEMTs as deflection sensors and high temperature pressure sensors.

4:40 PM – 5:00 PM

Paper 8016

Using a Convolutional Neural Network to Map Defects on Wide Bandgap Semiconductors on a Wafer Scale

Authors: James Gallagher, Nadeemullah Mahadik, Robert Stahlbush, Karl Hobart, Michael Mastro

Abstract: Wide bandgap semiconductors theoretically have the potential to surpass current Si-based technology in high-power electronics applications due to improvements in size, weight, and power. However, the current state-of-the-art wafers present significant challenges: they contain a large number of threading dislocations, basal plane dislocations, stacking faults, polytype inclusions, and screw dislocations. These structural imperfections are detrimental as they can induce electron and hole carrier scattering, subsequently impairing device performance. Addressing this critical issue, this research introduces a new approach using a convolutional neural network (CNN). This machine learning model is specifically trained to accurately identify and quantify dislocation defects. The ability to precisely and efficiently count dislocations represents a significant step towards enhancing quality control processes in the manufacturing of wide bandgap semiconductor-based electronic devices. By mitigating the adverse effects of dislocations on device performance, our findings contribute to the advancement of novel semiconductor devices, enabling a pivotal shift from traditional Si-based systems.

Setup for Poster Session II	(BALLROOM)
5:00 PM – 5:30 PM	**Poster Presenters:** Please report to the easel corresponding to the Poster number assigned on **Pages 50-51** of this program.

NAECON 2024 Topic List

1	**AES Focused Sessions**
1.2	Autonomous Systems
1.4	Radar, Tomography & RF Sensing
1.5	Machine Learning, Guidance & Control
1.6	Millimeter-Wave & Terahertz Technology
1.7	Cyber Systems & Security
2	**CAS Focused Sessions**
2.1	Low SWaP/Form Factor, Distributed & Agile Sensors
2.2	Manufacturing, Packaging & Integration of Emerging Microelectronics
2.3	Signal/Image Processing & Sensor Data Fusion
2.4	Dep Learning & Artificial Intelligence
2.5	Quantum Computing, Communication & Sensing
2.6	Electronics for Extreme Environments/WBG Semiconductors
2.7	Enabling Hardware for Artificial Intelligence
3	**Special Sessions**
3.1	Trusted Microelectronics Systems
3.2	Systems, Man & Cybernetics
3.3	Center for Hardware & Embedded Systems Security and Trust (CHEST)
3.4	Microwave Theory & Technology (sponsored by IEEE MTT-S)
4	**DoD Submissions**

Wednesday July 14, 2024

AFTERNOON SESSIONS (2:30 PM – 5:00 PM)

Machine Learning, Guidance, and Control III
(AUDITORIUM)

TRACK CHAIRS:	**Dr. Trevor Bihl** (AFRL/RYAR) **Dr. Anca Ralescu** (University of Cincinnati)

Machine Learning, Guidance, and Control III **(AUDITORIUM)**

2:30 PM – 2:50 PM
Paper 8052

A Data-Enabled Dual Learning Based Online Receding Horizon Safe-Critical Control for Nonlinear Systems Under Uncertainty

Authors: Shawon Dey, Hao Xu

Abstract: In this paper, a real-time reliable receding horizon control (RHC) with a guaranteed safe adaptation mechanism is developed for uncertain complex nonlinear systems. Ensuring receding horizon optimality and safety, particularly in the presence of uncertain nonlinear system dynamics, poses a significant challenge in both control and learning societies. To tackle this challenge, a novel safe-critical RHC framework has been developed to enhance classical RHC with the capability of prioritizing system safety by timely recognizing and adapting environmental uncertainties. Specifically, the developed framework utilizes a novel dual-learning approach with slow learning to recognize environmental uncertainties and further refine RHC along with a situation-aware physics-informed neural network (SA-PINN), and fast learning to ensure system safety by using a safe-critical control with fast learned adaptive control barrier (FA-CBF) function. Therefore, slow learning in the developed dual-learning approach can provide optimal RHC albeit with longer computation time, while the fast learning component provides safe control effectively adapting to the uncertain environment in real-time.

2:55 PM – 3:15 PM
Paper 8045

Trends in Advanced Tabletop Digital DJ Media Players from 2000-2023

Authors: Benjamin Goulart, Trevor Bihl, Jeffrey Travers

Abstract: Statistical analysis of DJ hardware trends does not appear to have been previously explored in the academic literature. This paper evaluates the features of DSP-based tabletop digital DJ media player separates that have at least some turntable simulation and were available from 2000 to 2023 in the USA. Trends across time were analyzed, with special attention to innovation and automation versus the ability to manually DJ. In particular, it was hypothesized that automation that no longer requires manual beat matching would correspond with an unfortunate relaxation in the requirement for fine resolution of pitch faders, the primary speed control on the players. This was incorrect, and pitch resolution has not significantly worsened over time on digital DJ media players in a general way, even with the advent of automation.

3:20 PM – 3:40 PM **Paper 8099**	**A Hybrid Neural Network and Likelihood-Ratio Approach to Multichannel SAR Change Detection** *Authors*: Stephen Herman, Joshua Ash **Abstract:** Previous research has shown that the Gaussian backscatter assumption breaks down for high-resolution synthetic aperture radar imagery, and non-Gaussian models such as the generalized gamma model more effectively represent the pixel magnitudes. This has shown advantages for non-coherent change detection. Unlike Gaussian based models, for generalized gamma models, time-intensive numerical optimizations methods are required for parameter estimation. In this paper, we propose a hybrid neural network and GLRT based approach to SAR change detection that addresses this problem. We consider the unique identifiability challenges associated with generalized gamma. We train our estimation algorithm using entirely synthetic data, and demonstrate the efficacy of our approach to polarimetric SAR change detection using the AFRL CD challenge dataset.
3:45 PM – 4:05 PM **Paper 8101**	**Exploration of Multi-Agent Reinforcement Learning for ISR Flight Path Planning** *Authors*: Lynphone Mark Xie, Emily Conway, Huaining Cheng, Fathi Amsaad **Abstract:** Intelligence, Surveillance, and Reconnaissance (ISR) is currently managed by humans through an assembly-like process involving extensive raw data processing and analysis. However, due to time constraints, optimization of routes and data collection are often neglected. The scale, complexity, and intensity of future conflicts will further exacerbate these challenges for ISR. Intellection, a board game designed to simulate flight path planning for ISR training, serves as the testing environment. Players, typically Air Force intelligence personnel, are tasked with planning routes within a limited timeframe. The game features predetermined and emerging collection points, challenging players to maximize point acquisition by strategically deploying collection assets. The current method of managing ISR poses challenges due to inefficiencies in route optimization and data collection. Traditional approaches rely heavily on human decision-making, leading to suboptimal outcomes. There is a need for automated systems that can enhance planning efficiency while reducing time and resource requirements.

Wednesday July 17, 2024

AFTERNOON SESSIONS (2:30 PM – 5:00 PM)

Trusted Microelectronic Systems II

(KITTY HAWK)

TRACK CHAIRS:	**Dr. Nicholas Kovach** (AFRL/RYWA) **Dr. Frank Wolff** (KBR)

Trusted Microelectronic Systems II **(KITTY HAWK)**

2:30 PM – 2:50 PM

Paper 8059

Trust Score-Based Zero Trust Architecture for Advanced Metering Infrastructure Security

Authors: Hrishav Bhattarai, Akshay Kulkarni, Mohammed Niamat

Abstract: The Advanced Metering Infrastructure (AMI), a key component of the SG, facilitates communication between utility companies and consumers. However, this communication layer is vulnerable to various cyber-physical attacks. To combat these vulnerabilities, this paper proposes a Zero Trust Architecture (ZTA) based on trust scores for securing the AMI. The ZTA model developed in this research assigns trust scores to various attributes of the smart grid and grants access based on dynamic policies that evaluate these scores. We define a comprehensive list of trust attributes corresponding to the components of the AMI, which are crucial for evaluating the trustworthiness of the entities within the network. Our proposed model ensures that access to the network is granted only when the total trust score exceeds a predetermined threshold, and more than half of the attributes meet their threshold scores. A case study is presented to demonstrate the model's efficacy, showing its effectiveness in securing communication in an AMI system. This approach enhances the security and reliability of smart grid communications by preventing unauthorized access and maintaining data integrity.

2:55 PM – 3:15 PM

Paper 8077

A 9-Bit Linear Time to Digital Converter Using Pulse Shrinking Rings

Author: Patricia Tutuani, Emmanuel Amankrah, Randall Geiger

Abstract: A compact linear 9-bit Time to Digital Converter (TDC) has been developed, integrating a pulse shrinking ring consisting of an even number of inverting delay elements with a pulse-arbiter delay line. This approach capitalized on the linearity of the pulse shrinking ring and the resolution capabilities of the pulse-arbiter delay line, resulting in a highly linear and accurate time-to-digital converter. The simulation results of the TDC implemented in a 0.18-µm standard CMOS technology demonstrates 69-ps resolution and 9-bit range that corresponds to 36.6-ns input time interval. With an INL of 0.13LSB and ENOB of 8.8-bits.

3:20 PM – 3:40 PM **Paper 8017**	**Silicon Reverb: Non-Invasive Low-Cost Solution for Detecting Hardware Trojans** *Authors*: Jeremy Hong, Saiyu Ren **Abstract:** This work introduces low-cost, non-invasive methods for detecting hardware trojans in Field Programmable Gate Arrays (FPGAs) mounted on the increasingly popular system-on-module (SoM) packaging. Previously, such detection required high-end test equipment and evaluation boards, making our approach significantly more accessible and cost-effective.
3:45 PM – 4:05 PM **Paper 8088**	**An AI Architecture with the Capability to Classify and Explain Hardware Trojans** *Authors*: Paul Whitten, Francis Wolff, Chris Papachristou **Abstract:** Hardware trojan detection methods based on machine learning (ML) techniques mainly to identify suspected circuits but lack the ability to explain how the decision was arrived at. An explainable methodology and architecture is introduced based on the existing hardware trojan detection features. Results are provided for explaining digital hardware trojans within a netlist using trust hub trojan benchmarks.
4:10 PM – 4:30 PM **Paper 8019**	**Post-Fabrication Side Channel Malicious Detection for 16X16 Booth Multiplier in 65nm CMOS Technology** *Authors*: Kanchan Vissamsetty, Saiyu Ren **Abstract:** A novel post-fabrication side channel detection method is devised to uncover potential malicious covert modifications to microelectronic circuits. The detection technique does not require a golden trojan free circuit, is insensitive to process variations and environmental changes, and is able to detect very small stealthy trojan circuits. The approach involves segmenting the circuit into parts, with each segment having equal (or nearly equal) and consistent leakage currents under specific static input patterns. Covert Hardware Trojan insertion is detected based on measuring the differences of leakage current between segments with the specified static input patterns.

WIFI ACCESS CODE (Holiday Inn): FBNPD

Wednesday July 17, 2024

EVENING TECHNICAL SESSION (5:30 PM – 6:45 PM)

NAECON RECEPTION & POSTER SESSION II

(BALLROOM/FOYER)

TRACK CHAIRS:	**Dr. Akshay Kulkarni** (University of Florida) **Dr. Fathi Amsaad** (Wright State University)

Poster Session II: 5:30 PM – 6:45 PM

Poster Number	Paper Number	Track	Title	Author(s)
Poster 1	8074	1.5	Trend Analysis through Large Language Models	Luke Alzapiedi, Trevor Bihl
Poster 2	8054	1.5	The Aggregated Model for Human Target Classification	Wenjiao Liu, Anca Ralescu
Poster 3	8084	2.2	Design of Ultra-Low Power FinFET Charge Pumps for Energy Harvesting Systems	Mohan Krishna Atluri, Maher Rizkalla, John Lee, Mukesh Kumar
Poster 4	8079	2.3	Dynamic Digital Twins for Situation Awareness	Erik Blasch, Paul Schrader, Simon Khan, Alex Aved, Genshe Chen, Sixiao Wei, Yu Chen, Erika Ardiles-Cruz, Arslan Munir
Poster 5	8095	2.3	Lightweight Diffusion Model for Synthesizing Malicious Network Traffic	Fuhao Li, Hongyu Wu, Jielun Zhang
Poster 6	8070	2.4	A Novel Dynamic Confidence Threshold Estimation AI Algorithm for Enhanced Object Detection	Mounika Thatikonda, Mithun Kumar PK, Fathi Amsaad
Poster 7	8071	2.4	Multi-Semantic-State Neural Networks	Christopher Menart, Michael Raymer
Poster 8	8080	2.4	Exploring AI Integration in Software Development: Case Studies and Insights	Ifiok Udoidiok, Hassan Reza, Jielun Zhang
Poster 9	8081	2.4	Extraction of Patient Subpopulations Using Transformer-Encoded Vectors	Benjamin Holmes, Michael Raymer, Tanvi Banerjee
Poster 10	8087	2.4	Prediction Interpretations of Ensemble Models in Chronic Kidney Disease Using Explainable AI	K M Tawsik Jawad, Anusha Verma, Fathi Amsaad

(continued on next page)

Poster Number	Paper Number	Track	Title	Author(s)
Poster 11	8089	2.4	Real-Time Automated Donning and Doffing Detection of PPE Based on Yolov4-Tiny	Anusha Verma, Ghazal Ghajari, K M Tawsik Jawad, Hugh Salehi, Fathi Amsaad
Poster 12	8093	2.4	SID: Stereo Image Dataset for Autonomous Driving in Adverse Conditions	Zaid El-Shair, Abdalmalek Abu-raddaha, Aaron Cofield, Hisham Alawneh, Mohamed Aladem, Yazan Hamzeh, Samir Rawashdeh
Poster 13	8096	2.4	Malicious Code Detection Using LLM	Al Amin Hossain, Mithun Kumar PK, Junjie Zhang, Fathi Amsaad
Poster 14	8075	2.4	ARIMA-DCGAN Synergy: A Novel Adversarial Approach to Outlier Detection in Time Series Data	Mithun Kumar PK, Mani Rupak Gurram, Al Amin Hossain, Fathi Amsaad
Poster 15	8040	3.2	ProprioLogger: Evaluating Proprioception During Post-Surgical Rehabilitation Using Portable IMUs	Samuel Bellaire, Abdalmalek Abu-Raddaha, Kevin Zaka, Angela Tate, Josephine Haller, Samir Rawashdeh
Poster 16	8097	3.2	Performance Degradation/Failure Detection on an Independent Cart System Using ANN	Rahul Sharma, Francis Wolff, Chis Papachristou

Immediately following the Poster Session, please join us for the

NAECON BANQUET (7:00 PM – 9:00 PM)

Ballroom

KEYNOTE PRESENTATION

Wednesday July 17, 2024

7:30 PM – 8:15 PM

Banquet Keynote
(Keynote 5)

Bond, James Bond and 007's Predictions of the Future of Microelectronics

Presenter: Ms. Jackie Janning-Lask, CEO, Midwest Microelectronics Consortium

Abstract: A look at the United States' future of microelectronics through James Bond Movie Titles that hold the key to some of the challenging issues of our future as well as recommended solutions. From "License to (S)Kill" addressing our workforce development and STEM issues to "For Your I's Only" introducing the criticality of "Integration (Supply Chain)," "Innovation" and "Interoperability (rapid scaling)."

Speaker Bio: Jackie Janning-Lask is CEO of the Midwest Microelectronics Consortium (MMEC). As an intrepid business strategist, thought leader and innovative engineer, Jackie's passion, enthusiasm, and drive comes from her 35 years serving the warfighter. Her dedication to STEM education is second to none and supports numerous foundations, societies, and communities to advance STEM education, especially for young women. Her vision for the future of MMEC is to create, develop and sustain a future microelectronics eco-system enabling unmatched superiority in prototyping, lab to fab, and microelectronics workforce development. She holds a B.S. and M.S. degree in Systems Engineering from Wright State University in Dayton, Ohio. She was selected to attend the Massachusetts Institute of Technology as a Sloan Fellow, graduating with an MBA in 2004.

Ballroom

KEYNOTE PRESENTATION

Thursday July 18, 2024

8:30 AM – 9:15 AM **The Application of 5G/6G Technologies for DoD Needs**

MTT-S Keynote
(Keynote 6)

Presenter: Mr. Steve Naboicheck, Senior Fellow, Lockheed Martin Corp (MTT-S Special Session)

Abstract: There is a need for networked unmanned platforms to support for both commercial and military functions. The technology required to achieve a low cost and low SWaP communications solution exists today. However, highly programmable solutions for military applications requires enhanced capabilities and technologies which is the focus of this topic.

Speaker Bio: Steve Naboicheck is an Lockheed Martin Senior Fellow and is a member of the corporate 5G.MIL IRAD Program which adapts commercial 5G technology for DoD applications. Naboicheck's background is in the RF/microwave, high speed digital, mixed signal and analog design fields for both commercial and military communications and sensing applications.

Ballroom

KEYNOTE PRESENTATION

Thursday July 18, 2024

9:30 AM – 10:15 AM

Military Keynote
(Keynote 7)

Presenter: MGen Bartman, Parallax Advanced Research

Abstract: The Ohio Federal Research Network (OFRN) has the mission to stimulate Ohio's innovation economy by building vibrant, statewide university/industry research collaborations that meet the requirements of Ohio's federal partners, resulting in the creation of leading-edge technologies that drive job growth for our state. Additionally, the Defense Innovation Unit OnRamp Hub: Ohio program which opened in 2023 aims to expedite the development of technology solutions for national security challenges and support Ohio-based small businesses in the tech sector.

Speaker Bio: General Bartman is the founder of 9G Consulting LLC and currently serves as the VP for Advanced Development for Parallax Advanced Research Corp. General Bartman also serves as the Program Executive (PE) for the Ohio Federal Research Network (OFRN) and the Defense Innovation Unit (DIU) OnRamp Hub: Ohio.

General Bartman's most recent military assignment was as The Adjutant General, Ohio National Guard, Joint Force Headquarters, Columbus, Ohio, from 2015 to 2019. He was a member of the Governor's cabinet and was responsible for the command of the Ohio National Guard and the military readiness of the Ohio Militia.

General Bartman graduated from The Ohio State University in 1982 and entered military service in September 1982 through the Air Force Reserve Officer Training Corps program as a distinguished graduate from Detachment 645. He is a command pilot with more than 3,200 flying hours, including 29 combat missions in Operations Provide Comfort, Northern Watch, and Southern Watch.

10:15 AM – 10:30 AM	**COFFEE BREAK**

Thursday July 18, 2024

MORNING TECHNICAL SESSIONS (10:30 AM – 11:30 AM)

Microwave Theory & Technology I & II

Sponsored by IEEE MTT-S

(BALLROOM)

TRACK CHAIRS:	**Dr. Guru Subramanyam** (University of Dayton) **Dr. Kaushik Annam** (Akoustis, Inc.)

Microwave Theory & Technology I – Keysight 5G/6G Workshop **(BALLROOM)**

10:30 AM – 11:00 AM

Invited Speaker

(Keysight-1)

Introduction to 6G Wireless Technologies and Use Cases

Presenter: **Mr. Akhilesh Daniel**, Keysight Technologies

Abstract: The next generation of cellular technology will enable ingenious ways for people to interact with their surroundings, including instantaneous communication, connected autonomous systems, and wireless artificial intelligent interactions. This session will discuss the significant challenges, and advancements underway to realize the vision for 6G.

Speaker Bio: Akhilesh Daniel leads development of Keysight's 6G and Emerging Technologies business with Universities and Research Institutions worldwide. In his 18 years at Keysight Akhilesh has contributed and led R&D, Product and Business teams in mobile communications from physical layer RF to applications software, including a Keysight invention in intelligent automation.

11:05 AM – 11:35 AM

Invited Speaker

(Keysight-2)

6G Research to Address the Key Performance Indicators (KPI) and Anticipated Use Cases with a Focus on EDA

Presenter: **Dr. Murthy Upmaka**, Keysight Technologies

Abstract: 6G is an ambitious huge jump from 5G wireless communications technology expected to roll out in 2030. The presentation tries to paint a picture of the use cases and to highlight the challenges and complexity to address them and points to research topics that arise. Few examples of use cases will be discussed in this talk.

Speaker Bio: Dr. Upmaka holds a Ph.D from IIT, Chennai, India. He conducted post-doctoral research on THz spectroscopy and has worked at HP-Agilent-Keysight for the past 28 years. He has been an IEEE-Senior member for the past 25 years. Dr. Upmaka holds three patents and has over 30 publications and one recorded invention. He is currently a Solution Engineer Fellow at Keysight Technologies with a focus on end-end system modeling and simulation.

Microwave Theory & Technology II	(BALLROOM)
11:40 AM – 12:00 PM **Paper 8072**	**Novel Defected Ground Structure with Vanadium Dioxide for Tunable BAND-Reject Filters** *Authors*: Xiaodong Deng, Jincheng Zhao, Eunsung Shin, Guru Subramanyam **Abstract:** This study proposed a novel sprout-shaped defected ground structure (DGS) and provided a feasible method for DGS devices to achieve tunability using a phase change material. The proposed structure has a 1.45 mm by 1.6 mm DGS size and has 13.5 dB rejection at 4 GHz for a single unit. The rejection can be enhanced to 50.2 dB by cascading two units. The fabricated device exhibits a maximum tunable range from 4.1 GHz to 6 GHz and verifies the potential of 58% tunability.
12:05 PM – 12:25 PM **Paper 8083**	**Modified Varactor Device Using Barium Strontium Titanate (Ba0.6Sr0.4TiO3) Thin Films for Low Loss Millimeter Wave Frequency Applications** *Authors*: Kaushik Annam, Malia Harvey, Ensung Shin, Guru Subramanyam **Abstract:** Modified varactor device using Barium Strontium Titanate (Ba0.6Sr0.4TiO3) thin films for low loss millimeter wave frequency applications has been demonstrated in this paper. MIM (Metal Insulator Metal) varactor devices with splits in the signal line presented in this work has >4:1 tunability. The overall capacitance of the device changes from 0.2pF to 0.046pF with 0V-10V dc bias voltage applied. The device has very low insertion loss of 0.9dB with 10V dc bias voltage applied at 50GHz.
12:30 PM – 12:45 PM	**Closing Remarks from the NAECON Conference Chairs**
12:45 PM – 1:45 PM	**LUNCH BUFFET OPEN**

Thank you for attending NAECON 2024!

See you next year for NAECON 2025 on July 28-31, 2025!

Many Thanks to Our Generous Sponsors and Patrons!

TECHNICAL COLLABORATORS

In Appreciation of All Planning Committee Members for the NAECON 2024 Conference

General Conference Chairs

Guru Subramanyam, University of Dayton
Charles Cerny, AFRL/RYMP
Robert Ewing, AFRL/RYMS

Conference Vice-Chair & Treasurer

Amy Neidhard-Doll, University of Dayton

Technical Sessions

Chair: Timothy Wolfe, AFIR/ENG
Elliot Brown, Wright State University
Charles Cerny, AFRL/RYMP
Robert Ewing, AFRL.RYMS
Ahmad Islam, AFRL/RYDD
Randall Geiger, Iowa State University
Joanne Maurice, AFOSR/ION
Amy Neidhard-Doll, University of Dayton
Guru Subramanyam, University of Dayton
Andy Terzuoli, AFRL (Retired)

Industry Sponsorship

William McQuay, AFRL Fellow, KBR

In Appreciation of All Planning Committee Members for the NAECON 2024 Conference

(continued)

Registration

Chair: Barath Narayanan, University of Dayton Research Institute
Tem Kebede, AFRL/RYWA
Daniel Koranek, AFRL/RYWA

Student Poster Session

Chair: Akshay Kulkarni, University of Florida
Fathi Amsaad, Wright State University

Publications & Printing

Roshan Kini, Pacific Northwest National Laboratory

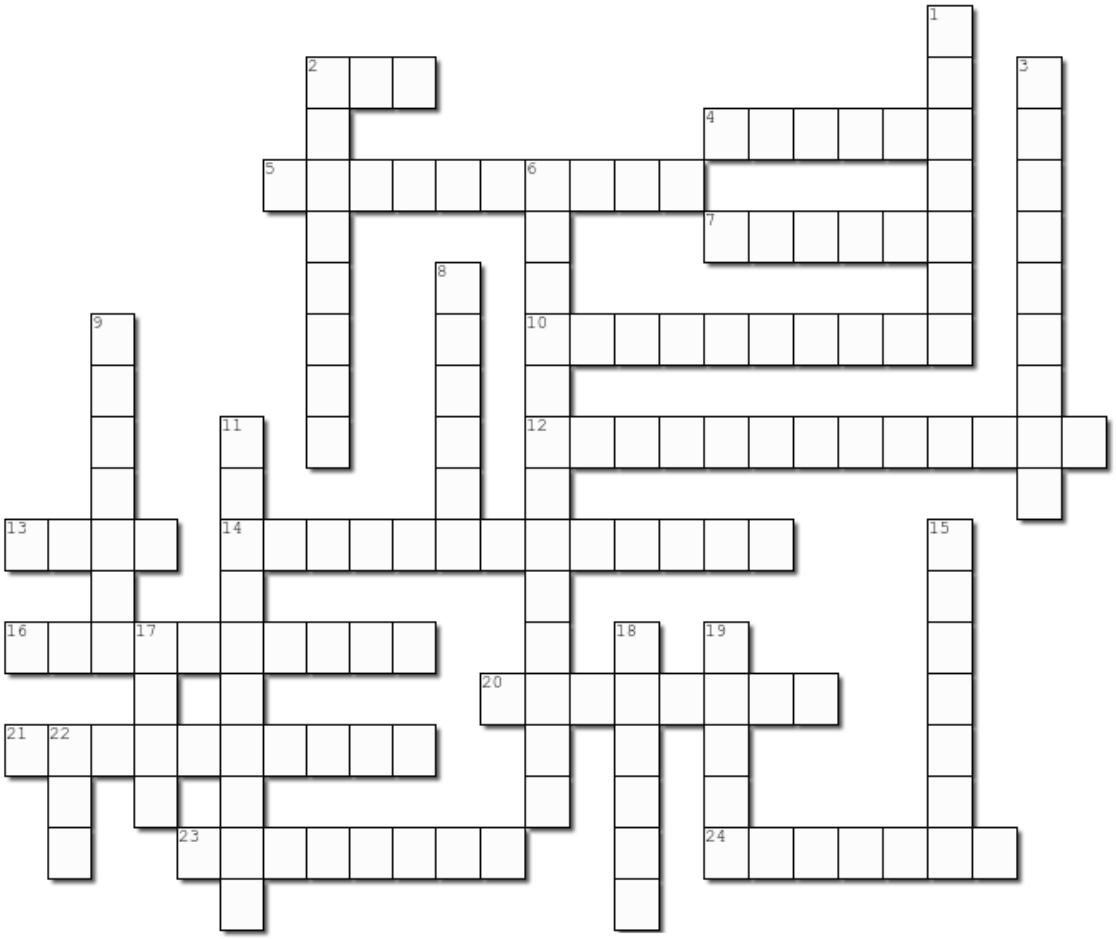
Local Arrangements

Amy Doll, University of Dayton
Charles Cerny, AFRL/RYMP

Website Development

Amy Doll, University of Dayton
Ethan Lin, NASIC/FTFE
Venkat Kumar, University of Dayton

A Snapshot of NAECON 2024



Created using the Crossword Maker on TheTeachersCorner.net

Across

2. Abbreviation for Wide Band Gap semiconductor
4. Abbreviation for National Aerospace and Electronics Conference
5. _____ Intelligence (fill in the blank)
7. An electronic device that produces an output signal corresponding to the measurement of a physical phenomenon
10. Type of engineer associated with 'EE'
12. Material with both conductor and insulator properties
13. Institute of Electrical and Electronics Engineers
14. The transmission of information
16. Type of emerging AI technology functioning without human intervention
20. Hard, brittle crystalline, semiconductor solid with a blue-grey metallic luster and atomic number 14
21. NAECON 2024 conference hotel
23. Machine _____ (fill in the blank)
24. Synonym for harsh type of operating environment

Down

1. Type of system that manages, commands, directs, or regulates the behavior of other devices using control loops
2. Type of communication system that does not use hard wiring
3. Electrical component used to store energy in an electric field
6. The practice of protecting digital systems from cyber attacks
8. City known as the Birthplace of Aviation
9. The flow of charged particles moving through a conductor
11. Form of electromagnetic radiation in the frequency range of 300 MHz to 300 GHz
15. Type of computing methodology based on quantum mechanics
17. The Buckeye state
18. Any time-varying voltage, current, or electromagnetic wave that carries information
19. Intel co-founder credited with the prediction that transistors in an integrated circuit would double every two years
22. SI unit for resistance

HISTORY OF NAECON

Celebrating 76 Years!

Founding members of NAECON

The National Aerospace and Electronics Conference (NAECON), which had its beginnings in the Fall of 1947, is the oldest and premier IEEE Conference representing research in all aspects of aerospace systems and sensors. Since 2008, NAECON has explored new research and contributions for core intelligent aerospace sensor integration in the following areas:

- Innovative Aerospace Technology
- Intelligent Sensory Exploitation
- Wireless & Information Interoperability

The NAECON conference is sponsored by the IEEE Dayton Section (founded in 1943) and the University of Dayton.

For more information, visit us at: https://r2.ieee.org/dayton/

NOTES

NOTES

Artificial Intelligence

U N H Q Z S P Y H X K F X W D G W G W H L T T B D U B X Q E
L N Z S P T Y J M D I C P B Y K D P H Z J O E Z M J Y M W V
G A S Y K I B T E G S O F G E C B B M W Q C C M T M Z F W W
W E H M E E T N U R Y Y F E S A W F H C E G N J I U S M Q I
E C Z Y Y S I C O Y D R O T C U D N O C I M E S U I M C X A
Q O A T T H L S M H E G F X O R Y V Z A N N E T N A Y X R C
E N Y K C O N R C P F U B B B R G L O Y Z C Y R G O X T O U
S H T A A E O T K R E B Y C K L N Y C H L S T L I R I R S J
M H M K S D M Y E G W O C U I F I W N R L N H L E F F P G G
K M O S F E T N F E W M B O N Y N Z O T P E J Z I D G P U I
F R U O P X J P E S W T Y R T V R B K D Y U Z C E A H E I V
D H V T M U T N Y G Q I R A W C A T Y G A R I K E B R Z D C
O F O Z N E Q W O U D J L D J M E X S L B A B V E W J S A R
W T I C R A Y G L T H R G A N M L G I U L L G W X Q F Y N R
L T R V Q O U Y Q U Y W I R V I J E B - D - K U E O Y S C K
Y O W H E R S Q F Y L A W L D C N N I Z Z N J L H C T T E H
K V R Q R O V W Z W G S D Y M R Q N H E H E I V A O A E I R
J B H T L M O R E H I H G Y H O T Z D N Z T M C I M Y M Y K
D A S Q N Y P P C L J O R L R E Y G E G J W M F E M V S G C
A H R S Q O O O L C L D A B L L S L T I H O D I S U I C L W
A S T A U H C Z A O V R D L L E A Y S N K R J F I N A M S I
M I Y G A K J M N W K C I Z S C B B U E G K U K S I E J Z U
Z B T H K G L H G R E G A U A T H Z R E O F X W I C T O A U
T S O Y J V C P I Y E A T M S R Q M T R M J H Y Z A U B V K
T L A C E E S Z S N V D I P G O Z I M I T Z L J T T C Y E E
Y D X K T S J I C N T L O M D N T Z W N U Q K O S I X P R L
U P N B T N N E X I V V N Q E I F T B G O T E I E O M G D G
S J W Y E I W Y G K A Y C O W C P L A H X X D Q H N U K X P
E L F H C S F O Y W C R S B F S P B P C Z Y O K C S E F M L
R T G Z S I W Z I O O N F E Z C L W E F Q W S C I W S R X Z

IEEE
TECHNOLOGY
RADIATION
CYBER
MTTS
DAYTON
CONTROL
ALIEN
LEARNING
INDUSTRY
NAECON
ROSWELL
ARTIFICIAL-INTELLIGENCE
ANTENNA
WBG
TRUSTED
MICROELECTRONICS
GUIDANCE
SYSTEM
RADAR
ENGINEERING
QUANTUM
SEMICONDUCTOR
CHEST
SIGNAL
SENSORS
COMMUNICATIONS
MACHINE
NEURAL-NETWORK
MOSFET

UPCOMING OPPORTUNITIES

Friday July 19, 2024 – DoD Only Session		
Location: Kenny Hall, Building 642, First Floor, Air Force Institute of Technology		
Topic: Thesis Research Topics for PhD & MS for Quantum, Virtual Simulations of AI/ML Algorithms and Distributed 3D RF Imaging		
10:00 AM – 10:45 AM	**CUI: Quantum – Future AF Goals for SWaP**	**Dr. Charles Cerny**
10:45 AM – 12:30 PM	**CUI: Virtual Simulation for AI/ML Algorithm Development**	**Dr. Vince Velten**
12:30 PM – 2:00 PM	**CUI: Autonomy/Machine Learning for Distributed 3D RF Imaging**	**Dr. Robert Ewing**

Advantages of IEEE Membership

- **MEMBERSHIP:** There are over 460,000 IEEE members in over 190 countries, more than 66 percent of whom are from outside the United States. IEEE members are engineers, scientists, and allied professionals whose technical interests are rooted in electrical and computer sciences, engineering, and related disciplines.

- **COMMUNITIES:** As the world's largest technical professional organization, IEEE offers a number of ways to get involved with technical and local communities. These communities are active participants in research and authorship, conferences, and important conversations about today's most relevant technical topics locally and globally. With 39 technical Societies, ten geographic Regions that host over 10,000 local meetings annually, several affinity and special interest groups, humanitarian opportunities, and virtual communities and private groups through IEEE Collabratec®, IEEE offers ample opportunity to network and grow professionally through communities.

- **CONFERENCES:** IEEE sponsors more than 2,000 conferences and events in 190 countries while contributing over 4 million total conference papers to IEEE Xplore since 1936, with more than 200,000 new papers added annually

- **PUBLICATIONS:** IEEE publishes approximately a third of the world's technical literature in electrical engineering, computing, and electronics. This includes more than 200 transactions, journals, and magazines published annually. In cooperation with John Wiley and Sons, Inc., IEEE also produces technical books, monographs, guides, and textbooks. IEEE journals are consistently among the most highly cited in electrical and electronics engineering, telecommunications, and other technical fields. The IEEE Xplore Digital Library contains more than 6 million documents from IEEE and IEEE journals, transactions, magazines, letters, conference proceedings, and active IEEE standards.

- **STANDARDS:** IEEE is a leading developer of international standards that underpin many of today's telecommunications, information technology, and power-generation products and services. Often the central source for standardization in a broad range of emerging technologies, the IEEE Standards Association has an active portfolio of nearly 1,144 standards and more than 1,018 projects under development. This includes the prominent IEEE 802® standards for local, metropolitan, and other area networks, including Ethernet and Wireless LAN (commonly referred to as Wi-Fi®).

For more information, visit: https://www.ieee.org