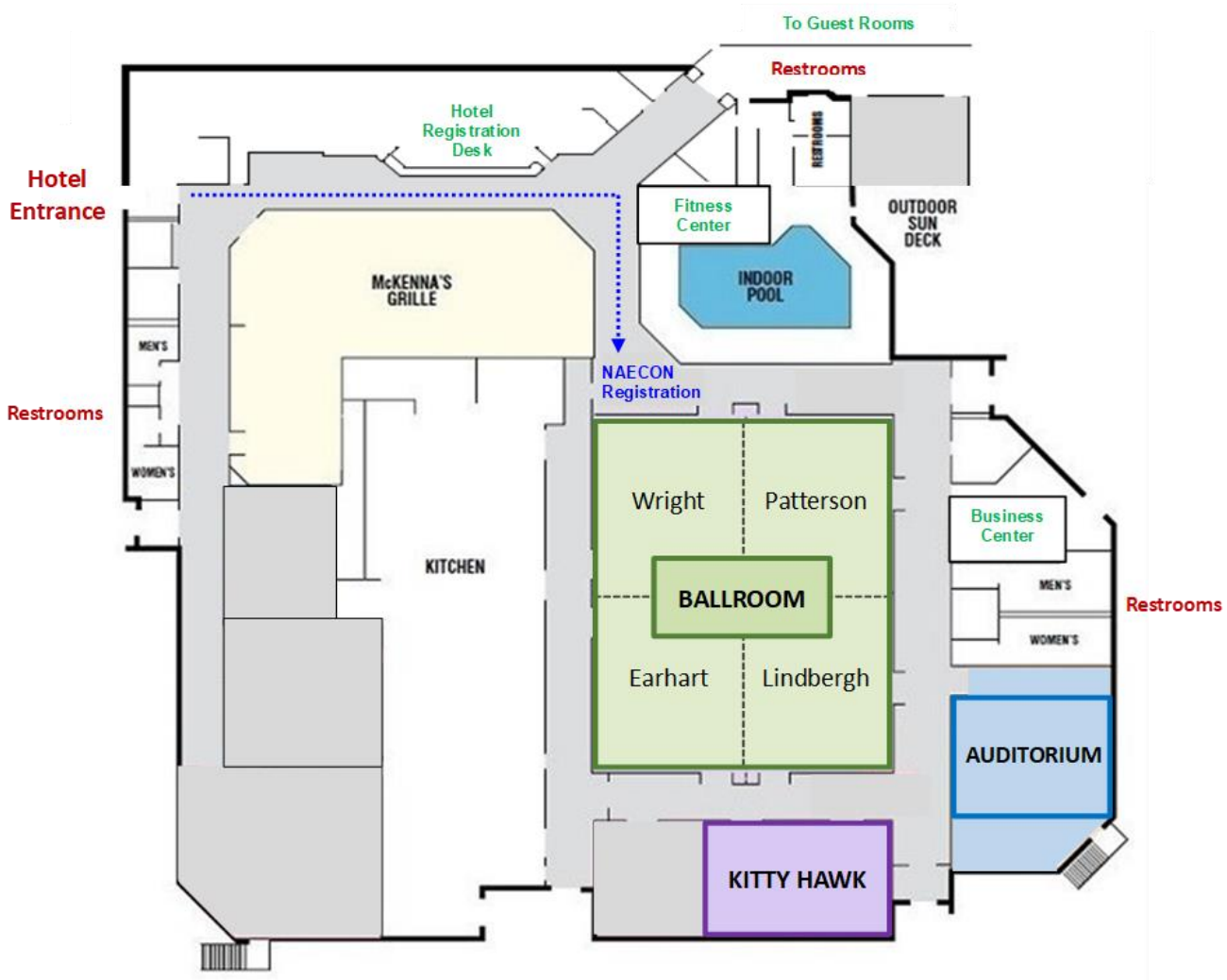
Special 75th Anniversary Program

IEEE NATIONAL AEROSPACE AND ELECTRONICS CONFERENCE (NAECON 2023)

PROGRAM CONTENTS

Holiday Inn Dayton/Fairborn I-675 Venue Floorplan



WIFI ACCESS CODE (Holiday Inn): FBNPD

CHAIR'S MESSAGE

from Dr. Charles Cerny

Welcome to the 75th Anniversary of the IEEE National Aerospace and Electronics Conference

NAECON 2023

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 75 years later, the spirit of that first NAECON is captured by this year's theme of "**6G, 3D and the Inflection Point for Aerospace Electronics**". The 2023 NAECON agenda includes 15 technical tracks aligned towards Aerospace Electronic Systems (AES), Circuits and Systems (CAS), along with tutorials on Neuromorphic Computing and Microwave Photonics, Special Sessions for Trusted Microelectronics and Microwave Theory and Technology. In addition, a panel session will discuss the CHIPS Act, and our Banquet Keynote speaker will discuss the future of computational architectures as he is honored with the NAECON 2023 Joseph Desch Award.

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Agenda DAY 1

Monday August 28, 2023

Time	Event	Location
12:00 PM – 5:00 PM	Registration	Ballroom Foyer
1:00 PM – 4:45 PM	**CONCURRENT TUTORIAL SESSIONS**	
1:00 PM – 4:45 PM	**TUTORIAL A:** **Memristors and Neuromorphic Computing**	**Ballroom**
2:45 PM – 3:00 PM	**COFFEE BREAK**	
1:00 PM – 4:30 PM	**TUTORIAL B:** **Analog Photonics**	**Auditorium**

WIFI ACCESS CODE (Holiday Inn): FBNPD

Ballroom

Tutorial A

Memristors and Neuromorphic Computing

Organized by: **Dr. Sabyasachi Ganguli (AFRL) and Dr. Guru Subramanyam (University of Dayton)**

Presenters:

1:00 PM – 1:45 PM

Memristors with Thousands of Conductance Levels for Analog Computing

Presenter: Dr. Joshua Yang, University of Southern California
(Invited Speaker)

Abstract: Field-programmable analog arrays (FPAAs) as the analog counterpart of FPGAs open opportunities for fast prototyping analog designs and computing. We have recently demonstrated 2048 conductance levels with memristors in fully integrated chips with 256 × 256 memristor arrays monolithically integrated on CMOS circuits in a standard foundry.

Speaker Bio: J. Joshua Yang is a professor of the Department of Electrical and Computer Engineering at the University of Southern California. His current research interests include post-CMOS hardware for neuromorphic computing, machine learning, and artificial intelligence. He is a fellow of IEEE and National academy of Inventors (NAI).

2:00 PM – 2:45 PM

Implementing Resistive Non-Volatile Memory for Neuromorphic Computing

Presenter: Dr. Nate Cady, SUNY Polytechnic Institute
(Invited Speaker)

Abstract: Non-volatile memory devices such as resistive random access memory (RRAM) are being explored as synaptic devices for neuromorphic and in-memory computing applications. Integrating these devices with CMOS and optimizing reliability is challenging. My research group utilizes small-scale materials and device development efforts to translate into fully-integrated hybrid CMOS-NVM hardware. In this presentation I will describe materials integration strategies and benchmarking of tantalum oxide and hafnium oxide RRAM and the application of the resulting hardware for in-memory and neuromorphic computing.

Speaker Bio: Professor Cady is an Empire Innovation Professor of Nanobioscience and Interim Vice President of Research in the College of Nanoscale Science & Engineering at SUNY Polytechnic Institute and has active research interests in the development of novel biosensor technologies and biology-inspired nanoelectronics, including novel hardware for neuromorphic computing**.**

Ballroom

Tutorial A

Memristors and Neuromorphic Computing

Organized by: **Dr. Sabyasachi Ganguli (AFRL) and Dr. Guru Subramanyam (University of Dayton)**

2:45 PM – 3:00 PM	**COFFEE BREAK**

Presenters:

3:00 PM – 3:45 PM

Ionic Transport in Ceramics in Neuromorphic Devices

Presenter: Dr. Yiyang Li, University of Michigan
(Invited Speaker)

Abstract: Ionic transport enables many materials to reconfigure their physical state, which can be harnessed to create devices for neuromorphic computing. This tutorial reviews the principles of ionic transport in transition metal oxides, with a focus on the role of nonideal materials thermodynamic on ionic transport in memory devices.

Speaker Bio: Yiyang Li is an assistant professor of materials science and engineering at the University of Michigan. He received his PhD from Stanford University and was previously a Harry Truman Fellow at Sandia National Laboratories. His research focuses on ionic transport for microelectronic devices and energy storage. Dr. Yi received the Intel Rising Star Faculty Award in 2022.

4:00 PM – 4:45 PM

A Memristor-Based Hybrid Analog-Digital Computing Platform for Mobile Robotics

Presenter: Dr. Wei Wu, University of Southern California
(Invited Speaker)

Abstract: A hybrid analog-digital computing platform enabled by memristors can work as the “cerebellum” (sensor fusion + motion control) of mobile robotic systems. The core of this system is implemented in memristor-based analog circuits, and the rest is implemented in digital circuits. Great performance enhancement has been archived.

Speaker Bio: Wei Wu graduated from Peking University with a BS in Physics in 1996 and received a Ph.D. in Electrical Engineering from Princeton University in 2003. He is an Associate Professor at the Ming Hsieh Department of Electrical and Computer Engineering, University of Southern California.

Auditorium

Tutorial B

Analog Photonics

Organized by: **Dr. Charles Cerny (AFRL)**

Presenter:

1:00 PM – 4:30 PM

Analog Photonic Systems: Features & Techniques to Optimize Performance

Presenter: Dr. Edward Ackermann, Photonics Systems, Inc.
(Invited Speaker)

Abstract: The aerospace community wishes to use ever-wider portions of the electromagnetic spectrum. This can create an analog-to-digital conversion "bottleneck". Analog photonic channelization, linearization, and frequency conversion systems can alleviate this bottleneck. This presentation highlights the advantages of these analog photonic systems, and reviews multiple techniques for optimizing their performance.

Speaker Bio: Edward Ackerman received his Ph.D. in electrical engineering from Drexel University. Since 1999 he has been Vice President of Research and Development for Photonic Systems, Inc. He has authored 140 publications about analog photonic system performance optimization. In 2007 he was elected an IEEE Fellow for contributions to the field.

2:45 PM – 3:00 PM	**COFFEE BREAK**

Ballroom

KEYNOTE PRESENTATIONS

Tuesday August 29, 2023

8:15 AM – 9:00 AM

Opening Keynote

All Optical Analog-to-Digital Convertor (ADC) for Millimeter Wave Direct Digital Receivers

Presenter: Dr. Afshin Daryoush, Drexel University
(Invited Speaker)

Abstract: Sampling and quantization of millimeter wave signals are key to future remote sensing applications. This talk presents an all-optical ADC system that employs integrated opto-electronic oscillator as clock, spatial light modulator as sampler, an array of photodiodes as optical quantizer for implementation of 40 GS/s ADC with 10 bits.

Speaker Bio: Afshin Daryoush is Professor of Electrical and Computer Engineering at Drexel University. He is a Life Fellow of IEEE, Senior Member of NAI, Chair of the Microwave Photonics Sub-Committee of MTT-S, and an Associate Editor of *Journal of Microwaves*. He has over 25 patents, 300 publications, and has supervised 21 PhD and 34 Masters Students.

12:30 PM – 1:15 PM

Lunch Speaker

Foresight, Imagination, and AI

Presenter: Dr. David Burke, Galois, Inc.
(Invited Speaker)

Abstract: Recent AI progress, whether you're talking about deep learning or chatbots, has certainly been rapid and impressive. But instead of focusing on these successes, this talk addresses pieces of the AI puzzle that haven't received as much attention: the rich human capabilities for foresight and imagination, and how these traits could be critical for future AI advancement.

Speaker Bio: David Burke is a Principal Scientist at Galois, Inc., investigating techniques for integrating human decision-making with machine intelligence. Since joining Galois in 2004, he has been the PI on various efforts for DARPA, AFRL, and DoD, encompassing research into logics for reasoning about trust in the design of secure systems, approaches for ensuring robust decision-making in multi-agent systems, and the development of hybrid AI techniques for reasoning under conditions of extreme uncertainty.

Ballroom

KEYNOTE PRESENTATIONS

Wednesday August 30, 2023

12:30 PM – 1:15 PM

Lunch Speaker

DoD Challenges, Issues, and Capability Gaps for Wide Area Motion Imaging (WAMI) or "Today's Stone Soup"

Presenter: Dr. Steve Suddarth, Transparent Sky, LLC
(Invited Speaker)

Abstract: WAMI is today's version of Stone Soup from the folktale in the 1500's, which can serve to enhance DoD's Intelligence, Surveillance and Reconnaissance. This talk addresses the "*HOW & WHY of Stone Soup Innovation/Funding*" for: affordable sustainment and modernization; Artificial Intelligence/Machine Learning (e.g., target recognition); support of Agile Combat Employment for legacy platforms; vehicle agnostic integrated multi-domain sensing technologies & modalities; low-cost, low-SWaP sensors; ISR SOF platform communication connections/nodes; Light Reconnaissance Aircraft; crypto/cyber protection; High Speed Vertical Lift; Digital Transformation Opportunities; and finally Innovation Opportunities.

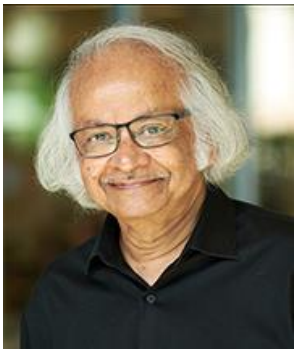
Speaker Bio: Directs Transparent Sky, a New Mexico company developing affordable 3D WAMI systems. Previously, Dr. Suddarth founded the COSMIAC Space R&D Center at the University of New Mexico. Steve also served 24 years in the Air Force, retiring as a Colonel, including duties at AFOSR, AFRL Sensors, and AFMC. He also served as the liaison to the National Labs from USSTRATCOM. During this activity, he originated both the World's first real-time WAMI system (Angel Fire), and a companion activity for young AFRL S&E's (the OpTech program) that morphed into the Commander's Challenge teams.

7:15 PM – 8:00 PM

Banquet Speaker

Computing with p-Bits: Between a Bit and a Qubit

Presenter: Dr. Supriyo Datta, Purdue University
(Invited Speaker, Desch Award Winner)



Abstract: Digital computing is based on a deterministic bit with two values, 0 and 1. On the other hand, quantum computing is based on a qubit which is a delicate superposition of 0 and 1. A p-bit is a robust classical entity fluctuating between 0 and 1, sharing characteristics of both.

Speaker Bio: Supriyo Datta joined Purdue University in 1981. The non-equilibrium Green function (NEGF) method pioneered by his group provides the basis for the quantum simulation tools used in semiconductor industry. He is also known for innovative theoretical proposals that have inspired new fields of research including spintronics and negative capacitance electronics.

Ballroom

KEYNOTE PRESENTATION

Thursday August 31, 2023

8:15 AM – 9:00 AM

Keynote

Technology Roadmaps: Communications and Intelligent Systems Technology Development in Support of NASA's Aeronautics and Space Mission Needs

Presenter: Dr. Felix Miranda, NASA Glenn Research Center
(Invited Speaker)

Abstract: This talk will discuss the time evolution of critical communications and intelligent systems technologies in support of NASA's Aerospace mission. The past, present, and future status of these technologies, as well as a path towards demonstration in relevant environment and mission infusion, will be also discussed.

Speaker Bio: Dr. Miranda is the Deputy Chief of the Communications and Intelligent Systems Division, NASA Glenn Research Center, Cleveland, Ohio. In this capacity, he provides expertise, plans, and directs research and engineering development in the fields of advanced communications and intelligent systems technologies for applications in current and future aerospace systems.

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Agenda DAY 2

Tuesday August 29, 2023

Time	Event	Location
7:00 AM – 5:00 PM	Registration	Ballroom Foyer
8:00 AM – 8:15 AM	**Opening Remarks by the NAECON Committee**	**Ballroom**
8:15 AM – 9:00 AM	**KEYNOTE 1:** **Optical Analog-to-Digital Converters (ADCs) for Millimeter Wave Direct Digital Receivers** *Presenter:* **Dr. Afshin Daryoush, Drexel University *(Invited Speaker)***	**Ballroom**
9:00 AM – 12:00 PM	**CONCURRENT MORNING SESSIONS**	
9:00 AM – 11:45 AM	Emerging Electronics & Microsystems I & II	**Coffee Break: 10:30 AM – 10:45 AM** — Ballroom
9:00 AM – 11:45 AM	Digital Signal & Image Processing I & II	**Coffee Break: 10:30 AM – 10:45 AM** — Auditorium
9:00 AM – 10:55 AM	Quantum Enabling Technologies & Complex RF Signal Processing	**Coffee Break: 10:00 AM – 10:15 AM** — Kitty Hawk
12:15 PM – 1:15 PM	**NAECON Luncheon**	**Ballroom**
12:30 PM – 1:15 PM	**KEYNOTE 2:** **Foresight, Imagination, and AI** *Presenter:* **Dr. Steve Burke, Galois**	**Ballroom**
1:30 PM – 3:00 PM	**Industry Panel on CHIPS Act and Microelectronics**	**Ballroom**
3:15 PM – 5:30 PM	**CONCURRENT AFTERNOON SESSIONS**	**Coffee Break: 3:00 PM – 3:15 PM**
3:15 PM – 4:05 PM	Emerging Electronics & Microsystems III	Ballroom
4:10 PM – 5:10 PM	Trusted Microelectronic Systems and Cyber Systems/Security I	Ballroom
3:15 PM – 5:00 PM	Integrated Photonics and Atmospheric Optics I & II	Auditorium
3:15 PM – 5:30 PM	Aerospace Power Systems & Power Electronics I & II	Kitty Hawk
5:00 PM – 7:00 PM	**NAECON Reception (Holiday Inn)** *Sponsored by*: **YP/WIE/MTT-S/APS/GRS and Industry Sponsors**	**Ballroom Foyer**

Tuesday August 29, 2023

MORNING SESSIONS (9:00 AM – 12:00 PM)

Emerging Electronics and Microsystems I and II

(Ballroom)

Chairs: **Dr. Rashmi Jha (University of Cincinnati), Dr. Ahmad Islam (AFRL/RYDD), and Dr. Vamsy Chodavarapu (University of Dayton)**

EMERGING ELECTRONICS & MICROSYSTEMS I	
9:00 AM - 9:30 AM	**Development of the Next Semiconductor Technology Ga2O3** *Presenter*: Dr. Andrew Green, USAF AFRL ***(Invited Speaker)*** **Abstract:** Gallium Oxide has undergone rapid technological maturation over the last decade, pushing it to the forefront of ultra-wide band gap semiconductor technologies. Maximizing the potential for a new semiconductor system requires a concerted effort by the community to address technical barriers which limit performance. We present the current state-of-the-art and future challenges in various topics which are being addressed at AFRL. Addressing these challenges will enhance the state-of-the-art device performance and allow us to design efficient, high-power, commercially scalable microelectronic systems using the newest semiconductor platform.
9:30 AM – 10:00 AM	**SiC Based Rugged Devices** *Presenter*: Dr. Amrita Masurkar, BAE Systems, Inc. ***(Invited Speaker)*** **Abstract:** This talk presents work on SiC transistors for use in extreme environments. The talk will cover device design and progress made on device fabrication.
10:00 AM – 10:30 AM	**Development of AlGaN and Ga2O3 Ultrawide Bandgap Semiconductor Devices** *Presenter*: Dr. Siddharth Rajan, Ohio State University ***(Invited Speaker)*** **Abstract:** Ultra-wide band gap semiconductors such as Gallium Oxide and high Al-content AlGaN provide unique challenges related to heterostructure design, transport, contacts, and extreme electric fields. This paper gives a review of recent activities on device engineering of ultra-wide bandgap semiconductor electronic devices, focusing primarily on managing high electric fields within the semiconductor.
10:30 AM – 10:45 AM	**COFFEE BREAK**

EMERGING ELECTRONICS & MICROSYSTEMS II	*(Ballroom)*
10:45 AM – 11:05 AM	**High Temperature Electronics Using ß-Ga2O3 FETs and AlGaN/GaN HEMTs** *Presenter*: Dr. Ahmad Islam, USAF AFRL *Co-Authors:* *Nicholas Miller, Antonio Crespo, Andreas Popp, Nicholas Sepelak, Matt Grupen, Gary Hughes, Kevin Leedy, Thadeus Asel, Kyle Liddy, Adam Neal, Kelson Chabak, Dennis Walker, Daniel Dryden, Shin Mou, and Andrew Green (AFRL), Adam Miesle (KBR), Wenjuan Zhu and Hanwool Lee (UIUC)* **Abstract:** In this manuscript, we summarize our recent results obtained from β-Ga2O3 field-effect transistors (FETs) and AlGaN/GaN high-electron mobility transistors (HEMTs). We present device details, electrical data collected at different temperatures, variation in device parameters such as transconductance, threshold voltage, contact resistance, gate leakage with temperature and time.
11:05 AM – 11:25 AM	**Direct Ink Write Processing of Signal Crossovers Using Aerosol Jet Printing Method** *Presenter*: Mr. Lucas Clark, Wright State University *Co-Authors:* *Fahima Ouchen (KBR), Thomas Taylor, Emily Heckman, and Carrie Bartsch (AFRL), Ahsan Mian (Wright State University)* **Abstract:** Direct ink write technology allows for the selective and precise deposition of dielectric and conductive materials to create microstructures. Aerosol jet printing can utilize this technology to manufacture a dielectric interlayer between an RF and DC signal trace to create a signal crossover. Two dielectric materials and two crossover structures were studied and compared based on ease of printing and performance.
11:25 AM – 11:45 AM	**Characterization of Printed Silver Thin Films Sintered by a Scanning Laser Technique** *Presenter*: Mr. William Metzger, Wright State University *Co-Authors:* *Mian Ahsan (WSU), Laura Davidson, Fahima Ouchen, and Roberto Aga (KBR), Twinkle Pandey, Carrie Bartsch, and Emily Heckman (AFRL)* **Abstract:** Direct write printing, which is part of additive manufacturing (AM) technology, offers unique capabilities that can complement traditional methods of electronics fabrication. Printing of electrical interconnects is one of the areas in AM that is very important in electronics fabrication. Post-print sintering is a critical step in printed electrical interconnects because it strongly influences the electrical resistivity of the interconnects. Interconnects require the lowest possible resistivity to achieve better performance. Thermal sintering is the most common technique employed in printed interconnects. However, it is limited to substrates that can handle the high temperature requirement of this technique. For plastics or other substrates with low thermal budget such as the ones used in wearable electronics, sintering becomes a challenge. In this work, we explored a scanning laser technique as an alternative to thermal sintering. Characterization of printed silver from different vendors and sintered by this technique has been performed. This characterization includes quantifying DC resistivity, temperature coefficient of resistance, surface morphology and porosity. The effect of different sintering parameters such as laser power and laser scan speed were also investigated. Results from this work demonstrate some advantages of this sintering technique such as being able to selectively wash off un-sintered silver, which is attractive for fabricating strain sensors.

Tuesday August 29, 2023

MORNING SESSIONS (9:00 AM – 12:00 PM)

Digital Signal and Image Processing I and II

(Auditorium)

Chairs: **Dr. Barath Narayanan (UDRI), Dr. Bradley Ratliff (University of Dayton), and Dr. Keigo Hirakawa (University of Dayton)**

DIGITAL SIGNAL & IMAGE PROCESSING I	
9:00 AM - 9:20 AM	**Design & Implementation of Optimized Resource Low Power SoC Multisoft Processor FPGA Hardware Architecture for Fast Digital Image Processing** *Presenter:* Mr. Leith Namou, University of Massachusetts-Lowell *Co-Authors:* *Dr. Dalila Megherbi, (UMass-Lowell)* **Abstract:** This paper focuses on designing and implementing/optimizing a distributed multi-soft processor SoC low-power FPGA-based software-hardware architecture for fast digital image processing. We demonstrate an on- and off-the-chip augmented hardware architecture implementation to overcome memory/cost/size and power prohibitive resource constraints. We experimentally achieve an optimized accelerated digital image processing execution time. The proposed method achieves 80 times computational speedup compared to baseline implementation.
9:20 AM – 9:40 AM	**Application of Electrical Network Frequency as an Entropy Generator in Distributed Systems** *Presenter:* Mr. Deeraj Nagothu, Binghamton University *Co-Authors:* *Ronghua Xu and Yu Chen (Bingampton University), Erik Blasch and Erika Ardiles-Cruz (AFRL)* **Abstract:** We studied the randomization nature of Electrical Network Frequency (ENF) signals and the societal impacts on its fluctuation patterns. Leveraging the ENF signal fluctuations, we integrate ENF as a source of randomness for the Random Bit Generator (RBG) system in cryptographic applications. An RGB-based encrypted communication and committee election mechanism is proposed for an enhanced distribution system.
9:40 AM – 10:00 AM	**An Investigation in the Use of Hyperspectral Imagery Using Machine Learning for Vision Aided Navigation** *Presenter:* Mr. Isaac Ege, UDRI *Co-Authors:* *Dylan Bowald (AFRL), Bradley Ratliff (University of Dayton), and Andrew Thompson (UDRI)* **Abstract:** We explore the use of hyperspectral imagery (HIS) for vision aided navigation. We employ a deep learning approach to HIS data collected across several regions of the United States with the goal of blindly categorizing these data by region. We present promising initial results from this work.

10:00 AM - 10:20 AM	**An Evaluation Platform for Channel Estimation in MIMO systems** *Presenter:* Mr. Venkataramani Kumar, University of Dayton *Co-Authors:* *Dalyana Mercado-Perez (University of Dayton), Feng Ye (University of Wisconsin), Rose Qinyang Hu (Utah State University), Yi Qian (University of Nebraska)* **Abstract:** The proposed end-to-end software evaluation platform mimics as well as analyzes the performance of channel estimation process in a typical MIMO system sequentially through three major functionalities namely channel estimation, data transmission and evaluation. Furthermore, the platform can be modified and tuned easily to meet the given requirements. Preliminary results from this platform are provided.
10:30 AM – 10:45 AM	**COFFEE BREAK**
DIGITAL SIGNAL & IMAGE PROCESSING II	***(Auditorium)***
10:45 AM – 11:05 AM	**Clustering RF Signals with the Growing Self-Organizing Map for Dynamic Spectrum Access** *Presenter:* Mr. Elliott Konink-Donner, University of Cincinnati *Co-Authors:* *Aaron Ruen and Rashmi Jha (University of Cincinnati)* **Abstract:** Dynamic spectrum access is becoming a popular research topic as the RF spectrum becomes more occupied. The goal of this work is to explore unsupervised learning methods to extract significant features for spectrum sensing. For our unsupervised clustering algorithm, we focus on the growing self-organizing map for lifelong learning capabilities.
11:05 AM – 11:25 AM	**Mitigating Cross Transport Key Derivation Attacks in Bluetooth Communication** *Presenter:* Mr. Jielun Zhang, University of Dayton *Co-Authors:* *Mohammad Ali (University of Dayton), Feng Ye (University of Wisconsin)* **Abstract:** This paper proposes modifications to the open-source Android Bluetooth stack to prevent key overwrites across transports from cross-transport key derivation (CTKD) in legitimate Bluetooth communications. Moreover, a framework is proposed and implemented to mitigate unintended session attacks. The proposed countermeasures aim to enhance Bluetooth security while minimizing user intervention.
11:25 AM – 11:45 AM	**A Patient-Specific Algorithm for Plasmodium Malaria Detection on Cell Images** *Presenter:* Dr. Barath Narayanan, UDRI *Co-Authors:* *Manawaduge Supun De Silva and Russell C. Hardie (University of Dayton)* **Abstract:** Computer-aided detection of plasmodium malaria on cell images from digital microscopy provides an invaluable second opinion to medical experts. Traditionally, well-established deep learning algorithms are widely used to detect plasmodium, but these techniques have not been deployed due to the uninterpretable nature of the decisions made by the network. To address this, we present an ensemble method that fuses the predictions based on the Class Activation Mapping (CAM) results from multiple networks via a novel selector network. We study the performance on a publicly available dataset of cell images by using three convolutional neural network architectures, Xception, ResNet50, and InceptionV3, to produce CAM results for the selector network and performance comparison. Our proposed approach helps enhance doctors' trust and outperforms traditional ensemble methods by 2%.

Tuesday August 29, 2023

MORNING SESSIONS (9:00 AM – 12:00 PM)

Quantum Enabling Technologies & Complex RF Signal Processing I and II
(Kitty Hawk)

Chairs: **Dr. Charles Cerny (AFRL), Dr. Robert Ewing and Lt Col James Sattler (AFIT)**

QUANTUM ENABLING TECHNOLOGIES & COMPLEX RF SIGNAL PROCESSING I	
9:00 AM - 9:20 AM	**A Hierarchical Entanglement Routing Protocol in Quantum Networks** *Presenter*: Mr. Matthew Slodov, Case Western University *Co-Authors:* *Dr. Chris Papachristou (Case Western University)* **Abstract:** We propose a hierarchical entanglement routing protocol over the nodes of a quantum network. The objectives are to develop realistic timing parameters of entanglement operations, design the protocol procedure steps, simulations and performance evaluation. The work has applications to link layer protocols for quantum networks and the future quantum internet.
9:20 AM – 9:40 AM	**Learning Quantum System Disturbance Models with Probabilistic Bayesian Neural Networks** *Presenter*: Dr. Zhenhua Jiang, UDRI *Co-Authors:* *Linh Nguyen (UDRI)* **Abstract:** This paper aims to discuss a probabilistic machine learning approach that is well suited to modeling and learning the unknown disturbance dynamics (which may be caused by errors, noise, and parameter variations) in complex quantum processes or systems from operational data using a Bayesian neural network.
9:40 AM – 10:00 AM	**Quantum Probabilistic Comparator Circuit Implementation** *Presenter*: Dr. Linh Nguyen, UDRI *Co-Authors:* *Zhenhua Jiang (UDRI)* **Abstract:** This paper aims to present and implement a quantum probabilistic comparation algorithm (QPC) that can help to find a desired solution between two random variables under uncertainty. This approach takes advantage of quantum computing to perform parallel comparation and fast calculation of the better matched probability of state vectors.
10:00 AM – 10:15 AM	**COFFEE BREAK**

QUANTUM ENABLING TECHNOLOGIES & COMPLEX RF SIGNAL PROCESSING II	*(Kitty Hawk)*
10:15 AM – 10:35 AM	**Machine Learning Approaches to Evaluating Quantum Phase Estimation Algorithm Output** *Presenter*: Mr. Charles Woodrum, USAF AFIT *Co-Authors:* *David Weeks, USAF AFIT* **Abstract:** Quantum phase estimation is one of the most fundamental and useful quantum computing algorithms available to researchers, but traditional methods for estimating the phase of a unitary operator acting on its eigenvalue leave information about the phase contained in all of the output from a quantum computer unused. Mean squared error (MSE) for such a scheme is 0.03 for simulated data with and without error. Machine learning with classical methods, like linear regression (MSE=0.011 for errored data and 0.0043 for error-free data) and random forests (MSE=0.01 for errored data and 0.006 for error-free data) increase the accuracy of the estimation drastically without requiring additional qubits like the traditional approach. However, neural networks reduce this number further (MSE=0.0077) in the case of errored data and with error-free data (MSE=0.003). Examining the performance of neural networks with different modifications also yields insight into their performance on quantum computing output that could be generalized to output from other algorithms and on quantum computers with different numbers of qubits.
10:35 AM – 10:55 AM	**Quantum Crosstalk as a Physically Unclonable Characteristic for Quantum Hardware Verification** *Presenter*: 2nd Lt, Christopher Chwa, USAF AFIT *Co-Authors:* *Leleia Hsia and Laurence Merkle (USAF AFIT)* **Abstract:** Quantum computers, like their classical counterparts, require supply chain security through hardware verification techniques. Qubit-to-qubit crosstalk variations that arise as a result of fabrication variations may be used as a physically unclonable characteristic to hardware verify qubits and quantum processors.

Industry Panel

Tuesday August 29, 2023

1:30 PM – 3:00 PM	Industry Panel on CHIPS Act and Microelectronics	Ballroom

Chaired by: **Dr. Charles Cerny (AFRL) and Mr. Bill McQuay (KBR)**

Panel Members:

Dr. Dirk Pfeiffer (IBM Yorktown Heights)

Panelist Bio: Dr. Dirk Pfeiffer manages a state of the art 200mm wafer scale nanofabrication facility at the IBM TJ Watson Research center in Yorktown Heights, NY, offering a wide range of design and fabrication services, ranging from novel devices fabrication to packaging, test, design, characterization, electronics, system integration and assembly. The laboratory supports a broad range of projects to develop new computing technologies for IBM including quantum computing, neuromorphic devices for AI based computing architectures, and unit process development for semiconductor fabrication.

Mr. Russ Harrison (IEEE-USA)

Panelist Bio: Russell Harrison serves as Managing Director of the IEEE-USA, the American component of the Institute of Electrical and Electronic Engineers. As an expert in immigration and innovation policy, Russ has worked to build enduring bridges between policy makers and technologists, helping each understand the other as they work to drive technological innovation across the US. Russ has spoken at over 300 local, national, and international events about the intersection between public policy and technology, always encouraging regular citizens to interact with their elected leaders. Russ has a Master's in Public Management from the University of Maryland and a B.A. in political science from Allegheny College.

Dr. Frank Wolff (KBR Wyle)

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.

Tuesday August 29, 2023

AFTERNOON SESSIONS (3:15 PM – 5:30 PM)

Emerging Electronics and Microsystems III
and
Trusted Microelectronic Systems and Cyber Systems/Security I
(Ballroom)

Chairs: *Emerging Electronics & Microsystems III*
Dr. Rashmi Jha (University of Cincinnati), Dr. Ahmad Islam (AFRL/RYDD), and Dr. Vamsy Chodavarapu (University of Dayton)

Trusted Microelectronic Systems and Cyber Systems/Security I
Dr. Nicholas Kovach (AFRL Sensors Directorate), Dr. Frank Wolff (KBR), and Dr. Kenneth Hopkinson (AFIT)

3:00 PM – 3:15 PM	**COFFEE BREAK**
EMERGING ELECTRONICS & MICROSYSTEMS III	
3:15 PM – 3:45 PM	**Compute-in-Memory Systems for In-Sensor Real-Time Processing** *Presenter*: Dr. Wei Lu, University of Michigan ***(Invited Speaker)*** **Abstract:** Many applications benefit from efficient hardware systems for real time, in-sensor processing of streaming data. Compute-in-memory (CIM) systems perform computing in place and in parallel, which can significantly improve the system's power consumption and latency. Scalable CIM designs and approaches that can directly process time-series inputs will be presented.
3:45 PM – 4:05 PM	**Evaluation of Leakage Currents in Memristor Crossbar Arrays** *Presenter*: Mr. Muana Kasongo, Indiana University *Co-Authors: Trond Ytterdal (Norwegian Institute of Technology), John Lee and Maher Rizkalla (Indiana University), Mukesh Kumar (IIT-Indore)* **Abstract:** Memristors are novel electronic devices. Memristor-based crossbar arrays have gained a lot of attention for potential applications in nonvolatile memory, in-memory computing, logic design, neuromorphic computing systems, and neural networks. In this paper, we demonstrate the sneaky path current issue within a 3x3 crossbar array. 1T1M scheme has been used to reduce the leakage current. Integrating nMOS and pMOS devices in series with memristors in the crossbar array has optimized the leakage currents. The results show that nMOS devices reduce the leakage currents by 97.35%, whereas pMOS devices reduce the leakage currents by 92.20%. Thus, nMOS outperform pMOS devices in leakage currents optimization.

TRUSTED MICROELECTRONIC SYSTEMS AND CYBER SYSTEMS/SECURITY I	*(Ballroom)*
4:10 PM – 4:30 PM	**Multitone Analysis for the Authentication of Electronic Devices** *Presenter*: Mr. Carl Bohman, KBR *Co-Authors: Aaron Jennings, Ryan Lachey, Mark Skouson, and Christian Eakins (KBR), Richard Ott and Jamin McCue (AFRL)* **Abstract:** Long-lived military platforms and slow acquisition cycles result in the use of legacy electrical components across the DoD. To prevent counterfeit parts from entering safety and mission critical systems, methods of classifying parts and determining risk are a necessity. This work discusses a revised view of the Power Spectral Analysis method of counterfeit detection utilizing targeted stimuli, Multi-Tone Analysis, to increase spectrum agility, target critical frequencies for investigation, and facilitate the simulation of this second-order effect classification technique.
4:30 PM – 4:50 PM	**ML Assisted Security for the Detection of DDoS Attacks in Connected IIoT Environment Implementation and Comparative Analysis** *Presenter*: Mr. Harshdeep Singh, Wright State University *Co-Authors: Niraj Prasad Bhatta, Tawshik Jawad, Harroop Singh, and Fathi Amsaad (WSU), Kenneth Hopkinson (AFIT)* **Abstract:** Distributed denial-of-service (DDoS) attacks are cyber security malicious attempts to disrupt the regular traffic of an Industrial Internet of Things (IIoT) network service by flooding the traffic of the connected IIoT infrastructure with endless packets. The article discusses DDoS attacks in connected IIoT environment and the use of machine learning (ML) models for defend against such security malicious attempts. For that, we initially explore the different types of DDoS attacks, the vulnerabilities of the network layer, and various ML techniques used for detecting attacks. Different ML-assisted security models are implemented and analyzed for detecting DDoS attacks targeting IIoT network. These models include logistic regression, support vector machine, naive Bayes, and neural network to learn the attack detection. Comparisons are made with these ML models on behalf of the accuracy and execution time. Further, we implement parallel processing to reduce the execution time of the training part, and comparisons are made considering different environments, CPU, and GPU. Our analysis of the results demonstrates a significant reduction in training time for the models while maintaining accuracy when using parallel processing to implement the ML-assisted security models.
4:50 PM – 5:10 PM	**Blockchain Based Distributed Hybrid Cloud Identity Management for Securing IoT Devices in the Cloud** *Presenter*: Mr. Khaled Alrawashdeh, Oklahoma City University *Co-Authors: Sahit Katta, Jake Adebayo, Mounika Tulasi, and Mounika Dokka (Oklahoma City University)* **Abstract:** The growing usage of Internet of Things (IoT) devices has led to a need for secure and decentralized identity management systems. In this paper, we propose a distributed hybrid cloud identity management system based on the blockchain. Our technology offers a decentralized identity management system, ensuring the privacy and security of IoT devices.

Tuesday August 29, 2023

AFTERNOON SESSIONS (3:15 PM – 5:30 PM)

Integrated Photonics and Atmospheric Optics I and II

(Auditorium)

Chairs: **Dr. Swanajit Chakravarty, Dr. Andrew Sarangan, Dr. Partha Banerjee, and Dr. Mikhail Vorontsov (University of Dayton)**

3:00 PM – 3:15 PM	**COFFEE BREAK**
INTEGRATED PHOTONICS & ATMOSPHERIC OPTICS I	
3:15 PM – 3:45 PM	**Optical Turbulence in the Atmospheric Boundary Layer** *Presenter*: Dr. Steve Hammel, Naval Information Warfare Center Pacific ***(Invited Speaker)*** **Abstract:** Optical turbulence is an important effect in the propagation of light through the atmosphere: It generates image blur and image dancing, and turbulence will cause laser beams to broaden and wander. We describe work to predict the refractive index structure parameter Cn2, the primary characterization of local optical turbulence.
3:45 PM – 4:15 PM	**Developing Directed Energy Weapons to Operate Across a Range of Atmospheric Conditions** *Presenter*: Dr. Steve Fiorini, USAF AFIT ***(Invited Speaker)*** **Abstract:** Quantification and prediction of atmospheric effects on HELs and other DE systems. Phenomena include optical turbulence, molecular, aerosol, and hydrometeor absorption/scattering effects. Enhances laser effectiveness across all weather conditions. Research includes conducting testing, modeling, and simulations to understand how directed energy weapons will perform for the joint warfighter.
INTEGRATED PHOTONICS & ATMOSPHERIC OPTICS II	
4:20 PM – 4:40 PM	**Highly Stable and Fully Integrated Optoelectronic Frequency Synthesizers for RF Front-End Receivers** *Presenter*: Mr. Joseph Fasbinder, Drexel University *Co-Authors: Kai Wei, Tianchi Sun, and Afshin Daryoush (Drexel University)* **Abstract:** Opto-electronic oscillator (OEO) based on heterogeneously integrated InP multi-mode laser (MML), SiN based 1-D photonic crystal delay line, and Si-Ge heterojunction bipolar transistor amplifiers are examined for reduction of phase noise for highly stable X-band frequency synthesizers.

4:40 PM – 5:00 PM	**Optimizing Solar Performance Using Graphene Microring Resonators** *Presenter*: Mr. Ramaa Saket Suri, Indiana University *Co-Authors: Mahar Rizkalla (Indiana University) and Mukesh Kumar (IIT-Indore)* **Abstract:** Absorption and conversion efficiency are two important characteristics of a solar cell. We propose a Graphene-based microring resonator (MRR) to the solar cell to achieve absorption over 95% at 1550nm wavelength and conversion efficiency is 41.2%. This paper also discusses the effects of multiple layers of Graphene in the MRR.

Tuesday August 29, 2023

AFTERNOON SESSIONS (3:15 PM – 5:30 PM)

Aerospace Power Systems and Power Electronics I and II

(Kitty Hawk)

Chairs: **Dr. Roshan Kini (Pacific Northwest Labs), Dr. Bang Tsao (UDRI), and Dr. Dong Cao (University of Dayton)**

3:00 PM – 3:15 PM	**COFFEE BREAK**
AEROSPACE POWER SYSTEMS & POWER ELECTRONICS I	
3:15 PM – 3:45 PM	**A Brief History of Aircraft Generators and a Look Towards the Future Using High Performance Power Electronics** *Presenter*: Mr. Kevin Yost, USAF AFRL/RQQE ***(Invited Speaker)*** **Abstract:** This talk will discuss aircraft electrical power generation technologies and the marvelous design topology incorporated with the limited tools and technology available at the time. It will then discuss future opportunities with the advent of high-performance power electronics and computation power available today.
3:45 PM – 4:05 PM	**Model Based Change Detection Approach for Sensor Fault Identification in Battery Packs** *Presenter*: Dr. Luis Herrera, University at Buffalo *Co-Authors: Anthony Frierson and Bang-Hung Tsao (UDRI), Joseph Fellner (AFRL)* **Abstract:** In this paper, a model-based sensor fault detection strategy is proposed for series connected Li-Ion cells. A state space model of the equivalent circuit of each cell is first derived and a Luenberger observer is designed for residual generation. A Quickest Change Detection (QCD) approach is presented to further process the residual and the Cumulative Sum algorithm is then used to solve the QCD problem. Simulation results are then presented to verify the feasibility of the proposed method.
4:05 PM – 4:25 PM	**Adaptive Method for Lithium Ion Cell State-of-Charge Estimation in Smart Aircraft Applications** *Presenter*: Mr. Anthony Frierson, UDRI *Co-Authors: Bang-Hung Tsao, Nicholas Zumberge, and Tim Farr (UDRI), Joseph Fellner (AFRL), and Luis Herrera (University at Buffalo)* **Abstract:** An adaptive version of the Kalman Filter (KF) algorithm is investigated as a potential for State of Charge (SOC) estimation in Li-Ion cells. Additionally, a real time emulation of the BMS model (using the Speedgoat Real-Time Target Machine) is performed to determine how the adaptive KF would perform in actual hardware.

AEROSPACE POWER SYSTEMS & POWER ELECTRONICS II	*(Kitty Hawk)*
4:30 PM – 4:50 PM	**Review of Equalization Techniques Applied to Second-Life EV Battery Packs and Their Efficiency** *Presenter*: Mr. Sanjaya Bhattarai, University of Toledo *Co-Authors: Ngalula Sandrine Mubenga (University of Toledo)* **Abstract:** Electric vehicles (EVs) are becoming increasingly popular, and as a result, second-life EV batteries are being produced in copious quantities. When the EV battery capacity falls below 80% of its original capacity, it is no longer considered suitable for use in EVs. The end-of-life EV battery issue is becoming more pressing with the rising popularity of EVs. One of the most popular uses for these batteries is in stationary energy storage systems, but to do so efficiently, it is crucial to ensure that every cell within the battery stack is charged and balanced properly. This paper conducts a literature review and an overview of different equalization techniques that have been adopted or are being researched for second-life EV batteries. It also provides information on which method is more efficient by measuring the efficiency of the equalizer. This paper details the advantages and disadvantages of each technique and evaluates their effectiveness in balancing cell charges. It also reviews techniques to measure the efficiency of charge transfer during equalization.
4:50 PM – 5:10 PM	**Visualization Tool for Turbine-Based Power System** *Presenter*: Dr. Roshan Kini, Pacific Northwest National Lab *Co-Authors: Sarmad Hanif and Warren Wiser (PNNL)* **Abstract:** This paper presents the development of a turbine-based power simulation web tool. Users can define control parameters, allowing them to customize the simulation according to their needs. The developed open-source tool enables users to simulate power profiles for turbine-based energy generation and allows users to investigate the generated profiles at various scales.
5:10 PM – 5:30 PM	**Advances in Planar Transformer Circuit Models: Stray Capacitance Equivalent Circuit for Two- and Four-Winding Transformers with H-Parameter Network Model** *Presenter*: Mr. Haitham Kanakri, Purdue University *Co-Authors: Euzeli Cipriano Dos Santos, Jr. and Maher Rizkalla (Purdue University)* **Abstract:** This paper presents a new circuit model of a two-winding and four-winding planar transformers taking into account the capacitive effects between layers. The h-parameters model has been derived. Voltage gain has been determined using both finite element analysis and experimental models. Significant agreement between both were found.

Agenda DAY 3

Wednesday August 30, 2023

Time	Event	Location
7:30 AM – 5:00 PM	Registration	Ballroom Foyer
8:30 AM – 12:00 PM	**CONCURRENT MORNING SESSIONS**	**Coffee Break: 10:00 AM – 10:15 AM**

8:30 AM – 12:05 PM	Deep Learning and Artificial Intelligence I & II	Ballroom
8:30 AM – 11:35 AM	Trusted Microelectronic Systems and Cyber Systems/Security II & III	Auditorium
8:30 AM – 9:50 AM	Radar, Tomography and RF Sensing	Kitty Hawk
10:15 AM – 11:45 AM	THz/mmWave	Kitty Hawk

12:15 PM – 1:15 PM	**NAECON Luncheon**	**Ballroom**

12:30 PM – 1:15 PM — **Ballroom**

KEYNOTE 3:

DoD Challenges, Issues, and Capability Gaps for Wide Area Motion Imaging (WAMI) or "Today's Stone Soup"

Presenter: **Dr. Steve Suddarth, Transparent Sky, LLC**

1:30 PM – 4:15 PM	**CONCURRENT AFTERNOON SESSIONS**	**Coffee Break: 3:00 PM – 3:15 PM**

1:30 PM – 4:15 PM	Machine Learning, Guidance and Control I & II	Ballroom
1:30 PM – 3:55 PM	Low SWaP Sensor Processing and Sensor Fusion I & II	Auditorium
1:30 PM – 4:00 PM	Industry Sponsor Presentations I & II	Kitty Hawk

5:30 PM – 8:30 PM	**NAECON Banquet**	**Ballroom**

6:45 PM – 7:30 PM — **Ballroom**

KEYNOTE 4:

DOD Challenges for Wide-Area Motion Imaging

Presenter: **Dr. Supriyo Datta, Purdue University**

JOSEPH DESCH AWARD WINNER FOR 2023

This award is named after Joseph Desch, who was an electrical engineer for the National Cash Register Co. (NCR), led the top-secrett codebreaking operations in Dayton, Ohio, during World War II. His electronics laboratory designed and manufactured the advanced machine needed to read the encrypted communications of the German Navy's Enigma machine. Desch and his colleagues kept the project secret for 50 years. For more information, visit: http://www.daytoncodebreakers.org/

WIFI ACCESS CODE (Holiday Inn): FBNPD

Wednesday August 30, 2023

MORNING SESSIONS (8:30 AM – 12:00 PM)

Deep Learning and Artificial Intelligence I and II

(Ballroom)

Chairs: **Dr. Anca Ralescu (University of Cincinnati), Dr. Tem Kebede (AFRL), Dr. David Kapp (AFRL), and Dr. Daniel Koranek (AFRL)**

DEEP LEARNING & ARTIFICIAL INTELLIGENCE I	
8:30 AM – 9:00 AM	**Of Two Minds: A Divided Vision of AI and Its Implications** *Presenter*: Dr. Ali A. Minai, University of Cincinnati ***(Invited Speaker)*** **Abstract:** Following recent developments in generative AI – and especially the emergence of ChatGPT and other systems based on large language models (LLMs) – there has been intense debate about the challenges and risks posed by AI, and potential ways to address them. Leading researchers and innovators in the field have expressed divergent opinions and, in some cases, rather extreme solutions. There is no indication that this confusion will ebb in the near future. This talk will attempt to show that the confusion is driven, in part, by inconsistent conceptions of AI and its role in the future of humanity – leading to very different expectations and risk analysis. The goal of the talk is to clarify some of the underlying issues as a prelude to seeking viable solutions.
9:00 AM – 9:20 AM	**Decentralized Vehicular Identification and Tracking on Lightweight IoT Edge Nodes** *Presenter*: Dr. Deeraj Nagothu, Binghamton University *Co-Authors:* *John Parker and Yu Chen (Binghampton University)* **Abstract:** Character recognition and object detection are computing and data-intensive, which are not affordable to lightweight IoT devices. We introduce a Decentralized Vehicular Identification (DvID) that is optimized for inexpensive IoT devices thanks to its capability of highly efficient inputs and outputs (IO) as well as low storage or power consumption.

(Continued on next page)

9:20 AM – 9:40 AM	**Lightweight Deep Learning Algorithm for Visual Odometry** *Presenter*: Dr. Tao Peng, University of Dayton *Co-Authors:* *Dingnan Zhan and John Loomis (University of Dayton), Ruixu Liu (DAAP-Research), and Danhuai Zhao (China Mobile Zhijin Institute)* **Abstract:** Visual odometry is a widely used approach for the relative localization problem in autonomous vehicles. However, achieving high-accuracy pose estimation in a dynamic driving environment while meeting safety requirements is challenging. Existing geometry-based visual odometry algorithms require individual design and fine-tuning. Therefore, we propose a new monocular visual odometry system based on a neural network for feature extraction and matching. The efficiency of measurement is a primary consideration due to safety requirements in complex environments, and reducing computational cost is crucial for enabling real-time processing on embedded platforms with limited hardware resources. Our system estimates poses directly from video sequences, and our main contribution is an efficient neural network model that reduces computational costs while maintaining accuracy. Our proposed model is suitable for applications such as robotics and autonomous driving, which require a lightweight, low-latency network model. Experimental results show that our system outperforms traditional approaches in terms of accuracy, and our efficient neural network model is a significant contribution to visual odometry.
9:40 AM – 10:00 AM	**Dishpolish Exploring the Recovery of Geometric Invariants in Deep Learning Models via Pose Estimation of Microwave Dish Antennae** *Presenter*: Dr. Christopher Liberatore, USAF AFRL *Co-Authors:* *Logan Boyd (Wright State University), John Bielas (Applied Research Solutions), Richard Borth and Rachel Kinard (AFRL)* **Abstract:** In this paper, we propose a deep learning algorithm, called Dishpolish to exploit geometric invariances of microwave dish antennae to perform a dish mensuration task–the study of estimating a microwave antenna dish pointing direction from imagery. We synthesize a dish imagery dataset from 5 distinct dish models and evaluate it on the proposed Dishpolish deep-learning architecture. We find that the method is capable of recovering dish orientation to 5.36° and 1.03° azimuth and elevation error, respectively, when it has seen the dish model before, but performs less effectively on unseen dishes.
10:00 AM – 10:15 AM	**COFFEE BREAK**
DEEP LEARNING & ARTIFICIAL INTELLIGENCE II	***(Ballroom)***
10:15 AM – 10:45 AM	**Memristor Based Online Learning Neuromorphic Processors for Adaptive Modulation Spectrum Sensing in Communication Jammed Environments** *Presenter*: Dr. Tarek Taha, University of Dayton ***(Invited Speaker)*** **Abstract:** A memristor based neuromorphic processor for on-chip training is presented. Additionally, a novel approach utilizing in-situ learning to improve wireless signal modulation classification under adversarial jamming is described. The neuromorphic system is over 50x energy efficient than optimized digital systems at this wireless signal modulation task for similar accuracy levels.

10:45 AM – 11:05 AM	**Aircraft Classification Using Flight Phase Identification** *Presenter*: Maj Sarah Bolton, USAF AFIT *Co-Authors: Richard Dill, Michael Grimaila, and Douglas Houdson (AFIT)* **Abstract:** Flight data collected from an Automatic Dependent Surveillance–Broadcast (ADS-B) can be used to make inferences about aircraft characteristics. This work uses all flight phases to identify an aircraft's Wake Turbulence Category (WTC), aircraft description and type designator as described in the International Civil Aviation Organization (ICAO) Document 8643.
11:05 AM – 11:25 AM	**Object Detection Using Vision Transformed EfficientDet** *Presenter*: Mr. Shreyanil Kar, Purdue University *Co-Authors: Mohamed El-Sharkawy (Purdue University)* **Abstract:** Computer vision, a subdivision of computer science and artificial intelligence focuses on enabling computers to interpret and analyze visual data from the world, such as images and videos. Recent advances in convolutional neural networks (CNNs), have improved the performance of computer vision systems remarkably, making them more accurate and efficient than ever before. Object detection using CNNs is a popular application of deep learning in computer vision.
11:25 AM – 11:45 AM	**Wireless Transmitter Angle of Arrival Estimation with FPGA Acceleration** *Presenter*: Mr. Jin Feng Lin, University of Massachusetts Dartmouth *Co-Authors: Todd Morehouse, Charles Montes, Erika Caushi, Artem Dudko, Samuel Rouillard, Noah Oikarinen, and Ruolin Zhou (UMass-Dartmouth)* **Abstract:** This paper is to develop an RF angle-of-arrival (AoA) estimator using signal processing techniques and machine learning (ML). Various methods, such as multiple signal classification (MUSIC) and estimation of signal parameters via rotational invariance technique (ESPRIT), were evaluated as the baseline. Different ML architectures have been evaluated as well and compared to the MUSIC and ESPRIT performance. ML outperforms the others by offering the capability to learn complex mappings, extract features, and handle challenging scenarios, such as high noise levels. A linear antenna array was chosen for its simplicity and ease of construction. The experimental setup involved the use of two USRP X310 software-defined radios (SDRs) to receive signals through the antenna array. To ensure synchronized sampling and phase alignment, an Octoclock external synchronization system was utilized. Additionally, ML algorithms were accelerated using a field programmable gate array (FPGA). The inference cycle can be reduced by 28.2\% on Xilinx ZCU102 FPGA.
11:45 AM – 12:05 PM	**Late-Stage Sensor Fusion Insights into Decision Level Heterogenous EO and Passive RF Fusion** *Presenter*: Mr. Asad Vakil, Oakland University *Co-Authors: Erik Blasch and Robert Ewing (AFRL), Jia Li (Oakland University)* **Abstract:** This paper presents a late-stage decision fusion model that seeks to provide explainability for Electro-Optical (EO) and Passive Radio Frequency (P-RF) target detection. Explainable insights that are intuitive and empirical are provided by heatmaps and counterfactual explanations, with a traditional algorithm handling late-stage fusion. Results show that at both the local and global level, the decision-tree explainability of fusion methods provides insights for EO and P-RF fusion methods.

Wednesday August 30, 2023

MORNING SESSIONS (8:30 AM – 12:00 PM)

Trusted Microelectronic Systems and Cyber Systems/Security II (Special Session on CHEST)

(Auditorium)

Chairs: **Mr. Luis Concha (University of Cincinnati) and Mr. Kevin McCamey (AFRL)**

TRUSTED MICROELECTRONIC SYSTEMS & CYBER SYSTEMS/SECURITY II	
8:30 AM – 8:50 AM	**Fast FPGA Reverse Engineering for Hardware Metering and Fingerprinting** *Presenter*: Dr. Anvesh Perumala, University of Cincinnati *Co-Authors:* *Heiko Stowasser and John Emmert (University of Cincinnati)* **Abstract:** We describe a fast, abstract method for reverse engineering field programmable gate array look-up-tables. Our method has direct applications to hardware metering and FPGA fingerprinting, and our approach allows easy portability and application to most LUT based FPGAs. Unlike conventional RE methodologies that rely on vendor specific code, tools, configuration files, components, etc., our methodology is not dependent on any specific FPGA or FPGA computer aided design tool.
8:50 AM – 9:10 AM	**Determining Confidence in FPGA Bitstream Reverse Engineering Result** *Presenter*: Dr. Anvesh Perumala, University of Cincinnati *Co-Authors:* *Ronald Williams, Zachary Collier, Thomas Polmateer, James Lambert, and John Emmert (University of Cincinnati)* **Abstract:** Reverse engineering (RE) is a widespread practice within engineering, and it is particularly relevant for discovering malicious functionality in digital hardware components. In this paper, we discuss bitstream or firmware RE for field programable gate arrays (FPGAs). A bitstream establishes the configuration of the FPGA device fabric. Complete knowledge of both the physical device fabric and a specific bitstream should be sufficient to determine the complete configuration of the programmed FPGA. However, a significant challenge to bitstream RE arises because information about the FPGA fabric and interpretation of the bitstream is typically incomplete. The uncertainties limit the confidence in the correctness of any configuration determined through the RE process. This paper identifies representative sources of uncertainty in bitstream RE of FPGA devices.
9:10 AM – 9:30 AM	**On-Chip EM Sensor Arrays for Reliability Monitoring of Integrated Circuits** *Presenter*: Mr. Manoj Yasaswi Vutukuru, University of Cincinnati *Co-Authors:* *Andrew Muha and Rashmi Jha (University of Cincinnati)* **Abstract:** A novel approach of utilizing the unintentional EM waves emanated from an IC to estimate its reliability. We focus on estimating characteristics like aging and electromigration which can have a significant impact on the performance and reliability of ICs using an on-chip EM sensor array of antennas embedded on top of an unpackaged die.

9:30 AM – 9:50 AM	**RRAM Devices for Hardware Age Monitoring** *Presenter*: Mr. Ryan Dewey, University of Cincinnati *Co-Authors:* *Rashmi Jha (University of Cincinnati)* **Abstract:** This paper outlines an approach for monitoring the aging and integrity of circuits using Resistive Random Access Memory (RRAM) devices. The intrinsic properties of these devices can be utilized in conjunction with circuitry to translate device changes over time into readout values relating to the age of the circuit under test (CUT).
10:00 AM – 10:15 AM	**COFFEE BREAK**
TRUSTED MICROELECTRONIC SYSTEMS & CYBER SYSTEMS/SECURITY III	***(Auditorium)***
10:15 AM – 10:35 AM	**Enhancing Hardware Security: A Comprehensive Analysis of SRAMPUFs** *Presenter*: Mr. Niraj Prasad Bhatta, Wright State University *Co-Authors:* *Fathi Amsaad and Harshdeep Singh (WSU), Ahmed Sherif (University of Southern Mississippi), and Kenneth Hopkinson (AFIT)* **Abstract:** Hardware security has witnessed a promising solution with the emergence of SRAM-PUFs. This research paper presents a comprehensive analysis of SRAM-PUFs, focusing on their architecture, design principles, and applications in hardware security. It examines the security properties, vulnerabilities, and countermeasures against attacks. The performance characteristics and potential use cases of SRAM-PUFs are evaluated, emphasizing their integration in real-world systems. The paper identifies current limitations, proposes future research directions, and highlights emerging trends for further exploration. Overall, SRAM-PUFs offer a robust solution for enhancing hardware security, but addressing challenges and exploring new developments are crucial for maximizing their potential.
10:35 AM – 10:55 AM	**FPGA Hardware Trojan Detection: Golden-Free Machine Learning Approach** *Presenter*: Mr. Ashutosh Ghimire, Wright State University *Co-Authors:* *Fathi Amsaad (WSU), Ahmed Sherif (University of Southern Mississippi), and Kenneth Hopkinson (AFIT)* **Abstract:** Ensuring trust in the semiconductor IC supply chain necessitates the critical detection of Hardware Trojans, yet current methods relying on side-channel analysis often require the use of golden chips for verification. This research paper presents a novel approach to detect Hardware Trojans in the semiconductor IC supply chain, addressing the need for trust and eliminating the use of golden chips. By combining unsupervised machine learning and side-channel analysis, the proposed technique leverages unique features from on-chip ring-oscillator networks to identify anomalies through unsupervised clustering. Evaluation on FPGA chips with Trojan insertion demonstrated exceptional accuracy, surpassing alternative methods with a 99\% accuracy rate. The centroid-based clustering model exhibited superior performance with a slight edge in false positive rate and an f1 score. This research contributes to enhancing trust in semiconductor IC supply chains by offering a fresh perspective on Hardware Trojan detection.

10:55 AM – 11:15 AM	**Protecting Hardware IP by Employing Non-Fungible Tokens (NFTs)** *Presenter*: Mr. Akshay Kulkarni, University of Toledo *Co-Authors: Hrishav Bhattarai, Talha Hussain Syed, and Mohammed Niamat (University of Toledo)* **Abstract:** The globalization of integrated circuits faces threats such as intellectual property piracy, which prevails in the area of assured and trusted microelectronics. The postulated technique of hardware IP transfer by converting the layout file as a non-fungible token not only protects the IP but also identifies the guilty party
11:15 AM – 11:35 AM	**High Resolution Linear Time-to-Digital Converter Using Pulse Shrinking Rings** *Presenter*: Ms. Patricia Tutuani, Iowa State University *Co-Authors: Randall Geiger (Iowa State University)* **Abstract:** A design of a high-resolution time-to-digital converter (TDC) that combines a Vernier delay line embedded in a pulse shrinking ring to take advantage of the linearity inherent in the pulse-shrinking ring and the resolution of the Vernier delay line is presented.

Wednesday August 30, 2023

MORNING SESSIONS (8:30 AM – 12:00 PM)

Radar, Tomography and RF Sensing
and
Terahertz and Millimeter Wave Devices
(Kitty Hawk)

Chairs: **Radar, Tomography and RF Sensing:**
Dr. Brian Rigling (University of Dayton) and Dr. Andrew Bogle (UDRI)

Terahertz and Millimeter Wave Devices:
Dr. Elliot Brown (Wright State University) and Dr. Kubilay Sertel (Ohio State University)

RADAR, TOMOGRAPHY & RF SENSING	
8:30 AM – 9:00 AM	**3D ISAR Image Reconstruction of Ground Vehicles Using 3D SL0 on Undersampled Aperture Data** *Presenter*: Dr. Paul Sotirelis, USAF AFRL ***(Invited Speaker)*** **Abstract:** We consider the 3D reconstruction of ground vehicles from significantly under-sampled ISAR data. A 3D SL0 algorithm is implemented that greatly reduces the computational expense compared to a previous 2D implementation by successive application of the 1D SL0 algorithm. We use synthetic data of a reduced scale pickup truck.
9:00 AM – 9:20 AM	**Time-Delay Digital Beamforming with 1.3 GHz Bandwidth Using Direct RF ADC** *Presenter*: Ms. Hong Neoh, Intel Corporation *Co-Authors: Dan Pritsker and Suk Bum Lee (Intel Corp.)* **Abstract:** Digital time delay beamforming brings benefits of wide bandwidth and simultaneous beams, with improved agility of scans. This paper presents the implementation of time delay digital beamforming with 1.3GHz bandwidth on Intel direct-RF FPGA with integrated ADC/DAC. Other issues like channel synchronization, and compensation for baseband delay are also investigated.
10:00 AM – 10:15 AM	**COFFEE BREAK**

TERAHERTZ & MILLIMETER WAVE DEVICES	*(Kitty Hawk)*
10:15 AM – 10:45 AM	**Resonant Tunneling Diodes for High-Bandwidth Wireless Communications** *Presenter*: Dr. A. Al-Khalidi, University of Glasgow, United Kingdom ***(Invited Speaker)*** **Abstract:** This talk covers high-capacity wireless links employing resonant tunneling diode (RTD) oscillators in the 220 – 325 GHz band with up to 1 mW output powers. Wireless communication links were demonstrated with a range of up to 20 meters. These results demonstrate the potential of RTD technology as a compact platform for terahertz (THz) applications.
10:45 AM – 11:05 AM	**A First Study of the Effect of Surface Roughness in Additively Manufactured Copper at THz Frequencies** *Presenter*: Mr. Thomas DiFulvio, Wright State University *Co-Authors: Elliott Brown, Andrew Huebner, and Michael Seville (WSU), Paul Sotirelis (AFRL)* **Abstract:** The surface roughness of additive-manufactured copper is characterized by profilometry, and its effect on the THz reflectance is measured at 600 GHz. A strong specular component is measured, as well as a non-specular component displaying fluctuations in the wings of the angular reflectance plot.
11:05 AM – 11:25 AM	**Sampling a Stepped-Frequency Continuous-Wave Imaging Radar in a Reverberating Chamber at 600 GHz** *Presenter*: Mr. M.A. Saville, Wright State University *Co-Authors: Andrew Huebner and Elliott Brown (WSU), Paul Sotirelis (AFRL)* **Abstract:** A coherent stepped-frequency continuous-wave radar imaging system is demonstrated at 600 GHz in a reverberating chamber. The trade-offs of sampling and collection time are investigated for target recognition measurement campaigns.
11:25 AM – 11:45 AM	**Non-Invasive Medical Imaging of Skin at Near-Field Range with a W-band Reflectometer** *Presenter*: Mr. W.D. Zhang, Wright State University **Abstract:** We developed a 94 GHz reflectometer for imaging skin burns under near-field conditions. Porcine skin was used as a surrogate for human skin. We validated Jackson's model and imaged burned letters. These experiments demonstrate the feasibility of this technology in assisting doctors with the analysis of second and third-degree burns.

Wednesday August 30, 2023

AFTERNOON SESSIONS (1:30 PM – 4:15 PM)

Machine Learning, Guidance and Control I and II

(Ballroom)

Chairs: **Dr. Trevor Bihl (AFRL), Dr. Jay Wilhelm (Ohio University), and Dr. Tim Machin (AFIT)**

MACHINE LEARNING, GUIDANCE & CONTROL I	
1:30 PM – 1:50 PM	**Comparing Deep Learning Performance for Aircraft Detection in Satellite Imagery** *Presenter*: Dr. Victor Vergara, Blue Halo *Co-Authors:* *Jeremy Wojcik (Blue Halo), Evan Kain and Tyler Lovelly (AFRL)* **Abstract:** This work compares object detection algorithms including You-Only-Look-Once (YOLO) and RetinaNet-ResNet variants performing aircraft detection on the publicly available RarePlanes satellite imagery dataset. Results indicate that YOLO variants generally provided better performance than RetinaNet-ResNet variants, especially when using high numbers of classes and with classes containing large numbers of annotations.
1:50 PM – 2:10 PM	**Real-Time Model Predictive Control for Shot Aiming in Pinball Using kNN Regression** *Presenter*: Mr. Michael Ikuru, University of Cincinnati *Co-Authors:* *Zachariah Fuchs (University of Cincinnati)* **Abstract:** We investigate the shot-aiming problem in Pinball and design a model predictive controller to take shots toward targets with minimal trajectory error using a k-Nearest Neighbors regression-based flip function. A flip function maps the pinball's state to its launch trajectory parameters. The k-Nearest Neighbors regression algorithm is applied to reduce the number of calibration shots required to estimate the flip function accurately. The controller is tested, and its results are compared to a controller built with a polynomial flip function.
2:10 PM – 2:30 PM	**Decoding Performance Testing Results and Empowering Trust with Explainable Artificial Intelligence XAI** *Presenter*: Mr. Haroon Malik, Marshall University *Co-Authors:* *Eric Shoemaker and David Dampier (Marshall University)* **Abstract:** The paper advocates utilizing Explainable Artificial Intelligence (XAI) to enhance the trustworthiness of both black-box and interpretable models in the context of performance testing. The proposed methodology involves employing the Shapley Additive exPlanation (SHAP) algorithm as a surrogate model to aid performance analysts in comprehending the decision-making process of black-box machine learning models. By incorporating SHAP around black-box models, analysts can gain insights into the factors influencing the models' pass-or-fail predictions and understand the relative importance of performance data. To validate the effectiveness of the approach, extensive load testing experiments were conducted on a real-world testbed, incorporating industry-standard benchmarks and manual injection of performance bugs. The results demonstrate that the proposed approach significantly improves the trustworthiness of machine learning models by offering explanatory capabilities for their decision-making. Furthermore, the approach can be applied across various domains and requires minimal effort to operate, thus showcasing its generalizability and practicality.

2:30 PM – 2:50 PM	**Experiments on Recognition of Malware Based on Static Opcode Occurrence Distribution** *Presenter*: Mr. Jacob Carlson, University of Cincinnati *Co-Authors:* *Anca Ralescu (University of Cincinnati), Temesgen Kebede and David Kapp (AFRL)* **Abstract:** This paper discusses a novel approach for a static method to recognize malicious code samples, represented by the distribution of the number of operations between consecutive calls of an opcode. These distributions are compared to ground truth distributions for benign and malicious code samples respectively. A dataset of distributions is also provided.
3:00 PM – 3:15 PM	**COFFEE BREAK**
MACHINE LEARNING, GUIDANCE & CONTROL II	***(Ballroom)***
3:15 PM – 3:35 PM	**Artificial Intelligence Based Evolutionary Approach and Its Application to Cybersecurity Program Modification and Function Generation** *Presenter*: Mr. Adam Holsinger, USAF *Co-Authors:* *Temesgen Kebede and David Kapp (AFRL), Anca Ralescu (University of Cincinnati)* **Abstract:** In artificial intelligence (AI), an evolutionary algorithm, among others such as Machine Learning and Deep Learning, is a subset of intelligent computation. In this paper, we make use of the evolutionary environment called AVIDA to provide cyber resiliency. More specifically, we demonstrate its capability to mitigate against what are known as “non-control flow” cyber-attacks. Furthermore, we also show its ability to modify a given program such that it is optimized. Lastly, experiments were performed to generate a program/code with desired functionality without utilizing or relying on any previous implementation for assistance (novel means of implementing the desired functionality). Our experimental results reveal successful outcomes in the three applications discussed in the above.
3:35 PM – 3:55 PM	**Model Predictive Control Utilizing Machine Learning Models within a Pinball-Based, Cyber-Physical Testbed** *Presenter*: Mr. Xavier Veselovec, University of Cincinnati *Co-Authors:* *Mayson Koliba and Zachariah E. Fuchs (University of Cincinnati)* **Abstract:** We examine the shot aiming problem within a physical pinball machine using model predictive control methods and machine learning based system models. A switched mode system model is developed and trained using data collected from an infrared beam-break sensor array that allows the estimation and prediction of future ball states.
3:55 PM – 4:15 PM	**Tasking Resources in Heterogeneous Aerial Sensor Environment with Algorithm Scalability Analysis** *Presenter*: Mr. Gabriel Greve, Air Force Institute of Technology *Co-Authors:* *Kenneth Hopkinson, Gary Lamont, and Mark Oxley (AFIT)* **Abstract:** This article evaluates three Multi-Objective Evolutionary Algorithms, including the novel Multi-Objective Evolutionary Algorithm Tasker, for generating schedules in the Heterogeneous Ariel Sensor Environment Problem domain. The problems are scaled and analyzed for performance using quality indicators, finding that SPEA2 outperformed the others as the number of decision variables increased.

Wednesday August 30, 2023

AFTERNOON SESSIONS (1:30 PM – 4:15 PM)

Low SWaP Sensor Processing and Sensor Fusion I and II

(Auditorium)

Chairs: **Dr. Marc Hoffman (AFRL), Dr. Stefan Westberg (AFRL), and Dr. Erik Blasch (AFOSR)**

LOW SWAP SENSOR PROCESSING & SENSOR FUSION I	
1:30 PM – 2:00 PM	**Live 3D Wide Area Motion Imaging (WAMI)** *Presenter*: Dr. Steven Suddarth, Transparent Sky, LLC ***(Invited Speaker)*** **Abstract:** A uniquely fast and accurate method of live 3D imaging is presented that permits large areas to be covered in continuous surveillance. The 3D-based processing also allows imagery to be merged via a future swarm architecture, thus providing the only feasible means of placing very large areas under surveillance, such as entire metropolitan regions.
2:00 PM – 2:20 PM	**Online Targetless Radar Camera Extrinsic Calibration Based on the Common Features of Radar and Camera** *Presenter*: Dr. Siyang Cao, University of Arizona *Co-Authors:* *Lei Cheng (University of Arizona* **Abstract:** This paper introduces a novel approach that leverages deep learning to extract a common feature from raw radar data (i.e., Range-Doppler-Angle data) and camera images. The extracted common feature is then used as an example to demonstrate an online targetless calibration method between the radar and camera systems.
2:20 PM – 2:40 PM	**X-Band Low SWaP-C LFMCW Airborne Radar for Counter-UAS Applications** *Presenter*: Dr. Genshe Chen, Intelligent Fusion Technology, Inc. *Co-Authors:* *Xing Lin, Bora Sul, Ping Zhuang, Yunki Zhang, Hua-mei Chen (Intelligent Fusion Tech), Shaji Kaniyantethu and Skender Alickolli (US Army DevCom), and Erik Blasch and Khanh Pham (AFRL)* **Abstract:** We developed a low-phase-noise, high-sensitivity X-band linear-frequency-modulated continuous-wave (LFMCW) airborne radar for counter-UAS (unmanned aerial system) applications. It has a low size, weight, power, cost (SWaP-C) (0.5 kg with batteries, operating for > 4 hours with 2 AA-size batteries), mountable on a Group 1 UAS, and detects small drones within 170 m in air using 16-dB-gain antennas.
3:00 PM – 3:15 PM	**COFFEE BREAK**

LOW SWAP SENSOR PROCESSING & SENSOR FUSION II	*(Auditorium)*
3:15 PM – 3:35 PM	**Fusion Orchestration Guidelines FOG for Collaborative Computing and Network Data Fusion** *Presenter*: Dr. Erik Blasch, USAF AFRL **Abstract:** In recent years, there has been the opportunity to develop data fusion methods closer to the sensor. Typically, the motivation was to process the sensor data at the edge and combine with other techniques, but the processing power and communications was limited. Hence, for many decades, the limitation of edge-based (or far edge) was limited to systems with small-bit processing. Currently, processing imagery at the edge from a device is possible and has been coordinated with seismic, acoustic, and radar sensing. Future edge-based heterogeneous data fusion methods would be facilitated from various constructs developed from big data, cyber-physical sensing, machine learning, and software architectures. This paper reviews these techniques and developments to support multi-domain operations for data fusion. A feasibility study shows the benefits of fog computing using the analytical hierarchy processing using metrics of timeliness, accuracy, confidence/credibility, throughput, and security.
3:35 PM – 3:55 PM	**SRAM Process and Debug Sensor** *Presenter*: Dr. Anoop Gopinath, Indiana University **Abstract:** In this paper, a RAZOR-based scheme is described for process variation characterization, that can result in improvement in memory access time by removing pessimistic margins on critical datapath in SRAM arrays. The scheme can identify whether slow-down on datapath has occurred due process variation or hard errors. This allows designers to estimate, with a margin of error, the impact of process variation on memory access time setting critical path. Pre-silicon characterized datapath delay via intentional selectable data delay lines called data TRIMs can be used to estimate the slow-down due to variation with a margin of error. This margin of error can be reduced by using finer granularity of data TRIM but come at the cost of marginal additional area and power overheads. The circuitry used in the scheme can be used in a column-by-column manner to test memory access time with respect to individual bit cells, which provide a level of visibility into SRAM macros post-silicon. The scheme can estimate with up to 99.2% accuracy the slow-down on memory access time setting critical path in a typical corner.

Wednesday August 30, 2023

AFTERNOON SESSIONS (1:30 PM – 4:15 PM)

Industry Sponsor Technical Presentations I and II

(Kitty Hawk)

Chairs: **Dr. Bill McQuay (KBR) and Dr. Charles Cerny (AFRL)**

INDUSTRY SPONSOR PRESENTATIONS I	
1:30 PM – 2:15 PM	**KBR Moving Forward by Looking Backward** *Presenter*: Bob Henning, Director of Microelectronics National Security Solutions, KBR **Abstract:** As computer systems and connectivity have improved vastly since the 1970s, so have system and network adversarial attacks against our systems. Now, advanced systems face an in-depth and hierarchical threat down to the integrated circuit level. This presentation will address what we have learned by looking at the results of previous efforts (successes and failures) that were used to mitigate past adversarial attack. We will identify lessons learned that we are bringing forward as we try to mitigate risk with the design of microelectronics and within the IC supply chain. KBR is at the forefront of developing unique and novel processes, techniques, and solutions to drive improved trust and assured security in the microelectronics supply chain.
2:15 PM – 3:00 PM	**Driving Innovation through the Triple Helix Model of Collaboration** *Presenter*: Dr. Viktoria Greanya, Chief Scientist Parallax Advanced Research **Abstract:** The presentation by Parallax offers a comprehensive overview of our organization as a 501(c)(3) nonprofit research institute dedicated to advancing the Nation's security and prosperity. Our mission centers on tackling critical challenges by leveraging the power of the U.S. science and technology enterprise. Using the Triple Helix Model of Innovation, we strategically combine resources, competencies, and perspectives from academia, industry, and government to accelerate innovation and find creative solutions. Our research efforts are aimed at addressing state- and federal-level challenges at the crossroads of these sectors, fostering collaboration and engagement among them. This presentation provides insights into how Parallax anchors and nurtures innovative ecosystems, facilitates boundary-spanning activities, and propels collaborative initiatives, all while highlighting our diverse R&D programs and capabilities.
3:00 PM – 3:15 PM	**COFFEE BREAK**

INDUSTRY SPONSOR PRESENTATIONS II	***(Kitty Hawk)***
3:15 PM – 4:00 PM	**Siemens EDA: Solutions for Aerospace and Defense** *Presenter*: Rich Powlosky, Siemens EDA **Abstract:** Siemens Digital Industries Software and Siemens Xcelerator are transforming the everyday by giving companies like yours the agility, flexibility and adaptability to turn ideas into innovation with greater efficiency and speed. Discover why companies of all sizes are embracing digital transformation. Software for the Aerospace and Defense Industry provides the tools to accelerate digital transformation. Learn how to create the most comprehensive digital twin with our software portfolio, combining the real and digital worlds. Siemens Electronic Design Automation provides integrated solutions for Aerospace and Defense, including 2.5/3d heterogeneous systems, advanced node and mixed signal design implementation and signoff, rad-hard assurance capabilities and Independent Verification and Validation of active programs.

Agenda DAY 4

Thursday August 31, 2023

Time	Event	Location
7:30 AM – 10:30 AM	Registration	Ballroom Foyer
8:15 AM – 9:00 AM	**KEYNOTE 5:** **Technology Roadmaps: Communication and Intelligent Systems Technology Development in Support of NASA Missions** *Presenter:* **Dr. Felix Miranda, NASA Glenn Research Center**	**Ballroom**
9:00 AM – 11:35 AM	**CONCURRENT MORNING SESSIONS**	**Coffee Break 10:00 AM – 10:15 AM**
9:00 AM – 10:55 AM	Autonomous Systems I & II	Ballroom
9:00 AM – 11:35 AM	Special Session on MTT-S I & II	Auditorium
11:45 AM – 12:45 PM	**NAECON LUNCHEON** **Closing Remarks from the NAECON Committee**	**Ballroom**

POST CONFERENCE PRESENTATION

VTC 3D Virtual NAECON for Artificial Intelligence and Cybersecurity

Thursday August 31, 2023 from 2:00 PM – 4:00 PM (Zoom only)

Students in the Discovery Lab - Global (DLG) summer program will conduct a virtual technical session of their Artificial Intelligence (AI) and Cybersecurity summer projects from inside of DLG's 3D virtual campus via Zoom. This 2-hour session via Zoom will cover student summer projects in Deep Learning AI, Generative AI, and development of a ChatGPT cybersecurity avatar tutor. DLG builds on the foundational legacy of the original AFRL Discovery Lab that Dr. Rob Williams led for 10 years before retiring as the founding director to continue it philosophically as the non-profit DLG which is in its 7th year.

Thursday August 31, 2023

MORNING SESSIONS (9:00 AM – 11:30 AM)

Autonomous Systems I and II

(Ballroom)

Chairs: **Dr. Vijayan Asari (University of Dayton) and Dr. Christopher Stewart (Ohio State University)**

AUTONOMOUS SYSTEMS I	
9:00 AM – 9:20 AM	**Range Limited Pursuit Evasion** *Presenter*: Dr. Isaac Weintraub, USAF AFRL *Co-Authors*: *Alexander Von Moll (AFRL), Meir Pachter (AFIT)* **Abstract:** In pursuit-evasion the objective of the pursuer is to capture the evader. In this work, the faster pursuer is modeled to have limited range and therefore optimal strategies for the pursuer and evader change. Depending upon the range limits of the pursuer the evader may evade capture by the pursuer. This paper describes the optimal strategies and nuances that appear for point-capture or when the pursuer is endowed with a non-zero capture radius.
9:20 AM – 9:40 AM	**A Programmable Hybrid Simulation Environment for Coordination of Autonomous Vehicles** *Presenter*: Mr. Hossein Mohammadi, UDRI *Co-Authors:* *Zhenhua Jiang and Linh Nguyen (UDRI)* **Abstract:** The aim of this paper is to investigate a programmable hybrid simulation environment (based on PX4 and ROS2, two commonly used packages for autonomous vehicle simulation) that enables the coordination of multiple autonomous vehicles or systems. This work also aims to demonstrate the potential benefits and significance of effective coordination and communication among these autonomous vehicles. In the paper, we present two hypothetical scenarios featuring two autonomous vehicles, a drone and a rover, interacting with each other and use them to showcase the possibility of autonomous operation and the performance of their behavior and sophisticated coordination. To achieve an effective and flexible communication among the ROS2 and PX4 platforms, the development of new topics and computing nodes that allow bi-directional communication between two vehicles is presented. The paper details two scenarios where the drone and rover interact actively in the PX4 and ROS2 platforms, respectively, using a custom bidirectional topic created on a ROS2 node. In either platform, the drone and rover can publish and subscribe to the topic for effective communication. The presented work is useful in various fields, such as aerospace systems, transportation, logistics, agriculture, and search and rescue operations, where efficient coordination of autonomous vehicles could significantly enhance efficiency, safety, and performance.

9:40 AM – 10:00 AM	**Connected Cars: GPS-OBD Sensor Fusion with Radio Communication** *Presenter*: Mr. Steven Nyeo, Case Western Reserve University *Co-Authors:* *Chris Papachristou (Case Western Reserve University) and Frank Wolff (KBR)* **Abstract:** This work proposes a decentralized wireless framework that can enable two or more connected vehicles to transmit and receive GPS/OBD data such as position, velocity, and acceleration to/from other vehicles during driving conditions. A prediction algorithm is developed that uses real-time data to mitigate and avoid collisions.
10:00 AM – 10:15 AM	**COFFEE BREAK**
AUTONOMOUS SYSTEMS II	***(Ballroom)***
10:15 AM – 10:35 AM	**Improving Object Detection Using Enhanced EfficientNet Architecture** *Presenter*: Mr. Michael Ibrahim, Purdue University *Co-Authors:* *Mohamed El-Sharkaway (Purdue University)* **Abstract:** EfficientNet is a neural network architecture designed to achieve noticeably better accuracy while using fewer parameters and less computational resources compared to previous models. In previous EfficientNet work, it was proposed to use a compound scaling method that uniformly re-weighs the network width, depth, and resolution, which results in better performance than older methods that scale only one or two of these dimensions. In this paper, we are using ImageNet dataset and weights, furthermore proposing MixConv, H-Swish and Sandglass, in addition to adjusting object detection rate, being more restrictive with losses ranges, manipulating focal losses values and finally using ratio method to group images for training, which demonstrated the effectiveness of EfficientNet on transfer learning and object detection tasks, where it achieves higher accuracy with fewer parameters and less computation. Our approach provides a scalable and efficient solution for both academic research and practical applications, where resource constraints are often a limiting factor.
10:35 AM – 10:55 AM	**Control Moment Gyroscope Equipped Quadcopter Control in Wind Conditions** *Presenter*: Mr. Sameer Bhalla, University of Cincinnati *Co-Authors:* *Donghoon Kim (University of Cincinnati)* **Abstract:** This study investigates the ability of a quadcopter equipped with two Control Moment Gyroscopes (CMGs) to hover in real-life wind conditions. The objective is to develop a mathematical model of the quadcopter and assess the performance of the CMG controller compared to a quadcopter without CMGs in the presence of wind disturbances.

Thursday August 31, 2023

MORNING SESSIONS (9:00 AM – 11:30 AM)

Special Session on MTT-S I and II

(Auditorium)

Chairs: Dr. Guru Subramanyam (University of Dayton) and Dr. Felix Miranda (NASA Glenn Research Center)

SPECIAL SESSION ON MTT-S I	
9:00 AM – 9:30 AM	**Microwave Filters Based Upon Tunable Thin Films** *Presenter*: Dr. Eric Hoppenjans, Indiana Microelectronics, LLC ***(Invited Speaker)*** **Abstract:** This talk will focus on microwave filter development at Indiana Microelectronics. The filters are based upon BST thin-film varactors, and advanced packaging techniques utilizing glass substrates are leveraged to create highly compact filters. Recent measured results will be presented.
9:30 AM – 10:00 AM	**Ultracompact Magnetoelectric Antenna and Magnetodielectric Antennas Beyond Chu's Limit** *Presenter*: Dr. Nian Sun, Northeastern University ***(Invited Speaker)*** **Abstract:** We report here ultracompact magnetoelectric antennas based on a mechanically coupled magnetic/piezoelectric heterostructures and magnetodielectric antennas. We will demonstrate that both antennas show bandwidth beyond the Chu's limit.
10:00 AM – 10:15 AM	**COFFEE BREAK**
SPECIAL SESSION ON MTT-S II	
10:15 AM – 10:45 AM	**Plasmon Field Effect Transistor for Biosensing and Tailored Photodetection** *Presenter*: Dr. Sung Jin Kim, University of Louisville ***(Invited Speaker)*** **Abstract**: A plasmon field effect transistor (FET) offers direct plasmon-to-electric signal conversion with signal amplification. We will present the device structure of plasmon FET and the operation details, as well as examples of application in bio sensing and tailored optical detection.

10:45 AM – 11:15 AM	**XBAW Technology – Enabling Next Generation Radio Frequency Filter Solutions Spanning FR1 and FR3 (2-20 GHz)** *Presenter*: Dr. Abhay Kochhar, Akoustis Technologies ***(Invited Speaker)*** *Co-Authors: Kamran Cheema* **Abstract:** Bulk acoustic wave (BAW) is the technology of choice for RF signal filtering in the range of 2 – 7 GHz. BAW technology enables small filter dimensions, leading to compact systems, improved design tradeoffs and lowered cost. In this talk, we showcase the Akoustis' capability and performance of resonators and filter solutions created using XBAW, a novel manufacturing process, capable of producing state-of-the-art BAW RF resonators and filters for WiFi, 5G infrastructure, 5G mobile, and defense/general applications. Using this XBAW wafer manufacturing process and a variety of advanced high purity piezoelectric AlN and AlScN thin films, RF filter solutions are created to address needed improvements in bandwidth, operating frequency and output power compared to incumbent BAW technology deployed today. Further, Akoustis' technological advancement leading towards high frequency solutions up to 20 GHz, will also be presented.
11:15 AM – 11:35 AM	**Ultra Low-Power Low-Noise GNRFET Wideband Amplifier for Cryogenic Applications** *Presenter*: Mr. Linknath Surya Balasubramanian, IUPUI *Co-Authors: Zachary Cochran, Maher Rizkalla, and John Lee (IUPUI), Trond Ytterdal (Norwegian Institute of Science and Technology)* **Abstract:** Cryogenics amplifiers feature very low noise injection and low power consumption, and therefore, they are of highly demand in RF imaging, space communications, medical applications, and quantum computing. Unconditional stability with high gain also features these applications. The band gaps of these devices are independent from temperature, suggesting their suitability for cryogenics applications. Furthermore, the nanometer scale lengths of these devices lead to ballistic transport with no scattering or diffusion, resulting in high-speed, low-power, and low noise capabilities within Extremely High Frequency (EHF) operating range that may extend into the THz. This study addresses these parameter issues within the range of 90K to 300K, assuming liquid nitrogen coolant medium, and further shows its stability above the room temperature as well. An appropriate model for the device that incorporates complex parasitics was investigated within this temperature range. The device with its estimated parameters, has been integrated into a simulated three-stage amplifier system. A low-noise gain between 16.9-18.9 dB with estimated noise figure of 2.97 dB and a bandwidth of 269 GHz bandwidth were predicted, with a high Stern stability factor suggesting unconditional stability over the bandwidth.

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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

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NOTES

NOTES

UPCOMING OPPORTUNITIES

VTC 3D Virtual NAECON for Artificial Intelligence and Cybersecurity

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December 11–13, 2023 in National Harbor, MD

The Association of Old Crows (AOC) is an organization for individuals who share common interests in Electronic Warfare (EW), Electromagnetic Spectrum Operations (EMSO), Cyber Electromagnetic Activities (CEMA), Information Operations (IO), and other information related capabilities.The Association of Old Crows provides a means of connecting members and organizations nationally and internationally across government, defense, industry, and academia to promote the exchange of ideas and information, and provides a platform to recognize advances and contributions in these fields.

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