Agenda

IEEE NATIONAL AEROSPACE ELECTRONICS CONFERENCE (NAECON 2017)

June 27– June 30, 2017

naecon.org

Luncheon, Banquet & Tutorials *(Fees Included with Conference Registration)*

Holiday Inn, 2800 Presidential Drive, Fairborn, OH 45324

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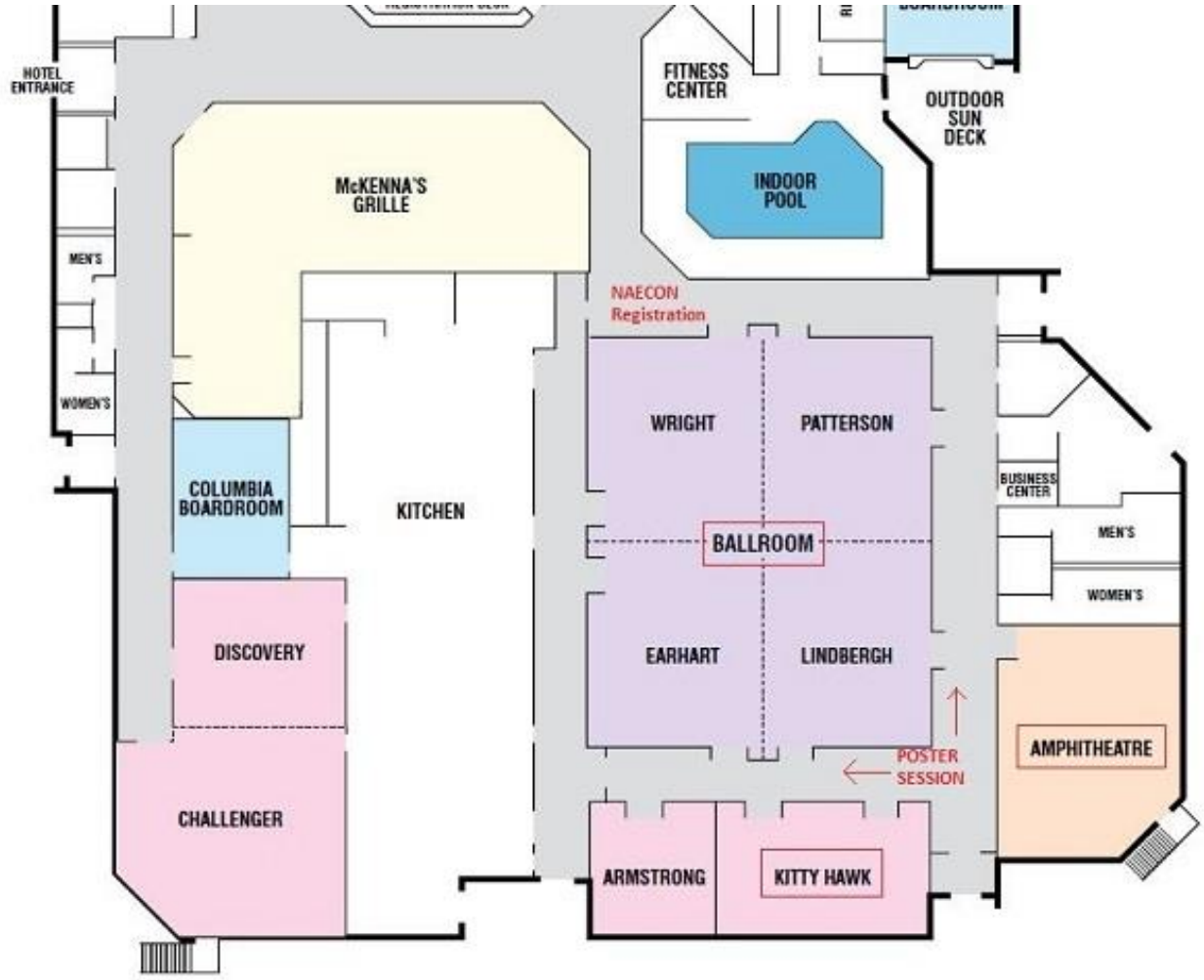
PROGRAM CONTENTS

Holiday Inn Dayton/Fairborn I-675
Venue Floorplan



Detailed Agenda

Day 1 – Tutorials-Tuesday, June 27, 2017

Time	Event	Location
12:00-5:00pm	Registration	Ballroom Foyer
Tutorial A (1:00 pm - 5:00 pm)	**Trusted Systems and Electronics**	**Ballroom**
Tutorial B (1:00 pm - 3:00 pm)	**Understanding Infrared Detection**	**Auditorium**
Tutorial C (3:15 pm -5:15 pm)	**Overview of 5G Developments**	**Auditorium**

NAECON Informal Social Event
Holiday Inn Fairborn (Restaurant-Cash Bar)
Time: 5:30pm-7:30pm

Day 2 – Wednesday, June 28, 2017

Time	Event	Location
7:30am-8:30am	**Registration (All-Day) Opens & Breakfast**	**Ballroom Foyer**
8:30am-8:45am	**Opening Ceremony (NAECON Committee)**	**Ballroom**
8:45am-9:30am	**Plenary 1 Speaker**	**Ballroom**

Dr. Patrick Roblin, Ohio State University,
"New Paradigm for the Accelerated Design of Power Efficient RF Amplifiers"

9:30am-10:15am **Plenary 2 Speaker**
Dr. Gary Scalzi, Air Force Research Lab
"Air Force ManTech – Bridging the Valley of Death: From Science & Technology to Manufacturing & Production"

Morning Sessions 10:30am-12:00pm (Coffee Break 10:15am-10:30am)

Title	Location
Low SWaP Sensor Processing (10:30am-11:50am)	**Ballroom**
THz and Millimeter Wave Sensors and Imaging (10:30am-12:00pm)	**Auditorium**
Aerospace Power Systems and Power Electronics (10:30am-11:40pm)	**Kitty Hawk**

10:30am-11:50pm **Low SWaP Sensor Processing** **Ballroom**
Chairs: Kerry Hill and Al Scarpelli, AFRL Sensors Directorate

10:30am-10:50am **Evaluation of Interference Covariance Estimation Leveraging OpenCL for FPGA**s, *Jonathon Skeans, UDRI Sensor APEX*
10:50 am-11:10am **Efficient and Autonomous Processing and Classification of Images on Small Spacecraft**, *Anthony Gillete, University of Pittsburgh*

*11:10am-11:*30am **OPIR Video Preprocessing and Compression for On-Board Aerospace Computing**, *Eric Shea, University of Pittsburgh*
11:30am-11:50am **Gate Density Advantage of Parellel-Operation-Oriented FPGA Architecture***, Takumi Fujimori, Shizuoka University, Japan*

10:30am-12:00pm THz and Millimeter wave Sensors Auditorium
Chairs: Elliott Brown (Wright State University) and Kubilay Sertel (Ohio State University)

10:30am-11:00am **Optically Controlled Tunable and Reconfigurable Terahertz Devices,** *Lei Liu (Invited), Notre Dame University*
11:00am-11:20am **New High-Extinction Wire-Grid Polarizers for Polarimetric W-Band Radar,** *Weidong Zhang, Wright State University*
11:20am-11:40am **THz Performance of 1550-nm-driven Photoconductive Switches made from GaAs:Er with ErAs Quantum Dots,** *Andrea Mingardi, Wright State University*
11:40am-12:00pm **Effects of Radio Frequency Radiation on Epidermal Cells***, Katrina Thede, Wright State University*

10:30am-12:00pm Aerospace Power Systems and Power Electronics Kitty Hawk
Chairs: Jinhui Zhang (GE EPISCenter) and Zhenhua Jiang (University of Dayton Research Institute)

10:30am-11:00am **Considerations for Failure Prevention in Aerospace Electrical Power Systems Utilizing Higher Voltages,** *Daniel Schiweickart (Invited), AFRL Aerospace Systems Directorate*
11:00am-11:20am **Negative Virtual Inductance for DC Microgrids with Constant Power Loads,** *Jianzhe Liu, Ohio State University*
11:20am-11:40am **Design and Implementation DC-DC Boost Converter with PI Controller for Lithium-ion Battery**, *Hamad Elwarfalli, University of Dayton*

Luncheon 12:00pm–1:15pm **Ballroom**

Keynote Speaker: Dr. Elliott Brown, Wright State University

Title: "Good Vibrations: Resonant RF Interactions with Bioparticles and Biomolecules from GHz to THz"

1:15pm-2:00pm Plenary 3 Speaker Ballroom
Mike Parker, Intel Corp,
"Stratix 10: Intel's latest FPGA technology and capabilities"

Afternoon Sessions 2:00pm - 5:45pm (Coffee Break 3:30pm - 3:45pm)

Title	Location
Low SWaP Sensor Processing (2:00pm - 3:20pm)	Ballroom
Guidance and Control (3:45pm - 5:15pm)	Ballroom
THz and Millimeter Wave Sensors and Imaging (2:00pm - 3:30pm)	Auditorium
Trusted Systems and Electronics (3:45pm - 5:45pm)	Auditorium
Emerging Electronics and Microsystems (2:00pm - 4:50pm)	Kitty Hawk

2:00pm-3:20pm Low SWaP Sensor Processing Ballroom
Chairs: Kerry Hill and Al Scarpelli (AFRL Sensors Directorate)

2:00pm-2:20pm **CNN on SUAV**, *Joshua Kaster, UDRI Sensor APEX*

2:20pm-2:40pm **Accelerated Pattern Matching on a Neuromorphic Processor with Application to Forensic DNA Profile Searches**, *William Mitchell, AFRL Sensors Directorate*
2:40pm-3:00pm **An Efficient FPGA-Based Direct Linear Solver**, *Zhenhua Jiang, UDRI*
3:00pm-3:20pm **High Sensitivity Low Noise Nano-Gas Sensing Device with IoT capabilities**, *Goel Tanu, Syscon International*

2:00pm-3:30pm THz and Millimeter Wave Sensors Auditorium
Chairs: Elliott Brown (Wright State University) and Kubilay Sertel (Ohio State University)

2:00pm-2:30pm **Fully-Automated Non-Contact Characterization of On-Wafer mmW and THz Devices & Ics**, *Cosan Caglayan, Ohio State University (Invited)*
2:30pm-2:50pm **High-Resolution Polarimetric THz Imaging,** *Nandhini Srinivasan, Ohio State University*
2:50pm-3:10pm **Single-bit Compressive Imaging for mmW and THz Applications,** *Syed Saqueb, Ohio State University.*
3:10pm-3:30pm **Imaging the Hydration Level of Human Skin with A Millimeter-Wave Reflectometer,** *Weidong Zhang, Wright State University*

2:00pm-3:30pm Emerging Electronics and Microsystems Kitty Hawk
Chairs: Vamsy Chodavarapu (University of Dayton) and Soumyajit Mandal (Case Western Reserve University)

2:00pm-2:30pm **Design and Prototype Implementation of an 8-Beam 2.4 GHz Array Receiver for Digital Beamforming using Multiplierless DFT Approximation Algorithms,** *Arjuna Madanayake (Invited), University of Akron*
2:30pm-3:00pm **Integrated Ferroics for Sensing, Power, RF, Microwave and mm-wave Tunable Electronics,** *Nian Sun (Invited), Northeastern University*
3:00pm-3:30pm **500°C Packaging Technology for SiC High Temperature Electronics – Most Recent Progress,** *Linagyu Chen (Invited), NASA Glenn Research Center and Ohio Aerospace Institute*

3:45pm-5:15pm Guidance and Control Ballroom
Chairs: Trevor Bihl (AFRL Sensors Directorate), and Raul Ordonez (University of Dayton)

3:45pm-4:15pm **Robotic Technology – A Merging of Engineering Disciplines,** *George Sutton (invited), Yashkawa Motoman*
4:15pm-4:35pm **Differential Flatness Based Hybrid PID/LQR Flight Controller for Complex Trajectory Tracking in Quadcopter UAVs,** *Rumit Kumar, University of Cincinnati*
4:35pm-4:55pm **Dynamic Modeling and Nonlinear Model Predictive Control of Hybrid Actuator Systems,** *Sayed Ata Raziei, University of Dayton*
4:55pm-5:15pm **Nonlinear Adaptive Control for Lateral Dynamics with Fixed Roll Angle of Hypersonic Vehicles at Subsonic Speeds,** *Turki Alsuwian, University of Dayton*

3:45pm-5:45pm Trusted Systems and Electronics Auditorium
Chairs: Charles Cerny and Matt Casto (AFRL Sensors Directorate)

3:45pm-4:05pm **Understanding Vulnerabilities in ReRAM Devices for Trust in Semiconductor Designs,** *Thomas Schultz, University of Cincinnati*
4:05pm-4:25pm **Formal Enforcement of Mission Assurance Properties in Cyber-Physical Systems,** *Scott Harper, Graf Research*
4:25pm-4:45pm **Sampling Iso-Functional Signal Switches in Library Circuits for Microelectronics Verification with Topological Constraints,** *Leleia Hsia, Eglin AFB*
4:45pm-5:05pm **Visible but Transparent Hardware Trojans in Clock Generation Circuits,** *Randall Geiger, Iowa State University*
5:05pm-5:25pm **Stochastic Approximation for Learning Rate Optimization for Generalized Relevance Learning Vector Quantization,** *Daniel Steeneck, AFIT*
5:25pm-5:45pm **The Use of Automated Theorem Proving for Error Analysis and Removal in Safety Critical Embedded System Specifications Enhancing FPGA Security through Trojan Resilient IP Creation,** *Jonathan Lockhart, University of Cincinnati*

5:45pm-6:05pm **Enhancing FPGA Security through Trojan Resilient IP Creation,** *Noor Ahmad Hazari, University of Cincinnati*

3:30pm-4:50pm Emerging Electronics and Microsystems **Kitty Hawk**
Chairs: Vamsy Chodavarapu (University of Dayton) and Soumyajit Mandal (Case Western Reserve University)

3:30pm-3:50pm **Embedded Silicon Odometers for Monitoring the Aging of High-Temperature Integrated Circuits,** *Jifu Liang, Case Western Reserve University*
3:50pm-4:10pm **A Compact On-Chip Threshold Voltage-Based Temperature Sensor with 0.29ºC/-0.26ºC Inaccuracy Using 130nm CMOS,** *Chin-wen Chen, Iowa State University*
4:10pm-4:30pm **Modeling of Segmented Controlled Electrostatically Actuated Bimorph Beams,** *Kullen Wagganor*
4:30pm-4:50pm **Design and Analysis of Wafer-level Vacuum-Encapsulated Disk Resonator Gyroscope Using a Commercial MEMS Process,** *Balaadhithya Uppalapati, University of Dayton*

Day 3 – Thursday, June 29, 2017

Time	Event	Location
7:30am-8:30am	**Registration (All-Day) Opens & Breakfast**	**Ballroom Foyer**

Morning Sessions 8:30am - 12:00pm (Coffee Break 10:15am - 10:30am)

Title	Location
Photonics and Electro-Optics (8:30am-11:50am)	**Ballroom**
Radar, Tomography and RF Sensing (8:30am-11:50pm)	**Auditorium**
Deep Learning, Artificial Intelligence and Cyber Security (8:30am-11:50am)	**Kitty Hawk**

8:30am-10:00am Photonics and Electro-Optics **Ballroom**
Chairs: Jia Li (Oakland University), Paul McManamon (University of Dayton), Nicholaos Limberopoulos (AFRL)

8:30am-9:00am **Lidar and Non-mechanical Beam Steering,** *Paul McManamon (Invited), University of Dayton*
9:00am-9:30am **Lidar and Indoor Localization System,** *Jia Li (Invited), Oakland University*
9:30am-10:00am **Coherent Lidar System on a Chip,** *Paul Suni (Invited), Lockheed Martin*

8:30am-10:10am Radar, Tomography and RF Sensing **Auditorium**
Chairs: Brian Rigling (Wright State University) and Ethan Lin (University of Dayton Research Institute)

8:30am-8:50am **Evaluation of Aperture Weighting Techniques for SAR Image Formation,** *Eric Balster, University of Dayton*
8:50am-9:10am **Applying Filtered Back Projection Algorithm for Pseudo-Coherent Radar,** *Mansour Aljohani, University of Dayton*
9:10am-9:30am **Optimality Problem of Sensor Geometry of Multiple Transmitters and Receivers for Below Ground Imaging of Objects in A Region of Interest,** *Abdulhakim Daloum, University of Dayton*
9:30am-9:50am **The Impact of Reflected Waves on the Reconstruction of Tomographic Imaging,** *Abdunasar Abdusamad, University of Dayton*
9:50am-10:10am **RF Tomography based Optimal Linear Filter***, Muftah Akroush, University of Dayton*

8:30am-10:20am Deep Learning, Artificial Intelligence and Cyber Security **Kitty Hawk**
Chairs: Tarek Taha (University of Dayton), Nilesh Powa (UDRI) and Tem Kebede (University of Dayton)

8:30am-9:00am **Are We At A Crossroads? Exploring A Future Convergence of Philosophy, Neuroscience, Computing, and Cyber Security***, Sherry Sparks(Invited), Clearhat Consulting*

9:00am-9:20am **Memristor Crossbar Based Implementation of a Multilayer Perceptron**, *Chris Yakopcic, University of Dayton*
9:20am-9:40am **Smart Translator for Climate Control Sensors and Devices on an Interoperable Climate Management Platform,** *Kelly Cashion, UDRI*
9:40am-10:00am **Neuromorphic Device Specifications for Unsupervised Learning in Robots,** *Mohamed Sarim, University of Cincinnati*
10:00am-10:20am **A Variable-Appearance-Driven and Multi-Model Enhanced Convolutional Neural Network for Object Tracking,** *Ying Li, Ohio State University*

Coffee Break 10:15am - 10:30 am

10:30am-11:50am Photonics and Electro-Optics **Ballroom**
Chairs: Jia Li (Oakland University), Paul McManamon (University of Dayton), Nicholaos Limberopoulos (AFRL)

10:30am-11:00am **Integrated Photonics in the US,** *Nick Usechak (invited), AFRL Sensors Directorate*
11:00am-11:30am **3D Mapping Performance Estimates of Integrated Photonic Phased Array Lidar,** *Richard M. Marino (Invited), MIT Lincoln Lab*
11:30am-11:50am **Metasurface Engineering via Evolutionary Processes,** *Kenneth Allen, Georgia Tech University*

10:30am-12:10pm Radar, Tomography and RF Sensing **Auditorium**
Chairs: Brian Rigling (Wright State University) and Ethan Lin (University of Dayton Research Institute)

10:30am-10:50am **On the Use of Expert Reasoning to Enhance Generalized Likelihood Ratio Test (GLRT) Performance,** *Ethan Lin, University of Dayton Research Institute*
10:50am-11:10am **Cohering a Pulse Train in Magnetron Oscillator Based Marine Radar,** *Hamsa Elraash, University of Dayton*
11:10am-11:30am **Demonstrating the Limitations on Target Detection (Pd) and False Alarm Control (Pfa) Due to Cross-Correlated Interference in a Bistatic / Multistatic Rada,** *Turki Alanazi, University of Dayton*
11:30am-11:50pm **A Low Power CMOS Amplitude Peak Detector for On-chip Self-calibration Applications,** *Hao Xue, Wright State University*

10:30am-11:50pm Deep Learning, Artificial Intelligence and Cyber Security **Kitty Hawk**
Chairs: Tarek Taha (University of Dayton), Nilesh Powa (UDRI) and Tem Kebede (University of Dayton)

10:30am-10:50am **Terahertz Spectroscopic Material Identification Using Approximate Entropy and Deep Neural Network,** *Yichao Li, Ohio University*
10:50am-11:10am **Reducing Calculation Requirements in FPGA Implementation of Deep Learning Algorithms for Online Anomaly Intrusion Detection**, *Khaled Alrawashdeh, University of Cincinnati*
11:10am-11:30am, **Sparse Connected Deep Neural Network for Multicore System,** *Yangjie Qi, University of Dayton*
11:30am-11:50am **A Low Power High Throughput Architecture for Deep Network Training,** *Raqibul Hasan, University of Dayton*

Luncheon 12:00pm–1:15pm **Ballroom**

Keynote Speaker: Dr. John Volakis, The Ohio State University

"Ultra-Wideband Arrays with Low Cost Beamforming Back-Ends"

Afternoon Sessions 1:15pm-5:00pm (Coffee Break-3:15pm-3:30pm)

Title	Location
Photonics and Electro-Optics (1:15pm-3:15pm)	Ballroom
Algorithms for Tracking and Surveillance (1:15pm-3:15pm)	Auditorium
Deep Learning, Artificial Intelligence and Cyber Security (1:15pm-2:55pm)	Kitty Hawk

1:15pm-3:15pm Photonics and Electro-Optics Ballroom
Chairs: Jia Li (Oakland University), Paul McManamon (University of Dayton), Nicholaos Limberopoulos (AFRL)

1:15pm-1:35pm **Passive and Active Sensing - Plasmonic grating geometries and wavelength-dependent focus depth in IR detectors** *Patrick Kennedy, AFIT*
1:35pm-1:55pm **A Signal Processing and Data Analysis Technique for Accurate Extraction and Estimation of FTIR Signal Aberrations in Microsphere-Lens-Enhanced MWIR Photo Detectors Via System Transfer Functions Mathematical Modeling,** *Dalila B. Megherbi, University of Massachusetts, Lowell*
1:55pm-2:15pm **Using FTIR Spectral Response Signals to Separate, Characterize and Quantify the Effects of Silicone Based Adhesive on Microsphere Lens Enhanced MWIR SLS Photo Detectors,** *Dalila B. Megherbi, University of Massachusetts, Lowell*
2:15pm-2:35pm **Quantification of Resolution in Microspherical Nanoscopy,** *Aaron Brettin, University of North Carolina, Charlotte*
2:35pm-2:55pm **Mode Hybridization in Photonic Molecules Comprised of Microspheres: Modeling and Experiment,** *Farzaneh Abolmaali, University of North Carolina, Charlotte*
2:55pm-3:15pm **Slanted electromagnetic wave propagation through atmospheric phase turbulence using altitude-dependent structure parameter,** *Ali Mohamed, University of Dayton*

1:15pm-3:15pm Algorithms for Tracking and Surveillance Auditorium
Chairs: Vijayan Asari and Theus Aspirus (University of Dayton)

1:15pm-1:35pm **Fusing Facial Shape and Appearance Based Features for Robust Face Recognition,** *Almabrok Essa, University of Dayton*
1:35pm-1:55pm **Fused Shape Features Based on Gradients and Local Phase in Color Domain,** *Hussin K. Ragb, University of Dayton*
1:55pm-2:15pm **Robust Multi-view Pedestrian Tracking Using Neural Networks,** *Md Zahangir Alom, University of Dayton*
2:15pm-2:35pm **Towards Autonomous Surveillance in Real World Environments,** *Gayatri Behara, University of Dayton*
2:35pm-2:55pm **Motion Model Enabled Appearance Prediction for Partial Human Body Tracking in Robot follower,** *Yingying Li, Ohio State University*
2:55pm-3:15pm **Sparse Representation Based Classification Performance under Different Optimization forms for Face Recognition**, *Khalfal Awedat, Pacific Luthern University*

1:15pm-2:55pm Deep Learning, Artificial Intelligence and Cyber Security Kitty Hawk
Chairs: Tarek Taha (University of Dayton), Nilesh Powa (UDRI) and Tem Kebede (University of Dayton)

1:15pm-1:35pm **Network Intrusion Detection for Cyber Security using Unsupervised Deep Learning Approaches,** *Md Zahangir Alom, University of Dayton*
1:35pm-1:55pm **Classification of Malware Programs using a Deep Learning Architecture and its Application to Microsoft Kaggle Dataset,** *Tem Kebede, University of Dayton*
1:55pm-2:15pm **Cognitive Domain Ontologies in a Memristor Crossbar Architecture,** *Chris Yakopcic, University of Dayton*
2:15pm-2:35pm **A Novel Hybrid Delay Based Physical Unclonable Function Immune to Machine Learning Attacks,** *Nitin Pundir, University of Toledo*
2:35pm-2:55pm **Big Cyber Data Analysis: Developing Embedded Analytics Methods for Efficient Cyber Data Mining,** *Brad Boehmke, AFIT Operational Sciences*

Coffee Break 3:00pm - 3:30pm

6:00pm-9:00pm NAECON Banquet Ballroom
7:00pm Banquet Speaker:
Daniel Both, Former Technical Director of Trusted Foundry Program
"50 Years of Trusted Microelectronics for the DoD and IC"

Day 4 – Friday, June 30, 2017

Time	Event	Location
7:30am-8:30am	Registration (Through 12:00pm) /Breakfast	Ballroom Foyer

8:30am-9:15am: Plenary 4 Speaker — **Ballroom**

Captain JT Elder, Commander of the Naval Surface Warfare Center

“"Globalization of MicroElectronics"

9:15am-10:00am: Plenary 5 Speaker — **Ballroom**

Representative Rick Perales, Ohio House of Representatives, 73rd District

10:00am - 10:15am: Coffee Break

10:15am-11:30am: Dr. Rob Williams, Discovery Lab Global

Lunch 11:30am-1:15pm (Buffet Lunch) — **Ballroom**

WOMEN IN ENGINEERING PANEL

"STEM-M, Fostering the Next Generation of Women Engineers, Mathematicians and Scientists"

Dr. Cassie Barlow, Executive Director, WSU Aerospace Professional Development Center

Dr. Emily Cory, Director, AFRL Maker Hub

Ms. Jackie Janning-Lask, Engineering Director, Agile Combat Support, AFLCMC

Dr. Patricia Ryan, Special Assistant to the Office of the Director NASA-Glenn Research Center

Dr. Sandra Specht, Chair, Women in Science, Technology, Engineering and Mathematics (WiSTEM)

1:15pm-3:30pm Poster Session - Judging of posters for awards — **South Corridor (Ballroom Foyers)**

Session chairs: Kenneth Simone, UDRI and Dr. Bob Penno, UD

3:30pm-4:00pm Best Poster Awards and Closing of NAECON 2017

Thank you for attending NAECON 2017!

Tutorials-Tuesday, June 27, 2017

Tutorial A Trusted Systems and Electronics

Presenters: Dr. Charles Cerny and Dr. Matt Casto

1:00-1:15 PM Welcome and Introduction - Charles Cerny
1:15-2:15 PM "History of Trusted IC's" - Daniel Both
2:15-3:00 PM “Engineering Trusted Systems” - Carla Purdy

Abstract: As software and embedded systems take on more responsibilities in such fields as consumer products, medical devices, automobiles, airplanes, defense systems, financial systems, and manufacturing, the need to ensure that they behave as expected has become critical. Users must be able to trust that these systems are safe, reliable, secure, and appropriately responsive to the task at hand. Many strategies and tools have been developed to ensure safety and reliability, especially at the hardware level, and these continue to be modified and extended to work for embedded systems and complex software. But major challenges exist in the continually evolving area of security. We will review commonly accepted definitions of trust in various domains and look at some strategies for enhancing tools for developing trusted systems in general and secure systems in particular.

3:00-3:15 PM Break
3:15-4:10 PM TBD
4:10-4:50 PM "Trusted Microelectronics and Supply Organization" - Matt Casto
4:50 PM Wrap-up and Questions

Tutorial B

Presenter: Dr. Kenneth Hopkins, Air Force Research Laboratory

Tutorial Description: Infrared detection and imaging is in general a mature technology that is fundamentally critical for tactical and strategic military applications. The infrared, for example, enables high-contrast sensing of jet engine exhaust against an earthscape and of satellites against space. Yet, there are numerous technical opportunities for further advancing the capabilities. The tutorial will quickly cover the physics of infrared detection and imaging with emphasis on state-of-the-art semiconductor technology, and the performance of various systems/devices/materials will be compared. The critical performance parameters for these devices will be explained and derived when possible. The lecturer assumes attendees’ have a technical background but without specialized study in the physics of these devices.

TUTORIAL OUTLINE:

Infrared Detectors

- Devices
  - Photoemissive
  - Photoconductor
  - Photodiode
  - Schottky detectors
  - Avalanche photodiode
  - Others
- Detection circuitry
- Infrared Imagers
  - Non-hybrid
  - Hybrid
    - Direct injection
    - CTIA

Tutorial C

Presenter: Michel Gagné, Keysight Technologies

Tutorial Description: The commercial communications industry is abuzz with 5G. Whether it is carriers like Verizon and DOCOMO, regulatory bodies like the FCC and OfCom, semiconductor companies like Qualcomm and Intel, or network giants like Nokia and Huawei, the race is on to see who will win in this next generation. This talk takes a step back to look at the market drivers for the vision of this next generation, a summary of key technologies getting the most attention in the R&D labs, and a brief overview of the business ecosystem including the regulatory and standards perspective. It will also cover the timing of 5G and what to expect in the next year or two.

Plenary Presentations (Wednesday – Friday)

Plenary 1 Speaker: Dr. Patrick Roblin, Ohio State University, "New Paradigm for the Accelerated Design of Power Efficient RF Amplifiers"

Abstract: The design of power efficient RF/microwave power amplifiers remains of critical importance for communication and radar systems. In the search for the optimal power-efficient PA operation, designers are now relying on waveform engineering at the current generator reference planes of the transistors. However a huge search space must be explored to find the source and load multi-harmonic impedance terminations required to realize these desired internal waveforms. Coming to the rescue a new design paradigm has emerged in which a nonlinear embedding device model is used to synthesize them in a single simulation for each input power level. Examples of such designs for Doherty, Chireix and class-J PAs will be presented to demonstrate how this technique streamlines the design of eco-friendly PAs.

Plenary 2 Speaker: Dr. Gary Scalzi, AFRL "Air Force ManTech – Bridging the Valley of Death: From Science & Technology to Manufacturing & Production"

Abstract: This talk will discuss the Air Force and Department of Defense Manufacturing Technology (ManTech) enterprise and how it is employed to help transition technologies from Research & Development into the US industrial base, what processes & programs exist within the Air Force Research Laboratory and the Defense Department, what makes a good transition program, and what companies can do to successfully engage with AF ManTech to become a successful supplier of technology to The AF & DoD.

Plenary 3 Speaker: Mike Parker, Intel Corp, "Stratix 10: Intel's latest FPGA technology and capabilities"

Abstract: Overview of Intel's latest Stratix 10 FPGA, which is now sampling.
This talk will introduce Intel's new HyperFlex enabled FPGA logic with SiP (system in package) architecture. The logic resources, floating point DSP architecture, ARM SoC and new memory hierarchy including HBM memory, as well as a suite of new tile based transceiver and supported protocols will be covered. Examples of Stratix 10 benchmarks pertinent to signal processing, and new device security architecture and capabilities will be reviewed. Additional topic will be Intel's OpenCL toolflow, ideally suited to for large Stratix 10 FPGAs, which is now allowing non-FPGA designers to benefit from FPGA acceleration capabilities.

Plenary 4 Captain JT Elder, Commander of the Naval Surface Warfare Center, Crane, Indiana "Globalization of MicroElectronics"

Abstract: NSWC Crane has supported the Department of Navy in the area of microelectronics for over 50 years. With this support, the Navy has made significant investments that have resulted in a facility with extensive support capability as is found in today's silicon foundries, all under one roof. These support activities address all aspects of the microelectronics device system: design, failure and material analysis, component test, technology protection, radiation effects, obsolescence, cyber hardware and firmware. As a result of the technical competency demonstrated by the NSWC Crane team, ASD(R&E) approached DASN(RDT&E) requesting DoN provide technical execution oversight for the Trusted and Assured Microelectronics (T&AM) Program. This effort is critical as the globalization of the microelectronics supply chain has introduced additional risk. It is imperative that the microelectronics used in our war fighter's systems operate as designed, whenever called upon.

Wednesday, June 28, 2017

Low SWaP Sensor Processing (MORNING)

Evaluation of Interference Covariance Estimation Leveraging OpenCL for FPGAs, *Jonathon Skeans, UDRI Sensor APEX*
Abstract: Space-time adaptive processing (STAP) is a signal processing technique that is most commonly used in radar applications. STAP involves the use of adaptive array processing algorithms to assist in target detection and classification. One of the key steps in the STAP is the computation of the interference covariance matrix. The interference covariance matrix is used to build the optimal filter for clutter suppression. STAP is a particularly demanding in terms of processing requirements and only recently have those requirements become practical on today's processing architectures. Most radars that would benefit from STAP have size, weight, and power constraints. One technology that would be beneficial is FPGAs. However, due to the long development time associated with FPGAs, they are unfavorable. Recently, FPGA vendors have adopted OpenCL to overcome the long development cycles traditionally associated with FPGAs. This paper will assess the performance of the interference covariance estimation algorithm leveraging OpenCL for FPGAs.

Efficient and Autonomous Processing and Classification of Images on Small Spacecraft, *Anthony Gillette, University of Pittsburgh*
Abstract: CubeSats and other small spacecraft and aerospace systems are severely resource-limited, and new sensors generate demanding data products. This research describes an autonomous image-classification framework to efficiently use downlink bandwidth, by prioritizing image products with high science value for download while deleting others, and a training framework for classifier calibration

OPIR Video Preprocessing and Compression for On-Board Aerospace Computing, *Eric Shea, University of Pittsburgh*
Abstract: Increasing bit-depth of new image sensors presents many challenges on resource-limited, on-board processors in aerospace. This paper provides new results, analysis, and insight with our novel methods for preprocessing with compression of Overhead Persistent InfraRed (OPIR) sensing on embedded processors including Xilinx Zynq-7020, Amlogic S905, and NVIDIA TX2.

Gate Density Advantage of Parallel-Operation-Oriented FPGA Architecture*, Takumi Fujimori, Minoru Watanabe, Shizuoka University, Japan*
Abstract: Recently, many studies of field programmable gate array (FPGA) hardware accelerators have been reported, in addition to studies of general-purpose computing on graphics processing units (GPGPUs), Xeon, Phi, and so on. Since parallel processing is indispensable for such accelerating applications on FPGAs, implementing numerous parallel processing circuits is important to improve the performance of such FPGA hardware accelerators. When implementing a parallel operation for a conventional FPGA, some waste occurs: the same context is stored on numerous regions of configuration memory. This waste presents a critical issue because FPGAs used as accelerators perform parallel processing exclusively in most cases. This paper therefore proposes a parallel-operation-oriented FPGA exploiting a common configuration context. Herein, we describe the advantages of gate density, propagation delay, and compilation time in parallel-operation-oriented FPGAs.

THz and Millimeter Wave Sensors and Imaging (MORNING)

Optically Controlled Tunable and Reconfigurable Terahertz Devices, *Lei Liu (Invited), Notre Dame University*
Abstract: Tunable and reconfigurable millimeter-wave to terahertz (mmw-THz) devices such as modulators/variable attenuators, tunable filters, coded apertures, phase shifters and high-level switches (e.g., DPDT) that are required for advanced imaging and adaptive wireless communication applications are challenging to realize. We report a promising approach to develop the above mmw-THz devices based on spatially-resolved optical modulation (SROM) using photo-induced (PI) free carriers in semiconductors. The fundamental mechanism for this approach will first be introduced followed by prototype demonstrations for reconfigurable coded-aperture imaging masks, beam steering/forming antennas and waveguide-based tunable attenuators. The potential to develop more advanced tunable/reconfigurable mmw-THz devices (e.g., tunable delay lines, SPDT, DPDT switches) using optically-controlled waveguide architectures such as PI electromagnetic band gap (EBG) structures and dynamically-reconfigurable PI substrate-integrated waveguides (SIWs) will also be discussed on the basis of performance-improved SROM using the so-called mesa-array technique.

New High-Extinction Wire-Grid Polarizers for Polarimetric W-Band Radar, *Weidong Zhang, A. Mingardi, S. Bennett and E. R. Brown, Wright State University*
Abstract: Broadband (~0.1-5THz) wire-grid polarizers with high extinction ratio (~60 dB) and low insertion loss (a few decibels) is achieved if the fill-factor (FF, ratio of metal strip width to polarizer period) exceeds 90%. In this research, we utilize these high FF wire-grid polarizers for implementation of a polarimetric W-band radar.

THz Performance of 1550-nm-driven Photoconductive Switches made from GaAs:Er with ErAs Quantum Dots, *Andrea Mingardi, W-D. Zhang, E.R. Brown Wright State University*
Abstract: Ultrafast 1550-nm extrinsic photoconductivity in GaAs:Er makes it possible to fabricate THz photoconductive devices having performance comparable to GaAs:Er devices based on traditional 780-nm intrinsic photoconductivity. This paper addresses the effect of Er doping concentration and its associated ErAs quantum-dot formation on THz device performance, focusing on photoconductive switches. The effect of THz antenna type will also be presented by comparing a broadband (square spiral) vs a narrow-band (resonant slot) design.

Effects of Radio Frequency Radiation on Epidermal Cells*, Katrina Thede, Amal Mirando, Kent Fagan, Weidong Zhang, Christina Rapp, Jeffery Travers, Elliott Brown, Wright State University*
Abstract: This paper compares the effects of radio frequency (RF) electromagnetic radiation vs heat alone on human cells consisting of platelet activating factor-receptor positive (KBP) keratinocytes. The RF radiation is in the microwave region at 12.0 GHz, and is continuous wave (cw) at a power level of 1.8 W. The experimental data, conducted in parallel with KBP and heat only samples, shows a change in the cell viability at approximately 15 minutes of exposure that is distinct from thermal effects.

Aerospace Power Systems and Power Electronics (MORNING)

Considerations for Failure Prevention in Aerospace Electrical Power Systems Utilizing Higher Voltages, *Daniel Schweickart (Invited), AFRL Aerospace Systems Directorate*
Abstract: Electrical power systems for advanced aircraft now utilize voltages well above the traditional levels of 12 to 42 Vdc and 115/200 Vac, 400 Hz. Current airborne systems can contain 270 Vdc, and bipolar systems with a 540 V differential are appearing in certain flight vehicles. This presentation will address the development of a guideline document containing methods of managing higher voltages in aerospace vehicles. Based upon both current and archival work, the design guidance provides a basis for identifying high voltage design risks, defines areas of concern as a function of environment, potential risk mitigation methods and test and evaluation techniques. It is intended for application to higher voltage systems used in aerospace vehicles operating to a maximum altitude of 30,000 m. (approximately 100,000 ft.), and maximum operating voltages of below 1500 Volts-RMS. Fundamental issues addressing some of the key areas will be described and discussed.

Negative Virtual Inductance for DC Microgrids with Constant Power Loads, *Jianzhe Liu,* Wei Zhang, Giorgio Rizzoni *Ohio State University*
Abstract: We develop a negative virtual inductance controller for stabilization and oscillation reduction of DC microgrids. It is observed that adjusting inductance is an effective approach to the problem. By design, we determine the desired inductance and make corresponding virtual adjustments to achieve the control objectives. Numerical studies validate our method.

Design and Implementation DC-DC Boost Converter with PI Controller for Lithium-ion Battery, *Hamad Elwarfalli, Akram Muntaser, Jitendra Kumar, Guru Subramanyam, University of Dayton*
Abstract: One of the important issues in modern electronic equipment is providing higher peak power while preserving high energy density. DC/DC power converters can appropriately control the power flow from the source. In this paper, a Proportional Integral (PI) controller will be designed and implemented for the Li-ion battery to control the output power and discharge operation. Moreover, the characteristics of the proposed control system will be simulated and tested using Simulink/MATLAB, and the hardware model will be implemented using Arduino board. The controller will improve the efficiency of the system and provide a higher power.

Low SWaP Sensor Processing (AFTERNOON)

CNN on SUAV, *Joshua Kaster, UDRI Sensor APEX*
Abstract: In the revolutionary field of deep learning and neural networks, many difficult computer vision challenges of today are being impressively overcome by application of cutting edge technologies. The challenge of detecting vehicular targets from aerial imagery is a long standing interest in computer vision. Performing this accurately in real-time while utilizing SWaP-limited payloads bay of a small unmanned aerial vehicle (SUAV) is even more desirable. In this paper, these challenges are successfully achieved with the use of Faster-RCNN, a highly cultivated aerial image dataset, supercomputers, and dedicated team of SUAV experts. By first training Faster-RCNN on a customized dataset of electro-optical annotated aerial imagery, then empirically testing on supercomputers across hundreds of hyperparameters, this optimized network can then be successfully integrated in to established SUAV operations.This combination of cutting edge technologies leads to strong performance, while requiring a fraction of the development time and meeting strict in-flight SWaP requirements

Accelerated Pattern Matching on a Neuromorphic Processor with Application to Forensic DNA Profile Searches, *William Mitchell, Ted Josue, Ben Ausdenmoore, Jeff Clark, Tarek Taha, Nate Adams, Dan Krane, University of Dayton, Riverside Research, Forensic Bioinformatics*
Abstract: Processors based on a neuro-synaptic model offer a new design paradigm in computer architecture. Highly reconfigurable and designed to combine memory and computation in one location, these neuromorphic processors provide a smaller footprint and lower power alternative to traditional von Neumann based architectures. We propose a simple technique for pattern matching on a neuromorphic processor and apply it to a pattern matching application for a large scale database search. Specifically, we demonstrate our pattern matching approach on IBM's TrueNorth neuromorphic processor for forensic DNA profile searches based on the FBI's CODIS dataset. Initial results suggest the ability to search the CODIS database, which currently contains 13 million profiles, in under 4 seconds using significanly less than 1W of power on a device comparable in size to a large smart phone.

An Efficient FPGA-Based Direct Linear Solver, *Zhenhua Jiang, Seyed A. Raziei, University of Dayton Research Institute*
Abstract: This paper will present an efficient FPGA-based implementation of a direct linear solver. The proposed solver is to solve systems of linear equations by applying Gaussian Elimination to an augmented matrix and computing the system solution through backward substitution, both in parallel on FPGA hardware. Applications of the proposed linear solver in least square estimation and real-time circuit simulation will be discussed.

High Sensitivity Low Noise Nano-Gas Sensing Device with IoT capabilities, *Goel Tanu, Syscon International*
Abstract: This study demonstrates a novel approach for designing a low noise nano-particle based gas sensing device with Internet of Things (IoT) capabilities. Sensing efficiency of graphene is catalyzed by decoration of Gold nanoparticles over its surface. IBM Bluemix IoT platform receives and transmits sensing data using Ethernet port of FRDM K64f development board.

Guidance and Control (AFTERNOON)

Robotic Technology – A Merging of Engineering Disciplines, *George Sutton (invited), Yashkawa Motoman*
Abstract: Robots were first introduced as Science Fiction characters, and as with many science fiction technologies introduced in the 19th and 20th centuries, they soon became part of reality. Over the past 40+ years, robots have mostly been deployed to perform repetitive and dangerous industrial tasks. This has resulted in significant growth in worker productivity/safety, and product quality. The traditional industrial robotic application includes the robot and peripheral equipment configured and taught to perform a single or similar jobs many times over, otherwise known as High Volume – Low Mix applications. Dramatic improvements in computational power, sensor technology, and supporting software give promise to deploy robots for High Mix-Low Volume industrial applications. This fusion will enable robot applications to expand beyond traditional industrial applications, and beyond the factory itself.

Differential Flatness Based Hybrid PID/LQR Flight Controller for Complex Trajectory Tracking in Quadcopter UAVs, *Rumit Kumar, Matthew Dechering, Austin Ottaway, Abhishek Pai, Mohammadreza Radmanesh, and Manish Kumar University of Cincinnati*
Abstract: In this paper, we present a differential flatness based hybrid flight controller for quadcopter UAV. The combination of conventional PID based controller with the full state feedback based LQR controller results in the proposed hybrid controller. The performance of the resulting controller is further enhanced by using differential flatness based feedforward control. The UAV with a hybrid flight controller is the perfect balance between stability and maneuverability, which makes it suitable for complex trajectory following applications.

Dynamic Modeling and Nonlinear Model Predictive Control of Hybrid Actuator Systems, *Sayed Ata Raziei, Zhenhua Jiang, University of Dayton*
Abstract: This paper will present a high-fidelity dynamic model of hybrid actuator systems and discuss a Model Predictive Control (MPC) method to coordinate multiple actuators in the hybrid system. The detailed process of designing the MPC algorithm will be discussed. Some issues about real-time implementation on FPGA may also be covered. Simulation results comparing the performance of MPC with PID controller will be presented.

Nonlinear Adaptive Control for Lateral Dynamics with Fixed Roll Angle of Hypersonic Vehicles at Subsonic Speeds, *Turki Alsuwian, Raul Ordonez and Lance Jacobsen, University of Dayton*
Abstract: Hypersonic vehicles are complex nonlinear systems with uncertain dynamics. This work presents a robust nonlinear adaptive (NA) control system for the operation of these vehicles at subsonic speeds. The complexity of the dynamic system is considered in the design, in order to address robustness issues. In this work, we only consider lateral dynamics with a fixed roll angle (five degrees of freedom, or 5-DOF). These dynamics are divided into subsystems for aircraft speed, flight-path angle, and yaw angle. A robust NA control design is implemented to provide asymptotic tracking regulation of these output quantities. Adaptation is employed in this study because of its robustness properties. The stability analysis is performed based on a Lyapunov function candidate for the feedback closed-loop system.Simulations of the design indicates that it successfully provides flight control.

THz and Millimeter Wave Sensors (AFTERNOON)

Fully-Automated Non-Contact Characterization of On-Wafer mmW and THz Devices & Ics, *Cosan Caglayan (Invited),, Ohio State University Syed An Nazmus Saqueb, and Kubilay Sertel, The Ohio State University*
Abstract: High cost and mechanical fragility of conventional contact probes have been a major hindrance for accurate and repeatable on-wafer characterization of high-speed devices and integrated circuits. To address this shortcoming, we recently proposed and demonstrated a non-contact on-wafer metrology system, which has since been validated across the 90-750GHz band for single-ended and differential-mode characterization of passive and active mmW/THz devices. The approach relies on quasi-optical coupling of test signal into and out of the wafer environment using on-chip antennas integrated with the device under test, thus, the potential for mechanical damage is eliminated. In this paper, we present the fully-automated version of the non-contact probes which enables for the first time hands-off calibration and characterization of entire wafers using automated micro-positioners and a closed-loop image recognition software using a digital microscope.

High-Resolution Polarimetric THz Imaging, *Nandhini Srinivasan, Ohio State University*

Abstract: *Terahertz (THz) frequencies have attracted increasing interest for key imaging modalities, among them,* biomedical THz imaging being particularly attractive due to the potential impact for evaluation and diagnosis of life threatening pathologies and malignancies. Most of existing literature on biomedical THz imaging is based on commercially-available spectroscopy instrumentation and can effectively address 60GHz-5THz band with diffraction-limited resolution. However, these systems do not generate a pure polarization state that is stable over this entire band. As such, the use of polarimetric imaging for analysis of tissues samples remains limited. To address this key shortcoming, we present a high resolution polarimetric imaging system using a vector network analyzer and frequency extenders. The system is used to study pure polarization images of formalin-fixed paraffin-embedded human brain tissue samples and achieves an unprecedented resolution, up to 3.4× better than commercial diffraction-limited systems.

Single-bit Compressive Imaging for mmW and THz Applications, *Syed Saqueb, Kubilay Sertel, Ohio State University*
Abstract: We present a novel mmW/THz imaging system that uses an extremely low cost sensor with extreme quantization (i.e. single bit value for each measurement), and can reconstruct the amplitude and phase of the scene using compressive sensing algorithms. An optically excited high-resistivity Si wafer is used to spatially modulate the object wave. The single bit sensor utilizes a simple comparator as the analog-to-digital converter to record the sign of received signal after spatial modulation. Doing so, we reconstruct 4k pixel 2D images of the scene through compressive sensing. We demonstrate this novel approach for the WR1.5 band (500-750GHz) and show that the imaging system can be faster than typical multi-bit compressive imaging methods.

Imaging the Hydration Level of Human Skin with A Millimeter-Wave Reflectometer, *Weidong Zhang, Elliott Brown, Wright State University*
Abstract: Significant variation of skin's hydration level can occur because of skin maladies or because underlying disease of human body. This research presents a hydration sensor for imaging of human skin based on a millimeter-wave reflectometer centered at either W-Band or Ka-band, with high accuracy (<1%), fine resolution (~2mm) , great depth of penetration (>1mm) and fast scan speed (<1s).

Trusted Systems and Electronics (AFTERNOON)

Understanding Vulnerabilities in ReRAM Devices for Trust in Semiconductor Designs, *Thomas Schultz, and Rashmi Jha University of Cincinnati*
Abstract: This paper discusses attack vulnerabilities in Resistive random access memory (ReRAM) devices potentially triggered by Trojan circuits. Vulnerabilities include current overshoot, accelerated failure due to local heating, and glitches in source voltages. Additionally, we report our studies on the impact of ReRAM clones or recycled devices on circuit performance.

Formal Enforcement of Mission Assurance Properties in Cyber-Physical Systems, *Scott Harper, Jonathan Graf, Graf Research Michael A. Capone, Justin Eng, Michael Farrell, Lee W. Lerner Georgia Tech Research Institute (GTRI)*
Abstract: Cyber-Physical Systems improve efficiency, accuracy, and access in systems ranging from household appliances to power stations to airplanes. They also bring new risks at the intersection of physical, information, and mission assurance. This paper presents CP-SMARTS, a framework providing a means for propagating CPS assurances from planning to deployment.

Sampling Iso-Functional Signal Switches in Library Circuits for Microelectronics Verification with Topological Constraints, *Leleia Hsia, Graziano Vernizzi, Mary Y. Lanzerotti, Derrick Langley 513th Electronic Warfare Squadron, Siena College, Augsburg College, and Air Force Space Command*
Abstract: This paper extends a methodology for microelectronics verification to the situation in which signal switches are applied to library circuits containing INV, NAND2, NOR2, NAND3, and NOR3 gates. Monte Carlo methods are used to sample the frequency distributions of the topological genus of library circuits including a 1-bit adder.

Visible but Transparent Hardware Trojans in Clock Generation Circuits, *Qianqian Wang, and Randall Geiger, Iowa State University*
Abstract: Hardware Trojans that can be easily embedded in synchronous clock generation circuits typical of what are used in large digital systems are discussed. These Trojans are both visible and transparent. Since they are visible, they will penetrate split-lot manufacturing security methods and their transparency will render existing detection methods ineffective.

Stochastic Approximation for Learning Rate Optimization for Generalized Relevance Learning Vector Quantization, *Daniel Steeneck, Air Force Institute of Technology, Trevor Bihl, Air Force Research Laboratory*
Abstract: Herein the authors apply the stochastic approximation method of Kiefer and Wolfowitz to optimize learning rate selection for Generalized Relevance Learning Vector Quantization - Improved (GRLVQI) neural networks with application to Z-Wave cyber-physical device identification. Recent work on full factorial models for GRLVQI optimal settings has shown promise, but is computationally costly and not feasible for large datasets. Results using stochastic optimization illustrate show fast convergence to high classification rates.

The Use of Automated Theorem Proving for Error Analysis and Removal in Safety Critical Embedded System Specifications Enhancing FPGA Security through Trojan Resilient IP Creation, *Jonathan Lockhart, Carla Purdy and Philip A. Wilsey, University of Cincinnati*
Abstract—As safety critical embedded systems increase in complexity, more functionality is delegated to software. New methods of design and testing, including formal methods, can increase system trust and reliability. Previously we demonstrated formal specification development. Here we demonstrate software error discovery and removal using automated theorem proving, another formal technique

Enhancing FPGA Security through Trojan Resilient IP Creation, *Noor Ahmad Hazari, and Mohammed Niamat, University of Cincinnati*

Abstract - For FPGA based IP, Trojans may be implanted by exploiting unused resources by bitstream modification of an FPGA. In this paper, Trojan Resilient IP is created by combining original IP with the dummy logic insertion by using free LUT resources in order to provide protection for FPGA based IP.

Emerging Electronics and Microsystems(AFTERNOON)

Design and Prototype Implementation of an 8-Beam 2.4 GHz Array Receiver for Digital Beamforming using Multiplierless DFT Approximation Algorithms, *Arjuna Madanayake (Invited), University of Akron*

Abstract: The design and laboratory-scale implementation of a direct-conversion digital multi-beamformer operating at 2.4 GHz is described. The proposed digital beamformer consists of an 8-element array with individual radio-frequency (RF) front-ends and in-phase/quadrature (I/Q) channels per antenna, each processed in real-time using Xilinx FPGA technology. The digital beamformer realizes eight simultaneous RF beams using low-complexity approximations of the discrete Fourier transform (DFT). The multi-beamformer is multiplier free and is also of very low in adder complexity. Design of the beamforming algorithm, antenna design and receiver electronics, digital signal processing, FPGA system design and implementation details, details of the test and measurement system as well as calibration, error metrics and beam quality will be discussed in the paper.

Integrated Ferroics for Sensing, Power, RF, Microwave and mm-wave Tunable Electronics, *Nian Sun (Invited), Northeastern University*

Abstract: The coexistence of electric polarization and magnetization in multiferroic materials provides great opportunities for realizing magnetoelectric coupling, including electric field control of magnetism, or vice versa, through a strain mediated magnetoelectric coupling in layered magnetic/ferroelectric multiferroic heterostructures [1-8]. Strong magnetoelectric coupling has been the enabling factor for different multiferroic devices, which however has been elusive, particularly at RF/microwave frequencies. In this presentation, I will cover the most recent progress on new integrated multiferroic devices for sensing, memory, RF and microwave electronics. Specifically, we will introduce magnetoelectric multiferroic materials, and their applications in different devices, including: (1) ultra-sensitive magnetometers based on RF NEMS magnetoelectric sensors with picoTesla sensitivity for DC and AC magnetic fields, which are the best room temperature nano-scale magnetometers; (2) novel ultra-compact multiferroic antennas with □200μm × 1μm or □0/600 in size, -18dBi gain, ~0.2% bandwidth, self-biased operation and 1~2% voltage tunable operation frequency; and (3) novel GHz magnetic and multiferroic inductors with a wide operation frequency range of 0.3~3GHz, and a high quality factor of close to 20, and a voltage tunable inductance of 50%~150%. At the same time, I will also demonstrate other voltage tunable multiferroic devices, including tunable isolating bandpass filters, tunable bandstop filters, tunable phase shifters, magnetoelectric random access memory, etc. These novel integrated multiferroic devices show great promise for applications in compact, lightweight and power efficient sensing, power, RF, microwave and mm-wave integrated electronics.

500°C Packaging Technology for SiC High Temperature Electronics – Most Recent Progress, *Linagyu Chen (Invited), NASA Glenn Research Center and Ohio Aerospace Institute*

Abstract: High-temperature environment operable sensors and electronics are required for long-term exploration of Venus and distributed control of next generation aeronautical engines. Various silicon carbide (SiC) high temperature sensors, actuators, and electronics have been demonstrated at and above 500°C. A compatible packaging system is essential for long-term testing and application of high temperature electronics and sensors in relevant environments. This talk will discuss a ceramic packaging system developed for high temperature electronics, and related testing results of SiC integrated circuits at 500°C facilitated by this high temperature packaging system, including the most recent progress.

Embedded Silicon Odometers for Monitoring the Aging of High-Temperature Integrated Circuits, *Jifu Liang, Case Western Reserve University*

Abstract: High-temperature (HT) integrated circuits (ICs) are important for many industrial applications, e.g. automobiles and aircraft engine control. However, the effects of HT on aging mechanisms that affect the lifetime reliability of IC have not been extensively studied. We develop data-driven predictive models for reliability and failure mechanisms of ICs at HT by characterizing their aging performance using integrated monitoring circuits ("silicon odometers"). A variety of odometer circuits are proposed to characterize i) the DC operating point and frequency response of analog circuits, and ii) propagation delays in digital circuits. Ring oscillators subjected to multiple stress profiles are promising as digital odometers. In preliminary experiments, three integrated ring oscillators implemented in 0.5μm CMOS were dual-stressed (running continuously at 195°C), while three others were single-stressed (exposed to the same temperature profile but only running intermittently). The frequencies of these oscillators was measured for more than six months and the data fitted to generate a transistor aging model. This model provides information on cumulative changes in transistor parameters (carrier mobility, threshold voltage, etc.) that can be utilized by designers to ensure that the system will meet specified HT reliability targets.

A Compact On-Chip Threshold Voltage-Based Temperature Sensor with 0.29ºC/-0.26ºC Inaccuracy Using 130nm CMOS, *Chin-wen Chen, Shu-Chuan Huang and Randall Geiger Iowa State University*

Abstract: A compact CMOS temperature sensor with small nonlinearity and low power consumption is proposed in this paper. The temperature sensor utilizes the temperature dependence of the threshold voltage of MOS transistors to generate the output voltage. The conventional four-transistor structure which adds an extra transistor to the three-transistor temperature sensor achieve high accuracy at a low supply but suffers from the biasing problems so that degrades the linearity of the output voltage with respect to temperature. The proposed thermal sensor adding a voltage

attenuator to achieve high linearity and enable the low supply voltage operation. In addition, the proposed structure prevents the biasing concerns because it is based on the three-transistor structure instead. The temperature sensor is implemented in a CMOS 0.13μm process with a 1.2 supply voltage. The peak nonlinearity is 0.29ºC in the temperature range from 0ºC to 120ºC and the power dissipation of the temperature sensor is 90μW.

Modeling of Segmented Controlled Electrostatically Actuated Bimorph Beams, *Kullen Waggoner and Robert Lake, Air Force Institute of Technology*

Abstract: Electrostatic actuating bimorph beams are a fundamental MEMS device that can be used to control arrays of small micromirrors for optical scanning. These device function through residual stresses from the PolyMUMPs foundry process that cause an initial upward deflection of the beams. When a potential difference is then applied, it creates an electrostatic force that actuates the beams downward, resulting in mirror actuation. Current state of the art has demonstrated that creating high-angle deflection is possible using these devices. However, precise control and measurement of the mirror deflection is difficult to achieve. This research effort proposes a solution to improve control and measurement by using segmented bias channels to control separate portions of the actuation arm. The device will function by allowing a selective actuation of different portions of the bimorph arm. The amount of mirror deflection will vary depending on which segments of the arm are actuated. This research effort seeks to model this approach to actuating micro-mirrors using Coventorware and ANSYS FEA software programs. Objectives of the modeling is to validate this new approach of using segmented channels and evaluate future designs for increasing mirror deflection angles.

Design and Analysis of Wafer-level Vacuum-Encapsulated Disk Resonator Gyroscope Using a Commercial MEMS Process, *Balaadhithya Uppalapati, Mohammed Jalal Ahamed, Vamsy P. Chodavarapu, University of Dayton*

Abstract: We present the design and analysis of a mode-matched disk resonator gyroscope that is characterized by a high Quality factor exceeding 1 million. The resonator is designed using Microelectromechanical systems (MEMS) Integrated Design for Inertial Sensors (MIDIS) process offered by Teledyne DALSA Semiconductor Incorporated (TDSI). The MIDIS process offers wafer-level vacuum encapsulation at 10 mTorr. The disk resonator gyroscope design has a circular shape of 600 μm diameter with a single crystal silicon device layer thickness of 40 μm.

Thursday, June 29, 2017

Photonics and Electro-Optics (MORNING)

Lidar and Non-mechanical Beam Steering, *Paul McManamon (Invited), University of Dayton*
Abstract: Dr McManamon will summarize lidar state of the art for various applications from auto lidar to synthetic aperture lidar, and he will discuss the current state of the art in beam steering for a couple applications. For example the auto lidar case is currently using mechanical steering, but all of the auto lidar contenders are searching for an inexpensive and capable solid state, non mechanical solution. This talk will serve as context for talks coming shortly after it.

Lidar and Indoor Localization System, *Jia Li (Invited), Oakland University*
Abstract: Smart mobile devices and consumer level LiDAR are becoming widely accessible in people's daily lives. Visual information based indoor localization has attracted lots of research attention in the computer vision community. In this talk, we present a 6-degree-of-freedom (6-DoF) pose estimation using a portable 3D visual sensor mounted on a mobile device. A detailed 3D model and a WiFi received signal strength model of the indoor environment are constructed in the offline training phase. During the online localization, WiFi signals are first used to locate the device in a 3D sub model. The initial pose is calculated through feature matching between the online captured 2D image and the key frame images used to build the 3D model. Then we employ iterative closest point (ICP) algorithm to estimate the rigid transform between online captured 3D point cloud and local 3D point cloud. The 6-DOF pose estimation is further refined by random sample consensus (RANSAC) algorithm. The system is implemented on an iOS platform. The experiments carried out in an indoor environment show promising result of our approach.

Coherent Lidar System on a Chip, *Paul Suni (Invited), Lockheed Martin*
Abstract: Rapid and revolutionary development of silicon photonics is bringing the long sought concept of lidar-on-a-chip to reality. Developing tool boxes enable integration of active and passive photonic integrated circuit components into full coherent lidar systems at the chip level. In this talk we highlight our current component and systems work.

Integrated Photonics in the US, *Nick Usechak (invited), AFRL Sensors Directorate*
***Abstract**:* An overview of integrated photonics will be presented including comments on submitting integrated photonic circuit designs to the American Institute for Manufacturing Integrated Photonics (AIM Photonics). This talk will conclude with a quick review of some of DARPA's recent integrated photonics programs.

3D Mapping Performance Estimates of Integrated Photonic Phased Array Lidar, *Richard M. Marino, MIT Lincoln Laboratory (Invited)*
Abstract: There are currently DoD efforts to develop planar non-mechanically-steered optical transmitters using integrated photonic optical phased arrays. One of the goals is to demonstrate a low-SWaP, rapidly steerable, wide field-of-view lidar. In this presentation we will describe 3D mapping performance estimates for such a lidar.

Meta surface Engineering *via Evolutionary Processes,* *Kenneth Allen, Daniel Dykes, Georgia Institute of Technology*
Abstract: Metasurfaces enable a new avenue to engineered responses of the electromagnetic scattering characteristics. The alteration of sub-wavelength structural features on the metasurface enables a tunable response. In this work, the geometrical structure of the metasurfaces are optimized by a multi-objective genetic algorithm mimicking evolutionary processes. Analysis is performed from for a variety of metasurface responses. Computational electromagnetic simulations for these frequency selective metasurfaces (FSmS) are presented and discussed. The concepts presented in this work can be applied to design metasurfaces and metamaterials from the microwave to the optical regimes.

Radar, Tomography and RF Sensing (MORNING)

Evaluation of Aperture Weighting Techniques for SAR Image Formation, *Eric Balster, Andrew M. Kordik, Frank A. Scarpino, and Kerry L. Hill University of Dayton*
Abstract: In this paper, a number of aperture weighting functions are tested in a synthetic aperture radar (SAR) image formation simulator. The SAR image simulator uses digital imagery to form radar phase history so that the resulting processed SAR images may be compared to the original images with traditional image processing metrics such as peak signal-to-noise ratio (PSNR) or structured similarity index (SSIM). Aperture weighting is a common technique to reduce the ringing associated ith side-lobes generated in a SAR imaging system. The weighting functions tested are Hamming, Blackman, Taylor, and Raised Cosine for their popularity within the SAR imaging community. Results show that a raised cosine window with a roll-off factor of Beta = 0.1 provides the best results in terms of image quality, outperforming a rectangular window by 0.11 dB in PSNR, and .014 in SSIM, on average.

Applying Filtered Back Projection Algorithm for Pseudo-Coherent Radar, *Mansour Aljohani, Hamdi Abdelbagi, Abdulmajid Mrebit, Lorenzo Lo Monte, Michael Wicks University of Dayton*
Abstract: Marine Radar technology has matured over the past several decades. Researchers have investigated coherening one or more marine radars by sampling the radar signal on transmit and receive. This research will contribute to the science and technology of RF Tomography based upon exploitation of these sampling techniques. This requires many steps. First, modifying marine radar. In this case, we employ a Furuno DRS25A. Second, create an RF sampling circuit. We use only Mini-Circuits components. Third, digitize both the transmit and receive signals using an ADC. Then, establish an experimental geometry and collect data. Finally, applying Filtered

Back projection (FPB) based on the Fourier Slice Theorem (FST), Algebraic reconstruction technique (ART), and Inverse Synthetic Aperture Radar (ISAR) to the matched filtered data. We will provide both simulation analysis and experimental results.

Optimality Problem of Sensor Geometry of Multiple Transmitters and Receivers for Below Ground Imaging of Objects in A Region of Interest, *Abdulhakim Daloum, Michael C. Wicks, Hamdi Abdelbagi, Abdunaser Abdusamad, Muftah Akroush, Turki Alanazi University of Dayton*

Abstract: In this paper, we present a unique Ground Penetrating Radar (GPR) technique currently under development to image deeply buried targets over relatively small areas of regard. This GPR computes the optimal sensor geometry for a given bistatic and multi-static radar distribution of transmitters and receivers operating in the microwave band of frequencies. There are N receivers, and they can be arranged arbitrarily. In addition, we have M transmitters that we can also arrange in the same way. Each receiver can process all frequencies from the multiple transmitters. The transmitters are deployed above ground, while the receivers are embedded in the ground or in the space between the surface of the ground and the multitude of transmitters. Radio frequency (RF) tomography is proposed including the use of Green's function and Maxwell's equations for algorithm development to image underground targets. The targets are assumed to be buried inside the region of interest (ROI). We design different transmitter (Tx) and receiver (Rx) geometries such as; concentric circles and concentric squares. Based on these different geometries we can see which distribution is best for depths of shallow buried targets imaging. Also, the development of the optimal sensor geometry and strong scatterers is considered to provide the best configurations and increase overall tomographic image quality. Simulation results show excellent performance in the absence of significant unknown disturbances.

The Impact of Reflected Waves on the Reconstruction of Tomographic Imaging, *Abdunasar Abdusamad, Michael C. Wicks, Hamdi Abdelbagi, Abdulhakim Daluom, Muftah Akroush, Turki Alanazi University of Dayton*

Abstract: Tomography is defined as an image reconstruction technique that exploits different points of view, and different observation points. Generally, tomographic images can be constructed by illuminating the target with a microwave signals and measuring the energy that passes through the target e.g. transmission tomography, or reflected from the target as in reflection tomography. Reflection tomography is used in some cases when the transmission tomography cannot be accomplished due to physical limitations, or high attenuation losses due to high material impedance. In this paper, we investigate the impact of surfaces placed beside the transmitter and/or the receiver, and quantify these effects via image analysis at high frequency domain. Our goal in this paper is to reduce the effect of sidelobes that may appear as result of these surfaces. We reduce the reflected waves from the surfaces by designing the surfaces using specific materials or by changing the placement of both the transmitter and/or receiver antenna. Moreover, the resulting tomographic image will be processed using the Winner filter to remove any remaining noise.

RF Tomography based Optimal Linear Filter, *Muftah Akroush, Michael C. Wicks, Hamdi Abdelbagi, Turki Alanazi, Abdunaser Abdusamad, Abdulhakim Daluom, University of Dayton*

Abstract: Reconstructing high quality images of underground objects using ground penetrating radar (GPR) depends on method for 3D GPR data collection and processing. In this paper, we propose an accurate, fast method to reconstruct the image of underground targets using an optimal linear filter, such as matched filter processing. The match filter is the most common approach to simplify the solution of the inversion problem in GPR model. The proposed method is an optimal technical that increases the signal to noise ratio (SNR) to sharpen the quality of the image. Using this technique leads to decrease of reconstruction time. Also, it reduces the data acquisition time which is critical in most GPR applications. Compared with other algorithms, such as truncated singular value decomposition (TSVD) or algebraic reconstruction technique (ART), matched filter algorithms yield a high quality 2D image of shallowly buried objects faster and with minimal computational load or noise effect. Simulation results were carried out using the computational electromagnetic software FEKO and MATLAB, which demonstrate the effectiveness and feasibility of the proposed reconstruction method.

On the Use of Expert Reasoning to Enhance Generalized Likelihood Ratio Test (GLRT) Performance, *Devin Smarra, University of Dayton and Defense Engineering Corp, Ethan Lin, University of Dayton Research Institute*

Abstract: This paper presents the use of tailored covariance matrix estimates that may differ for the three components of the GLRT. These components are an adaptive filter and two different quadratic forms that function as a limiter and a detector. Expert reasoning is used to optimize the covariance matrix in each component.

Cohering a Pulse Train in Magnetron Oscillator Based Marine Radar, *Hamsa Elraash, University of Dayton*

Abstract:The goal of this research is to sample and process the measured data which has been collected mono-statically using a Marine Radar. This class of Radar is commonly used aboard vessels for obstacle avoidance and situational awareness. Therefore, marine radars use non-coherent radio wave signals, and hence, are inherently incompatible for imaging applications. In this research, non-coherent signals are made by cohering the transmit and scattered waveforms. These "pseudo-coherent" waveforms can be used for many purposes, such as Tomography. In general, the aim of this research is provide coherent technology using affordable marine radars.

Demonstrating the Limitations on Target Detection (Pd) and False Alarm Control (Pfa) Due to Cross-Correlated Interference in a Bistatic / Multistatic Radar, *Turki Alanazi, University of Dayton*

Abstract: The goal of this research is to develop a method that allows for processing bistatic non-coherent marine radarsignals, in order to demonstrate the limitations on target detection (Pd) and false alarm control (Pfa) due to cross-correlated interference in a bistatic/multistatic radar. Non-coherent radar offers limited surveillance in cluttered environments as opposed to more expensive coherent MTI (moving target indication) systems. In this work, a method is presented for coherent processing of signals from a bistatic magnetron oscillator based marine radar. The feasibility of this approach was previously demonstrated for a single radar through a hardware modification that allowed for capturing data via a Xilinx ADC and processing via FPGAs. It is demonstrated here that operating a pair of radars in this manner and combining their resulting signals allows for an improvement in overall detection and track.

Our approach works by sampling the transmitted and received signals at each radar. Cross-correlations between all four combinations of transmitted and received signals are used to demonstrate the limits due to cross-correlations interference in a bistatic/multistatic systems of radars. This processing is successfully demonstrated with software modeling, showing the potential of using this technique for cross-correlations between two marine radars. In general, bistatic coherent radars are generally very expensive, and this work provides a method for achieving the equivalent coherent performance using a two non-coherent radar systems.

A Low Power CMOS Amplitude Peak Detector for On-chip Self-calibration Applications, *Hao Xue, Wright State University*
Abstract: A CMOS peak detector is used for detecting active circuit process, voltage, temperature (PVT) variation error. The detector transfers AC input amplitude to corresponding DC voltage. Such DC output can be recognized and compared to determine whether active circuit needs to be compensated to eliminate the PVT variation error.

Deep Learning, Artificial Intelligence and Cyber Security (MORNING)

Are We At A Crossroads? Exploring A Future Convergence of Philosophy, Neuroscience, Computing, and Cyber Security*, Sherry Sparks (Invited), Clearhat Consulting*
Abstract: This multi-disciplinary talk will explore some thoughts about how the fields of philosophy, neuroscience, computing and cyber security may converge in the future. It will attempt to show how our understanding of ourselves needs to expand because at a fundamental level we are not separate from the systems that we design. As researchers and developers, we currently wield the power to shape the evolution of the global computing infrastructure, but we need to consider that in that process we may also be shaping our own minds.

Memristor Crossbar Based Implementation of a Multilayer Perceptron*, Chris Yakopcic, Tarek M. Taha, University of Dayton*
Abstract: This paper describes a memristor-based neuromorphic system that can be used for ex-situ training of various multi-layer neural network algorithms. This system is based on an analog neuron circuit that is capable of performing an accurate dot product calculation. The presented ex-situ programming technique can be used to map many key neural algorithms directly onto the grid of resistances in a memristor crossbar. Using this weight-to-crossbar mapping approach along with the dot product calculation circuit, complex neural algorithms can be easily implemented using this system. To show the effectiveness and versatility of this circuit, a Multilayer Perceptron (MLP) is trained to perform Sobel edge detection. Following these simulations, an analysis was presented that shows how both memristor accuracy and neuron circuit gain relates to output error. Additionally, this paper discusses how circuit noise and neural network layout contribute to testing accuracy.

Smart Translator for Climate Control Sensors and Devices on an Interoperable Climate Management Platform, *Kelly Cashion, UDRI*
Abstract: Large buildings manage climate control using devices from various manufacturers. Communication between these devices requires expert translation (domain expert) of each device's data to a common integration engine and storage historian. The domain expert must understand the non-standard naming convention used for each device. We can implement a smart translator to assist by automatically assigning registers to standardized labels.

Neuromorphic Device Specifications for Unsupervised Learning in Robots, *Mohamed Sarim, Rashmi Jha, and Manish Kumar University of Cincinnati*
Abstract: We recently developed a novel learning solution for unsupervised learning in robots based on resistive memory devices arranged in a crossbar fashion and validated it by navigating a robot in an unknown environment with randomly placed obstacles. In this work, we aim to study the effects of variability in such devices based on several factors, such as fabrication technology limitations, sensor data quality, and communication delays. The objective of studying the effect of variability of such factors on the mission performance is to develop a set of specifications for such devices to be used for robotic navigation tasks.

A Variable-Appearance-Driven and Multi-Model Enhanced Convolutional Neural Network for Object Tracking, *Ying Li, Ohio State University*
Abstract: Appearance variation has been a challenge for object tracking for long. During a fast appearance change, a single model updated from the previous frame may not be appropriate for the current object. If multiple models are used for each frame, the computation load may be heavy, and for frames where object appearance does not present a large change, there will be no need to apply all the models. In this work we propose a convolutional neural network based object tracking approach, which utilizes multiple models to achieve accurate and fast tracking. The model is chosen based on the estimation of the appearance change to decide the number and the choosing scheme of the model. Our approach is compared with the state-of-the-art algorithms to demonstrate its advantages.

Terahertz Spectroscopic Material Identification Using Approximate Entropy and Deep Neural Network, *Yichao Li,, Melih Altun, Xiaoping A. Shen, Ohio University, Robert L. Ewing, AFRL*
Abstract: Terahertz spectroscopy and imaging can produce high dimensional data that is prohibitive for material identification. Here, we have developed a feature extraction method based on approximate entropy to analyze the Thz spectrum, which is then combined with a deep neural network for material classification. Experiment results show that approximate entropy can capture key properties of Thz spectrum and the overall recognition accuracy is 91.1%.

Reducing Calculation Requirements in FPGA Implementation of Deep Learning Algorithms for Online Anomaly Intrusion Detection, *Khaled Alrawashdeh, Carla Purdy University of Cincinnati*

Abstract: We use dynamic fixed-point arithmetic to reduce Deep Belief Network (DBN) calculations in an FPGA. We trained a three-layer DBN, fine-tuning the network using a softmax function. We used the MNIST dataset for evaluation before testing online intrusion detection and achieved accuracy of 94% on the NSL-KDD dataset and 95% on the HTTP CSIC 2010 dataset. We produced efficient resource utilization and detection speed of .008ms.

Sparse Connected Deep Neural Network for Multicore System, *Yangjie Qi, Tarek Taha University of Dayton*

Abstract: In this paper, we propose two versions of sparse connected deep neural networks, which can be used to replace fully connected deep neural networks, or fully connected layers in Convolutional Neural Networks in these limited input multicore system. Our simulation results show that the proposed networks achieve the same accuracy level and faster convergence as fully connected networks.

A Low Power High Throughput Architecture for Deep Network Training, *Raqibul Hasan, Tarek Taha University of Dayton*

Abstract: This paper proposes a SRAM-based digital multicore architecture for deep neural network training. We utilized a dual ported SRAM memory in the neural core which has both row-wise and column-wise access capability. Novel routing circuit is designed for energy efficient data transfer among the neural cores. Proposed architecture can provide up to three orders of magnitude more energy efficiency over GPGPUs for deep neural network processing.

Photonics and Electro-Optics (AFTERNOON)

Passive and Active Sensing - Plasmonic grating geometries and wavelength-dependent focus depth in IR detectors, *Patrick Kennedy, Tod Laurvick, Air Force Research Laboratory*

Abstract: The objective for this research is to determine a relationship between plasmonic grating geometries and the wavelength-dependent focus depth. This research is focused on enhancing the signal collected by infrared detectors by using a metal grating as a planar lens to focus light in the detecting region of the substrate. This can be used to maintain a thinner absorbing region and possibly to create multi-colour imaging in a single pixel.

A Signal Processing and Data Analysis Technique for Accurate Extraction and Estimation of FTIR Signal Aberrations in Microsphere-Lens-Enhanced MWIR Photo Detectors Via System Transfer Functions Mathematical Modeling, *Dalila Megherbi, J. DiZoglio, P. Mack, I. Vakil, N. Limberopoulos, and A. Urbas , University of Massachusetts, Lowell, Air Force Research Laboratory*

Abstract: In this paper we focus on using signal processing techniques and mathematically-derived models to analyze, characterize, and relatively accurately extract and estimate the effect of spectral integrated aberrations on microsphere-lens-enhanced photo-detector FTIR response sensitivity, as a function of the wavenumbers. In particular, one of the difficulties here relates to the noisy nature of the detector FTIR experimental signals in the MWIR band. We show how mathematical modeling of the detector FTIR response signals (with and without microsphere-lens enhancement), combined with a signal boundary-absorption partial replacement is successfully effective in estimating interesting information such as the microsphere-lens-silicone-glue-photo detector combined and integrated system aberrations. Based on the experimental FTIR data considered, our findings show that (a) not all 4 microsphere lens material types considered in this work, namely, PS, BGT, Sapphire, and SLS result in necessarily increasing the microsphere-lens-enhanced detector sensitivity at all wavelengths in the MWIR 3μm-5μm band. In fact, the PS-microsphere-lens enhanced detector sensitivity turns out to be less than that of the mesa (without microsphere-lens) in the 2.3μm-2.5 μm band where the PS material exhibits significant absorptions. In this case the PS-microsphere-lens-enhanced detector spectral sensitivity becomes lower than that of the mesa spectral response itself. (b) there seems to exist some global integrated aberrations introduced by the microsphere lens-silicone-glue-photo-detector system that we extracted and estimated from the FTIR spectral data and the proposed generated mathematical models. (c) the comparison of the experimental FTIR spectral responses of eleven (11) single photo detectors (with microsphere-lenses of different sizes and material types) with their respective derived mathematically modeled FTIR data, result in realistic mathematically-synthesized detector FTIR data signals. Experimental results show the potential value of the proposed method for detector real-time aberration extraction, estimation and automatic correction.

Using FTIR Spectral Response Data to Extract, Characterize, Analyze and Quantify the Effects of Silicone-Based Adhesives on Microsphere-Lens-Enhanced MWIR SLS Photo Detectors, *D. B. Megherbi, P. Mack , J. DiZoglio , I. Vakil, N. Limberopoulos, and A. Urbas University of Massachusetts, Lowell, Air Force Research Laboratory*

Abstract: In our prior work we have analyzed, proposed global performance metrics, and shown how MWIR microsphere-lens-enhanced single detectors have exhibited an increase in detector sensitivity and reduction in Noise-to-Signal Ratio (NSR). We have also shown how microsphere lens material absorptions and misalignment can affect and reduce microsphere-lens-enhanced MWIR detectors spectral responses, as functions of the wavelengths. When placing a microsphere-lens on a photo-detector, usually an optical silicone-based “glue” or adhesive is used to adhere and hold the microsphere lens on the single photo-detector. In this paper, we present a novel hybrid model-based signal processing-based, and data analysis technique for analysis of the effect of the silicone-based-adhesive, used when gluing a microsphere lens to an SLS single photo-detector. As we demonstrate here, the results show that for different types of adhesive silicone-based materials, the adhesive material has a unique refractive index and material absorption that affect relatively adversely the Fourier transform infrared spectroscopy (FTIR) response of the microsphere-enhanced single detector with different material structures. Furthermore, these silicone-based characteristics were modeled and compared to experimental microsphere-enhanced single detector FTIR data. These two sources of information led to the analysis, extraction, and estimation of the effect of the adhesive material used to bond a microsphere lenses to SLS detectors across the 3-5 μm MWIR range in question.

Quantification of Resolution in Microspherical Nanoscopy, *Aaron Brettin, Cobey L. McGinnis, Kylen F. Blanchette, Yuri E. Nesmelov, Nicholaos I. Limberopoulos, Dennis E. Walker Jr., Augustine M. Urbas, and Vasily N. Astratov University of North Carolina, Air Force Research Laboratory*
Abstract: We perform resolution quantification for imaging F-actin protein filaments using contact microspherical nanoscopy. For the filaments deposited at the top of thin nanoplamonic arrays and observed through the coverslips with embedded high-index microspheres, the resolution of the magnified virtual image was found to be beyond the classical far-field diffraction limit.

Mode Hybridization in Photonic Molecules Comprised of Microspheres: Modeling and Experiment, *Farzaneh Abolmaali, Yangcheng Li, Kenneth W. Allen, Nicholaos I. Limberopoulos, Augustine M. Urbas, Yury Rakovich, Alexey V. Maslov, and Vasily N. Astratov University of North Carolina-Charlotte, Air Force Research Lab*
Abstract: Bonding and hybridization effects for whispering gallery modes in dielectric microspheres are studied by using side-coupled configuration with tapered fibers. Various molecular configurations of spherical atoms are studied by finite difference time domain modeling. The results are in a good agreement with the experimental studies of corresponding molecular configurations.

Slanted electromagnetic wave propagation through atmospheric phase turbulence using altitude-dependent structure parameter, *Ali Mohamed and Monish R. Chatterjee, University of Dayton*
Abstract: Electromagnetic propagation through MVKS-type turbulence is examined assuming a slanted path using the Hufnagel-Valley model. The propagation path consists of turbulent (L_T) and non-turbulent (L_D) zones; using a split-step approach, the diffracted field characteristics for a Gaussian-profile beam are examined under varying turbulence strengths, and L_T/ L_D ratios.

Algorithms for Tracking and Surveillance (AFTERNOON)

Fusing Facial Shape and Appearance Based Features for Robust Face Recognition, *Almabrok Essa, Vijayan Asari University of Dayton*
Abstract: How to describe an image accurately with the most useful information is the key of any face recognition task. In this paper, a new technique that combines the facial shape with the local structure of a face image is proposed, namely fusing shape and appearance features (FSAF). It is based on Gabor theory and local edge/corner feature integration technique. FSAF is evaluated on several challenging face datasets and provided promising results.

Fused Shape Features Based on Gradients and Local Phase in Color Domain*, Hussin K. Ragb, Vijayan K. Asari University of Dayton*
Abstract: Over the last decade, detection of human beings become one of the most significant tasks in computer vision due to its extended applications that include human computer interaction, visual surveillance, person identification, event detection, gender classification, robotics, automatic navigation, and safety systems, etc. However this task is rather challenging because of the fluctuations in appearance of the human body as well as the cluttered scenes, pose, occlusion, and illumination variations. For such a difficult task, most of the time no single feature algorithm is rich enough to capture all the relevant information available in the image. To improve the detection accuracy we propose a new human detection descriptor based on shape features. The shape features are extracted based on both, the image gradients, and the local phase in color space. The fusing of these complementary information yields to capture a broad range of the human appearance details that improves the detection accuracy. The proposed features are formed by computing the phase congruency of the three color channels in addition to the gradient magnitude and orientation for each pixel in the image with respect to its neighborhood. Only the maximum phase congruency values are selected from the corresponding color channels. The histogram of oriented phase and the histogram of oriented gradients for the local regions of the image, are determined. These histograms are concatenated to construct the proposed descriptor and it is named as Fused Gradients and local Phase in Color space (FGPC). Several experiments were performed to test and evaluate the detection performance of the proposed descriptor. A linear support vector machine (SVM) classifier is used to train the pedestrians. The experimental results show that the human detection system based on the proposed features has less error rates and better detection performance over a set of state of the art feature extraction methodologies.

Robust Multi-view Pedestrian Tracking Using Neural Networks*, Md Zahangir Alom, Tarek Taha University of Dayton*
Abstract: In this paper, we present a real-time robust multi-view pedestrian detection and tracking system for video surveillance using neural networks which can be used in dynamic environments. The proposed system consists of two phases: multi-view pedestrian detection and tracking. First, pedestrian detection utilizes background subtraction to segment the foreground blob. An adaptive background subtraction method where each of the pixel of input image models as a mixture of Gaussians and uses an on-line approximation to update the model applies to extract the foreground region. The Gaussian distributions are then evaluated to determine which are most likely to result from a background process. This method produces a steady, real-time tracker in outdoor environment that consistently deals with changes of lighting condition, and long-term scene change. Second, the Tracking is performed at two phases: pedestrian classification and tracking the individual subject. A sliding window is applied on foreground binary image to select an input window which is used for selecting the input image patches from actually input frame. The neural networks is used for classification with PHOG features. Finally, a Kalman filter is applied to calculate the subsequent step for tracking that aims at finding the exact position of pedestrians in an input image. The experimental result shows that the proposed approach yields promising performance on multi-view pedestrian detection and tracking on different benchmark datasets.

Towards Autonomous Surveillance in Real World Environments, *Gayatri Behara, Vamsy Chodavarapu University of Dayton*

Abstract: We present a portable autonomous surviellance system for real-world environments. The system functionality is expanded by combining autonomous object recognition along with depth perception which would provide the ability to both identify the object and its distance from the camera. Such capability would prove invaluable to autonomous surveillance applications, where persons carrying any forbidden and/or dangerous objects are detected in real-time and appropriate warnings are signaled. We have selected Microsoft Kinect V2 system which includes built-in hardware implementation of algorithms to identify humans in a complex real-world setting. In addition, the system can simultaneously track 6 people at any time and provide their skeletal joint diagrams for motion tracking. The current work deals with using the skeletal joint diagrams and depth maps to create a focus area around the hand area of the people. Our developed algorithm deals with object detection after the segmentation of hands. We use machine learning techniques with establishment of training datasets that includes the library of objects that we aim to detect. Finally, the complete signal processing software is implemented within a single board computer.

Motion Model Enabled Appearance Prediction for Partial Human Body Tracking in Robot follower, *Yingying Li, Ohio State University*
Abstract: Robot follower, a robot following its human operator, has found its application in many areas such as senior care, manufacturing, transportation, and etc. Tracking the target person is a key technique for the follower. In this paper, we present a new method for partial human body tracking, namely human feet tracking. Human feet tracking suffers from weak visual features and appearance variations, making it more critical to continuously update the foot appearance model. We propose to utilize the human motion model to predict foot appearance. It is achieved by first defining a motion phase to each human foot appearance. Due to the fact that the foot appearance across different motion cycles with the same motion phase is similar, we can predict the target appearance using the current motion phase and the target images stored from previous walking cycles. A phase labeled exemplar pool is built to serve the motion phase indexed appearance searching. We combine this phase labeled exemplar pool into particle filtering and have achieved robust human feet tracking.

Sparse Representation Based Classification Performance under Different Optimization forms for Face Recognition*, Khalfal Awedat, Almabrok Essa[b], Vijayan Asari and David Stoppenbrink[a] Pacific Luthern University, University of Dayton*
Abstract: Sparse representation-based classification (SRC) has become one of the most powerful methods for robust face recognition. However, there are some limitations of SRC performance at the presence of noise, occlusion, and illumination variation problems, which make it unstable. Therefore, we investigate the performance of SRC under different data conditions by applying the most powerful optimization methods based on SRC and focusing on the corrections between data samples and the sparseness. For evaluation, we utilize several challenging face datasets that include diversity of illumination and occlusion conditions.

Deep Learning, Artificial Intelligence and Cyber Security (AFTERNOON)

Network Intrusion Detection for Cyber Security using Unsupervised Deep Learning Approaches, *Md Zahangir Alom, Tarek Taha, University of Dayton*
Abstract: In the paper, we demonstrate novel neuromorphic cognitive computing system for network Intrusion Detection System (IDS) for cyber security using unsupervised Deep Learning (DL) approaches of Auto Encoder (AE) and Restricted Boltzmann Machine (RBM). Very often, the techniques with supervised learning or rules based approach like SNORT fetch problem with new type of cyber-attack. This is where the deep learning based unsupervised intrusion detection ensures around 92% detection for cyber security. In this implementation, the data is encoded numerically and features are extracted with un-supervised deep learning techniques of AE and RBM. Finally, iterative K-means is used for clustering of extracted features. We have experiment on KDD-99 dataset, and achieved around 92.12% detection accuracy using RBM+K-means technique. The proposed technique show around 4.4% and 2.95% improvement of detection accuracy against K-mean clustering and Unsupervised Extreme Learning Machine (USELM) respectively.

Classification of Malware Programs using a Deep Learning Architecture and its Application to Microsoft Kaggle Dataset, *Temesguen Messay Kebede, Barath Narayanan Narayanan, Ouboti Djaneye-Boundjou, David Kapp University of Dayton, AFRL*
Abstract: Distinguishing and classifying different types of malware is important to better understanding how they can infect computers and devices, the threat level they pose and how to protect against them. In this paper, a system for classifying malware programs is presented. The paper describes the architecture of the system and assesses its performance on a publicly available database (the Kaggle dataset provided by Microsoft for the Microsoft Malware Classification Challenge) to serve as a benchmark for future research efforts. First, the malicious programs are preprocessed such that they are visualized as gray scale images. We then make use of an architecture comprised of multiple layers (multiple level of encoding) to carry out the classification process of those images/programs. We compare the performance of this approach against traditional machine learning and pattern recognition algorithms. Our experimental results show that the deep learning architecture yields a boost in performance over those conventional/standard algorithms. A hold-out validation analysis using the superior architecture shows an accuracy in the order of 99:15%.

Cognitive Domain Ontologies in a Memristor Crossbar Architecture, *Chris Yakopcic, Nayim Rahman, Tanvir Atahary, and Tarek M. Taha Scott Douglass, University of Dayton, Air Force Research Laboratory*
Abstract: Cognitive agents are typically utilized in autonomous systems for automated decision making. These systems interact at real time with their environment and are generally heavily power constrained. Thus, there is a strong need for a real time agent running on a low power platform. This paper examines how some of the components of a cognitive agent can be mapped onto lookup tables stored in memristor crossbar circuits capable of highly parallel string matching. The agent examined is the Cognitively Enhanced Complex Event Processing (CECEP) architecture. This is an autonomous decision support tool that reasons like humans and enables enhanced agent-based decision-making. It has applications in a large variety of domains including autonomous systems, operations research,

intelligence analysis, and data mining. One of the most time consuming and key components of CECEP is the mining of knowledge from a repository described as a Cognitive Domain Ontology (CDO). We show that CDOs can be implemented using memristor crossbars

A Novel Hybrid Delay Based Physical Unclonable Function Immune to Machine Learning Attacks, *Nitin Pundir, University of Toledo*

Abstract: In this paper, a novel delay based Arbiter Ring Oscillator PUF (AROPUF) is designed which generates more unique challenge response pairs than previous designs and is immune to machine learning attacks. Different machine learning attacks are performed on this device. The results show that the challenge-response pairs generated cannot be predicted from a small set of CRPs which the hacker may have obtained.

Big Cyber Data Analysis: Developing Embedded Analytics Methods for Efficient Cyber Data Mining, *Bradley C. Boehmke, Trevor J. Bihl, Robert J. Gutierrez, Kenneth W. Bauer, Cade M. Saie, AFIT Operational Sciences, AFRL Sensors Directorate, US Air Force, AFIT Operational Sciences, US Army Cyber Command*

Abstract: As the number of cyber-attacks continues to grow on a daily basis, so does the delay in threat detection. For instance, in 2015, the Office of Personnel Management (OPM) discovered that approximately 21.5 million individual records of Federal employees and contractors had been stolen. On average, the time between an attack and its discovery is more than 200 days. In the case of the OPM breach, the attack had been going on for almost a year. Currently, cyber analysts inspect numerous potential incidents on a daily basis, but have neither the time nor the resources available to perform such a task. Current work in firewall log analysis is manual intensive and involves manpower hours to find events to investigate. This is predominantly achieved by manually sorting firewall log data. This work aims to improve the data mining capabilities of analysts to assist in this process. A Tabulated Vector Approach (TVA) is proposed to create meaningful state vectors from time-oriented blocks. Multivariate and graphical analyses are then used to analyze state vectors in a human-machine collaborative interface. Statistical tools, such as the Mahalanobis distance, factor analysis, and histogram matrices, are employed for outlier detection. This research also illustrates how these analytic methodologies can be integrated into embedded analytic tools so that cyber analysts on the front-line can efficiently deploy the anomaly detection capabilities.

Friday, June 30, 2017

Poster Session

Poster 1: A Wideband mmWave Antenna Element with a Single Feed Point, *David W. Landgren, Daniel J.P. Dykes, and Kenneth W. Allen, Advanced Concepts Laboratory, Georgia Tech Research Institute, Georgia Institute of Technology*
Abstract: An ultra-wideband (UWB), millimeter wave fragmented antenna with a single feed point is presented. The conductor region of the antenna aperture is approximately 0.5 mm by 2.0 mm or 0.07λ x .25λ at the shortest wavelength of operation. The antenna was fabricated on a 50 mil thick Rogers 5880LZ substrate using standard etching processes. Prior to fabrication, the antenna was simulated across two different full-wave electromagnetic (EM) solvers, HFSS and GTRI's in-house finite-difference time-domain (FDTD) code; agreement between the two codes was very good. Nominal antenna measurements were taken including reflection coefficient, realized gain, and principle plane patterns. The measurements are in good agreement with EM predictions.

Poster 2: Wideband Fragmented Aperture mmWave Antenna, *Daniel J.P. Dykes, Katherine E. Bowland, and Kenneth W. Allen, Advanced Concepts Laboratory, Georgia Tech Research Institute, Georgia Institute of Technology*
Abstract: A mmWave antenna is presented with approximately 2:1 bandwidth in the Ka and V bands. The antenna operates from 30 to 60 GHz with greater than 10 dB return loss over the majority of the band. The design process is presented, starting with initial dimensions and material considerations. An outline of the computational design method and its iterations follows, leading to the converged result. Validation is provided by simulations in both proprietary FDTD, and HFSS, models. Finally, measurement results of a prototype are shown for comparison with modeled results along with a discussion of these results.

Poster 3: Radiating metasurface with thermally controlled reconfigurable states: A simulation study, *Kenneth W. Allen, Daniel J.P. Dykes, and David W. Landgren Advanced Concepts Laboratory, Georgia Tech Research Institute, Georgia Institute of Technology*
Abstract: In this work, a simulation study of a radiating metasurface demonstrates a reconfigurable conductive topology that alters the radiation characteristics of the antenna. Surrogate RLC values are used to model the conductivity change when micro-heaters force metal-insulator-transitions (MIT) in vanadium dioxide switches. These switches connect sub-wavelength metallic patches arrayed across the aperture (i.e. metasurface). This enables a thermally controlled conductive topology as a mechanism to manipulate the radiation characteristics of the metasurface for desired performance (e.g., frequency, polarization, radiation pattern).

Poster 4: Predicting Total Secondary Electron Emission from Porous Surfaces Using a 3D Pore Geometry, James *M. Sattler, Robert A. Lake, Ronald A. Coutu, Jr. , and Tod Laurvick, Air Force Institute of Technology (AFIT) Marquette University*
Abstract: Multipactor continues to be a significant problem faced by modern space-based systems and vacuum electronic devices. Often described as an "avalanche" of free electrons inside high power RF components under vacuum, multipactor can reflect large amounts of RF power and trigger RF breakdown that can destroy the RF component. A new and promising field of multipactor prevention research is using engineered surfaces at micro and nano scales to control the secondary electron yield (SEY) of the surfaces involved to unity or below. The key to this approach is maintaining the surface SEY < 1, which prevents electron population growth rendering impossible a multipactor event. As a new field of research, there remains a significant need to develop models that accurately predict the SEY of an engineered surface based on the surface topography (i.e. feature aspect ratio and distribution density). We have developed a new 3D model describing the probability that an electron, emitted from the bottom of a cylindrical pore, will escape the pore. We then incorporate this 3D probability model in another model to predict the SEY of an entire porous surface based on four parameters: the SEY of the two reference surfaces (i.e. the surface at the bottom of the pores and the surface in-between the pores), the pore aspect ratio, and the pore density (i.e. porosity). Finally, we use the entire model to explore the relationship between the topography of a surface and its corresponding SEY and determine optimal engineered surface designs to control SEY for multipactor suppression.

Poster 5: A New Model for Simulation of Scattered EM Fields from a Conducting Cylinder in Rotation and Translation using Static Data, *Esmail M. M. Abuhdima Robert P. Penno, Ph.D University of Dayton*
Abstract: Simulation of the rotation and translation of a very good conducting cylinder upon the backscattered field of an incident plane wave (H-wave) is investigated using the Franklin transformation and the Lorentz transformation. It is seen that both phase and magnitude of the backscattered field are affected during the movement (rotation and translation) of the very good conducting cylinder. FEKO is used to generate static backscattered field data of the complex object, and then this data is inserted into the proposed model to demonstrate simulation of rotation and translation. Also, this result is compared with the analytical method.

Poster 6: *Medical Applications of Conformal Flexible Antennas,* *Altan M. Ferendeci, University of Cincinnati*
Abstract: Flexible conformal antennas are developed for medical applications. The overall antenna thicknesses are thin and processed on flexible substrates. In addition to normal metallic antennas, slotted versions are developed so that they can be more flexible and cover wider frequency ranges. Various antenna configurations such as Composite Right/Left-handed (CRLH), fractal, elongated circular and logarithmic spiral antennas were processed. Possible applications are listed.

Poster 7: Electricity Theft Concerns within Advanced Energy Technologies, *Trevor J. Bihl, Salam Hajjar Air Force Research Laboratory, Marshall University*

Abstract: Developments in ambient energy and radio frequency (RF) energy harvesting (E-harvesting) have the potential to provide in situ power for sensor systems; however, they also have the potential to illicitly collect generated energy. Additionally, new methods of electricity theft (E-theft) have appeared with the introduction of smart grid components. This paper provides an understanding of E-theft as it relates to advanced energy applications, e.g. E-harvesting and the smart grid.

Poster 8: Detecting of tundra lake patterns on permafrost historical maps, *Almabrok Essa, Ivan Sudakov, and Vijayan Asari, University of Dayton*
Abstract: Detailed knowledge of the lake pattern geometry in a changing arctic tundra landscape is potentially valuable in order to understand their spatiotemporal dynamics. In this paper we develop a new approach for computational image analysis of tundra lake patterns on historical maps. For the assessment, we utilize the historical maps of permafrost and detect the features of patterns geometry.

Poster 9: Low Power Smart Embedded System for Pre-Fall Detection Application, *Neeraj Rathi Purdue University*
Abstract: Fall has become a serious medical problem, and sometimes leading to physical disabilities and death. This led researchers to pursue automatic monitoring systems for detecting the falls before they occur. Much of the existing efforts have successfully achieved a hardware system which provide a fall pattern after the fall. However, the existing fall detection systems deficient in achieving efficient pre-fall pattern, power optimization, optimum sensor structures, and internet of things capabilities. In this study, we have demonstrated a pre-fall detection system using motion sensors associated with Arm Processor, Wifi sensor, and MicroSD Card. The Hardware system is designed to get dependable embedded system to detect fall, with an approach to make easy wearable device for subject. The software is developed to get optimal low power consumption by switching the processor between sleep and active modes. The algorithm enables the system on interrupts, which then calculates angular positon and linear velocity of the subject using motion sensors. The algorithmic high pass and low pass filters are used to reduce the drift and noise from motion sensor data. To differentiate fall with activity of daily living (ADL) Signal Vector Magnitude (SVM) and Signal Magnitude Area (SMA) is calculated and combined with filtered value for the final decision. The fall information is sent to caretaker using IoT and gets store in SD card for further analysis. The designed system after practical experiments found out to consume 409.1μA in deep sleep mode and 15mA in the active mode with 100% sensitivity and 98.07% specificity. The system stays in sleeping mode during majority of user activity of daily living (walking, sitting), thus improving battery life of the device. The system also successfully differentiates between the a ADL like walking, sitting running, and climbing stairs with actual fall.

Poster 10: The Effect of Range-Sidelobe-Reduction Windows on the Complex Stretch Processor's Response to Arbitrarily Bandlimited Gaussian Noise, *John N. Spitzmiller, Parsons Government Services*
Abstract: This paper derives the response to bandlimited Gaussian noise with arbitrary center frequency and bandwidth of a complex stretch processor using conventional (window-based) range-sidelobe reduction. The paper then identifies three jamming-related applications of the derived characterization. Digital simulation results for the three identified jamming applications verify the derivation's correctness.

Poster 11: Power analysis-based Hardware Trojan Detection, *Hao Xue, Wright State University*
Abstract: An attacker who has access to IC fabrication process can alter the genuine hardware with the insertion of concealed hardware elements (Hardware Trojan). A zero-overhead, power analysis-based microelectronic circuit Hardware Trojan detection methodology is proposed. Based on simulation results, a Hardware Trojan with area that is over 0.021% of host-circuitry area is detectable.

Poster 12: Design of Tunable Shunt and Series Interdigital Capacitors Based on Vanadium Dioxide Thin Film, *Liangyu Li, Weisong Wang, Eunsung Shin, Tony Quach, and Guru Subramanyam, University of Dayton, Air Force Research Laboratory*
Abstract: Tunable coplanar waveguide interdigital capacitor (IDC) designed with vanadium dioxide (VO2) thin film was fabricated on the sapphire substrate is presented in this paper. Two different configurations, series IDC and shunt IDC, are proposed. Tunable capacitance can be implemented by the thermally controllable VO2 thin film. The tunability of IDC structures are 95.6% and 85.4% corresponding to the series IDC and shunt IDC, respectively.

Poster 13: Design and Implementation of Customized Encryption Algorithm for Authentication and Secure Communication between Robots, *Bhavana Daddala, Hong Wang, Ahmad Javaid University of Toledo*
Abstract: In this paper, we propose a customized encryption algorithm to implement secure transfer of information. The algorithm is a variation of Advanced Encryption Standard (AES) and is carried out between multiple robots. AES ensures secure transmission of data and uses only one private key (symmetric key) to encrypt the data. The implementation works on a standard irreducible polynomial of degree '8' which is further used to compute multiplicative inverse tables, S-boxes and inverse S-Boxes required for the working of every block in the algorithm. Key sizes for AES are usually 128, 192 and 256 bits in size. A random number generator produces a key and the same key is transferred to the other end for decryption. On the contrary asymmetric cryptography uses two keys, private and public keys. The public keys are shared among the communicating parties, while the private keys are still kept secret (not shared with anyone). The keys are supposed to be large in size to maintain strength, thus they usually range from 512 bits to 1024 bits or more for asymmetric cryptography. The communicating parties can start with public-private keys and agree upon a common key (session key) which can be used as a key to AES. This means symmetric key is derived from asymmetric key (also known as Diffie-Hellman Key Exchange). Our algorithm focuses on devising a new protocol for key establishment and agreement. The algorithm being developed includes hash functions (SHA-2 algorithm) as digital signatures for authentication. It will be tested for successful communication between multiple robots (nodes) using centralized server (Kerberos) protocol. The outcome is to establish a different approach of

encryption and enhance security by providing protection against malicious attacks including man-in-the-middle attack. The customized algorithms will be programmed in Python and deployed on Raspberry Pi.

Poster 14: Modeling of Current Conduction Mechanism within $LiNbO_3$ based Memristor Devices, *Ayesha Zaman, Weisong Wang, Guru Subramanyam, University of Dayton*
Abstract: A physical model describing the flow of current due to the inelastic Trap Assisted Tunneling (TAT) mechanism through the metal oxide interface, deep into the dielectric layer has been depicted in this work. This is particularly meant for a lithium niobate ($LiNbO_3$) based memristor device.

Poster 15: Focal plane arrays with large collection efficiency and wide angle-of-view: New design freedoms offered by nanoscribe technology, *Aaron Brettin, Farzaneh Abolmaali, Daniel B. Fullegar, Nicholaos I. Limberopoulos, Augustine M. Urbas, and Vasily N. Astratov University of North Carolina, Air Force Research Laboratory*
Abstract: Nanoscribe technology allows fabricating surface photonic microstructures aligned with the mesas of mid-IR (MWIR) focal plane arrays (FPAs). Our preliminary FDTD modeling and fabrication results show a great potential of arrays of microcones for achieving highly efficient collection of light with wide angle-of-view and small thermal noise in MWIR FPAs.

Poster 16: Coherent and incoherent image formation: resolution analysis for contact microlenses. *Farzaneh Abolmaali, Nicholaos I. Limberopoulos Augustine M. Urbas, Alexey V. Maslov, Vasily N. Astratov University of North Carolina, Air Force Research Laboratory, University of Nizhny Novgorod, Russia*
Abstract: The imaging properties of the hemispherical and microspherical lenses are studied by FDTD modeling with point sources. It is shown that the resolution of incoherent imaging roughly corresponds to that in the solid immersion lens concept. The coherent imaging leads to artifacts determined by the phase distribution in the objects.

Poster 17: Design and implementation of conventional (PID) and modern (Fuzzy) controllers for energy storage system in hybrid electric vehicle, *Akram Muntaser, Hamed Elwarfalli, Jitendra Kumar, Guru Subramanyam University of Dayton*
Abstract: Hybrid electrical vehicles are became widely used over the last 20 years, which makes the energy systems of these vehicles are very common area for research. Hybrid vehicle energy system mainly consists of a battery (usually Lithium ion battery) and ultra-capacitor connected in a specific way to give the car velocity and acceleration as desired. The purpose of this paper, first is to study the performance of energy storage systems in hybrid electrical vehicles, then design two different controllers (Conventional PID and modern Fuzzy logic controller) in order to minimize the energy loss between the energy system components (mainly batteries and Ultra-capacitors), and to achieve instant and accurate response of the energy system to the power demand that needed in output in ordered to move a car as desired. Second, is to compare these two controllers in terms of design, cost, and performance.

Poster 18: Identification of whispering gallery modes in a fiber side-coupled in a polarization-controlled setup for developing sensor functionality, *Farzaneh Abolmaali, Yangcheng Li, Anatole Lupu, Maria Tchernycheva, Alexey V. Maslov, Nicholaos I. Limberopoulos, Augustine M. Urbas, and Vasily N. Astratov University of North Carolina at Charlotte, University Paris, France University of Nizhny Novgorod, Russia Air Force Research Laboratory*
Abstract: Development of whispering gallery mode (WGM) sensors of nanoparticles deposited on a sidewall surface of circular resonators require identification of polarizations and modal numbers of WGMs involved. Using FDTD modeling and analytical approach based on Mie scattering theory, we identified WGMs excited experimentally in a side-coupled configuration with controlled polarization.

NAECON-2017 Agenda At-A-Glance

Start	End				
Day 1– Tuesday, June 27, 2017 Coffee Break: 3:00pm - 3:15pm					
			Registration (Tuesday starting at 11:00am, then Daily 7:30am – 4:00pm; Ends Friday at 12:00pm)		
1300	1700		**Tutorial A Trusted Systems & Electronics, Dr. Charles Cerny and Dr. Matt Casto, AFRL Sensors Directorate (Ballroom)**		
1300	1500		**Tutorial B Understanding Infrared Detection, Dr. Kenneth Hopkins, AFRL Materials and Manufacturing Directorate (Auditorium)**		
1515	1700		**Tutorial C Overview of 5G Communication Technologies, Dr. Michel Gagne, Keysight Technologies Inc. (Auditorium)**		
1730	1930		**NAECON INFORMAL SOCIAL EVENT HOLIDAY INN RESTAURANT (530pm– 730pm) (CASH BAR)**		
Day 2– Wednesday, June 28, 2017 Coffee Breaks: 10:15am – 10:30am , 3:30pm - 3:45pm					
0730	0830		**Continental Breakfast**		
0830	0845		**Welcome and Introductions (Ballroom)**		
0845	0930		**Plenary 1: Dr. Patrick Roblin, "New Paradigm for the Accelerated Design of Power Efficient RF Amplifiers" (Ballroom)**		
0930	1015		**Plenary 2: Dr. Gary Scalzi, AFRL "Air Force ManTech – Bridging the Valley of Death: From Science & Technology to Manufacturing & Production"**		
1030	1200		**Low SWaP Sensor Processing (10:30am – 11:50pm) Ballroom**	**THz & mmwave (10:30pm - 12:00pm) Auditorium**	**Aerospace Power (10:30pm - 11:40pm) Kitty Hawk**
1200	1315		**Keynote Luncheon; (Ballroom) Keynote Speaker: Dr. Elliott Brown, WSU "Good Vibrations: Resonant RF Interactions with Bioparticles and Biomolecules from GHz to THz"**		
1315	1400		**Plenary 3: Mike Parker, Intel Corp, "Stratix 10: Intel's latest FPGA technology and capabilities" (Ballroom)**		
1400	1745		**Low SWaP Sensor Processing (2:00pm – 3:30pm) Ballroom Guidance and Control (3:45pm - 5:15pm) Ballroom**	**THz & mmwave (2:00pm - 3:30pm) Auditorium Trusted Systems & Electronics (3:45pm - 5:45pm) Auditorium**	**Emerging Electronics and Microsystems (2:00pm - 5:45pm) Kitty Hawk**
Day 3– Thursday, June 29, 2017 Coffee Break: 10:15am – 10:30am , Break 3:15pm - 3:30pm					
0730	0830		**Continental Breakfast**		
0830	1200		**Photonics and EO (8:30am - 12:00pm) Ballroom**	**Radar, Tomography and RF Sensing (8:30am - 12:00pm) Auditorium**	**Deep Learning, Artificial Intelligence and Cyber Security (8:30am - 12:00pm) Kitty Hawk**
1200	1315		**Keynote Luncheon - (Ballroom) Keynote Speaker: Dr. John Volakis, OSU "Ultra-Wideband Arrays with Low Cost Beamforming Back-Ends"**		
1315	1745		**Photonics and EO (1:15pm - 3:15pm) Ballroom**	**Algorithms for Tracking and Surveillance (1:15pm - 3:15pm) Auditorium**	**Deep Learning, Artificial Intelligence and Cyber Security (1:15pm - 3:05pm) Kitty Hawk**
1800	2100		**NAECON BANQUET (6:00pm – 9:00pm) Ballroom Banquet Speaker: Dan Both, Former Technical Director of Trusted Foundry Program**		
Day 4– Friday, June 30, 2017 Coffee Break: 10:00am - 10:15am, 3:15pm - 3:30pm					
0730	0830		**Continental Breakfast**		
0830	0915		**Plenary 4 Captain JT Elder, Commander of the Naval Surface Warfare Center, Crane, Indiana** (Ballroom)		
0915	1000		**Plenary 5: Representative Rick Perales, Ohio House of Representatives, 73rd District** (Ballroom)		
1015	1130		**Dr. Rob Williams, Discovery Lab Global** (Ballroom)		
1130	1315		**Women in Engineering Panel "STEM-M, Fostering the Next Generation of Women Engineers, Mathematicians and Scientists" (**Ballroom**)** (Buffet Lunch)		
1315	1530		**Networking for industry/ Poster Session (Judging/Awards)** (South Corridor/Ballroom Foyer)		
1530	1600		**Closing NAECON 2017 with best poster paper awards (**Ballroom**)**		