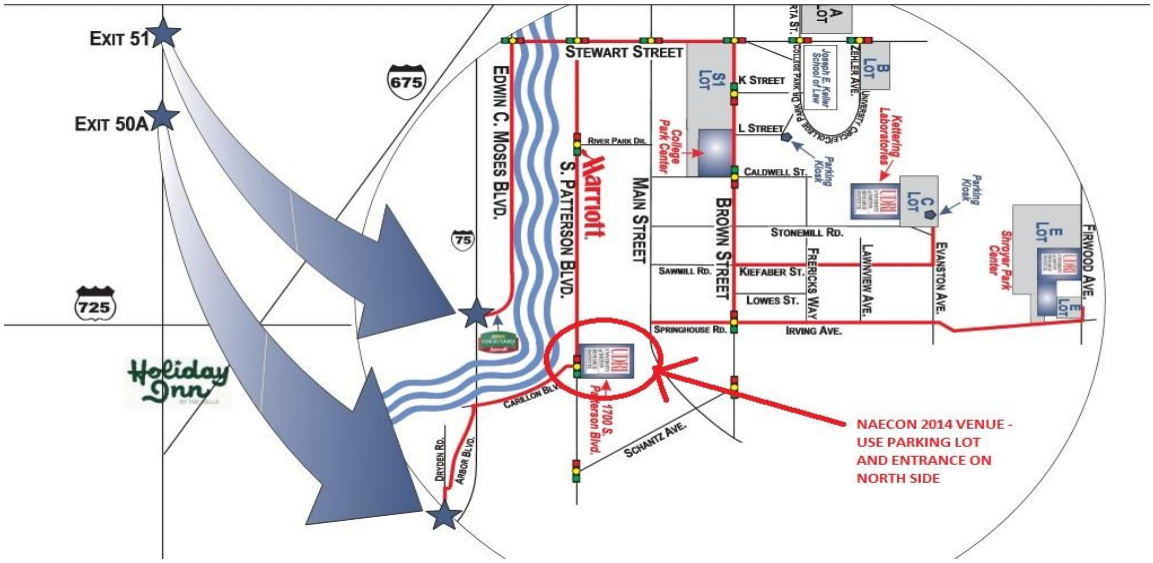
Agenda

NAECON 2014 June 25 – June 27, 2014

"Sensory Processing"

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

University of Dayton's River Campus (Meyer Room), 1700 Patterson Blvd, Dayton, Ohio



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NAECON Agenda At-A-Glance

Start	End				
Day 1– Wednesday, June 25, 2014 (Pages 4-10) ***Coffee Breaks: 10:00 – 10:15 , 15:30 -15:45***					
7:00	8:00		**Continental Breakfast (All Days)** *Exhibit Room (N1840)*		
7:00	16:00		**Registration (7:00 – 16:00 Daily; Ends Friday at 12:00pm)** *Lobby*		
8:00	8:25		**Introduction by NAECON Committee** *Meyer Room (N1650)*		
8:30	11:45		**Tutorial A 9:00am - 10:00am (Sonntag)** **Tutorial B 10:15am - 11:45am (Balster)** *Southside Exhibit Room (N1840)*	**(RCS) Radar, Cognitive Signal Processing & Visualization for RF Sensing (8:25am - 11:30am)** *Meyer Room (N1650)*	**(SDM) Sensors, Devices & MEMs (8:25am - 11:15am)** *North Dining Room (N1620)*
11:45	14:00		**Luncheon with Speakers (12:00 Keynote: Bonneau ; 13:00 Plenary: Bandyopadhyay)** *Meyer Room (N1650) (Buffet in Exhibit Room, Beverages in Meyer Room)*		
14:00	18:00		**Tutorial C 2:00pm – 3:30pm (Abdel-Aty-Zohdy)** *Southside Exhibit Room (N1840)* **(CIP) Collaborative and Image Processing 2:00pm – 5:30pm** *Exhibit Room (N1840)*	**(APS) Aerospace Power Systems and Electronics (2:00pm - 5:30pm)** *Meyer Room (N1650)*	**(THZ) Advanced Terahertz and Millimeter Wave Devices (2:00pm - 6:00pm)** *North Dining Room (N1620)*
Day 2– Thursday, June 26, 2014 (Pages 11-16) ***Coffee Breaks: 10:00 – 10:15 , 15:30 -15:45***					
8:00	11:45		**Tutorial D 8:00am – 11:45am (Blasch)** *Southside Exhibit Room (N1840)*	**(TIS) Trust in Semiconductors (8:00am - 11:45am)** *Meyer Room (N1650)*	**(RFT) Recent Advances in RFIC Technology Advanced Terahertz and Millimeter Wave Devices (10:15am - 11:45am)** *North Dining Room (N1620)*
11:45	14:00		**Luncheon with Speakers (12:00 Keynote: Barnsley; 13:00 Plenary: Weinstock)** *Meyer Room (N1650) (Buffet in Exhibit Room, Beverages in Meyer Room)*		
14:00	18:30		**Tutorial E 2:00pm – 3:30pm (Barnsley)** **Tutorial F 3:45pm – 5:30pm (Sonntag/Curtice)** *Southside Exhibit Room (N1840)*	**(PHS) Photonics, nanoDevices and Advanced Materials for IR (2:00pm - 6:30pm)** *Meyer Room (N1650)*	**(MSM) Monitor & Surveillance Methods (2:00pm - 6:30pm)** *North Dining Room (N1620)*
Day 3– Friday, June 27, 2014 (Pages 17-20) ***Coffee Break: 10:00 – 10:15 , Ice Cream Break 15:30 -15:45***					
8:00	12:20		**Tutorial G 9:00am – 11:45am (Loomis)** *Southside Exhibit Room (N1840)*	**(ANS) Antennas, Navigation, RF and Nonlinear Signal Processing (8:00am - 10:00am)** **(BSC) Bio-Inspired Systems and Cyber-Physical Applications (10:15am - 12:00pm)** *Meyer Room (N1650)*	**(RCT) Reconfigurable Computing (10:10am - 12:30pm)** *North Dining Room (N1620)*
12:30	14:00		**Luncheon with Speaker (13:00 Keynote: Morton)** *Meyer Room (N1650)(Buffet in Exhibit Room, Beverages in Meyer Room)*		
14:00	17:00		**(IEE) IEEE Membership, Women in Engineering & UD Tour (2:00pm - 5:00pm)** *Exhibit Room (N1840)*	**(TEC) Tec^Edge Student Presentations (2:00pm - 5:00pm)** *Meyer Room (N1650)*	**(NGC) NAECON GRAND CHALLENGE (Student Paper) (2:00pm - 5:00pm)** *North Dining Room (N1620)*

ROOM LOCATION MAP PAGE 22

Day 1 (Morning) – Wednesday, June 25, 2014

Time	Event	Location
7:00am-4:00pm	Registration	Lobby
7:00am-8:00am	Breakfast	Exhibit Room (N1840)
8:00am-8:25am	Introduction/ NAECON Committee	Meyer Room (N1650)

Tutorial A & B (Coffee Break-10:00am-10:15am)

Tutorial A (9:00 am – 10:00am) — **Location: SW Side Exhibit Room (N1840)**
Chairs: Catherine Deardorf & Felicia Harlow

Topic: "John Boyd vs Gordon Moore: Hackerspaces and Tactical Electronic Device Prototyping"
Dr. David Sonntag, USAF School of Aerospace Medicine

Tutorial B (10:15 am -11:45am) — **Location: SW Side Exhibit Room (N1840)**
Chairs: Catherine Deardorf & Felicia Harlow

Topic: "Image and Video Compression Fundamentals"
Dr. Eric Balster, University of Dayton

Morning Sessions 8:25am-11:30am (Coffee Break-10:00am-10:15am)

Session (8:25am-11:30am)	Title	Location
RCS	**Radar, Cognitive Signal Processing & Visualization for RF Sensing** *Chairs: Dr. Yuan Zheng, The Ohio State University & Dr. Annie Shen, Ohio University*	North Dining Room (N1620)

(8:25am-8:55am) Sensitivity Simulation of Compressed Sensing based EW Receiver using Orthogonal Matching Pursuit Algorithm

Authors: Lee L. Liou, David M. Lin, Ethan Lin, and Chien-In Chen; Air Force Research Laboratory

Abstract: *The major challenge of electronic warfare (EW) receiver is to detect in real-time the unknown signals of radar signals which may present threat to air platform in theater. Traditional digital wideband EW receiver performs frame-based FFT process to detect and classify the incoming signal. The wideband coverage is limited by the sampling frequency of the analog-to-digital converter (ADC). Compressed sensing (CS) concept has been proposed and applied to process wideband sparse signals with reduced sampling rate. Potential CS applications have been successfully demonstrated in both image and RF fields. The next step of CS-based EW receiver development requires a systematic performance evaluation. In this study, we apply a traditional methodology to calculate the sensitivity of a CS based EW receiver. Two modulation schemes of CS are used. One is non-uniform sampling (NUS) and the other is pseudorandom chip (PRC) modulation. The orthogonal matching pursuit (OMP) algorithm is used to process CS data. Sparcity of the signal adversely affects sensitivity. Remedy methods for this problem in NUS and PRC modulation are proposed, and the sensitivity improvements are presented.*

(8:55am-9:25am) Implementation of Polynomial Classifier using Memristor Crossbar Circuits

Authors: Raqibul Hasan and Tarek M. Taha; University of Dayton

Abstract: *The memristor is a novel device having a large varying resistance range. Physical memristors can be laid out in a high density grid known as a crossbar. This paper demonstrates that memristor crossbar based neural circuits can be trained to implement non-linearly separable functions. Here memristors are used as the synaptic weight of neurons. Memristor crossbars are utilized to evaluate a large number of multiplication and addition operations concurrently in the analog domain. In this paper we have demonstrated implementation of polynomial classifier utilizing memristor crossbar. The circuit simulations were performed using SPICE so that alternate current paths and wire resistances within the memristor grid could be accurately simulated.*

(9:25am-9:55am) Radar Data Classification using IC Daubechies Wavelet Chip

Authors: Stephanie Roth and Hoda S. Abdel-Aty-Zohdy; Oakland University

Abstract: *The Daubeauchies 4 wavelet is used for compressing and filtering non-periodic signals and proves to be a useful preprocessor for noisy signals. Our system is specifically set up to process measurements of the Angle Of Arrival (AOA) from a radar array of 16-antenna to classify the AOA with high fidelity The filtered signals using the Daubeuchies 4 wavelet design send the resulting data to a spiking neural network for the AOA identification. However, this pre-processing technique can be used for different applications and is especially useful for signals with noise greater than the signal. Simulations of the wavelet applied to measured radar data will be presented. The current IC wavelet chip is a SPI based chip that can interface with a SPI bus on a microcontroller to apply the transform to the incoming signal. The chip design will be presented and discussed, as well as the physical layout, testing, and future work.*

(10:00am-10:15am) BREAK

(10:15am -10:45am) Transform Sensing for Phased Array Sensor

Authors: Siyang Cao, Balsam Dakhil, Yuan F. Zheng, and Robert L. Ewing; The Ohio State University, Air Force Research Laboratory

Abstract: *A completely new scheme called transform sensing is proposed for phased array radar. The new scheme forms certain beam patterns, which directly perform desired transform, such as discrete cosine transform (DCT) or discrete wavelet transform (DWT), to the space. The received signals will be the coefficients of transform instead of raw data. By doing so, signal processing is performed in an online fashion to render attractive advantages which we never experienced before.*

(10:45am-11:15am) INVITED PAPER, "A comparison of theoretical, computational, and experimental human electromagnetic scattering at VHF, UHF, X-band, and Ku-band"

Authors: Loria Wang, M. Brian Calderon, Randall Jarusiewic, Elena Martinez, Lynise Starr, and Analee Miranda; MacCauley Brown, Infocitex, Dayton, Air Force Research Laboratory

Abstract: *Radar based human detection and classification is a diverse field that is rich with challenging open problems. There are currently several commercial off the shelf computational electromagnetic software packages that have developed human packages specifically for the purpose of radar based human detection and classification. In this paper we compare a select set of theoretical and computational state-of-the-art software to recent experimental data collection on adult and child human subjects using static and Doppler radars operating in VHF, UHF, X-band, and Ku-band. We find that there are unique human-based resonances in the UHF band that may aid researchers in finding a way to classify a general age class and estimate certain physical body indexes from radar scattering measurements. We continue the analysis by comparing the regions of the human body that maximally scatter based on frequency selection. We conclude the paper by listing a set of open problems that have been determined based on our paper's analysis.*

Session	Title	Location
(8:25am-11:15am)		
SDM	**Sensors, Devices & MEMs**	Meyer Room
	Chairs: Dr. Elena Guliants & Dr. Mark Patterson, University of Dayton	(N1650)

(8:25am-8:45am) Electrical Properties of Graphene Oxide-Silver Nanocomposite

Authors: C.L.H. Devlin, R.L. Ewing, and E. Guliants, Air Force Research Laboratory, University of Dayton

Abstract: *Most carbon nanomaterials are touted for their unusually good conductive or semiconductive properties. We, however have studied a many-layered graphene oxide-silver nanocomposite "paper" and its simpler sister material made with graphene oxide alone, to elucidate their unusual resistive properties. We have observed significant nonlinearities in resistivity, its dependence on temperature, and a number of current-induced effects on the resistivity of these materials (both reversible and non-reversible). We present these results along with compositional, microscopic and other analyses.*

(8:45am -9:05am) Novel composite film of Ag-Si to develop an Infrared (8-14 um) detector

Authors: Moussa Souare, Clayton Bates, Christos Papachristou, Robert L. Ewing; Case Western University. Air Force Research Laboratory

Abstract: *A composite film of Ag-Si was sputtered on the substrate of Si (111) to study the electrical properties using the Hall Effect. The composite is designed to be used to make a detector in the wavelength range of 8-14 microns. A volume fraction of 20% and 80% Ag and Si were used respectively. The sample of thickness of 2.0 microns was subjected to chemical cleaning until complete removal of the segregated layer, a thin conductive layer caused by the rising of Ag atoms to the surface. The following step after etching was the evaporation of 200Å chromium (Cr) and 2000Å gold (Au) in the chamber of the vacuum. To create lower resistance between the evaporated metals and composite, the sample was annealed at 70000C in a RTA for 30 seconds. An I-V measurement was taken to ensure that the contacts were ohmic, i.e. linear. The final step before measuring the Hall Effect was to sand blast a cloverleaf pattern on the composite with the contact on the periphery of each leaf. Finally, Hall measurement showed average carrier concentration of 2.94E20 (cm3) and the average mobility of 86.4 (cm2/ volt-sec).*

(9:05am-9:25am) Vanadium dioxide thin film series single-pole single throw switch

Authors: K.C. Pan, D. Brown, Weisong Wang, and G. Subramanyam, University of Dayton

Abstract: *Vanadium dioxide (VO2) thin films have unique insulator to metal transition above the critical temperature of 72 ºC. The selectively deposited VO2 thin film based devices showed insulator performance at room temperature and less than 40 Ω at 80 ºC. Switching devices designed using a VO_2 series varistor showed good isolation (>20 dB) and low insertion loss (<1 dB) up to 20 GHz. This paper presents series varistor devices designed and fabricated on sapphire substrates.*

(9:25am-9:45am) Construction of a Twin-Tier Platform for Biological Sensing

Authors: M. Patterson, K. Hansen, D. Walker, M. Qumsiyeh, H. Yue, & G. Subramanyam, University of Dayton

Abstract**:** *This paper describes the successful construction of a twin-tier platform for use in biological sensing applications. The two piers are inline and have a tunable gap between them, with gap distance varying between 60-200 nm. The proximal ends of the piers are contiguous with a Co-Planar Waveguide structure that allows for testing. The basic pier structure was created by ablation of a customized MMA/PMMA stack using a JEOL laser system. A layer of Ti-Au was then deposited on silicon using standard electron beam deposition techniques. Electromagnetic testing of the structures was correlated with SEM imagery for characterization of electrical properties and gap integrity. The overall design is to create a biological sensing bridge by tethering molecules across the distal ends of the piers thereby completing the circuit. The type and composition of biological bridge provides sensor selectivity and sensitivity.*

(9:45am-10:05am) Characterization of Electrical and Physical Properties of Single-Walled Carbon Nanotube Ink

Authors: Kris Warner, Carrie Bartsch, Jack Lombardi, and Mary Lanzerotti, Air Force Institute of Technology

Abstract: *This paper presents a method of characterizing single-walled carbon nanotube (SWCNT) ink. The process of ink jet printing SWCNT ink onto organic and inorganic substrates is discussed. The tests for measuring sheet resistance, conductance, thickness, roll-off, and S-parameters of the ink are described. Future research will be discussed, including the characterization of SWCNT ink.*

(10:05am-10:15am) BREAK

(10:15am-10:35am) Inexact Computing with Approximate Adder Application

Authors: Derrick Langley, Christopher Allen, James C. Lyke; Air Force Institute of Technology, Air Force Research Laboratory

Abstract: This paper provides a taxonomic survey of inexact computation for power reduction. Mutual information is introduced as a metric to describe the usefulness of a logically-minimized inexact digital circuit. Results show that a 23 percent power reduction is achieved for several approximate adder architectures while maintaining a root-mean square error of 16 percent.

(10:35am-10:55am) A Unidirectional 3D-SiC MESFET for High Power Aerospace Applications

Authors: Ramana Thakkallapally, Vamshi Veesam, Ibrahim Abdel-Motaleb and Zheng Shen; Northern Illinois University and Illinois Institute of Technology

Abstract: *A one-directional 3D normally-on SiC MESFET, suitable for safe multi-KW/cm2 power applications, is designed and analyzed using the numerical analysis simulator, Silvaco Atlas. The analyses show that the drain current is a 100% higher than a surface device with the same dimensions, while occupying less than 33% of the area. At gate voltage of 0V, the drain current reaches 600 mA/mm with a breakdown voltage greater than 600V. The proposed vertical structure allows for more efficient heat dissipation and can be easily connected in parallel to provide power of more than 10 kW/cm2.*

(10:55am-11:15am)Three-Dimensional 3C-SiC/Si Normally-off MOSFET for High Power High Speed Aerospace Applications

Authors: Vamshi Veesam, Ramana Thakkallapally, Ibrahim Abdel-Motaleb, and Zheng Shen; Northern Illinois University and Illinois Institute of Technology

Abstract**:** *An optimized power system requires the integration of more than one technology. In this paper we present a 3D 3C-SiC/Si MOSFET, where high performance power devices can be integrated with low cost Si technology. Using the numerical analysis simulator Silvaco Atlas to simulate the device performance, it was found that these devices can provide double the current while occupying less than 33% of the substrate area of a lateral device with the same gate length and width. The device simulation shows that the breakdown voltage can reach265V and the drain current can reach 0.5 A/mm at Vg =4 V. The stability of this device with temperature makes it an excellent candidate for high power applications.*

WEDNESDAY Luncheon 11:45am–2:00pm (Food located in Exhibit Room) Meyer Room

12:00pm

Keynote Speaker: Vic Bonneau, President
General Electric Aviation Electrical Power Systems Design and Controls

Title: SiC Business Potential

1:00pm

Plenary Speaker: Anirban Bandyopadhyay, Ph.D.
National Institute of Material Science, Tsukuba City, Japan

Title: Computing with Organic Brain Jelly

Day 1 (Afternoon) – Wednesday, June 25, 2014

Tutorial C

Tutorial C (2:00pm - 3:30pm)
Chairs: *Catherine Deardorf & Felicia Harlow*

Location: SW Side Exhibit Room (N1840)

Topic: "Bio-Inspired Chips for High Fidelity Classifications"
Dr. Hoda S. Abdel-Aty-Zohdy, Oakland University

Afternoon Sessions 2:00pm-6:00pm (Coffee Break-3:30pm-3:45pm)

Session	Title	Location
(2:00pm-3:30pm; 3:45pm-6:00pm)		
THZ	**Advanced Terahertz and Millimeter Wave Devices Sensing**	North Dining Room (N1620)

Chairs: Dr. Elliott Brown, Wright State University & Dr. Kubilay Sertel, The Ohio State University

(2:00pm-2:20pm) A Numerical Examination of the Diffraction Properties of Profiled Beam Transmission through Binary Apertures and Random Phase Screens"

Authors: Monish R. Chatterjee and Fathi H. A. Mohamed; University of Dayton

Abstract: *Propagation of uniform and profiled electromagnetic beams through apertures with binary amplitude transmission and random phase distributions at the far field (Fraunhofer limit) is investigated, and simulation results based on two approaches, (a) using the Fresnel-Kirchhoff diffraction integral directly, and (b) using a split step propagation concept whereby the aperture or phase screen is placed at an arbitrary location along the propagation path, are applied separately and compared. Results for uniform, Gaussian and Bessel profile beams propagating through a variety of binary apertures are examined and compared with analytical predictions wherever feasible. A power spectrum density of the modified von Karman spectrum (MVKS) model is also used to describe a planar aperture as a random phase distribution. This approach is prompted by the problem of electromagnetic propagation through a turbulent medium. Simulation results are limited to the diffraction intensity calculation of the intensity in the far-field or Fraunhofer regime evaluated in the in the transverse (image) plane. Additional examples, including diffraction through thin sinusoidal amplitude grating and far-field diffraction following propagation through a random phase screen for profiled input beams are also presented. These results, derived serendipitously while examining turbulent propagation, provide insight into the mechanisms of diffraction through variable apertures, beam profiles and medium characteristics. It should therefore be of interest to the study in general of near- and far-field diffraction of electromagnetic waves taken as a whole.*

(2:20pm-2:40pm) Phase-change Material for Reconfigurability in THz Band

Authors: Varittha Sanphuang, Nima Ghalichechian, Niru K. Nahar and John L. Volakis; The Ohio State University

Abstract: *We propose a phase-change materials to demonstrate the reconfigurablility of THz filter. Here vanadium dioxide (VO2) is studied since it shows insulator-to-metal transition properties at transition temperature of 70 °C. Therefore, we can achieve on/off switching in filters by employing VO2 to increase the frequency selectivity of devices in THz band.*

(2:40pm-3:00pm) Integrated Circuit Inspection with a Sub-wavelength Terahertz Imaging System

Authors: Georgios C. Trichopoulos and Kubilay Sertel,;The Ohio State University

Abstract: *We present a new terahertz (THz) imaging approach with 90μm achievable resolution at 750 GHz. The system uses a quasi-optical setup with a hemispherical high-resistivity silicon lens and a vector network analyzer frequency extender to measure reflection images of the sample. The high density integrated circuit (IC) under test is placed on the focal plane of the lens, making direct contact with the flat focal surface. A raster-scan image is obtained using computer-controlled 2-axis translation stages. Using the proposed imaging system, 2-dimensional THz images of planarized samples, including integrated circuits, chemical substances and biological tissue samples can be readily characterized. Due to the high refractive index of the hemispherical lens materials, the image resolution is significantly better that the free-space diffraction limit.*

(3:00pm-3:20pm) On-wafer Calibration Using Offset-Shorts and Known-Through Standards for THz-frequency Network Analysis

Authors: Cosan Caglayan, Georgios C. Trichopoulos, and Kubilay Sertel; The Ohio State University

Abstract: *We present a novel, 2-port, on-wafer calibration technique using offset shorts with different electrical delay lengths and a simple through connection as the known standards. Previously, the offset-short approach was used for 1-port calibration at THz frequencies (Chen et al., "Terahertz Micromachined On-Wafer Probes: Repeatability and Reliability", IEEE Trans. Microw. Theory Techn., vol. 60, no. 9, 2012). Here, we develop a 2-port calibration procedure as an alternative to the conventional multiline TRL (Thru-Reflect-Line) calibration for on-wafer device characterization. The TRL-type calibration techniques typically require different physical separation between measurement probes, leading to mischaracterization of probe-to-probe coupling (crosstalk), and detrimental impact on the overall accuracy, particularly for the mmW and THz bands. Use of fixed probe separation minimizes such artifacts. Our approach is particularly suited for measurements where the separation between the probe locations is fixed. We demonstrate the validity and accuracy of the new calibration method in the G-Band (140-220 GHz) using a non-contact THz-frequency characterization test bed (Caglayan et al. "On-wafer device characterization with non-contact probes in the THz band",IEEE Int. Symp. on Antennas and Propagation, 2013).*

(3:30pm-3:45pm) BREAK

(3:45pm-4:05pm) 1550-nm Time-Domain Study of ErAs:GaAs Photoconductive Switches Function of the Erbium Concentration

Authors: Matthieu Martin, John R. Middendorf, Elliott R. Brown; Wright State University

Abstract: *We present the performance of ultrafast ErAs:GaAs photoconductive-switch antennas measured with a 1550-nm time-domain spectrometer. A 1%- and 2%-Er ErAs:GaAs PC switch were tested and showed detected transmitted frequencies up to at least 2.5 and 4.0 THz, respectively, with a dynamic range of ~50 and ~55 dB below ~200 GHz.*

(4:05pm-4:25pm) Numerical Modeling of Plasma Oscillations in 2D Electron Gas for THz HEMT Devices

Authors: Shubhendu Bhardwaj, Niru K. Nahar, John L. Volakis; The Ohio State University

Abstract: *There has been growing interest in all-electronic sources in the terahertz frequencies. A compact THz source is obtainable, if plasma-oscillations in the 2DEG of a high electron mobility transistor (HEMT) are appropriately utilized. With this goal in mind, we develop a numerical tool which can model such oscillations. We use hydrodynamic equations to model drifting plasma in the 2DEG, whereas the surrounding environment is modeled using the Maxwell's equations. Using this tool, we find that the plasmon-wavelengths in 2DEG can be controlled by tuning the electron density and the drift velocity of electrons. We also observe that most energy in 2DEG couples to attenuating modes, rather than amplifying modes. At the conference, we will present these phenomena and the possibilities of efficient utilization of plasma wave oscillations for the THz sources.*

(4:25pm-4:45pm) Phaseless Method of Gain Characterization for Circularly Polarized Antennas for mmWave and THz band

Authors: Shubhendu Bhardwaj, Niru K. Nahar, John L. Volakis; The Ohio State University

Abstract*: Millimeter wave and terahertz band antennas are of growing interest due to applications in radar, imaging and communications. Specifically, circularly polarized (CP) antennas find special interest in satellite communications and applications involving mobile transceivers. For mmWave and THz band, gain characterization for CP antennas is a difficult task on the account of phase errors due to alignment. To avoid practical difficulties in traditional CP measurement, we propose a simple, phase-less measurement method for CP-gain characterization. The method relies only on amplitude based measurements. At the conference, this new gain measurement method will be demonstrated for a CP radial-line slot array (RLSA) antenna operating at 106 GHz.*

(4:45pm-5:05pm) Extraction of Parasitics in GaN HEMTs for THz Applications using Full-Wave Electromagnetic Modeling

Authors: Yasir Karisan* and Kubilay Sertel; The Ohio State University

Abstract: *We present a new equivalent circuit model for millimeter-wave and submillimeter wave GaN high electron mobility transistor (HEMTs) that can capture the geometry and material-dependent parasitic effects within the device. The impact of electromagnetic interactions on overall device performance is analyzed extensively via full-wave EM simulations using high-fidelity device geometries. An empirical lumped-element equivalent circuit model is developed to capture the electromagnetic behavior not only within the internal structure of the device but also the surrounding impedance environment. Based on this parasitic-aware equivalent circuit, a multiple-step parameter extraction algorithm is employed to determine the equivalent lumped elements. Numerical results, using a conventional sub-mmW HEMT topology are presented to illustrate the performance of the proposed circuit models in capturing device physics in the THz band.*

(5:05pm-5:25pm) AC Conductivity Parameters of Graphene Films with THz Spectroscopy

Authors: W-D. Zhang, E.R. Brown; Phi H. Q. Pham and P. Burke; Wright State University and University of California

Abstract: *The complex conductivity of CVD-grown graphene films are obtained using a non-destructive THz etalon transmittance technique between 0.1 and 1.6 THz. Critical parameters such as ionized-impurity scattering width and chemical potential are derived. The technique can be extended to extract the complex ac conductivity parameters of other thin conducting films or 2DEG materials with high sheet conductance.*

(5:25pm-5:45pm) Fast-Scanning THz Fabry-Perot Spectrum Analyzer based on Wire-Grid Reflectors

Authors: J.R. Middendorf and E.R. Brown; Wright State University

Abstract: *We present a novel scanning Fabry-Perot spectrum analyzer that uses substrate-based, wire-grid polarizers as the reflectors. One improvement over previous designs is the continuous tuning of the spectral resolution via the angular orientation of the wire grid relative to the THz polarization. Another improvement is the ability for fundamental-mode operation without frequency ambiguity below ~1.0 THz.*

SPECIAL TRACK SESSION- INVITED SPEAKERS

Session	Title	Location
(2:00pm-3:30pm;3:45pm-5:30pm)		
APS	**Aerospace Power Systems and Electronics**	Meyer Room
	Chairs: Dr. Xiaochuan Jia and Dr. Hao Huang, General Electric Aviation Electrical Power	(N1650)

(2:00pm-2:30pm) Design and Analysis of New Starter-Generator Technology Based on Switching-Capacitor Topology for Airplane Applications;

Author: Dr. Longya Xu, Director, Center of High Performance Power Electronics (CHPPE) at The Ohio State University

Abstract: *This presentation contributes to the development of a new converter topology for aircraft application, based on switched capacitor cells. It is proven by computer simulation and prototype design that the new circuit topology is much suited for exploring the high speed switching and high voltage blocking capabilities of modern SiC power devices. Performance, size/weight and cost comparison is made for the new converter topology with that of the existing technology to highlight the salient advantages of the new system.*

(2:30pm-3:00pm) Test Results of 200C Rated SiC Power MOSFET Qualification for Aerospace Applications, Dr. Steve Authur; GE Global Research Center

(3:00pm-3:30pm) Research on Power Electronic Converters using Wide Bandgap Devices for Increased Power Density and High Temperature Capability;

Author: Dr. Bulent Sarlioglu; Associate Director of the Wisconsin Electric Machines and Power Electronics Consortium (WEMPEC) at the University of Wisconsin

Abstract: *Power electronic converters are critical part of many applications including aerospace, electric and hybrid vehicles, renewable energy systems, and industrial drives. There is a need for better efficiency, higher power density, greater reliability, and higher thermal capabilities from these converters. The advantageous properties, such as high critical field, high electron saturation velocity, and high thermal conductivity, have made silicon carbide (SiC) and Gallium Nitride devices an emerging and enabling technology for higher power density and higher temperature power converter designs. Presentation will include research results on efficiency improvement, impact of parasitic inductances, and power density increase for various power electronic converters.*

(3:30pm-3:45pm) BREAK

(3:45pm-4:15pm) Advanced Simulation of Electrical Machines using coupled Transient Finite Element - Circuit Analysis

Author: Mark Christini; ANSYS Inc.

Abstract: *This presentation will give a high level overview of coupled electromagnetic and system analysis. Transient Finite Element Analysis (FEA) coupled with system simulation will be introduced. Simulation results for several types of electromagnetic components such as electrical machines, transformers and associated power electronics in a system mode*l will be shown.

(4:15pm-4:45pm) Point of Use Power Conversion using SiC power devices, Antonios Challita, Robert Cravens, Ewane Etinga; IAP

(4:45pm-5:15pm) Device evaluation and advanced circuit prototyping with wide bandgap power devices, Dr. Jin Wang, CHIPPE/OSU

Session	**Title**	**Location**
(2:00pm-5:30pm)		
CIP	**Collaborative and Image Processing**	Posters Exhibit Room
Chair: William McQuay	*The Design Knowledge Company*	(N1840)

POSTER-No-reference Blur Metric using and Dual-Density and Dual-Tree Two-Dimensional Wavelet Transformation

Authors: Soundararajan Ezekiel, Kyle Harrity, Mark Alford, David Ferris, Adnan Bubalo, Erik Blasch, Maria Scalzo; Indiana University of Pennsylvania; Air Force Research Lab, Rome, NY

Abstract: *In the past decade the digital camera has become widely available in many devices such as cellphones, computers, etc. Therefore, the perceptual quality of digital images is an important and necessary requirement to evaluate the use of such imagery. To improve the quality of images captured with camera or embedded system, we must identify and measure the artifacts that cause blur within the images. Blur is mainly caused by pixel intensity due to multiple sources. The most common types of blurs are known as object motion, defocus, and camera motion. To evaluate blur, we use the wavelet transformation, which is widely used in many science and engineering disciplines. The development of wavelets resulted from the need to generate algorithms that would quickly compute compact representation of signals and data sets. In the last two decades, the discrete wavelet transformation has become a cutting-edge technology in signal and image processing. The major disadvantages of the discrete wavelet transform (DWT) is that it is not able to observe blur coefficients directly. In this paper, we propose a novel framework for a blur metric for an image. Our approach is based on the double-density dual tree two dimensional wavelet transformation (D2DTWT) which simultaneously processes the properties of dual-density DWT and dual tree DWT. D2TDWT provides a way to isolate blur coefficients directly, using gradient properties of edges for the horizontal, vertical, and diagonal sub-band images to evaluate blurring artifacts and measure the image quality. The preliminary experimental results show that our D2DTWT method can be computed in near real-time and provide an image quality assessment and prediction.*

POSTER-Context aided Sensor and Human-based Information Fusion

Authors: Erik Blasch (AFRL), Alan Steinberg, Chris Bowman (DFNN), Mike Morefield, Charles Morefield

Abstract: *Information Fusion consists of organizing a set of data into meaningful understanding such as answering queries, forging a consistency story, and providing meaning reports. To provide situation understanding requires context both in information estimation and data management. In this paper, we highlight the importance of context assessment and context management to support information fusion analysis. A demonstrated example for multimodal text and video sensing is shown as context provides the means for associating the multimode data that is aligned in space and time.*

POSTER-Comparison of Stochastic Integration Filter with the Unscented Kalman Filter for Maneurvering Targets

Author: Erik Blasch (Air Force Research Laboratory), Jindřich Duník, Ondřej Straka, Miroslav Šimandl (University of West Bohemia, CZ)

Abstract: *Sigma-Point Filtering (SPF) has become popular to increase the accuracy in estimation of tracking parameters such as the mean and variance. A recent development in SPF is the stochastic integration filter (SIF) which has shown to increase estimation over the Extended Kalman Filter (EKF) and Unscented Kalman filter (UKF); however, we wanted to explore the notion of the SIF versus the UKF for maneuvering targets. In this paper, we compare these methods with that of the KF, EKF, UKF, and SIF using the Average Normalized Estimation Error Square (ANEES) for non-linear, non-Gaussian tracking. When the nonlinear turn-rate model is similar to the linear constant velocity model, all methods are the same. When the turn-rate model differs from the constant velocity model, our results show that the UKF with a large number of sigma-points performs better than the SIF.*

POSTER-Event Recognition for Intelligence Knowledge

Authors: Erik Blasch; Air Force Research Laboratory

Abstract: *Numerous video technologies exist for tracking data as well as methods of event recognition from human analysts. In this paper, we describe novel techniques for fusion of multi-modal data for event recognition. Event recognition has a start and stop where in between are activities of interest. WE define various activities of movement of things or people in the environment from which change detection supports event recognition and event stops. The enhanced exploitation and analysis tools of event recognition use various multi-modal source s such as video, geospatial information, text, and user defined semantic audio cues. Fusing the information provides a richer understand than one modality alone for intelligence knowledge.*

POSTER-No-Reference Multi-Scale Blur Metric

Authors: Soundararajan Ezekiel, Kyle Harrity, Mark Alford, David Ferris, Adnan Bubalo, Maria Scalzo ,Erik Blasch; Indiana University of Pennsylvania, Indiana, PA, Air Force Research Lab, Rome, NY

Abstract: *In recent years, digital cameras have been widely used for image capturing. These devices are equipped in cell phones, laptops, tablets, webcams, etc. Image quality is an important characteristic for any digital image analyzing. To assess image quality for these mobile products, the standard image is required as a reference image. In this case, Root Mean Square Error and Peak Signal to Noise Ratio can be used to measure the quality of the images. However, these methods are not valid if there is no reference image. Recent studies show that a Contourlet is a multi-scale transformation - which is an extension of two dimensional wavelet transformation - that can operate on an image at different noise levels. In this paper, we develop a no-reference blur metric for digital images. The blur metric is based on edges and noises in images. In our approach, a Contourlet transformation is applied to the blurred image, which applies Laplacian Pyramid and bank of Directional Filters to get various image representations. The Laplacian Pyramid is a difference of Gaussian Pyramids between two consecutive levels. That is, at each level, an image is smoothed with two Gaussians of different sizes then subtracted, subsampled and the input image is decomposed into directional sub-bands of images. Directional filter banks are designed to capture high frequency components representing directionality of the images which is similar to detailed coefficient in wavelet transformation. We then focus on noise- and blur-measuring for each level and directions at the finest level of images to assess the image quality. We then compute noise mean, noise ratio blur means and blur ratio from each partitions. Further, we use a weighted scale to determine the percentage to which the image is blurred. From these statistics, we can compare to normal useful image statistics for image quality without needing a reference image. We experimented with arbitrary weighting scales and various images, both blurred and non-blurred, and the result demonstrated the effectiveness of the algorithm. Further statistical experiments, such as R-squared statistics, need to be conducted to assign proper values to the weighting system.*

POSTER-Denoising an Image using Contourlets and Curvelets

Authors: Ryan Moore, Mark Alford, Erik Blasch, Dr. Soundararajan Ezekiel; Rochester Institute of Technology, AFRL Rome, NY, Indiana University of Pennsylvania

Abstract: *Image denoising techniques such as the discrete wavelet transformation (DWT) and the Fast Fourier transform (FFT), developed in the 1960's, are slowly becoming outdated. Two alternatives, curvelet transformations and contourlet transformations, developed in the early 2000's, are gaining greater recognition for denoising images. These two transformations, developed by Emmanuel Candès and Minh N. Do, respectively, are better alternatives than the discrete wavelet transformation (DWT) and the Fast Fourier transform (FFT). The curvelet and contourlet transforms can detect the contours' curves, and directional information that the DWT and FFT cannot. The problem is that there is no definitive proof that these transformations are currently the best denoising technique. This paper aims to prove the hypothesis that these transformations currently provide the best denoising technique. In the experiment, various types of noise will be added to sample data obtained from various images. Next the Fourier, wavelet, curvelet, and contourlet transforms will be applied to each image. The benchmark for determining the effectiveness of each transform is the peak signal-to-noise ratio between the original image and the denoised image. Peak signal-to-noise ratio (PSNR) is the relationship between the maximum power of a value, in this case an image, and the power of a noise that distorts it. Many variables will be tested, including multiple decomposition levels and different thresholding values of all four transformations. The results should be promising and should indicate that the curvelet and contourlet transforms are better alternatives for denoising images than the DWT and FFT.*

Day 2 (Morning) – Thursday, June 26, 2014

Time	Event	Location
7:00am-4:00pm	Registration	Lobby
7:00am-8:00am	Breakfast	Exhibit Room (N1840)

Tutorial D (Coffee Break-10:00am-10:15am)

Tutorial D (8:00 am – 10:00am; 10:15 am -11:45am) **Location: SW Side Exhibit Room (N1840)**
Chair: William McQuay
Topic: Overview of High-Level Information Fusion, Models, and Representations
Dr. Erik Blasch, Air Force Research Laboratory

Morning Sessions 8:00am-11:45am (Coffee Break-10:00am-10:15am)

Session	Title	Location
(8:00am-10:00am; 10:15am-11:45am)		
TIS	**Trust in Semiconductors**	Meyer Room (N1650)
	Chair: Dr. Charles Cerny, Air Force Research Laboratory	

(8:00am-8:30am) Novel RPM Technique to Dismiss Systematic Variation for ROPUF on FPGA
Authors: Muslim Mustapa, Muhammed Niamat; University of Toledo
Abstract*: Physical Unclonable Function (PUF) is a function that cannot be modeled as it utilizes the random process variations on silicon chip to generate unique bit stream of '1's and '0's (response bits) which can be used for authentication and cryptography applications. As PUF is highly relying on the process variation, the response bits generated are dominated by the systematic process variations instead of stochastic process variations, which will reduce the randomness in the response bits. In this paper we propose novel Random Patch Mixer (RPM) technique to dismiss the systematic variations effect on the response bits generated. We applied RPM technique on data obtained from 29 FPGA chips. We proved that our RPM technique has successfully dismiss the systematic variation effect and increase the randomness on the response bits generated from ROPUF on FPGA. We also proved that the response bits generated by applying the RPM Technique passed the NIST statistical test for randomness.*

(8:30am-9:00am) Gate-Level Commercial Microelectronics Verification with Standard Cell Recognition
Authors: Leleia A. Hsia, Michael K. Seery, Mary Y. Lanzerotti, Len Orlando; Air Force Institute of Technology
Abstract: *The DARPA TRUST program was established to address the need to verify integrated circuits (ICs). This paper explores methodologies to resolve conflicts in prior applications of commercial software to verify IC designs ranging in size from 1 to 283,359 cells. Preliminary results for designs composed of standard cells are discussed.*

(9:00am-9:30am) Early lifetime failure detection in FPGAs sing delay faults
Authors: Kavya Vittala, Srinivasa Vemuru, and Mohammed Niamat; University of Toledo
Abstract: *In this work early fault identification to mitigate lifetime/aging failures such as electromigration and hot-carrier effect in wiring/routing interconnect resources of the FPGA is presented. An approach to demonstrate the fault location within a chain of switch blocks and interconnects used in routing the signal within the FPGA is provided.*

(9:30am-10:00am) Hardware Trojan State Detection for the Semiconductors and Systems
Authors: Yen-Ting Wang, Qianqian Wang, Randall L. Geiger; Iowa State University
Abstract : *The circuit structures with positive feedback loops are likely to have multiple operating points, and the unwanted Trojan state is easy to be triggered by process, voltage, and temperature variation or user's action. In this paper, Homotopy methods are used to find all operating points and detect Trojan states. Furthermore, the temperature characteristic of the positive feedback loop circuits can also identify the Trojan state. Examples are given to show both Homotopy and temperature methods are valid.*

(10:05am-10:15am) BREAK

(10:15am-10:45am) Quantifying Digital Diversity in TRUST Supply Chain
Authors: Authors: R. Tatum, L. Orlando, M. Lanzerotti, Air Force Institute of Technology
Abstract: *DARPA has funded the TRUST program to verify the operation of integrated circuits from untrusted sources. This research focuses on using open source hardware IP cores and running these cores through the TRUST suite to perform a characteristic study of different structures.*

(10:45am-11:15am) Low Overhead Design for Improving Hardware Trojan Detection Efficiency
Authors: Hao Xue, Tyler Moody, Shuo Li, Xiaomeng Zhang, Saiyu; Wright State University
Abstract: *Outsourcing of IC fabrication has increased the potential for altering the genuine design with the insertion of concealed circuits (hardware Trojans). A methodology for detecting hardware Trojans (HTs) that has been pursued recently is based on comparing the power and delay response of a genuine chip to the manufactured chip/device under test (DUT). However, the probability of detecting the HT remains small in many cases due to the low probability of activating the concealed circuits. This paper proposes a technique to increase HT activity*

during testing by inserting probability increase circuits (PICs) at critical points in the design. Preliminary results for a standard HT example show a reduction in time for HT activation of over 95% with modest increases in power, size, and delay overhead.

(11:15am-11:45am) A Graphical Method for Identifying Positive Feedback Loops automatically in Self-Biasing Circuit for Determining the Uniqueness of Operating

Authors: Shiya Liu, Randall L. Geiger, Degang Chen; Iowa State University

Abstract: *Bias generators and references are vulnerable to not "starting-up" correctly. A standard method for verifying this issue is to run transient simulation which is time-consuming and cannot guarantee circuit start-up correctly. The cause of start-up issue is positive feedback loop embedded in the circuit. We implemented an algorithm which can identifying all the positive feedback loops in the circuits. After that, breaking these positive feedback loops and applying homotopy method can guarantee circuit start-up correctly.*

Session	Title	Location
(10:15am-11:45am)		
RFT	**Recent Advances in RFIC Technology**	North Dining Room
	Chairs: Tony Quach, Air Force Research Laboratory	(N1620)
	& Dr. Waleed Khalil, The Ohio State University	

(10:15am-10:35am) Design of 10 Bit Current Steering DAC in 90 nm Technology

Authors: Shuo Li, Xiaomeng Zhang, Robert Ewing, Saiyu Ren; Wright State University

Abstract: *The design of a high speed current steering DAC using IBM 90 nm CMOS technology is presented. The resolution for this design is 10 bits, segmented into 6 thermometer encoded current cells and 4 binary weighted current cells. Thermometer encoding is used instead of binary coded decimal to reduce glitches since only one bit changes at a time. The design methodology of the sub-components such as current cell, thermometer encoder, and bias circuits will be discussed. Target clock frequency for the DAC is 1 GHz.*

(10:35am-10:55am) Multi-finger MOSFET Low Noise Amplifier Performance Analysis

Authors: Xiaomeng Zhang, Shuo LI, Tylor Moody, Hao Xue, Saiyu Ren; Wright State University

Abstract: *The Multi-finger layout technique has been extensively used in Nano-scale CMOS circuit design due to the increased circuit performance compared to a single finger layout. However choosing a finger width and number of fingers to optimize circuit performance is a challenging problem. In this paper the performance of a 2.4 GHz single ended low noise amplifier (LNA) with a fixed total transistor width in 90nm CMOS technology is analyzed as function of number of fingers (Nf) . The results show that the drain to source current (Ids), transconductance (gm) and effective gate capacitance (geff) increase with increasing Nf. The effect of Nf on transistor cutoff frequency (fT) and LNA noise figure (NF), Gain (AV), center frequency (fC), and impedance/noise matching is presented.*

(10:55am-11:15am) Analysis of a 130nm CMOS SRAM in a SiGe Foundry Offering for Low Earth Orbit Applications

Authors: Christopher L. Allen, James C. Petrosky, Len Orlando Air Force Institute of Technology, and Air Force Research Laboratory

Abstract: *This research predicts the effects of the natural radiation environment in low earth orbit on a 6T SRAM cell designed in a 130 nm CMOS technology. It is determined that the SRAM cell would likely fail given ionizing doses of 0.57 Mrad due to threshold voltage shifts of 175 milliVolts.*

(11:15am-11:35am) Thin Film Barium Strontium Titanate Dielectric Modeling Techniques Applied to Coupled Open Loop Resonator Filters

Authors: Shu Wang, Dustin Brown, Jay Ramadugu, Guru Subramanyam, Tony Quach, Kevin Leedy; University of Dayton, Air Force Research Laboratory

Abstract: *Two bandpass filters that utilize an unpatterned barium strontium titanate thin film operating at C band and X band respectively, are presented. The performance of the filters is predicted using a simplified effective dielectric model in place of the multilayered structure. The model was examined using the AXIEM EM simulation tool in AWR Microwave Office. The modeling technique showed general agreement with measured results with approximately 4x improvement to simulation time.*

THURSDAY Luncheon 11:45am–2:00pm (*Food located in Exhibit Room*) Meyer Room

12:00pm

Keynote Speaker: Dr. Michael Barnsley
Department of Mathematics, Australian National University Canberra, Australia

Title: V-Variable Fractals and Superfractals; Modeling a wide range of Phenomena across Science and Technology

1:00pm

Plenary Speaker: Harold Weinstock, Ph.D.
Air Force Office of Scientific Research (AFOSR/RTD)

Title: What Quantum Electronic Solids Can Do for Aerospace Electronics

Day 2 (Afternoon) – Thursday, June 26, 2014

Tutorial E & F (Coffee Break-3:30pm-3:45pm)

Tutorial E (2:00pm-3:30pm) — **Location: SW Side Exhibit Room (N1840)**
Chairs: Catherine Deardorf & Felicia Harlow

Topic: Superfractals
Dr. Michael Barnsley, Australian National University

Tutorial F (3:45pm-5:30pm) — **Location: SW Side Exhibit Room (N1840)**
Chairs: Catherine Deardorf & Felicia Harlow

Topic: Zombie Apocalypse Data: Robust Ad-hoc Mesh Networking
Dr. Dave Sonntag , USAF School of Aerospace Medicine and
Bill Curtice, Greene County Ohio Amateur Radio Emergency Service

Afternoon Sessions 2:00pm-6:00pm (Coffee Break-3:30pm-3:45pm)

Session	Title	Location
(2:00pm-3:40pm;3:50pm-6:30pm)		
PHS	**Photonics, nanoDevices and Advanced Materials for IR** *Chair: Dr. Nicholaos Limberopoulos, Air Force Research Laboratory*	Meyer Room (N1650)

Plasmonics, Fluorescence Enhancement:

(2:00pm-2:20pm) High Throughput, Large Scale, Broadband, Plasmonic Nanostructure Fabrication for Optical Sensors

Authors: Jarrett H. Vella, John Goldsmith, Nicholaos I. Limberopoulos, John S. Derov, and Alvin J. Drehman; Air Force Research Laboratory, Wyle

Abstract: *Plasmonics have the potential to enhance the performance of detectors but require sub-wavelength features. Practically, they must be fabricated using easily scaled, high throughput processes. Plasmonic structures were fabricated using a thermal metal dewetting procedure providing broadband plasmon resonances tunable over a wide 1000 nm wavelength range. Their integration into fluorescence-based sensors will be described*

(2:20pm-2:40pm) Surface Plasmon Enhanced Rare Earth Luminescence for Increased Imaging Efficiency

Authors: Jarrett H. Vella, Vladimir Vasilyev, John Goldsmith, Nicholaos I. Limberopoulos, and John S. Derov; Air Force Research Laboratory. Wyle

Abstract: *Ions of rare earth metals are widely known for their versatile ultraviolet, visible, near infrared and middle infrared luminescence; it can be excited by wavelengths ranging from the ultraviolet to near infrared. The preparation and optimization of infrared luminescent ceramics will be discussed, as well as their thin film incorporation into plasmonic systems for luminescent imaging with enhanced efficiency*

Imaging/Detector Enhancement:

(2:40pm-3:00pm) Super-Resolution Imaging by Arrays of High-Index Spheres Embedded in Transparent Matrices

Authors: Kenneth W. Allen, Navid Farahi, Nicholaos I. Limberopoulos, Dennis E. Walker Jr., Augustine M. Urbas, and Vasily N. Astratov; University of North Carolina at Charlotte, Air Force Research Laboratory

Abstract: *We fabricated thin-films made from polydimethylsiloxane (PDMS) with embedded high-index (n~1.9-2.2) microspheres for super-resolution imaging applications. To control the position of microspheres, such films can be translated along the surface of the nanoplasmonic structure to be imaged. Microsphere-assisted imaging, through these matrices, provided lateral resolution of ~λ/7 in nanoplasmonic dimer arrays with an illuminating wavelength λ=405 nm. Such thin films can be used as contact optical components to boost the resolution capability of conventional microscopes*.

(3:00pm-3:20pm) Photonic Jets for Superlattice Infrared Photodetector Enhancement

Authors: Kenneth W. Allen, Joshua M. Duran, Gamini Ariyawansa, Nicholaos I. Limberopoulos, Augustine M. Urbas, and Vasily N. Astratov; University of North Carolina at Charlotte, Air Force Research Laboratory, UES

Abstract: *Photonic jets are light beams focused by dielectric microspheres down to subwavelength dimensions. In this work, we show that they can be used for enhancing performance of strained-layer superlattice (SLS) infrared (IR) photodiodes in the midwave-infrared spectral band (3-5μm). We optimized the design of these structures and experimentally demonstrated the increased sensitivity compared to conventional photodetectors.*

(3:20pm-3:40pm) Optimizing surface plasmonic structures for high infrared photodetector Enhancement

Author: Guiru Gu, UMass Lowell

Abstract: Abstract: Surface plasmonic resonance has been proved to be an effect way for enhancing infrared photodetector performance. In this paper, we report the optimization of the plasmonic structures by numerical simulation and experimentally verification. The mechanism of the high enhancement is also analyzed and discussed for different plasmonic structures.

(3:40pm-3:50pm) BREAK

(3:50pm-4:10pm) Optical Imaging over a Plasmonic Thin Film with Deep-Subwavelength Surface Roughness

Authors: Leung Tsang, Kung-Hau Ding, Philippe N. Duvelle, Jarrett H. Vella, John Goldsmith, Christie L. H. Devlin, and Nicholaos I. Limberopoulos; University of Washington, Air Force Research Laboratory, Wyle, Adatom Scientific

Abstract: *Subwavelength imaging has been reported for a layer of plasmonic thin film. In this paper, we investigate the enhancement of the sub-diffraction-limit imaging using subwavelength surface roughness. Full wave simulations are carried out based on Lippmann Schwinger equation with linearized scattering potentials. Progresses in experiment are also reported.*

(4:10pm-4:30pm) Demonstration of whispering-gallery-mode resonant enhancement of optical forces

Authors: Yangcheng Li, Alexey V. Maslov, Nicholaos I. Limberopoulos, and Vasily N. Astratov; University of North Carolina at Charlotte, University of Nizhny Novgorod, Air Force Research Laboratory

Abstract: *We experimentally studied whispering-gallery-modes (WGMs) and demonstrated resonance enhancement of optical forces evanescently exerted on dielectric microspheres. We showed that the resonant light pressure can be used for optical sorting of microparticles with extraordinary uniform resonant properties that is unachievable by conventional sorting techniques.*

Electronics/Image Processing:

(4:30pm-4:50pm) Scaled Carbon-Ionogel Supercapacitors for Electronic Circuits

Authors: Leland Smith, Jonathan Lau, Greg Leung, Chi On Chui, and Bruce Dunn; University of California at Los Angeles

Abstract: *Capacitors are ubiquitous in signal processing circuits. Currently, dielectric capacitors such as Metal-Oxide-Semiconductor and Metal-Insulator-Metal designs are the industry standard for onchip charge storage. By comparison, electric double-layer capacitors (supercapacitors) offer capacitances that are orders of magnitude higher than dielectric capacitors. In this paper we present some early work in fabricating solid-state, on-chip EDLC.*

(4:50pm-5:10pm) Guided Execution of Similarity Measures to Automate Registration of Partially Overlapped Aerial Imagery

Authors: M. Imran Vakil, John A. Malas, Dalila Megherbi; Air Force Research Laboratory, University of Massachusetts at Lowell

Abstract: *This work presents an image registration technique utilizing a hybrid feature and area based similarity measure of partially overlapped aerial imagery in presence of translation and rotation. The inherent statistical attributes of area based methods are exploited through the sequential use of complex correlation and mutual information on physics based features.*

Gradient Index Media/Metasurfaces/Photonic Crystals (Extreme Control of Optical Waves):

(5:10pm-5:30pm) Nanoscale Gradient Index Media Fabrication for Extreme Control and Tunability of Optical Wave Propagation

Authors: Christie Devlin, Jarrett H. Vella, Dennis E. Walker Jr., Jack P. Lombardi, Nicholaos I. Limberopoulos, and John S. Derov ; Air Force Research Laboratory, Wyle, Adatom Scientific

Abstract: *Gradient index media can be utilized to provide the capability of extreme control and tunability of wave propagation. A single exposure E-Beam lithographic process along with a uniform etch process for the spatially varying nanoscale feature sizes has been developed for "on-chip" devices providing extreme control and tunability of optical wave propagation. Such control is focused in this work on Luneburg lenses. The gradient index media and their "on-chip" integration will be described.*

(5:30pm-5:50pm) Metasurfaces for Phase and Polarization Control

Authors: Carl Pfeiffer and Anthony Grbic, University of Michigan

Abstract: *Reflectionless metasurfaces are reported that efficiently transform linearly and circularly polarized Gaussian beams into vector Bessel beams: radially and azimuthally polarized cylindrical vector beams with a Bessel profile. Each unit cell acts as a wave-plate to control the polarization of the transmitted field. In addition, the wavefront is transformed from a Gaussian profile to a Bessel profile by controlling the absolute phase shift of each wave-plate.*

(5:50pm-6:10pm) Study and Simulation of Microstructured Photonic Crystal Optical Fiber

Authors: Ahmed M. Al-Muraeb and Hoda S. Abdel-Aty-Zohdy, Oakland University

Abstract: *Photonic Crystal Fibers (PCF) have interesting features such as high nonlinearity, four-wave mixing, and polarization-maintaining. These features offer new improvements and solutions for optoelectronic elements such as multi-channel filters, PCF lasers, PCF amplifiers, and tunable (multi-wavelength) fiber lasers. This work presents study and simulation using MATLAB® for a microstructured optical fiber based on defected square Photonic Crystal Lattice (PCL) with fixed value of longitudinal component of propagation constant, deploying Plane Wave Expansion (PWE) method. The PCL parameters considered are: structure period a = 1 µm; element radius = 0.2 µm; background material relative permittivity = 2.1316; element relative permittivity = 1; number of plane waves = 3; number of mesh nodes per unit cell = 30 (in each x & y directions); unit cell size of strictly periodic (defectless) structure = 30 x 30 nodes; unit cell size of the defected structure = 5 x unit cell size of strictly periodic structure; defect location is at center. The paper results include modes field distribution, and effects of: permittivity difference change, number of plane waves, and propagation constant. The results and the associated effects are highlighted and discussed.*

(6:10pm-6:30pm) Black Aluminum: a novel anti-reflective Absorbing Coating

Authors: John Goldsmith, Vladimir Vasilyev, Jarrett H Vella, Nicholaos Limberopoulos, Lavern Starman; Air Force Research Laboratory, Wyle

Abstract: *Black absorbing and antireflective coatings have many optical sensing applications. A Process to deposit Black Aluminum, a novel anti-reflective coating has been discovered using magnetron sputtering. The reflection spectrum of Black Aluminum films deposited on silicon was investigated. To test the effectiveness of the absorbing properties of this new material, simple pyro-electric devices were fabricated with Black Aluminum absorbing layers. Significant increases in the spectral response of devices coated with a black aluminum are reported as compared to devices without black absorbing layers.*

Session	Title	Location
(2:00pm-3:30pm;3:45pm-6:30pm)		
MSM	**Monitor & Surveillance Methods**	North Dining Room
	Chairs: Dr. Nikolaos Bourbakis, Wright State University,	(N1620)
	Ms. Olga Mendoza-Schrock, Air Force Research Laboratory & Dr. Sanjay Boddhu, QBase	

(2:00pm-2:15pm)The Emergence of QUEST in Information Fusion

Author: Erik Blasch, Air Force Research Laboratory

***Abstract**: Qualia-based Exploitation of Sensing Technology (QuEST) is a Cognitive Exoskeleton to Improve Human-Machine Decision Quality. In this paper, we discuss the motivation of the QUEST working group as it pertains to man-machine information fusion. In a dynamic scene in which an operator seeks to understand their surroundings, many issues arise as to the internal cognitive perceptions that are real or instinctive that affects exploitation. We outline QUEST elements and tenets towards a reasoning display that amplifies intelligence. In a use case example, we showcase the need for enhanced understanding of the man (mind and body) and the machine (sensor and resasoner).*

(2:15pm-2:30pm) Video Observations for Cloud Activity-Based Intelligence (VOCABI)

Authors: Erik Blasch, Phillip Dibona (LMCO), Michael Czajkowski, Jay Ritchie, Jeff Freeman, Kevin Newman, Alex Aved, Mike Hinman ; Air Force Research Laboratory

Abstract: *The reduction in imaging size, cost, and distances has enabled an explosion of video sensor technology. With so much imagery available, there is a need to understand the usefulness of video for missions such as Activity-based Intelligence (ABI), situation understanding, and event-based processing. In this paper, we explore some of the emerging developments in video observations with a focus on cloud technology which is aided by characterization of algorithms, for analytics, storage, indexing, and workflow and visualizations. In the paper, we show multiple tools using the Ozone Widget Framework that support various environments such as permissive surveillance supporting analytics, algorithms, and visualization.*

(2:30pm-2:45pm) Minor Area Motion Imagery (MAMI) Dismount Tower Data Challenge Problems

Authors: Andrew Freeman, Holly Zelnio, Lindsay Cain, Edward Watson, Olga Mendoza-Schrock, Air Force Institute of Technology, Air Force Research Laboratory

***Abstract:** The ability to classify a dismount and its activity is of interest for both military and non-military applications. This effort describes a database that is rich for dismount activity classification and is available to the public--the MAMI Dismount Tower Data Collection. The Minor Area Motion Imagery (MAMI) Dismount Tower Data collection was gathered in the Summer of 2013 and contains several examples of dismount activity such as running, walking, walking with a load, etc. It is unique because it contains a variety of operating conditions including angular diversity. Furthermore, it contains multi-modal data--Polarmetric IR, passive visible, etc. This paper provides a detailed description of the data collection and details some interesting challenges such as gender, activity, and hierarchical classification.*

(2:45pm-3:00pm) Cloud-Induced Uncertainty for Visual Navigation: Development of Cloud Templates

Authors: Alan Jennings and Alyssa Gutierrez, Air Force Institute of Technology

***Abstract**: This paper describes the algorithm created to produce realistic cloudy aerial images using pictures of clouds taken from ground level. After performing a one-time manual operation, this otherwise autonomous algorithm produces cloud imagery that is capable of retaining the natural transparency of the clouds. These cloud template images can be overlaid on aerial imagery to test influences of clouds on navigation algorithms. The algorithm is tested with a variety of input images and is generally found to produce satisfactory results with thicker, more robust clouds, but less desirable results with thinner and wispier clouds.*

(3:00pm-3:15pm) Vehicle Classification for Civilian and Non-Civilian Applications: A Survey

Authors: Olga Mendoza-Schrock, Nikolaos Bourbakis, Mateen Rizki, and Vincent Velten; Wright State University

***Abstract:** The ability to classify a vehicle is of extreme importance for both civilian and non-civilian applications. For non-civilian applications the state-of-the-art leaves much to be desired, as hierarchal and real-time classification have yet to be truly investigated. This paper provides a survey of the current state-of-the-art in vehicle classification and provides recommendations for future research areas to advance the current capabilities.*

(3:15pm-3:30pm) Automatic Detection of Train Platform Events

Author: Blanca Delgado, Khalid Tahboub, and Edward J. Delp; Universitat Polit`ecnica de Catalunya, Barcelona, Spain, and Purdue University

***Abstract:** A typical video surveillance system deployed by a transit authority makes it infeasible for officers to monitor video feeds continuously due to the large number of cameras. Many automatic detection methods have been proposed to identify threats and anomalies. In this paper, we present a method to automatically detect people jumping or falling off a train platform. An experimental evaluation is conducted using a dataset that was recorded at a train station.*

(3:30pm-3:45pm) BREAK

(3:45pm-4:00pm) Automated Crowd Flow Estimation Enhanced by Crowdsourcing

Author: Javier Ribera, Khalid Tahboub, and Edward J. Delp; Universitat Polit`ecnica de Catalunya, Barcelona, Spain, and Purdue University

***Abstract**: The widespread increase in video surveillance systems with large number of cameras makes the continuous monitoring of video feeds a practically impossible task. In this paper, we present improvements to a previously developed crowd flow estimation method. We incorporate crowdsourcing to enhance the performance. An experimental evaluation is conducted using publicly available datasets.*

(4:00pm-4:15pm) A Generic Sensor Fusion Architecture for enhancing Situational Awareness

Author: Sanjay Kumar Boddhu; Qbase Inc., Wright State University

Abstract: *The advances in smart devices technology and their profuse availability have made the prospective of human-centric sensing and computing paradigms a viable reality. Further, recent work in human-centric sensing research has shown its applicability to enhance situational awareness in different domains. Additionally, there already exist various operational intelligent systems in different domains like defense, healthcare, energy and disaster management that have been developed by employing human-centric sensing as their backbone. But, to support building more complex or novel human-centric based systems that have to integrate with existing sensors/devices and possible future sensors, there exists practical issue like accommodating disparate data formats, modality and connectivity interfaces. These low-level issues make integration of different sensing devices and fusion of sensed data a challenge and time consuming process, delaying the high-level implications, which can be targeted towards solving real world problems. In this paper, a generic sensor fusion architecture has been presented that has been developed to solve the mentioned challenges and support seamless integration and development of human-centric sensing devices and also platforms to enhance situational awareness.*

(4:15pm-4:30pm) Model-Based Simulation Systems for Adaptive Training in Time-Critical Decision Making

Author: Subhashini Ganapathy; Wright State University

Abstract: *The fundamental goal of education and training is to provide capabilities that can help humans improve performance and accelerate decision-making. Advances in mobile computing (e.g., sensor technology, context aware computing, and cloud computing) allow for the design of systems that goes beyond the traditional methods of simulation training to support adaptive learning. The focus of this paper will be to present a human performance model for predictive analysis of time-critical decision making through real-time sensor-based information.*

(4:30pm-4:45pm) Utilization of Keyboard Dynamics for Unique Identification of Human Users

Authors: Tyler Highlander, Dale Bassett, and Derek Boone; Wright State University

Abstract: *For the past two decades, as the role of computer technology has expanded, computer security (secure processors, information encryption, network protection with biometrics) has also become increasingly important. Many computer security schemes have been developed over this time period; however, none of these are foolproof yet. A username and pass-word combination is one of the most popular approaches to securing a computer system, but this system is vulnerable because passwords can be stolen or cracked. However, research suggests that it is possible to identify a user based strictly on their typing style, using pattern recognition, neural networks, and other techniques. This paper focuses on using the keyboard dynamics of the user's password to add an extra layer of security to the natural log-in process.*

(4:45pm-5:00pm) Vibrometry-based Vehicle Identification Framework Using Nonlinear Autoregressive Neural Networks and Decision Fusion

Authors: Marc R. Ward, Trevor J. Bihl, Kenneth W. Bauer, Air Force Institute of Technology

Abstract: *This research considers simulated laser radar (LADAR) vibrometry for vehicle identification. Time sampled data is considered for developing multiple nonlinear autoregressive neural network (NARNet) classifier models. Emphasis is placed on robustness to sensor location and using small amounts of data. Decision level fusion is used to combine results from multiple classifiers. Results offer improved classification performance over literature.*

(5:00pm-5:15pm) Machine learning approach to fusion of high and low resolution imagery for improved target classification

Author: Roman Ilin, Air Force Research Laboratory

Abstract: *This work utilizes high resolution images in order to improve the classification accuracy on low resolution images. The approach is based on the machine learning paradigm called LUPI - "Learning Under Privileged Information". In this contribution, the LUPI paradigm is applied to images from the Caltech 101 dataset.*

(5:15pm-5:30pm) Skin Detection with Multispectral Imagers onboard Small Unmanned Aerial Systems

Author: Stephen Sweetnich, Air Force Institute of Technology

Abstract: *Dismount skin detection from an aerial platform has posed challenges for skin detection compared to ground-based platforms. Computer vision registration, stereo camera calibration, and geolocation from autopilot telemetry were utilized to design a dismount detection platform. Close range comparison with a line scan HSI resulted in an average 5.112% difference in ROC AUC. This research indicated that SUAS-based Spectral Imagers are capable tools in dismount detection protocols.*

(5:30pm-5:45pm) RIPPLE: Scalable Medical Telemetry System for Supporting Combat Rescue

Author: Adam Renner; Air Force Research Laboratory

Abstract: *The U.S. Air Force desires to bring telemedicine to the most difficult and challenging environments. The Air Force Pararescue Jumpers (PJ) and Combat Rescue Officers (CRO) perform rescue and life-saving measure in these austere environments. Currently, Bluetooth aided pen-and-paper systems are employed to collect and store medical data, from the time it is sensed to its dissemination, which is proving to be more tedious and non-scalable, especially when PJ and CRO teams outnumber the casualties in a given mission. Pararescue Jumpers, Combat Rescue Officers and similar medical rescue agencies are seeking medical vital sign sensors and telemetry solutions for mass casualty responses in which a small team of medical rescuers must be able to rescue and sustain the life of multiple casualties in critical condition. Project Ripple, to be described in this paper, is meant to create a network of Medical Body Area Network (MBAN) to assist in triage and general patient data collection in a disaster scenario. The system is meant to provide an improved alternative to existing Bluetooth and pen-and-paper systems by stream lining the processes of data collection, storage, transfer, and visualization. Low-power, wireless devices that utilized open standards makeup the sensor network while a custom mobile applications were used for the visualization of the sensor data. Also, a flexible generic sensor fusion architecture is being explored.*

(5:45pm-6:30pm) Poster Reviews & Questions

Day 3 (Morning) – Friday, June 27, 2014

Time	Event	Location
7:00am-12:00pm	Registration	Lobby
7:00am-8:00am	Breakfast	Exhibit Room (N1840)

Tutorial G (Coffee Break-10:00am-10:15am)

Tutorial G (9:00 am – 10:00am)
(10:15 am -11:45am)
Chairs: Catherine Deardorf & Felicia Harlow

Location: SW Side Exhibit Room (N1840)

Topic: Arduino and Physical Computing
Dr. John Loomis, University of Dayton

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

Session	Title	Location
(8:00am-10:00am)		
ANS	**Antennas, Navigation, RF and Nonlinear Signal Processing** *Chairs: Dr. Lorenzo Lo Monte & Dr. Bob Penno, University of Dayton*	Meyer Room (N1650)

(8:00am-8:20am) Wavelet-Based Gaussian Wavelet for Spotlight Synthetic Aperture Radar

Authors: Siyang Cao, Yuan F. Zheng, and Robert L. Ewing, The Ohio State University, Air Force Research Laboratory

***Abstract**: A new wavelet based Gaussian waveform is proposed. The proposed waveform takes the advantages of both the Gaussian waveform and the wavelet-based waveform for improving the performance in range detection. The new form can completely remove the near-sidelobes and push the far-sidelobes out of the detecting boundary. As a result, it is particularly suitable for the spotlight synthetic aperture radar (SAR).*

(8:20am-8:40am) Small Size Planar Widebandwidth Antennas

Author: Altan M. Ferendeci; University of Cincinnati

***Abstract:** A new geometrical configuration of a widebandwidth thin slotted antenna with a ground plane is introduced that can be conformally placed on any arbitrary surface. Special geometries are chosen to reduce the corresponding surface area of the antenna for low frequency applications. The parameters associated with antenna, its response as a function of frequency and its possible application areas are presented.*

(8:40am-9:00am) Phase Measurement Approaches for a Multi-tier Weak Radio Signal Detection Process with N Simultaneous Signals

Authors: Mary Lanzerotti, Charles Cerny, Richard Martin; Air Force Institute of Technology

***Abstract:** This paper reviews a generalized theoretical analysis of Tsui's phase measurement approach for detection of extremely weak radio signals to the situation in which there are N simultaneous signals, where one signal is strong, and N-1 signals are weak. Applications to a multi-tier detection process for N=2, N=3, and N=4 simultaneous signals are described. Signal parameters are extracted for the case of N=2. This work has applications for electronic warfare receivers for detection and characterization of weak signals with unknown parameters.*

(9:00am-9:20am) Qualifying Pixels for Attributed Scattering Center Extraction

Authors: Justin Farmer and Michael A. Saville, Wright State University

***Abstract:** Use of co- and cross-polarization phase history data has been shown to enhance feature extraction from synthetic aperture radar (SAR) data. Recent work with the spectrum-parted linked image test uses polarization with Fourier-based peak detection to qualify pixels for attributed scattering center (ASC) extraction from SAR phase history data. Extraction of closely spaced scattering centers suffers because only the dominant scatterer can be detected resulting in incomplete information about the object. We propose an ASC extraction method based on 2D Prony method and fully polarimetric SAR phase history similar to the SPLIT algorithm. In this work, we compare the signal parameter estimation performance when using a back-projection imaging operator to that when using 2D Prony method. We also examine the performance of feature estimation using experiments of primitive shapes that could represent a complicated feature needed for target classification.*

(9:20am-9:40am) Low-Power and High Speed CPL-CS Adder

Authors: Naga Venkata, Vijaya Krishna, Boppana; Wright State University

***Abstract:** High speed, low power, area efficient adders continue to play a key role in hardware implementations of Digital Signal Processing applications. Adders based on Complimentary Pass Transistor Logic (CPL) are power and area efficient, but are slower compared to Square Root Carry Select (SQRT-CS) based adders. This paper proposes a unique custom adder design in 250-nm process technology, which is based on a combination of CPL and CS logic to obtain a very fast and power/area efficient adder design. A 16 bit CPL/CS adder is presented which is faster compared to the standard SQRT-CS adder while significantly reducing the power and area.*

(9:20am-9:40am) POSTER-Phased Array Feed for Sparse Parabolic Reflector

Authors: Eric Moore, Stephen Hartzell, Joshua Wilson, Lee Burchett, Dr. Terzuoli, Wright State University, Air Force Institute of Technology

Abstract: *To maximize the aperture efficiency of a 150m parabolic reflector, a novel feed was researched. A phased array is proposed as the feed for this reflector. Two types of phased array elements are investigated and simulated using the time-domain solver in CST Microwave Studio. The results of each array are compared.*

Session	Title	Location
(10:15am-12:00pm)		
BSC	**Bio-Inspired Systems and Cyber-Physical Applications**	Meyer Room
	Chair: Dr. Hoda Abdel-Aty-Zohdy, Oakland University	(N1650)

(10:15am-10:35am) Human Decision-making in a Contested Information Domain

Author: Michael Haas, Air Force Institute of Technology

Abstract: *Future conflicts will necessitate the ability to conduct effective military operations in a contested information environment. The building and maintaining of robust situational awareness, protection of decision-making effectiveness of individuals and teams, and fighting through information attacks from both in, and through, the cyberspace domain, will be essential. Increasing the knowledge of the mechanisms involved in degrading task performance and decision-making during information attacks through cyberspace will enable the development of advanced human-centered defensive techniques that will increase fight-through capability. Previous research has shown that task performance could be degraded through the use of information manipulation and, anecdotally, has also shown indications of affective response. Maintaining an appropriate level of affect is a key element in timely and accurate human decision-making. Decision-making quality can be reduced and overall task performance can suffer due to inappropriately regulated affect level. Understanding how affect can be influenced in the information domain has become a primary focus of this research. Recently completed experiments have indicated that decision-making, situational awareness, and emotion regulation may be impacted by the presence of malware operating in computational processes during task performance. These indications are seen in overall task performance as well as brain imaging studies. This paper will summarize the results of several studies performed previously investigating human operations in the contested information domain as well as describing in detail the approach taken and results obtained in the most recent empirical effort sponsored by the Air Force Office of Scientific Research.*

(10:35am-10:55am) Optimized Fingerprint Generation Using Unintentional Emission Radio-Frequency Distinct Native Attributes

Authors: Randall Deppensmith, Samuel Stone, Air Force Institute of Technology

Abstract: *Device discrimination has been effectively demonstrated using classification processes acting on RF-DNA features as input sequences. Device discrimination utilizing RF-DNA classifiers require training signals representative of the expected test signals that capture device uniqueness. Current techniques divide collected signals into uniformly distributed and sized bins prior to generating the RF-DNA feature input sequences. This paper proposes a new method of dividing the collected signals using non-uniform signal regions tailored to the signal attributes to create RF-DNA fingerprints*.

(10:55am – 11:15am) Integrated Circuit (IC) Aging Effects on Radio-Frequency Distinctive Native Attributes (RF-DNA)

Authors: Randall Deppensmith, Samuel Stone, Air Force Institute of Technology

Abstract: *Device Device discrimination using RF-DNA utilizes the uniqueness generated from integrated circuit (IC) manufacturing process variation. As an IC ages toward wear-out failure, internal physical alterations may impart additional changes on the order of initial process variations. This paper explores: 1) the impact of aging on RF-DNA discrimination accuracy, and 2) proposes a means to monitor IC aging using RF-DNA.*

(11:15am-11:35am) BioInspired THz Applications for Microorganism Fingerprinting

Author: Leamon Viveros, , Alexei Bykhovski , Weidong Zhang, and Elliott R. Brown, Wright State University and North Carolina State University

Abstract: *THz imaging is a novel technique for examining spores and other microorganism.*
It has also been applied to identify new characteristics of other biomolecules. Within this talk, experimental examples will be examined showing unique signatures using THz spectrometry.

(11:35am- 11:55am) Design and Construction of 9-DOF Hyper-Redundant Robotic Arm

Authors: Xingsheng Xu, University of Dayton

Abstract: *Hyper-redundant robotics is a branch of advanced robotic technology recognized as a method to improve manipulator performance in complex and unstructured environments. Research in both kinematic and dynamic control of hyper-redundant manipulator plays an important role in high-tech field like modern industry, military and space applications. The kinematic redundancy considered in this paper means the total degrees of freedom (DOF) of robot is more than the degrees of freedom required for the task to be executed. The redundancy provides in insight solutions to achieve the same position and orientation of the end-effector. Therefore, the efficacy of kinematic algorithm affects the accuracy and stability of both motion control and path tracking. In this paper, we mainly focus on constructing an application robotic platform based on kinematic modeling of a 9-DOF hyper-redundant manipulator. We firstly take a brief introduction of the background, related work, significance and objective of this paper. Then the kinematic model of 9-DOF manipulator is established along with its home position configuration. The next work is divided into two parts: first is the construction of hardware platform, and the second one is to design an application software with user interface (UI). In addition, the result of proposed thesis design is demonstrated in a number of experiments. In the end, conclusion and future work are presented.*

Session	Title	Location
(10:10am-12:30pm)		
RCT	**Reconfigurable Computing**	North Dining Room
	Chairs: Kerry Hill & Al Scarpelli, Air Force Research Laboratory	(N1620)

(10:10am-10:30am) Via-Configurable Arrays (VCAs)

Authors: Luke Beno, James Kemerling ; Triad Semiconductor, Inc.

Abstract: *A new alternative to full-custom analog/mixed signal ASICs will be introduced. This new approach applies many of the concepts of deep-submicron digital structured arrays to larger geometry analog processes. Consequently a place-and-route tool (normally only for the digital domain) can be used to configure an analog ASIC while maintaining performance comparable to classical full-custom design. Specifically, this concept uses a single via layer to configure an entire semi-custom mixed-signal integrated circuit. These new devices are called via-configurable arrays (VCAs.)*

(10:30am-10:50am) Optimized FPGA Based Implementation of Particle Filter for Tracking Applications

Authors: Amin Jarrah, Mohsin M. Jamali, and Soheil Hosseini, University of Toledo

Abstract: *Particle filter has been proven to be a very effective method for identifying targets in non-linear and non-Gaussian environment. However, particle filter is computationally intensive. So, particle filter has been implemented on FPGA by exploiting parallel and pipelining approaches to reduce the computational burden. Our optimized FPGA implementation improves up to twelve times speed up. Also more speed ups are achieved with increasing number of particles.*

(10:50am-11:10am) Hybrid Crossbar Architecture for a Memristor Based Memory

Authors: Tarek M. Taha, and Raqibul Hasan, University of Dayton

Abstract: *This paper describes a new memristor crossbar architecture that is proposed for use in a high density cache design. This design has less than 10% of the write energy consumption than a simple memristor crossbar. Also, it has up to 4 times the bit density of an STT-MRAM system and up to 11 times the bit density of an SRAM architecture. The proposed architecture is analyzed using a detailed SPICE analysis that accounts for the resistance of the wires in the memristor structure.*

(11:10am-11:30am) Tolerance to Defective Memristors in a Neuromorphic Learning Circuit

Authors: Raqibul Hasan, Tarek M. Taha, Mark McLean, and Douglas Palmer, University of Dayton

Abstract: *This paper describes a memristor based neuromorphic circuit that is capable of learning. Using SPICE, target memristors within the crossbar circuit were set to be stuck in either high or low resistance states to observe fault tolerance within the memristor crossbar. In some cases the circuit was able to successfully learn when half of the memristors in the crossbar were set to be defective. Due to additional bias circuitry, this neuromorphic memristive learning circuit appears to be more tolerant to error than alternative designs.*

(11:30am-11:50am) Energy Efficient Circuits for Network Intrusion Detection on Mobile Platforms

Authors: Venkataramesh Bontupalli, Chris Yakopcic, Tarek M. Taha; University of Dayton

Abstract: *With pervasive use of networked mobile systems, it is essential to secure these systems against cyber-attacks. One of the commonly used applications for this is SNORT, a network based intrusion detection algorithm. SNORT is typically run by the networking hardware. With mobile systems there is no guarantee that SNORT would be running on the networking hardware being utilized, thus having such network intrusion detection algorithms running directly on the mobile platform has significant security benefits. Mobile systems however are typically power constrained and therefore would benefit from specialized extreme low power intrusion detection hardware. This paper describes a neuromorphic memristor crossbar architecture that is capable of implementing the pattern matching capabilities of the SNORT cybersecurity algorithm. A memristor crossbar is capable of pattern matching a large number of malicious data strings in parallel, thus performing the SNORT algorithm quickly and efficiently. This paper uses SPICE to show how a data string is input to the crossbar and how a neuromorphic circuit can be trained to signal when malicious data is present.*

(11:50am-12:10pm) FPGA design of a Digital Neuromorphic Processing Core

Authors: Hua Chen, Yangjie Qi, Bin Zhang, Raqibul Hasan, and Tarek M. Taha, University of Dayton

Abstract: *Neuromorphic processing cores can significantly reduce the power consumption of embedded computing systems for a wide class of applications. This paper examines the design of such a core and its FPGA implementation. This core can be used in a multicore configuration with onchip routing. The paper presents the control logic and optimized component designs for the neuromorphic processor. These components will eventually be utilized for memristor crossbar based neuromorphic processors.*

(12:10pm-12:30pm) Fabrication, Characterization, and Modeling of Memristor Devices

Authors: Weisong Wang, Chris Yakopcic, Eunsung Shin, Tarek M. Taha, and Guru Subramanyam, University of Dayton

Abstract: *This paper describes a fabrication and characterization method of memristor devices based on switching oxides. The device cross sectional area is varied to observe the impact this has on the current-voltage characteristic. A modeling technique is then describes that is capable of matching the current-voltage characteristics of these devices very accurately.*

FRIDAY Luncheon 12:30pm–2:00pm (*Food located in Exhibit Room*) Meyer Room

1:00pm

Keynote Speaker: Jade Morton, Ph.D.
Miami University

Title: Sensing and Navigation using Global Navigation Satellite Systems Signals

Day 3 (Afternoon) – Friday, June 27, 2014

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

Session	Title	Location
(2:00pm-5:00pm)		
TEC	**Tec^Edge Student Presentations** *Chairs: Dr. Robert Williams, Air Force Research Laboratory*	Meyer Room (N1650)

Session	Title	Location
(2:00pm-5:00pm)		
IEE	**IEEE Membership, Women in Engineering & UD Tour**	Exhibit Room

Session	Title	Location
(2:00pm-3:30pm)		
NGC	**NAECON GRAND CHALLENGE (Student Paper)** *Chairs: Kenneth Simone,Dr. Joanne DeGroat, Dr. Erik Blasch, and Dr. Doug Petkie*	North Dining Room

Presentation Title: Detection Probability of Automotive Radars Using Maximum Length Sequences to Suppress Interference from Nearby Radars.

Authors: Hiroshi Kato and Takehiko Kobayashi, Wireless Systems Laboratory, Tokyo Denki University

Abstract: *Performance of automotive radars is degraded by interference from nearby radars operating at the same frequency. Code division multiple access technology can alleviate the degradation. Probabilities of detecting a passing car and false alarms were numerically evaluated for automotive radars using binary maximum length sequences. Ultra wideband (UWB) automotive radars, recently approved by governments of many counties, are expected to be instrumental in reducing traffic accidents. In comparison with conventional vehicular sensing systems using ultrasound, visible and infra-red light, and millimeter waves, these recently-developed Ka-band UWB radar systems hold several advantages, such as no blind angle, high resolution in ranging, weatherproof, and lower price than millimeter-wave radars. However, performance of automotive radars is degraded by interference from nearby radars operating at the same frequency. The degradation can be alleviated with code division multiple access technology using pseudo noise sequences, but its quantitative evaluation has not been fully exploited. In this present paper, a desired-to-undesired signal power ratio (DUR) was first examined when two cars pass through each other. Next, suppression of interference was calculated for the assumed range of DUR with use of binary maximum length sequences (MLS). Then the probability of false alarms and the probability of detecting passing car were evaluated. We assumed a scenario where two cars pass each other on a road. For collision avoidance, both cars are equipped with UWB radars aiming horizontally and 60 degrees from the axial direction of travel of the cars, as schematically depicted in Fig. 1. The desired signal is a received radar signal reflected from an oncoming car; and the undesired signal is one transmitted from the other radar on the oncoming car. The desired and the undesired signals are inversely proportional to R^4 and R^3 respectively, where R is the range between the cars. Assuming the antennas for transmission and reception having a gain of 7.0 dBi, lane widths ranging from 2.8 to 3.5 m, and a car having a radar cross section of 8 dbM^2, DUR was found to vary approximately from -10 to 10 dB. Simulations were carried out in a range of -20 < DUR < 20 dB. The UWB radar under consideration transmits a UWB pulse train that is modulated by binary phase shift keying with an MLS. Pulse waveform can be arbitrarily selected to comply with a UWB spectrum mask that a regulatory body specifies. When a duty cycle of the pulses, 133 ns, e.g. the maximum detection range = 20 m, where c is the velocity of the electromagnetic wave. The time interval to give the alarm to the driver was assumed to be 100 ms, considering normal human reaction time. During this 100 ms, 750,000 pulses can be transmitted. Since the length of an MLS is 2^K-1 when generated with a shift register of length k (the number of MLS stages), the BPSK-modulated pulse train repeated within the 100 ms, as shown in Fig. 2. A Block diagram of the simulation is presented in Fig. 3.*

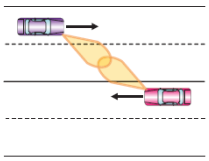

Fig. 1. Scenario for evaluating a range of *DUR*.

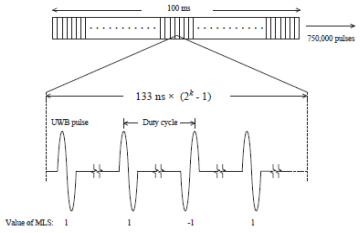

Fig. 2. BPSK-modulated pulse train with an MLS.

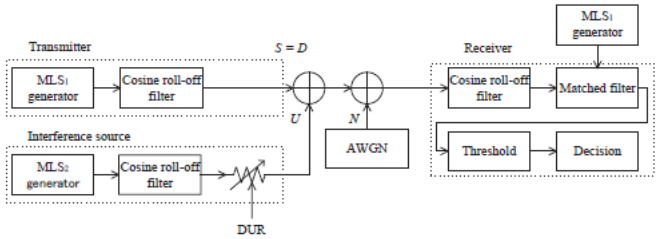

Fig. 3. Block diagram of the simulation.

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Location of Rooms within University of Dayton's River Center