University of Dayton's River Campus, 1700 S. Patterson Blvd, Dayton, Ohio

-Parking is located next to the River Campus building On North side nearest the Meyer Room Entrance (See map below & page 33)
-No Parking Pass is required for this event, but “Only” if you park next north of River Campus Building, University of Dayton
### Day 1 – Tuesday, June 16, 2015
**Coffee Breaks: 10:00 – 10:15, 15:30 – 15:45**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00</td>
<td>Continental Breakfast (Wed-Fri) Exhibit/Marshall Room (N1840)</td>
</tr>
<tr>
<td>7:00</td>
<td>Registration (Opens Tuesday at 9 am, Daily 7:00 – 16:00; Ends Friday at 12:00pm) Lobby Entrance</td>
</tr>
<tr>
<td>10:00</td>
<td>Tutorial A 10:00am - 12:00pm (LoMonte)</td>
</tr>
<tr>
<td>10:00</td>
<td>Tutorial B 13:00pm - 15:00pm (Wicks)</td>
</tr>
<tr>
<td>10:00</td>
<td>Tutorial C 15:00pm - 17:00pm (Baker)</td>
</tr>
<tr>
<td></td>
<td>Meyer Room (N1650)</td>
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<tr>
<td>10:00</td>
<td>Tutorial D 13:00pm - 17:00pm (Blasch)</td>
</tr>
<tr>
<td></td>
<td>North Dining Room (N1620)</td>
</tr>
<tr>
<td>10:00</td>
<td>Tutorial E 13:00pm - 16:00pm (Devgan, Cerny, Usechak)</td>
</tr>
<tr>
<td></td>
<td>Tutorial F 16:00pm - 17:00pm (Sabin)</td>
</tr>
<tr>
<td></td>
<td>Executive Dining Room</td>
</tr>
</tbody>
</table>

### Day 2 – Wednesday, June 17, 2015
**Coffee Breaks: 10:15 – 10:30, 15:00 – 15:20**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30</td>
<td>Introduction by NAECON Committee</td>
</tr>
<tr>
<td></td>
<td>Meyer Room (N1650)</td>
</tr>
<tr>
<td>8:45</td>
<td>Plenary Speakers (Yagi, Asai)</td>
</tr>
<tr>
<td></td>
<td>8:45am – 10:15am</td>
</tr>
<tr>
<td>8:45</td>
<td>Algorithms &amp; Tracking I (10:30am – 12:10pm)</td>
</tr>
<tr>
<td></td>
<td>Meyer Room (N1650)</td>
</tr>
<tr>
<td>8:45</td>
<td>Photonics I (8:00am - 11:45am)</td>
</tr>
<tr>
<td></td>
<td>North Dining Room (N1620)</td>
</tr>
<tr>
<td>8:45</td>
<td>Trust in Microelectronics I (10:30am - 12:10pm)</td>
</tr>
<tr>
<td></td>
<td>Executive Dining Room</td>
</tr>
<tr>
<td>12:10</td>
<td>Keynote Luncheon - Dr. Paul F. McManamon;</td>
</tr>
<tr>
<td></td>
<td>Cafeteria</td>
</tr>
<tr>
<td>13:10</td>
<td>SUMMER at the Edge</td>
</tr>
<tr>
<td></td>
<td>(13:10pm – 15:00pm)</td>
</tr>
<tr>
<td>13:10</td>
<td>Algorithms &amp; Tracking II (15:20pm – 17:40pm)</td>
</tr>
<tr>
<td></td>
<td>Meyer Room (N1650)</td>
</tr>
<tr>
<td>13:10</td>
<td>Photonics II (15:20pm - 18:10pm)</td>
</tr>
<tr>
<td></td>
<td>North Dining Room (N1620)</td>
</tr>
<tr>
<td>13:10</td>
<td>Trust in Microelectronics II (15:20pm - 17:40pm)</td>
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<tr>
<td></td>
<td>Executive Dining Room</td>
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</tbody>
</table>

### Day 3 – Thursday, June 18, 2015
**Coffee Break: 9:45 – 10:00, Break 15:00 – 15:15**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>8:00</td>
<td>Invited/Plenary Speakers (Newman, Kelley-Loughnane)</td>
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<tr>
<td></td>
<td>(8:10am – 9:50am)</td>
</tr>
<tr>
<td>8:00</td>
<td>Algorithms &amp; Tracking III (10:00am – 11:40am)</td>
</tr>
<tr>
<td></td>
<td>Meyer Room (N1650)</td>
</tr>
<tr>
<td>8:00</td>
<td>Radar &amp; Imaging I (10:00am – 12:00pm)</td>
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<tr>
<td></td>
<td>North Dining Room (N1620)</td>
</tr>
<tr>
<td>8:00</td>
<td>Sensors and Devices (10:00am - 12:00pm)</td>
</tr>
<tr>
<td></td>
<td>Executive Dining Room</td>
</tr>
<tr>
<td>12:00</td>
<td>Keynote Luncheon - Dr. Chris Baker;</td>
</tr>
<tr>
<td></td>
<td>Cafeteria</td>
</tr>
<tr>
<td>13:00</td>
<td>Monitoring &amp; Surveillance (ISMSR) (13:00pm - 15:00pm)</td>
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<tr>
<td></td>
<td>Woolpert Presentation (15:15pm - 16:15pm)</td>
</tr>
<tr>
<td></td>
<td>Meyer Room (N1650)</td>
</tr>
<tr>
<td>13:00</td>
<td>Radar &amp; Imaging II (13:00pm - 15:00pm)</td>
</tr>
<tr>
<td></td>
<td>North Dining Room (N1620)</td>
</tr>
<tr>
<td>13:00</td>
<td>Poster Session</td>
</tr>
<tr>
<td></td>
<td>(16:15pm - 18:00pm)</td>
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<tr>
<td></td>
<td>Exhibits/Marshall Room</td>
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</tbody>
</table>

### Day 4 – Friday, June 19, 2015
**Coffee Break: 10:15 – 10:30**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>8:00</td>
<td>Reconfigurable Computing I (8:10am – 9:50am)</td>
</tr>
<tr>
<td></td>
<td>Meyer Room (N1650)</td>
</tr>
<tr>
<td>8:00</td>
<td>Innovative Information Processing (8:10am - 9:50am)</td>
</tr>
<tr>
<td></td>
<td>North Dining Room (N1620)</td>
</tr>
<tr>
<td>8:00</td>
<td>BioInspired Systems (8:10am - 10:10am)</td>
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<tr>
<td></td>
<td>Executive Dining Room</td>
</tr>
<tr>
<td>10:30</td>
<td>Reconfigurable Computing II (10:30am – 11:30am)</td>
</tr>
<tr>
<td></td>
<td>Meyer Room (N1650)</td>
</tr>
<tr>
<td>11:45</td>
<td>Keynote Luncheon - Dr. Jennifer C. Ricklin;</td>
</tr>
<tr>
<td></td>
<td>Cafeteria</td>
</tr>
<tr>
<td>13:00</td>
<td>Sensor Exploitation (13:00pm – 15:00pm)</td>
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<tr>
<td></td>
<td>Meyer Room (N1650)</td>
</tr>
</tbody>
</table>

**FACILITY MAPS ON PAGE 33
ABSTRACTS START ON PAGE 15**
Woolpert provides architecture, engineering and geospatial services for public and private companies, and federal, state and local governments. The Dayton-based firm, founded in 1911, has gone from designing runways for Orville Wright to becoming the first surveying company to earn an FAA exemption to fly unmanned aerial systems (UAS) commercially in designated airspace. Woolpert has been providing mapping via aerial and mobile LiDAR for more than a decade and currently is collaborating with the U.S. Geological Survey to produce 3D elevation data. The organization also has worked with the U.S. military for more than 60 years, supplying architecture, data collection, imagery and IT services in a safe and secure environment. Woolpert creates advanced design solutions with applied technologies and resiliency planning, is blazing a domestic trail in Institute of Asset Management certification and permitting system implementations, and provides holistic water supply and conservation solutions. The private company has forged professional partnerships with Google, Planet Labs, Optica Consulting and Cityworks, among others, to provide its clients with the most progressive and comprehensive solutions possible. Woolpert has more than 600 employees in 25 offices nationwide. For more information, visit woolpert.com.
The University of Dayton Research Institute is a national leader in scientific and engineering research, serving government, industry and nonprofit customers. Our professional engineers and scientists conduct research and provide support in a wide variety of technical areas, ensuring customer success by delivering affordable and innovative solutions, leading edge technologies and outstanding service. Our accomplishments are marked by integrity, respect for others, and commitment to the individual growth of our employees. Our major research areas include materials, energy and the environment, aeropropulsion, structures, mechanical systems, sensors and human factors. UDRI also contributes to the fulfillment of the University’s commitments to education, research and public service through the involvement of students, faculty and external partners.

Established as the research arm of the University of Dayton in 1956, UDRI broke the $1.5 billion mark in cumulative sponsored research in fiscal year 2010. Sponsored research for 2014 alone topped $87 million. The University of Dayton Research Institute is ranked number three in the nation among all colleges and universities for sponsored materials research, according to the National Science Foundation. In Ohio, UDRI is number two among nonprofit institutions receiving contracts and grants from the Department of Defense.

Footprint

Footprint is a Dayton, Ohio based software and services company specializing in solutions for the public safety and security industries. With a guiding principal of providing an open-platform for integrating current and future technologies, Footprint benefits from the combined expertise of three companies, Woolpert, Optica Consulting, and UDRI in blending leading-edge technologies and industry expertise into seamless software solutions.

Footprint’s signature product, Footprint-LE leverages over 20 years’ experience with public safety, geospatial, and sensor technologies into a robust, map-centric situational awareness platform. Footprint-LE integrates an extensive data warehouse of public safety and sensor data with an intuitive, browser-based user interface that is accessible even from mobile devices. City, regional, and even state-wide situational awareness can be enhanced with a software tool that puts valuable, time-sensitive information at the fingertips of officers and investigators.

Future technologies under development for inclusion in Footprint-LE include robust link-analysis, automated facial and situation recognition, and advanced data analytics.

For more information, visit our website at www.footprintsas.com. For questions or to schedule a demo, e-mail sales@footprintsas.com or by phone at (937)716-5335.
## Day 1 – Tutorials-Tuesday, June 16, 2015

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00am-5:00pm</td>
<td>Registration Open</td>
<td>Entrance/Marshall Room</td>
</tr>
</tbody>
</table>
| Tutorial A (10:00 am – 12:00pm) | Topic: “Rf/Radar System Engineering”  
Dr. Lorenzo LoMonte, University of Dayton | Location: Meyer Room (N1650)                  |
| Luncheon (10:00 am – 12:00pm) |                                                                                     | Cafeteria (M1555)                             |
| Tutorial B (13:00 pm -15:00pm) | Topic: “Distributed Sensing”  
Dr. Michael Wicks, University of Dayton | Location: Meyer Room (N1650)                  |
| Tutorial C (15:00 pm – 17:00pm) | Topic: “Passive Radar”  
Dr. Chris Baker, The Ohio State University | Location: Meyer Room (N1650)                  |
| Tutorial D (13:00 pm -17:00pm) | Topic: “Image Fusion Fundamentals (Models & Representations)”  
Dr. Erik Blasch, Air Force Research Laboratory | Location: North Dining Room (N1620)           |
| Tutorial E (13:00pm -16:00pm) | Topic: “RF Photonics Tutorial”  
Dr. Preetpaul Devgan, Charles Cerny, and Nick Usechak, Air Force Research Laboratory | Location: Executive Dining Room (M1425)       |
| Tutorial F (16:00 pm -17:00pm) | Topic: “Security Offload using the SmartNIC, a Programmable 10 Gbps Ethernet NIC”  
Dr. Gerald Sabin, RNET Technologies | Location: Executive Dining Room (M1425)       |

### Special Tuesday Evening Event:
**NAECON-OIS 2015 Social**

**Sponsored by Platinum Supporter: Woolpert**

**Time:** 5:30pm-7:30pm  
**Location:** Warped Wing Brewing Company  
26 Wyandot Street  
Dayton, Ohio 45402
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00am-8:30am</td>
<td>Registration “All-Day” Open &amp; Breakfast</td>
<td>Entrance/Marshall Room</td>
</tr>
<tr>
<td>8:30am-8:45am</td>
<td>Opening Ceremony (Dr. Robert Ewing, NAECON and Larrell Walters, OIS)</td>
<td></td>
</tr>
<tr>
<td>8:45am-9:30am</td>
<td>Plenary Speaker: Dr. Shogo Yagi</td>
<td>Meyer Room</td>
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<tr>
<td></td>
<td>NTT Advanced Technology Corporation, Japan</td>
<td>Topic: Electro-Optic Properties of KTN Crystals and their Applications</td>
</tr>
<tr>
<td>9:30am-10:15am</td>
<td>Plenary Speaker: Dr. Kazu Asai</td>
<td>Meyer Room</td>
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<tr>
<td></td>
<td>Tohoku Institute of Technology</td>
<td>Topic: LIDAR and Developments in Japan</td>
</tr>
<tr>
<td>10:15am-10:30am</td>
<td>Coffee Break and Exhibits</td>
<td>Marshall Room</td>
</tr>
<tr>
<td>10:30am-12:10pm</td>
<td>Tracks</td>
<td>Location</td>
</tr>
<tr>
<td></td>
<td>Algorithms &amp; Tracking I</td>
<td>Meyer Room</td>
</tr>
<tr>
<td></td>
<td>Chairs: Vijayan Asari, University of Dayton; Andreas Savakis, Rochester Institute of Technology</td>
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</tr>
<tr>
<td>10:30am-10:50am</td>
<td>The influence of gradient estimation on the extraction of boundary Point cloud</td>
<td>Qian Huang, Thomas Wischgoll, Wright State University</td>
</tr>
<tr>
<td>10:50am-11:10am</td>
<td>A Collaborative Adaptive Wiener Filter for Multi-frame Super-resolution</td>
<td>Khaled M. Mohamed and Russell C. Hardie, University of Dayton</td>
</tr>
<tr>
<td>11:10am-11:30am</td>
<td>Multiframe Super Resolution with JPEG2000 compressed images</td>
<td>Barath Narayanan, University of Dayton</td>
</tr>
<tr>
<td>11:30am-11:50am</td>
<td>VNIIRS Fusion Modeling for EO/IR Systems</td>
<td>Erik Blasch, Bart Kahler, Air Force Research Laboratory</td>
</tr>
<tr>
<td>11:50am-12:10pm</td>
<td>Using ROC and AUC Curves to Evaluate Performance of Curvelet and Contourlet Image Fusion Algorithms</td>
<td>Michael J. McLaughlin, Samuel M. Grieggs, Soundararajan Ezekiel, University of Pennsylvania</td>
</tr>
<tr>
<td></td>
<td>Photonics I</td>
<td>North Dining Room</td>
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<td></td>
<td>Chair: Dr. Nicholas Limberopoulos, AFRL Sensors Directorate</td>
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<tr>
<td></td>
<td>Photonics/Materials</td>
<td></td>
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<tr>
<td>10:30am-10:50am</td>
<td>Coupling properties and sensing applications of photonic molecules</td>
<td>Yangcheng Li, Farzaneh Abolmaali, Nicholas I. Limberopoulos, Augustine M. Urbas and Vasily N. Astratov, University of North Carolina, Air Force Research Laboratory</td>
</tr>
<tr>
<td>10:50am-11:10am</td>
<td>Observation of the influence of the gain on parity-time-symmetric properties of photonic molecules with coupled whispering gallery modes</td>
<td>Farzaneh Abolmaali, Nicholas I. Limberopoulos, Augustine M. Urbas, and Vasily N. Astratov, University of North Carolina, Air Force Research Laboratory</td>
</tr>
<tr>
<td>11:10am-11:30am</td>
<td>Increased Near-to-Far Infrared Imaging Sensitivity with Surface Plasmon Enhanced Down Conversion</td>
<td>Jarrett H. Vella, John H. Goldsmith, Vladimir Vasilyev, Nicholas I. Limberopoulos, and John S. Derov Air Force Research Laboratory, and Wyle, SelectTech Services Corporation, and Wesleyan University</td>
</tr>
<tr>
<td></td>
<td>Photonic Devices</td>
<td></td>
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<tr>
<td>11:30am-11:50am</td>
<td>Reflective Optical Limiter Based on Gallium Arsenide</td>
<td>Jarrett H. Vella, John H. Goldsmith, Andrew T. Browning, Nicholas I. Limberopoulos, Ilya M. Vitebskiy, Eleana Makri, and Tsampikos Kottos, Air Force Research Laboratory, Wyle, SelectTech Services Corporation, and Wesleyan University</td>
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### Day 2 – Wednesday, June 17, 2015

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</table>
| 10:30am-10:50am | **Analog Hardware Trojan Threats, Detection, and Mitigation**  
Yen-Ting Wang, Zhiqiang Liu, You Li, Degang Chen, and Randall L. Geiger, Iowa State University |
| 10:50am-11:10am | **Camouflage circuitry and programmable cells to secure semiconductor designs during Manufacturing**  
Ron Cocchi, SypherMedia International Inc.  |
| 11:10am-11:30am | **Detecting Anomalous Behavior in Microcontrollers Using Unintentional Radio Frequency (RF) Emissions**  
Justin P. Wylie, Samuel J. Stone, Air Force Research Laboratory |
| 11:50am-12:10pm | **Hardware Trojans Embedded in the Dynamic Operation of Analog and Mixed-Signal Circuits**  
Qianqian Wang, Randall L. Geiger, Degang J. Chen, Iowa State University |

#### Luncheon 12:10pm–13:10pm
- **Cafeteria**
- **Keynote Speaker:** Dr. Paul F. McManamon  
University of Dayton
- **Topic:** “The International Year of Light-Optics and Photonics as an Enabling Technology for the World”

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</table>
| 13:10pm-15:00pm | **SUMMER at the Edge**  
Chairs- Barbara Frantom, Air Force Research Laboratory, Julie Skipper, Wright State University and Robert Williams |
|             | **Overview of the AFRL Discovery Lab and Summer-at-the-Edge**,  
Dr. Robert Williams |
|             | **Deep Horizons & Massive Open Online Research**, David Brendel |
|             | **Virtual Science and Engineering Festival**, Anna Hayslett |
|             | **Deep Horizons’ Computer Vision Research Institute**, Mohit Deshpande |
|             | **Ripple: Medical Telemetry for Combat Rescue Operations**, Alex Opp |
|             | **JARVIS: The Internet of Things**, Tirzah Weiss |
|             | **Rosie the FPV Telepresence Robot & Project AVATAR**, Freddy Gu |
|             | **DragonFire: a 3D-printed Micro Air Vehicle**, Andrew Mason |
|             | **Cyber Security for Autonomous Systems**, Dustin Naylor |
| 15:00pm-15:20pm | **Coffee Break and Exhibits**  
**Marshall Room** |
| 15:20pm-18:10pm | **Algorithms & Tracking II**  
Chairs: Vijayan Asari, University of Dayton; Andreas Savakis, Rochester Institute of Technology |
| 3:20pm-3:40pm | **Bandelet Denoising in Image Fusion**  
Samuel M. Grieggs, Michael J. McLaughlin, Soundararajan Ezekiel |
| 3:40pm-4:00pm | **Characterization of Detectable Objects using an Uncalibrated and Passive Volumetric Change Detection Approach**  
Yakov Diskin, Nina Varney, and Vijayan Asari |
| 4:00pm-4:20pm | **A Modular Approach for Key-Frame Selection in Wide Area Surveillance Video Analysis**  
Almabrok Essa, Sidike Paheding, and Vijayan Asari; University of Dayton |
| 4:20pm-4:40pm | **Intrusion Detection in Aerial Imagery for Protecting Pipeline Infrastructure**  
Sidike Paheding, Almabrok Essa, and Vijayan Asari; University of Dayton |
| 4:40pm-5:00pm | **Improved Detection and Track Processing Through Scan-to-Scan Processing and Scan Rate Reduction**  
Abdulmajid Mrebit, LoMonte and Wicks; University of Dayton |
| 5:00pm-5:20pm | **Automatic Building Change Detection in Wide Area Surveillance**  
Sidike Paheding, Almabrok Essa, Fatema Albaloooshi, Vijayan Asari and Varun Santhaseelan; University of Dayton |
| 5:20pm-5:40pm | **FPGA-Based Coherent Doppler Processor for Marine Radar Applications**  
Hamdi Abdelbagi, Lorenzo LoMonte, and Michael Wicks, University of Dayton |
Day 2 – Wednesday, June 17, 2015

**Photonics II**
Chair: Dr. Nicholas Limberopoulos, AFRL Sensors Directorate

**North Dining Room**

**Photonic Devices (Continued)**
3:20pm-3:40pm *Designing, Fabricating and Testing multi-junction Silicon Solar Cell*
   Jimmy Lohrman and Ronald A. Coutu, Jr.; Air Force Institute of Technology
3:40pm-4:00pm *LEDs Application in Solar Cells in a Unique Way*
   Arjun Krishnappa, University of Dayton
4:00pm-4:20pm *Frequency Adaptable Maser Source*
   Christie Devlin, Brahmanand Jogai, John Cetnar, Altan Ferendeci and Robert Ewing; RNET Technologies, University of Cincinnati

**Photonic Device Performance Metrics, Signal/Image Processing, Imaging**
4:30pm-4:50pm *Performance Metric for Overall Characterization and Comparison of Strained-Layer Superlattice Infrared Photodetectors Enhanced With Microsphere Lenses of Various Material*
   Dalila B. Megherbi, G. Paradiso, I. Vakil, N. Limberopoulos, and A. Urbas; University of Massachusetts Lowell, Air Force Research Laboratory
4:50pm-5:10pm *A Signal Processing Method for Signal-to-Noise (SNR) Profile Extraction, Characterization and Comparison of Strained-Layer Superlattice (SLS) Infrared Photodetectors Enhanced With Microsphere Lenses of Various Material Structure Types and Sizes*
   Dalila B. Megherbi, G. Paradiso, I. Vakil, N. Limberopoulos, and A. Urbas; University of Massachusetts Lowell, Air Force Research Laboratory
5:10pm-5:30pm *An Information Theoretic Metric for Identifying Optimum Solution for Normalized Cross Correlation based Similarity Measures*
   Mohammad Imran Vakil, John A. Malas, Dalila B. Megherbi; Air Force Research Laboratory and University of Massachusetts Lowell
5:30pm-5:50pm *Information Theoretic Approach for Template Matching in Registration*
   Mohammad Imran Vakil, John A. Malas, Dalila B. Megherbi; Air Force Research Laboratory and University of Massachusetts Lowell

**Trust in Microelectronics II**
Chair: Mary Lanzerotti, Augsburg College & Charles Cerny, Air Force Research Laboratory

**Executive Dining Room**
3:20pm-3:40pm *Radio Frequency Based Reverse Engineering of Microcontroller Program Execution*
   Barron Stone and Samuel Stone, Air Force Research Laboratory
3:40pm-4:00pm *Topological Constraints of Gate-Level Circuits Obtained Through Standard Cell Recognition*
   Leleia Hsia, Graziano Vernizzi, Mary Lanzerotti, Derrick Langley; Air Force Institute of Technology, Siena College, and Augsburg College
4:00pm-4:20pm *Trusted Microelectronics: Options for the Future*
   Daniel J. Radack, Brian Cohen, Vashisht Sharma; Institute for Defense Analyses
4:20pm-4:40pm *Phase Measurement Approaches for a Multi-tier Weak Radio Signal Detection Process with N Simultaneous Signals having Continuous Phase*
   Mary Lanzerotti, Charles Cerny, Elizabeth Hiteshue, Kelsey Irvin, Richard Martin, Air Force Institute of Technology and Augsburg College
<table>
<thead>
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<tbody>
<tr>
<td>7:00am-8:00am</td>
<td>Registration/Breakfast</td>
<td>Entrance/Marshall Room</td>
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<tr>
<td>8:10am-9:00am</td>
<td>Invited Speaker</td>
<td>Meyer Room</td>
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<td>Kevin Newman, Lockheed Martin Advanced Concepts</td>
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<td>Topic: Using Big Data to Make Data: “Lowering the cost of end-to-end performance estimation”</td>
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<tr>
<td>9:00am-9:45am</td>
<td>Plenary Speaker</td>
<td>Meyer Room</td>
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<td></td>
<td>Dr. Nancy Kelley-Loughnane, Air Force Research Laboratory</td>
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<td>Topic: Wearable Sensory Electronics</td>
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<tr>
<td>9:45am-10:00am</td>
<td>Coffee Break and Exhibits</td>
<td>Marshall Room</td>
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<tr>
<td>10:00am-12:00pm</td>
<td>Tracks</td>
<td>Meyer Room</td>
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**Algorithms & Tracking III**

Chair: Vijayan Asari, University of Dayton; Andreas Savakis, Rochester Institute of Technology

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<tr>
<th>Time</th>
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<tr>
<td>10:00am-10:20am</td>
<td>Vehicle Tracking under Occlusion Conditions using Directional Ringlet Intensity Feature Transform</td>
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<td></td>
<td>Evan W. Krieger, Paheding Sidike, Theus Aspiras, and Vijayan K. Asari; University of Dayton</td>
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<tr>
<td>10:20am-10:40am</td>
<td>Using an A-priori Learnt Motion Model with Particle Filters for Tracking a Moving Person Using a Linear Infrared Array Network</td>
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<td>Ankita Sikdar, Yuan F. Zheng, and Dong Xuan, The Ohio State University</td>
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<tr>
<td>10:40am-11:00am</td>
<td>MicRAFT for Aerial Surveillance User Exploitation</td>
<td>North Dining Room</td>
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<td>Erik Blasch, Air Force Research Laboratory</td>
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<tr>
<td>11:00am-11:20am</td>
<td>Cloud technology Applications for Area Surveillance</td>
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<td>Greg Horvath, E Blasch, Yu Chen; Air Force Research Laboratory</td>
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<tr>
<td>11:20am-11:40am</td>
<td>Extraction of weak target features from radar tomographic imagery</td>
<td>North Dining Room</td>
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<td>Muhammad Almutiry, University of Dayton</td>
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<tr>
<td>11:40am-12:00pm</td>
<td>Towards a Ground Penetrating Radar System for Fine Root Analysis</td>
<td>North Dining Room</td>
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<td>Nihad Al-Faisali, University of Dayton</td>
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# Day 3 – Thursday, June 18, 2015

**Sensors and Devices**

**Executive Dining Room**

Chairs: Elena Guliants, University of Dayton; Mark Patterson, AFRL Sensors Directorate

10:00am-10:20am *Design and Fabrication of Phase Change Material Devices – Electrical Properties of GeTe Resisters*
James M. Sattler and Ronald A. Coutu, Jr., Air Force Institute of Technology

10:20am-10:40am *Tunable Pressure Sensing Applications of a MEMS Buckled Membrane*
Robert A. Lake and Ronald A. Coutu, Jr., Air Force Institute of Technology

10:40am-11:00am *Wide Temperature Range Resonant-Mode Absolute MEMS Pressure Sensor*
George Xereas, Charles Allan and Vamsy P. Chodavarapu, McGill University, Canada

11:00am-11:20am *Interfacing Nanoparticles to CMOS Quad Instrumentation Amplifiers for Gas Sensing Devices*
Tanu Goel, Maher Rizkalla, Jong Eun Ryu and Vinay Kumar Suryadevara, Indiana University, Purdue University

11:20am-11:40am *MW Blood Sample Characterization Using Co-Axial Transmission Line*
Evan Hilderbrand, Joseph Korfhagen, George Shaw, Altan M. Ferendeci, University of Cincinnati

11:40am-12:00pm *Mechanical Logic using MEMS*
Chris Kodama, Jimmy Lohrman, and Ronald A. Coutu, Jr., Air Force Institute of Technology

**Luncheon 12:00pm–1:30pm**

*Keynote Speaker: Dr. Chris Baker*

The Ohio State University

Topic: “Radar and Cognition: From Theory to Experiment”

13:00pm-15:00pm **Tracks Location**

<table>
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<tr>
<th>Tracks</th>
<th>Location</th>
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<tr>
<td>7th IEEE International Symposium on Monitoring &amp; Surveillance Research (ISMSR)</td>
<td>Meyer Room</td>
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</tbody>
</table>

Chairs: Nikolaos Bourbakis, Wright State University and Sanjay Boddhu, QBASE Inc.

1:00pm-1:20pm *A Dialogue Monitoring Scheme for a Virtual Doctor*
S. Mallios and N. Bourbakis, CART, Wright State University

1:20pm-1:40pm *An LG Graph Monitoring Scheme for Representing Incomplete Objects*
M. Robberloth and N. Bourbakis, CART, Wright State University

1:40pm-2:00pm *Monitoring Issues for detecting Human Body’s sitting positions*
Fnu Pranav and N. Bourbakis, CART, Wright State University

2:00pm-2:20pm *A Survey on Robotic Wheelchairs mounted with Robotic Arms for Assisting People at Need*
I. Ktistakis and N. Bourbakis, CART, Wright State University

2:20pm-2:40pm *Improving Transfer of Care using wearable technology*
Sriram Raju, Subhashini Ganapathy and Mary McCarthy, Wright State University

2:40pm-3:00pm *Tracking a Moving Target Using Mobile Robot*
A. Abdelgawad, Y. Ismail and K. Yelamarthi, Central Michigan University

**Radar & Imaging II**

**North Dining Room**

Chairs: Dr. Yuan Zheng of Ohio State University and Dr. Xiaoping Shen, Ohio University

1:00pm-1:20pm *Calculation of Aircraft Target’s Single-Pulse Detection Probability*
Shichun Chen, Beihang University, China

1:20pm-1:40pm *From Phased Array to Holographic Radar*
Siyang Cao, Yuan F. Zheng, Robert L. Ewing, The Ohio State University

1:40pm-2:00pm *Two Viewing Angles for Holographics in Radar and Light*
Sihaos Ding, Siyang Cao, Yuan Zheng and Robert Ewing, The Ohio State University

2:00pm-2:20pm *Automatic Modulation Classification via Instantaneous Features*
Elliott Moser, Michael K. Moran, Erric Hillen and Zhiquiang Wu, Wright State University

2:20pm-2:40pm *BBnect: a pulsed Doppler radar simulator using Kinect input*
Michael A. McGrath, The Ohio State University

2:40pm-3:00pm *Slepian wavelets and its application in radar waveform design*
Xiaoping A. Shen and Robert Ewing; Ohio University
Day 3 – Thursday, June 18, 2015

15:00pm-15:15pm   Coffee Break and Exhibits  Marshall Room

15:15pm-16:15pm   Woolpert Presentation  Meyer Room
Just-In-Time High Resolution Aerial Images from Unmanned and Conventional Airframes
Aaron Boesch, Director – Small Aerial Data Collection Systems, Woolpert, Inc.
Matt Hutchinson, PhD – UAS Lead Scientist, Woolpert, Inc.

16:15pm-18:00pm   Poster Session  Marshall Room
Chair: Robert Penno, University of Dayton

- A Dual-Band Reconfigurable LNA for Multi-Standard Receiver using 90 nm CMOS Technology
  Pushpak Vasanth Rayudu Arja; Wright State University
- Brain Machine Interface for Robotic Arm
  Dan Prince, Wenjie Lu, Mark Edmonds, Andrew Sutter, Matthew Cusumano; University of Dayton
- A Comprehensive Survey on Intrusion Detection techniques on various hardware’s
  VenkataRamesh Bontupalli; Tarek Taha, University of Dayton
- Security Offload using the SmartNIC, A Programmable 10 Gbps Ethernet NIC
  Gerald Sabin and Mohammad Rashti; RNET Technologies
- Towards an Assistive Network Accessibility Design
  Gahangir Hossain, Purdue University
- Adjusting of Absolute Point Positioning Accuracy
  A.A. Elashiry, Mohamed A. Youssef, & A.M. Abdel Hamid; Beni-Suef University, Assiut University, Egypt
- Analysis of Motor Imagery EEG Patterns in Voice Controlled Prosthetic Arm Design
  Gahangir Hossain, Purdue University
- Perturbation-based Extremum Seeking Control Design for the Observer SISO/SIMO Linear System
  Abdulhakim Daluom, University of Dayton
- Fractional Fourier Filtering Revisited - Algorithm and Applications
  Xiaoping A. Shen, Robert Ewing and Samatha Hampton; Ohio University
- Phase-Phase & Phase-Code Methods Modification for Precise Detection & Predicting the GPS Cycle Slip Error
  A.A. Elashiry, Mohamed A. Youssef, & A.M. Abdel Hamid; Beni-Suef University, Assiut University, Egypt

18:00pm-21:00pm   BANQUET NAECON-OIS
(River Campus – Cafeteria, just down the hall from Meyer Room)

7:15 NAECON/OIS Banquet Speaker:
Thursday Evening– 18 June, Pete Luongo, former CEO of the Berry Company
Topic:”10 Truths about Leadership:...It’s Not Just about Winning”

NAECON-OIS Banquet
# Day 4 – Friday, June 19, 2015

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<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>7:00am-8:00am</td>
<td>Registration/Breakfast</td>
<td>Entrance/Marshall Room</td>
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<tr>
<td>8:10am-9:50am</td>
<td>Reconfigurable Computing I</td>
<td>Meyer Room (N1650)</td>
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<td></td>
<td>Chairs: Kerry Hill and Al Scarpelli, AFRL Sensors Directorate</td>
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<tr>
<td>8:10am-8:30am</td>
<td>A Hardware Implementation of an Orthorectification Process</td>
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<td>Daniel Shaffer, Air Force Research Laboratory</td>
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<td>8:30am-8:50am</td>
<td>FPGA Demonstration of IR Spectral Target Imaging Algorithm</td>
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<td>Woo-Yong Jang, M. Imran Vakil, Jarrett H. Vella, and Michael Noyola,</td>
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<td>Air Force Research Laboratory</td>
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<td>8:50am-9:10am</td>
<td>Ex-Situ Programming of a Memristor Crossbar</td>
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<td>Chris Yakopcic, University of Dayton</td>
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<tr>
<td>9:10am-9:30am</td>
<td>SPICE Analysis of Dense Memristor Crossbars for Low Power Neuromorphic</td>
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<td>Processor Designs</td>
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<td></td>
<td>Chris Yakopcic, University of Dayton</td>
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<tr>
<td>9:30am-9:50am</td>
<td>Methods for Reducing Memristor Crossbar Simulation Time</td>
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<td>Roshni Uppala, University of Dayton</td>
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<td>8:10am-10:10am</td>
<td>BioInspired Systems</td>
<td>Executive Dining Room</td>
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<td>Chairs: Tarek Taha and Chris Yakopcic, University of Dayton</td>
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<tr>
<td>8:10am-8:30am</td>
<td>Precision of Value Represented by Memristor and its Impact on</td>
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<td>Application Accuracy</td>
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<td>Raqibul Hasan, and Tarek M. Taha, University of Dayton</td>
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<td>8:30am-8:50am</td>
<td>Lihium Based Memristive Devices</td>
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<td>Weisong Wang, Shu Wang, Eunsung Shin, Chris Yakopcic, Guru Subramanyam</td>
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<td></td>
<td>and Tarek Taha, University of Dayton</td>
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<td>8:50am-9:10am</td>
<td>Unsupervised Learning in Neuromemristive Systems</td>
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<td>Cory Merkel, Dhireesha Kudithipudi; Rochester Institute of Technology</td>
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<td>9:10am-9:30am</td>
<td>Intrusion Detection using Deep Belief Neural network</td>
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<td>VenkataRamesh Bontupalli Md. Zahangir Alom, Tarek; University of</td>
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<td>9:30am-9:50am</td>
<td>Robust Understanding of EEG Patterns in Silent Speech</td>
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<td>P. Ghane, D. Maridi and G. Hossain, Purdue University</td>
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<tr>
<td>8:10am-9:50am</td>
<td>Innovative Information Processing</td>
<td>North Dining Room</td>
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<td>Chair: William McQuay, The Design Knowledge Company</td>
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<td>8:10am-8:30am</td>
<td>CIRRUS: Increased Image Dissemination Speed using Cloud Resources</td>
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<td>Jeff Collier, Herb Hirsch; The Design Knowledge Company</td>
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<td>8:30am-8:50am</td>
<td>COMPOSIT: A Practical Real-time Video Feature Overlaying Solution</td>
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<td>Jeff Walrath, Herb Hirsch; The Design Knowledge Company</td>
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<td>8:50am-9:10am</td>
<td>WattProf: Fine-grained High Performance Computer Power Monitoring</td>
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<td>Gerald Sabin and Mohammad Rashti, RNET Technologies, Inc.</td>
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<td>9:10am-9:30am</td>
<td>Challenges and Opportunities with Concolic Testing</td>
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<td>Raghudeep Kannavara, Christopher J Havlicek, Bo Chen, Mark R Tuttle,</td>
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<td>Kai Cong, Sandip Ray, Fei Xie, Intel Corporation, Portland State</td>
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<td>University</td>
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<td>9:30am-9:50am</td>
<td>Person-Oriented Nurse Call Management System with Cognitive Networks</td>
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<td>Manasa Nelluri, Raghu Teja Nimmagadda, Tejas Bhogaraju, Aneesh</td>
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<td>Ankem and Gahangir Hossain, Purdue University</td>
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<td>10:15am-10:30am</td>
<td>Coffee Break and Exhibits</td>
<td>Marshall Room</td>
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Day 4 – Friday, June 19, 2015

10:30am-11:30am  Reconfigurable Computing II  Meyer Room (N1650)
Chairs:  Kerry Hill and Al Scarpelli, AFRL Sensors Directorate

10:30am-10:50am  **Modeling Memristor Devices Using a Pulsed Switching Characterization**
William Mitchell, Air Force Research Laboratory

10:50am-11:10am  **OrFPGA: An Empirical Performance Optimization Tool for FPGA Computing**
Chekuri S. Choudary, Gerald Sabin, Azamat Mametjanov, Prasanna Balaprakash, Stefan Wild, Paul Hovland; RNET Technologies Inc.

11:10am-11:30am  **Inexact Adder and Multiplier Simulations using Probabilistic Boolean Logic**
Christopher I. Allen, Derrick Langley, Air Force Institute of Technology

**Luncheon**  11:45am-13:00pm  Cafeteria
Keynote Speaker:  Dr. Jennifer C. Ricklin
Director, Homeland Security Advanced Research Projects Agency (HSARPA)
Topic: “Prospective of HSARPA”

13:00pm-15:00pm  Sensor Exploitation  Meyer Room (N1650)
Chairs: Jia Li, Oakland University and Lorenzo LoMonte, University of Dayton

1:10pm-1:30pm  **2D LiDAR and Camera Fusion in 3D Modeling of Indoor Environment**
Juan Li, Xiang He, Jia Li, Oakland University

1:30pm-1:50pm  **Active Visual Search (AViS) Dataset**
Hildenbrandt and Bernard Abayowa, Wright State University

1:50pm-2:10pm  **Extraction and Classification of Moving Targets in multi-sensory MAMI-1 Data Collection**
Roman Ilin, Scott Clouse, Air Force Research Laboratory

2:10pm-2:30pm  **A novel multi-loop QFT robust control methodology**
Sameer Alsharif, Mario Garcia-Sanz, Case Western Reserve

2:30pm-2:50pm  **Gain and directivity of a plasmonic dipole optical antenna**
Neda Mojaverian, Guiru Gu, and Xuejun Lu; University of Massachusetts Lowell, Hanscom Air Force Base
TUESDAY PRESENTATION ABSTRACTS

Tutorial A
Topic: “Rf/Radar System Engineering”
Dr. Lorenzo LoMonte, University of Dayton
This introductory level short course provides the student with an ability to perform basic system engineering analysis, design and prototyping for common radar applications. This course will present a procedure to translate mission requirements into detailed radar designs, including subsystems and components. The student will learn how to develop requirements for each subsystem, the top-level hardware design and software architecture as well as an incremental plan for developing and testing capabilities. Specifically, this course provides the systems design theory and test techniques needed to develop radar prototypes, maximally relying upon commercial-off-the-shelf (COTS) components. Fundamental radar engineering principles are presented with an emphasis on component selection and RF component chain analysis techniques. These concepts can be used to efficiently design and test RF systems for initial prototype designs of radars, receivers, transmitters.

Tutorial B
Topic: “Distributed Sensing”
Dr. Michael Wicks
Many applications require imaging, shape reconstruction and material characterization of objects in clutter, including, for example, aircraft and airport surveillance, below ground imaging, foliage penetration (FOPEN), concealed weapons detection (CWD), crowd control, border control, through the wall surveillance (TWS), antenna and RCS measurements, as well as quality control, industrial automation, medical imaging and 3D/4D printing. Recent advances in computing, computational sciences and radio frequency (RF) technology improved the potential for successful applications tomography to these challenging problems. Tomographic systems may be supported by a variety of technologies, but they all share one common feature in that they all require viewing of the environment from a variety of angles. This is referred to as geometric diversity of illumination and observation. The technology that supports geometric diversity is based upon distributed sensors. For applications where sensing occurs using electromagnetic waves, the most common sensor is radar. Distributed sensing systems employ a single aperture that is moved to form a synthetic aperture radar (SAR) or numerous simultaneous fixed aperture systems. RF tomography is typically employs a distributed system of low-cost, reconfigurable electromagnetic transmit and receive antennas placed arbitrarily around the region of interest. RF tomography transmitters radiate known waveforms. But, sources of opportunity may also be exploited, while spatially distributed receivers sample of the scattered fields, and relay this information to a central processor. The distinctive attribute of RF tomography is its high resolution capabilities: sub-wavelength, range-independent, bandwidth-independent, resolution which is a function of the RF carrier frequency.
This tutorial will present the principles of RF tomography, and the relationship between classical electromagnetics, signal processing, and applications specific phenomenology as in medical imaging, SAR, and seismic sensing. This tutorial will include results from the most recent experiments and trends with many different applications. In particular, this tutorial will demonstrate theoretical concepts using experimental results obtained via one of the first dedicated RF tomography chamber.

Tutorial C
Topic: “Passive Radar”
Dr. Chris Baker, The Ohio State University
Passive radar is currently a hot topic with commercial systems starting to appear as well as a wealth of research being conducted by many of the leading laboratories around the world. It is a rapidly maturing technology showing great promise for a range of applications, especially those requiring air target detection and tracking. New modes of operation such as imaging and MIMO are also possible. Passive radar exploits emissions of opportunity to form an RF sensor. It is covert, can counter stealth technology and is inherently low cost. Passive radar also is both frequency and space diverse. Further, an increasingly congested spectral environment is set to continue to improve passive radar performance for the foreseeable future. This short course introduces the principles and practice of passive radar from basic principles, conceptual design, processing methods for detection, tracking and imaging as well as hardware requirements. Examples from full-scale experimentation are used throughout to illustrate achievable performance. Latest developments in imaging and use of wideband signals are also included.

Tutorial D
Topic: “Image Fusion Fundamentals (Models & Representations)”
Dr. Erik Blasch, Air Force Research Laboratory
This course presents methods and applications of multispectral image fusion and night vision colorization organized into three areas (1) image fusion methods, (2) evaluation, and (3) applications. Multiscale fusion approaches, image pyramid and wavelet transform, will be emphasized. Image fusion comparisons include data, metrics, and analytics.

Fusion applications presented include off-focal images, medical images, night vision, and face recognition. Examples will be discussed of night-vision images rendered using channel-based color fusion, lookup-table color mapping, and segment-based method colorization. These images resemble natural color scenes and thus can improve the observer’s performance. After taking this course you will know how to combine multiband images and how to render the result with colors in order to enhance computer vision and human vision.
In addition to the course notes, attendees will receive a set of published papers, the data sets used in the analysis, and MATLAB code of methods and metrics for evaluation. A FTP website is established for course resource access.

Tutorial E
Topic: “RF Photonics Tutorial”
Dr. Preetpaul Devgan, Charles Cerny, and Nick Usechak, Air Force Research Laboratory
2015 has been designated as the International Year of Light (IYL) by the United Nations, in recognition of the importance that light plays in our everyday lives. One field using light that is of particular interest to the NAECON community is RF photonics. RF photonics uses photonic devices in place of traditional electronic devices for RF applications. However, the capabilities of RF photonics are not well understood in the larger RF community. We propose to hold a tutorial at NAECON that will provide the audience a background on RF photonic basics as well as discuss some current applications that are being investigated for use in the Air Force. RF photonics has been identified by the Sensors Directorate of the Air Force Research Lab as a preferred solution for addressing high speed signal processing needs. The key advantage of the RF photonic system is the ability to handle large instantaneous bandwidths. As signals of interest evolve to higher frequencies, the use of RF photonics provides a path to identify and catalog these new signals. Advancements in the performance of the key components that make up an RF photonic system allow these systems to meet or beat the performance of traditional electronic solutions. With the acceptance of the fiber optic link as a replacement to coax, the next step is to move the photonic technology to provide signal processing capability in the optical domain before converting back to an electrical signal. The current challenges are to continue to explore new photonic technologies for improved RF performance at the receive end of the link. This tutorial will cover the basics of RF photonics, showing how the photonic components’ performance can be mapped to RF system metrics. Some examples of current RF photonic systems will also be explored. Examples include optoelectronic oscillators, antenna remoting, spectrum analyzers, photonic based analog to digital converters and frequency down-conversion.

Tutorial F
Topic: “Security Offload using the SmartNIC, a Programmable 10 Gbps Ethernet NIC”
Dr. Gerald Sabin and Mohammad Rashit, RNET Technologies
Network Offloading is a well-established concept in High Performance Computing (HPC), where host machine resources are required for application computations, such as scientific simulations and data processing jobs. In such systems, offloading network processing offers several benefits, most notably reducing load on host resources, reducing OS noise on applications, and reducing security risk for the compute nodes and the overall system. In particular, offloading compute-intensive network security operations such as data encryption and deep packet inspection can significantly reduce the burden on host and isolate the host from potential attacks.

In this tutorial, we will present the RNET SmartNIC, which is a user programmable, multi-port 10Gbps Ethernet card. The SmartNIC is capable of offloading arbitrary network and application processing functionality from the host to the SmartNIC. The SmartNIC is a network processor based platform that features network and security processing accelerator units. We will show how you can program the SmartNIC to inspect network data packets using an embedded scripting language and/or C based applications.

The target audience for this tutorial includes students and experts in the following areas: high performance computing, high speed networks, network/cyber security, and data centers.
WEDNESDAY PRESENTATION ABSTRACTS

Plenary Speaker: Dr. Shogo Yagi
NTT Advanced Technology Corporation, Japan

Topic: Electro-Optic Properties of KTN Crystals and their Applications
KTN has an extremely large dielectric constant that provides large a Kerr effect, and a large trapped charge density. While KTN can be used for conventional electro-optic devices when electron migration is blocked, migrated electrons make KTN a cylindrical convex lens whose optical axis is electrically displaced, or a deflector.

Plenary Speaker: Dr. Kazu Asai
Tohoku Institute of Technology
Sendai, Japan

Topic: LIDAR and Developments in Japan
An electromagnetic wave emitted from the typical laser has attractive characteristics compared with a radio wave, i.e. a shorter wavelength, a narrower beam and a shorter pulse width. If the laser is applied to a detecting and ranging system, namely the lidar, it shows significant features like a smaller transmitting/receiving antenna, lower transmitting power and higher range resolution against the radar. Therefore, the lidar is expected not only in the aerospace engineering but also in scientific applications. This talk mostly focuses on lidar development in JAXA, e.g. an ISS-JEM vegetation lidar named “Multi footprint Observation Lidar and Imager (MOLI)” for observing global forest canopy height, laser altimeters which have successfully operated for an near-Earth asteroid named 25143 Itokawa landing in 2005 and on orbiting satellite at an altitude of 100km from the lunar surface in 2007 and the other launched in 2014 is now flying toward another asteroid named 1999 JU3. As a part of aeronautical technology development, an airborne coherent Doppler lidar (CDL) program called “SafeAvio” has been carried out for establishing warning system for wake vortex, mountain wave or clear air turbulence. In addition, a ground-based CDL for sounding atmospheric wind has been developing at National Institute of Information and Communication Technology (NICT). Activities of CDL development are briefly mentioned, too.

Algorithms & Tracking I

The influence of gradient estimation on the extraction of boundary Point cloud
Qian Huang, Thomas Wischgoll, Wright State University

Abstract: To extract an object boundary from a volumetric image is important to compute the morphometric properties, like the estimation of the boundary curvature, or the radius of a tubular object, for example, the radius is one of the descriptions of blood vessel for detecting the soft plaque. How to Interpolate of the volumetric data influence to the computation results of the morphometric properties. Extract the points of maximum gradient along the gradient direction in 3D as the boundary point cloud of an object is used by. The boundary points are computed by trilinearly interpolated the volumetric datasets, and apply the parabolic interpolation to find the maximum gradient along the gradient direction. The extraction of boundary point cloud depends on the estimation of the image gradients. This paper is to compare the tricubic and trilinear interpolation algorithms on the estimations of morphometric properties of the volumetric dataset.

A Collaborative Adaptive Wiener Filter for Multi-frame Super-resolution
Khaled M. Mohamed and Russell C. Hardie, University of Dayton

Abstract—During acquisition, digital images are invariably degraded by a number of phenomena that limit image resolution and utility. Aliasing from undersampling, blur from optics, and sensor noise are some factors which can affect the image resolution. Multi-frame super-resolution (SR) is a technique that takes several low-resolution (LR) frames of a particular scene and processes them together to produce one or more high-resolution (HR) images. The HR images have higher spatial frequency content, and less noise and blur, than any of the LR frames. A collaborative adaptive Wiener filter (CAWF) for multi-frame SR, proposed by the current authors, is one of the very recent effective multi-frame SR algorithms. In this paper, we modify the original CAWF SR method by employing a spatially varying signal variance estimate. Instead of using a global signal variance estimate as an external input to the original CAWF SR algorithm, we estimate the desired signal variance in each processing window and incorporate it to estimate the HR pixels. The modified CAWFSR is presented and demonstrated. In addition, performance comparisons between the original and the modified CAWF SR are conducted. The modified CAWF SR outperforms the original CAWF SR, particularly in low signal-to-noise ratio images.

Multiframe Super Resolution with JPEG2000 compressed images
Barath Narayanan, University of Dayton

Historically, Joint Photographic Experts Group 2000 (JPEG2000) image compression and multiframe Super Resolution (SR) image processing techniques have evolved separately. We focus on the adaptive wiener filter (AWF) method of SR and study the SR performance as JPEG2000 is incorporated in three different ways. In particular, we perform compression prior to SR using independent and difference frame methods. We also consider performing compression after SR. We find that the effects of compression can be reduced by decreasing the signal-to-noise (SNR) ratio in the correlation model for the AWF SR method, providing a novel approach to treat the compression artifacts. This SNR modification can be done globally or locally. The experimental results include the use of simulated imagery for quantitative analysis. We also include real video results for subjective analysis.

VNIIRS Fusion Modeling for EO/IR Systems
Erik Blasch, Bart Kahler, Air Force Research Laboratory

Using ROC and AUC Curves to Evaluate Performance of Curvelet and Contourlet Image Fusion Algorithms
Michael J. McLaughlin, Samuel M. Grieggs, Soundararajan Ezekiel, University of Pennsylvania
**Photonics I**

**Coupling properties and sensing applications of photonic molecules**
Yangcheng Li, Farzaneh Abolmaali, Nicholas I. Limberopoulos, Augustine M. Urbas and Vasily N. Astratov, University of North Carolina, Air Force Research Laboratory

Photonic molecules formed by microresonators with coupled whispering gallery modes were studied by finite-difference time-domain modeling. The advantages of photonic molecules over single resonators for sensing applications were demonstrated. Using resonant polystyrene spheres, the bi-spherical molecules were assembled. A good agreement between simulated and measured mode splitting parameters was found.

**Observation of the influence of the gain on parity-time-symmetric properties of photonic molecules with coupled whispering gallery modes**
Farzaneh Abolmaali, Nicholas I. Limberopoulos, Augustine M. Urbas, and Vasily N. Astratov, University of North Carolina, Air Force Research Laboratory

Parity–time (PT) symmetry breaking in coupled-cavities is studied by finite-difference time-domain modeling. Normal mode splitting is studied as a function of the coupling strength. It is demonstrated that in bi-atomic molecules with distributed gain and loss, reduction of the coupling beyond a certain value leads to PT symmetry breaking.

**Increased Near-to-Far Infrared Imaging Sensitivity with Surface Plasmon Enhanced Down Conversion**
Jarrett H. Vella, John H. Goldsmith, Vladimir Vasilyev, Nicholas I. Limberopoulos, and John S. Derov, Air Force Research Laboratory, Wyle

Thin films of fluorescent terbium-yttrium polytantalate (Tb0.15Y0.85Ta7O19) sputtered onto plasmonic gold nanoparticles demonstrated an 11-fold increase of intensity between 1.5 μm when excited at 375 nm. This enabled the efficient down conversion of diffusely scattered UV light to be imaged by a NIR camera. Enhanced imaging in the 7-12 μm region will also be discussed.

**Reflective Optical Limiter Based on Gallium Arsenide**

We show that a photonic structure composed of silicon dioxide, silicon nitride, and gallium arsine layers can act as a reflective optical limiter at near-infrared wavelengths. The limiter transmits low intensity light while totally reflecting high intensity laser radiation, thereby protecting the limiter and the sensor from overheating and destruction.

**Trust in Microelectronics I**

**Analog Hardware Trojan Threats, Detection, and Mitigation**
Yen-Ting Wang, Zhiqiang Liu, You Li, Degang Chen, and Randall L. Geiger, Iowa State University

There is considerable concern about trust and security in both military and commercial electronic systems. This is driven to a large extent by the presence of a group of unscrupulous individuals around the world that have developed a motivation to insert malware, often referred to as Trojans, into the software fabric of the tightly coupled information network that has become an integral part of societies around the globe. Though part of these efforts are driven simply by a perceived challenge and opportunity for dubious recognition, there are also major financial incentives in the commercial sector and substantial opportunities to alter the international power balance in military defense systems with these Trojans. To counter these efforts, teams of experts in both the commercial and military communities work continuously to develop methods for rendering the Trojans ineffective. Growth in efforts by both the unscrupulous Trojan inventors and the counter-efforts by security teams is anticipated for the foreseeable future. More recently, concerns have been growing about hardware security and the potential devastating effects Trojans can have on the hardware that supports the information network. Almost all ongoing efforts to detect and combat hardware Trojans focus on Trojans that are inserted into the digital part of a system. In this paper, emphasis will be placed on a different class of hardware Trojans that has received very little attention, analog hardware Trojans.

**Camouflage circuitry and programmable cells to secure semiconductor designs during Manufacturing**, Ron Cocchi, SypherMedia International Inc.

SypherMedia International Inc. utilizes camouflage circuitry to create programmable cells to provide a secure key store embedded in the standard logic area, i.e. not as separate One-Time-Programmable (OTP) or Non-Volatile Memory (NVM) block. Camouflage circuitry and the obfuscated embedded secure key store serve to secure designs during semiconductor manufacturing.


This paper proposes a process of utilizing RF Distinct Native Attributes (RF-DNA) as a method of detecting anomalous behavior in microcontrollers. The number of Trojans and counterfeit devices being found in military systems is increasing. Therefore, we require an effective method of detecting anomalous behavior to determine whether the device is functioning properly. This may be accomplished by comparing the current operations of a device against a pre-established baseline.

**Hardware Trojans Embedded in the Dynamic Operation of Analog and Mixed-Signal Circuits**
Qianqian Wang, Randall L. Geiger, Degang J. Chen, Iowa State University

In this paper, several examples of dynamic analog hardware Trojans are discussed that can occur in either board-level designs or SoC scale integrated circuits. Included in these examples are oscillators that sustain oscillation at more than one frequency or more than...
One amplitude with trigger from one mode of operation to another mode of operation occurring by simply changing the initial conditions on some energy storage elements in the circuit. Also included in these examples are analog filter circuits where a Trojan mode of operation can be triggered that exhibits different transfer characteristics based upon either changes in the input signal or changes in initial conditions in the circuit. Irrespective of whether these dynamic analog hardware Trojans are accidentally or maliciously introduced, they can occur in many widely used circuit structures and can be easily introduced by making modest modifications of a circuit similar to those modifications that are often made by good and clever analog circuit designers to enhance performance of the desired dynamic mode of operation.

**Keynote Speaker:** Paul F. McManamon, PhD, Fellow IEEE, SPIE, OSA, AFRL, MSS, DEP

**University of Dayton**

**Topic:** "The International Year of Light-Optics and Photonics as an Enabling Technology for the World"

Dr. McManamon will touch on both of those studies, the National Photonics Initiative activities and activities around the world to recognize the International year of light.

**Algorithms & Tracking II**

*Bandlet Denoising in Image Fusion*

Samuel M. Grieggs, Michael J. McLaughlin, Soundararajan Ezekiel

**Characterization of Detectable Objects using an Uncalibrated and Passive Volumetric Change Detection Approach**

Yakov Diskin, Nina Varney, and Vijayan Asari

We present an analysis of a novel 3D change detection technique that is designed to support various wide-area-surveillance applications, in changing environmental conditions. Our technique determines the volumetric changes between two 3D models reconstructed from video sequences. In this work, we identify the characteristics and limitations of detectable scene changes.

**A Modular Approach for Key-Frame Selection in Wide Area Surveillance Video Analysis**

Almabrok Essa, Sidike Paheding, and Vijayan Asari; University of Dayton

This work addresses the data redundancy problem in wide area surveillance. Our proposed key-frame selection method utilizes the statistical differences among subsequent frames and discards insignificant frames in the dataset from further analysis for object detection/recognition in wide area surveillance applications. Three real-world datasets are used for evaluation and testing.

**Intrusion Detection in Aerial Imagery for Protecting Pipeline Infrastructure**

Sidike Paheding, Almabrok Essa, and Vijayan Asari; University of Dayton

We present an automated mechanism that can detect and issue warnings of machinery threats such as construction vehicles on pipeline right-of-way. The proposed scheme models the human visual perception that analyzes entire imagery to find fine details of possible objects in the scene. We used real-world aerial image datasets for testing and evaluation.

**Improved Detection and Track Processing Through Scan-to-Scan Processing and Scan Rate Reduction**

Abdulmajid Mrebit, LoMonte and Wicks; University of Dayton

The objective of this research is to improve bistatic radar detection performance and track formation via joint scan-to-scan processing (SSP) and scan rate reduction. This concept employs two mechanically scanned radars (MSRs), with one operating as a master control radar (MCR) and the other a secondary slave radar (SSR).

**Automatic Building Change Detection in Wide Area Surveillance**

Sidike Paheding, Almabrok Essa, Fatema Albalooshi, Vijayan Asari and Varun Santhaseelan; University of Dayton

We present an automated mechanism that can detect and issue warnings of machinery threats such as construction vehicles on pipeline right-of-way. The proposed scheme models the human visual perception that analyzes entire imagery to find fine details of possible objects in the scene. We used real-world aerial image datasets for testing and evaluation.

**FPGA-Based Coherent Doppler Processor for Marine Radar Applications**

Hamdi Abdelbagi, Lorenzo LoMonte, and Michael Wicks, University of Dayton

**Photonics II**

*Gain and directivity of a plasmonic dipole optical antenna*

Neda Mojaverian, Guiru Gu, and Xuejun Lu; University of Massachusetts Lowell, Hanscom Air Force Base

(Presented at the “Sensor Exploitation” Session on Friday at 2:30pm)

Metallic plasmonic structures can modify the EM wave distribution and convert free-space propagation infrared light to localized surface plasmonic resonance (SPR). This can effectively function as an optical antenna and thus can enhance the performance of optical devices such as detectors and lasers. Most of the reported optical antenna devices are not closely interacted, which doesn’t take full advantages of optical antennas. In addition, there is very few report on important antenna properties such as far-field pattern and antenna directivity. In this paper, we report a closed coupled plasmonic antenna and quantum dot infrared photodetector (QDIP). The plasmonic antenna directivity and directional gain are measured are analyzed.
Designing, Fabricating and Testing multi-junction Silicon Solar
Jimmy Lohrman and Ronald A. Coutu, Jr.; Air Force Institute of Technology
Photovoltaic research and technology have grown exponentially in recent years due to the continuing and increasing global demand for energy. However, to be economical for global production and utilization, the efficiency of solar cells must increase without escalating manufacturing costs. Because of the abundance of silicon and vast knowledge obtained from silicon study, exhaustive exploitation of silicon-based solar cell design is vital to meet both criteria. Positive thermal control and improved photon recycling are two methods to increase solar cell efficiency. A recently developed hybrid multi-junction silicon (HMJ-Si) solar cell with an integrated airgap between two stacked silicon substrates demonstrated 8.42% efficiency. The HMJ-Si airgap reduced the sandwiched-cavity temperature by 1.7°C, while the bottom, silver-covered silicon substrate boosted photo absorption into the top silicon substrate: increasing the efficiency by as much as 1.15% versus the top substrate alone. The top and bottom substrates were electrically connected in parallel via a copper o-ring with a thickness of 385μm which was the optimal, calculated airgap distance for photon propagation wavelengths of 800nm – 1100nm. Other parameters and configurations that were studied included irradiance enhancement, transparent conductive oxide, unpolished substrate pn-junctions, and incorporated distributed Bragg reflectors. The HMJ-Si solar cell was tested using a solar simulator with an air mass 1.5 full spectrum sunlight output and a class II pyranometer with a spectral response of 310nm – 2800nm.

LEDs Application in Solar Cells in a Unique Way
Arjun Krishnappa, University of Dayton
Light Emitting Diode (LED) is being used by many Car manufacturers in their car’s headlights. The LEDs can also be seen in street lights. The LEDs are used in these two areas because it has high directivity and high light quality. It is common to see that solar cells are placed over these street lights. But there is another way of placing the solar cells, that is, the solar cells can be placed on the road just right below the LED. By placing like this, one can recycle the light, that is, LED to Solar cell to LED. To put it another way, we know only about sunlight to solar cell and from solar cell to bulb. But this paper talks about how to recycle the light that emits from the LED in a street light. Along with LED light recycling, the same solar cell can be used to capture sunlight. Not only this, the same solar cell can be used to capture the light from the car’s headlight. In total we have three benefits by placing the solar cells on the street light. This is a remarkable approach that opens new thinking.

Frequency Adaptable Maser Source
Christie Devlin, Brahmanand Jogai, John Cetnar, Altan Feredenci and Robert Ewing; RNET Technologies, University of Cincinnati
A novel adaptable RF MASER source using the Smith-Purcell effect, which is tunable from 5 to 8 GHz has been designed. A detailed simulation of the performance was done using the open source software package, MEEPS from MIT/LL, incorporating an axially slotted rectangular waveguide. Experimental construction of the prototype rectangular slot-type unit was completed.

Performance Metric for Overall Characterization and Comparison of Strained-Layer Superlattice Infrared Photodetectors Enhanced With Microsphere Lenses of Various Material
Dalila B. Megherbi, G. Paradiso, I. Vakil, N. Limberopoulos, and A. Urbas; University of Massachusetts Lowell, Air Force Research Laboratory
Advanced infrared systems are in need of high sensitivity in the presence of scenes that have large intra-scene and inter-scene dynamic range variations. With the latest advancement in MWIR and LWIR detector technologies, there is still no widely accepted industry standard to evaluate and assess detector overall spectral sensitivity over the dynamic range variations. With the latest advancement in MWIR and LWIR detector technologies, there is still no widely accepted industry standard to evaluate and assess detector overall spectral sensitivity over the dynamic range variations. With the latest advancement in MWIR and LWIR detector technologies, there is still no widely accepted industry standard to evaluate and assess detector overall spectral sensitivity over the dynamic range variations. With the latest advancement in MWIR and LWIR detector technologies, there is still no widely accepted industry standard to evaluate and assess detector overall spectral sensitivity over the dynamic range variations. With the latest advancement in MWIR and LWIR detector technologies, there is still no widely accepted industry standard to evaluate and assess detector overall spectral sensitivity over the dynamic range variations. With the latest advancement in MWIR and LWIR detector technologies, there is still no widely accepted industry standard to evaluate and assess detector overall spectral sensitivity over the dynamic range variations. With the latest advancement in MWIR and LWIR detector technologies, there is still no widely accepted industry standard to evaluate and assess detector overall spectral sensitivity over the dynamic range variations. With the latest advancement in MWIR and LWIR detector technologies, there is still no widely accepted industry standard to evaluate and assess detector overall spectral sensitivity over the dynamic range variations. With the latest advancement in MWIR and LWIR detector technologies, there is still no widely accepted industry standard to evaluate and assess detector overall spectral sensitivity over the dynamic range variations. With the latest advancement in MWIR and LWIR detector technologies, there is still no widely accepted industry standard to evaluate and assess detector overall spectral sensitivity over the dynamic range variations. With the latest advancement in MWIR and LWIR detector technologies, there is still no widely accepted industry standard to evaluate and assess detector overall spectral sensitivity over the dynamic range variations. With the latest advancement in MWIR and LWIR detector technologies, there is still no widely accepted industry standard to evaluate and assess detector overall spectral sensitivity over the dynamic range variations.

Dalila B. Megherbi, G. Paradiso, I. Vakil, N. Limberopoulos, and A. Urbas; University of Massachusetts Lowell, Air Force Research Laboratory
Infra-red detectors focus has been primarily in the Mid-Wave (MWIR) 3μm-5μm, and in the Long-Wave (LWIR) 8μm-15μm. MWIR detectors have received a lot of attention due to their importance and high viability in many civilian and military applications, such as target identification, bio-imaging, medical field, and defense. One crucial component in achieving high-sensitivity performance in MWIR photo-detectors, is obtaining reasonable MWIR high detector signal-to-noise ratio (SNR) profiles. In this paper we present and discuss a non-parametric wavelet-based signal processing de-noising method for accurate extraction, characterization and comparison of the combined effects of detector spectral fabrication imperfection noise, electronics testing equipment imperfection noise, and any microsphere lens material fabrication/alignment imperfection noise, among others, in 3μm-5μm MWIR InAs/GaSb strained-layer Superlattice (SLS) infra-red single photodetectors.

An Information Theoretic Metric for Identifying Optimum Solution for Normalized Cross Correlation based Similarity Measures
Mohammad Imran Vakil, John A. Malas, Dalila B. Megherbi; Air Force Research Laboratory, University of Massachusetts Lowell
Similarity measures such as normalized cross correlation (NCC) are widely employed for applications such as pattern recognition but are not immune to noise variations present in the images. This work proposes a metric which identifies the best NCC coefficient value selection (single or spectral) for optimized application of similarity measures.

**Information Theoretic Approach for Template Matching in Registration**

Mohammad Imran Vakil, John A. Malas, Dalila B. Megherbi; Air Force Research Laboratory, University of Massachusetts Lowell

This work presents an information theoretic technique, targeted towards multi and hyperspectral images, as a similarity measure for registration of aerial imagery. Furthermore, system level noise is modelled and injected into the images to evaluate the algorithmic performance as a function of signal to noise ratio (SNR).

**Trust in Microelectronics II**

**Radio Frequency Based Reverse Engineering of Microcontroller Program Execution**

Barron Stone and Samuel Stone, Air Force Research Laboratory

This paper describes a methodology for reverse engineering the sequence of operations executed in a microcontroller system. Unintentional radio-frequency (RF) emissions are passively collected from a device and compared with a library of reference features to identify operations. The reconstructed program sequence can be used to detect rogue device operation.

**Topological Constraints of Gate-Level Circuits Obtained Through Standard Cell Recognition**

Leleia Hsia, Graziano Vernizzi, Mary Lanzorotti, Derrick Langley; Air Force Institute of Technology, Siena College, and Augsburg College

This paper presents topological constraints of gate-level circuits obtained through standard cell recognition applied to gate-level commercial microelectronics verification. A suite of topological constraints, including the circuit genus, Euler characteristic, gate vertex count, net vertex count, edge count, and number of faces are extracted from gate-level circuits obtained through standard cell recognition. The values of the topological constraints are computed for a few circuits, and potential capabilities of these constraints for gate-level circuits are discussed.

**Trusted Microelectronics: Options for the Future**

Daniel J. Radack, Brian Cohen, Vashisht Sharma; Institute for Defense Analyses

Microelectronics give US systems technological advantages over adversaries by significantly improving communication, ISR and electronic warfare capabilities. Today commercial suppliers dominate the microelectronics industry; much of DoD’s microelectronics come from globalized companies that are not aligned with DoD. And things are changing rapidly. This presentation describes the microelectronics technology base, industry direction, technological, and economic challenges; and gives options for obtaining trustable defense components from today’s supplier base, including design and fabrication approaches, and innovative concepts.

**Phase Measurement Approaches for a Multi-tier Weak Radio Signal Detection Process with N Simultaneous Signals having Continuous Phase**

Mary Lanzorotti, Charles Cerny, Elizabeth Hiteshue, Kelsey Irvin, Richard Martin, Air Force Institute of Technology and Augsburg College

This paper presents a generalization of Tsui’s phase measurement approach to detection of N - 1 weak signals to situations in which the weak signals have a phase that is continuous at any point in time. Examples are provided for the situation in which N = 2 and for four cases. This approach provides the capability for accurate identification of zero crossings and extraction of signal parameters. The capability for N ≤4 simultaneous signals is desired for electronic warfare (EW) receivers.
THURSDAY PRESENTATION ABSTRACTS

Invited Speaker
Kevin Newman, Lockheed Martin Advanced Concepts

Topic: Using Big Data to Make Data: “Lowering the cost of end-to-end performance estimation”
This talk details a development effort that increases overall data fidelity without the high the cost of collecting field data over many contexts using a “reversed process” to generate data over a varied but realistic set of bounded parameters. Performance estimation is the science and art of predicting how sensors and systems will perform under a wide variety of conditions once they are deployed on missions. Significant engineering cost is devoted to the attempt that once fielded; particular sensors (and all associated components that move data (“end-to-end”)) to the analyst) are tuned to maximize their value to users. Unfortunately the cost to acquire, understand and curate data from reality is currently greater than the value generated because of the complexity and the need for mission adaptability. A new version of the Lockheed Martin software system AKITA (Application Knowledge Interface To Algorithms) uses a combination of a knowledgebase, a machine learning neural network and a genetic algorithm to generate data over a varied but realistic set of bounds which increases the overall data fidelity. This experimental technique reduces the cost of “good enough” data production and makes improved end-to-end performance estimation a profitable return on investment. Research described in the full paper details the “Data Production” system in Figure 1 and documents a verification process using racked mounted platform hardware, systems, and sensors scheduled for the second half of 2015.

Plenary Speaker
Dr. Nancy Kelley-Loughbane, Air Force Research Laboratory

Topic: Physiological Monitoring in the DoD: Medical and Human Performance Applications
Advances in smartphones, microelectronics, microfluidics, and flexible electronics have enabled a new generation of “wearables”, which allow us to measure physiology in a very non-invasive manner. This opens up the applications in the DoD tremendously. This presentation will review these recent advances, and help define some of the application areas for this emerging technology area.

Algorithms & Tracking III

Vehicle Tracking under Occlusion Conditions using Directional Ringlet Intensity Feature Transform
Evan W. Krieger, Paheding Sidike, Theus Aspiras, and Vijayan K. Asari; University of Dayton
The tracking of vehicles in wide area motion imagery (WAMI) can be a challenge due to the full and partial occlusions that can occur. The proposed solution for this challenge is to use the Directional Ringlet Intensity Feature Transform (DRIFT) feature extraction method with a Kalman filter. The proposed solution will utilize the properties of the DRIFT feature to solve the partial occlusion challenges. The Kalman filter will be used estimate the object location during a full occlusion. The proposed solution will be tested on several vehicle sequences from the Columbus Large Image Format (CLIF) dataset.

Using an A-priori Learnt Motion Model with Particle Filters for Tracking a Moving Person Using a Linear Infrared Array Network
Ankita Sikdar, Yuan F. Zheng, and Dong Xuan, The Ohio State University
An infrared sensor has been primarily used as a proximity sensor, its use being mostly limited because of imprecise measurements attributing to the non-linearity of the device as well as its dependence on the reflectivity of the surrounding objects. However, one cannot overlook the fact that these sensors are quite low-cost, can be easily mounted on small robotic systems, and are computationally very efficient. In this paper, we try to use an infrared sensor array network to detect a person in its environment and also track the person. A traditional particle filter algorithm using a given motion model poses challenges for tracking a person using infrared sensors, primarily because the motion model might fail to keep up with complex dynamic changes in motion directions coupled with the fact that in the presence of noisy readings or missed detections from the infrared sensor data, small errors in position estimation could add up over time making the particle filter completely lose track of the person. In this paper, instead of using a fixed motion model, we propose to learn a motion model statistically from the initial target motion data and subsequently use this model with the particle filtering approach in order to track the person. In addition, the learnt motion model is regularly updated so as to support the particle filtering approach in establishing a more accurate track of the person.

MiCRAFT for Aerial Surveillance User Exploitation
Erik Blasch, Air Force Research Laboratory

Cloud technology Applications for Area Surveillance
Greg Horvath, E Blasch, Yu Chen; Air Force Research Laboratory

Space based sensor management strategies based on information uncertainty
Dan Shen, Bin Jia, G. Chen, E Blasch, K Pham; Air Force Research Laboratory

Radar & Imaging
An Improved Model for the Phase of Backscattered Electromagnetic Fields from a Conducting Rotating Cylinder
Esmail Abuhdima and Robert Penno, University of Dayton
The rotation or vibration of a complex scattering object induces frequency modulations on the scattered signal. This modulation during this rotation or vibration is referred to as the micro-Doppler effect. The Micro-Doppler effect was investigated by many researchers in
the past for different types of rotating objects, such as propellers of a fixed wing aircraft and rotors of a helicopter. In this paper, we examine the time-frequency analysis of a rotating, very good conducting cylinder. The scattering of an electromagnetic H-wave by a rotating very good conducting cylinder is investigated using the Franklin transformation. Then, micro-Doppler effects can be extracted by using the short time, fast Fourier transform for scattered fields associated with the rotational motion. The simulated results confirm that the Franklin transformation gives a more accurate analysis for a rotating, very good conducting cylinder than Galilean transformation. Also the results demonstrate the difference between the stationary and rotating very good conducting cylinders in time frequency analysis. Finally, the simulation shows that this approach produces a different result than previous approaches such as the Chen model.

FEKO Based ISAR Analysis for 3D Object Reconstruction
Ali Nassib, LoMonte and Wicks, University of Dayton

Extraction of weak target features from radar tomographic imagery
Muhammad Almutiry, University of Dayton
Radar Tomography has a feature of Multiview due to the distribution of the transmitters and receivers. The geometry diversity increases the information achieved from the investigation domain. Using the principles of linear scattering (Born approximation), a (linear) relation exists between the measured returns and the shape of targets and an image can be formed by inverting such relation. A strong scatterer sidelobe in investigation domain masks weak target reflection. In this paper, we propose a method to increase overall image quality of the weak scatterer by modelling the strong scatterer in the investigation domain as a dipole to work as extra transmitter. The purpose of modelling the strong scatterer as a dipole is to gain more information about weak scatterer and remove the effects of the sidelobe of the strong scatterer. We estimate the modelled dipole electromagnetic characteristics by performing each cell in the investigation domain’s image as dyadic function. The eigenvalue and eigenvector of each cell are representing phase and magnitude of the modelled dipole. The process of modelling targets as dipoles could be repeated to decrease uncertainty in the investigation domain. Simulations and results demonstrate this concept.

A Fast Matched Filter Approach for Below Ground Imaging
Yasar Guzel, University of Dayton
Imaging below ground objects is proposed using the match filtering technique. To image below ground objects, a set of distributed transmitters and receivers are placed in a grid above the ground, or slightly buried. These transmitters radiate low-frequency waveforms into the subsurface. The resulting wavefront impinges upon underground objects, scattering electromagnetic energy in all directions. Receivers collect the reflected electromagnetic signal, retrieve the phasor of the scattered signals, and transmit this information to systems. After applying adaptive signal processing algorithms to collected data, an image of the buried objects can be reconstructed. Reconstructed 2D of buried objects are computed via numerical discretization and match filtering techniques. Match filtering technique is faster and it reduces computational power that required to process the collected data. The matched-filtered approach is easier to implement compared to matrix inversion. Results from simulation analysis are used to validate this method.

Top 3 Reasons We Must Develop Performance Prediction for Radar
Aaron Jones, Brian Rigling and Muralidhar Rangaswamy; Wright State University, Air Force Research Laboratory
Performance prediction, or the ability to forecast system behavior, is a widespread technique used to advance the comprehension of how systems, and systems of systems, will react under certain circumstances and assumptions. In this paper, we describe the onerous challenge for today’s radars and motivate use of an adaptive system on transmit. While the optimal transmit waveform (for detection) is known, it is generally not suitable for practical use. Therefore, as we apply constraints on the waveform design we are forced to give up signal-to-interference-and-noise ratio (SINR) to meet the constraints, i.e., there is no free lunch. Understanding the consequences of applying constraints in arbitrary waveform design can benefit the decision making process of an adaptive system by providing insight into selection of the transmit signal. In this paper, we discuss the Top 3 motivating factors for development of performance prediction (2P) for radar. We will develop a use-case for 2P as well as how we can borrow concepts from more mature fields, like computer science and even employee acquisition to create performance prediction for radar! Also, we discuss several examples of successful 2P models as well as the inherent trade-space of usefulness verses rigorous mathematical development and the trade-off between accuracy and speed. Lastly, we mention several current areas of promising research and give selected results and comment on future needs to realize effective 2P for radar.

Towards a Ground Penetrating Radar System for Fine Root Analysis
Nihad Al-Faisali, Lorenzo LoMonte, Yasar Guzel, Gerald Sabin, and Michael Wicks, University of Dayton, and RNET Technologies.
The HD TomoGPR will be a mobile, fieldable high-resolution subsurface 3D image generation system based on unconventional Ground Penetrating Radar (GPR). The primary benefits, as compared to other GPR systems, are improved resolution and 3D imaging for easy survey analysis. The 3D imaging benefits are derived from the increased data collection (via multiple antenna look) that supports state-of-the-art GPR tomography to generate high-resolution 3D images.

Sensors and Devices
Design and Fabrication of Phase Change Material Devices – Electrical Properties of GeTe Resistors
James M. Sattler and Ronald A. Coutu, Jr., Air Force Institute of Technology
In recent years, research incorporating phase-change (PC) materials into microelectronics has demonstrated the ability to create novel switches and adaptive circuit devices. These devices exploit the ability of a PC material to transition between amorphous (high resistance) and crystalline (low resistance) states resulting in a resistivity change of several orders of magnitude. Furthermore, this
change occurs rapidly (on the order of microseconds to crystallize and nanoseconds to amorphize) making these devices suitable for RF switching applications. In this paper, we report on the electrical properties of the PC material, Germanium Telluride (GeTe), and discuss the fabrication and testing of GeTe resistors. Vertical and horizontal GeTe resistors are fabricated and tested through resistance measurements before and after substrate heating and voltage pulsing. Successful phase change of the resistors is shown to change resistance by four orders of magnitude. The horizontal resistor design is demonstrated to be impractical for voltage pulsing applications. Various sizes of GeTe resistors ranging from 15x15x0.14μm to 3x3x0.05 μm are tested and a model is proposed relating GeTe resistor volume and the threshold voltage pulse required for phase change.

**Tunable Pressure Sensing Applications of a MEMS Buckled Membrane**

Robert A. Lake and Ronald A. Coutu, Jr., Air Force Institute of Technology

Buckled membranes are commonly used microelectromechanical systems (MEMS) structures. One application of a microfabricated membrane is pressure sensing. A differential pressure across the membrane causes deflection, up or down, which can be measured and related to a specific pressure change. Recent work has demonstrated that the deflection and stiffness of these membranes can be tuned through localized joule heating. This opens up a wider range of possible applications of these membranes. In typical pressure sensor design, the mechanical properties of the membrane are constant resulting in a limited range of response to pressure. By tuning the stiffness of the membrane, its pressure response is varied providing a wider range of application for the pressure sensor. A 1.5mm by 1.5mm square membrane demonstrated a decrease in pressure sensitivity from 6μm/psi to 0.2μm/psi over a range of 0 to 15 volts applied to an electrothermal heater on top of the membrane.

**Wide Temperature Range Resonant-Mode Absolute MEMS Pressure Sensor**

George Xerias, Charles Allan and Vamsy P. Chodavarapu, McGill University, Canada

In the current paper, we present a resonant mode absolute MEMS pressure sensor for wide temperature operation from -55°C to 225°C suitable for aerospace applications. Pressure sensors presently form the largest market segment of MEMS sensors and used in automobiles, medical equipment, smartphones, and industrial applications. Resonant pressure sensors were first introduced in 1990 [2] and have attracted significant interest since then. Key advantages include a substantial size reduction, a direct frequency output that eases the requirements on the interfacing electronics, and a dramatic improvement in noise insensitivity [3]. However, a set of challenges still need to be addressed to better compete with capacitive and piezo-resistive devices. First, the physical nature of silicon micromechanical resonator introduces high temperature sensitivity on the resonant frequency. A series of attempts have been made to address this issue, with the most promising ones relying on obtaining a differential signal from two resonators [4] [5]. The second challenge is to overcome stress-induced effects on the resonant structures. Multiple methods have been proposed to overcome this issue with innovative packaging methods [6] and resonator designs that are effectively immune to packaging stresses [7]. With the above issues partially addressed, the last remaining challenge is the limited temperature operating range for the resonant-mode pressure sensor.

**Interfacing Nanoparticles to CMOS Quad Instrumentation Amplifiers for Gas Sensing Devices**

Tanu Goel, Maher Rizkalla, Jong Eun Ryu and Vinay Kumar Suryadevara, Indiana University, Purdue University

In this study, we demonstrate a novel approach of a low noise performance gas sensory system using an SOC approach. The system is capable of minimizing the cross talk between four instrumentation amplifiers that receive gas-sensing information from four different nanoparticle assemblies using Graphene sheets. These amplifiers were isolated by guard rings on the chip to minimize the cross talk that is caused by minority carriers crossing the parasitic BJT devices within the SOC system. The study leads to the preferable nanotechnology assembly that optimizes the sensing capability, and layout scalability. The paper details the mathematical models of the gas sensing devices, and the interface circuits that drive the differential potentials, resulting from the sensing unit. More than 75db attenuation was achieved between the instrumentation amplifiers. The paper presents the first phase of a long-term project, detailing the design approach of the processing unit within the SOC system.

**MW Blood Sample Characterization Using Co-Axial Transmission Line**

Evan Hilderbrand, Joseph Korhagen, George Shaw, Altan M. Ferendeci, University of Cincinnati

Microwave Tomography (MWT) is being developed as an accurate detection of hemorrhagic strokes using microwaves. A transmission line technique is used to measure the relative permittivity of blood as a function of frequency and is presented to provide insight on an appropriate operating frequency for MWT. A response calibration method is used on a coaxial sample holder to accurately measure the scattering parameters of and characterization of liquid samples. This paper will demonstrate the ability to accurately measure liquid samples by replacing the coaxial line dielectric with liquid. Two methods are used to verify the transmission line measurements. Experimental results from water and 99% isopropl alcohol are compared against known values to provide verification of the coaxial airline to accurately measure blood samples in the microwave region.

**Mechanical Logic using MEMS**

Chris Kodama, Jimmy Lohrman, and Ronald A. Coutu, Jr., Air Force Institute of Technology

This MEMS design consists of 30 double-arm, electrothermal actuators for the two logic inputs, a gear train of 13 fixed and floating cogwheels, and a micromirror for actuation and visual binary representation. A clockwise gear rotation represents a 0, and a counterclockwise gear rotation represents a 1, both of which are independently provided by 15 electrothermal actuators for the desired input logic. The Logic Slider, which consists of 4 floating gears attached to a floating polysilicon bar, provides the AND logic computation by lateral translation assisted by a thin and flexible, gear-meshed cantilever. Because it was calculated that each set of 15 electrothermal actuators provide about 1.6 nJ of work and the requirement for flexing of the cantilever and lateral movement of the Logic Slider is only about 0.02 nJ, more MEMS mechanical logic AND gates could be meshed together using the same logical input sources. Potential exists for the basis of this design to produce other fundamental mechanical logic gates and eventually into more complex logic flip-flop and decoder mechanical circuits.
Keynote Speaker: Dr. Chris Baker  
The Ohio State University  
Topic: “Radar and Cognition: From Theory to Experiment”  
Cognitive approaches to radar sensing have attracted a great deal of attention in the research literature, promising much in the way of improved capabilities and even the generation of new capabilities. To date, however, concepts have been proposed and evaluated through theory and simulation only. To address this, the cognitive sensing lab at Ohio State, in conjunction with the Air Force Research Laboratory, has embarked on a program of research aiming to develop and examine cognitive processing concepts experimentally. This talk will describe the essentials of cognitive radar sensing and present the very first experimental results that demonstrate the superior performance that can be realized in a relatively easy and straightforward fashion.

7th IEEE International Symposium on Monitoring & Surveillance Research (ISMSR)  
Monitoring & Surveillance  
A Dialogue Monitoring Scheme for a Virtual Doctor  
S. Mallios and N. Bourbakis, CART, Wright State University  
In today’s digital world the information exchange has reached very large volumes per minute assisting people to do their business from long distances without their presence. At the same time Human Machine Interaction (HMI) devices are used in many places of service and interaction by removing humans from the loop. Although these devices have advanced, they still far a way to replace the human from the interaction loop. Their major problem is that cannot reliably and efficiently respond to human requests and mainly behave as “answer” machines. In response to this problem we proposed a new MHI scheme capable to offer a better communication and interaction to human users. Our scheme is based on SPN dialogue rather answers.

An LG Graph Monitoring Scheme for Representing Incomplete Objects  
M. Robberloth and N. Bourbakis, CART, Wright State University  
Who has not watched a modern television drama or mystery series that centers on the adventures of an investigative team that when they study the video of some crime is able to freeze a frame, zoom in an object of interest like a vehicle, and get a perfect identification of its make, model, color, and license plate number at a high definition resolution? It almost seems magical. Of, course, the reality is far from this and investigators often have to work with low resolution, grayscale, grainy film where the objects of interest may be partially obstructed. This paper focuses on the use of a geometrically focused image-processing algorithm, the LG Algorithm, when simple objects are partially objects and the results from the application of such an algorithm.

Monitoring Issues for detecting Human Body’s sitting positions  
Fnu Pranav and N.Bourbakis, CART, Wright State University  
There have been several attempts to recognize the sitting posture of human body. Different models like stick model or body volumetric model have been followed. In this paper we have made a few assumptions and a basic scenario has been chosen to verify the methodology/solution. Attempting to solve the sitting problem directly has not been found appropriate. Instead, it has been divided into small three sub-problems and then each sub problem has been catered differently. Sub problems are also very unique in nature. These sub problems are (a) face recognition, (b) upper body recognition (c) full body recognition and (d) lower body analyzer. Each of the sub-problems in them is as complex as the parent problem. Thus, here different approaches, like Haar Cascade Classifier and Histogram of oriented gradients (HoG), have been utilized to obtain solutions for the sub-problems. We also demonstrate some problems regarding human sitting positions and by breaking down these problems into sub problems a possible solution may be obtained.

A Survey on Robotic Wheelchairs mounted with Robotic Arms for Assisting People at Need.  
Iosif Kitistakis-Papadakis and N. Bourbakis, CART, Wright State University  
In this paper, we investigate robotic wheelchairs mounted with robotic arms. Several projects have been studied and analyzed. The abilities of these wheelchairs vary from simple orders as door opening to more complex as lifting objects from the ground. With the aging of the society, the demand for human-interactive robotic wheelchairs that can help people with disabilities and the elderly is increasing. That also means that the need for solving the problems of these people is increasing. That leads to more researchers and industry teams to try solving some of the problems and optimizing the existing wheelchairs. The goal of this survey is not to criticize, but to serve as a reference for researchers and developers in this scientific area and to move the research on robotic wheelchairs further, by merging independent efforts.

Improving Transfer of Care using wearable technology  
Sriram Raju, Subhashini Ganapathy and Mary Mcarthy, Wright State University  
Small screen devices are foreseen as ubiquitous in the medical field especially in the fields of surgery and trauma care. The purpose of this study is to analyze the effects of information complexity and mental workload on emergency doctors/surgeon during emergency response scenarios for heads-up display.

Tracking a Moving Target Using Mobile Robot  
A. Abdelgawad, Y. Ismail and K. Yelamarthi, Central Michigan University  
Mobile robot has many application fields because of its high workability. One of the most challenging problems in mobile robot is the tracking of a moving target. This paper proposes a novel technique of navigation and tracking of a moving target using the principles of odometry and Kalman filter. The target is also characterized by uncertainty in motion. The position of the moving target is estimated and updated with respect to its observed values using the Kalman filter. Kalman filter provides the prediction and correction steps under effects of uncertainties and noise to track the moving target. The simulation results validate the proposed tracking method.


Radar & Imaging II

**Calculation of Aircraft Target’s Single-Pulse Detection Probability**

Shichun Chen, Beihang University, China

The original radar cross section (RCS) data or some rough models are often used to estimate a given aircraft target’s detection probability. The calculation results may not be very accurate as targets are different from one another and the real radar detection process is complex. A new method for RCS model generation is proposed and it takes the random factors like air turbulence into account, this makes it conform to the reality better. In addition, this RCS model can be directly applied to other radar detection processes to calculate the detection probability of a specific aircraft at any attitude. Four typical aerial vehicles are taken as examples to demonstrate this method and information such as detection probability, signal to noise ratio (SNR) and detection distance, can be obtained. Target’s instantaneous probability of being tracked, which corresponds to target’s detection probability, can also be calculated. Using these calculation results, we can compare two different aircraft’s stealth performance in detail or optimize an aircraft’s flight path.

**From Phased Array to Holographic Radar**

Siyao Cao, Yuan F. Zheng, Robert L. Ewing, The Ohio State University

A new microwave sensing system named holographic radar is proposed in this paper. This new radar mimics optical holograph in an attempt of recording, storing and processing target or environment information in a 3D manner. The radar detects and records the transmitted and echoed wave fields of the electromagnetic signals in real-time, instead of singular amplitude and phase information related to individual targets. It differs from the conventional synthetic aperture radar in the way of recording. The wave patterns are recorded by an array of antennas, each being able to detect, record, and store both amplitude and phase of an incoming waveform. The stored information by the elements forms a pattern which can be processed, and studied for feature extraction, viewing angle variation for versatile target detection/identification and/or imaging construction. Receiving plate and test plate are each devised for the complete process of sensing and reconstruction of the 3D EM wave fields.

**Two Viewing Angles for Holographics in Radar and Light**

Sihao Ding, Siyao Cao, Yuan Zheng and Robert Ewing, The Ohio State University

We propose to synthesis (recover) holograms (holographic radar) for a large target or targeted area using a moving array of elements sensors called receiving plate. Our idea is to use two holograms recording at two ends with large angle discrepancy. Assume that two holograms of the same target or targeted area are recorded, with the same reference light (microwaves). The distance of the receiving plates of these two holograms is greater than the physical size of the receiving plates. Each of the two holograms records part of the information (the amplitude) of the whole wave field generated by the target and the reference light. We expect to fill the gap between the two holograms without using the synthetic aperture approach as previously employed by other researchers. Knowing the geometric position and configuration of the two receiving plates, the whole wave field is to be estimated by the two knowing holograms at the two ends. A virtual receiving plate connecting the two true receiving plates is formulated by an innovative iterating approach such that the hologram of the entire area can be created.

**Automatic Modulation Classification via Instantaneous Features**

Elliott Moser, Michael K. Moran, Erric Hillen and Zhiqiang Wu, MacAulay Brown, Inc, Wright State University, and Air Force Research Laboratory

Automatic modulation classification has attracted a lot of interests in the research community in recent years due to the advances in cognitive RF signal processing such as cognitive radio, cognitive radar and cognitive electronic warfare. There are two major approaches in automatic modulation classification, namely the feature based approach and the decision theoretic approach. In our previous work, we have demonstrated the feasibility of using cyclostationary statistical features such as spectrum correlation function to perform modulation detection and classification for both RF signals and underwater acoustic signals. In this paper, we try to develop automatic modulation classification algorithms employing instantaneous features such as instantaneous amplitude, phase and frequency parameters. By extending previously developed features and evaluating appropriate decision metrics, we have been able to expand our modulation classification capability to 9 popular modulations including 2ASK, 4ASK, 8ASK, 2FSK, 4FSK, 8FSK and 2PSK, 4PSK, 8PSK. Thorough simulation results confirm the effectiveness of our proposed algorithm and threshold choices. The success of this approach also suggests a future research direction to combine statistical features with instantaneous features to provide a more accurate and more robust modulation identification algorithm.

**BBnect: a pulsed Doppler radar simulator using Kinect input**

Michael A. McGrath, The Ohio State University

We present a system for simulating the inband and quadrature output of a mote-scale pulsed Doppler radar by utilizing depth information from the Microsoft Kinect sensor.

**Slepian wavelets and its application in radar waveform design**

Xiaoping A. Shen and Robert L. Ewing; Ohio University

Slepian wavelets are constructed from the prolate spheroidal wave functions (PSWFs) by coupling the multiscale structure of wavelets and the energy concentration property of PSWFs. This article is dedicated to the discussion of Slepian wavelets and their application in waveform design.

Woolpert Presentation

Just-In-Time High Resolution Aerial Images from Unmanned and Conventional Airframes
This presentation will describe the quick and efficient high resolution aerial image techniques that have recently been developed for both UAS (unmanned aerial systems) and small conventional piloted aircraft. Mr. Boesch and Mr. Hutchinson will discuss both the advantages and shortcomings of aerial data collection from each platform for multiple sensor types including EO (electro-optical), IR (inferred), multispectral, and hyperspectral. These small area data collects require rapid data dissemination techniques that are well suited to web-based viewers that have exceptional processing power to process, pyramid, and tile the data.

**Poster Session**

**A Dual-Band Reconfigurable LNA for Multi-Standard Receiver using 90 nm CMOS Technology**
**Pushpak Vasanth Rayudu Arja; Wright State University**

Abstract-In this paper, a reconfigurable dual band CMOS LNA with a switching-type circuit topology is proposed. 90nm CMOS Technology is chosen for simulating the design. The proposed design utilizes inductively source degenerated common source cascode LNA topology, as it has been proven to be a finer choice for obtaining optimum noise and good resistive input matching simultaneously. The reverse isolation performance can also be enhanced as the miller effect is reduced in this topology. The reconfigurable dual-band LNA can be tuned to operating frequency of either 1.575 GHz for global positioning system (GPS) or 2.4GHz for WLAN 802.11b standards. The simulated results performed power gain of 11.2 dB and 12.4 dB,and noise figure of 3.4 dB and 2.9 dB, an input return loss(S11) of -29.26 dB and-21.4 dB and a third-order input intercept point of -3.12 dBm and -2.137 dBm and the design dissipates 8.9 mW and 4.68 mW of power at 1.2 V power supply at the two frequency bands 1.575 GHz and 2.4 GHz, respectively.

**Machine Interface for Robotic Arm**
**Dan Prince, Wenjie Lu, Mark Edmonds, Andrew Sutter, Matthew Cusumano; University of Dayton**

The purpose of this project was to develop, build, and test an electroencephalography (EEG) thought recognition software suite. This suite is designed to recognize human thoughts and eventually pair them to actions for a robotic arm. Raw EEG brain activity is collected using an Emotiv EPOC headset. The EEG data is run through our processing suite, where an intended action is identified. The EEG recognition suite is being developed to increase the number of distinct actions that can be identified, in order to improve on the performance of the Emotiv recognition software. The results of the system show promise. The EEG classifier was able to correctly distinguish between a neutral gesture and a right gesture in non-realtime processing. Utilizing linear discriminant analysis as the primary classifier performed well across many channels of the headset. Future goals for this project include recognition of more gestures, and enabling of real time processing.

**A Comprehensive Survey on Intrusion Detection techniques on various hardware’s**
**VenkataRamesh Bontupalli  Tarek Taha; University of Dayton**

Intrusion Detection System (IDS) is an intelligent specialized system designed to interpret the intrusion attempts in incoming network traffic. It aims at minimizing the risk of accessing the unauthorized data and potential vulnerabilities of critical systems. Hence it is imperative to study and understand the capabilities as well as limitations of IDS system present in the literature. In this paper, we present a comprehensive survey on various IDS and compare the results performed on multiple platforms so that our paper can serve as an aid for researchers in cyber security.

**Security Offload using the SmartNIC, A Programmable 10 Gbps Ethernet NIC**
**Gerald Sabin and Mohammad Rashti, RNET Technologies**

The SmartNIC (User Programmable 10Gbps Ethernet NIC) has been developed to offload application-aware network computation and control from the Host OS, libraries, and applications to the NIC. Security processing is an example application that is well suited to the SmartNIC. The hardware can accelerate crypto processing, isolate intrusion detection algorithms, and provide an off-host platform for intrusion prevention.

**Towards an Assistive Network Accessibility Design**
**Gahangir Hossain, Purdue University**

Research shows that there are more than 10 billion wireless connected devices in the market today with over 30 billion devices expected by 2020. To intelligently access these devices, cognitive networks are rapidly proliferating into all aspects of computing and communication. However, very few of them are designed for the people with disabilities or in their need of some assistance from the network. The goal of this project is to study network accessibility issues and their impact in network performance towards adaptive and cognitive network design. The study proposes effective-network-access-time (ENAT) as a measure in cognitive network, which can improve networking efficiency into the physical world for the people with disabilities and elderly ages.

**Adjusting of Absolute Point Positioning Accuracy**
**A.A. Elashiry, Mohamed A. Youssef, & A.M. Abdel Hamid; Beni-Suef University, Assiut University, Egypt**

In this paper, some trials were done to increase the positioning accuracy using one unit of GPS receiver. Firstly, the positioning accuracy improved from 40 to 20 m when errors correction models have been used, except ionospheric model. Secondily, the ionospheric error was studied relative to the other GPS errors, and it was founded a good relation (Empirical equation) between the ionospheric error and the earth rotation with correlation coefficient 99.4%. The usage of this relation improved the accuracy to 10m; which means that this relation is not accurate enough to predict the ionospheric error. Thirdly, a new positioning method , called (interpolation relative positioning), has been done by observing a fixed point in the observation area and moving in a short time , 5 minutes , to the unknown point. The resulting accuracy from this is improved to 50cm.

**Phase-Phase and Phase-Code Methods Modification for Precise Detection and Predicting the GPS Cycle Slip Error**
**A.A. Elashiry, Mohamed A. Youssef, & A.M. Abdel Hamid; Beni-Suef University, Assiut University, Egypt**
There are three famous detecting methods for cycle slip error, which are; Doppler measurement method, Phase - Code differencing method, and Phase - Phase Differencing Method. The first method depends on the comparison between observables and the fact that; Doppler measurements are immune to cycle slip error. This method is considered as the most precise method for cycle slip detecting, because it succeed in detecting and predicting the smallest cycle slip size (1 cycle). That in case of the local oscillator has low bias. The second method depends on the comparison between observables (phase and code) and the code measurements are immune to the cycle slip error. But this method can’t detect or predict cycle slip size smaller than 10 cycles, because the code measurements have high bias effect. The third method depends on the comparison between observables (phase 1 and phase 2) and the phases measurements have low noise effect. But this method can’t detect or predict cycle slip size smaller than 5 cycles, because the ionospheric change might be has high variation. For enhancing the precision of the last two methods in detecting the smallest cycle slip size reaches 1 cycle, a new algorithm was deduced in this research to determine the change in the ionospheric values and the code bias from epoch to epoch; that might be done by solving all observables equations by least square technique. This modification on these methods succeed in detecting and predicting cycle slip size 1 cycle.

Analysis of Motor Imagery EEG Patterns in Voice Controlled Prosthetic Arm Design
Gahangir Hossain, Purdue University

Introduction: Understanding neural mechanism of communication between human and machine has become more interesting research issue in last few decades. One of the most motivating purposes is to help the people with motor disabilities. This excites researchers to work on the interaction between brain-computer-interfacing (BCI) systems, which in turn needs a fast and accurate algorithm to decode the commands in the brain or electroencephalogram (EEG) signals. EEG signals are very noisy and contain several types of artifacts, so it would be very important to use efficient methods to train the BCI system. Aims and Goals: The goal of this project is to train an intelligent system based on the information in the sample EEG data. This system is going to predict the person’s intention in future experiments with new EEG data.

Perturbation-based Extremum Seeking Control Design for the Observer SISO/SIMO Linear System
Abdulhakim Daluom, and Raul Ordonez; University of Dayton

In this control strategy proposal, we try to address the problem of output (performance) function by applying the Perturbation-based Extremum Seeking Control (PESC) approach to reach the maximum and the minimum of the performance function. PESC is applied to the Single-Input Single-Output (SISO) and Single-Input Multiple-Output (SIMO) linear time-invariant systems. The construction of the seeking algorithm is used to drive the system variables to the desired set-points that maximize and minimize the value of an objective (performance) function. This controller is designed in the availability of full and known variables which are fed to the objective function by applying the observer model to estimate the system variables. Also, Lyapunov’s stability theorem and the perturbation theory including the averaging method are used in the design of the extremum seeking controller structure to check the stability of the system. The simulation results which are obtained from addressing this problem of the plant show an excellent performance in the absent of the disturbances.

Fractional Fourier Filtering Revisited - Algorithm and Applications
Xiaoping A. Shen, Robert Ewing and Samatha Hampton; Ohio University

The fractional Fourier transform (FrFT) is a family of linear transformations which generalize the conventional Fourier transform (FT). It can be defined as the Fourier transform to the alpha-th power, where alpha is arbitrary (not necessary to be an integer). As a result, FrFT possesses the flexibility to transform a signal to any intermediate domain between time and frequency. One can find applications in filter design, signal filtration and optimization of holographic storage efficiency, to name a few. This poster is intended to review two efficient computational algorithms for FrFT and illustrate their application by examples.
FRIDAY PRESENTATION ABSTRACTS

Reconfigurable Computing I
A Hardware Implementation of an Orthorectification Process
Daniel Shaffer, Air Force Research Laboratory

This paper presents a hardware implementation of an orthorectification process using the back-projection algorithm. Image orthorectification is integral to effective analysis and exploitation of aerial imagery and is often one of the largest processing bottlenecks. As imaging sensors grow in pixel count and associated target footprint, orthorectification processes require an associated increase in compute capability. In order to support size, weight, and power (SWaP) constrained processing environments, such as on-board systems for unmanned air vehicles (UAVs), efficient and scalable solutions must be developed. Moreover, in surveillance applications minimizing latency is paramount. This paper presents a high performance FPGA implementation of a back-projection algorithm for orthorectification. A nine times speedup is achieved over software processing with a reduction in SWaP.

FPGA Demonstration of IR Spectral Target Imaging Algorithm
Woo-Yong Jang, M. Imran Vakil, Jarrett H. Vella, and Michael Noyola, Air Force Research Laboratory

We report the implementation of an adaptive spectral sensing algorithm in hardware description language (HDL) for IR target detection and classification. The synthesized logic performs computation in digital domain between IR FPA images and a set of prescribed algorithmic weights to extract desired spectral information from targets.

Ex-Situ Programming of a Memristor Crossbar
Chris Yakopcic, University of Dayton

This paper discusses techniques for successfully programming a memristor crossbar once a trained set of weights is determined in software. Several papers that exist in the literature assume that this can be done without discussing the low level circuit details or how to store the floating point weights in a grid of resistances. This paper provides a circuit level solution to this issue.

Impact of Switching Noise in a Memristor Crossbar
Chris Yakopcic, University of Dayton

Many existing memristor models have a direct relationship between resistance change and the voltage pulse applied. However, this results in a memristor model that can be tuned nearly to a floating point value if a small enough voltage pulse is applied. This paper discusses how noise can be added to the dynamic resistive switching component of a memristor model in SPICE. The proposed memristor model has a tunable degree of stochastic noise during switching. Therefore, each time an identical voltage pulse is applied to a memristor device, a varying amount of resistance change will occur. This provides a much more realistic model of memristor behavior.

Methods for Reducing Memristor Crossbar Simulation Time
Roshni Uppala, University of Dayton

Memristor crossbars have the potential to perform parallel resistive computations in the analog domain, and they can be used to develop high density neural network algorithms. However, accurately simulating large memristor crossbars (with more than 256 devices) is very difficult and time consuming. This paper discusses using XYCE (a parallel SPICE platform developed by Sandia Labs) to simulate memristor crossbars more quickly. Furthermore, MATLAB is used to evaluate memristor crossbars at a higher level before more detailed SPICE simulations are performed to compare performance. Modeling a crossbar in MATLAB takes significantly less time, but is slightly less accurate. Two different applications are used to compare these results including the MNIST dataset for handwritten digits and the CBCL face dataset. The memristor crossbars in XYCE account for realistic input drivers and comparators, as well as wire resistance between memristors. This paper will present a first published result that describes using XYCE to simulate a neuromorphic memristor crossbar using accurate device modeling techniques. Also, this paper shows some sources of error that occur when approximating a crossbar simulation in MATLAB, a method that is commonly used in existing literature.

Bioinspired Systems

Precision of Value Represented by Memristor and its Impact on Application Accuracy
Raqibul Hasan, and Tarek M. Taha, University of Dayton

Lithium Based Memristive Devices
Weisong Wang, Shu Wang, Eunsung Shin, Chris Yakopcic, Guru Subramanyam, and Tarek Taha, University of Dayton

This paper describes the fabrication and characterization of memristor devices based on different lithium oxide structures. The devices are patterned with a varying cross sectional area to observe the impact this has on the current-voltage characteristic. The results of the characterization experiments were used to determine the effectiveness of these devices in circuit designs. The parameters that will be studied include the voltage that must be surpassed for resistive switching to take place, as well as the minimum and maximum device resistances. These parameters are also very useful when developing a model for these particular memristor devices.

Unsupervised Learning in Neuromemristive Systems
Cory Merkel, Dhireesha Kudithipudi; Rochester Institute of Technology

Unsupervised algorithms such as clustering are critical operations in neuromemristive systems as they allow multiple data to be stereotyped by a single point in hyperspace. However, digital CMOS implementations of unsupervised algorithms require a large number of hardware resources to store cluster centers and compute euclidean/manhattan distances. In this work, we design a mixed-signal clustering hardware architecture based on probabilistic CMOS/memristor hybrid circuits. We study the ways in which device-level
properties, such as switching probability, propagate to architecture-level behavior, including clustering accuracy measured by the Minkowski metric. In addition, the proposed architecture is compared to existing digital designs across area, power, and accuracy measures.

**Intrusion Detection using Deep Belief Neural network**

**VenkataRamesh Bontupalli, Md. Zahangir Alom, Tarek; University of Dayton**

With the advent of digital technology, security threats for computer networks have increased dramatically over the last decade. There is a great need for an effective Intrusion Detection System (IDS) that can intelligently interpret the intrusion attempts in incoming network traffic. On the other hand, Deep belief neural (DBN) networks proved to be the most influential and generative deep neural networks which can intelligently learn from its inputs. In this paper, we explored and estimated the detection capabilities of DBN's after training it with NSL-KDD benchmark dataset through series of experiments. The trained DBN network can identify any kind of trained or untrained attack in dataset with good detection accuracy and minimal false positive rate.

**Robust Understanding of EEG Patterns in Silent Speech**

**P. Ghane, D. Maridi and G. Hossain, Purdue University**

This article describes the secondary research on decoding the brain electroencephalograph (EEG) signals for design a Brain Computer Interface (BCI) system to control prosthetic arm movement. It considers EEG pattern recognition using Principal Component Analysis (PCA) for Feature Extraction, Hidden Markov Model (HMM) for Classification, and preliminary results. The data used for research is the EEG signal that is recorded during the imagination of vowels /a/, /e/, /i/, /o/, /u/ by 20 subjects. The goal of our research is to train the system based on the information in the sample EEG data and make it ready to classify the pattern correctly.

**Leveraging Biologically Inspired Models for Cyber-Physical Systems Analysis**

**Keith L. Keller, The George Washington University**

Cyber-physical systems (CPS) are systems composed of distributed sensors, physical actuators and controlling computers that are interconnected through a computer network. Notable examples include: electric utility “smart grids” that can sense and optimize power distribution, transportation systems, and healthcare and medical systems. As an emerging area of research, CPS engineering combines and extends the more mature disciplines of computing, control theory and communications engineering. As CPS complexity increases, system level trade studies become more challenging due to the combined interaction of the computing, network communications, and physical sensor and actuator elements. Although fundamentally different, complex CPS and biological systems share common attributes that suggest the use of similar modeling approaches. This work investigates the utility of employing modeling techniques developed for the analysis of biological systems for the system level trade study analysis of a distributed robotic wireless sensor network CPS.

**Innovative Information Processing**

**CIRRUS: Increased Image Dissemination Speed using Cloud Resources**

**Jeff Collier, Herb Hirsch; The Design Knowledge Company**

For the image compression support, we tested and characterized several compression methods, including lossless and lossy commercial products and open-source compressors. As a result, we derived mathematical formulas by which the compressed file size, compression ratio or factor, and compression time for a given image and compressor combination could be predicted. The prediction capability would allow proper, dynamic selection of cloud resources to perform the compression. Results from this characterization and prediction effort are presented.

**COMPOSIT: A Practical Real-time Video Feature Overlaying Solution**

**Jeff Walrath, Herb Hirsch; The Design Knowledge Company**

We describe an innovative solution to the basic feature-to natural image registration problem, which contained two alternative approaches. One approach used complexity-based features in a raster-scanning paradigm, and the other applied a unique filtering modification to a conventional frequency-domain registration technique. Both approaches handled all registration dimensions – rotation, scale, and translation - and the two approaches complemented each other to overcome each other’s weaknesses. Results from testing these two alternative approaches on sample imagery and feature data are presented.

**WattProf: Fine-grained High Performance Computer Power Monitoring**

**Gerald Sabin and Mohammad Rashidi, RNET Technologies, Inc.**

WattProf enables high frequency (multiple kilohertz) direct power measurement of hardware components in a compute node (e.g., CPU, DRAM, GPU, NIC, PCIe cards, fans, hard drives, SSD). The platform includes support for streaming the collected data to the host, storing them on the controller, and streaming via network. Software enables synchronization of the measurements with applications under test to allow fine-grained application power profiling.

**Challenges and Opportunities with Concolic Testing**

**Raghudeep Kannavara, Christopher J Havlicek, Bo Chen, Mark R Tuttle, Kai Cong, Sandip Ray, Fei Xie, Intel Corporation, Portland State University**

Although Concolic testing is increasingly being explored as a viable software verification technique, its adoption in mainstream software development and testing in the industry is not yet extensive. In this paper, we discuss challenges to widespread adoption of Concolic testing in an industrial setting and highlight further opportunities where Concolic testing can find renewed applicability.

**Person-Oriented Nurse Call Management System with Cognitive Networks**

**Manasa Nelluri, Raghu Teja Nimmagadda, Tejas Bhogaraju, Aneesh Ankem and Gahangir Hossain, Purdue University**
The current, place-oriented nurse call systems are very static. Context information is becoming increasingly important in a world with more and more wireless devices that have to be in touch with the environment around them. Implementation of a person-oriented system with the available context information is carried out to assign the correct nurse to a call – with an expository analysis on cognitive sensor network. The experiment deals with the design of a software platform that supports the transition to mobile and wireless nurse call buttons in hospitals and residential care and the design of a sophisticated nurse call algorithm. The arrival times of nurses at the location of a call, the workload distribution of calls amongst nurses and the assignment of priorities to calls are compared for the current, place-oriented nurse call system and the performance of the system is discussed. Thus it significantly improves the assignment of nurses to calls and workload distribution.

Reconfigurable Computing II

Modeling Memristor Devices Using a Pulsed Switching Characterization
William Mitchell, Air Force Research Laboratory
This paper presents a memristor model that has been matched to characterization data obtained at Sandia Labs. The dataset used for modeling provides much more data when compared the current-voltage characteristics that are typically provided in research papers. Using this data we were able to determine the resistance change in a memristor due to a single pulse, for a large range of voltage magnitudes and initial resistance states. This data is used to model many memristor characteristics that have not been previously modeled, such as the amount of noise that is present when reading a device. Also, the data provided shows a unique correlation between resistance change and device state that has not been previously modeled. Using this data we have presented a memristor model that can account for more complex device properties compared to the models in existing literature.

OrFPGA: An Empirical Performance Optimization Tool for FPGA Computing
Chekuri S, Choudary, Gerald Sabin, Azamat Mametjanov, Prasanna Balaprakash, Stefan Wild, Paul Hovland; RNET Technologies Inc.
OrFPGA is a tool that assists hardware engineers in designing FPGAs for performance critical applications. The tool enables automatically exploring the user tunable parameter space of an FPGA design and assists in deducing the near optimal design in terms of timing score, device utilization, and power consumption. The tunable parameter space includes the IPCore parameters, HDL and HLS code constructs, and parameter settings of the vendor's design tools.

Inexact Adder and Multiplier Simulations using Probabilistic Boolean Logic
Christopher I. Allen, Derrick Langley, Air Force Institute of Technology
Inexact digital adders and multipliers were simulated using Probabilistic Boolean Logic (PBL) to determine error magnitudes and rates. Various integer and floating-point architectures were considered. Spectre simulations of 14 nm CMOS technology were used to validate PBL predictions, and predict energy consumption. Energy versus error trade-offs were reported.

Keynote Speaker: Dr. Jennifer C. Ricklin
Director, Homeland Security Advanced Research Projects Agency (HSARPA)
Topic: “Prospective of HSARPA”

Sensor Exploitation

2D LiDAR and Camera Fusion in 3D Modeling of Indoor Environment
Juan Li, Xiang He, Jia Li, Oakland University
Detailed 3D modeling of indoor scene has become an important topic in many research fields. It can provide extensive information about the environment and boost various location based services, such as interactive gaming and indoor navigation. This paper presents an indoor scene construction approach using 2D line-scan LiDAR and entry-level digital camera. Both devices are mounted rigidly on a robotic servo, which sweeps vertically to cover the third dimension. Fiducial target based extrinsic calibration is applied to acquire transformation matrices between LiDAR and camera. Based on the transformation matrix, we perform registration to fuse the color images from the camera with the 3D point clouds from the LiDAR. The whole system setup has much lower cost as compared to systems using 3D LiDAR and omnidirectional camera. Using pre-calculated transformation matrices instead of feature extraction techniques such as SIFT or SURF in registration gives better fusion result and lower computational complexity. The experiments carried out in office building environment show promising results of our approach.

Active Visual Search (AVIS) Dataset
Alexandra Hildenbrandt and Bernard Abayowa, Wright State University and Air Force Research Laboratory
Image retrieval is a vital function for a active vision system recognizing vehicles in dynamic scenes. A pan-tilt-zoom camera provides a range of retrieval options, but is somewhat limited for algorithm development purposes in that if the conditions are not within a certain operative range (very bad weather, poor lighting conditions, etc.), retrieved images are not likely to be very useful. Therefore it becomes imperative to have an alternate source during development. This paper presents a dataset with an associated application programming interface (API) which seeks to be that alternative. In addition to simulating the actions and capabilities of pan-tilt-zoom cameras, this dataset and API provides access to template vehicle images as well as information on verified locations of targets which can be used for training and testing purposes.

Extraction and Classification of Moving Targets in multi-sensory MAMI-1 Data Collection
Roman Ilin, Scott Clouse, Air Force Research Laboratory
This work explores methodologies for extraction and classification of moving targets in wide area imagery. We use the Air Force Research Laboratory’s (AFRL) airborne multi-sensor dataset, MAMI-1, for testing, wherein moving targets mostly consist of people and
vehicles. We compare two methodologies of mover extraction: one based on frame-to-frame registration and background subtraction, and the second based on a novel sparse and low-rank matrix decomposition technique. We further compare the classification performance based on mid-level features (geometric shape, kinematics of target movement, etc.) derived from low level features (such as HoG, SIFT, or SURF) of these movers.

**A novel multi-loop QFT robust control methodology**
Sameer Alsharif, Mario García-Sanz, Case Western Reserve
In attempt to master the drawbacks of the conventional method, we proposed a new iterative methodology based on new developments of the Quantitative Feedback Theory. The new methodology starts with the inner loop to design a controller with desired control specifications formulated as quadratic inequalities and QFT-bounds. Then, with the resulting inner controller the outer loop is designed in a similar way as the inner one, and as a function of the inner loop design. Subsequently new control specifications, quadratic inequalities and QFT-bounds based on sensitivity functions of two controllers already designed are formulated and added to the original set of QFT-bounds of the inner loop, restarting the design of the controllers in an iterative methodology. By Cascade-Control theory, the inner loop must be faster; therefore, adding QFT-bounds of the outer loop to the inner loop will be helpless because the inner loop is more demanding one. Therefore, we add a new cascade controller external to the outer loop (new loop) and apply our theory on the outer and the new loops. We continue this process, adding additional external loops, until we meet our objective function.

**Gain and directivity of a plasmonic dipole optical antenna**
Neda Mojaverian, Guiru Gu, and Xuejun Lu; University of Massachusetts Lowell, Hanscom Air Force Base
Metallic plasmonic structures can modify the EM wave distribution and convert free-space propagation infrared light to localized surface plasmonic resonance (SPR). This can effectively function as an optical antenna and thus can enhance the performance of optical devices such as detectors and lasers. Most of the reported optical antenna devices are not closely interacted, which doesn’t take full advantages of optical antennas. In addition, there is very few report on important antenna properties such as far-field pattern and antenna directivity. In this paper, we report a closed coupled plasmonic antenna and quantum dot infrared photodetector (QDIP). The plasmonic antenna directivity and directional gain are measured are analyzed.