



ALERT
AWARENESS AND LOCALIZATION
OF EXPLOSIVES-RELATED THREATS

Awareness and Localization of Explosives-Related Threats (ALERT)

ALERT is supported by the Department of Homeland Security (DHS)
Science and Technology (S&T) Directorate through the
Office of University Programs (OUP)

ALERT Technology Showcase

May 14, 2019, 10:00 AM – 5:00 PM
Interdisciplinary Science and Engineering Complex
805 Columbus Ave
Northeastern University, Boston, MA

Demos

Demo #	Project Lead and Presenters	Title and Abstract	Location
1	Prof. Jimmie Oxley <i>University of Rhode Island</i> Erica Vieira <i>University of Rhode Island</i> Michelle Gonsalves <i>University of Rhode Island</i> Robert Ichiyama <i>University of Rhode Island</i> Lindsay McClennan <i>University of Rhode Island</i> Alex Yeudakimau <i>University of Rhode Island</i>	TEAS Microspheres and K-9 Detection in collaboration with Detectachem Certain homemade explosives (HMEs), like TATP (triacetone triperoxide) and HMTD (hexamethylene triperoxide diamine), have been used in a number of terrorist attacks. These peroxide explosives are extremely dangerous to transport and handle, yet law enforcement officers and their canine partners need to be trained on how to detect them. Prior to TEAS, there were no aids on the market for TATP. TEAS was the first training aid to provide first responders with a safe method of training on actual TATP. Canines and their human handlers need access to safer trace explosives aids. Advancements in Trace Detection via ADI (Ambient Desorption Ionization) in collaboration with Smith's Detection To improve the operation of Explosives Trace Detection(ETD) devices, i.e. lower false alarm rate and increase the number of detectable species, we have developed ADI. ADI offers a new way to introduce the analyte into the IMS. Instead of relying on heat to drive the analyte into the instrument to be ionized, ADI (Ambient Desorption Ionization) performs the ionization first; this facilitates the introduction of the analyte into the IMS. In ADI the swab containing the analyte is treated with both high voltage and solvent to create an environment somewhat analogous to that created in electrospray ionization (ESI) used in many mass spectrometers. In other words, ionization, volatilization, and potentially adduct formation are all performed as part of the process of introducing the sample into the IMS.	142



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1(cont.)	Prof. Jimmie Oxley <i>University of Rhode Island</i> Erica Vieira <i>University of Rhode Island</i> Michelle Gonsalves <i>University of Rhode Island</i> Robert Ichiyama <i>University of Rhode Island</i> Lindsay McClennan <i>University of Rhode Island</i> Alex Yeudakimau <i>University of Rhode Island</i>	SCHMOO - Safe Control of Hazardous Materials or Others Onsite Many threat materials present themselves as powders or crystals. When such a material discovered in a public place and it is perceived to be a threat, it is the first-responders job to remove it without threat to the public. If the material is an explosive, the need is to render it unable to initiate while handling or in transport. If it is an inhalation hazard, the need is to render it immobile. SCHMOO can be carried as a powder, liquid or gel. Diluted with water it can be applied to any threat material where it quickly forms an immobilizing matrix. To complete matrix hardening, a second liquid is sprayed on the matrix. Now, the matrix is so hard it can be picked up and removed to a safe location. If desired, once in an appropriate facility, the threat material can be recovered, intact, from the matrix for forensic analysis. URI Explosive Database Physical properties of explosives and their precursors' are available online—IR, Raman, DSC, MS, and more.	142
2	Prof. Matteo Rinaldi <i>Northeastern University</i> Zhenyun Qian <i>Northeastern University</i> Vageeswar Rajaram <i>Northeastern University</i>	Zero Power Infrared Wireless Sensor Node in collaboration with United Technology Corporation (UTC) This demo showcases a near-zero power, event-driven sensor for ultra-long lifetime persistent infrared (IR) sensing. A conventional remote sensor functions by actively monitoring the surroundings for an event of interest, even when it is not present. The results in a finite standby power drain, which means its battery must be replaced frequently. It is unfeasible to greatly scale the number of such sensors (as required for border security) since the associated effort and maintenance costs also scale. The technology presented aims to fundamentally transform remote sensing applications by replacing/augmenting conventional sensors with event-driven, zero-standby power sensors that altogether eliminate the need for battery replacements. These devices exploit the energy present in the signal associated with the event of interest itself to perform its detection without requiring a power supply or active components. In this exhibit, such a near-zero power IR wireless sensor node is demonstrated. It employs a micromechanical photoswitch (MP) capable of passive, spectrally-selective IR detection. The MP is interfaced to a wireless transmitter that it wakes-up to transmit data only in the presence of IR radiation while the entire system remains dormant with near-zero standby power consumption at all other times.	142



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3	Prof. Jose Martinez <i>Northeastern University</i>	System Design for "Stand-off" & "On-the-Move" Detection of Security Threats Conventional airport checkpoints require passengers to pause and pose, which makes the process slow and inefficient. Future mm-wave imaging checkpoints must be able to perform the screening at speed, while enhancing threat detection accuracy and reducing manufacturing costs. Conventional phased array imaging systems are suboptimal due to the often large, mutual information existing between successive measurements. The use of wave-field coding in 4D at the physical layer—performed by using artificial structures— enables the collection of the scene information in a reduced amount of time; thus enabling real-time imaging. Moreover, compressive sensing (CS) imaging algorithms reduce the number of transceivers required to perform the imaging, thus reducing the overall cost of the system while enhancing the detection accuracy. This work present the experimental results of our 4D-coded mm-wave CS imaging system, which performs the wave-field coding using an array of compressive reflector antennas (CRAs). These results show the efficacy of our system to image targets moving at 1 m/s.	142
4	Prof. Octavia Camps <i>Northeastern University</i> Prof. Mario Sznaier <i>Northeastern University</i> Prof. Rich Radke <i>Rensselaer Polytechnic Institute</i> Prof. Henry Medeiros <i>Marquette University</i> Sadjad Asghari-Esfeden <i>Northeastern University</i> Dan Luo <i>Northeastern University</i> Timothy A Rupprecht <i>Northeastern University</i> Dong Yin <i>Northeastern University</i> Yuxi Zhang <i>Northeastern University</i>	Dynamics-Based Video Analytics: In-the-Exit, Re-ID and Correlating Luggage and Specific Passengers (CLASP) In collaboration with CLE, MassPort, TSA and DHS Person Re-Id and Activity Detection in Real-time Who is doing What, When and Where? Detecting passengers in video is crucial to any surveillance system, so is detecting the type of activity they are doing. We provide a real-time software that does both and also has the capability of re-identifying individuals given a sequence of videos/set of cameras. This demo shows the spatio-temporal localization of human behavior through a live stream of video in real-time. Actions of interest for this demo are taken from a public dataset consisting of 60 daily human activities (i.e. walking, talking, sitting, watching, etc.) to answer “What”. An optimized person Re-Identification is incorporated in the system to identify passengers even if they disappear for a while and show up again.	140



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4(cont.)	Prof. Octavia Camps <i>Northeastern University</i> Prof. Mario Sznaier <i>Northeastern University</i> Prof. Rich Radke <i>Rensselaer Polytechnic Institute</i> Prof. Henry Medeiros <i>Marquette University</i> Sadjad Asghari-Esfeden <i>Northeastern University</i> Dan Luo <i>Northeastern University</i> Timothy A Rupprecht <i>Northeastern University</i> Dong Yin <i>Northeastern University</i> Yuexi Zhang <i>Northeastern University</i>	<p>Real-time Instance Segmentation</p> <p>How many backpacks and suitcases are there in a check-in line? Detecting each instance of objects of interest in the pixel level will significantly improve the performance of a Re-Id system. In this demo we show a real-time object instance segmentation in order to identify objects and count them. The results highlight the set of pixels belonging to each object instance (different colors for different instances) as well as providing a bounding box with confidence level. The model was trained on Common Objects in Context (COCO) dataset, providing a rich set of pixel level labels for 80 object categories.</p> <p>Real-time Human and Bin Detection with Human Pose Estimation</p> <p>Computer vision plays an important role in surveillance and security of public spaces. This demo showcases algorithms that we use in the CLASP (Correlating Luggage And Specific Passengers) task force project. The main objective of CLASP is to associate passengers and their belongings while they go through an airport security checkpoint. Towards this goal, we need to detect passengers, the bins where they place or remove items, and the passengers' pose to detect these actions. We use YOLO 3, a real-time object detection deep learning algorithm, as our backbone. The algorithm was fine-tuned using our own collected data to detect passengers and bins. Since we are interested in the passengers' actions with the bins, we also integrated into our system the real-time human pose estimation OpenPose algorithm. On the demo screen, person and bin detections are shown with annotated bounding boxes of different colors, along with confidence scores and the full-body human skeletons. The demo shows that the algorithms perform well and in real time.</p>	140



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5	Scott Howard <i>University of Notre Dame</i> David Benirschke <i>University of Notre Dame</i> Bernardo Cruz <i>University of Notre Dame</i>	Optical trace explosives detection using commercially available low-cost devices Energetic material residues have distinct absorption features when exposed to in the mid-infrared (MIR) light. These explosive “fingerprints” have been used in laboratories to identify trace explosive residues, and recently been used in a field demonstration of stand-off MIR spectroscopic imaging of explosive residues after improvised explosive device (IED) detonation of vehicles. More widespread use of this technology, however, is limited by the size, weight, power, and cost (SWAP-C) of MIR imaging platforms. In this tech demo, we demonstrate MIR spectroscopic imaging using a low SWAP-C imaging array on a low power, standalone wireless networked node. ALERT research work has adapted these commercial systems to be used in quantitative spectroscopic molecular imaging, including using machine learning and probabilistic detection models to achieve sensitive detection with these uncooled, low power, low-cost imaging arrays.	140
6	Mark Witinski <i>Pendar</i> Romain Blanchard <i>Pendar</i> Prof. Eric Miller <i>Tufts University</i>	Standoff Detection of Hazardous Materials at Pendar Technologies Pendar Technologies will feature its two complimentary eye-safe standoff detection platforms. The first is the recently launched Pendar X10 handheld product for the specific identification of bulk chemicals and chemical residues at distances of nearly 1 meter. In addition to achieving eye-safe standoff Raman capability, the X10 allows for chemical identification through containers such as glass and opaque plastics, as will be demonstrated. The second platform is a tripod-mounted infrared hyperspectral imaging tool that is currently at an advanced developmental stage. Its underpinning technology is a DHS-supported Quantum Cascade Laser Array system. This technology, as well as binary classifications methods developed with our ALERT partner, allow for the location and classification of trace amounts of material at standoff distances between 1-2 meters.	140



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7	Francois Zayek <i>Astrophysics Inc.</i> Prof. David Castanon <i>Boston University</i> Fernando Quivira <i>Northeastern University</i>	The Multi-View CT: The World's First 3D CT Cargo System <i>Transforming the future of air cargo security</i> Astrophysics Multi-View CT is the world's first 3D CT cargo system. Combining multi-view radiographic (X-ray) transmission with 3D computed tomography (CT), the Multi-View CT allows airlines and freight forwarders to perform rapid and effective cargo inspection of high-density pallets. The Multi-View CT features a 450kV generator capable of penetrating up to 100mm of steel, twice the penetration of a conventional cargo system. In both multi-view and CT screening modes, the clarity of the image allows operators to identify threats in any location of the pallet. Operators can rotate the image a full 360° and apply advanced imaging functions and filters to examine complex, cluttered and even non-homogenous pallets without the need for break-bulk screening. With these techniques, the Multi-View CT is capable of processing up to 60 pallets per hour, four times the speed of a conventional cargo system. The Multi-View CT reduces labor costs, increases productivity and ensures an unparalleled level of inspection and threat detection. The first Multi-View CT will be deployed this summer at John F. Kennedy International Airport. The Astrophysics Research Center (ARC) in California is rapidly developing advanced algorithms for Automated Threat Recognition, to further enhance the Multi-View CT's effectiveness. Ultimately, the Multi-View CT is a disruptive technology that is transforming air cargo security.	Auditorium 102