Awareness and Localization of Explosives-Related Threats (ALERT)

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Virtual ALERT Technology Showcase

April 21, 2021, 1:00 PM ET – 4:00 PM ET
April 22, 2021, 1:00 PM ET – 4:00PM ET

Demo List

Project Lead and Presenters	Title and Abstract	Date/Time
Carl Crawford *Csuptwo LLC*	**Simulated Air Cargo Skids Task Order** Under DHS's Air Cargo Program (ACP), screening requirements have necessitated faster deployment of new technologies to screen palletized air cargo. ALERT was awarded the Simulated Air Cargo Skids Task Order to develop methods to simulate the contents of palletized air cargo. The simulated air cargo, when used in conjunction with extant x-ray simulation tools, will provide the following benefits to ACP and TSA: increasing the number of people developing automated threat recognition (ATR) algorithms by providing publicly available data sets for unrestricted use by third parties such as academia and industry other than vendors; allowing the application of deep learning to ATR algorithms using the ground truth data that are automatically provided with computer simulated datasets; allowing automated assessment of certification testing using the ground truth data; faster assessment of emerging scanning modalities by obviating the cost and time of developing prototypes; and faster deployment of operator training aids, on screen alarm resolution protocols (OSARP) and threat image projection (TIP). The following topics will be demonstrated at the Technology Showcase: object creation, box packing, anomaly insertion, skid loading, x-ray project creation and validation of x-ray projections.	Wednesday, April 21 1:30 PM ET – 1:45 PM ET
Deanna Beirne *Northeastern University* Octavia Camps *Northeastern University* David Castañón Boston University	**The Correlating Luggage and Specific Passengers (CLASP) project** The goal of the CLASP project is to enable the smart checkpoint of the future: one that knows exactly where all the passengers and their belongings are at every point in time, and can use this information to assess flow rates, detect	Wednesday, April 21 1:45 PM ET – 2:00 PM ET

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Henry Medeiros *Marquette University* Rich Radke *Rensselaer Polytechnic Institute*	(CONT'D) thefts and left-behind items, and enable risk-based screening. We will introduce the CLASP testbed, an accurate simulation of an airport security screening checkpoint, and overview the algorithms the ALERT team has developed for person tracking, bin tracking, and person-to-object association.	
Eric Miller *Tufts University* Romain Blanchard *Pendar Technologies*	**Autonomous Raman system for the analysis of trace residues on surfaces** Prof. Eric Miller from Tufts University and Dr. Romain Blanchard from Pendar Technologies will showcase an automated Raman system for the detection of trace residues on surfaces to identify potential threats, from explosives to toxic chemicals. The system is a compact Raman microscope which uses an image processing pipeline developed in collaboration between Tufts and Pendar with support from ALERT. Equipped with this machine vision solution, the system is able to autonomously image a surface, locate particles, and analyze their chemical composition, without user intervention. The system allows non-expert users with minimal training to analyze surfaces and detect potential threat chemicals or forensic evidence.	Wednesday, April 21 2:00 PM ET – 2:15 PM ET
Otto Gregory *University of Rhode Island*	**UAV-Based Sensors for the Detection of Threats** There is a growing need among military, first responders, and law enforcement for an ultrasensitive chemical sensor platform that can not only identify potential threats but locate the direction from where the threat is coming; i.e. the source of the threat. By integrating our thermodynamic sensors with a drone platform, we can build-in a directional capability that can lead to the source of threats. Many threats whether they be explosives, automatic weapons or drugs can go largely undetected in many venues where crowds can gather and as such may be difficult to identify, locate and follow. Currently, densely populated venues are patrolled by canines which are specially trained to selectively identify and locate threats. However, these dogs require extensive training, lose their focus after several hours of working, and require periodic rest in order to perform effectively. Therefore, development of a drone-based sensor platform capable of continuously monitoring threats in real-time represents yet another tool in DHS's toolbox for those tasked with protecting us.	Wednesday, April 21 2:25 PM ET – 2:40 PM ET

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	(CONT'D) We have demonstrated that URI's thermodynamic sensor or "digital dog nose" is able to detect a wide variety of threats in the vapor phase at very low concentrations. Recently, our sensor platform was optimized for integration with a 5mAh ultrathin solid state lithium battery (SSLB) into a single package. These low-power (<150mW) sensors displayed excellent sensitivity at remarkably low operating temperatures (<100°C) and were capable of operating for extended periods (> 8 hours) on a single charge. This battery life and low maintenance operating requirement means that such a system could be easily implemented onboard a small drone platform to supply power to the "digital dog nose" sensors. Building upon this capability, we have integrated our "digital dog nose" sensors onto a drone platform for the localized detection of threats. Towards this end, we will demonstrate that a plume of vapor (threat) can be detected using our "digital dog nose" sensors mounted on a drone. These minuscule sensors were placed on board a drone and flown into a plume of analyte in one demonstration and in another demonstration, we determined if a threat was discretely hidden in a box, it could still be detected using a UAV platform. This represents the first step in developing a viable solution to distance detection, that will complement 24/7 video surveillance.	
Steve Beaudoin *Purdue University*	**A Tool and Method for Simulating Explosives Particle Adhesion** Energetic materials powder technology plays a significant role in security applications. Most explosives are handled at some point in the form of powder. The behavior of such powders is impacted by the behavior of the individual particles which comprise these powders, especially their adhesion. An experimental and modeling framework that maps particle-scale properties onto experimentally-validated effective Hamaker constant distributions that describe van der Waals adhesion forces between particles in powders is presented here. These distributions represent an engineering approach that allows powders comprised of particles of complex shape and roughness (challenging to model) to be described as if they were perfect, smooth spheres (simple to model). The complexity associated with the shape and size distributions of	Wednesday, April 21 2:40 PM ET – 2:55 PM ET

Project Lead and Presenters	Title and Abstract	Date/Time
	(CONT'D) the individual particles is captured by the effective Hamaker constants that are used to describe the smooth spheres. The result of the method is size-dependent Hamaker constant distributions that describe the adhesion between explosive powders and various substrate surfaces, binder, or other particles of explosive nature.	
Scott Howard *University of Notre Dame*	**Distributed Sensor Network for Low SWaP-C Mid-Infrared Spectroscopic Imaging** Through the ALERT project, we have developed imaging and analysis technology for mid-infrared (MIR) trace molecular imaging using low SWaP-C off-the-shelf vanadium oxide bolometer arrays. In this technology demonstration, we show the results of integrating the MIR imaging system with the "RadioHound" distributed sensor network developed by collaborators at the Army Research Lab Electronic Warfare/Sensors group and Notre Dame Wireless Institute. The system allows for real time imaging and parallel cloud data analysis, on demand, and is now scalable to include any arbitrary sensor (e.g., electrochemical, sound, RF emission, visible/IR imaging, RADAR/LIDAR). This presentation will also demonstrate new neural network denoising and trace explosive detection methods designed to be used with the higher noise present when using uncooled, low SWaP-C MIR spectroscopic molecular imaging.	Thursday, April 22 1:25 PM ET – 1:40 PM ET
David Castañón *Boston University* François Zayek *Astrophysics Inc.* Brett Tally *Astrophysics Inc.*	**The Multi-View CT: The World's First 3D CT Cargo System Transforming the future of air cargo security** 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 85mm of steel. 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. The Multi-View CT reduces labor costs, increases productivity and ensures an unparalleled level of inspection	Thursday, April 22 1:40 PM ET – 1:55 PM ET

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	(CONT'D) and threat detection. The first Multi-View CT is now operational 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. ALERT assisted Astrophysics in this effort, by developing algorithms for the 3D CT reconstruction of the pallets from the collection of multi-view projections. ALERT's algorithms were based on extensions of medical tomosynthesis algorithms in order to addressing the sparse, limited view collection geometries. ALERT also developed efficient implementations of the 3D CT algorithms using GPUs that allow for the reconstructed CT images to be available in under 6 seconds after the object data collection is completed, enabling operators to use the 3D reconstructions along with the 2D projections to inspect the pallet contents.	
Matteo Rinaldi *Northeastern University* Zhenyun Qian *Northeastern University* Sungho Kang *Northeastern University*	**Zero Power Infrared Wireless Sensor Node in collaboration with United Technology Corporation (UTC)** Infrared (IR) based human detection technologies have been extensively used in motion-triggered automation, indoor/outdoor security, search-and-rescue and many other applications. The relatively high-power consumption of state-of-the-art motion detectors limits their battery life and increases the maintenance cost of sensor networks deployed in remote or hazardous locations. We have developed miniaturized human detectors with near-zero standby power (<10 nW) for applications in places such as underground caves and tunnels where energy harvesting is not available. Furthermore, the demonstrated technology shows a distinct advantage in lowering the false alarm rate commonly encountered by the state-of-the-art passive IR (PIR) sensing technologies whose detection is inherently dependent on the motion of a human body, rather than its presence. The demonstrated IR sensor will be easily retrofitted to hide in the wall of caves and tunnels, while completely eliminating maintenance cost associated with sensor battery (battery lifetime extended from several months to ~ 10 years	Thursday, April 22 1:55 PM ET – 2:10 PM ET

Project Lead and Presenters	Title and Abstract	Date/Time
	(CONT'D) compared to using commercial off-the-shelf IR detector). In this demo, we show the operation of the core component of the zero-power human detector, an IR micromechanical photoswitch that can be triggered by the thermal radiation emitted from a human body, without consuming any power in standby. Moreover, unlike PIR motion detectors, the device is able to activate a light and keep it ON even when the person inside the room is stationary (motionless).	
Jimmie Oxley *University of Rhode Island*	**SCHMOO - Safe Control of Hazardous Materials or Others Onsite** SCHMOO, or Safe Control of Hazardous Materials or Others Onsite, is a two-part system designed to handle hazardous material spills. Part One is a viscous gel which can be diluted with water for sprayer application. When SCHMOO Part One is applied it renders explosives inert to impact, friction, electrostatic discharge, and fire. Part Two solidifies SCHMOO and allows for easy pickup for transport. In this demo triacetone triperoxide (TATP), a highly sensitive primary explosive, was made safe to fire using SCHMOO. TATP stored in SCHMOO can be analyzed using a variety of techniques, including FTIR and Raman.	Thursday, April 22 2:20 PM ET – 2:35 PM ET