



Photo courtesy of Argonne National Laboratory

# **NEWSLETTER** The Newsletter of the First Responder Technologies Program

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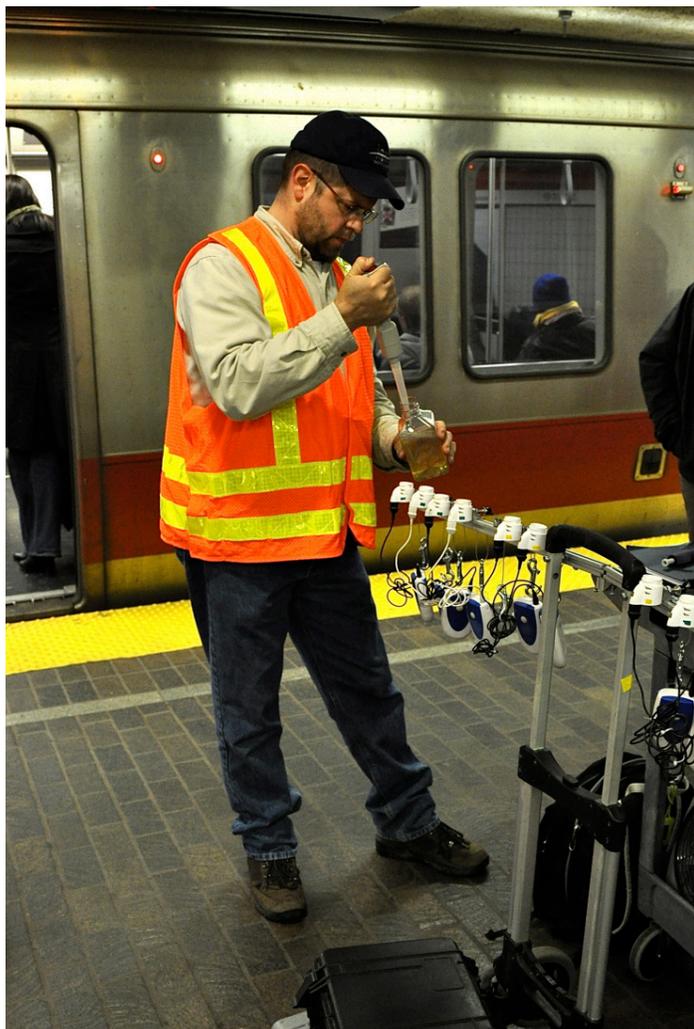
*This Newsletter discusses technologies of interest to first responders that have received funding, in part, from the government. Mention of these technologies should not be construed as an endorsement of either the technology, or the entity producing it, by the Federal government.*

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# MAKING TRACKS

## DHS Investigates the Risks of Airborne Chemicals and Biological Agents in Subways

Millions of commuters in America rely on subway systems to travel. This makes mass transit an attractive target for terrorists, as proven by the Tokyo subway terrorist attack in 1995 in which sarin was released on several train cars, killing 12 and injuring thousands. To limit the impact of similar attacks and determine the best actions to take during a chemical or biological agent release, scientists are investigating how these contaminants would travel through a subway system's underground tunnel network. The Department of Homeland Security (DHS) Science and Technology Directorate (S&T) is studying the way gasses and particulates behave by conducting a series of airflow tests in subway systems.



A researcher releases tracer particles in a Boston subway station during a December 2009 airflow test. Photo courtesy of Argonne National Laboratory.

Boston's Massachusetts Bay Transportation Authority (MBTA) subway was host to the latest experiment in December. DHS S&T conducted controlled releases of harmless substances – sulfur hexafluoride (SF6) and perfluorocarbon (PFC) gas, as well as sodium fluorescein particles – to simulate a chemical or biological agent's movement, according to Teresa Lustig, the program manager leading the study for DHS S&T's Chemical and Biological Division. Scientists released the gases and particles into the MBTA subway system during a seven-day test.

The data from the testing will help researchers test and refine models that predict how chemical and biological agents spread through subway systems as well as how they escape into the streets above. The results could help first responders act more effectively to evacuate subway stations, adjust ventilation, and modify train movements to save lives after an attack or accidental release of hazardous substances. "We need to better understand airflow and how that affects transport so that we can then better develop technologies to support [chemical and biological] detection, as well as planning and response strategies, in case there is a terrorist attack," Lustig said.

Researchers from Argonne National Laboratory, Lawrence Berkeley National Laboratory, ICx Technologies, the Defense Science and Technology Laboratory of the United Kingdom, and Chemistry Centre of Australia tracked the tracer gases and particles in the MBTA system. About 40 gas samplers and more than 25 particle counters placed throughout the underground system monitored the concentration of the tracer gases and particles DHS S&T used to simulate a chemical or biological attack, said David Brown, a research scientist from Argonne National Laboratory, which designed and led the test.

Preliminary findings from the December 2009 tests showed that chemicals and biological agents can spread quickly through a subway system, according to Lustig. There are differences in how these materials transport in the underground subway environment. The particles simulating biological agents tend to deposit on surfaces and were less likely to round corners than gases.

*Making Tracks (continued)*

MBTA Transit Police plan to use the airflow test's findings to enhance strategic response and preparedness, said Deputy Chief Lewis Best. Understanding how substances travel through the subway's five lines will help the MBTA Transit Police fine tune evacuation plans to protect the subway's more than 1.3 million daily riders. Other transit systems will be able to use the airflow models researchers create from the data to draft their own preparedness plans. The data also will help scientists design more effective chemical detectors to alert police quickly to any spill or attack. "It's obviously going to help scientists and researchers develop next-generation detection systems," Best said.

Researchers plan to combine the MBTA airflow test data with findings from similar tests conducted in the Washington D.C. Metro system in December 2007 and August 2008. Lustig explained that the tests will allow scientists to see if there is a difference between the way chemicals travel through an older subway system, like Boston, and a newer one, like the Washington D.C. Metro.

Scientists plan to return to Boston to repeat the testing in August 2010 to determine if there is any seasonal variation in airflow. The researchers will complete a final report on the subway tests in late 2010 or early 2011, Brown said. The data will not be made public for security reasons, but it will be provided to the Transportation Security Administration and first responders, according to Lustig.

Researchers had developed models for subway airflow, but these experiments were the first to examine whether those predictions held true during a system-wide,



A researcher monitors sulfur hexafluoride concentrations on a subway train using a real-time MIRAN gas analyzer during a December 2009 airflow test in the Boston subway system. Photo courtesy of Argonne National Laboratory.

rush-hour test, according to Brown. Previous models indicated chemicals would spread quickly through a subway system. The MBTA and D.C. Metro tests will help first responders judge how serious a threat chemical and biological releases are and determine how best to prepare for them. "They know these data are going to help them plan for not only terrorism-type events but accidental spills and fire and smoke events," Brown said. "This type of data is very useful for them to gauge vulnerabilities in their system."

For more information, visit [www.dhs.gov/ynews/releases/pr\\_1259790815577.shtm](http://www.dhs.gov/ynews/releases/pr_1259790815577.shtm).

## MARKED FOR LIFE

### Tattoo Matching Software to Identify Suspects

When a criminal's face is masked, police have to search for other identifying markers. Many law enforcement agencies and correctional facilities keep a database of tattoos and scars that can be used to identify disguised suspects captured on surveillance cameras. However, searching a computerized tattoo database isn't as simple as flipping through a few photographs. Most databases catalogue thousands of images using text-based descriptions and have text-based search functions. This complicates the task of finding the correct image, as descriptions in the database may not be consistent or

easily determined. If the suspect's tattoo shows a snake entwined around a rose stem, for example, one person might search for the term "rose," while another might look under "snake."

A technological advance simplifies the search process by comparing crime scene images of tattoos to those in law enforcement databases. TattooID, a software program developed at Michigan State University, uses the principles employed in computerized fingerprint matching technology, said Anil Jain, a distinguished

*Marked for Life (continued)*

professor in the University's Department of Computer Science and Engineering. TattooID identifies distinctive image features, called keypoints. Keypoints are places where pixel values undergo some stable transitions, such as a color change or a boundary between two parts of an image. TattooID compares those points to images in existing law enforcement databases to find the closest matches.

The automated process is able to effectively identify similar tattoos in law enforcement databases and avoid the difficulties that can arise from a text-based search, according to Eric Hess, senior biometric product manager for MorphoTrak, Inc., which plans to launch a commercial version of the TattooID software in 2011. "By using technology to analyze the patterns, we can actually remove the variability of the human and how we interpret that image ourselves," he said.

MorphoTrak acquired TattooID in late 2009. Michigan State University developed the software with funding from the Federal Bureau of Investigation (FBI) Biometric Center of Excellence (BCOE). The U.S. Army Research Office and the National Science Foundation Center for Identification Technology Research provided seed funding for the project, which began two years ago. Michigan State University researchers used nearly 64,000 photographs of tattoos from the Michigan State Police database to develop TattooID.

Many law enforcement agencies photograph tattoos and scars as part of the booking process. Soft biometrics such as tattoos offer a way for police to identify a suspect or a homicide victim when fingerprints cannot be used, according to Jain. The technology would help police in situations where a suspect provides a false name, according to Inspector Greg Michaud, assistant division commander of the Michigan State Police Forensic Science Division. In addition, tattoo-matching technology could help medical examiners identify bodies. "What it does is provide the capability to search tattoos against a known database, resulting in additional possible clues as to the identity of the individual," he said.

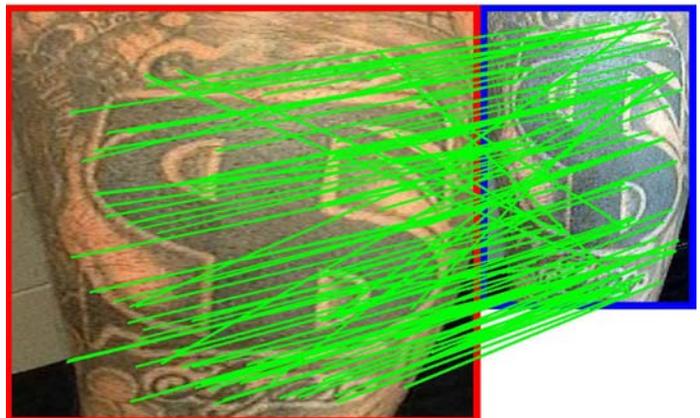
Tattoo databases also can help police and corrections officers investigate gang activity, according to Hess. Certain tattoos, such as the Latin Kings' five-pointed crown, are associated with a specific gang. Police can



TattooID software checks a picture of an unknown individual's tattoo, on the left, against an image from a law enforcement database to identify the person. Photo courtesy of Michigan State University.



The TattooID software program compares keypoints of visual interest in a photograph to those in a database image. Photo courtesy of Michigan State University.



TattooID concludes the two tattoos are a match after identifying 121 points of visual interest that were the same. Photo courtesy of Michigan State University.

*Marked for Life (continued)*

identify suspected gang members and gain valuable information by observing tattoos. Teardrop tattoos, for example, can signify that the person killed a rival when they were in prison.

TattooID's visual matching capabilities are not limited to tattoos. Police can use the technology to track graffiti and match gang symbols. This offers another way to investigate gangs, according to John Manzo, supervisor of the FBI BCOE Innovative Sciences & Identification Technologies group. "[TattooID] will provide state-of-the-art tools that will change the way law enforcement identifies victims and suspects," he said.

In a similar vein, the FBI is expanding its Integrated Automated Fingerprint Identification System to

include other biometric capabilities. This system, Next Generation Identification, will have databases for tattoos, iris scans, mug shots, and other biometric data, as well as improved fingerprint matching capabilities.

TattooID will make it easier for police to use existing tattoo databases to identify individuals. "We believe that this will be a very valuable technology ... to make available to other law enforcement agencies in the country," Hess said.

For more information on TattooID, visit [www.cse.msu.edu/rgroups/biometrics/Publications/SoftBiometrics/Jainetal\\_TattooCBIR\\_ICIP09.pdf](http://www.cse.msu.edu/rgroups/biometrics/Publications/SoftBiometrics/Jainetal_TattooCBIR_ICIP09.pdf).

## SOCIAL MEDIA SHAKE UP

### Twitter Provides Firsthand Accounts of Emergencies

Stories pile up quickly in the moments after an earthquake. People wonder if the shaking was an earthquake or just a large truck rumbling past. They share where they were, what they felt, and whether there was any damage.

Twitter – the microblogging site where users share messages containing up to 140 characters – offers a treasure trove of eyewitness reports following an earthquake. Using funds from the American Recovery and Reinvestment Act, the U.S. Geological Survey (USGS) is sponsoring a project to tap into those reports to see whether the almost instantly available information could benefit first responders heading to the scene or seismologists studying earthquakes. The Twitter Earthquake Detector (TED), which USGS set up in 2009, tracks Twitter posts, called *tweets*, after any seismic activity occurs. TED monitors tweets from the surrounding area for earthquake-related terms. The system recorded a peak activity of 450 tweets per minute following an Indonesian earthquake in the fall of 2009, according to Paul



An October 2009 earthquake and tsunami leaves debris in American Samoa. Photo courtesy of the Federal Emergency Management Agency.

Earle, a seismologist with the USGS National Earthquake Information Center in Golden, Colo. "It allows us to monitor the stream of information for anybody who is talking about an earthquake," he said.

*Social Media Shake Up (continued)*

The volume of Twitter posts tends to spike immediately after an earthquake, in some cases before the seismic activity has been officially confirmed. It can take between 2 and 25 minutes for USGS to issue an earthquake alert, Earle said. Firsthand accounts from Twitter can give seismologists and first responders instant feedback on the effects of the event and the locations shaken, according to Earle. After receiving preliminary reports of an incident from Twitter, first responders can follow up with more authoritative, scientific information sources and decide what type of response is warranted. The system works best as an inexpensive supplement to earthquake alerts and detection systems that are already in place, according to Earle, though USGS is exploring TED's potential other uses.

Immediately after an earthquake, USGS conducts an online survey called "Did You Feel It?" to gather more detailed witness accounts that can help seismologists calculate how strong an earthquake was. Also, USGS produces ShakeMaps, which provide near-real-time maps of ground motion and shaking intensity following significant

earthquakes. These maps are used by federal, state, and local organizations, both public and private, for post-earthquake response and recovery, public and scientific information, as well as for preparedness exercises and disaster planning. Twitter accounts could provide valuable information during the brief period before the detailed surveys and ShakeMaps are available. If emergency responders want to learn more about the data collected by TED, they can contact USGS for more information, according to Earle.

USGS is still researching how Twitter's information flow could be best harnessed to help provide first responders heading to an earthquake scene with more and better information, according to Earle. "It is really in the exploratory phase," he said. "We're analyzing the content of these tweets and seeing what kinds of content they can provide."

Social media sources can alert emergency managers to problems that might not have been reported through

other channels, said Bobbie Atristain, chief technology officer for the Virginia Department of Emergency Management (VDEM). TED could inform first responders about where people would be likely to need assistance following an earthquake, according to Atristain.

Like USGS, Virginia uses social media to monitor conditions on the ground during emergencies. VDEM incorporated Twitter posts and photographs posted on Flickr, a photograph sharing Website, into the



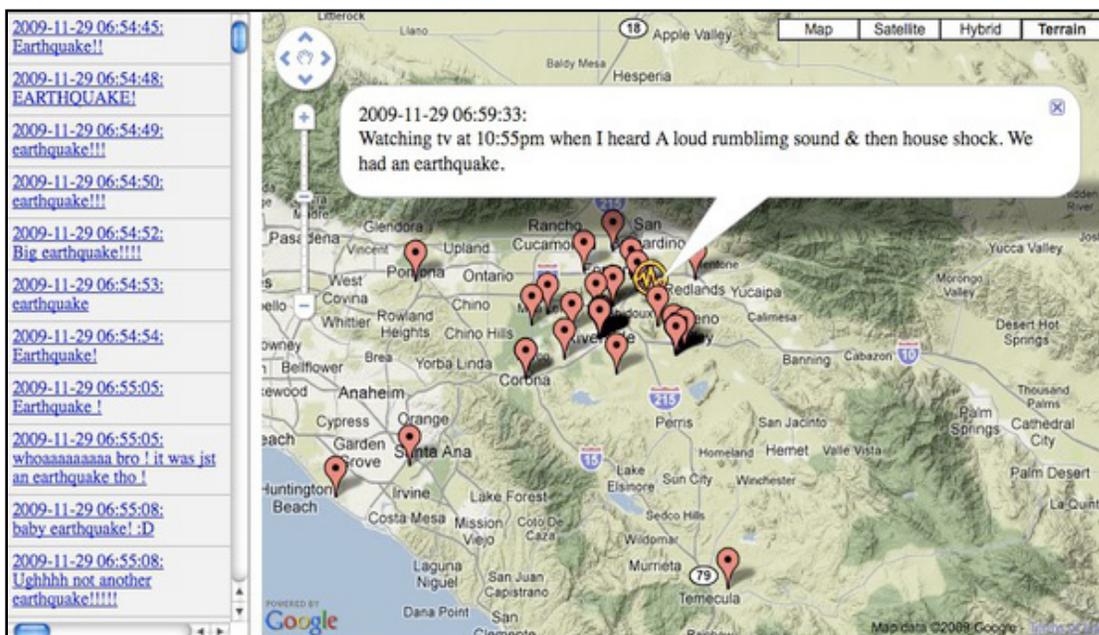
Volunteers help clear debris left after an October 2009 earthquake and tsunami in American Samoa. Photo courtesy of the Federal Emergency Management Agency.

*Social Media Shake Up (continued)*

Virginia Interoperability Picture for Emergency Response (VIPER), the state's geospatial platform for emergency response and preparedness information. VIPER collects and can display tweets and Flickr postings related to hazardous material spills, snowstorms, and other incidents, according to Atristain, possibly adding vital details to first responders' initial understanding of an emergency. If emergency managers notice several motorists posting about being stranded on a rural road during a blizzard, for instance, the state's Emergency Operations Center (EOC) can let local authorities know about the problem or offer state assistance to help clear the road. "It gives us some different ways to get information into the EOC," Atristain said.

Relying too heavily on Twitter posts, however, could be problematic for first responders, said Jordan Scott, public information officer for the California Emergency Management Agency (CalEMA). Tweets reporting an emergency would need to be confirmed before first responders could rush to the scene. "From an emergency response standpoint, you really need specifics as far as who is being affected and where they are," he said.

Twitter's format does create some limitations, according to Earle. Tweets submitted using cell phones with global positioning systems have specific geographic information if the user has enabled this Twitter feature, but, in other



The Twitter Earthquake Detector collects reactions from California after a November 2009 earthquake. Image courtesy of the U.S. Geological Survey.

cases, researchers only have location details from the Twitter user's account profile. Posts are short because Twitter limits the length to 140 characters. Also, TED captures some unrelated tweets that use earthquake terms for other subjects, such as references to the videogame Quake. The social media technology, however, can provide emergency managers with a quick, inexpensive way to obtain eyewitness accounts of a disaster. Twitter users provide accounts of their experiences without outside prompting, and emergency responders can use those details to gain a better understanding of an incident's scope. "For very little money, you can get this added information," Earle said.

To view the USGS TED Twitter feed, visit <http://twitter.com/usgsted>. To read the transcript of a USGS podcast describing the project, visit [www.usgs.gov/corecast/details.asp?ep=113](http://www.usgs.gov/corecast/details.asp?ep=113). To learn more about VIPER, visit the public site at <https://cop.vdem.virginia.gov/viper>.



## RESPONDER KNOWLEDGE BASE

### Reporting Equipment Problems to the Manufacturer

When first responders have a problem using a piece of personal protective equipment (PPE), it can be difficult or time consuming to contact the manufacturer. The Responder Knowledge Base (RKB) Website ([www.rkb.us](http://www.rkb.us)) offers an avenue that allows first responders to easily report issues with a product directly to the manufacturer.

RKB facilitates the problem reporting process by providing the most up-to-date contact information for first responders to directly reach out to a manufacturer, as well as any associated certifying organizations, to report their issues with the PPE. To use this feature, first responders can visit the RKB Website's problem reporting page or click on the "Report Product Problems" link located at the bottom right of every product page in the Website's PPE section.

This feature of RKB provides the emergency response community with an effective and easy-to-use tool to contact the manufacturer and the certifying organization quickly. It also provides the required information the users will need to provide when reporting a problem. This information includes the product's model and serial number, the date and place of purchase, and a description of the problem.

This seamless, integrated approach will help both manufacturers and the certifying organizations, as both require this information to track and report problems, thereby leading to improved products in the future.

The RKB help desk is available with any questions or concerns regarding this process. Please call 1-877-FEMA-RKB (1-877-336-2752) for assistance.



First responders rely on their personal protective equipment to keep them safe. Problems with equipment designs or functions can be reported directly to the manufacturers using links through the Responder Knowledge Base. Photo courtesy of the U.S. Coast Guard.



Coast Guard members and researchers prepare for a dive in the Arctic Circle in October 2009. If responders have problems with equipment like this, they can contact the manufacturer using links on the Responder Knowledge Base Website. Photo courtesy of the U.S. Coast Guard.