Dr Christina Baxter, of EmergencyResponseTIPS.com and Hazard3.com, offers helpful advice for first responders

Keeping you safe!

This column is intended to provide operational guidance to the hazmat/CBRNE community regarding the selection and performance of equipment and tactics. In this edition we are focusing on the use of artificial intelligence (AI) in hazmat/CBRN response. The National Security Commission on Artificial Intelligence (NSCAI) defines AI as the ability of a computer system to solve problems and perform tasks that would otherwise require human intelligence. In the future AI applications will cross the entire realm of emergency response including threat analysis, fundamental science such as synthesis, toxicology, medical countermeasures, detection including analysis, neutralisation, etc, and identifying patterns or relationships that are not immediately obvious.

Over the past decade, the sensors and systems used by the emergency response and defence communities have increasingly taken advantage of the internet of things concepts of connectivity, data accessibility and automation. This already allows for AI assistance with data analysis, interpretation and decision-making. The 2019 American Artificial Intelligence Initiative, supported under Executive Order 13859 directs federal government agencies to bolster their use of AI technologies by investing in R&D, training and collaboration.

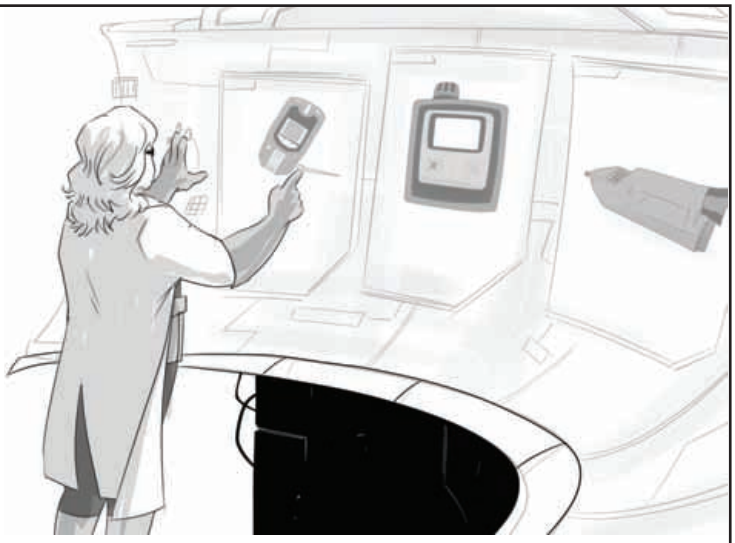
AI in emergency response: today

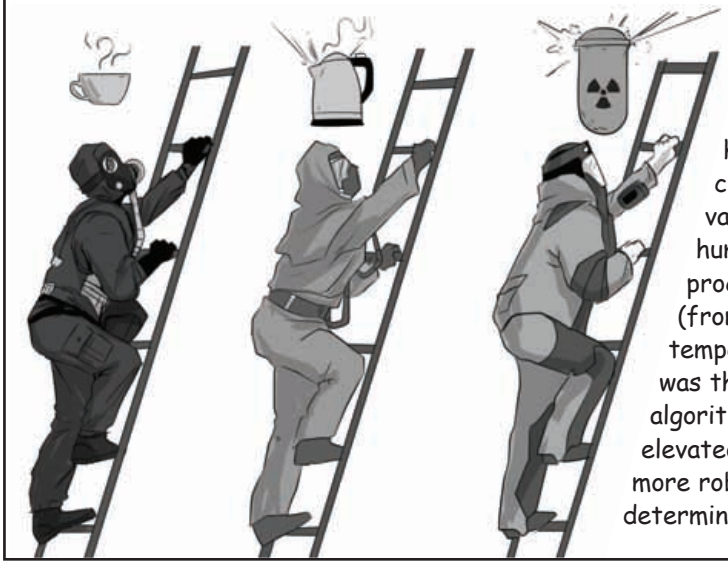
Early application of AI to hazmat/CBRN response has focused on issues like syndromic surveillance and early warning systems. Such surveillance, performed by monitoring a combination of social media, internet search word combinations, news reports, and public health data, can identify a biological threat, or pandemic, far sooner than traditional methods. In fact, syndromic surveillance tools were used to identify the start of the Covid-19 pandemic in the US.

Leveraging technologies such as the Oura ring, the US Defense Threat Reduction Agency has built predictive analytics toolsets to estimate when a soldier will become ill, based on biometric indicators. This has been possible due to the vast number of users that were able to build a large data set for training the system, resulting in robust algorithms.

The Copenhagen based Corti system uses years of emergency medical data to provide life-saving diagnostics in hospital pre-care. Using data such as symptoms, breathing patterns, tone of voice, word choice, etc, this system can provide dispatch with relevant questions and provide timely triage information.

AI is also being used to take sensor feeds from a variety of sensing systems and combine the data into one smart output recommending actions. While a variety of different systems are available today that provide a common operating picture, they often don't take the next step, analysing the data and recommending action. This is the basis for the development of the Emergency Response Decision Support System (ERDSS) detection environment tool whereby disparate sensor readings are combined with cross sensitivities to identify potential threats. ERDSS then highlights toxicity and flammability hazards while also recommending respiratory and skin protection, and decontamination guidance based on the initial sensor feeds.





A team at the Georgia Tech Research Institute developed a heat stress calculator utilising genetic programming (enhanced machine learning) and experimental data gathered with human subjects wearing chemical protective clothing and bomb protective clothing, over a variety of conditions such as temperature, humidity, equipment weight, and work rates. The process was started using a standard physics model (from TNO - Netherlands) for estimating core temperature, based on operational parameters. This was then enhanced with genetic programming algorithms for other critical parameters such as elevated heart rate. The combined approach provides a more robust algorithm for emergency responders to determine operating times in harsh environments.

AI in emergency response: within 5 years

Near term tools will leverage capabilities already in place in industrial bases where emergency response applications can be modified. This area will 'explode' as applications are investigated, and solutions tested. All aspects of prevention, preparedness, response, and recovery will be affected as well as the fundamental science and technology supporting first responders.

An important step forward will be the integration of predictive analytics with data extracted from drone footage and satellite imagery providing real time situational analysis even in communications-denied environments above ground. The development of these capabilities will rely heavily on the continued enhancement and hardening of communications systems including cellular, wireless, satellite, drone and others.

Tools will also be developed enabling continuous monitoring of equipment maintenance, operational status and data analysis. These will rely upon robust data sets and data collection now, in order to have sufficient data sets available to develop algorithms in five years' time. In addition, predictive analytics will allow for optimised maintenance on systems to minimise downtime and optimise field performance.

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AI in emergency response: long term

Imagine an emergency response system whereby predictive analytics can be used to optimise personnel and equipment deployment based on past accident history, societal changes and their impacts, along with real time weather, traffic and route planning for hazmat carriers. Prediction would not eliminate accidents, but could optimise responses including planning and preparation (such as resources and station locations) and minimise the impact. Similar approaches will be used to identify new threat agents, develop medical countermeasures, and predict the type, frequency and location of incidents as society, climate, threats or infrastructure changes. Finally, tools are in development and testing to identify new threats, emerging terror groups, targets, attack methods and tactics, as well as identifying individuals vulnerable to radicalisation. One of the long term goals for including AI in hazmat/CBRN response has always been the connected responder. In this case the responder becomes a node in the sensing system, with both individual health sensors and environmental sensors being used to provide real time information about the incident. Thus a broader and more robust picture can be painted.

Potential pitfalls

Implementing new technologies is not without risk or challenges. Firstly, quality and completeness of initial data sets drive the accuracy and precision of AI predictions. Remember GIGO - garbage in, garbage out! Next, database security protocols need to be enhanced and maintained to safeguard data sets. If we can't protect credit card and medical data, can we keep intelligence and operations data safe?

Secure and redundant communication systems must be maintained to ensure connectivity. There are still major areas of the world where cellular, wifi or satellite coverage is not conducive to managing events using automation. The development of AI tools for hazmat/CBRN response relies upon coordination between the AI community and the response sector. Historically, tools that have been built without user input have failed.

Finally, don't forget about malicious use and/or misuse of AI data sets or predictions, since all technologies can be applied for good or for harm. AI can be used to develop and deliver the next threat as easily as it can be used for the next solution. Care must be taken when considering the integration of classified and unclassified data sets, and when unclassified data sets become 'smart' and enter the classified realm. The user community must be actively engaged in this space, thinking about where it will help them, and developing relationships with those developing the AI tools. Get involved in the testing, but don't forget to ground truth the results.

Images are courtesy of Phil Buckenham
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