Editorial

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Biographical notes: James D. O'Shea is a Senior Lecturer in the School of Computing, Mathematics and Digital Technology at Manchester Metropolitan University (MMU). He received his BSc in Chemistry from Imperial College. He worked in computer R&D at International Computers on the simulation of LSI chip designs and in writing microcode. He was also an independent consultant under the UK Microelectronics Applications Project and the Microelectronics Awareness Programme until 1985. His research interests include various forms of artificial neural network, decision tree and other machine learning paradigms in particular regarding their applications in adaptive psychological profiling and dialog systems. He co-founded the Intelligent Systems Group (ISG) at MMU and is one of the inventors of the silent talker lie detector, which has attracted worldwide interest.

Welcome to the special edition of the *International Journal of Intelligent Defence Support Systems* dedicated to improvised explosive devices (IEDs). IEDs provide one of the greatest challenges to security, both domestic and foreign, as a vehicle for asymmetric warfare attacks on peacekeeping troops in troubled regions throughout the world and as the basis of terrorist attacks on civilian populations.

My personal interest in IEDs is driven by the number of near misses I have experienced over the decades, two of the more spectacular examples are the random choice on a visit to London in 1983, to visit Harrods in London on the 18th of December instead of the 17th, and missing a shopping trip to Manchester on the morning 15th of June 1996 (as a result of an alarm clock failure). On the 17th of December 1983, a conventional car bomb was detonated outside Harrods, using an estimated 14 Kg of Semtex, provided by the Libyan regime and caused six deaths and one severe injury. On the 15th of June 1996, a large truck bomb containing an estimated 1,500 kg of explosives, based on ammonium nitrate fertiliser with Semtex, was detonated outside Manchester's Arndale shopping mall. Although there were no fatalities, over 200 people were injured and the cost of rebuilding has been estimated at £1 billion at current rates (2012).

Preparing the calls for papers for this issue revealed that although researchers in the field of IEDs are often highly specialised, collectively they cover a broad range of disciplines. Furthermore, these disciplines offer opportunities for intervention at different points in time. For example, the social sciences have a role to play in modelling and predicting the causal factors leading to the kind of conflict in which IEDs are brought into play.

Research into prevention includes access control, preventing the entry of suicide bombers and intelligence gathering infiltrators to airports, other public buildings and military bases. This is an area where the MMU intelligent systems group contributes through its silent talker technology (Rothwell et al., 2006a, 2006b). In the field of conflict, the first port-of-call may be a range of investigative, modelling and materials science techniques to optimise the robustness of vehicles to blast and the creation of barriers to protect buildings and personnel. In the field, sensor technologies contribute to the detection of such devices, for example, spectroscopic devices operating in the infrared and terahertz bands. Such technologies may be mounted on UAVs and UGVs as well as human operated units.

Robotics and vehicle research extends to the development of EOD bots intended to reduce the risk to human expert disposal officers. In the end, disarming and disposal may require the intervention of a human expert; this activity itself may be supported by data mining of intelligence on the varieties of IEDs being produced. When casualties have occurred, there is a range of medical research activities on the changing effects of trauma caused by the different approaches to protecting personnel and vehicles, for example, on the toxicity of fragments of protective materials embedded in wounds. This naturally leads to work on rehabilitation including bio-engineering of prosthetics. Finally, when conflict ends there is a legacy of unexploded ordnance affecting the civilian population, leading to research on feasible and cost-effective methods of clearing such devices.

This suggests the possibility of a full lifecycle model of the IED as a useful research topic in its own right to maximise the combined effect of the various interventions.

The outcome of the above is that the papers in this special edition have been chosen to reflect the diversity of IED research.

The first paper, contributed by Weiss, Briscoe, Whitaker, Trewhitt, Hayes and Horgan is concerned with computational modelling of behaviour related to the development, deployment and perpetration of IEDs. Whilst there are a number of specialised models of relatively small-scale behaviour, this paper addresses the need for more holistic modelling by providing methods to analyse and evaluate the differing views and opinions expressed in existing models prior to integration.

The second paper, contributed by Finkenstadt, Lambrakos, Bernstein, Jacobs, Huang, Massa and Shabaev reviews a framework for the prediction of explosive molecular spectra (in the THz band) for the materials commonly used to create IEDs. The use of terahertz radiation for detecting IEDs is a highly active research area at present, but there are practical problems of discrimination between harmless substances and explosives. This paper contributes two types of permitivity function to simulate both detection scenarios and molecular level response characteristics intended to detect explosives in complex environments.

The third paper, contributed by Usbeck, Cleveland and Regli establishes a framework for coordinating distributed resources such as UAVs and UGVs, with static resources, to protect a specified area. In particular, the paper explores network-awareness as a means of allowing distributed agents to adapt to highly dynamic and volatile networks engendered by the environments in which IEDs are placed.

The final paper, contributed by Grant and Stewart proposes a systemic model for probabilistic assessment of the risks arising from IED attacks. The model was investigated using the GTD database and supports the estimation of the probability of IED success and the relationship between probabilities of hazards and losses in terms of casualties and infrastructure arising from IEDs. One expected outcome of the work is to automate the risk assessment process, reducing the need for expert opinion.

In summary, this special issue provides examples which illustrate the breadth and depth of the IED lifecycle. All of the papers are concerned with some form of modelling or framework construction and clearly illustrate the importance of intelligence in systems intended to defend us from the IED.

References

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