

Special Issue: Modeling and Simulation in Homeland Security

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1. Introduction

The terrorist attack on September 11, 2001 and the follow-up anthrax attack in the United States have attracted the world's attention to countering terrorism and catalyzed a national push for homeland security research. Efforts to protect people, safeguard the nation's critical infrastructures, and secure homeland from terrorism require a variety of decisions and response strategies. To ensure that these decisions and response strategies are made in the most beneficial manner, effective decision modeling and system support are necessary. Modeling and computing simulation are powerful tools that can be used to support decision-making through all phases of responses, by highlighting the potential impacts of various preventive and protective actions, providing assessments of the operational feasibility of such actions, and suggesting effective strategies in preparing for and responding to potential homeland threats.

This special issue aims to link the protégé (public) and the protector (response forces) and thereby recognize how to enhance national and social response capabilities in the presence of human-made or natural disasters. We are concerned with (1) how the public and/or communities respond to an attack, and (2) how response capability can be improved through effective modeling and simulation systems because speed is critical in saving lives and securing infrastructures.

Each paper focuses on a specific topic that falls under the theme of enhancing response capabilities and protecting people. The first part of the special issue examines how dynamic system modeling helps understand how anxiety and fear translate into impacts on effective response and/or social productivity. The second part covers system development for capability building.

2. The Psychological Impacts of an Attack

Direct attacks not only cause physical damages to the target population but also transmit messages to people, beyond the immediate victims, that may cause them to feel vulnerable as individuals, anywhere and anytime. Indirect psychological threats hence may result in fear and anxiety.

In the first paper, "Modeling the Psychosocial Effects of Terror or Natural Disasters for Response Preparation," Ding models how people react to an unexpected disaster or threat and quantifies the potential psychosocial effects that a person may experience. Because fear and beliefs can be shared by people, Ding presents a mathematical model to capture disaster-induced possible collective anxiety to understand how it may challenge the effectiveness of response efforts or social productivity. Analytic solutions of the model project the range and severity of the possible psychosocial consequences of a disaster.

Burns and Slovic, in the next paper, “The Diffusion of Fear: Modeling Community Response to a Terrorist Strike,” investigate how a community is likely to prepare for and respond to an attack. Using system modeling, they examine how some critical factors such as risk signal (terrorism versus accident and infectious disease versus explosion), media coverage, length of investigation, and community intervention impact the diffusion of fear. The authors present simulation results under three scenarios: an anthrax attack, bomb blast and accidental propane tank explosion. Their study presents an attempt to capture some of the dynamics likely to drive community response to certain hazardous events.

In summary, planning for behavioral health responses in advance is urgent and necessary. In our view, dynamic systems theory and modeling can lead to important advancements in planning for such responses.

3. Enhance Response Capability

Many tasks such as a real-time missile detection and tracking require a fast process. In the first paper, “Towards a Multi-FPGA Infrared Simulator,” Sriram and Kearney present their efforts using a multi field programmable gate array (FPGA) hardware acceleration platform to speed up the process of infrared scenes. The research focuses on how to construct a multi-FPGA platform and how it can overcome the computing limitations imposed by PC-based dual core processors. The authors explain algorithms used in the platform and present implementation results.

McGill and Ayyub, in the next paper, “Multicriteria Security System Performance Assessment Using Fuzzy Logic,” introduce a fuzzy logic approach to assessing the performance of a security system, which is measured by the probability of adversary success given an attack. A human expert can assess characteristics of a security system on a scale of 0 to 10 along several dimensions such as access control, personnel barriers, vehicle barriers, surveillance ability, guard force, and reaction force with heavy weapons. The authors present a fuzzy system that approximates the functional relationships among those dimensions to generate the probability of adversary success given a threat type. Quantifying a security system performance requires significant time and analytical resources, McGill and Ayyub’s model provides a simple, quick, and general approach to achieving this goal.

Effective response depends on sufficient preparedness. Shao and Lee, “Applying Software Product Line Technology to Simulation Modeling of Emergency Response Facility,” show how software product line (SPL) technology can provide a flexible approach to the development of simulation-based training modules to support incident management. By introducing and discussing a family of simulated emergency response facilities such as hospital emergency rooms, on-site emergency triage stations, decontamination stations, first-aid stations, and ambulances, the authors demonstrate the reusability of SPLs and its easy adaptation to meet emergency responders’ needs.

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