

Special issue on defense and disaster response technologies

1 | INTRODUCTION

In today's technological landscape, the rapid and widespread adoption of new technologies is crucial to enhance the capabilities, robustness, and efficiency of military defense and disaster response operations. Technologies such as artificial intelligence, mobile communication, and the Internet of Things have enriched battlefield communication, surveillance, tactical decision-making, and early warning systems. This trend is common across various fields, including disaster response technologies, and has led to considerable improvements in disaster prediction, mitigation, response, and recovery applications.

The emergence of new technologies has resulted in dramatic changes in the operational environment. For example, the increasing diversity of connections between combat/rescue equipment, weaponry, and operational headquarters imposes complex communication requirements related to availability, reliability, and latency, as well as the need for safe processing of unprecedented volumes of data. Conversely, responses to disasters must consider their potential impacts, including their high frequency, widespread damage, and global scale. Additionally, preemptive interventions that allow for accurate forecasting of disasters are essential for modern disaster response. Overall, myriad factors collectively contribute to the complexity of developing efficient solutions for military defense and disaster response applications.

The Electronics and Telecommunications Research Institute (ETRI) Journal is a peer-reviewed open-access journal launched in 1993 and published bimonthly by ETRI (Republic of Korea), aiming to promote worldwide academic exchange in the fields of information, telecommunications, and electronics. This special issue explores recent research trends in the technological advances driving the digital transformation of military defense and disaster response systems. It presents notable, cutting-edge studies aimed at improving the efficiency, safety, and real-time responsiveness of these critical domains. Given the central role of technologies such as virtual training, robotic navigation, drone countermeasures, and

secure communications in the modernization of defense operations, the contributions in this special issue offer valuable insights into the future direction of digitalized military defense and disaster response strategies. Accordingly, we have selected eight critical papers on three aspects of military defense and disaster response technology for this special issue. A brief review regarding commitments for this special issue follows.

The first invited paper [1], entitled "Next-generation wireless communication technologies for improved disaster response and management" by Song et al., introduces next-generation wireless communication technologies that can improve disaster response and management. This study proposes an integrated disaster-response communication framework with the potential to achieve ultralow latency and high-speed data transmission to support rescue operations and provide more reliable situational awareness to enable more accurate and quicker decision-making in disaster environments so that human risk can be minimized.

The second paper [2], entitled "Marker-based adaptive virtual military training system for enhanced immersion and realism," by Tong et al., presents a major contribution to the field of virtual military training by introducing the marker-based adaptive virtual military system. This approach effectively reduces the physical burden on the trainees by minimizing the use of wearable devices, which is a commendable advancement over existing systems. The editorial board selected this paper as a "featured article." It addresses important problems related to a recent military defense virtual learning system and is considered as a suitable topic for this special issue.

The third paper [3], entitled "A semantic potential field for mobile robot navigation using grid map," by Pham et al., proposes a new Semantic Potential field method for mobile robot navigation. Because the proposed scheme is based on both geometric and semantic data using a semantic grid map, it can improve navigation efficiency and adaptability. The effectiveness of the proposed scheme is evaluated using simulations and real-world experiments. The proposed scheme is considered a promising method for mobile robot navigation in various

applications, such as disasters, defense, and autonomous logistics.

The fourth paper [4], entitled “Design of specific situation estimation function using multirobot system in military operations” by Choi et al., proposes a new framework for fast and efficient object location identification and hazard-zone assessment functions, which would be performed by military robots, even when limited resources are available. It is worth noting that the proposed framework merges object location data in space using a swarm of robots without relying on simultaneous localization and mapping (SLAM). The proposed framework is promising for situational assessments during indoor military operations.

The fifth paper [5], entitled “5G defense network using commercial gNodeB with zero trust architecture” by Kim et al., proposes a network leveraging commercial gNodeBs (gNBs) with a military public land mobile network identity, ensuring extensive coverage, robust security, and cost efficiency. To enhance secure access, a zero-trust (ZT) architecture using a software-defined perimeter (SDP) is employed. The connection process for user equipment to access private networks is explained based on 5G and ZT access management. This study provides a simulated 5G analysis that compares scenarios before and after applying SDP to denial-of-service and IP scanning attacks.

The sixth paper [6], entitled “Multimodem-based FHSS-drone takeover with precision spoofing,” by Kang et al., introduces a method for hijacking a frequency hopping spread spectrum (FHSS)-based drone using C2 signal emission for takeover and precision spoofing signals to invalidate the owner’s transmitter signal using a multimodem. The proposed method simultaneously transmits C2 signals to the target drone for safe takeover, and precision spoofing signals to neutralize the owner’s transmitter, thereby minimizing radiofrequency collisions with other equipment.

The seventh paper [7], entitled “Maximization of near-infrared modulation by optimizing the transparent conducting electrode resistance” by Han et al., proposes a method to optimize infrared transmission by adjusting the indium tin oxide (ITO) thickness, exhibiting excellent modulation in electrochromic devices. Devices with ITO thicknesses of 40, 75, and 302 nm were tested, and the 75 nm electrode achieved a transmittance modulation performance of 67.73% in the visible range and 51.41% in the near-infrared range. Response times for bleaching and coloration were respectively 4.0 and 2.8 s.

The eighth paper [8], entitled “Distance mean-square loss function for the ordinal classification of emergency service response codes in disaster response,” by Lee et al.,

proposes a distance mean-square (DiMS) loss function to enhance the accuracy of classifying the severity of disasters by the National Police Agency (NPA). NPA data have characteristics of ordinal data, such as Emergency Service Response Code (ESRC) data, which are classified based on their magnitude (ranging from C0 to C4). Risk-recognition methods employing the DiMS loss function have the potential to enhance disaster response efforts.

The guest editors would like to thank all authors, reviewers, and editorial staff of the ETRI Journal for making this special issue successful. The guest editors are pleased to have been part of this effort to publish high-quality technical papers in a timely manner. These studies will contribute to the emergence of various military defense and disaster response technological innovations that will ensure everyday safety at present and in the future.

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest.

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