Computer Modeling in
Engineering & Sciences

Tech Science Press

DOI: 10.32604/cmes.2022.020646

EDITORIAL

Introduction to the Special Issue on Intelligent Models for Security and Resilience in Cyber Physical Systems

Qi Liu[1,*], Xiaodong Liu[2], Radu Grosu[3] and Ching-Nung Yang[4]

[1]School of Computer and Software, Nanjing University of Information Science and Technology, Nanjing, 210044, China

[2]School of Computing, Edinburgh Napier University, Edinburgh, 018373, UK

[3]Institute of Computer Engineering, Vienna University of Technology, Wien, 1040, Austria

[4]Department of Computer Science and Information Engineering, National Dong Hwa University, Hualien, 97401, Taiwan

[*]Corresponding Author: Qi Liu. Email: qi.liu@nuist.edu.cn

Received: 04 December 2021 Accepted: 21 December 2021

Cyber Physical Systems (CPS) have been appealing in recent years as a result of the rapid emergence of unique hardware and software compositions that create smart, autonomously behaving devices. End-to-end procedures and new types of user-machine interaction are made possible via the CPS. On the one hand, these CPS applications have the potential to deliver crucial services in a variety of developing application areas, including energy management, healthcare, traffic monitoring, industrial assessment and surveillance.

Four guest editors have arranged this special issue, all of whom have made significant contributions to the field of CPS and CPS-based hardware and software. Following rigorous peer review procedure, eight papers were accepted and published. Topics include environment perception, Internet of Things, network communication, network security and others.

The summary of accepted papers in this special issue is shown as follows:

As the development of cyber-physical systems has gradually improved, the status of snow cover has increased greatly. Snow cover is an essential metric in the domains of computer modeling, engineering technology, and energy development. Zhang et al. [1] proposed a snow cover detection method using the FY-4A satellite data revolving around the unsupervised Gaussian mixture model (GMM) to offer reliable snow detection performance for the terminal of CPS. The method combined the threshold-based and Gaussian mixture model methods, resulting in decreased cloud cover and a greater snow detection rate, implying that the method could adjust to complicated hilly terrain under a set threshold lacked of assigned labels.

The Internet of Things (IoT) technology has advanced in recent years as related researches mature and become more extensively employed in a variety of fields. Predicting air quality has been a prevalent issue, as has the necessity for precise meteorological data. Existing techniques, however, usually seek forecast accuracy while ignoring changes in many pollution indicators. To address this issue, Kong et al. [2] developed a predicted-trend-based loss function (PTB) that can track changing trends. In addition, this article worked in conjunction with the established RNN model to achieve a dual option of prediction outcomes and trends. PTB based on the RNN model is also presented to forecast all air quality data, which not only successfully predicts results but also accurately monitors changes in various indicators.

Sensors and sensor-based systems have increasingly been integrated with CPS and device-to-device communications in recent years. Given the restrictions of restricted bandwidth, connecting billions of smart IoT devices with varying Quality of Service (QoS) needs is a challenge. Zhang et al. [3] put forward a smart CR-NOMA model created in an IoT situation in which the interference of primary user had a major impact on the secondary quality of transmission channel. The model considered two scenarios; they are a) transmission that begins following Channel State Information (CSI) acquisition and cognitive user feedback, and b) the primary user who maintains stable transmission during the channel state information acquisition and secondary communication phases. The outage probability of the system was examined under the above two scenarios, revealing that NOMA systems with interference-independent BS had a higher likelihood of being interrupted than interference-aware systems.

The IoT becomes one of the primary sources of big data, and it is critical to handle and transfer large amounts of data in order to address big data security concerns. Data aggregation is a significant manner to solve the IoT big data problem. Chun et al. [4] designed an IoT data aggregation scheme based on Software Defined Networking (SDN) and modified the NUMFabric algorithm for estimating the total cost of congestion, applying ideas of the upper-level method to the kernel controller of an SDN network in a cloud computing IoT data center. The results showed that the modified NUMFabric approach can provide greater rate consistency, minimize data aggregation time delay, increase data aggregation reliability, and improve network performance.

Vehicle sensor networks (VSN) are becoming increasingly crucial in smart cities because of the interconnectedness of the infrastructure. Vehicle sensor networks, on the other hand, are vulnerable to a wide range of assaults due to properties such as self-organization, quick adaptability, and extensive channels. Many existing authentication mechanisms for VSN are not created to safeguard the privacy. In view of this, Zhou et al. [5] offered a threshold authentication, anonymity, non-negativity, and regulated link capability strategy for vehicle sensor networks based on group signatures. Threshold authentication allows receivers to determine whether the received signature was created by the same sender, aiming at avoiding replay attacks. The trustworthiness, reliability and the way to achieve other important security features of the scheme using the random oracle model was demonstrated.

MapReduce has been discovered to offer enormous practical value for massive data processing throughout the last decade. Most firms have employed MapReduce on a routine basis over the past decade to handle digital information tasks, and it has significant practical utility for large data processing. Although MapReduce has been excessively successful, it still suffers from many issues. One of the challenging issues is skewing, which refers to a situation where the load is not balanced between tasks. Skewing can cause a few mapping or reduction activities to take longer than other similar operations, leading to increase job completion time. In response to this problem, Liu et al. [6] presented a runtime dynamic resource tuning approach called DynamicAdjust to mitigate skew in MapReduce. DynamicAdjust not only dynamically adjusts the execution of monitoring tasks at runtime, but also the resources of slower-running tasks with existence of excess resources, mitigating the skew that occurs in the map and reduction phases.

CPS technologies offer a wide range of applications in the biomedical area, including Parkinson Disease (PD) diagnosis. The PD is a progressive neurological illness that impairs mobility.

Symptoms appear gradually, with tremors in only one hand sometimes scarcely apparent. The basic symptoms of Parkinson disease can be distinguished, which has sparked a lot of interest in detecting tremor signals in Parkinson in recent decades. However, determining how to make the detection precise and the gadget convenient to use for senior people remains a difficulty. Yang et al. [7] presented the design and implementation of a tiny ring device for detecting hand tremors in Parkinson disease patients. It is unavoidable that there will be increased need for tiny, portable equipment for early diagnosis of Parkinson disease.

The term “hardware Trojan” refers to a specific circuit module that has been deliberately implanted or altered during the design or manufacture of an integrated circuit (IC), or to an accidental design flaw in an IC. Once activated, a Trojan horse may alter the functionality or specifications of an IC, resulting in the disclosure of sensitive information, degeneration of performance, or even permanent damage to the IC. Zhang et al. [8] proposed an evolutionary algorithm called Mixed Feature Gene Expression Programming (MF-GEP), in order to find the original IC. The algorithm can be developed as nodes and mixing multiple features into a single operator by employing a singular circuit module or set of circuit structures.

In conclusion, we hope that the works gathered in this special issue will be a valuable resource for researchers working on relevant themes and will encourage them to pursue more research findings and outcomes on the design, application and simulation in the CPS.

Funding Statement: This work has received funding from the Key Laboratory Foundation of National Defense Technology under Grant 61424010208, National Natural Science Foundation of China (Nos. 41911530242 and 41975142), 5150 Spring Specialists (05492018012 and 05762018039), Major Program of the National Social Science Fund of China (Grant No. 17ZDA092), 333 High-Level Talent Cultivation Project of Jiangsu Province (BRA2018332), Royal Society of Edinburgh, UK and China Natural Science Foundation Council (RSE Reference: 62967_Liu_2018_2) under their Joint International Projects funding scheme and basic Research Programs (Natural Science Foundation) of Jiangsu Province (BK20191398 and BK20180794).

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

References

1. Zhang, Y., Ma, G., Tian, W., Wang, J., Chen, S. (2020). Threshold-based adaptive Gaussian mixture model integration (TA-GMMI) algorithm for mapping snow cover in mountainous terrain. *Computer Modeling in Engineering & Sciences, 124(3),* 1149–1165. DOI 10.32604/cmes.2020.010932.
2. Kong, W., Wang, B. (2020). Combining trend-based loss with neural network for air quality forecasting in internet of things. *Computer Modeling in Engineering & Sciences, 125(2),* 849–863. DOI 10.32604/cmes.2020.012818.
3. Zhang, Y., Liu, J., Peng, Y., Dong, Y., Zhao, C. (2020). Performance analysis of intelligent CR-NOMA model for industrial IoT communications. *Computer Modeling in Engineering & Sciences, 125(1),* 239–257. DOI 10.32604/cmes.2020.010778.
4. Chun, S., Chen, X., Deng, G., Liu, H. (2021). A trusted NUMFabric algorithm for congestion price calculation at the internet-of-things datacenter. *Computer Modeling in Engineering & Sciences, 126(3),* 1203–1216. DOI 10.32604/cmes.2021.012230.
5. Zhou, Y., Chen, L., Zhao, X., Yang, Z. (2020). An anonymous authentication scheme with controllable linkability for vehicle sensor networks. *Computer Modeling in Engineering & Sciences, 125(3),* 1101–1118. DOI 10.32604/cmes.2021.013289.

6. Liu, Z., Zhang, S., Liu, Y., Wang, X., Yin, D. (2021). Run-time dynamic resource adjustment for mitigating skew in MapReduce. *Computer Modeling in Engineering & Sciences, 126(2),* 771–790. DOI 10.32604/cmes.2021.013244.
7. Yang, H., Shen, Y., Zhuang, W., Gao, C., Dai, D. et al. (2021). A smart wearable ring device for sensing hand tremor of Parkinson's patients. *Computer Modeling in Engineering & Sciences, 126(3),* 1217–1238. DOI 10.32604/cmes.2021.014558.
8. Zhang, H., Zhou, J., Wu, X. (2021). An evolutionary algorithm for non-destructive reverse engineering of integrated circuits. *Computer Modeling in Engineering & Sciences, 127(3),* 1151–1175. DOI 10.32604/cmes.2021.015462.