

Soft computing for security services in smart and ubiquitous environments

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Published online: 7 August 2014
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The recent advances in new generation information systems and global communication are due to the development of many complex technical solutions and sophisticated methods for secure communication between remote systems and also of the numerous technology implementations, which mean that the world of modern technologies surrounding us becomes friendlier in how it communicates with humans. The progress in modern and smart technologies is made possible, among other reasons, by the use of state-of-the-art achievements in soft computing approaches, cognitive computational models, as well as a number of other algorithmic techniques inspired by biology like neural computation, artificial intelligence or genetic programming. Recently, such methods have made it possible to intelligently manage secure data transmissions as well as to analyze various patterns coming from almost all facets of our life, thus contributing to the development of computer technology and security services in ubiquitous computing.

Describing the extremely wide-ranging and interesting problems from the intelligent, secure and smart ubiquitous computing areas, we have decided to publish a Special Issue on “Soft Computing for Security Services in Smart and Ubiquitous Environments”, which presents selected, subjects

concerning practical, and methodological solutions from such fields as security and information processing, genetic systems, advanced machine learning, security models and attacks prevention, fuzzy systems and cognitive economy, optimization heuristics, network management and broadcasting schemes, emotional robots, and intelligent smart buildings.

This S.I. is a collection of 15 papers carefully selected as the best from a few dozen publications submitted on this subject. Each accepted article has been subject to a rigorous peer review procedure and has been assessed by several independent reviewers.

In the paper “A soft computing based location-aware access control for smart buildings” [Hernández et al. \(2014\)](#), J. L. Hernández et al. proposed a distributed location-aware access control mechanism and its application in the smart building context. Presented approach is based on an access control engine embedded into smart objects, which are responsible to make authorization decisions by considering both user location data and access credentials. User location data are estimated using a novel indoor localization system based on magnetic field data sent by user through her personal phone. The localization system implements a combination of soft computing techniques providing the benefits of a decentralized approach for smart environments.

Paper entitled “Towards cognitive economy” [Ogiela \(2014\)](#), by Lidia Ogiela, discusses new development directions of cognitive economics based on cognitive processes of financial data analysis. The foundation for the operation of economic cognitive systems consists in both the semantic analysis of the situation of an enterprise described by various economic ratios and the assessment of the future situation of this enterprise. Methods of cognitive analysis were developed inspired by the operation of the human mind. The cognitive, decision-making, reasoning, understanding and pre-

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diction processes running in this mind have become the basis for attempts to create new branch of science called cognitive economy.

In the paper “Opportunistic sharing scheme for spectrum allocation in wireless virtualization” [Yang et al. \(2014\)](#) describe some aspects of wireless virtualization, enabling multiple concurrent virtual networks running on shared wireless substrate resources. This paper presents the characteristics of virtual networks’ requirements, and then divides the requirement into a baseline part and a fluctuant part. It also introduces an opportunistic spectrum sharing approach, through which we formulate the spectrum resource allocation problem as an NP-Hard problem. For solving this problem an efficient genetic algorithm was presented.

The paper entitled “A method of DDoS attack detection using HTTP packet pattern and rule engine in cloud computing environment”, by [J. Choi et al. \(2014\)](#), presents a method of integration between HTTP GET flooding among Distributed Denial-of-Service attacks and MapReduce processing, for fast attack detection in a cloud computing environment. This method can ensure the availability of the target system for an accurate and reliable detection based on HTTP GET flooding. Also some experiments on the processing time were described to compare the performance with a pattern detection of the attack features using Snort detection based on HTTP packet patterns and log data from a Web server.

In the paper “Binary and m-ary encoding in applications of tree-based genetic algorithms for QoS routing”, [Maniscalco et al. \(2014\)](#) refer to Mobile ad Hoc Networks and investigate on genetic algorithms (GA) for QoS routing services. They used genetic algorithm to solve the NP search of QoS routes with multiple constraints. They elaborate on tree-based GAs, which represent the set of paths from source to destination as a tree, and encode them through the crossed junctions. Binary encoding is used to improve the convergence speed. Some simulation are performed to compare speed and scalability of proposed applications using binary and m-ary encoding.

The paper “Case-based context ontology construction using fuzzy set theory for personalized service in a smart home environment”, by [M. Sohn et al. \(2014\)](#), presents implemented on case-based context ontology PASCUZZY framework, dedicated for context-based personalized services utilizing smart appliances in a smart home environment. In this framework a fuzzy set theory was used to transpose numerical-type context data sensed from the surrounding environment, and to adjust the generic fuzzy membership functions according the inhabitants’ context. Results of the conducted experiments confirmed the high effectiveness and superiority of this framework.

In the paper “The simulation of an emotional robot implemented with fuzzy logic”, [Leu et al. \(2014\)](#) designed and simulated a robot, named Shiau_Lu, which is empowered with six universal human emotions like happiness, anger,

fear, sadness, disgust and surprise. This robot recognizes voice sentence and outputs a sentence to reveal its current emotional states. Additionally artificial intelligence and psychological theories of human behaviors have been applied to the robot to simulate how emotions are influenced by the outside world through languages.

The paper “Multi-objective performance optimization of a probabilistic similarity/dissimilarity-based broadcasting scheme for mobile ad hoc networks in disaster response scenarios”, by [D. G. Reina et al. \(2014\)](#), presents a communication system for establishing real-time communications in disaster situation, between different elements (victims, crew members, etc.). Such system allow users to establish decentralized communications quickly and using common devices like mobile phones. The objective of this paper is also to optimize a broadcasting scheme based on similarity/dissimilarity coefficient designed for disaster response scenarios through a multi-objective optimization problem in which several performance metrics such as reachability, number of retransmissions and delay are optimized simultaneously.

In the paper “Network security management with traffic pattern clustering” [Chiou et al. \(2014\)](#) deal with profiling network traffic pattern, which is important in several network security problem. They propose a new method to identify randomly generated domain names and pinpoint the potential victim groups. They characterize normal domain names with the so-called 2gram to distinguish between active and non-existent domain names, and track the destination IPs with analysing their similarity of connection pattern, to uncover potential anomalous group network behaviors.

The paper entitled “A quantum-inspired Tabu search algorithm for solving combinatorial optimization problems”, by [H.-P. Chiang et al. \(2014\)](#), presents a novel evolutionary algorithm called quantum-inspired Tabu search (QTS). This algorithm is based on the classical Tabu search and characteristics of quantum computation, such as superposition. The process of qubit measurement is a probability operation that increases diversification. This paper also shows how to implement QTS into NP-complete problems such knapsack problems and the traveling salesman problem.

In the paper “Trustworthiness in P2P: performance behavior of two fuzzy-based systems for JXTA-overlay platform” [Spaho et al. \(2014\)](#) proposed two fuzzy-based trustworthiness system for Peer-to-peer (P2P) communication in JXTA-overlay. The first system is based on one fuzzy logic controller (FLC) and uses input parameters like mutually agreed behavior, actual behavior criterion (ABC), peer disconnections (PD) and number of uploads, and the output is peer reliability. The second system has two fuzzy logic controllers with different input parameters. The simulation results show that the proposed systems have a good behavior and can be

used successfully to evaluate the reliability of the new peer connected in JXTA-overlay.

The paper entitled “An efficient PHR service system supporting fuzzy keyword search and fine-grained access control”, by F. Xhafa et al. (2014), proposed a novel personal health record (PHR) service system, which supports efficient searching and fine-grained access control for PHR data in a hybrid cloud environment. In this system a private cloud is used to assist users to interact with the public cloud for processing PHR data. Additionally, the attribute-based encryption (ABE) technique was used to obtain fine-grained access control for PHR data and to protect the privacy of PHR owners. Described solution can also allow efficient fuzzy search over PHR data, which can greatly improve the system usability.

In the paper “Cooperative-Filter: countering Interest flooding attacks in named data networking” Wang et al. (2014) describe how to detect and mitigate the Interest Flooding Attack (IFA) in the Named Data Networking (NDN) paradigm, which can excessively consume the resource of each involved router by flooding too many malicious interest packets with fake names. In this paper to detect IFA attack authors proposed a special architecture called *Cooperative-Filter*, which allows to detect IFA using fuzzy logic and mitigates it based on the cooperation between routers at the granularity of per-prefix-per-interface. Presented results demonstrate that Cooperative-Filter can detect IFA and effectively mitigate its damage effect on NDN.

In the paper entitled “Hybrid P2P traffic classification with heuristic rules and machine learning”, by W. Ye and K. Cho (2014), an improved two-step hybrid P2P traffic classifier is proposed, which provides high accuracy and low overhead compared to other known schemes. The first step in hybrid procedure is a signature-based classifier at the packet-level combined with connection heuristics. But the second step mainly consists of a statistics-based classifier with pattern heuristics for classification of the remaining unknown traffic at the flow level. The statistics-based classifier is implemented with REPTree, a decision tree algorithm.

The paper “A Dynamic Trust Model Exploiting the Time Slice in WSNs” by G. Wu et al. (2014), describes a new dynamic trust model, proposed for Wireless Sensor Networks, which allow to resist some selfish nodes’ misbehaving. The open nature of WSNs makes them easily exposed to a variety of security attacks. To prevent such attacks from selfish nodes, authors proposed a fuzzy-based dynamic trust model, which uses fuzzy sets combined with grey theory. Such approach allows to calculate neighbors’ trust values and rank them, based on the direct and indirect trust relationship. Simulation results have shown that proposed trust model can demonstrate not only the effectiveness in detecting selfish nodes, but also possess better performance in the bursty traffic.

We strongly believe that the papers presented in this Special Issue make a significant contribution not only to academic researchers and industry professionals, but also to students and all interested of this subject readers, wanting to extend their knowledge from the areas of advanced soft computing approaches and technologies for mobile services, security systems, as well as advanced information processing solutions dedicated for distributed ubiquitous computing and communication.

We would like to express our sincere appreciation to the all authors for their valuable contributions. Our special thanks go to the Editorial Board for this S.I. and Professors Vincenzo Loia and Antonio Di Nola, Editors in Chief of the Soft Computing journal, for inviting us to organize this S.I. and their great support throughout the entire publication process.

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