Guest Editorial Special Issue on Hybrid Intelligence for Internet of Vehicles

INTERNET of Vehicles (IoV) refers to dynamic mobile communication systems that communicate between vehicles and public networks using vehicle-to-vehicle, vehicle-to-road, vehicle-to-human, and vehicle-to-sensor interactions. It enables information sharing and the gathering of information on vehicles, roads, and their surroundings. Moreover, it features the processing, computing, sharing, and secure release of information onto information platforms. Based on this data, the system can effectively guide and supervise vehicles and provide abundant multimedia and mobile Internet application services. The next generation IoV is an emerging field that crosses multiple disciplines including automotive, intelligent transportation, information technology, communications, energy, etc. In the recent years, there have been more and more system technologies and system intelligence being used to make transportation more clean, efficient, connected, and safe. Given that transportation represents one-seventh of the world's economy, the IoV will play an important part of the wisdom city in the future.

This Special Issue aims at presenting the current state-of-the-art research and future trends on various aspects of IoV technologies. It combines the emerging mobile communications and IoV paradigms, in a common research ground, in order to present various research concepts. The major subjects of this Special Issue cover methodologies, modeling, analysis, and newly introduced communication technologies and applications. More specifically, main topics are computational intelligence for ambient-assisted driving, human behavior analysis, modeling and understanding, driver's activity recognition, processing of sensor data, vehicle communication, information security, mobile social networks, and machine learning. All of these papers not only provide novel ideas and state-of-the-art techniques in the field, but also stimulate future research in the sustainable environment.

The first two papers address issues in vehicular and surveillance technologies. With the advances of information communication technologies and automotive electronics, vehicular ad hoc networks (VANETs) is becoming feasible and provides efficient communication between vehicles. Live road surveillance (LRS) video streaming is a new type of safety data that can be transmitted in VANETs. Clustering is an efficient technique to relieve network congestion because it can reduce the number of vehicles to transmit data. The paper by Huang *et al*., "EVAC-AV: The Live Road Surveillance Control Scheme Using an Effective-Vision-Area-Based Clustering (EVAC) Algorithm with the Adaptive Video Streaming Technique" proposed an effective-vision–area-based clustering algorithm with the adaptive video streaming technique (EVAC-AV) for LRS services. By adopting the adaptive video streaming mechanism to adaptively adjust the video streaming bit rate can have suitable video quality in the not so good wireless network conditions. Simulation results shown that the proposed techniques can provide more stable services and better video quality.

The traditional routing protocols in VANETs are mainly based on planar scenarios, however, the actual application environments are three dimensional (3-D). The paper by Zhu *et al*., "A Hybrid Routing Protocol for 3-D Vehicular Ad Hoc Networks" focuses on discussing routing issues in 3-D scenarios of VANETs. The authors analyzed the characteristics of 3-D city road network and the key design points of the 3-D routing protocols in VANETs. In the complex 3-D interchange scenario, this work introduces completion process of neighbor list considering the feature of the concept of virtual neighbor node and the fluctuant transmission range. Simulation results show that the proposed protocols can achieve better performance in terms of packet delivery ratio, average hop count, and end-to-end delay.

The third paper focuses on cooperative spectrum sensing. Cognitive radio is intelligent wireless communication method that is aware of its environment and adapts accordingly to utilize the spectral efficiency. The efficient utilization of spectrum resource, self-adaptation, and dynamic spectrum sharing in vehicular environments makes cognitive radio a major candidate for vehicular communication. However, high mobility in vehicular communication can reduce the performance of the spectrum sensing. The paper by Paul *et al*., "Cooperative Cognitive Intelligence for Internet of Vehicles" proposed a system model for cooperative spectrum sensing on vehicular network. This research suggested an architecture for cooperative centralized and distributed spectrum sensing in vehicular networks that fully unitize the entire spectrum band. The authors designed a system model for decision fusion techniques using renewal theory and analyzed the probability of detection of primary channel and the average waiting time. Experimental results show that the proposed cooperative cognitive model can minimize interference and reduce average waiting time of cognitive radio user on cooperative spectrum sensing. The proposed cooperative spectrum sensing techniques can be applied to various M2M schemes and extended to the IoT environment as well.

Digital Object Identifier 10.1109/JSYST.2017.2718318

The fourth paper focuses on novel applications. Advertising among vehicles is a promising application, which will inform drivers and passengers features of products and information about sales promotions. The paper by Zhang *et al*., "Bus-Ads: Bus Trajectory-Based Advertisement in VANETs Using Coalition Formation Game" proposed a bus trajectory-based advertising in VANET, where the buses broadcast advertisements to private vehicles running within their communication range. The scheme includes two phases, the bus broadcasting phase and the private vehicle sharing phase. In the bus broadcasting phase, a bus searches for and broadcasts the most priced advertising segment to private vehicles in the communication range of it. In the private vehicle sharing phase, the authors applied coalition formation game to guide private vehicles construct broadcast coalitions for efficient advertisement sharing. Extensive experiments were conducted in this work. Simulation results show that bus-ads scheme can achieve about twice the total benefits for private vehicles compared with that of the noncoalition-based scheme.

All of the above papers either address technical issues in vehicle communication or information security or propose novel application models in the various IoV and mobile social networks fields. They also trigger further related research and technology improvements in application of situated computing. Honorably, this Special Issue serves as a landmark source for education, information, and reference to professors, researchers, and graduate students interested in updating their knowledge about or active in IoV, vehicle safety, adaptive systems, and novel application models for future information services and systems.

This Special Issue covers different aspects of the problem, both from the theoretical to practical side. After a large open call for papers, an international editorial committee selected four research papers. Each paper was reviewed by at least three reviewers.

The guest editors would like to express sincere gratitude to Prof. Vincenzo Piuri for giving the opportunity to prepare this Special Issue. In addition, we are deeply indebted to numerous reviewers for their professional effort, insight, and hard work put into commenting on the selected papers that reflect the essence of this Special Issue. Last, but not least, we are grateful to all the authors for their contributions and for undertaking two-cycle revisions of their manuscripts, without which this Special Issue could not have been produced.

CHING-HSIEN HSU, *Guest Editor*
Department of Computer Science and Information Engineering
Chung Hua University
Hsinchu 30012, Taiwan
(e-mail: chh@chu.edu.tw)

SHANGGUANG WANG, *Guest Editor*
State Key Laboratory of Networking and Switching Technology
Beijing University of Posts and Telecommunications
Beijing 100088, China
(e-mail: sgwang@bupt.edu.cn)

YU YUAN, *Guest Editor*
Senses Global Corporation
Shenzhen, Guangdong 518057, China
(e-mail: y.yuan@senses.global)

Ching-Hsien Hsu is a Professor and the Chairman of the Department of Computer Science and Information Engineering, Chung Hua University, Hsinchu, Taiwan. From 2012 to 2016, he was a Distinguished Chair Professor with the Tianjin University of Technology, Tianjin, China. He has authored or coauthored 200 papers, including top journals such as the IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS, IEEE TRANSACTIONS ON SERVICES COMPUTING, IEEE TRANSACTIONS ON SERVICES COMPUTING, IEEE TRANSACTIONS ON EMERGING TOPICS IN COMPUTING, IEEE TRANSACTIONS ON SUSTAINABLE COMPUTING, IEEE SYSTEMS JOURNAL, *IEEE Network*, and *IEEE Communications Magazine*. His research interests include high-performance computing, cloud computing, parallel and distributed systems, big data analytics, ubiquitous/pervasive computing, and intelligence.

Dr. Hsu was the nine-time recipient of the Distinguished Award for Excellence in Research from Chung Hua University. He is the Vice Chair of the IEEE Technical Committee on Cloud Computing, Executive Committee of the IEEE Technical Committee on Scalable Computing, and the Taiwan Association of Cloud Computing.

Shangguang Wang (GS'11–M'11–SM'16) received the Ph.D. degree from the Beijing University of Posts and Telecommunications (BUPT), Beijing, China, in 2011.

He is an Associate Professor with the State Key Laboratory of Networking and Switching Technology, BUPT. He has coauthored more than 100 papers. His research interests include service computing and cloud computing.

Dr. Wang has played a key role at many international conferences and workshops in such roles as General Chair and TPC Chair. He is the Editor-in-Chief of the *International Journal of Web Science*.

Yu Yuan (M'04–SM'10) founded the Senses Global Corporation, Shenzhen, Guangdong, China, a multinational technology company specializing in virtual reality, augmented reality, human augmentation, and smart robots. Prior to this, he was with IBM Research, as a Research Scientist. As a veteran Researcher and Practitioner in the areas of consumer electronics, transportation, and Internet of Things, he has filed numerous patents and has been published extensively in referred conferences and journals.

Dr. Yuan is currently the Chair of the IEEE Digital Senses Initiative, the Standards Chair of the IEEE Consumer Electronics Society, the Chair of the IEEE Virtual Reality and Augmented Reality Working Group (IEEE P2048 Standards Series), and a Board member of the IEEE Standards Association Standards Board. He is also serving on several TRB Standing Committees and IFAC Technical Committees.