

Guest Editorial

Special Issue on Big Data Analytics and Management in Internet of Things

THIS JOURNAL'S "Special Issue on Big Data Analytics and Management in Internet of Things" provides a highly exciting opportunity to explore the interdisciplinary nature of the management of Internet of Things (IoT) and big data analytics. Both IoT and big data keep making headlines everywhere, drawing a large amount of research interest, a fast expanding universe of applications, and highlighting unprecedented challenges. On one hand, the IoT has been generating widespread research interest across a variety of technical areas, including the sensor network management, data communication, temporal and spatial data analysis, and visualization. On the other hand, big data are providing innovative solutions addressing the challenges posed by data volume, velocity, variety, and veracity, known as the 4Vs. Instead of being overwhelmed by these issues, researchers and scholars are making significant progress in generating value out of big data. One such effort is to exploit the synergies between IoT and big data, so that both have increased impact. Therefore, we are delighted to introduce this JOURNAL'S Special Issue as a forum to present innovative ideas and emerging solutions in this new interdisciplinary area.

The primary objective of this JOURNAL'S Special Issue is to publish current, high quality, and original research work alongside relevant, insightful reviews, making this Special Issue engaging, accessible, integrative, and vibrant. As such, in this JOURNAL'S Special Issue, there is a collection of technical papers covering recent research findings. This collection consists of the following types of work. First, we have four research papers, which demonstrate the theoretical and methodological underpinnings to the management of IoT and big data analytics. These form clear and solid contributions toward this evolving, interdisciplinary field. Second, we have two application papers, which provide specific application solutions in Internet of vehicles (IoV) environment and large-scale data centers. Taken as a whole, the six papers address the innovations and challenges in the management of IoT and big data analytics at different levels, offering a comprehensive set of technologies to meet the objective of this Special Issue.

The first paper is entitled "Meta Expert Learning and Efficient Pruning for Evolving Data Streams" and focuses on studying the pruning function for maintaining the appropriate set of experts. This paper takes advantage of the algorithmic procedure of meta expert learnings to study how pruning the set of base learners in the meta expert learning affects

the prediction accuracy for different types of drifts, which may explain the main reason behind the weak performance of boosting methods in the streaming environments.

The second paper is entitled "Predictable Low-Latency Event Detection With Parallel Complex Event Processing" and addresses the problems of traditional complex event processing (CEP). In order to overcome the shortcomings of traditional CEP which is not capable of supporting low-latency event detection for large-scale IoT applications and keeping a predictable buffer limit, this paper proposes a novel pattern-sensitive stream partitioning model which allows to consistently parallelize a wide class of CEP operators and ensures a high degree of parallelism, and methods to model the workload and dynamically adapt the parallelization degree utilizing queuing theory (QT), so that a buffering limit of each operator can be met predictably.

The third paper is entitled "CrowdMi: Scalable and Diagnosable Mobile Voice Quality Assessment Through Wireless Analytics" and considers the scalable and diagnosable for voice call quality assessment in mobile networks. Revisiting the problem, and for the first time exploring wireless, the causal factor that directly impacts the mobile voice quality but yet lacks of attention, this paper designs a wireless analytics algorithm, named CrowdMi, which models the mobile voice quality by crowdsourcing and mining network indicators of cellphones, and implements a light-load CrowdMi Client APP in Android smartphones. The pilot trial in VoLTE network in different geographical areas and network coverages shows that the CrowdMi does not require any additional hardware or human effort, and has very high model accuracy and strong diagnosability.

The fourth paper is entitled "Efficient Multi-Pattern Event Processing Over High-Speed Train Data Streams" and focuses on the shortcomings of multipattern complex event detection in the high-speed train onboard system. This paper proposes a multipattern complex event detection model, Multipattern Event Processing (MPEP), constructed by three parts: 1) multipattern state transition; 2) failure transition; and 3) state output. Based on MPEP, an intelligent onboard system for high-speed train is preliminarily implemented. Experimental results show that MPEP can effectively optimize the complex event detection process and improve its throughput by eliminating duplicate automata states and redundant computations.

The fifth paper is entitled "Coalition Games for Spatio-Temporal Big Data in Internet of Vehicles Environment: A Comparative Analysis" and considers the spatio-temporal nature of database repository in IoV environment. The nature of collected data varies in size, volume, and dimensions with

the passage of time which requires large storage and computation time for processing. This paper uses Bayesian coalition game (BCG) and learning automata (LA) to analyze the spatio-temporal big data, and provides a comparative analysis of cooperative or noncooperative BCGs for VANETs in IoV environment.

The sixth paper is entitled “Improving Routing Performance via Dynamic Programming in Large-Scale Data Centers” and remedying the shortcoming of being able to work out the shortest paths occurred in most existing novel server-centric network structures in large-scale data centers, which original routing mechanisms are based on divide and conquer (DC). This paper proposes the Athena routing mechanism (ARM) which is an improving routing mechanism based on dynamic programming (DP) and applies it for the communication delay reduction.

Finally, we would like to take the opportunity to thank our editors and reviewers for their endeavor. Without the great efforts from them, we could not have made this JOURNAL’S Special Issue happen. We would also like to thank this JOURNAL’S Editor-in-Chief, Dr. Chonggang Wang, for his constant support, and express our appreciation to Prof. M. Daneshmand from the Stevens Institute of Technology, for supporting this JOURNAL’S Special Issue.

HUANSHENG NING, *Guest Editor*
School of Computer and Communication Engineering
University of Science and Technology Beijing (USTB)
Beijing 100083, China

DAVID G. BELANGER, *Guest Editor*
School of Business
Stevens Institute of Technology
Hoboken, NJ 07030 USA

YINGLONG XIA, *Guest Editor*
IBM T. J. Watson Research Center
Yorktown Heights, NY 10598 USA

VINCENZO PIURI, *Guest Editor*
Department of Computer Science
Università degli Studi di Milano
20122 Milan, Italy

ALBERT Y. ZOMAYA, *Guest Editor*
School of Information Technologies
The University of Sydney
Sydney, N.S.W. 2006, Australia



Huansheng Ning (M’10–SM’12) is currently a Professor with the University of Science and Technology Beijing (USTB), Beijing, China. He has authored more than 50 journal/conference papers and 2 books on the Internet of Things. His research interests include Internet of Things, cyber physical modeling, and electromagnetic sensing and identification.

Prof. Ning serves as an Associate Editor of the IEEE SYSTEMS JOURNAL and the IEEE INTERNET OF THINGS JOURNAL. He hosted the 2013 World Cybermatics Congress as the Joint Executive Chair. He was the recipient of the IEEE Computer Society Meritorious Service Award in 2014.



David G. Belanger (M’01–SM’03) received the B.S. degree in mathematics from Union College, Schenectady, NY, USA, and the M.S. and Ph.D. degrees from Case Western Reserve University, Cleveland, OH, USA, both in mathematics.

He joined Bell Telephone Laboratories in 1979. Currently, he is a Senior Research Fellow with the Stevens Institute of Technology, Hoboken, NJ, USA. He teaches and is a Leader of the Business Intelligence and Analysis Graduate Degree Program, Stevens Institute of Technology. He retired from AT&T Laboratories as a Chief Scientist, and 15 years as a Vice President of Information, Software, and Systems Research, AT&T Laboratories, and as a Creator of the AT&T InfoLab. InfoLab was an early participant in “Big Data” research and practice. He holds 24 patents. His research interests include big data, software engineering, data management and analysis, and networking.

Dr. Belanger is an ACM Distinguished Engineer. Currently, he is a Co-Leader of the IEEE Big Data Initiative, and a member of the Steering Committee of the New Jersey Big Data Alliance.

He was the recipient of the AT&T Science and Technology Medal in 1998, IEEE Communications Society Industrial Innovator Award in 2009, and named an AT&T Fellow in 2006.



Yinglong Xia (GSM'10–M'11) received the M.S. degree from Tsinghua University, Beijing, China, in 2006, and the Ph.D. degree from the University of Southern California (USC), Los Angeles, CA, USA, in 2010.

Currently, he is a Research Staff Member with the IBM T. J. Watson Research Center, Yorktown Heights, NY, USA. He also serves as a Director on the Board of the EU Linked Data Benchmark Council (LDBC). He has authored extensively including 2 book chapters and more than 40 papers in refereed journals and conferences/workshops.

Dr. Xia is active in professional activities, including chairing/cochairing the Technical Program of IEEE CBD'15, the publicity of IEEE IPDPS'15 and HiPC'15, and the Industry Program of IEEE ICME'14. He was an NSF/CRA Computing Innovative Fellow in 2010–2012. He was the recipient of the IBM Research Division Eminence and Excellence Award in 2013.



Vincenzo Piuri (S'84–M'86–SM'96–F'01) received the Ph.D. degree in computer engineering from the Politecnico di Milano, Milan, Italy, in 1989.

He has been an Associate Professor with the Politecnico di Milano, and a Visiting Professor with The University of Texas at Austin, Austin, TX, USA, and George Mason University, Fairfax, VA, USA. He has been a Full Professor of computer engineering with the Università degli Studi di Milano, Milan, Italy, since 2000. He has authored more than 350 papers in international journals, proceedings of international conferences, books, and book chapters. His research interests include signal and image processing, machine learning, pattern analysis and recognition, theory and industrial applications of neural networks, biometrics, intelligent measurement systems, industrial applications, fault tolerance, digital processing architectures, embedded systems, and arithmetic architectures.

Dr. Piuri is a Distinguished Scientist of the ACM. He is a Senior Member of INNS. He is the IEEE Vice President for Technical Activities in 2015, and the Editor-in-Chief of the IEEE

SYSTEMS JOURNAL, from 2013 to 2015.



Albert Y. Zomaya (S'88–M'91–SM'97–F'04) is currently the Chair Professor of High Performance Computing and Networking with the School of Information Technologies, The University of Sydney, Sydney, N.S.W., Australia. He is also the Director of the Centre for Distributed and High Performance Computing, which was established in late 2009. He has authored more than 500 scientific papers and has authored, coauthored, or edited more than 20 books. His research interests include areas of parallel and distributed computing and complex systems.

Prof. Zomaya is a Chartered Engineer. He served as the Editor-in-Chief of the IEEE TRANSACTIONS ON COMPUTERS, from 2011 to 2014. Currently, he serves as an Editor-in-Chief of Springer's *Scalable Computing* and he is an Associate Editor for 22 leading journals such as *ACM Computing Surveys* and the *Journal of Parallel and Distributed Computing*. He was the recipient of the IEEE Technical Committee on Parallel Processing Outstanding Service Award in 2011, the IEEE Technical Committee on Scalable Computing Medal for Excellence in Scalable

Computing in 2011, and the IEEE Computer Society Technical Achievement Award in 2014. He is a Fellow of AAAS and IET (UK).