Digital Object Identifier 10.1109/TETC.2021.3113485

Guest Editorial: Special Section on New Trends in Parallel and Distributed Computing for Human Sensible Applications

DANIELE D'AGOSTINO, FRANCESCO LEPORATI, MASSIMO TORQUATI, AND JINGLING XUE

Parallel, Distributed, and Network-Based Processing has undergone impressive changes over recent years. New architectures, advanced programming models, improved efficiency, and novel application domains have rapidly become the central focus of this discipline.

These changes are often a result of the cross-fertilization of parallel and distributed computational paradigms with other rapidly evolving technologies in different disciplines. Therefore, it is of paramount importance to review and assess these new developments in relation to the recent research achievements in the different areas of parallel and distributed computing, considering both the industrial and scientific points of view.

Often these technologies can affect our daily life, and several are the applications into which parallel computers find full usage: the increasing widely usage of biomedical image processing often in real-time and with the application of complex machine and deep learning algorithms, it is only one of the most evident examples of this. Even the continuous monitoring of the environmental situations with the full integration of cloud architectures is a more and more considered approach. Many and diversified are the fields into which these approaches find application: from commercial/financial predictions to meteo forecasts, from computational physics/fluid dynamics to all those problems related to healthcare, wellness and personal monitoring. Safety moreover is really crucial and not secondary in all these applications.

This Special Section aimed at collecting high-quality scientific contributions from the research community working in the fields of parallel and distributed computing, data analytics algorithms and big data frameworks, application specific processing. Specifically, the main focus is on emerging new computing trends that affect *the concrete human life,* the so-called "*Human Sensible Applications*".

Problems in parallel computing related to implement precision medicine and novel therapeutical targets, real-time architectures for biomedical IoT, computational biology and chemical compounds simulations, realistic modelling of human body organs, bioimaging processing, but even emerging computing systems for Human Sustainability, including weather and climate changes monitoring/prediction, resources management, safety, disaster prediction and prevention, belong to this scenario.

Few of the papers included in this Special Section are extended versions of those presented at the Euromicro Conference on Parallel, Distributed and Network Based Processing (PDP 2019) held in Pavia (Italy). Others come from authors very active in the fields touched by this proposal.

All of them show how the high-performance computing is becoming dramatically important in many situations of the daily life: Security (I. Kotenko *et al.*), Wellness and Personal Monitoring (De Giovanni *et al.*), Genomics (Blanzieri *et al.*), Transports safety (Sai Prasanth *et al.*), Neuroscience (Olden *et al.*), Bio-imaging (Conti *et al.*), Bio-informatics (Colonnelli *et al.*), Remote Sensing (Li Tao).

We believe, on the other hand, that not only these applications could arouse interest of the readers but also the methodologies and the technological approaches exploited. From the hardware-oriented point of view the two papers from De Giovanni and Olden illustrate an application specific design of the multicore hardware targeting subjects needs and characteristics and advanced staging techniques for optimizing huge amount of data processing in Deep Learning (DL).

Parallel computers are well known for processing Machine-Deep Learning algorithms that sometimes are optimized for the specific architecture and modified to target the particular problem. The paper by Kotenko describes a distributed parallel processing implementation for efficient and timely detection in IoT systems, while Li Tao presents new solutions for training Cube-CNN networks in hyperspectral image processing and Conti bio-inspired algorithms to maintain quality and efficiency in Service Oriented Networks.

In terms of tools for parallel processing, the paper by Colonnelli illustrates Streamflow, a novel workflow approach for execution environments.

Finally, about modelisation and simulation approaches, the papers by Blanzieri and Sai Prasanth describe respectively

2168-6750 © 2021 IEEE. Personal use is permitted, but republication/redistribution requires IEEE permission. See https://www.ieee.org/publications/rights/index.html for more information.

simulations of protein-protein interactions (significant to evaluate kind and degree of relationship between human genes) and heuristic models of passenger distribution to reschedule train traffic.

Hence the Guest Editors hope to have provided a good coverage of many issues, aspects and problems typical of high-performance computing implementations through this Special Section, and all the readers can enjoy reading.

DANIELE D'AGOSTINO received the PhD degree. He is currently a researcher with the Institute of Electronics, Information Engineering and Telecommunications, National Research Council. He has coauthored more than 100 scientific papers, which were published in journals, book chapters, and conference proceedings. His research focuses on the design of science gateways in different research fields, the resource allocation in grid/cloud for multidisciplinary applications. He is a program committee member of several European conferences on high performance and distributed computing, co-organized the 22th Euromicro International Conference on Parallel, Distributed, and Network-Based Processing, was the guest editor of several special issues on ISI journals.

FRANCESCO LEPORATI received the PhD degree. He is currently an associate professor of mechatronics, industrial informatics and embedded systems, and digital systems design with the Electrical, Biomedical and Computer Department, University of Pavia. He has authored more than 100 publications in journals, international conference proceedings, books chapters and special issue, and of invited talks. His research focuses on the design and the implementation of architectures for high performance computing, in particular exploiting FPGA technology, applied to parallel computing and special purpose computers, signal and image processing, automotive, and biomedical instrumentation. He is the reviewer of several ACM or IEEE journals and collaborates with *Elsevier Microprocessors and Microsystems* Editorial Board, where he is the handling editor of the subject area of FPGA-based systems and biomedical applications. His researches were the recipients of awards by Altera (Intel), Altran Engineering, and Texas Instruments. He was the chair of the Euromicro Conferences on Parallel and Distributed Processing and Networks (PDP) held in Mantova in 2001 and Pavia in 2019 and the Euromicro Conference on Digital Systems Design (DSD) held in Parma in 2008, Verona in 2014, and in Palermo in 2021. He is a member of the Euromicro Society (director of Italian correspondents and deputy chairman). He is also the co-chair of the Microcomputer laboratory that received the GPU research Center acknowledgment from NVIDIA.

MASSIMO TORQUATI is currently an assistant professor with the Computer Science Department, University of Pisa. He was with the Industry for major Italian companies, having the opportunity to participate in large-scale international projects. He has authored or coauthored more than 100 peer reviewed papers in conference proceedings, books, and international journals, mostly in the fields of parallel programming models, parallel and distributed programming, and run-time systems for parallel and distributed systems. He was involved in a number of Italian, EU, and industry-supported research projects, including the Artemis SMECY, EU FP7 ParaPhrase, EU FP7 REPARA, and EU H2020 RePhrase, EuroHPC ADMIRE, and TEXTAROSSA. He also organized several conferences and workshops in the field of parallel and distributed computing. He was the editor of the Springer book *Smart Multicore Embedded Systems* and the guest editor of several journal special issues.

JINGLING XUE received the BEng and MEng degrees in computer science and engineering from Tsinghua University in 1984 and 1987, respectively, and the PhD degree in computer science and engineering from Edinburgh University in 1992. He is currently a scientia professor with the School of Computer Science and Engineering, UNSW Sydney. He has authored or coauthored a research monograph on loop tiling, one of the most important loop transformations for improving parallelism and locality, more than 70 journal articles, and more than 160 conference papers, with many appearing in prestigious IEEE/ACM journals and conferences. His research interests include programming languages, compiler technology, and program analysis. He is also interested in sharing the outcomes of his research projects in the form of open-source tools, by supporting scientific replicability and reproducibility. He has coauthored papers with his students, which have been selected for Best/Distinguished/Test-of-Time awards at a number of prestigious conferences. He was the program/general chair of a number of major conferences in his field, including LCTES'13, CC'18, CGO'20, and LCTES'20. He was also on program committees of major conferences in programming languages, compiler technology, and software engineering, including PLDI (ERC), POPL (ERC), OOPSLA, PPoPP, CGO, ICSE, and ISSTA. He was an associate editor for the *IEEE Transactions on Computers* and is currently on the editorial boards of *IEEE Transactions on Emerging Topics in Computing* and SP&E.