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Marina L. Gavrilova · C. J. Kenneth Tan
Nabendu Chaki · Khalid Saeed (Eds.)

Transactions on Computational Science XXXI

Special Issue on Signal Processing
and Security in Distributed Systems

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LNCS Transactions on Computational Science

Computational science, an emerging and increasingly vital field, is now widely recognized as an integral part of scientific and technical investigations, affecting researchers and practitioners in areas ranging from aerospace and automotive research to biochemistry, electronics, geosciences, mathematics, and physics. Computer systems research and the exploitation of applied research naturally complement each other. The increased complexity of many challenges in computational science demands the use of supercomputing, parallel processing, sophisticated algorithms, and advanced system software and architecture. It is therefore invaluable to have input by systems research experts in applied computational science research.

Transactions on Computational Science focuses on original high-quality research in the realm of computational science in parallel and distributed environments, also encompassing the underlying theoretical foundations and the applications of large-scale computation.

The journal offers practitioners and researchers the opportunity to share computational techniques and solutions in this area, to identify new issues, and to shape future directions for research, and it enables industrial users to apply leading-edge, large-scale, high-performance computational methods.

In addition to addressing various research and application issues, the journal aims to present material that is validated – crucial to the application and advancement of the research conducted in academic and industrial settings. In this spirit, the journal focuses on publications that present results and computational techniques that are verifiable.

Scope

The scope of the journal includes, but is not limited to, the following computational methods and applications:

- Aeronautics and Aerospace
- Astrophysics
- Big Data Analytics
- Bioinformatics
- Biometric Technologies
- Climate and Weather Modeling
- Communication and Data Networks
- Compilers and Operating Systems
- Computer Graphics
- Computational Biology
- Computational Chemistry
- Computational Finance and Econometrics

- Computational Fluid Dynamics
- Computational Geometry
- Computational Number Theory
- Data Representation and Storage
- Data Mining and Data Warehousing
- Information and Online Security
- Grid Computing
- Hardware/Software Co-design
- High-Performance Computing
- Image and Video Processing
- Information Systems
- Information Retrieval
- Modeling and Simulations
- Mobile Computing
- Numerical and Scientific Computing
- Parallel and Distributed Computing
- Robotics and Navigation
- Supercomputing
- System-on-Chip Design and Engineering
- Virtual Reality and Cyberworlds
- Visualization

Editorial

The *Transactions on Computational Science* journal is published as part of the Springer series *Lecture Notes in Computer Science*, and is devoted to a range of computational science issues, from theoretical aspects to application-dependent studies and the validation of emerging technologies.

The journal focuses on original high-quality research in the realm of computational science in parallel and distributed environments, encompassing the facilitating theoretical foundations and the applications of large-scale computations and massive data processing. Practitioners and researchers share computational techniques and solutions in the area, identify new issues, and shape future directions for research as well as enable industrial users to apply the techniques presented.

The current issue is devoted to research on *Signal Processing and Security in Distributed Systems* and is edited by Nabendu Chaki, Professor at the University of Calcutta, India, and Khalid Saeed, Professor at Bialystok University of Technology, Poland. This special issue comprises seven articles preceded by the guest editor's preface. The three best papers were invited following the 4th Doctoral Symposium on Applied Computation and Security Systems (ACSS), and four other contributions were accepted following an open call for papers. The authors for the selected papers are from Europe, North America, and India.

We would like to extend our sincere appreciation to the special issue guest editors, Nabendu Chaki and Khalid Saeed, for their dedication, diligence, and inspiration in preparing this special issue on a very relevant and important topic. We would also like to thank all of the authors for submitting their papers to the special issue and the associate editors and referees for their valuable work. We would like to express our gratitude to the LNCS editorial staff of Springer, who supported us at every stage of the project.

We do hope that the fine collection of papers presented in this special issue will be a valuable resource for *Transactions on Computational Science* readers and will stimulate further research into the vibrant area of computational science applications.

November 2017

Marina L. Gavrilova
C. J. Kenneth Tan

Guest Editors' Preface

This special issue includes the extended versions of high-quality papers selected from the 4th Doctoral Symposium on Applied Computation and Security Systems (ACSS) held at the National Institute of Technology (NIT) Patna, India, during March 17–19, 2017. ACSS has been co-organized annually since 2014 by the University of Calcutta together with Ca Foscari University, Italy, and Bialystok University of Science and Technology in Poland.

The Doctoral Symposium on Applied Computation and Security Systems (ACSS) aims to facilitate PhD scholars enrolled at universities and research institutes around the world to present and discuss part of their research work with peers in their fields. Each contributed paper presented at ACSS must have at least one enrolled PhD student as the first author of the submission and his/her supervisor(s) as co-author(s). As indicated in the name of the symposium, security remains one of the primary focus areas for this annual meet.

A two-volume post-symposium book has been published by Springer in the AISC series since the inception of ACSS in 2014. The ACSS books are indexed by Scopus and Web of Sciences. In 2015, a new sub-series called ACSS was introduced under AISC and the post-symposium ACSS books are published in this sub-series. The papers selected for this special issue indicate the excellence that marks the success of ACSS in bringing PhD scholars into this forum for the exchange of ideas toward achieving greater scientific goals.

The first paper in this volume is “A ZigZag Pattern of Local Extremum Logarithm Difference for Illumination invariant and Heterogeneous Face Recognition” authored by Hiranmoy Roy and Debotosh Bhattacharjee. The authors propose a new method for face recognition and in the process they introduce Local Extremum Logarithm Difference (LELD) image representation, which is illumination-invariant. A novel methodology for matching of illumination-invariant and heterogeneous faces is proposed here. In this work, the authors build on the premise that since edges are invariant for different modalities, the focus for recognition would be on edges. A novel local zigzag binary pattern, called Zigzag Local Extremum Logarithm Difference (ZZPLELD) is proposed by the authors to capture the local variation of LELD. The proposed methodology is tested for different illumination variations, sketch photos, etc. Recognition of around 96% accuracy with multiple databases under varying illuminations establishes the efficacy of the work. The accuracy is even higher for the sketches viewed. A rank-1 accuracy of 99.69% is achieved for the NIR-VIS benchmark database.

In the second paper titled “Automatic Identification of Tala from Tabla Signal” by Rajib Sarkar, Ankita Singh, Anjishnu Mondal, and Sanjoy Kumar Saha, the authors present a scheme for identifying the *Tala* from the *Tabla* signal. *Tabla* is the mostly widely used percussion instrument in Indian classical music and it is played according to a *Tala*. Each *tala* is formed as a specific sequence of *Bols* that repeats itself. In this

paper, the authors have segmented *Bols* using an Attack-Decay-Sustain-Release (ADSR) model. This leads to the generation of a transcript showing the *Bol* sequence for a given *Tabla* signal. A novel matching scheme is proposed to match the *Tala* templates and transcript for the given signal. Experimental verification using a large variety of datasets confirms the performance of the proposed methodology. The work may turn out to be pioneering research in developing a robust and automated system for analyzing and evaluating the performance of a learner.

The third paper in is titled “A Novel Approach of Retinal Disorder Diagnosing Using Optical Coherence Tomography Scanners” and is written by Maciej Szymkowski and Emil Saeed. In this work, the authors present a detailed study of OCT and OCT-related diseases. The authors conduct the work on the hypothesis that it is possible to create an image-based system for automatic diagnosis of various retinal diseases with high accuracy. OCT is a promising technology that provides a great amount of data in each sample. The novelty is the automatic identification of healthy images from pathological retinas. They propose a new algorithm and implement the same. The objective is to detect sick eyes suffering from diabetic retinopathy and certain types of age-related macular degeneration. Experiments validate that it is possible to automatically detect anomalies in the retinal structure. If the proposed technology is translated to the actual application scenario, this would help shorten the diagnostic pathway.

The fourth work titled “Algebraic and Logical Emulations of Quantum Circuits” is by Kenneth Wingate Regan, Amlan Chakrabarti, and Chaowen Guan. The paper contributes to the theory of quantum circuits with a number of original theoretical results. The focus is on complexity issues that are particularly relevant as the scalability problem is paramount for quantum circuits. The authors adopt a novel approach using algebraic and logical emulations. This provides an interesting setting to formally model complexity properties. The contribution is mostly theoretical, but a few experimental results provide evidence of their actual impact. We hope that readers will agree that this paper is one of the most thought-provoking articles in this special issue.

The fifth paper, “Advanced Monitoring-Based Intrusion Detection System for Distributed and Intelligent Energy Theft: DIET Attack in Advanced Metering Infrastructure,” authored by Manali Chakraborty, presents a new attack type specific to smart power grids called Distributed and Intelligent Energy Theft (DIET) attack. The authors subsequently propose a two-tier intrusion detection system (IDS) to detect the DIET attack. The proposed solution also includes passive monitoring on the system to ensure an additional level of security. The idea is novel and supported by significant analysis of simulation results using standard simulation software. The results are interesting and impressive. The proposed IDS is also capable of detecting type-1 and type-2 attacks.

The sixth paper in this Special Issue titled “Combining Symbolic and Numerical Domains for Information Leakage Analysis” by Agostino Cortesi, Raju Halder, Pietro Ferrara, Matteo Zanioli deals with securing information flow. The proposal is based on an abstract interpretation framework comprising symbolic and numerical domains for information-flow analysis of software combining variable dependency analysis with numerical abstractions. The accuracy of the dependency variable sensitivity is enhanced by analyzing the abstract programs over a numerical abstract domain. Static analysis of information leakage with the tool Sample provides the proof of concepts for

the proposed theory. The authors claim that the proposed approach yields improvement in accuracy and efficiency. A propositional formula domain based on a dependency variable was developed to realize the information flow for the abstract language. Besides, further abstract semantics are developed for both imperative and database query languages. The proposed theory is sound and able to analyze the information flow without any major constraint of the target language. An interesting experimental result is illustrated over a set of security benchmarks. The work is interesting, and the results are adequate to establish the claims.

The last article in this volume, “Minimizing Aliasing Effects Using Faster Super Resolution Technique on Text Images” by Soma Datta, Khalid Saeed and Nabendu Chaki, presents a novel resolution enhancement technique to reduce the aliasing effects from the text documented image maintaining low computational time. The proposed hybrid method provides better resolution for the most informative regions. The proposed method is verified on aliasing-affected text documented images. A distinct advantage of the proposed method over other conventional approaches is that it requires lower computational time to construct a high-resolution image from the respective low-resolution one. The proposed method offers much better smoothness value than the other existing methods.

We take this opportunity to express our heartfelt thanks and indebtedness to Prof. Marina Gavrilova, Editor-in-Chief of *Transactions on Computational Science*, for her continual guidance in making this Special Issue. We thank the journal's editorial staff for their support and hard work toward developing the volume. We are grateful to the authors for their high-quality contributions and cooperation in preparing this special issue. With a deep sense of gratitude, we appreciate the support from the ACSS Program Committee members and reviewers, especially from Prof. Agostino Cortesi and Prof. Rituparna Chaki for choosing the best of the submissions from ACSS 2018. They did an excellent job in encouraging authors to make significant extensions and advancements of the original works that were presented during the symposium. Our special thanks to the organizers of ACSS 2018 for their support in organizing the symposium. The culmination of their efforts at the grass-root level has led to this special issue.

This foreword will remain incomplete without a mention of the readers of this special issue of the *Transactions on Computational Science* journal. Many thanks to all of them!

November 2017

Nabendu Chaki
Khalid Saeed

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Contents

A ZigZag Pattern of Local Extremum Logarithm Difference for Illumination-Invariant and Heterogeneous Face Recognition	1
<i>Hiranmoy Roy and Debotosh Bhattacharjee</i>	
Automatic Identification of <i>Tala</i> from <i>Tabla</i> Signal.	20
<i>Rajib Sarkar, Anjishnu Mondal, Ankita Singh, and Sanjoy Kumar Saha</i>	
A Novel Approach of Retinal Disorder Diagnosing Using Optical Coherence Tomography Scanners	31
<i>Maciej Szymkowski and Emil Saeed</i>	
Algebraic and Logical Emulations of Quantum Circuits	41
<i>Kenneth Regan, Amlan Chakrabarti, and Chaowen Guan</i>	
Advanced Monitoring Based Intrusion Detection System for Distributed and Intelligent Energy Theft: DIET Attack in Advanced Metering Infrastructure.	77
<i>Manali Chakraborty</i>	
Combining Symbolic and Numerical Domains for Information Leakage Analysis	98
<i>Agostino Cortesi, Pietro Ferrara, Raju Halder, and Matteo Zanioli</i>	
Minimizing Aliasing Effects Using Faster Super Resolution Technique on Text Images.	136
<i>Soma Datta, Nabendu Chaki, and Khalid Saeed</i>	
Author Index	155