

# 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 possibility 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
- Bioinformatics
- 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
- Computational Physics
- Data Storage and Information Retrieval
- Data Mining and Data Warehousing
- Grid Computing
- Hardware/Software Co-design
- High-Energy Physics
- High-Performance Computing
- Numerical and Scientific Computing
- Parallel and Distributed Computing
- Reconfigurable Hardware
- Scientific Visualization
- Supercomputing
- System-on-Chip Design and Engineering

# Preface

We would like to present, with great pleasure, the inaugural volume of a new scholarly journal, *Transactions on Computational Science*. This journal is part of the Springer series *Lecture Notes in Computer Science*, and is devoted to the gamut of computational science issues, from theoretical aspects to application-dependent studies and the validation of emerging technologies.

This new journal was envisioned and founded to represent the growing needs of computational science as an emerging and increasingly vital field, now widely recognized as an integral part of scientific and technical investigations. Its mission is to become a voice of the computational science community, addressing researchers and practitioners in areas ranging from aerospace to biochemistry, from electronics to geosciences, from mathematics to software architecture, presenting verifiable computational methods, findings, and solutions.

*Transactions on Computational Science* focuses on original high-quality research in the realm of computational science in parallel and distributed environments, encompassing facilitation of the theoretical foundations and the applications of large-scale computations to massive data processing. The Journal is intended as a forum for practitioners and researchers to share computational techniques and solutions in the area, to identify new issues and to shape future directions for research, while industrial users may apply techniques of leading-edge, large-scale, high-performance computational methods.

This inaugural volume is devoted to computer systems research and the application of such research, which naturally complement each other. In this spirit, the volume is divided into two parts, with the first devoted to core computational science issues faced by researchers and industries today, and the second focusing on the development of novel computational techniques that are versatile and verifiable in a wide range of applications.

Part 1 of this volume comprises five manuscripts, connected by a unifying theme: information systems design. Specifically, the presented articles can be categorized into the following groups:

- Data flow analysis
- Building fuzzy interference systems
- Multi-agent systems design
- Models for curve fitting
- Network map topology representation

These articles exemplify the analysis and exploration of complex computational models and data sets from various domains. They provide invaluable insights into the studied problems and offer convincing case studies and experimental analysis.

Part 2 is concerned with the specific computational science problems in the areas of data processing and their industrial applications. The four papers comprising this part present original research in the following areas:

- Missing value imputation techniques in data mining
- Normalization techniques for electrocardiogram data analysis
- A unified method for solving laminar forced convection problems
- A new versatile technique for solving non-linear stochastic differential equations

Each article provides an example of a concrete industrial application or a case study of the presented methodology to amplify the impact of the contribution.

Many scientists and institutions have contributed to the creation and the success of the computational science community. We are very thankful to everybody within that community who supported the idea of creating a new LNCS journal subline – the *Transactions on Computational Science*. We are certain that this very first issue will be followed by many others, reporting new developments in the computational science field. This issue would not have been possible without the great support of the Editorial Board members, and we would like to express our sincere thanks to all of them. We would also like to express our gratitude to the LNCS editorial staff of Springer, in particular Alfred Hofmann and Ursula Barth, who supported us at every stage of the project. Throughout preparation of this volume the Editors were supported by various research programs and funds, including NSERC funding.

It is our hope that this fine collection of articles will be a valuable resource for *Transactions on Computational Science* readers and will stimulate further research into the vibrant area of computational science.

March 2008

Marina L. Gavrilova  
C.J. Kenneth Tan

# LNCS Transactions on Computational Science – Editorial Board

Marina L. Gavrilova, Editor-in-chief	University of Calgary, Canada
Chih Jeng Kenneth Tan, Editor-in-chief	OptimaNumerics, UK
Tetsuo Asano	JAIST, Japan
Brian A. Barsky	University of California at Berkeley, USA
Alexander V. Bogdanov	Institute for High Performance Computing and Data Bases, Russia
Martin Buecker	Aachen University, Germany
Rajkumar Buyya	University of Melbourne, Australia
Hyungseong Choo	Sungkyunkwan University, Korea
Danny Crookes	Queen's University Belfast, UK
Tamal Dey	Ohio State University, USA
Ivan Dimov	Bulgarian Academy of Sciences, Bulgaria
Magdy El-Tawil	Cairo University, Egypt
Oswaldo Gervasi	Università degli Studi di Perugia, Italy
Christopher Gold	University of Glamorgan, UK
Rodolfo Haber	Council for Scientific Research, Spain
Adolfy Hoisie	Los Alamos National Laboratory, USA
Daniel Kidger	Quadrics, UK
Deok-Soo Kim	Hanyang University, Korea
Ivana Kolingerova	University of West Bohemia, Czech Republic
Vladimir V. Korenkov	Joint Institute for Nuclear Research, Russia
Vipin Kumar	Army High Performance Computing Research Center, USA
Antonio Lagana	Università degli Studi di Perugia, Italy
D.T. Lee	Institute of Information Science, Academia Sinica, Taiwan
Laurence Liew	Platform Computing, Singapore
Nikolai Medvedev	Novosibirsk Russian Academy of Sciences, Russia
Graham M Megson	University of Reading, UK
Jaime H Moreno	IBM T.J. Watson Research Center, USA
Youngsong Mun	Soongsil University, Korea
Yuriy I. Nechaev	Russian Academy of Sciences, Russia
Genry E Norman	Russian Academy of Sciences, Russia
Dimitri Plemenos	Université de Limoges, France
Viktor K. Prasanna	University of Southern California, USA
Muhammad Sarfraz	KFUPM, Saudi Arabia
Dale Shires	Army Research Lab, USA
Masha Sosonkina	Ames Laboratory, USA
Alexei Sourin	Nanyang Technological University, Singapore
David Taniar	Monash University, Australia

Athanasios Vasilakos

Chee Yap

Igor Zacharov

Zahari Zlatev

University of Western Macedonia, Greece

New York University, USA

SGI Europe, Switzerland

National Environmental Research Institute, Denmark

# Table of Contents

## Part 1 - Information Systems Design

Formalization of Data Flow Computing and a Coinductive Approach to Verifying Flowware Synthesis . . . . .	1
<i>Phan Cong Vinh and Jonathan P. Bowen</i>	
Partners Selection in Multi-Agent Systems by Using Linear and Non-linear Approaches . . . . .	37
<i>Fenghui Ren and Minjie Zhang</i>	
Topology Representing Network Map – A New Tool for Visualization of High-Dimensional Data . . . . .	61
<i>Agnes Vathy-Fogarassy, Attila Kiss, and Janos Abonyi</i>	
Curve Fitting by Fractal Interpolation . . . . .	85
<i>Polychronis Manousopoulos, Vassileios Drakopoulos, and Theoharis Theoharis</i>	
Building Fuzzy Inference Systems with a New Interval Type-2 Fuzzy Logic Toolbox . . . . .	104
<i>Juan R. Castro, Oscar Castillo, Patricia Melin, and Antonio Rodríguez-Díaz</i>	

## Part 2 - Data Processing and Industrial Applications

Comparative Analysis of Electrocardiogram Data by Means of Temporal Locality Approach with Additional Normalization . . . . .	115
<i>Victor F. Dailyudenko</i>	
Missing Value Imputation Based on Data Clustering . . . . .	128
<i>Shichao Zhang, Jilian Zhang, Xiaofeng Zhu, Yongsong Qin, and Chengqi Zhang</i>	
Laminar Forced Convection in Circular Duct for Power-Law Fluid . . . . .	139
<i>Tudor Boaca and Ioana Boaca</i>	
The Homotopy Wiener-Hermite Expansion and Perturbation Technique (WHEP) . . . . .	159
<i>Magdy A. El-Tawil</i>	
<b>Author Index</b> . . . . .	181

