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Transactions on Computational Science XIV

Special Issue on Voronoi Diagrams
and Delaunay Triangulation

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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
- 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

Editorial

The Transactions on Computational Science 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.

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 volume, edited by Mir Abolfazl Mostafavi, is devoted to Voronoi Diagrams and Delaunay Triangulation. It is comprised of extended versions of nine papers, carefully selected from the papers presented at the International Symposium on Voronoi Diagrams, Quebec City, Canada, June 28–30, 2010. It also contains a Guest Editor's Editorial with reflections on the historical background of the Voronoi diagram.

We would like to extend our sincere appreciation to the Special Issue Guest Editor Mir Abolfazl Mostafavi for his dedication to preparing this high-quality special issue, to all authors for submitting their papers, and to all Associate Editors and referees for their valuable work. We would also like to express our gratitude to the LNCS editorial staff of Springer, in particular Alfred Hofmann, Ursula Barth, and Anna Kramer, who supported us at every stage of the project.

It is our hope that the fine collection of papers presented in this 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.

July 2011

Marina L. Gavrilova
C.J. Kenneth Tan

Voronoi Diagrams and Delaunay Triangulation
Guest Editor's Preface

The Voronoi diagram is a concept that has been around for a long time. In "Le monde de M. Descartes et le traité de la lumière" published in 1644, Descartes used Voronoi-like diagrams to show the disposition of matter in the solar system and its surroundings. However, the first presentation of the concept of the Voronoi diagram appeared in the work of Dirichlet (1850) and was named after the Russian mathematician Georgy Fedoseevich Voronoi (or *Voronoy*), who defined and studied the general n-dimensional case in 1908. Since then, several extensions have originated from these publications. The first extension to the Voronoi diagram was in crystallography, where a set of points was placed regularly in space and the Voronoi cells were labeled as Wirkungsberich (area of influence) (Niggli, 1927). Thiessen (1911) used Voronoi regions, which are referred to as Thiessen polygons, to compute accurate estimates of regional rainfall averages. Another extension of the Voronoi diagram was seen in natural and social sciences for studying market areas (Bogue 1949). The Voronoi diagram in geography is used to analyze 2D point patterns (Boots, 1974). It was only in the early 1970s that a number of algorithms for the efficient construction of the Voronoi diagram were developed. This motivated further developments in several areas using computer science and computational geometry.

Voronoi diagrams continue to be developed and their applications are expanding from natural sciences to engineering and from medical sciences to social sciences. This special issue of the journal Transactions on Computational Science is devoted to the latest advances in Voronoi diagrams and their applications in sciences and engineering. It presents a collection of the best papers that were selected from the papers presented during the 7th International Symposium on Voronoi Diagrams and their applications in sciences and engineering. This edition of the symposium, which was chaired by Mir Abolfazl Mostafavi, Professor at the Department of Geomatics and the Director of the Centre for Research in Geomatics at Laval University, was organized in Quebec City, Canada and was sponsored by the Center for Research in Geomatics (CRG), Laval University and the GEOIDE networks of Centres of Excellence.

This special issue presents nine selected papers presented during the symposium. The papers were extended by the authors and passed through two rounds of reviewing before publication. Several interesting topics are discussed in this issue which include:

- Development of new generalized Voronoi diagrams and algorithms including round-trip Voronoi diagrams, maximal zone diagrams, Jensen-Bregman Voronoi diagrams, hyperbolic Voronoi diagrams, and moving network Voronoi Diagrams.
- New algorithms based on Voronoi diagrams for applications in sciences and engineering, including geosensor networks deployment and optimization and homotopic object reconstruction
- Application of Delaunay triangulation for the modeling and representation of Cosmic Web and rainfall distribution.

The editor expects that readers of the Transactions on Computational Science (TCS) will benefit from the papers presented in this special issue on the latest advances in Voronoi diagrams and Delaunay triangulation and their applications in sciences and engineering.

Acknowledgment

July 2011   Mir Abolfazl Mostafavi
                                                                Guest Editor

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