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# Transactions on Computational Science XIX

Special Issue on Computer Graphics



Springer

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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
- Data Mining and Data Warehousing
- Geology and Geophysics
- Grid Computing
- Hardware/Software Co-design
- High-Energy Physics
- High-Performance Computing
- Information Retrieval
- Modeling and Simulations
- Numerical and Scientific Computing
- Parallel and Distributed Computing
- Reconfigurable Hardware
- Supercomputing
- System-on-Chip Design and Engineering
- Virtual Reality
- Visualization

# 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 is devoted to the topic of computer graphics and is edited by Anton Konushin. It is comprised of 12 excellent papers selected from over 100 submissions to GRAPHICON 2012, held at Lomonosov Moscow State University, Moscow, Russia, in October 2012.

We would like to extend our sincere appreciation to the special issue guest editor Anton Konushin for his effort on this special issue. 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, 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 special issue will be a valuable resource for Transactions on Computational Science readers and will stimulate further research into the vibrant area of computer graphics.

April 2013

Marina L. Gavrilova  
C.J. Kenneth Tan

# Special Issue on Computer Graphics

## Guest Editor's Preface

While computer graphics can be regarded as a mature discipline, computer vision and image processing continue to be among the most rapidly evolving areas of computer science. Both computer graphics and vision have enabled a lot of applications, ranging from medical visualization to interactive videogames and gesture-based interfaces.

The international conference GraphiCon 2012 addressed a wide range of research and development topics in the field of computer graphics and vision. Out of 77 registered papers a final selection of 3 invited, 47 full, and 11 short papers comprised the GraphiCon 2012 program. All papers were subjected to a double blind review and were sent to three members of the program committee. The 12 articles appearing in this special issue are revised and extended versions of a selection of papers presented at GraphiCon 2012. The papers were selected based on several criteria, including reviewers' comments, quality of presentation, and feedback of conference participants.

Nowadays computer tomography (CT) is a common medical analysis tool, but each scanning involves radiation. Lowering radiation doses leads to increased noise in CT images, which in turn can make processing erroneous. New methods, described in the paper "2.5D Extension of Neighborhood Filters for Noise Reduction in 3D Medical CT Images", are a step forward in solving this important problem.

Real-time photorealistic rendering with global illumination is a long-term goal of computer graphics. The improvement of Graphics Processing Units (GPUs) during the last decade has resulted in a great advancement of this topic. However, most papers on ray tracing and global illumination with GPU acceleration focus on interactive frame rates and do not pay enough attention to the quality. "Implementing Irradiance Cache in a GPU Realistic Renderer" provides a balanced approach to implementing widely used irradiance cache techniques in a GPU. We have a second paper in our selection dedicated to implementation of ray tracing techniques in a GPU – "GPU Ray Tracing – Comparative Study on Ray-Triangle Intersection Algorithms", with a title that speaks for itself.

3D images and 3D cinema are a booming and highly-marketed technology. "Adaptive Generation of Color Anaglyph" deals with problems arising during anaglyph-image preparations on consumer printing hardware for education and entertainment.

"Audio-adaptive Animation from Still Image" is devoted to another consumer application – creating animated images from still photos, which is a fun way to improve the visual quality of a presentation. Three effects – Flashing Light, Soap Bubbles, and Sunlight Spot – are described in details.

“Auto-calibration for Image Mosaicing and Stereo Vision” explores the problem of camera calibration, which is a necessary step during panoramic image stitching or 3D reconstruction. Existing algorithms are extended to get a robust method that computes internal camera parameters given a series of distant-object images. Experiments show that accurate calibration without patterns is possible if the quality of input images is sufficient.

Spectral methods constitute a popular technique for image segmentation and matting. However, careful parameter selection is required to obtain optimal performance. In “Learning Graph Laplacian for Image Segmentation” a new method is presented, which allows for unsupervised learning of graph Laplacian parameters individually for each image without using any prior information.

Virtual Reality is a very popular subject in science fiction, figuring mainly as a feature of entertainment systems. However, currently it is still too expensive, has significant limitations, and is used mainly for research, e.g., psychological studies. “Virtual Reality Technology for the Visual Perception Study” assesses effects of 2D vs. 3D displays on lightness perception using the CAVE system.

Machine vision industrial applications usually require a special setup, including digital camera and lighting system, e.g., several LEDs as point light sources. In “Locally Adapted Detection and Correction of Unnatural Purple Colors in Images of Refractive Objects Taken by Digital Still Camera” one particular setup is examined. It was observed that images captured with a digital still camera occasionally exhibit bright purple (almost pink) colors, which do not correspond to any monochromatic color. A set of algorithms is proposed to identify image areas to be corrected and to map all unnatural colors to the natural ones in those areas.

Personal robotics will greatly improve quality of life for many people. A lot of problems still should be solved in order to create a robot that will be fully capable of performing such mundane duties as washing plates and dishes. One particular problem is the detection and relative 3D location estimation of transparent objects, like glass bottles and cups. “Pose Refinement of Transparent Rigid Objects with a Stereo Camera” explores this problem and proposes a new method for it.

Finally, two papers in our selection are both devoted to scientific visualization. In “Some Theoretical Issues of Scientific Visualization as a Method of Data Analysis” characteristics of scientific visualization as a modern computer-based method of scientific data analysis are given as observed by the authors from the generalization of practical experience. “Analysis of Space-Time Flow Structures by Optimization and Visualization Methods” considers a specific problem of space-time structures analysis for unsteady problems in CFD (computational fluid dynamics). A new approximate approach is proposed, based on the solution of optimization problems combined with methods of data visual presentation.

Thanks and appreciation go to the authors, the reviewers, and the staff working on the Transactions of Computational Science.



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