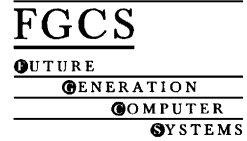




ELSEVIER

Available online at www.sciencedirect.com

Future Generation Computer Systems xxx (2004) xxx–xxx

www.elsevier.com/locate/future

Guest editorial

Introduction

1. Motivation

It is my pleasure and a great honor to introduce this FGCS Special Issue on “Computer Graphics and Geometric Modeling” based on (but not confined to) the papers accepted for the “First International Workshop on Computer Graphics and Geometric Modeling—CGGM’2002” held in Amsterdam, The Netherlands, in April 2002. Although computer graphics and geometric modeling are two of the most exciting and challenging areas in computer science, they rarely appear as major themes in general computational science conferences. Because of that, I am grateful to the FGCS staff, and especially to its Editor-in-Chief Prof. Sloot for having given me the opportunity to collect some of the most recent developments in these fields and to publish them in this special issue.

Until recently, computer graphics was seen as a field whose requirements (expensive display devices, substantial computer resources, etc.) far exceeded those commonly available for computer scientists and researchers. Fortunately, in the last few years, the situation has changed dramatically: the field has greatly benefited from many spectacular developments in hardware and software leading to a drastic reduction in the hardware price/performance ratio and the appearance of powerful, high-level device-independent graphics packages and libraries. Nowadays, computer graphics is unanimously recognized as a major field in computer science with remarkable applications in a number of areas as diverse as science, engineering,

medicine, business, education, advertising, entertainment, etc. In fact, almost every time we use a computer we are also using computer graphics since most computer programs, including the most popular operating systems, have a graphical user interface.

Another exciting computer science field is that of geometric modeling. Strictly speaking, it is defined as a collection of methods to describe geometric characteristics of an object [1]. However, its most comprehensive meaning (which is also assumed in this issue) often includes the representation of curves and surfaces by using computers, a field usually referred to as computer-aided geometric design (CAGD). Geometric modeling is a fundamental tool in many CAD/CAM settings, with outstanding applications in (among many others) the automotive, aerospace and ship-building industries, scientific simulations, computer animations, robotics, etc.

A few years ago, some researchers decided to organize a series of international conferences (consisting of a set of workshops and technical sessions as well as the general session) on all aspects of computational science. The first edition of this annual conference was held in San Francisco in 2001 under the name of International Conference on Computational Science (ICCS) [2]. After the success of this conference, subsequent editions were held in Amsterdam in 2002 [3] and Saint Petersburg and Melbourne (a single event held at two different locations) in 2003 [4]. The next edition will take place in Krakow (Poland), June 7–9, 2004 [5].

After participating in ICCS'2001, I realized that no special event devoted to either computer graphics or geometric modeling had been organized at that conference. Aiming to fill this gap, I proposed a special session on these topics to the ICCS'2002 organizers. Their enthusiastic reply encouraged me to organize the "First International Workshop on Computer Graphics and Geometric Modeling—CGGM'2002" [6]. A total of 81 papers from 21 countries were submitted to the workshop and then reviewed by, at least, two referees each. As a result, 35 high quality papers were finally accepted and published by Springer-Verlag in its Lecture Notes in Computer Science series [3].

At the time of ICCS'2002, I was kindly invited to select the best papers of the workshop for this special issue. Based on the reports from the workshop's referees, the authors were asked to improve and extend their papers substantially as well as to include the results of their most recent research. The resulting papers were subsequently sent to a second review by, at least, two more reviewers different from those of the workshop. All papers were carefully reviewed in terms of relevance, significance of results, originality, technical accuracy and soundness and readability. Authors of the selected papers were required to incorporate the referees' suggestions and follow the publisher guidelines for the final version, which has also been reviewed before being sent to the publisher. Obviously, this process has demanded an extraordinary effort from both authors and referees and explains why the issue took more than a year to finish.

I would like to remark that, due to the success and the positive feedback of authors and participants of the first two workshops, the "Third International Workshop on Computer Graphics and Geometric Modeling—CGGM'2004" will take place at the ICCS'2004 conference in Krakow (Poland), June 7–9, 2004. For details about this third edition of the workshop, please refer to [7].

2. Background

The 11 contributed papers in this special issue have been selected to provide the readers with an overview on some of the most interesting problems involved in computer graphics and geometric modeling. The different topics and questions analyzed in these papers

reflect clearly the diversity of interests, methods and techniques involved. In a first approach, the papers can be classified into four categories:

2.1. Information storage/transfer techniques

Here, we consider those methods intended for either Internet transmission and remote navigation (papers by Kim et al. and Vazquez et al.) or real-time rendering (papers by Perez et al. and Belmonte et al.). The paper by Kim et al. addresses the problem of efficient transmission of 3D shape models through Internet by introducing a new approach to compress the normal vectors of those models using the concept of clustering and relative indexing. This method yields significant compression ratios while still maintaining a similar visual appearance of the shape models. The paper by Vazquez and Sbert explores a set of techniques to reduce the bandwidth required by remote navigation systems. Their combination of lossless and lossy methods produces bandwidth reductions of up to 9:1 and 4:1 ratios, respectively, and the final images are often indistinguishable from the original ones. The papers by Pérez et al. and Belmonte et al. focus on levels of detail (LODs). The first one concerns the generation of LODs for terrain representation models in interactive graphics. In many models, visual artifacts appear in areas naturally or artificially modified. The authors propose a combination of fractal and wavelet theories and the use of energy reduction masks to provide extra data and overcome the problem of terrain modified areas. In its turn, the second paper proposes to take advantage of the connectivity information between the triangles in a mesh in order to reduce the amount of information sent into the graphics pipeline.

2.2. Surface reconstruction techniques

Given a cloud of points sampled from a surface, the problem consists of constructing another surface interpolating the points and approximating the surface. This interesting question is analyzed in Alberts' paper by considering additional information often available in form of scan paths (for example, from 3D scanning) and in the paper by Iglesias et al. by applying a new artificial intelligence technique, the so-called functional networks. In both papers nice, accurate approximations to the original surface are obtained.

2.3. Geometric modeling techniques

Blending surfaces (surfaces constructed to join other unconnected surfaces with some kind of continuity) are very common in manufacturing and mechanical engineering. The paper by Zhang and You analyzes the problem of surface blending with C^2 continuity based on the use of partial differential equations. The paper discusses the cases in which an analytical solution is obtainable and proposes a least square method for the remaining cases. The paper by Sarfraz and Khan presents an automatic and efficient algorithm for outline capture of bitmap characters. The method is especially adequate for non-Roman languages such as Arabic, Japanese, Urdu, Persian, etc. and produces optimal results from an automatic process that includes the detection of boundaries, corner points and break points and curve fitting.

2.4. Illumination and visualization techniques

Illumination is a very important field in computer graphics. The paper by Debelov and Sevastyanov discusses a modification of the ray tracing method that allows soft shadows to be obtained. The proposed method is quicker than conventional ray tracing for scenes with a large number of lights and/or very high resolution. A number of computer graphics techniques for realistic modeling and rendering of water are described by Iglesias in a paper that offers a survey classifying the vast literature on this topic with more than 110 references intended to provide the reader with a gentle introduction to the field. In her paper, Boada describes the hybrid octree, a new technique for dealing with hybrid scenes (scenes containing both surface and volume data). The paper describes the capabilities of this scheme to efficiently manipulate surface and volume data independently, render these data using texture hardware and support multiresolution. Some examples from medical data illustrate this new technique.

Acknowledgements

To conclude, I wish to thank the authors for their high-quality contributions and their great cooperation in preparing this special volume. I also thank the referees (see the CGGM'2002 Reviewer Board given in

Appendix A) for their hard work in reviewing the papers and making constructive comments and suggestions, which have substantially contributed to improving all the papers. They undoubtedly did a great job! Once again, I would like to express my sincere acknowledgement to the FGCS Editor-in-Chief for computational science, Prof. Peter Sloot, for having offered me the great opportunity to present this issue. Special recognition is also due to the FGCS staff (in particular, to Miss Beatrice Fournier and Miss Daniela Georgescu, former and current FGCS Publishing Editors, respectively, and to Miss Winona Wet, Publishing Assistant) for their support and assistance during the editing process. Last, but certainly not least, I wish thank the readers for their interest in this issue and for supporting FGCS. Many thanks to all of them!

Appendix A. CGGM'2002 Reviewer Board

Marc Alexa	GNS Darmstadt, Germany
Norman Badler	University of Pennsylvania, Philadelphia, USA
Salvador Bayarri	ESRI, USA
Philippe Beccaert	Max Planck Institute fur Informatik, Germany
Yves Bertrand	Université de Poitiers, France
Mark Cavazza	University of Bradford, UK
Miguel Chover	Universidad Jaume I, Spain
Tor Dokken	SINTEF, Norway
Tom Duchamp	University of Washington at Seattle, USA
Jean-Francois Dufourd	Université Louis-Pasteur, France
Charles Dyer	University of Wisconsin-Madison, USA
Jihad El-Sana	University Ben Gurion, Israel
Ahmad Nasri	American University of Beirut, Lebanon
Gerald E. Farin	Arizona State University, USA
Michael Gloud	Universidad Jaume I, Spain

Lee Byung Gook	Dongseo University, Korea	Mateu Sbert	Universidad de Girona, Spain
Miguel de Guzman	Universidad Complutense de Madrid, Spain	Harmut Schimacher	Max Planck Institute fur Informatik, Germany
Hans Hagen	University of Kaiserslautern, Germany	Meera Shitaram	University of Florida, USA
Aaron Hertzmann	University of Washington at Seattle, USA	Daniel Thalmann	Swiss Federal Institute of Technology, Switzerland
Christopher Hoffmann	Purdue University, USA	Roberto Vivó	Universidad Politecnica de Valencia, Spain
Miklos Hoffmann	Karol Esterhazy College, Hungary	Jinhui Yu	Zhejiang University, China
Andres Iglesias	Universidad de Cantabria, Spain	Yizhou Yu	University of Illinois, Urbana-Champaign, USA
Christophe Jermann	Université Nice, Sophia Antipolis, France	Jiri Zara	Czech Technological University, Czech Republic
Robert Joan-Arinyo	Universidad de Girona, Spain		
Hyunchan Lee	Hongik University, Korea		
Kunwoo Lee	Seoul National University, Korea		
Lars Linsen	University of California-Davis, USA		
Nadia Magnenat-Thalmann	Miralab, Geneva, Switzerland		
Russell Manning	University of Wisconsin-Madison, USA		
Dominique Michelucci	Ecole des Mines, St. Etienne, France		
Claudio Montani	Instituto di Ellab. della' Informazione, Pisa, Italy		
Joonyoung Park	Dongkuk University, Korea		
Pierre Poulin	University of Montreal, Canada		
Ajay Rajkumar	New York University, USA		
Tomas Recio	Universidad de Cantabria, Spain		
Eugenio Roanes-Lozano	Universidad Complutense de Madrid, Spain		
Mark Roberts	InfoSphere Inc., USA		
Jarek Rossignac	Georgia Institute of Technology, USA		
Javier Sanchez-Reyes	Universidad de Castilla-La Mancha, Spain		

References

- [1] M.E. Mortenson, *Geometric Modeling*, second ed., Wiley, New York, 1997.
- [2] V.N. Alexandrov, J.J. Dongarra, B.A. Juliano, R.S. Renner, C.J.K. Tan (Eds.), *Proceedings of the International Conference on Computational Science—ICCS 2001, Parts I–II, Lecture Notes in Computer Science*, vols. 2073–2074, Springer-Verlag, Berlin/Heidelberg, May 2001.
- [3] P.M.A. Sloot, C.J.K. Tan, J.J. Dongarra, A.G. Hoekstra (Eds.), *Proceedings of the International Conference on Computational Science—ICCS 2002, Parts I–III, Lecture Notes in Computer Science*, vols. 2329–2331, Amsterdam, The Netherlands, Springer-Verlag, Berlin/Heidelberg, April 2002.
- [4] P.M.A. Sloot, D. Abramson, A.V. Bogdanov, J.J. Dongarra, A.Y. Zomaya, Y.E. Gorbachev (Eds.), *International Conference on Computational Science—ICCS 2003, Parts I–IV, Lecture Notes in Computer Science*, vols. 2657–2660, Saint Petersburg (Russian Federation), Melbourne (Australia), Springer-Verlag, Berlin/Heidelberg, June 2003.
- [5] <http://www.cyfronet.krakow.pl/iccs2004/>.
- [6] <http://personales.unican.es/iglesias/CGGM>.
- [7] <http://personales.unican.es/iglesias/CGGM2004>.



Andrés Iglesias is currently associate professor at the Department of Applied Mathematics and Computational Sciences of the University of Cantabria (Spain). He holds a BSc degree in mathematics (1992) and a PhD degree in applied mathematics (1995). He has been the chairman and organizer of some international conferences in the fields of computer graphics, geometric modeling and symbolic computation, such as the CGGM (2002–2004), TSCG (2003–2004)

and CASA (2003– 2004) conference series. In addition, he has served as a program committee member and steering committee member in conferences such as ICCSA, GMAG, WSCG, CGA, ICICS, CGIV, 3IA or Cyberworlds. He is currently guest editor of four special issues of the journals *Future Generation Computer Systems (FGCS)* and *International Journal of Image and Graphics (IJIG)* on the topics of computer graphics, geometric modeling and symbolic computation. He is an ACM Siggraph and Eurographics member.

Andrés Iglesias
*Department of Applied Mathematics
and Computational Sciences
University of Cantabria, Avda. de los Castros
s/n, 39005 Santander, Spain*
E-mail address: iglesias@unican.es (A. Iglesias)
URL: <http://personales.unican.es/iglesias/>