Guest Editor's Foreword

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This special issue on Computational Methods in Computer Graphics and Scientific Visualisation is comprised of the selected papers from the International Conference on Computational Science and Its Applications (ICCSA'04), a premium scientific event devoted to the state-of-the-art research in the computational science. Eight contributions that span the theory and applications of computational methods were selected for the special issue. They are connected by the common theme: application of recent theoretical advances in computational science area to important computer graphics and scientific visualisation problems.

The first paper "Smooth Natural Neighbour Interpolants Over the Whole Domain" by Hisamoto Hiyoshi and Kokichi Sugihara studies a very important computational technique – interpolation, that is an essential part of many physical phenomena simulation. As an alternative to Finite Element method, the paper introduces the improved method based on the global continuity property of natural neighbour interpolation. The method is realised through the utilisation of a powerful technique based on the Voronoi diagram data structure. In order to guarantee a higher-order continuity, a C^2 interpolant over the whole domain C, given by a fifth-degree polynomial, is proposed by the authors. The method to construct a C^q interpolant with order $(q + 1)$ precision is also described.

The second paper "Boundary Filtering Approach in Surface Reconstruction" by Michal Varnuška and Ivana Kolingerová explores another application of the Voronoi diagram techniques, this time in surface reconstruction. In the field of computer graphics, there are numerous applications where the need to work with a piecewise linear approximation of the existing real 3D objects is evident. One of the methods for acquiring the 3D models is the digitisation of a real 3D object, followed by the reconstruction. The paper improves the CRUST algorithm based on Delaunay triangulation and presents an elegant way of handling the manifold extraction process.

The third paper "Upper and Lower Bounds of Op-Code Probabilities for Edgebreaker" by Cheol-Hyung Cho, Youngsong Cho, Jooonghuyn Ryu and Deok-Soo Kim is devoted to the problem of rapid transmittion of the 3D mesh model over the network. The goal is achieved through the application of the Edgebreaker topology compressor to the transmitted mesh. In this approach, the mesh model is transformed to a string of five alphabets, or op-codes, that represent the complete topological information. The paper presents a comprehensive and rigorous analysis of the probability of the distribution of those op-codes, which both optimises the compression performance and allows *a priori* estimation of a compressed file size.

The fourth paper "Fast and Efficient Rendering System for Real-Time Terrain Visualisation" by Russel A. Apu and Marina L. Gavrilova presents an efficient technique for real-time non-photorealistic 3D terrain visualisation from the Digital Elevation Model (DEM). The applications of the proposed technique are found in computer graphics, modelling, and game industries, as well as in geography and GIS (Geographical Information Systems) areas. The method presented in the paper is based on an improved version of the Real-time Optimally Adapting Mesh (ROAM), and boosts performance by improving the rendering speed and enhancing the visual continuity of the model. The paper also pioneers the application of a Geo-morph technique which allows to eliminate the visual discontinuity during terrain rendering.

The fifth paper is titled "Polygonisation of Disjoint Implicit Surfaces by the Adaptive Edge Spinning Algorithm," and is written by Martin Cermak and Vaclav Skala. The paper presents an adaptive method for polygonisation of implicit surfaces based on the surface tracking scheme. It also introduces a new method for detecting, counting, and polygonisation of disjoint implicit surfaces in a given locality. Authors demonstrate how the method can be applied to polygonise implicit surfaces of C^1 continuity, thin objects and some non-complex objects of C^0 continuity.

The sixth paper, "Polygonal Silhouette Error Correction: A Reverse Subdivision Approach" by Kevin Foster, Mario Costa Sousa, Faramarz Samavati and Brian Wyvill, presents a way for automatic removal of artifacts and errors that appear in silhouettes extracted from polygonal meshes. These errors typically appear in polygonal silhouettes due to the discrete nature of meshes and numerical instabilities in the extraction procedures. The paper introduces approach based on silhouette curves comprised by chaining together silhouette edges and utilisation of multiresolution techniques. Two hidden line removal methods to render strokes of 3D triangle strips in object space are also presented.

The seventh paper, "Texture Mapping on Arbitrary 3D Surfaces" by Tong-Yee Lee and Shaur-Uei Yan,

investigates a distortion-less texture mapping on arbitrary 3D surfaces. Texture mapping is one of the important techniques in computer graphics that is often used to enhance the reality of computer-generated 3D models. There is, however, no easy way to parameterise a general 3D surface over 2D domain without introducing a distortion. The paper proposes a method to minimise the distortion of surface parameterisation based on original clustering algorithm followed by minimal spinning tree cutting technique. Experimental results confirm the computational performance and feasibility of the method.

The final paper of the issue, "Incremental Subdivision for Triangle Meshes" by Hamid-Reza Pakdel and Faramarz Samavati, discusses the adaptive subdivision algorithm for triangular meshes. Subdivision surfaces are increasingly used in computer modelling and computer animation. They can also be applied to arbitrary topology meshes, hence providing a power representation for a free-form solid and surface modelling. Since many applications do not require refinement over the entire mesh, adaptive subdivision provides a covenient tool for targeted refinement. The paper proposes to use restricted meshes over the red–green triangulation technique in order to obtain better behaved adaptive subdivision surfaces. The resulting surface has a proper connectivity and geometry with a gradual change in subdivision depth between coarse and fine areas.

In conclusion, I would like to extend sincere appreciation to all authors for submitting their papers to the special issue and to all referees for their meticulous and valuable reviews. It is my hope that the final collection of papers presented in this issue will be a valuable resource for all IJCSE readers and will stipulate further research into the growing area of applications of computational methods.

Sincerely,
Marina L. Gavrilova
IJCSE Guest Editor