Editorial

The Visual Computer

Shape modeling and processing

Research in computer graphics has produced various important and powerful techniques for image synthesis. Recent advances in the production of computer-generated feature films are mostly based on successful applications of these imaging techniques. While shape modeling and processing techniques are relatively well understood, user-interface techniques for creating and manipulating computer models of truly 3D shapes are still relatively primitive. They provide a user-experience far inferior to sculpting in the real world. Because of this limitation, shape modeling is a very laborious procedure that requires considerable human time and effort.

In the 21st century we expect that research in computer graphics will be focused on 3D shape analysis and synthesis. We believe that new theories and techniques will be developed to facilitate efficient creation and processing of 3D objects of arbitrary shape complexity. This special issue reports interesting new results in this direction of research.

The first two papers of this special issue concern shape design based on triangular meshes. Kobbelt reviews recent developments in fair surface design based on variational subdivision. This survey article also does an excellent job as a tutorial on this topic. Suzuki et al. introduce an interactive shape-manipulation technique based on mesh dragging and remeshing. This approach has much potential for further development.

The next two papers deal with relatively conventional CAGD techniques. Qin presents an explicit matrix formula for B-spline curves and surfaces. Then he demonstrates the effectiveness of this compact representation by showing how it reduces the number of arithmetic operations in B-spline-based algorithms. Wang and Qin show the existence and then the construction of spherical rational quartic curves that interpolate given Hermite data on a sphere. Spherical curves have various important applications in computer graphics, e.g., for 3D rotation control in computer animation.

The last two papers are related to sweeping. De Voogt et al. present an efficient ray-tracing algorithm for deformed generalized cylinders. Although the contour curves are restricted to piecewise quadratic curves, the deformed generalized cylinders represent a variety of natural 3D shapes. Thus the result is useful in practice. Lee et al. propose an efficient and robust algorithm that uses polygons to approximate the boundary of a 2D general sweep of a curved object. This result has important applications in robotics and CAD/CAM, and is not only limited to shape design in computer graphics.

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