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PREFACE

Special Issue on Volume Modeling

Volume graphics is concerned with graphical models defined in volume data types, such as regular and irregular volume datasets, scalar fields, spatial occupancy models, and other spatial or nonspatial representations, which are capable of modeling both solid and amorphous objects, and interiors as well as surfaces. Evolved from volume visualization techniques, volume graphics is emerging as an important subfield of computer graphics. While the primary objective of volume visualization is to extract meaningful information from volumetric data, volume graphics is a far broader subject. It is the study of the input, storage, construction, analysis, manipulation, display, and animation of spatial objects in a *true three-dimensional form*. To date, there has been considerable research on techniques for rendering volume data types, but limited research on modeling volume objects.

Volume modeling is a process for constructing and manipulating 3D models using a range of volume data types. It is a generalization in dimension to surface modeling by allowing the specification of the internal structures of objects and amorphous phenomena. It provides appropriate input to the volume rendering integral. With the technological advances and cost reduction of 3D imaging equipment, volume modeling is expected to play a more prominent role in computer graphics. This special issue brings readers four technical papers on this subject, all of which have employed volume data types as the pivotal model representations and addressed the interoperations between volume and surface data types.

Computer animation encompasses a wide range of graphical modeling techniques and is often considered the "crown jewel" of computer graphics. The paper by Gagvani and Silver describes a technique for animating 3D sampled volumes directly and demonstrates the feasibility of associating kinematics to such models and achieving deformation through a skeleton representation. This work highlights the technical relevance between volume modeling and computer graphics in general.

Interactive model construction challenges the effectiveness and usability of a modeling scheme as well as its support for real-time rendering. The paper by Ferley, Cani, and Gascuel presents a sculpture metaphor based on a multiresolution volumetric representation. Their effort brings volume modeling close to the potential end-users of volume graphics.

Discrete volume representation and implicit surface representation are both underlain by a common mathematical concept, *scalar field*, and have a close link that can be traced back to the 1980s. The paper by Stolte and Kaufman strengthens this connection by providing an extensive study on the voxelization of implicit surfaces. The octree concept is utilized to support progressive refinement in voxelization, whilst providing efficiency in managing the discrete data generated by the process.

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Complex models need complex modeling schemes. The paper by Pasko, Adzhiev, Schmitt, and Schlick proposes a new modeling scheme by bringing together two constructive representations, namely *function representation (FRep)* and *constructive volume geometry (CVG)*. The former traditionally focuses on implicit surface modeling, and the latter is a generalization of constructive solid geometry, capable of modeling heterogeneous interiors and amorphous phenomena.

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Min Chen
Gregory M. Nielson
Arie E. Kaufman
Guest Editors