Guest Editors' Introduction

Computer-Aided Geometry Modeling: A Key to Effective Use of Computers in Science and Engineering

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To a large extent, the limit of what can be accomplished with the aid of computers in scientific or engineering analysis, design, or manufacturing is governed by the complexity of the geometry involved. In the past it has often been necessary to make simplifying approximations of complex models, for example (1) using two-dimensional models of three-dimensional situations, (2) using simplified shapes such as rectangles or spheres, and (3) limiting consideration to individual components rather than the total configuration. Today, however, the continued growth in speed, capacity, and connectivity of computers of all sizes and significant advances in display and data entry devices open the way to deal with realistic three-dimensional geometries. Furthermore, there has been a commensurate advancement in the ability to represent complex geometries in a form that can be readily stored, manipulated, and displayed by computers.

The technology of computer-aided geometry modeling has now reached a stage at which numerous systems can embody wireframe and solid-model, three-dimensional geometric objects, and such systems are widely used in a broad spectrum of applications. In fact, several companies have been established to provide support for these systems. But to provide increased capability for future applications, advances in technology are needed in such areas as mathematical representation, logical structuring and management of geometric data, development of appropriate geometry standards, and improvement in user interfaces through interactive graphics techniques.

To help meet this need, the Symposium on Computer-Aided Geometry Modeling was held at the NASA Langley Research Center in April 1983.* Persons who have made significant contributions in crucial areas were invited to give lead presentations. The seven articles in this issue, and three more to be published in the November issue, are selections from the presentations at the Langley symposium. These articles summarize the state of the art in various aspects of geometry modeling and identify opportunities for future research. They also illustrate applications of computer-aided geometry to representative problems. Their authors are leading contributors to a highly dynamic, intellectually stimulating, and exciting field.

The first five articles address mathematical and algorithmic aspects of geometry modeling. Barnhill summarizes surface representation by means of two classes of interpolation methods and identifies needed research in this area. Gordon describes the mathematical techniques that form the foundation for most practical surface and solid modeling. Requicha and Voelcker give a comprehensive survey of the current status of solid modeling and research now in progress. Their article includes a table of currently available solid modeling software. In a sidebar of the article, Hartquist describes the PADL-2 system. Hanna, Abel, and Greenberg summarize their work in developing an intersection algorithm for parametric surfaces, showing its application to several representative problems. Goldman draws an interesting comparison between geometry representations and discrete probability distributions and uses this

analogy to introduce some new types of curves and surfaces.

The management of geometric information is a topic currently receiving increased attention. Dube and Smith describe how a database management system developed by the NASA IPAD project can be used to manage geometric information as an integral part of an integrated CAD/CAM system.

The cover images for this issue are taken from Cohen's article, which summarizes experience at the University of Utah in modeling several complex aerodynamic shapes. Cohen points out the importance of human interaction with the computer and the need for a variety of software tools in the modeling process.

The November issue will include articles by Wozny on interactive graphics for the display of geometric objects, by Smith on the IGES standard for representation of geometries, and by Lores, Chasen, and Garner on an evaluation of 3-D graphics software.

The goal of this collection of articles is to provide a focal point for a better understanding and assessment of the state of the art and research trends in computer-aided geometry modeling. We thank the authors for their contributions and hope the readers find that the desired goal has been met.

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