Seminar: Solid Modeling

Dr. Herbert Voelker, Chairman

9:00	Introduction to Geometric Modeling I/Voelcker, Requicha
10:30	Break
10:45	Introduction to Geometric Modeling II/Voelcker, Requicha
12:00	Lunch
1:30	The ROMULUS, BUILD, and DESIGN Systems/Hillyard
3:00	Break
3:15	The GMSOLID System/Sarraga

PREFACE

These notes contain

-- a topical outline of the material presented orally,

-- a list with brief summaries of nine primary references,

-- a selected bibliography on geometric modelling, and

-- copies of the primary references.

We recommend that those attending the tutorial just sit back and listen; take notes only if you are compulsive. Most of the slides used in the presentations either are similar to the illustrations in the primary references or paraphrase portions of the text in these references. Read (or at least scan) the primary references in the indicated order shortly after the seminar sessions, while the presentations are fresh in your memory. You should be able to relate the topics on the outline to sections in the various papers, and to "reconstruct" the seminar. Finally, use the bibliography to delve more deeply into topics that are important to you.

SEMINAR

on

SOLID MODELLING

at

SIGGRAPH '81

Dallas, Texas
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Lecturers (in order of appearance)

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Any opinions, findings, conclusions, or recommendations expressed in the seminar and/or this document are those of the individual lecturers/authors and do not necessarily reflect the views of their employers or of any other private or public organizations.

TOPICAL OUTLINE

1. Useful geometry systems

   1.1 The role of geometry in mechanical design and manufacturing

   a black-box view
   - some of the internals
   - the role of representations and algorithms
   - geometric modelling systems

   1.2 Goals of the seminar

   Provide an abstract view that facilitates the assessment of

   - modelling systems
   - application-oriented algorithms

   Survey the state-of-the-art
   Illustrate

   - system design issues
   - what can be achieved today

   through case studies of systems which are at the forefront of geometric modelling technology.

2. Representations, algorithms, and systems

   2.1 A non-geometric example

   2.2 Some fundamental issues

   - completeness of representations
   - validity of representations
   - correctness of algorithms

   2.3 System design

   2.4 Preview of the remainder of the seminar

3. Characterization of representation schemes

   3.1 The syntax and semantics of representations

3.2 Formal properties of representation schemes

- domain
- validity
- completeness
- uniqueness

3.3 Informal properties of representation schemes

- conciseness
- ease of creation
- efficacy in the context of applications

4. Mathematical models of solids

4.1 Properties to be captured mathematically

- rigidity
- solidity
- finiteness
- closure under operations
- finite describability
- boundary determinism

4.2 R-sets

5. Survey of schemes for representing solids

- ambiguous representations
- pure primitive instancing schemes
- spatial occupancy enumeration
- cell decompositions
- CSG (Constructive Solid Geometry)
- sweep representations
- boundary representations

6. Brief survey of geometric modelling systems

7. Applications I: functions and algorithms

- evaluation of functions
- an introductory example: calculating projections of polygons
- characteristics of algorithms: correctness, efficiency, robustness, extensibility
  another example: set membership classification

8. Applications II: case studies

   - evaluation of integral properties of solids
   - verification of NC programs

9. Brief survey of applications of GMS's

10. Systems

    - history
    - a new generation of systems
    - design issues
    - an exemplary system: PADL-2
    - the near-term future

11. A family of boundary-based systems: ROMULUS, BUILD, DESIGN

    - family relationships (history)
    - the systems' objectives
    - methods of representation
    - definitional operators
    - design (input) modes
    - integration
    - analysis capabilities
    - surface types
    - implementation languages
    - computing environments

12. An example: MBB's "Gehause"

13. A closer look at DESIGN

    13.1 Main features

    - interaction
    - primary representation
    - databases

    13.2 Applications

    - integral properties (method used)
    - interference analysis
    - drafting output

14. GMSOLID

14.1 Introduction

- history and objectives
- the CADANCE environment
- APL/VDAM

14.2 Internal representations

- the CSG tree
- b-representations under the tree

14.3 Interfaces and applications

- the current graphic interface
- current capabilities
- intended applications