

SIAM

PRELIMINARY PROGRAM

Third SIAM Conference on Geometric Design

November 1 - 5, 1993

Radisson Tempe Mission Palms Hotel
Tempe, Arizona

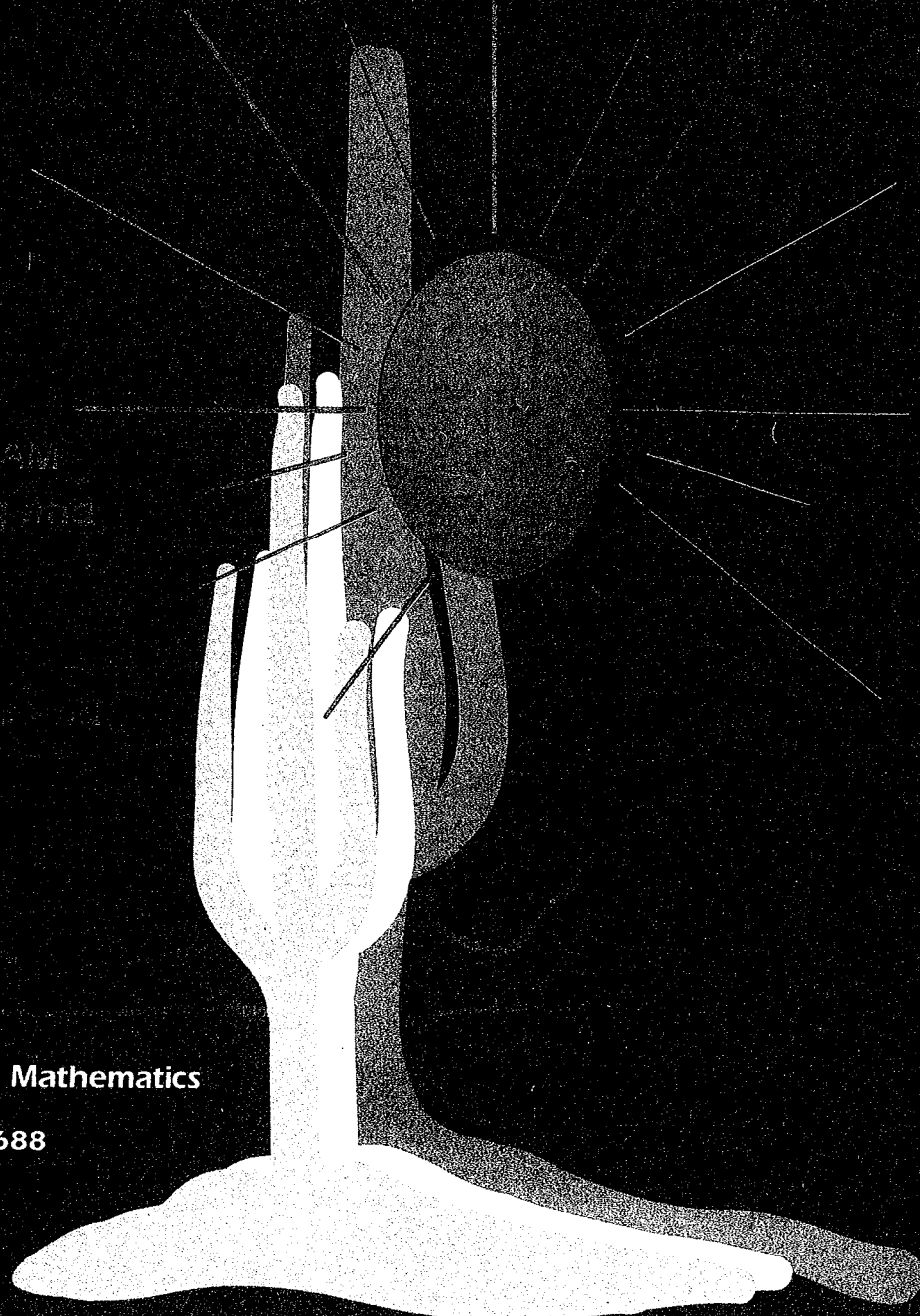
Plus Tutorials on:

NURBS: Geometry and Applications
Data Reduction and Decomposition Techniques
for Curves and Surfaces
October 31, 1993

CONFERENCE THEMES

Curve and Surface Design
Solid Modeling and CAD/CAM
Multidimensional Modeling and
Visualization
Geometric Algorithms
Industrial Applications
Applications in Geosciences and
Biomechanics

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DEADLINE DATES

Hotel Reservations

Monday, October 11, 1993

Advance Conference Registration

Monday, October 18, 1993**ORGANIZING COMMITTEE**

Robert E. Barnhill, Co-chair

Arizona State University

Rosemary E. Chang, Co-chair

Silicon Graphics Computer Systems

Donald M. Austin

University of Minnesota, Minneapolis

Anthony D. DeRose

University of Washington, Seattle

Gerald E. Farin

Arizona State University

David A. Field

General Motors Research Laboratories

Thomas A. Foley

Arizona State University

David Gossard

Massachusetts Institute of Technology

Hans Hägen

Universität Kaiserslautern, Germany

Josef Hoschek

Technische Hochschule Darmstadt, Germany

Tom J. Lyche

University of Oslo, Norway

Harry W. McLaughlin

Rensselaer Polytechnic Institute

Ramon F. Sarraga

General Motors Research Laboratories

Michael J. Wozny

Rensselaer Polytechnic Institute

FUNDING AGENCY

SIAM is conducting this conference with the partial support of the National Science Foundation and the Department of Energy.

A TRIBUTE TO JOHN A. GREGORY



1944-1993

John Gregory died suddenly on March 26, 1993 at the age of 48. He received his doctorate at Brunel University under John Whiteman's direction in the early 1970s. During a visit to the University of Utah in 1974 to collaborate with Robert Barnhill, John invented what has become known as the "Gregory Square." This construction corrected the ambiguity of twists in bicubically blended Coons patches. This collaboration also developed the Boolean sum theory for surface interpolants which did not have the compatibilities assumed by Steve Coons and Bill Gordon in their earlier pioneering work. John did fundamental work in geometric continuity and most recently on subdivision algorithms.

John's work and presentations were always marked with a beautiful clarity. He was always willing to listen and to make helpful suggestions to his colleagues and students. He sought for, and achieved, excellence of a very high level.

He was one of the pioneers of CAGD. He will be missed very much.

On Monday, November 1 at 2:00 PM, we will be gathering for a tribute to our colleague, John A. Gregory.

NURBS: Geometry and Applications

October 31, 1993

Radisson Tempe Mission Palms Hotel, Tempe, Arizona

Organizer: Gerald E. Farin

Department of Computer Science, Arizona State University

Tutorial Description

The instructors in this tutorial will develop NURBS from the viewpoint of projective geometry. Thus there is an introduction to projective geometry, followed by a treatment of conics. These are the most basic NURBS. The instructors will then generalize to rational Bézier curves and B-splines. Rational surfaces are treated next, including quadrics and surfaces of revolution. Applications include offsets, faceting, conversions, and rendering.

The objectives of this tutorial are to demonstrate how projective geometry is the "natural" geometry for NURBS, the differences between rational and nonrational curves and surfaces, and address some of the latest applications.

Who Should Attend

System programmers of graphics and CAD/CAM systems. Anyone wishing to be informed about current trends in geometric modeling.

Recommended Background

Linear algebra, calculus, basic concepts of Bézier and B-spline curves.

Lecturers

Gerald E. Farin received his Ph.D. in mathematics from the University of Braunschweig, Germany in 1979. He then worked for Mercedes-Benz, where he implemented B-splines. He then became an Assistant Professor at the University of Utah, and is now with Arizona State University. He is author of the books "Curves and Surfaces for CAD" and "NURBS for Curve and Surface Design".

Andrew Worsey received his Ph.D. from Brunel University, Uxbridge, United Kingdom. He then became an Assistant Professor first at the University of Utah, then at the University of North Carolina at Wilmington. He joined General Electric and, currently, works for CAMAX Systems, Inc. He has published numerous articles in the field of curve/surface design.

PROGRAM

9:00-10:30 AM	Projective Geometry and Conics Gerald E. Farin
10:30-11:00 AM	Coffee
11:00 AM-12:30 PM	Rational Bézier and B-spline Curves Andrew Worsey
12:30-2:00 PM	Lunch
2:00-3:00 PM	Rational Surfaces Gerald E. Farin
3:00-3:30 PM	Coffee
3:30-4:30 PM	Industrial Applications (rendering, offsetting, and conversions) Andrew Worsey
4:30-5:00 PM	Discussion
5:00 PM	Tutorial adjourns

Note: Each session will have subtopics and will leave ample room for discussion.

The tutorial will take place in Palm 1. Lunch and coffee will be served in the Courtyard.

Registration Fees*

	SIAG/GD**	SIAM Member	Non-Member	Student
Preregistration	\$120	\$120	\$135	\$55
Registration	\$135	\$135	\$155	\$55

*Registration fees are for either tutorial. Tutorial Notes, coffee and lunch are included in the registration fees.

**Member of SIAM Activity Group on Geometric Design.

Attendees are advised to pre-register for the tutorials. On-site registration cannot be guaranteed. Tutorial Notes will be distributed upon check-in at the SIAM registration desk.

Data Reduction and Decomposition Techniques for Curves and Surfaces

October 31, 1993

Radisson Tempe Mission Palms Hotel, Tempe, Arizona

Organizer: Tom Lyche

Institutt for Informatikk, University of Oslo, Norway

Tutorial Description

As more and more data are being processed by computers, transmission and storage become serious issues. Geometric objects such as curves and surfaces arising in areas like CAD, image processing and seismology require huge amounts of data space. Multi-resolution techniques are a way to transform curves and surfaces to objects on which data reduction is easily accomplished. Multi-resolution and similar techniques can also be used for hierarchical modelling, more efficient analysis and for data visualization at various resolutions.

The main part of the course explains hierarchical modelling, decomposition techniques, and knot removal. Hierarchical modelling starts with a surface which models global trends, and hence can be defined on a relatively coarse mesh. By subsequently defining finer and finer meshes more and more details can be modelled locally. Decomposition usually starts with some object (curve or surface) on a relatively fine mesh and creates a sequence of approximations to this object on coarser and coarser meshes. By ignoring small coefficients (small with respect to some measure) we obtain data reduction. Knot removal is a technique for removing knots from a spline without perturbing the spline more than a given tolerance. Several examples will be presented in order to illustrate the methods and algorithms.

Who Should Attend

Researchers, developers in industry and educators who wish to gain in-depth understanding of spline techniques, hierarchical modelling and decomposition techniques as tools for curve and surface construction and manipulation and for data reduction/compression.

Recommended Background

Attendees should have some background in curve and surface representation, in particular piecewise polynomials (splines). Familiarity with the elementary concepts of calculus and linear algebra is assumed.

Instructors

Richard Bartels received his Masters in Mathematics degree from the University of Michigan in 1963 and his Ph.D. from Stanford in 1968. He was on the faculty of the Computer Science Department of the University of Texas at Austin from 1968 to 1974, on the faculty of the Mathematical Sciences Department at The Johns Hopkins University from 1974 to 1979, and since 1979 he has been with the University of Waterloo, Waterloo, Canada, where he is a Professor of Computer Science. His interests are in parametric spline fitting, direct manipulation techniques for curves and surfaces, and hierarchical splines.

Morten Daehlen received his M.Sc. and Ph.D. in numerical analysis from the Computer Science Department at the University of Oslo in 1985 and 1989, respectively. Since 1985 he has been a research scientist at SINTEF in Oslo. He is currently research manager of the Section for Industrial Mathematics at SINTEF. He is also part time Professor at the University of Oslo. His main research interests are geometric modelling, univariate and multivariate spline theory, multiresolution analysis and data reduction.

Tom Lyche received his M.Sc. from the University of Oslo in 1969, and a Ph.D. from the University of Texas in 1975. He has worked at the University of Oslo since 1972 and is currently Professor of Numerical Analysis in the Computer Science Department. He is also a part time consultant for the industrial mathematics group at SINTEF in Oslo. His main research interests are spline methods in: geometric modelling, numerical analysis, and approximation theory.

PROGRAM

9:00-9:45 AM	Spline Basics Tom Lyche
9:45-10:30 AM	Data Reduction by Knot Removal Tom Lyche
10:30-11:00 AM	Coffee
11:00-11:45 AM	Decomposition of Parametric Curves Morten Daehlen
11:45 AM-12:30 PM	Hierarchical Splines Richard Bartels
12:30-2:00 PM	Lunch
2:00-3:00 PM	Surface Fitting with Hierarchical Splines Richard Bartels
3:00-3:30 PM	Coffee
3:30-4:30 PM	Surface Decomposition and Data Reduction Morten Daehlen
4:30-5:00 PM	Discussion
5:00 PM	Tutorial adjourns

The tutorial will take place in Palm 2. Lunch and coffee will be served in the Courtyard.

GET-TOGETHERS

SIAM Welcoming Reception

Sunday, October 31, 1993
6:30 PM-8:30 PM
Palm 2
Cash bar and assorted hors d'oeuvres

Meet-and-Greet Hour

Monday, November 1, 1993
6:00 PM-7:00 PM
Courtyard
Here's an opportunity to join colleagues for an authentic Margarita, refreshing beer or soda, tortilla chips and salsa, and chips and dip to converse about the day's events or make plans for dinner.
Cost \$5.00

Business Meeting

SIAM Activity Group on
Geometric Design
Tuesday, November 2, 1993
8:00 PM
Palm 2
Open to all interested attendees

Mexican Dinner at Phoenix Desert Botanical Gardens

Wednesday, November 3, 1993
5:30 PM-9:00 PM
The evening begins with a short bus ride (10 minutes) to Phoenix Desert Botanical Gardens. Fountains of margaritas, fruit punch, beer, and sodas will be available for your enjoyment when you first arrive. Time is allotted so that you can stroll through the luscious garden. Dinner will be catered by Macayo, one of Phoenix's authentic Mexican caterers. A lavish display of hors d'oeuvres, dinner, and dessert will be available from 7:00 PM - 8:30 PM. Hors d'oeuvres include trio of chips, pineapple salsa, macayo original salsa, hot sauce, black bean canape, and chile canape. Dinner includes a buffet of mini beef chimichangas, blue corn fajita taquitos, chicken fajita skewers, green corn tamales, spinach enchilada, frijoles negros, and Mexican rice. Dessert will consist of a cinnamon crisp layered with chocolate fudge and caramel, topped with white chocolate mousse and chopped nuts. Dinner will be served on the Ullman Terrace of the Botanical Gardens.
Cost per person: \$40.00

Following are subject classifications for the sessions. The codes in parentheses designate session type and number. The session types are invited presentations (IP), contributed presentations (CP) and minisymposia (MS). Please refer to page 9 for the poster session.

Curve and Surface Design

Approximations (CP6, page 8)
Blossoming: The Polar Form Approach to Spline Curves and Surfaces (MS4, page 6)
Constrained Knot Removal Techniques for Spline Curves and Surfaces (IP8, page 12)
Curves (CP8 and CP8a, pages 9, 10)
Cyclides Applications in CAGD (MS20, page 12)
Designing for Shape (CP9, page 10)
Mathematics and Art: A Relationship of 3000 Years (IP1, page 5)
Measuring and Improving Shape Quality in Surface Design (MS2, page 5)
Numerical Algorithms (CP3, page 6)
NURBS Curves (CP18, page 17)
NURBS Surfaces (CP14, page 13)
Scattered Data Methods (MS18, page 12)
Shape (CP10, page 11)
Smooth Low Degree Polynomial Surfaces of Arbitrary Topological Structure (MS21, page 13)
Special Functional Forms for Parametric Curves (MS1, page 5)
Surface Construction (CP13, page 13)
Surface Modeling Using Control Point Based Gregory Patches (IP2, page 5)
Surface Modeling (CP12, page 12)
Triangular Patches (CP4, page 7)
Tile Based Methods (CP15, page 16)
Variational Design - Parts I and II (MS25 and MS 27, pages 17, 18)

Geometric Algorithms

CAGD Methods in Robotics and Animation (MS11, page 8)
Computational Geometry (CP1, page 5)
Discrete Geometry Representations (MS14, page 10)
Geometric Aspects of Rational Curves and Surfaces (IP2, page 5)
Geometric and Control Modeling for Simulation of Virtual Environments (MS12, page 8)
Geometry Processing (CP20, page 18)
Grid Generation (CP2, page 5)
Mathematical Tools for Geometric Programming (MS19, page 12)
Surface-Surface Intersections (MS10, page 8)

Industrial Applications

Computer-Aided Design of Developable Surfaces (IP10, page 17)
Computer-Aided Geometric Design Based on Kinematic Measures (MS8, page 7)
Constraint Management (MS7, page 7)
Current Trends in Interactive Grid Generation System (MS16, page 11)
Data Sharing, the Need for Standards, and IGES (MS9, page 8)
New Connections Between CAGD and FEA (MS3, page 6)
Surfaces in Automobile Design (MS6, page 7)
The Direct Modification of Surface Curvatures in Car Body Design (IP5, page 7)

Multidimensional Modeling and Visualization

CAGD in the Geosciences: Why Is It Important and Why Conventional Approaches Don't Work (IP7, page 10)
Can Geometric Modeling and Photorealistic Display Share the Same Representation? New Possibilities for Car Body Design (IP9, page 12)
Interpolation, Approximation and Design by Multivariate Splines (MS22, page 13)
Modeling Surfaces of Geologic Origin (MS13, page 10)
Multivariate Data Fitting (MS24, page 16)
Vision and Shape: Chunnelling Between the Two (IP11, page 17)
Visualization (CP16, page 16)
Visualization of Space Science Data (MS15, page 11)

Solid Modeling and CAD/CAM

Are "Style Design" and Accuracy Compatible? (IP4, page 7)
Computation, Tessellation and Modeling Techniques of NURB Surfaces (MS26, page 17)
Curve and Surface Interrogation (MS5, page 6)
Geometric Issues in Rapid Prototyping and Solid Freeform Fabrication (MS23, page 16)
Geometric Modeling I and II (CP5 and CP7, pages 8, 9)
Geometric Tolerance Modeling (MS17, page 11)
Manufacturing (CP11, page 12)
Solid Modeling of Buildings for Interactive Walkthroughs (IP6, page 10)
Solid Modeling I and II (CP17 and CP19, pages 17, 18)

7:30/Palm Ballroom Foyer
Registration opens

8:15/Palm Ballroom
Opening Remarks

Rosemary Chang, Silicon Graphics Computer Systems

8:30/Palm Ballroom

IP1/Chair: Robert E. Barnhill, Arizona State University

Mathematics and Art: A Relationship of 3000 Years

Geometric Design is placed in the larger context of the relationship between mathematics and art. While this relationship is of long standing, the intensity of its mutual interaction has been sporadic. We seem now to be experiencing a new high point of this interaction.

The speaker will describe some previous high points of this interaction and discuss their philosophical bases. He will also offer some speculations on current trends.

Philip J. Davis
Division of Applied Mathematics
Brown University

9:15/Palm Ballroom

IP2/Chair: Robert E. Barnhill, Arizona State University

Geometric Aspects of Rational Curves and Surfaces

NURBS (in a narrow meaning: non-uniform rational B-splines, but used in a more general sense here) are becoming increasingly important both in industrial applications and in theoretical research. Much of the underlying geometry, in the areas of projective and algebraic geometry, was already known to mathematicians 100 years ago. In this presentation, the speaker will focus on some of these results, show how to interpret them in a modern context, and point out their relevance for CAGD applications.

Wolfgang Boehm
Department of Mathematics
Technische Universität Braunschweig, Germany

10:00/Courtyard
Coffee

10:30 AM-12:30 PM
Concurrent Sessions

MS1/Palm Ballroom

Special Functional Forms For Parametric Curves

In computer-aided design applications, parametric curves are usually defined in terms of (piecewise) polynomial or rational functions. The computational and representational advantages offered by these forms are mitigated, however, by difficulties incurred in controlling curvature, measuring arc lengths, and computing offsets. For applications in which such requirements are of crucial importance, the use of a broader class of functions, or of special types of polynomial and rational curves, can offer significant benefits. The speakers will illustrate this theme with three novel curve forms.

Organizer: Rida T. Farouki
IBM Thomas J. Watson Research Center

10:30 Guided Clothoid Splines

Dereck S. Meek and Desmond J. Walton,
University of Manitoba, Canada

11:00 Algebraically Rectifiable Parametric Curves

Takis Sakkalis, Oakland University, and
Rida T. Farouki, Organizer

11:30 Recent Advances With Pythagorean-Hodograph Curves

C. Andrew Neff, IBM Thomas J. Watson
Research Center, and Rida T. Farouki,
Organizer

MS2/Palm 2

Measuring and Improving Shape Quality in Surface Design

Recently, a number of CAGD researchers have focused on the problem of "fair" curve and surface construction, an issue of vital importance in many areas of work and especially in industrial design and styling. More specifically, the issues are mathematically defining "fairness" or "shape quality", developing new curve and surface schemes that guarantee fairness, and assisting a user in identifying shape infidelities in a surface model and removing them without destroying the shape characteristics of the model. The speakers will address these issues and present new results and algorithms based on a variety of mathematical ideas, including optimization, infinitesimal bending methods, and direct manipulation of curvature. In particular, some emphasis will be placed on "fair" curves and surfaces interpolating given data, e.g., points, a requirement appearing often in industrial applications

Organizer: Nickolas S. Sapidis, General Motors Research Laboratories, and Panagiotis D. Kaklis, National Technical University of Athens, Greece

10:30 Efficient, Fair Interpolation using Catmull-Clark Surfaces

Anthony D. DeRose, University of
Washington; Mark Halstead, University of
California, Berkeley; and Michael Kass,
Apple Computer, Inc.

11:00 Stability Concept for Surfaces
Hans Hagen, Universität Kaiserslautern,
Germany

11:30 Polynomial Splines of Non-uniform Degree: Controlling Convexity and Fairness
Panagiotis Kaklis and Nickolas Sapidis,
Organizers, and Giannis Ginnis, National
Technical University of Athens, Greece

12:00 Minimum Curvature Variation Curves, Networks, and Surfaces for Fair Free-Form Shape Design

Henry P. Moreton, Silicon Graphics Inc.,
and Carlo H. Sequin, University of
California, Berkeley

CP1/Augustine Room

Computational Geometry

Chair: Julia Komissarchik, University of
California, Berkeley

10:30 Partitioning Trees as a Linear Multi-resolution Implicitization of Quadratic NURBS

Bruce Naylor, AT&T Bell Laboratories

10:50 An Efficient Approach for Determining Point/Polygon Containment

Wayne E. Robertz, Computer Aided Systems
for Engineering, Milford, OH

11:10 Elimination of Intersections for the Routing and Manhattan Wiring

Mohamed Senouci, Université de Franche-
Comté, France

11:30 The Extraction of Skeletons Distributes Over the Product of Polyhedral Complexes

Alberto Paoluzzi, V. Pascucci and M.
Vicentino, Università "La Sapienza", Italy

11:50 Modeling Scenes of Geometric Objects and Querying Large Scenes Efficiently

Hartmut W. Noltemeier, University of
Wuerzburg, Germany

12:10 Non-Convex Hull in k-Dimensional Space
Julia Komissarchik, University of California,
Berkeley

CP2/Xavier Room

Grid Generation

Chair: B.K. Soni, NSF Engineering Research
Center

10:30 Mesh Optimization

Hugues Hoppe, University of Washington

10:50 3D Composite Grids Using Bézier Curves and Surfaces for CFD Applications

Ramana G. Venkata, Joseph Oliger, and Joel
Ferziger, Stanford University

11:10 Tensor Product Surfaces and Volumes for Geometric Modeling and Grid Generation

C. Wayne Mastin, Mississippi State
University

11:30 Automatic Generation of Hexahedral FEM-Meshes

Robert Schneiders, Rheinisch-Westf Hochschule,
Germany

11:50 Combination of Quadtree and Delaunay Techniques for FEA Triangulation

Luiz Fernando Martha, Marcelo Tilio
Monteiro de Carvalho, and Joaquim Bento
Cavalcante Neto, Catholic University of Rio
de Janeiro (PUC)-Rio, Brazil

12:10 A NURBS Based Grid Redistribution Remapping Algorithm

B.K. Soni, NSF Engineering Research Center

12:30-2:00
Lunch

2:00/Palm Ballroom
Tribute to John Gregory

2:15/Palm Ballroom
IP3/Chair: Gerald E. Farin, Arizona State University
Surface Modeling using Control Point Based Gregory Patches

The speaker will present a surface modeling method using Control point based Gregory Patches. In this method, a designer first makes a curve mesh representing the outline of the final surface model. After generating Gregory patches on the mesh, a designer can easily modify the surface shape using control points, keeping C1 or C2 continuity.

Although the topology of a curve mesh must be regular in the conventional methods, this method can interpolate an irregular curve mesh including triangle and pentagonal faces. In addition, a boundary of a face may be either a polynomial curve, a rational curve or a spline composed of many curve segments. This method has been implemented in a surface/solid modeling toolkit, DESIGNBASE V4.

Hiroaki Chiyokura
Faculty of Environmental Information
Keio University, Japan

3:00/Courtyard
Coffee

3:30-5:30
Concurrent Sessions

MS3/Palm Ballroom
New Connections Between CAGD and FEA

Recent work in industry and in universities is creating a closer integration between computer-aided geometric design (CAGD) and finite-element analysis (FEA). Two important examples of this integration are: (a) direct use of CAGD models within FEA codes, e.g., to represent the shape of a die punch during formability analysis, and (b) the use of FEA to optimize the shape of parts as they are designed within a CAGD modeler. This integration of methodologies is making feature-based design a reality and is achieving a new level of automation in the process of producing and validating designs for mechanical parts. The speakers will provide an overview of some new developments and applications.

Organizer: Ramon F. Sarraga
General Motors Research Laboratories

- 3:30 **Surface Description Requirements for Efficient Computer Simulation of Sheet Metal Forming**
Thomas B. Stoughton, General Motors NAO R&D Center
- 4:00 **Using CAGD as a Connector between Finite Element Analyses in Sheet Metal Forming**
Michael P. Campbell, General Motors NAO Die Management Group and Kuo-Kuang Chen, General Motors NAO R&D Center
- 4:30 **Multi-patch Parametric Surfaces with Minimal Energy**
Greg Fasshauer and Larry L. Schumaker, Vanderbilt University
- 5:00 **Functional Surface Creation with a Link to FEA**
Barbara M. Balents and David C. Gossard, Massachusetts Institute of Technology
- 5:30 **Structurally Optimal Shape and Topology Synthesis**
Ashok V. Kumar and David C. Gossard, Massachusetts Institute of Technology

MS4/Palm²
Blossoming: The Polar Form Approach to Spline Curves and Surfaces

Polar forms provide a coherent and intuitive approach to many B-spline curve and surface problems. The speakers in this minisymposium will illustrate the theoretical and practical applicability of polar forms to B-spline curves and surfaces, and show how polar forms can be used to extend B-spline results to related curve and surface schemes. They will discuss the fundamentals of polar forms, B-spline algorithms, geometrically continuous spline curves, multivariate spline surfaces, and a spline software package.

Organizer: Phillip Barry
University of Minnesota, Minneapolis

- 3:30 **An Introduction to Polar Forms**
Gunther Greiner, Universität Erlangen, Germany
- 4:00 **Polar Forms and Knot Insertion for B-spline Curves**
Ronald N. Goldman, Rice University
- 4:30 **Polar Forms for Geometrically Continuous Splines**
Phillip Barry, Organizer
- 5:00 **Polar Forms and Triangular B-Splines**
Hans-Peter Seidel, Universität Erlangen, Germany
- 5:30 **Programming with Polar Forms**
Anthony DeRose, University of Washington

MS5/Augustine Room
Curve and Surface Interrogation

The geometric modelling of free-form curves and surfaces is of central importance for sophisticated CAD/CAM systems. Apart from the pure construction of these curves and surfaces, the analysis of their quality is equally important in the design and manufacturing process. The speakers will discuss some of the central issues and present some of the latest results.

Organizer: Hans Hagen
Universität Kaiserslautern, Germany

- 3:30 **Surface Curvature Analysis Using Color**
Robert Jerard, University of New Hampshire
- 4:00 **Generalized Focal Surfaces: A New Method For Surface Interrogation**
Hans Hagen, Organizer, and Stefanie Hahmann, Universität Kaiserslautern, Germany
- 4:30 **Surface Analysis using Arithmetic Operations**
Thomas Schreiber, Universität Kaiserslautern, Germany
- 5:00 **Grid Quality Control in CFD**
Bharat Soni, Mississippi State University
- 5:30 **Curve and Surface Interrogation Simplified via Graphics Libraries/Hardware**
Henry P. Moreton, Silicon Graphics Inc.

CP3/Xavier Room
Numerical Algorithms

Chair: Christopher J. Van Wyk, Drew University

- 3:30 **Construction of Branched Surfaces**
Vadim I. Matov, QMS, Inc., Santa Clara, CA
- 3:50 **Parametrization of an Implicit Curve by a Pseudo Abelian Integral**
Jean-Jacques Malosse, Integraph Corporation, Huntsville, AL
- 4:10 **Sparse Implicit Equations in Geometric Design**
Luiz Henrique de Figueiredo, IMPA-Instituto de Matematica Pura e Aplicada, Brazil; Eli L. Isaacson, University of Wyoming; and Dan Marchesin, IMPA-Instituto de Matematica Pura e Aplicada, Brazil
- 4:30 **Efficient Solutions of Polynomial Systems**
Dinesh Manocha, University of North Carolina, Chapel Hill
- 4:50 **Experience with Efficient Exact Arithmetic**
Steven Fortune, AT&T Bell Laboratories and Christopher J. Van Wyk, Drew University

6:00/Courtyard
Meet-and-Greet Hour

8:00/Palm Ballroom Foyer
Registration opens

8:30/Palm Ballroom

IP4/Chair: Ramon F. Sarraga, General Motors Research Laboratories

Are "Style Design" and Accuracy Compatible?"

Style design is mainly based on aesthetic criteria and designer creativity, which seem to be incompatible with the "hard mathematics" and interactivity of most of CAD/CAM systems. Nevertheless, some style design problems, when they are "not too over-constrained" could be solved using "hard mathematics".

One can dream of a system able to help the style designer as well as the engineering designer, thus avoiding some data transfer problems encountered today in the industrial field by companies using both kinds of tools (style and engineering).

The speaker will present some key issues and discuss attempts to solve them.

Alain C. Massabo
Vice President, Research and Development
CISIGRAPH, France

9:15/Palm Ballroom

IP5/Chair: Ramon F. Sarraga, General Motors Research Laboratories

The Direct Modification of Surface Curvatures in Car Body Design

In traditional surface generation, desired shape properties are approached indirectly through trial-and-error. For surfaces in car body design in particular, the procedure is difficult, since most geometric properties depend on the design variables in a complex way.

Computer graphics combined with sufficient computer power enables an alternative approach. In this, the user governs the surface by modifying certain geometric properties which can be visually interpreted.

Analyses of normal curvatures and curvatures of other plane sections along carefully chosen fields of directions play an important role in the interactive design of surfaces. Such a process requires local solutions to certain non linear partial differential equations. The speaker will discuss surface generation based on direct modification of these curvatures. For the curvatures considered, the linearized equations are in general degenerate, preventing straightforward solution processes. The speaker will discuss the qualitative properties of the solutions as well as processes for computing them.

Roger Andersson
Department of Applied Mathematics and Statistics
Volvo Data AB, Sweden

10:00/Courtyard
Coffee

10:30 AM-12:30 PM
Concurrent Sessions

MS6/Palm Ballroom

Surfaces in Automobile Design

Free form surfaces play the most important role in the computer aided design for car bodies. An important topic is the creation of a surface model from a set of irregularly placed (digitized) points using approximation techniques. Another is the modification of surfaces. A third is the definition of criteria for surface quality and the methods to guarantee and influence these criteria. The speakers will discuss some aspects of the current development of CAD-functionality and its mathematical background.

Organizers: Reinhold Klass and Werner Dankwort
Mercedes-Benz, Germany

10:30 Lifting of Spline Surfaces

Josef Hoschek and Markus Schichtel,
Technische Hochschule Darmstadt, Germany

11:00 Direct Construction of Polynomial Surfaces from Dense Range Images Through Region Growing

Nickolas Sapidis and P. Besl, General Motors Research Laboratories

11:30 Quality Requirements for Surfaces in Car Body Design

Reinhold Klass, Organizer, and Ekkehart Kaufmann, Mercedes-Benz AG, Germany

12:00 Automatic Local Updating of CAD Surface Models to Digitized Data

Thomas Reuding, Bayerische Motoren Werke AG, Germany and Milan Sreckovic, Alias Research Inc., Canada

MS7/Palm 2

Constraint Management

The description and maintenance of constraints on and between geometric objects is a fundamental issue in geometric design and applications. Examples of constraints are: dimensions, tangency, relative location (coincident, parallel, concentric, offset). Some of the issues that must be dealt with are geometric coverage, efficiency of algorithms, analytic vs. numerical approaches, and the use of constraint information in applications. The speakers will present some results and discuss some of the issues in geometric computing which arise from constraint management as an application.

Organizer: Pierre Malraison
Autodesk, Inc., Sausalito, CA

10:30 Interactive Constraint Solving in Geometric Design

Christoph M. Hoffmann, Purdue University, West Lafayette

10:55 Geometric Constraints in Three Dimensions

John Owen, D-Cubed Ltd, United Kingdom

11:20 Geometric Constraint Satisfaction Using Degrees of Freedom Analysis

Glenn A. Kramer, Schlumberger Laboratory for Computer Sciences, Austin

11:45 Extensions of Parametric, Variational and Rule Based Modeling for Tightly Coupled CAE Applications

Malcolm S. Casale, PDA Engineering, Costa Mesa, CA

12:10 Control Nets and Constraints

Pierre Malraison, Organizer

MS8/Augustine Room

Computer Aided Geometric Design Based on Kinematic Measures

Kinematicians and machine theorists have long been studying problems in kinematic geometry of machines and motion. In recent years, computer scientists and mathematicians have been developing algorithms and methods to solve geometric problems in computer graphics and computational geometry. There has, however, been very little effort to merge the two fields, and address the wide range of existing problems such as those related to the optimal geometric design of objects that are to be manipulated by robots, the components of the machines, the motion for optimal assembly of parts or manufacturing processes.

The speakers will address a number of topics related to geometric design based on kinematic measures, the mathematical models and the computational algorithms and techniques that must be developed, and discuss the application of such developments in the areas of robotics, computer vision, and manufacturing.

Organizer: Jahangir S. Rastegar
State University of New York, Stony Brook

10:30 Computational Geometry of Motion

B. Ravani, University of California, Davis

11:00 On Representation and Interpolation of Line-Segments for Computer Aided Geometric Design

Q. Jeffrey Ge, University of New Orleans and B. Ravani, University of California, Davis

11:30 Optimal Geometric Design of Robot Manipulator Link Shapes

Q. Tu, University of Redlands

12:00 A Kinematic Object Manipulability Measure for Optimal Geometric Shape Design

S. Zhang, State University of New York, Stony Brook and Jahangir Rastegar, Organizer

CP4/Xavier Room

Triangular Patches

Chair: Hartmut Prautzsch, University of Karlsruhe, Germany

10:30 Continuity Preserving Degree Reduction of Triangular Bézier Surfaces

Suresh K. Lodha, University of California, Santa Cruz

10:50 A C² Clough-Tocher Interpolant

Praveen Kashyap and Gerald Farin, Arizona State University

11:10 Scattered Data Interpolation Using a Hybrid Cubic Finite Element

Sriram Dayanand and Thomas A. Foley, Arizona State University

11:30 eG1 Polynomial Approximations of Non-polynomial Surfaces

Stephen Mann, University of Waterloo, Canada

11:50 Approximate Ck Blending with Bézier Triangles

Hartmut Prautzsch, University of Karlsruhe, Germany

12:30-2:00
Lunch

2:00-4:00
Concurrent Sessions

MS9/Palm 2

Data-Sharing, the Need for Standards, and IGES

CAD/CAM systems use differing internal representations for geometric entities, but their users are often required to communicate data between these systems. This minisymposium will begin with the commercial requirements for data-sharing and the trade-offs inherent in the various methods used (direct versus neutral-format translators, for example). The geometry of the most widely used neutral format, IGES, will be described, along with an analysis of its technical defects. More general technical problems and solutions in the exchange of geometric data, particularly for surfaces and computational fluid dynamics data will be described.

Organizer: Tracy M. Whelan
CAMAX Systems Inc., Minneapolis

- 2:00 **Data-Sharing in the Manufacturing Enterprise**
Alan K. Jones, Boeing Computer Services, Seattle
- 2:30 **A Technical Introduction to Geometry in IGES**
Edward R. Clapp, Autodesk Inc., Sausalito, CA
- 3:00 **Technical Problems with Data-Sharing**
Tracy M. Whelan, Organizer
- 3:30 **IGES Based Database for Computational Fluid Dynamics (CFD) Analysis**
Jin Chou, NASA Ames Research Center

MS10/Palm Ballroom

Surface-Surface Intersections

In many applications, we need to find the curves where two surfaces intersect. Although presently there are many algorithms available, none meets all demands, and thus the problem of developing such an algorithm remains one of the most difficult problem in CAGD.

The speakers will give an overview of the different methods and their specific advantages and disadvantages and discuss special bounding elements to generate bounds of tangent directions as well as bounds to the surfaces themselves tracing the intersection in a lower dimensional space obtained by eliminating variables and solving the system of equations of the intersection problem by converting them into equations of higher dimensionality through the introduction of auxiliary variables.

Organizer: Dieter Lasser
Universität Kaiserslautern, Germany

- 2:00 **Surface-Surface Intersection Algorithms**
Dieter Lasser, Universität Kaiserslautern, Germany
- 2:30 **Using Pyramidal Surfaces to Detect and Isolate Surface/Surface Intersections**
Alan Zundel, Brigham Young University
- 3:00 **Evaluating Surface Intersections in Lower Dimensions**
Dinesh Manocha, University of North Carolina, Chapel Hill
- 3:30 **Robust Shape Interrogation**
Nicholas M. Patrikalakis and T. Maekawa, Massachusetts Institute of Technology

CP5/Augustine Room

Geometric Modeling I

Chair: James D. Emery, Allied Signal Inc., Kansas City, MO

- 2:00 **Geometric Modeling with Rational Gaussian Curves and Surfaces**
Ardeshir Goshtasby and Eun-Hee Ko, University of Illinois, Chicago
- 2:20 **Form Analysis and Evaluation Methods in CAD**
Ichiro Harashima, Norihiro Nakajima and Hiroshi Arai, Hitachi Ltd., Japan
- 2:40 **Object Oriented Geometric Modeling in a Rule Based Environment**
Ernest J. Mintel, Pratt and Whitney
- 3:00 **Application of Implicit Solids to Sculptured Surface Model Synthesis**
James H. Oliver, Iowa State University; Mark A. Ganter and Duane W. Storti, University of Washington
- 3:20 **Multi-Surface Modeling for CAD/CAM**
Peter C. Rimkus, CNC Software, Tolland, CT
- 3:40 **Applications of Geometry to Stereolithographic Molecular Models**
James D. Emery, Allied Signal Inc., Kansas City, MO

CP6/Xavier Room

Approximations

Chair: Alain LeMehauté, Université de Nantes, France

- 2:00 **On Computing with Wavelet-type Functions**
Angela Kunoth, Freie Universität Berlin, Germany
- 2:20 **On Copositive Approximation**
Yingkang Hu, Georgia Southern University and Xiang Ming Yu, Southwest Missouri State University
- 2:40 **Using Mixed and Hybrid Variational Formulations in CAGD**
Michel Bercovier, Hebrew University of Jerusalem, Israel
- 3:00 **Chronometric Theory: the Need for Computer Aided Representation and Investigation**
Alex Levichev, Institute of Mathematics, Russia
- 3:20 **Surfaces Spline Under Tension Interpolants of Scattered Data**
Alain LeMehauté and A. Bouhamidi, Université de Nantes, France

4:00/Courtyard
Coffee

4:30-6:30
Concurrent Sessions

MS11/Palm 2

CAGD Methods in Robotics and Animation

The construction of smooth one-parametric motions which fulfil certain conditions - such as matching a finite number of prescribed positions and avoiding obstacles - arise in robotics and animation. Although these areas are being considered application areas for techniques from Computer Aided Geometric Design, most emphasis has so far been laid on generating paths rather than motions.

The speakers will motivate further investigations of the problem by describing recent advances. The solution strategies involve the use of appropriate kinematic mappings, the rational Bézier/B-Spline method and techniques from algebraic geometry. Furthermore, geometric modeling schemes which are well-suited for applications in robotics, animation, and related areas are presented together with the description of special applications.

Organizer: Helmut Pottmann
Technical University of Vienna, Austria

- 4:30 **Design Prototyping in a Collaborative Environment**
Chandrajit L. Bajaj, Purdue University, West Lafayette
- 5:00 **The Drexel Modeler: Applications and Algebraic Background**
Hoon Hong and Sabine Stifter, Research Institute for Symbolic Computation, Austria
- 5:30 **Interpolation of Spatial Displacements**
Bert Jüttler, Technische Hochschule Darmstadt, Germany
- 6:00 **Rational B-spline Motions**
Michael G. Wagner, Technische Universität Wien, Austria

MS12/Palm Ballroom

Geometric and Control Modeling for Simulation of Virtual Environments

Geometry and control play a large role in physical system simulation and the simulation of virtual environments. In physical system simulation, the problems of integrating geometric analysis with dynamic analysis, to enable handling of contact, collision, and control phenomena, is particularly difficult. In virtual environments, geometry and control problems are exacerbated by the diversity of simulated objects and phenomena. The speakers in this minisymposium will present a spectrum of work in these areas, including (a few) results and (quite a few) exciting new problems for applied geometric computation.

Organizers: James Cremer, University of Iowa and Richard Palmer, Cornell University

- 4:30 **Rama Project: Simulating Virtual Worlds**
George Vanecek, Jr., Purdue University, West Lafayette
- 5:00 **Control Modeling in Virtual Environments with Applications to Real-time Vehicle Simulation**
James Cremer, Organizer, and Joseph Kearney, University of Iowa
- 5:30 **Robust Geometry and Dynamics Computation in Simulation of Rigid-body Contact**
William Bouma, Purdue University, West Lafayette and James Cremer, Organizer
- 6:00 **Computational Representations of Distributed Parameter Systems**
Richard Palmer, Organizer, and Vadim Shapiro, General Motors Research Laboratories

4:30-6:30
Concurrent Sessions

CP7/Augustine Room

Geometric Modeling 2

Chair: Frank C. Park, University of California, Irvine

- 4:30 **Fast Collision Detection between Geometric Models**
Ming C. Lin, University of California, Berkeley; *Dinesh Manocha*, University of North Carolina, Chapel Hill; and John Canny, University of California, Berkeley
- 4:50 **Surface Deformation with Differential Geometric Structures**
Masahiro Kimura, Takafumi Saito, and Mikio Shinya, NTT Human Interface Laboratories, Japan
- 5:10 **The Sum of Splines (SMS) Representation for Curves, Surfaces and Volumes**
Ari Rappoport and Erez Shilat, The Hebrew University, Israel
- 5:30 **A Multiscale Spline Representation for Implicit Objects**
Luiz Velho and Jonas de Miranda Gomes, IMPA-Instituto de Matematica Pura e Aplicada, Brazil
- 5:50 **A Reimannian Approach to Multidimensional Interpolation**
Frank C. Park, University of California, Irvine
- 6:10 **Planar Cuts Without a Trace**
Richard D. Fuhr, Electronic Data Systems, Bellevue, WA

CP8/Xavier Room

Curves I

Chair: Yuesheng Xu, North Dakota State University

- 4:30 **Dual Functionals for Geometrically Continuous Splines**
Phillip Barry, University of Minnesota, Minneapolis
- 4:50 **Characterisation of Planar Rational Cubic Curves**
Yongming Li and Robert J. Cripps, University of Birmingham, United Kingdom
- 5:10 **Interactive Curve Design using Rational Cubic Splines**
Keith Unsworth and Tim Goodman, University of Dundee, Scotland
- 5:30 **On Interpolating Polar Values**
Lyle Ramshaw and James B. Saxe, Digital Equipment Corporation, Palo Alto
- 5:50 **Degree Reduction of Bézier Curves**
Przemyslaw Bogacki, and Stanley E. Weinstein, Old Dominion University and Yuesheng Xu, North Dakota State University

POSTER SESSION

Palm Ballroom Foyer

Degree Reduction of a Piecewise Bézier Curve, with the Preservation of Geometric Smoothness
Przemyslaw Bogacki, and Stanley E. Weinstein, Old Dominion University; and Yuesheng Xu, North Dakota State University

Geometric Design of Hydrodynamic Surfaces to Control Flow Separation
Thomas Peter Svobodny, Wright State University

Single-valued B-spline Solids

Javier Sanchez-Reyes, Polytechnic University of Catalonia, Spain

8:00/Palm 2

Business Meeting

SIAM Activity Group on Geometric Design

Upcoming SIAM Conferences and Tutorials

1994

January 23-25, 1994

Fifth Annual ACM-SIAM Symposium on Discrete Algorithms

Key Bridge Marriott Hotel Arlington, VA

Abstract deadline: 7/13/93

Organizer: Daniel D. Sleator, Carnegie-Mellon University

April 18-20, 1994

SIAM Conference on Emerging Issues in Mathematics and Computation from the Material Sciences

Pittsburgh Vista Hotel, Pittsburgh, PA

Abstract deadline: 10/12/93

Organizer: David Kinderlehrer, Carnegie-Mellon University

June 15-18, 1994

Fifth SIAM Conference on Applied Linear Algebra

Snowbird Ski and Summer Resort,

Snowbird, Utah

Abstract deadline: 12/6/93

Sponsored by SIAM Activity Group on Linear Algebra

Organizer: Beresford N. Parlett, University of California, Berkeley

June 22-25, 1994

Seventh SIAM Conference on Discrete Mathematics

Ramada Classic Hotel

Albuquerque, NM

Abstract deadline: 12/20/93

Sponsored by SIAM Activity Group on Discrete Mathematics

Organizer: William T. Trotter, Bellcore

July 25-29, 1994

1994 SIAM Annual Meeting

Sheraton Harbor Island Hotel

San Diego, CA

Abstract deadline: 1/24/94

Organizer: Barbara Lee Keyfitz, University of Houston

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**8:00/Palm Ballroom Foyer
Registration opens**

8:30/Palm Ballroom

IP6/Chair: Harry W. McLaughlin, Rensselaer Polytechnic Institute

Solid Modeling of Buildings for Interactive Walk-throughs

Real-time virtual walk-through exploration of computer graphics models of fully furnished buildings comprising millions of polygons are possible on today's high-end workstations. This requires a suitable spatially-organized database, the use of furniture models at various levels of detail, and substantial preprocessing to determine worst-case visibility ranges. Realistic, radiosity-based illumination further increases the model complexity and requires extra levels of consistency not typically found in the original architectural CAD models.

The speaker will discuss these requirements, describe memory and display management schemes, and illustrate their application to the new CS building under construction at UCB.

Carlo H. Sequin
Computer Science Division
University of California, Berkeley

9:15/Palm Ballroom

IP7/Chair: Harry W. McLaughlin, Rensselaer Polytechnic Institute

CAGD in the Geosciences: Why Is It Important and Why Conventional Approaches Don't Work

In order to maintain essential production levels, understanding the geometry, internal structure, and fluid distributions in the world's oil and gas reservoirs is critically important.

Geoscientists have not used CAGD techniques in modeling and simulating reservoir geometries. Reservoirs are treated as "layer-cake" models and as a result performance predictions are typically far too optimistic.

CAGD techniques offer great promise in providing compact editable realistic 3-D geological models, but the dearth of data and the geometric and topological complexities make most conventional techniques impractical. Volume-volume intersections, 3-D geostatistical interpolation, simulation, and visualization remain major challenges. The speaker will describe these challenges in detail and discuss some partial solutions.

Thomas J. Lasseter
Tech-Logic, Inc.
Woodinville, WA

**10:00/Courtyard
Coffee**

**10:30 AM-12:30 AM
Concurrent Sessions**

MS13/Palm Ballroom

Modeling Surfaces of Geologic Origin

The modeling of geological features such as bedding layers, stratigraphic bodies, and faults, has a set of requirements specific to the underlying data and the types of phenomena modeled. Because of these requirements traditional methods for curved surface design and visualization are not directly applicable, and must be modified, or replaced by alternative approaches. The speakers will present a broad range of recent work in this field.

Organizer: Henry P. Moreton
Silicon Graphics Inc., Mountain View, CA

10:30 Geometric Modeling of Material Property Fields

George Celniker, Indranil Chakravarty, Jim Hargrove, and Karen Lu, Schlumberger Laboratory for Computer Science, Austin, TX

11:00 Modeling Complex Geologic Surfaces with 2D Graphs

Jean-Laurent Mallet, Laboratoire Informatique et Analyse des Donne'es, France

11:30 Visualizing Spatial Uncertainty
Mohan Srivastava, FSS International, Canada

MS14/Palm 2

Discrete Geometry Representations

Discrete geometry representations include triangulations, tessellations, and polyhedrizations. They are of practical importance for many applications, including rendering, FEM, stereo lithography, data compression, and space partition. A number of algorithms have been developed for each of these representations; typically, however, one approach will not suffice for all applications. Thus the necessity arises to build a toolkit of methods. The speakers in this minisymposium will present several methods for solving the discrete representation problems and relate the methods to practical applications.

Organizer: Dianne C. Hansford
Manufacturing and Consulting Services Inc., Scottsdale, Arizona

10:30 Data Dependent Triangulations and Simulated Annealing

Larry L. Schumaker, Vanderbilt University

11:00 A Bootstrapping Technique for Mesh Refinement of 2- and 3-D Unstructured Grids for Industrial Applications

Andrew J. Worsey, CAMAX Systems, Inc., Minneapolis

11:30 Multiresolution Approximation of Polyhedra

Michael Lounsbery, Anthony DeRose, University of Washington and Joe Warren, Rice University

12:00 Using Binary Space Partitions to Approximate Constrained Tetrahedrizations: A Preliminary Report
Carol Hazlewood, Southwest Texas State University

**CP8a/Xavier Room
Curves II**

Chair: Jeannine Mosely, ICAD, Inc., Cambridge, MA

10:30 Determining the Distance Between Two Parametric Curves

Przemyslaw Bogacki, and Stanley E. Weinstein, Old Dominion University; and Yuesheng Xu, North Dakota State University

10:50 Bézier Curves on the Rigid-Body Motions
Frank C. Park, University of California, Irvine

11:10 Computational Morphology for Curve Reconstruction

Luiz Henrique de Figueiredo and Jonas de Miranda Gomes, IMPA-Instituto de Matematica Pura e Aplicada, Brazil

11:30 Composite Parabolic Arcs of Specified Arc Length

Bruce Piper, Rensselaer Polytechnic Institute and John A. Roullet, University of Connecticut, Storrs

11:50 Hybrid Analysis of Arc and Line Constraint Systems

Jeannine Mosely, ICAD, Inc., Cambridge, MA

CP9/Augustine Room

Designing for Shape

Chair: Carlo H. Sequin, University of California, Berkeley

10:30 Interactive Design Using Partial Differential Equations

Malcolm Bloor and *Michael Wilson*, University of Leeds, United Kingdom

10:50 Convexity Preserving Interpolation by Algebraic Curves and Surfaces

David Levin, Tel-Aviv University, Israel and *Edmond Nadler*, Wayne State University

11:10 Specifying the Arc Length of Rational Parametric Curves

John A. Roullet, University of Connecticut, Storrs and *Bruce Piper*, Rensselaer Polytechnic Institute

11:30 Automatic Shape Design

Malcolm Bloor and *Michael Wilson*, University of Leeds, United Kingdom

11:50 Shape Preserving Techniques for Direct Manipulations of Curves and Surfaces

Markus Schichtel, Darmstadt University of Technology, Germany

12:10 Generic Minimum-Cost Shapes in 2 and 3 Dimensions

Carlo H. Sequin, University of California, Berkeley; and *Henry P. Moreton*, Silicon Graphics Inc., Mountain View, CA

12:30-3:00

Lunch

ASU Geometric Design Tour

3:00-5:00

Concurrent Sessions

MS15/Xavier Room

Visualization of Space Science Data

The increase in size and complexity of space science data has necessitated the development of visualization techniques in order to facilitate the understanding of this data. These techniques are often derived from geometric design methods, and find a wide range of application, from the analysis of fluid flows to the visualization of planetary terrains and geologic that researchers are now developing techniques that allow scientists to more clearly understand their data, but the large volume of data from current and future missions will require more efficient algorithms and the use of supercomputers. The speakers will present several methods currently being used for the visualization of unsteady fluid flows, magnetic fields around planetary bodies, and planetary terrains, and discuss future directions for the analysis of such data.

Organizer: Stephen H. Watson
Jet Propulsion Laboratory

3:00 The Visualization of Planetary Surfaces and Atmospheres

Eric M. De Jong, Jet Propulsion Laboratory

3:30 3D Unsteady Flow Visualization in Computational Fluid Dynamics

David A. Lane, NASA Ames Research Center

4:00 Supercomputing, Visualization, and Space Sciences

Steven L. Groom and Stephen H. Watson, Jet Propulsion Laboratory

MS16/Augustine Room

Current Trends In interactive Grid Generation System

Grid generation is concerned with discretizing 3D surfaces and volumes surrounding them. This is a necessary, extremely time-consuming process, in for example computing the flow around aircraft. The input for any grid generation system consists of data describing a 3D geometry. The given data might contain errors which need to be corrected before a 3D grid is generated. Efficient, easy-to-use interactive methods are required for defining the volume for which a grid is computed. The speakers will point out how far these steps can be automated and what kind of user interaction is still required, and they will discuss techniques to accelerate the grid generation process.

Organizer: Bernd Hamann
Mississippi State University

3:00 An Overview of the National Grid Project
Joe F. Thompson, Mississippi State University

3:30 Approximation and Reconstruction of Incorrect CAD/CAM Data Grid Generation
Bernd Hamann, Organizer

4:00 Advances in Interactive Structured Grid Generation
John F. Dannenhoffer, III, United Technologies Research Center

4:30 New Trends in Unstructured Grid Generation
Nigel P. Weatherill, University College of Swansea, University of Wales, United Kingdom

MS17/Palm 2

Geometric Tolerance Modeling

There are three aspects of tolerances that one needs to consider: mathematical, representational, and computational. Mathematical theories provide the basic concepts to view an imperfect or variational part. Representation schemes attempt to document tolerance specifications for storage in a computer data base. Computational methods have been devised to understand the design and manufacturing consequences of tolerance specification. When one examines the specific approaches presented in the literature, one finds that it is often difficult to separate the three aspects.

Mathematical models have been grouped roughly as follows: set theoretic, offset zones, parametric zones, vector spaces, and graph-based. There is also the relatively new approach based on fractals.

The speakers will discuss several of these approaches and provide an overview of the influence these methods will have on the future of tolerance standards.

Organizer: Jami J. Shah
Arizona State University

3:00 Geometric Tolerances: Basic Concepts and Alternative Approaches for Modeling
Jami J. Shah, Organizer

3:30 The Offset-Zone Theory of Tolerancing
Aristides A.G. Requicha, University of Southern California

4:00 Fractal Abstractions of Design Tolerances and Manufacturing Process Precision
Kristin L. Wood, University of Texas, Austin

4:30 Tolerancing Semantics and Computational Metrology
Ramesh Srinivasan, IBM T. J. Watson Research Center

CP10/Palm Ballroom

Shape

Chair: B.P. Leonard, University of Akron

3:00 Shape Handles for Algebraic Cubic Splines
Marco Paluszny, Universidad Central de Venezuela, Venezuela and Richard R. Patterson, Indiana University-Purdue University, Indianapolis

3:20 Scale Invariance, Functional Minimization, and Shape Design
Henry P. Moreton, Silicon Graphics, Mountain View, CA and Carlo H. Sequin, University of California, Berkeley

3:40 Generation of Shapes Constrained by PDEs
George M. Turkiyyah and Munikumar Vimawala, University of Washington

4:00 Surface Inflection Curves
David Hoitsma, CAD/CAM Systems, Grumman Data Systems, Bethpage, NY

4:20 The Need for Accurate Shape-Preserving Interpolation in Computational Fluid Dynamics
B.P. Leonard, University of Akron

5:30

Phoenix Desert Botanical Garden Dinner

Geometric Design Titles by Hans Hagan

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**8:00/Palm Ballroom Foyer
Registration Opens**

8:30/Palm Ballroom

IP8/Chair: Josef Hoschek, Technische Hochschule Darmstadt, Germany

**Constrained Knot Removal
Techniques for Spline Curves and
Surfaces**

Knot removal can be used for compression of data, conversion, and data fitting. A technique for removing knots without perturbing the spline more than a given tolerance was introduced some years ago by Morken and the speaker. In practice one often wants the reduced surface to satisfy certain constraints. The speaker will discuss linear and nonlinear shape constraints.

Tom J. Lyche
Institutt for Informatikk
University of Oslo, Norway

9:15/Palm Ballroom

IP9/Chair: Josef Hoschek, Technische Hochschule Darmstadt, Germany

**Can Geometric Modeling and
Photorealistic Display Share the Same
Representation? New Possibilities for
Car Body Design**

Parametric surface representations are commonly used for free form surface modeling. Complex shapes can be accurately described or designed with the aid of relatively few control points. High quality rendering schemes such as ray tracing typically apply to polygonalized surface representations which are completely different in nature and require extensive memory.

The speaker will discuss the possibilities of combining both tasks more closely, in particular, by using implicit surfaces as common geometry representation. He will review some fundamental concepts of representing and rendering geometric objects and point out some inherent difficulties in combining these concepts. He will then present some basic requirements for a common geometry representation and describe, as a candidate, the basic features of an implicit scheme based on C1-piecewise algebraic surfaces of degree three. He will illustrate the scheme by some applications in car body design. The implicit scheme was developed and implemented in collaboration with T. Thamm-Schaar and Mental Images in Berlin.

Wolfgang Dahmen
Institut für Geometrie und Praktische Mathematik
Rheinisch-Westf. Technische Hochschule, Germany

**10:00/Courtyard
Coffee**

**10:30 AM-12:30 PM
Concurrent Sessions**

MS18/Palm Ballroom

Scattered Data Methods

Measurement of data at scattered locations in several independent variables occur in most branches of science and engineering. The applications then require approximation of the underlying surface for values at other locations. Interpolation by various schemes has been addressed many times, with only limited attention to approximation. But there are still advances to be made in interpolation methods. The speakers will present some new ideas for interpolation of scattered data as well as some for approximation of the underlying surface.

Organizer: Richard Franke
Naval Postgraduate School

- 10:30 Least Squares Approximation using Multiquadric Functions**
Richard Franke, Organizer
- 11:00 Moving Least Squares Smoothing and Interpolation with Radial Basis Functions**
Kestutis Salkauskas, University of Calgary, Canada
- 11:30 Scattered Data Hermite Interpolation by Radial Basis Functions**
Xingping Sun, Southwest Missouri State University
- 12:00 The Minimum Norm Network Method for Interpolating Scattered Volumetric Data**
Gregory M. Nielson, Arizona State University

MS19/Palm 2

**Mathematical Tools for Geometric
Programming**

Development and advancement of the science of CAGD depends critically upon the mathematical tools utilized by its practitioners. The purpose of this minisymposium is to introduce some little known mathematical techniques that would be of important theoretical and practical use if they were more universally known and utilized. The speakers will discuss a new interactive program environment called Weyl; Grassmann Algebra as a unifying replacement for the hybrid algebra presently use in CAGD; the four basic recurrences; using derivatives as points.

Organizer: Alvin Swimmer
Arizona State University

- 10:30 Weyl: An Interactive Environment for Geometric Programming**
Anthony D. DeRose, Austin Dahl and William Longabaugh, University of Washington
- 11:00 Recursive Techniques in CAGD**
Ronald N. Goldman, Rice University
- 11:30 Derivative Curve and Surfaces**
Praveen Kashyap, Arizona State University
- 12:00 Grassmann Algebra for Geometric Programming**
Alvin Swimmer, Organizer

MS20/Colonnade Room

Cyclides Applications in CAGD

Cyclide surfaces are an attractive subset of fourth order algebraic surfaces. They admit rational parametrization, possess intuitive geometric parameters, and are closed under offsetting. Consequently, their inclusion in geometric modelers is attractive: increased geometric domain and a wider applications base. The speakers in this minisymposium will discuss cyclide applications in CAGD.

Organizer: D. Dutta
University of Michigan

- 10:30 Cyclides in Blending**
John Johnstone, Johns Hopkins University and C.-K. Shene, Northern Michigan University
- 11:00 Cyclides in Solid Modeling: Recent Developments**
Mike J. Pratt, Rensselaer Polytechnic Institute
- 11:30 Surface Composition using Cyclides**
D. Dutta and Y. L. Srinivas, University of Michigan
- 12:00 Generalized Cyclides in CAGD**
W. Degen, Universität Stuttgart, Germany

CP11/Xavier Room

Manufacturing

- Chair: Victor Milenkovic, Harvard University
- 10:30 Optimal Positioning, Orientation, and Step-over for 5-Axis Machining of Sculptured Surfaces**
C.G. Jensen, S.H. Mullins, and D.C. Anderson, Purdue University, West Lafayette
- 10:50 On Determining Mold Parting Surfaces for Tube-shaped Objects**
Ming-En Wang, Lin-Lin Chen, and Shuo-Yan Chou, Iowa State University
- 11:10 A Geometrical Algorithm for the Systematic and Simplified Design of a Planar Robotic Workcell in Two Space**
J.K. Davidson, Arizona State University and N.A. Soman, Massachusetts Institute of Technology
- 11:30 Topological Spaces for Modeling Feature Conversions from Design to Manufacturing**
Thomas J. Peters, University of Connecticut, Storrs; and David W. Rosen, Georgia Institute of Technology
- 11:50 The Effect of Surface Finish in Layered Manufacturing**
Joanna Brown, University of Leeds, United Kingdom
- 12:10 Compaction of a 2D Layout of Non-convex Shapes with Small Rotations**
Zhenyu Li and Victor Milenkovic, Harvard University

CP12/Augustine Room

Surface Modeling

- Chair: David Y. Gao, Virginia Polytechnic Institute and State University
- 10:30 Representation of Surfaces with Shape Features**
Emmanuel M. Tsimis, Electronic Data Systems, Troy, MI
- 10:50 Implicit Simplicial Models for Adaptive Curve and Surface Reconstruction**
Gabriel Taubin and Remi P. Ronfard, IBM Thomas J. Watson Research Center
- 11:10 Semiregular B-spline Surfaces**
Jens Gravesen, Technical University of Denmark, Denmark
- 11:30 New Procedural Interpolation Schemes**
Leif Kobbelt, University of Karlsruhe, Germany
- 11:50 An Interpolatory Subdivision Algorithm for Surfaces over Arbitrary Triangulations**
Ruibin Qu, National University of Singapore, Singapore
- 12:10 Boundary Element Method for Minimal Surface Design**
David Y. Gao, Virginia Polytechnic Institute and State University and Shin-Tung Yau, Harvard University

12:30-2:00
Lunch

2:00-4:00 PM
Concurrent Session

MS21/Xavier Room

Smooth Low Degree Polynomial Surfaces of Arbitrary Topological Structure

B-splines are widely used to represent surfaces. They combine a low degree polynomial or rational representation of maximal smoothness with a geometrically intuitive variation of the surface in terms of the coefficient mesh. But the B-spline or NURB representation has a major shortcoming. It cannot model certain real world objects without singularity, because each point in the interior of the B-spline mesh must be regular, that is surrounded by exactly four quadrilateral mesh cells. This restricts the topological structure of the objects that can be modeled by the splines. The speakers will present algorithms that build smooth low degree polynomial surfaces from irregular input meshes and curve networks.

Organizer: Jorg Peters
Purdue University, West Lafayette

- 2:00 **Smooth Low Degree Polynomial Spline Surfaces over Irregular Meshes**
Charles T. Loop, Apple Computer, Inc., Cupertino, CA
- 2:30 **Continuity by Optimization with Penalties**
Henry P. Moreton, Silicon Graphics Inc., Mountain View, CA and Carlo H. Sequin, University of California, Berkeley
- 3:00 **A Polytope Smoothing Algorithm that Generates Polynomial Pieces of Low Degree**
Jorg Peters, Organizer
- 3:30 **Biquadratic G-Spline Surfaces**
Ulrich Reif, Universitat Stuttgart, Germany

MS22/Augustine Room

Interpolation, Approximation and Design by Multivariate Splines

The subject of this session is multivariate splines, smooth piecewise polynomial functions, defined on two or three dimensional domains. Multivariate splines of this type are useful in finite element analysis and in geometric design techniques often employ special multivariate splines. They can also be used for the interpolation of scattered data and are particularly useful for handling domains with a complicated geometry.

The speakers will give an overview of the state-of-the-art, and describe new results with emphasis on progress that has been made recently by importing techniques from discrete applied geometry and from rigidity analysis.

Organizer: Peter Alfeld
University of Utah

- 2:00 **The State-of-the-Art and Recent Progress in Bivariate Splines**
Larry L. Schumaker, Vanderbilt University
- 2:30 **The State-of-the-Art and Recent Progress in Trivariate Splines**
Peter Alfeld, Organizer
- 3:00 **Approximation from Bivariate Spline Spaces over Triangulations**
Dong Hong, Texas A&M University, College Station
- 3:30 **Multivariate Splines Using Methods from Discrete Applied Geometry**
Walter Whiteley, York University, Canada

CP13/Palm Ballroom

Surface Construction

Chair: Louis J. Nachman, Oakland University

- 2:00 **Piecewise Cubic Interpolation Surfaces**
Zhen-Xiang Xiong, Alhambra, CA
- 2:20 **Trimmed Bézier Surfaces**
Dieter Lasser and George Pierre Bonneau, Universität Kaiserslautern, Germany
- 2:40 **Construction of Parametrized Rational Curves and Surface Patches on Quadrics**
Roland Dietz, Technical University of Darmstadt, Germany
- 3:00 **Blending Tori with Dupin Cyclides**
Ching-Kuang Shene, Northern Michigan University
- 3:20 **C⁰ Local Control Interpolation of an Arbitrary Mesh**
Marshall Walker, York University, Canada
- 3:40 **Interactive B-spline Surface Modification**
Louis J. Nachman, Oakland University

CP14/Palm 2

NURBS Surfaces

Chair: Josef Hoschek, Technical University, Germany

- 2:00 **Feature-Based Modeling for Curve and Surface Data Fitting**
Gregory T. Dobson and Warren N. Waggenspack, Jr., Louisiana State University
- 2:20 **NURBS with Lagrangian Dynamics**
Hong Qin and Demetri Terzopoulos, University of Toronto, Canada
- 2:40 **G² Continuous Interpolation with C³ Gregory-type Patches**
Kenjiro Takai Miura, University of Aizu, Japan
- 3:00 **NURBS for Surface Inspection**
H.X. Zhou, C.B. Besant, and M. Ristic, Imperial College, United Kingdom
- 3:20 **Approximation of (Nonregular) Data Set With Integral and Rational Tensor-Product B-Spline Surfaces**
Josef Hoschek and Franz-Josef Schneider, Technical University, Germany

4:00/Courtyard
Coffee

PROGRAM-AT-A-GLANCE



Saturday, October 30

6:00 PM-8:00 PM
Registration for Tutorial opens
Palm Ballroom Foyer

Sunday, October 31

8:00 AM-4:00 PM
Registration for Tutorial opens
Palm Ballroom Foyer

9:00 AM-5:00 PM
Tutorial on NURBS: Geometry and Applications
Palm 1

9:00 AM-5:00 PM
Tutorial on Data Reduction and Decomposition Techniques for Curves and Surfaces
Palm 2

6:30 PM-8:30 PM
Registration for Conference opens
Palm Ballroom Foyer

6:30 PM-8:30 PM
Welcoming Reception
Courtyard

PROGRAM-AT-A-GLANCE

	Monday, November 1	Tuesday, November 2	Wednesday, November 3	Thursday, November 4	Friday, November 5
AM 7:30	Registration opens Palm Ballroom Foyer				
8:00		Registration opens Palm Ballroom Foyer	Registration Opens Palm Ballroom Foyer	Registration opens Palm Ballroom Foyer	Registration opens Palm Ballroom Foyer
8:15	Opening Remarks Rosemary Chang Palm Ballroom				
8:30	IP1 Mathematics and Art: A Relationship of 3000 Years Philip J. Davis Palm Ballroom	IP4 Are "Style Design" and Accuracy Compatible? Alain C. Massabo Palm Ballroom	IP6 Solid Modeling of Buildings for Interactive Walk- Throughs Carlo H. Sequin Palm Ballroom	IP8 Constrained Knot Removal Techniques for Spline Curves and Surfaces Tom J. Lyche Palm Ballroom	IP10 Computer Aided Design of Developable Surfaces William H. Frey Palm Ballroom
9:15	IP2 Geometric Aspects of Rational Curves and Surfaces Wolfgang Boehm Palm Ballroom	IP5 The Direct Modification of Surface Curvatures in Car Body Design Roger Andersson Palm Ballroom	IP7 CAGD in the Geosciences: Why Is It Important and Why Conventional Approaches Don't Work Thomas J. Lasser Palm Ballroom	IP9 Can Geometric Modeling and Photorealistic Display Share the Same Representation? New Possibilities for Car Body Design Wolfgang Dahmen Palm Ballroom	IP11 Vision and Shape: Channeling Between the Two Ayn P. Rockwood Palm Ballroom
10:00	Coffee Courtyard	Coffee Courtyard	Coffee Courtyard	Coffee Courtyard	Coffee Courtyard
10:30	MS1 Special Functional Forms for Parametric Curves Organizer: Rida T. Farouki Palm Ballroom MS2 Measuring and Improving Shape Quality in Surface Design Organizer: Nickolas S. Sapidis and Panagiotis D. Kaklis Palm 2 CP1 Computational Geometry Augustine Room CP2 Grid Generation Xavier Room	CONCURRENT SESSIONS MS6 Surfaces in Automobile Design Organizers: Reinhold Klass and Werner Dankwort Palm Ballroom MS7 Constraint Management Organizer: Pierre Malraux Palm 2 MS8 Computer Aided Geometric Design Based on Kinematic Measures Organizer: Jahangir S. Rastegar Augustine Room CP4 Triangular Patches Xavier Room	CONCURRENT SESSIONS MS13 Modeling Surfaces of Geologic Origin Organizer: Henry P. Moreton Palm Ballroom MS14 Discrete Geometry Representations Organizer: Dianne C. Hansford Palm 2 CP8a Curves II Xavier Room CP9 Designing for Shape Augustine Room	CONCURRENT SESSIONS MS18 Scattered Data Methods Organizer: Richard Franke Palm Ballroom MS19 Mathematical Tools for Geometric Programming Organizer: Alvin Swimmer Palm 2 MS20 Cyclides Applications in CAGD Organizer: Debashis Dutta Colonade Room CP11 Manufacturing Xavier Room CP12 Surface Modeling Augustine Room	CONCURRENT SESSIONS MS25 Variational Design - Part 1 of 2 Guido Brunnert Xavier Room MS26 Computation, Tesselation and Modeling Techniques of NURBS Surfaces Organizer: Fuhua Cheng Augustine Room CP17 Solid Modeling I Palm 2 CP18 NURBS Curves Palm Ballroom
PM 12:30	Lunch	Lunch	Lunch	Lunch	Lunch
2:00	Tribute to John A. Gregory Palm Ballroom	CONCURRENT SESSIONS MS9 Data-Sharing, the Need for Standards, and IGES Organizer: Tracy M. Whelan Palm 2 MS10 Surface-Surface Intersections Organizer: Dieter Lasser Palm Ballroom CP5 Geometric Modeling I Augustine Room CP6 Approximations	Tour: Geometric Design Arizona State University	CONCURRENT SESSIONS MS21 Smooth Low Degree Polynomial Surfaces of Arbitrary Topological Structure Organizer: Jorg Peters Xavier Room MS22 Interpolation, Approximation and Design by Multivariate Splines Organizer: Peter Alfeld Augustine Room	CONCURRENT SESSIONS MS27 Variational Design - Part 2 of 2 Organizer: Guido Brunnert Augustine Room CP19 Solid Modeling II Palm 2 CP20 Geometry Processing Palm Ballroom

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4:30-6:30
Concurrent Sessions

MS23/Xavier Room

Geometric Issues in Rapid Prototyping and Solid Freeform Fabrication

Solid Freeform Fabrication (SFF) technologies address the problem of creating three-dimensional objects directly from a geometric database without part-specific tooling or human intervention. The development of these technologies and their assimilation into manufacturing industries present unique problems for the geometric design community in robust computational algorithms, data exchange standards, and geometric representations to support SFF process control. The speakers in this minisymposium, representatives from the SFF industry, the manufacturing industries, and universities, will discuss some of the important issues in SFF.

Organizer: Richard H. Crawford
The University of Texas, Austin

- 4:30 Solid Freeform Fabrication Technologies and Geometric Input Sources**
Richard H. Crawford, Organizer
- 5:00 Geometric Data Requirements for Solid Freeform Fabrication**
James F. Darrach, DTM Corporation, Austin, Texas
- 5:30 Direct Engineering/Manufacturing**
Peter R. Sferro, Ford Motor Company
- 6:00 Systems Issues in Solid Freeform Fabrication**
Michael J. Wozny, Rensselaer Polytechnic Institute

MS24/Augustine Room

Multivariate Data Fitting

Interpolation and approximation of multidimensional data has many scientific and engineering applications. The primary focus of this minisymposium is on the applications and representation of multivariate functions that model data sampled at arbitrary locations, including data sampled on a subset of a rectilinear grid, data sampled in a volume using a piecewise defined trivariate interpolant data sampled on an arbitrary G^1 surface domain, and interpolating a reduced set of data using multiquadric basis functions.

Organizer: Thomas A. Foley
Arizona State University

- 4:30 Approximation of Large Scattered Data Sets**
Erlend Arge, Morten Daehlen, and Aslak Tveito, SINTEF-SI, Norway
- 5:00 A Hybrid Quintic Bezier Tetrahedron**
Thomas A. Foley and Hans J. Wolters, Arizona State University
- 5:30 Data Fitting on Surfaces**
Karsten Opitz, Forschungsgruppe Scientific Visualization, Germany
- 6:00 Multiquadric Approximations Using a Reduced Data Interpolation Set**
Ralph Carlson, and Balas Natarajan, Lawrence Livermore National Laboratory

CP15/Palm 2

Tile Based Methods

Chair: Leonardo Traversoni, Universidad Autonoma Metropolitana, Mexico

- 4:30 Constructing Voronoi Diagrams of Polyhedra using Rounded Arithmetic**
Victor Milenkovic, Harvard University
- 4:50 Extrapolation of Sibson's Coordinates in the Plane**
Jeffrey L. Brown, University of North Carolina, Wilmington
- 5:10 Emulation of Uniform Cracking**
Donal MacVeigh, Saint Peter's College
- 5:30 Some Results using Natural Neighbors**
Leonardo Traversoni, Universidad Autonoma Metropolitana, Mexico

CP16/Palm Ballroom
Visualization

Chair: Jonathan Yen, Hewlett-Packard Laboratories

- 4:30 An Accurate Algorithm for Rasterizing 2D Projections of 3D Algebraic Curves**
Gabriel Taubin, IBM Thomas J. Watson Research Center
- 4:50 Visualizing Algebraic Curves**
Douglas W. Moore and Joe Warren, Rice University
- 5:10 Two Global Theorems in Closed Discrete Curves and Surfaces**
Li Chen and Jianping Zhang, Utah State University
- 5:30 Geodesics on an Irregular Geometry Using a Salient Assemblage Representation**
William L. Anderson, Elements Research, Inc., Palo Alto, CA
- 5:50 Visualization for Differential Geometry of B-spline Curves and Surfaces**
Jonathan Yen, Hewlett-Packard Laboratories

ICIAM 95



Third
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Congress on
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Mathematics

July 3-7, 1995

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Hamburg, Germany

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Hosted by:

Gesellschaft für Angewandte
Mathematik und Mechanik
(GAMM)

8:00/Palm Ballroom Foyer
Registration opens

8:30/Palm Ballroom

IP10/Chair: Thomas A. Foley, Arizona State University

Computer Aided Design of Developable Surfaces

Surfaces that can be formed by isometric bending of a flat sheet of material (paper, sheet metal, glass, plastic, etc.) are said to be developable. Mathematically, developable surfaces are those ruled surfaces having a constant tangent plane along every ruling. Although it is easy to design and modify ruled surfaces in most CAD systems, maintaining a constant tangent plane for developables more general than cones and cylinders requires extra effort. Recently, researchers have explored a variety of methods for computer aided design of developable surfaces. In this presentation, the speaker will describe several of these approaches, devoting special attention to the design of developable Bezier surfaces.

William H. Frey
General Motors Research Laboratories

9:15/Palm Ballroom

IP11/Chair: Thomas A. Foley, Arizona State University

Vision and Shape: Chunneling Between the Two

The Chunnel is a political and engineering feat conceived to connect two diverse lands and cultures. Mathematical sculpturing implies a similar undertaking. The effort to automate the design and manufacture of mathematical concepts traverses diverse areas such as "rubber sheet" and hyperbolic geometries, approximation theory, algebraic groups and CAGC. The start of the trip begins with a vision of the concept. It ends with a piece of hard sculpture - the shape.

Although the primary intent is to computerize sculpting, the techniques have applications to general design and representation problems, NC milling, surface texturing, graphics and others.

Alyn P. Rockwood
Department Computer Science
Arizona State University

10:00/Courtyard
Coffee

10:30 AM-12:30 PM
Concurrent Sessions

MS25/Xavier Room

Variational Design (Part 1 of 2)

Variational design involves a variational principle to model shape. The methods used are of importance for both the theoretical and practical aspects of geometric design. The main aspirations of variational design are (a) to understand what shape characteristics are produced by certain minimum properties; (b) to develop curve/surface schemes that satisfy application relevant variational principles; (c) to develop curve/surface optimization techniques employing variational fairness criteria. The speakers in this minisymposium will report on current achievements in applying variational methods to problems of geometric design.

Organizer: Guido Brunnett
Naval Postgraduate School

- 10:30 Shape Parameters and Variational Splines**
Pierre-Jean Laurent, Universite Joseph Fourier, France
- 11:00 Splines of Minimal Length with Lipschitz Constrained Tangent Vector**
Guido Brunnett, Organizer
- 11:30 Weighted Minimum Norm Networks**
Len Bos and D. Holland, University of Calgary, Canada
- 12:00 Fair Vertex Blends**
Tamas Varady and Alyn P. Rockwood, Arizona State University

MS26/Augustine Room

Computation, Tessellation and Modeling Techniques of NURB Surfaces

New techniques in modeling, computation and visualization, enable a user to design and visualize a 3D object more accurately and quickly, thereby facilitating the design process.

The speaker will discuss the application of NURB surface in the generation of sweep surfaces and offset surfaces. They will present a new approach for shape controlling of NURB surfaces.

They will discuss and compare three techniques used in the NURB surface and derivative evaluation process and analyse the performance of their respective algorithms.

Finally, they will present a new trimmed NURB surface rendering technique and compare its performance with existing techniques.

Organizer: Fuhua Cheng
University of Kentucky

- 10:30 Modeling Using NURB Surfaces**
Wenping Wang, University of Alberta, Canada
- 11:00 Tessellation of Trimmed NURB Surfaces**
William L. Luken, IBM Thomas J. Watson Research Center
- 11:30 Shape Editing Criteria and Techniques of NURB Surfaces**
Kenki T. Miura, University of Aizu, Japan
- 12:00 Computation Techniques of NURB Surfaces**
Fuhua Cheng, Organizer

CP17/Palm 2

Solid Modeling 1

Chair: Paulo Cezar Pinto Carvalho, IMPA-Instituto de Matematica Pura e Aplicada, Brazil

- 10:30 Syntactic Solid Modeling Using NURBS Primitives and Plex Grammar Production Rules**
Vassilios E. Theodoracatos and Amalesh Chakraborty, University of Oklahoma
- 10:50 Using Boundary Evaluation for Partially Boundary Solids and C++ Class Hierarchies for User Extensibility**
James R. Miller, University of Kansas
- 11:10 On the Shape of Geometric Solid Models**
Abel Gomes and Jose Teixeira, Universidade de Coimbra, Portugal
- 11:30 Maintenance of Geometric Representations Through Space Decompositions**
Vadim Shapiro, General Motors Research Laboratories
- 11:50 Multimatierial Modeling Based on Spatial Decomposition Schemes**
Paulo Cezar Pinto Carvalho, IMPA-Instituto de Matematica Pura e Aplicada, Brazil

CP18/Palm Ballroom

NURBS Curves

Chair: Jin J. Chou, NASA Ames Research Center

- 10:30 NURB Representations of Circular Arcs**
George Allen, EDS/Unigraphics, Cypress, CA
- 10:50 A Software Engineering Approach to Degree Elevation of B-spline Curves**
Les Piegil, University of South Florida and Wayne Tiller, Tyler, TX
- 11:10 Approximative Knot Removal for B-Splines**
Matthias Eck and Jan Hadenfeld, Technische Hochschule Darmstadt, Germany
- 11:30 Matrix Representation for Spline Curves and Surfaces in Terms of Nonuniform B-splines**
Hans Grabowski and Xiaohu Li, University of Karlsruhe, Germany
- 11:50 Bézier Curves That Are Circles**
Jin J. Chou, NASA Ames Research Center

12:30-2:00
Lunch

2:00-4:00
Concurrent Sessions

MS27/Augustine Room

Variational Design (Part 2 of 2)

(For description, see MS25, page 17)

Organizer: Guido Brunnett
Naval Postgraduate School

- 2:00 **Constrained Optimization in Surface Design**
Michael Kallay, EDS, Bellevue, WA
- 2:30 **Variational Design of Rational Curves and Surfaces**
Georges-Pierre Bonneau and Hans Hagen, Commissariat a l'Energie Atomique, France
- 3:00 **Convexity Preserving Bivariate Splines Interpolating Spatial Gridded Data**
P.D. Kaklis, National Technical University of Athens, Greece
- 3:30 **Variational Fairing of B-splines**
Matthias Eck and Jan Hadenfeld, Technische Hochschule Darmstadt, Germany

CP19/Palm 2

Solid Modeling 2

Chair: Mark A. Ganter, University of Washington

- 2:00 **Recognition of Volumetric Features from CAD Models: Problem Formalization and Algorithms**
William C. Regli and Dana S. Nau, University of Maryland, College Park
- 2:20 **Automatic Sheet Metal Flattening from Solid Models**
S.-H. Frank Chuang, National Chung-Hsing University, Taiwan
- 2:40 **Design Applications of Implicit Solid Modeling (ISM)**
Mark A. Ganter and Duane W. Storti, University of Washington
- 3:00 **Modelling Solids with Tolerances**
David J. Jackson, Shape Data, EDS-Scicon, United Kingdom
- 3:20 **FORTTRAN Programs for Computing Surface Area and Volume of Rotational Solid**
Guofa Wu, Roger J. McNichols, and Robert Abella, University of Toledo
- 3:40 **Implicit Solid Modeling (ISM) with Local Control**
Mark A. Ganter, Duane W. Storti, and Halldor Magnusson, University of Washington

CP20/Palm Ballroom

Geometry Processing

Chair: Helmut Pottmann, Technical University of Vienna, Austria

- 2:00 **Tracing a Surface Surface Intersection Curve through a Singular Point**
Dale Lear, Applied Geometry Corporation, Seattle
- 2:20 **General Offset Surfaces and Their Applications**
Eric L. Brechner, Boeing Computer Services
- 2:40 **Computing the Intersection of Plane and a Torus**
Ching-Kuang Shene, Northern Michigan University
- 3:00 **Filletting Between Multiple Trimmed Surfaces by Simulating the Motion of a Rolling Ball**
Mark Feldman, Camax Systems, Inc., Minneapolis
- 3:20 **Interrogation and Control of Aesthetic Characteristics of Free-Form Surfaces Based on Reflection Analysis**
Yasushi Yamaguchi, Tokyo Denki University, Japan and Fumihiko Kimura, University of Tokyo, Japan
- 3:40 **Rational Curves and Surfaces with Rational Offsets**
Helmut Pottmann, Technical University of Vienna, Austria

4:00
Conference Adjourns

EXHIBITS

Be sure to visit the tabletop exhibits, which will be located in the Palm Ballroom III, Monday, November 1 through Friday, November 5, 1993.

Stop and browse through recently published titles on Geometric Design and related topics.

A list of confirmed exhibitors for this 1993 meeting is not available at press time. Companies who have exhibited at previous SIAM Geometric Design Conferences include:

Academic Press, Inc.

American Society of Mechanical Engineers

Butterworth-Heinemann

Cambridge University Press

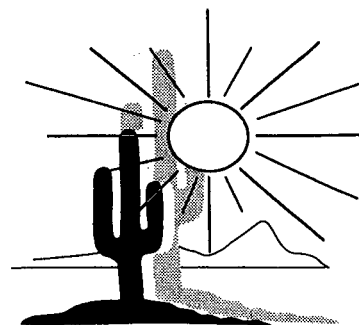
Elsevier Science Publishers

Jones & Bartlett Publishers

Pergamon Press

Springer-Verlag NY, Inc.

VSP International Science Publishers



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Darrah, J.F.	MS23	16	Thu 5:00	MacVeigh, D.	CP15	16	Thu 5:10	Stifter, S.	MS11	8	Tue 5:00
Davidson, J.K.	CP11	12	Thu 11:10	Makawa, T.	MS10	8	Tue 3:30	Storti, D.W.	CP19	18	Fri 2:40
Davis, P.J.	IP1	5	Mon 8:30	Mallet, J-L.	MS13	10	Wed 11:00	Stoughton, T.B.	MS3	6	Mon 3:30
Dayanand, S.	CP4	7	Tue 11:10	Malosse, J.J.	CP3	6	Mon 3:50	Sun, X.	MS18	12	Thu 11:30
de Figueiredo, L.H.	CP3	6	Mon 4:10	Malraison, P.	MS7	7	Tue 12:10	Svobodny, T.P.	PS	9	Tue 4:30
de Figueiredo, L.H.	CP8a	10	Wed 11:10	Mann, S.	CP4	7	Tue 11:30	Swimmer, A.	MS19	12	Thu 12:00
Degen, W.	MS20	12	Thu 12:00	Manocha, D.	CP3	6	Mon 4:30	Taubin, G.	CP12	12	Thu 10:50
De Jong, E.M.	MS15	11	Wed 3:00	Manocha, D.	MS10	8	Tue 3:00	Taubin, G.	CP16	16	Thu 4:30
DeRose, A.D.	MS2	5	Mon 10:30	Manocha, D.	CP7	9	Tue 4:30	Theodoracatos, V.E.	CP17	17	Fri 10:30
DeRose, A.D.	MS4	6	Mon 5:30	Martha, L.F.	CP2	5	Mon 11:50	Thompson, J.F.	MS16	11	Wed 3:00
DeRose, A.D.	MS19	12	Thu 10:30	Massabo, A.C.	IP4	7	Tue 8:30	Tiller, W.	CP18	17	Fri 10:50
Dietz, R.	CP13	13	Thu 2:40	Mastin, C.W.	CP2	5	Mon 11:10	Traversoni, L.	CP15	16	Thu 5:30
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Dutta, D.	MS20	12	Thu 11:30	Meek, D.S.	MS1	5	Mon 10:30	Tu, Q.	MS8	7	Tue 11:30
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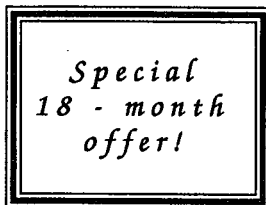
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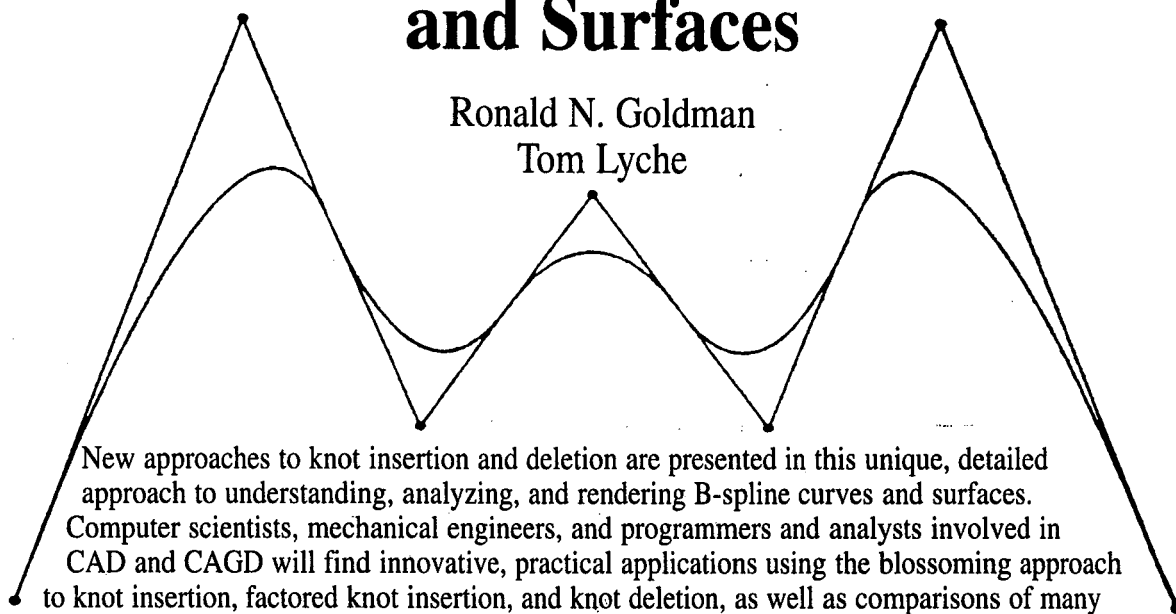
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Tempe, Arizona 85281
(602) 894-1400

SIAM is holding a block of rooms at the Radisson Tempe Mission Palms Hotel on a first come first serve basis at the specially discounted rates of \$78/Single and \$88/Double. A 9.5% occupancy tax will be added to your room rate. Rooms will be held for our exclusive use until October 11, 1993, after which date reservations will depend on availability and the above rates may not be in effect. To make reservations use the Hotel Reservation Card in the back of this program or call (602) 894-1400. Identify yourself as an attendee at the SIAM Conference on Geometric Design. Be sure to request a confirmation number.

Arrivals and Departures: Check-in time is 3:00 PM. Check-out time is 12:00 Noon.

Location: The hotel is located in the heart of historic Old Town Tempe, Arizona. It is just fifteen minutes from the Sky Harbor International Airport and twenty minutes from downtown Phoenix. Adjacent Arizona State University, the hotel is only 150 yards from the Sun Devil Football Stadium, home of the ASU football team, the NFL Phoenix Cardinals team and the renowned Fiesta Bowl. Across the street from the hotel is a shopping complex filled with quaint shops, galleries, restaurants and entertainment.

Hotel Facilities: The hotel is equipped with two lighted tennis courts, sundeck, health club with the latest exercise equipment, sauna and whirlpool, and heated swimming pool. The Concierge at the hotel can assist you with any arrangements that you may need in seeing the area's attractions.

Restaurants and Lounges: The hotel has three restaurants that serve just about anything that you may be looking for. The Arches serves breakfast, lunch and dinner. The Cloister, a gourmet dining room, features superb continental cuisine, with selections prepared tableside. The Monster Lobby Lounge is open Monday through Friday 4:30 PM–12:00 PM. There are complimentary hors d'oeuvres and entertainment from 4:30 PM–8:30 PM.

REGISTRATION INFORMATION

The registration desk will be located in the Palm Ballroom Foyer and will be open as listed below:

Saturday, October 30	6:00 pm – 8:00 pm
Sunday, October 31	8:00 am – 4:00 pm 6:30 pm – 8:30 pm
Monday, November 4	7:30 am – 4:00 pm
Tuesday, November 5	8:00 am – 4:30 pm
Wednesday, November 6	8:00 am – 12:00 pm 2:30 pm – 4:00 pm
Thursday, November 7	8:00 am – 4:30 pm
Friday, November 8	8:00 am – 2:00 pm

Please complete the Preregistration Form on the inside back cover and return it with your payment to SIAM in the enclosed envelope. We urge attendees to preregister as the registration fees are lower for preregistrants. Your Preregistration Form and payment must arrive at SIAM by October 18, 1993. Attendees whose Preregistration Form are received at SIAM after October 18 will be required to pay the difference between the preregistration and the registration fees at the conference.

GET-TOGETHERS

SIAM Welcoming Reception

Sunday, October 31, 1993
6:30 PM - 8:30 PM
Palm 2
Cash bar and assorted hors d'oeuvres

Meet-and-Greet Hour

Monday, November 1, 1993
6:00 PM - 7:00 PM
Courtyard
Here's an opportunity to join colleagues for an authentic Margarita, refreshing beer or soda, tortilla chips and salsa, and chips and dip to converse about the day's events or make plans for dinner.
Cost \$5.00

Business Meeting

SIAM Activity Group on Geometric Design
Tuesday, November 2, 1993
8:00 PM
Palm 2
Open to all interested attendees

Mexican Dinner at Phoenix Desert Botanical Gardens

Wednesday, November 3, 1993
5:30 PM-9:00 PM
The evening begins with a short bus ride (10 minutes) to Phoenix Desert Botanical Gardens. Fountains of margaritas, fruit punch, beer, and sodas will be available for your enjoyment when you first arrive. Time is allotted so that you can stroll through the luscious garden. Dinner will be catered by Macayo, one of Phoenix's authentic Mexican caterers. A lavish display of hors d'oeuvres, dinner and dessert will be available from 7:00 PM - 8:30 PM. Hors d'oeuvres include trio of chips, pineapple salsa, macayo original salsa, hot sauce, black bean canape, and chile canape. Dinner includes a buffet of mini beef chimichangas, blue corn fajita taquitos, chicken fajita skewers, green corn tamales, spinach enchilada, frijoles negros, and Mexican rice. Dessert will consist of a cinnamon crisp layered with chocolate fudge and carmel, topped with white chocolate mousse and chopped nuts. Dinner will be served on the Ullman Terrace of the Botanical Gardens.
Cost per person: \$40.00

Registration Fees:

	SIAG/GD+	SIAM Member	Non-Member*	Student
Tutorial on NURBS				
Preregistration	\$120	\$120	\$135	\$55
Registration**	\$135	\$135	\$155	\$55
Tutorial on Data Reduction				
Preregistration	\$120	\$120	\$135	\$55
Registration**	\$135	\$135	\$155	\$55
Conference				
Preregistration	\$145	\$150	\$180	\$25
Registration	\$180	\$185	\$215	\$25

+Member of SIAM Activity Group on Geometric Design.

*Non-member attendees who are employed by SIAM corporate members listed below are entitled to the SIAM member rate.

**Tutorial Notes, coffee, and lunch are included in the tutorial registration fees.

SIAM Corporate Members

Non-member attendees who are employed by the following institutions are entitled to the SIAM member rate.

Amoco Production Company
AT&T Bell Laboratories
Bellcore
The Boeing Company
BP America
Cray Research Inc.
E.I. du Pont de Nemours & Company
Eastman Kodak Company
Exxon Research and Engineering Company
General Motors Corporation
GTE Laboratories Inc.
Hollandse Signaalapparaten, B.V.
IBM Corporation
ICASE
IDA Center for Communications Research
MacNeal-Schwendler Corporation
Martin Marietta Energy Systems
Mathematical Sciences Research Institute
NEC Research Institute
Supercomputing Research Center, a Division of Institute for Defense Analyses
Texaco, Inc.
United Technologies Corporation
Visual Numerics, Inc.

Non-SIAM Members (For Preregistration Only)

Non-SIAM members are encouraged to join SIAM to obtain the member rate for meeting registration and enjoy all the other benefits of SIAM Membership. Join SIAM by sending your completed membership application (see page 21) along with your Preregistration Form. Be sure to include both membership dues and preregistration fees in your payment. This offer applies to preregistrants only; membership application, preregistration form, and payment must be received by SIAM no later than Monday, October 18, 1993. Offer expires after Monday, October 18, 1993.

Special Note

There will be no prorated fees. No refunds will be issued once the conference has started. If your Preregistration Form and payment are not received at the SIAM office by Monday, October 18, 1993, you will be asked to register and pay the full registration fee at the conference.

Cancellation Policy

Full refunds for conference and special event fees will be given to attendees who cancel prior to October 18, 1993. Fees for special event tickets are not subject to refund after October 18, 1993. Cancellation after October 18, 1993 will receive a refund payment less a \$25.00 cancellation fee. Cancellations after conference has started (October 30, 1993) are not subject to refund.

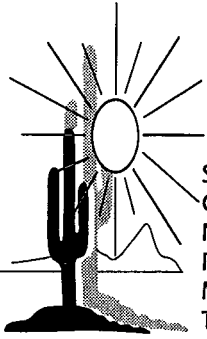
Telephone Messages

The telephone number at the Radisson Tempe Mission Palms Hotel is (602) 894-1400. The Radisson will either connect you with the SIAM registration desk or forward a message to the attendees room.

Credit Cards

SIAM accepted VISA, MasterCard and American Express for payment of registration fees, memberships, special functions and book orders. When you complete the Preregistration Form, please indicate the type of credit card, the account number and the expiration date.

HOTEL RESERVATION FORM



SIAM Conference on
Geometric Design
November 1-5, 1993
Radisson Tempe
Mission Palms Hotel
Tempe, Arizona

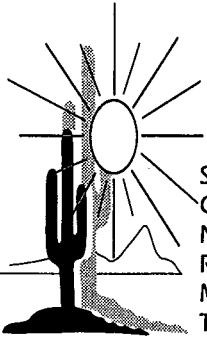
Specially discounted rooms are being held for SIAM's exclusive use until Monday, October 11, 1993. After that date, reservations will depend on availability. Your reservation is not confirmed until acknowledged in writing by the hotel or verified by telephone. A deposit in the amount of one night's room rate is required to confirm your reservation. When making reservations by telephone, identify yourself as an attendee at the SIAM Conference on Geometric Design.
Telephone: (602) 894-1400.

PLEASE SEND ME A CONFIRMATION NOTICE. **PLEASE PRINT.**

Name _____
First Middle Initial Last
Address _____
City _____ State _____ Zip _____
Telephone _____ E-Mail _____
Fax: _____
Please reserve ☐ Single (\$78) ☐ Double (\$88)
Arrival Date _____ Arrival Time _____
Departure Date _____
☐ I am a disabled participant and require appropriate accommodations
I am enclosing my deposit for the first night's room rate. I choose to pay by:
☐ AMEX ☐ VISA ☐ MC ☐ Check
Credit Card No. _____ Exp. Date _____
Deposit \$ _____
Signature _____

Detach this card and enclose it in an envelope with postage and mail to:
Reservations, The Radisson Tempe Mission Palms Hotel, 60 East Fifth Street, Tempe, AZ 85281.

PREREGISTRATION FORM



SIAM Conference on
Geometric Design
November 1-5, 1993
Radisson Tempe
Mission Palms Hotel
Tempe, Arizona

Preregistration Form and payment must be received at the SIAM office by Monday, October 18, 1993, or you will be required to pay the full registration fee. please make checks payable to SIAM.

Registration Fees: (Please circle your appropriate fee category)

	SIAG/GD+	SIAM Member	Non-Member*	Student
Tutorial on NURBS**				
Preregistration	\$120	\$120	\$135	\$55
Registration	\$135	\$135	\$155	\$55
Tutorial on Data Reduction**				
Preregistration	\$120	\$120	\$135	\$55
Registration	\$135	\$135	\$155	\$55
Conference				
Preregistration	\$145	\$150	\$180	\$25
Registration	\$180	\$185	\$215	\$25
Meet and Greet	\$ 5	\$ 5	\$ 5	\$ 5
Garden Dinner	\$ 40	\$ 40	\$ 40	\$40
TOTAL	\$ _____	\$ _____	\$ _____	\$ _____

+Member of SIAM Activity Group on Geometric Design.

*Non-member attendees who are employed by SIAM corporate members listed on page 26 are entitled to the SIAM member rate.

**Tutorial Notes, coffee, and lunch are included in the tutorial registration fees.

PLEASE PRINT

Name _____
First Middle Initial Last
Organization _____
Department _____
Business Address _____
City _____ State _____ Zip _____
Telephone _____
Fax _____
E-mail _____
Home Address _____
City _____ State _____ Zip _____
Local address in Tempe _____
☐ I am a disabled participant and require appropriate accommodations
Please update my SIAM records ☐ Yes ☐ No
All correspondence from SIAM should be sent to the following address: ☐ Home ☐ Business
I wish to pay by ☐ AMEX ☐ VISA ☐ MC ☐ Check
Credit Card No: _____ Exp. Date _____
Signature _____

NAME BADGE—I prefer my name and affiliation to read as follows:

Name: (20 Characters) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Affiliation: (30 Characters) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Detach this form and enclose it with payment in the envelope provided (domestic mail only) and mail to SIAM Conference Department, 3600 University City Science Center, Philadelphia, PA 19104-2688. Telephone: 215-382-9800; E-mail: meetings@siam.org; Fax: 215-386-7999. Preregistration and payment must be received by Monday, October 18, 1993, or you will have to pay the full registration fee on-site.

siam.

Society of Industrial and Applied Mathematics
3600 University City Science Center
Philadelphia, PA 19104-2688

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