Conference Program:

Monday, June 17

7:30–17:00 Registration for Tutorials & Conference

9:00–12:00 and 13:30–16:30 Tutorial T1:
Geometric Algorithms for Planning and Simulation Tasks in Virtual Prototyping
Organizer: E. Schömer, MPI Informatik
(cf. page 8 for details)

9:00–12:00 and 13:30–16:30 Tutorial T2:
A Framework for the Acquisition, Processing and Interactive Display of High Quality 3D Models
Organizer: H.-P. Seidel, MPI Informatik
(cf. page 9 for details)

Tuesday, June 18

7:30–19:30 Registration for Tutorials & Conference

9:00–12:00 and 13:30–16:30 Tutorial T3:
Compression and Progressive Transmission of 3D Models
Organizer: Jarek Rossignac, Georgia Institute of Technology
(cf. page 10 for details)

9:00–12:00 and 13:30–16:30 Tutorial T4:
Handling Large Geometric Datasets: Proximity Queries and Interactive Walkthroughs
Organizer: Dinesh Manocha and Ming Lin, University of North Carolina, Chapel Hill
(cf. page 12 for details)

Wednesday, June 19

7:30–17:20
Registration

8:15–8:30
Conference Opening Remarks

8:30–9:45
Session 1: Modeling I
Chair: M. C. Hoffmann

- S. Raghothama, V. Shapiro: Topological Framework for Part Families
- D. Marcheix, G. Pierra: A Survey of the Persistent Naming Problem
- J. Keyser, T. Culver, M. Foskey, S. Krishnan, D. Manocha: ESOLID - A System for Exact Boundary Evaluation

Break

10:15–11:30
Session 2: Curves and Surfaces
Chair: B. Falcidieno

- J. Cotrina-Navau, N. Pla-Garcia, M. Vigo-Anglada: A Generic Approach to Free Form Surface Generation
- A. Angelidis, M.-P. Cani: Adaptive Implicit Modeling using Subdivision Curves and Surfaces as Skeletons
- K. Hormann, U. Labsik, M. Meister, G. Greiner: Hierarchical Extraction of Iso-Surfaces with Semi-Regular Meshes

Lunch

13:00–14:00
Invited Presentation 1
CSG-Brep Duality and Compression
Speaker: J. Rossignac
Chair: R. Joan-Arinyo
(cf. page 13 for details)

14:00–15:15
Session 3: Model Simplification
Chair: J. Vandenbrande

- S. Venkataraman, M. Sohoni: Reconstruction of Feature Volumes and Feature Suppression
- M. Bertram: Biorthogonal Wavelets for Subdivision Volumes
- S. Venkataraman, M. Sohoni, R. Rajadhyaksha: Removal of Blends from Boundary Representation Models

15:15–16:30 Break
and Poster Session 1 (cf. page 18 for details)

16:30–17:20
Session 4: Constraints
Chair: B. Brüderlin

- X.-S. Gao, C. M. Hoffmann, W.-Q. Yang: Solving Spatial Basic Geometric Constraint Configurations with Locus Intersection
- R. Joan-Arinyo, A. Soto-Riera, S. Vila-Marta, J. Vilaplana-Pasto: Revisiting Decomposition Analysis of Geometric Constraint Graphs

17:30–19:00 Welcome Reception

Thursday, June 20

7:30–17:00
Registration

8:30–9:45
Session 5: Reverse Engineering
Chair: R. Martin

- J.-D. Boissonnat, J. Flototto: A Local Coordinate System on a Surface
- M. Djebali, M. Melkemi, N. Sapidis: Range-Image Segmentation and Model Reconstruction Based on a Fit-and-Merge Strategy
- D. Attali, J.-D. Boissonnat: A Linear Bound on the Complexity of the Delaunay Triangulation of Points on Polyhedral Surfaces

Break

10:15–11:30
Session 6: Triangulation
Chair: R. Klein

- J.-M. Morvan, B. Thibert: Smooth Surface and Triangular Mesh: Comparison of the Area, the Normals and the Unfolding
- L. De Floriani, P. Magillo, E. Puppo, D. Sobrero: A Multi-Resolution Topological Representation for Non-Manifold Meshes
- Y. Ohtake, A. G. Belyaev: Dual/Primal Mesh Optimization for Polygonized Implicit Surfaces

Lunch

13:00–14:00

Invited Presentation 2:
Interactive Sculpting with Implicit Surfaces
Speaker: M.-P. Cani
Chair: A. Pasko
(cf. page 15 for details)

14:00–15:15

Session7: Modeling II
Chair: S. Allen

- P. A. C. Varley, R. R. Martin: Estimating Depth from Line Drawings
- V. Adzhiev, E. Kartasheva, T. Kunii, A. Pasko, B. Schmitt: Cellular-Functional Modeling of Heterogeneous Objects
- D. Liao, S. Fang: Fast Volumetric CSG Modeling Using Standard Graphics System

15:15–17:00 Break

and Poster Session 2 (c.f. page 18 for details)

19:00–22:00

Symposium Banquet

Friday, June 21

7:30–11:00
Registration

8:00–9:15
Session 8: Geometric Reasoning
Chair: G. Turkiyyah

- S. W. Choi, H.-P. Seidel: Linear One-sided Stability of MAT for Weakly Injective 3D Domain
- T. K. Dey, W. Zhao: Approximate Medial Axis as a Voronoi Subcomplex
- S. Mukai, S. Furukawa, M. Kuroda: An Algorithm for Deciding Similarities of 3-D Objects

Break

9:30–10:30
Invited Presentation 3:
Discrete Models for Geometric Objects
Speaker: P. Brunet
Chair: N. Sapidis
(cf. page 16 for details)

10:30–11:45 Session 9: Engineering Applications
Chair: H. Qin

- M. Higashi, N. Aoki, T. Kaneko: Application of Haptic Navigation to Modify Free-Form Surfaces through Specified Points and Curves
- R. Bidarra, N. Kranendonk, A. Noort, W. F. Bronsvoort: A Collaborative Framework for Integrated Part and Assembly Modeling
- M. Drumheller: Constraint-based Design of Optimal Transport Elements

11:45–12:15
Closing Comments and Plans for next Year (Solid Modeling '03)

Lunch

Tutorials:

There will be four full day tutorials (two on Monday, two on Tuesday) as listed below. Tutorials are scheduled from 9:00 – 12:00 and 13:30 – 16:30 with two 1/2 hour coffee breaks in both the morning (10:30 – 11:00) and afternoon (15:00 – 15:30). This makes for a total of five hours of lectures.

Monday, June 17:

Tutorial T1: Geometric Algorithms for Planning and Simulation Tasks in Virtual Prototyping

Organizer: E. Schömer, MPI Informatik

Abstract: Virtual prototyping of mechanical systems requires efficient and robust geometric algorithms in its core. We present algorithms for collision detection and distance calculation, which can be used in interactive virtual reality applications in order to perform ergonomy studies and assembly planning tasks in automotive industry. Avoiding the interpenetration of the virtual objects and modeling their physical behavior when they collide are a prerequisite for realistically simulating assembly operations in a virtual environment. We report on experimental results we achieved together with our cooperation partner, the virtual reality competence center of DaimlerChrysler.

As further industrial applications we discuss algorithms for computing the reachable space of mechanisms (e.g. the steering column of a car) or measuring the trunk interior of a car by solving a packing problem.

Tutorial T2: A Framework for the Acquisition, Processing and Interactive Display of High Quality 3D Models

Organizer: H.-P. Seidel, MPI Informatik

Abstract: High quality 3D models are quickly emerging as a new multimedia data type with applications in such diverse areas as e-commerce, online encyclopaedias, or virtual museums, to name just a few. This tutorial presents new algorithms and techniques, developed by the speakers and others, for the acquisition and real-time interaction with virtual 3D objects. These algorithms and techniques are presented in a complete framework for the acquisition, processing, and interactive display of high quality 3D models.

Realistic appearance of 3D models necessitates the modeling of physical properties of an object. An object's reflectance behavior is crucial for photorealistic rendering quality and requires the measurement of accurate material properties. Recent work on the image-based reconstruction of spatially varying BRDFs enables the generation of high quality models of real objects from a sparse set of input data. This together with advanced interactive rendering techniques realistically reproduces the appearance of the original object under arbitrary viewing and lighting conditions. Beyond changes to viewing and lighting conditions, a wider class of interactions with virtual 3D object is desirable. Modeling of an object's interaction behavior requires the measurement of physical properties which governthis behavior. This tutorial will briefly introduce the University of British Columbia active measurement facility (ACME), a novel type of scanner of object interaction behavior. In particular, the scanning of the deformation behavior of soft objects is discussed in detail.

Tuesday, June 18:

Tutorial T3: Compression and Progressive Transmission of 3D Models

Organizer: Jarek Rossignac, Georgia Institute of Technology

The current MPEG-4 standard for 3D compression is based on the award-winning Topological Surgery technique that Rossignac has co-invented at IBM. His more recent work on 3D compression, supported by the NSF, has resulted in a new 3D compression technique called Edgebreaker, for which Rossignac has received a SigmaXi Best Paper Award. A very simple and effective implementation of Edgebreaker is available at http://www.gvu.gatech.edu/~jarek/edgebreaker/eb. It uses Rossignac's Corner Table, which represents the connectivity of any manifold triangle mesh by two arrays of integers. Edgebreaker compresses the connectivity of meshes of T triangles down to about T bits. Its guaranteed cost of 1.8T bits holds the theoretical record for encoding planar triangle graphs. Edgebreaker also supports more general triangle meshes with handles, holes, and non-manifold singularities. It has been adapted to quadrilateral and to more general polygonal meshes, further reducing the average storage cost per vertex. The Edgebreaker principle has also been applied to compress irregular tetrahedral meshes, such as those used for Finite Element Analysis. More recently, the Edgebreaker connectivity encoding has been combined with new geometric prediction schemes that improve the compression of vertex location and attributes. Some of the relevant publications on compression are available in electronic form from http://www.gvu.gatech.edu/~jarek/papers.

Compression reduces the bit-count, but does not alter the complexity (triangle count) of the mesh. To further reduce the transmission time of 3D models and to accelerate their rendering, simplification and progressive transmission techniques are used. In the early 90's Rossignac has co-invented the simple, fast, and versatile vertex clustering simplification technique, which was used in several commercial products and has inspired numerous recent developments in 3D simplification. Later, in collaboration with Andrzej Szymczak and Renato Pajarola, he has developed simplification and compressed progressive transmission techniques for triangle and tetrahedral meshes. Finally, working with Ghassan Al-Regib and Yucel Altunbasak, he has recently developed unequal error protection mechanisms that maximize the expected quality of the model received over lossy channels.

The tutorial will cover these results in details, describing simple and practical data structures and algorithms for implementing them. The speaker will also put them in the broader context of the vast body of research in 3D simplification and compression.

Tutorial T4: Handling Large Geometric Datasets: Proximity Queries and Interactive Walkthroughs

Organizers: Dinesh Manocha and Ming Lin, University of North Carolina, Chapel Hill

Abstract: This course will address issues in designing and building systems for interactive walkthroughs of large geometric datasets including architectural buildings and mechanical CAD models like submarines and power plants. Starting from an overview of interactive walkthroughs, the course will cover the entire gamut of associated technologies–model representations and taxonomy, database management and prefetching, model simplification, rendering spline models and collision detection.

We will also address a number of issues in implementing and integrating these techniques and applying them to real-world models. Finally, we will address issues in creating effective walkthrough illusions and discuss their applications.

Invited Presentations

Jarek Rossignac
(Georgia Institute of Technology)

CSG-BRep Duality and Compression

Solid Modeling technology has been traditionally divided into two camps: CSG and BRep. Constructive Solid Geometry (CSG) represents a shape as a Boolean combination of half-spaces. A Boundary Representation (BRep) specifies the location of the vertices, their connectivity, and a description of how they should be interpolated or approximated by a piecewise simple surface (such as a polyhedron, a subdivision surface, a B-spline, or a trimmed implicit or parametric patch). We will investigate the equivalence between CSG and BRep (using a simple duality) and will show that for a large class of polyhedral models, both can be encoded using (3k+4)N bits, where N represents the number of primitives in a CSG model or equivalently the number of vertices in the dual BRep, and where k represents the number of bits used to represent a quantization of each coordinate of vectors that define each either a vertex of the BRep or a plane of the CSG primitive. We will review recent advances in lossless and lossy compression and in selective and progressive transmission over error-prone connections. In particular, we will describe in detail the Corner Table, a simple and compact data structure for processing triangle meshes, and the Edgebreaker 3D connectivity compression algorithm, whose simplicity (2 pages of code) and effectiveness (between 1 and 1.8 bits per triangle) surpasses other compression techniques and standards. Details and source code may be found at www.gvu.gatech.edu/~jarek/edgebreaker/eb/

Curriculum Vitae of Jarek Rossignac:

Jarek Rossignac is Professor in the College of Computing at Georgia Tech. His current research is focused on the design, compression, progressive transmission, and interactive inspection of complex 3D models. The MPEG-4 standard for 3D compression is based on the award-winning Topological Surgery technique that he co-invented and patented at IBM, where, until 1996, he was Senior Manager and Visualization Strategist and managed research activities in 3D graphics, Computer Aided Design, 3D Interactive Visualization, and VR. He was also responsible for the development, maintenance, and commercialization of IBM's Data Explorer and 3D Interaction Accelerator products. At Georgia Tech, from 1996 till 2000, he served as the Director of the GVU Center, which he grew to 50 faculty and 14 scientists, focused on computing and communication technologies that make humans more effective. His recent work on 3D compression is supported by the NSF and has resulted in the Edgebreaker system, which has been adopted by several companies and has received the Sigma Xi Award for the Best Paper published by Georgia Tech faculty in 1999. He has authored 80 technical papers and 17 patents, for which he has received 7 Best Paper and 5 Invention Awards. He chaired 18 conferences, workshops, and technical program committees. He has served on the Editorial Boards of 7 journals and on 50 technical Program Committees of international conferences and workshops. He Guest-Edited 8 special issues of professional journals and gave 14 keynote or invited lectures. He was elected Fellow of the Eurographics Association in 2000. In 1985, he received a PhD in E.E. from the University of Rochester, New York. He also holds a Diplome d'Ingenieur from the French Engineering School E.N.S.E.M. and a Maitrise in Mechanical Engineering from the University of Nancy in France.

Marie-Paule Cani
(INP Grenoble, France)

Interactive Sculpting with Implicit Surfaces

Providing the user with an intuitive sculpting system similar to real clay is one of the most challenging long term goals in interactive modelling. The user should ideally be able to deform, add and remove material, with no restriction on the geometry and topological genius of the solid being edited. Implicit surfaces, defined as iso-surfaces of scalar fields, are a very attractive model in such situations. This talk reviews two alternative implicit representations, the constructive approach versus sampled fields, and discusses their convenience for modelling virtual clay. An implicit sculpting system which incorporates force feedback and relies on multiresolution to accelerate editing is presented.

Curriculum Vitae of Marie-Paule Cani:
Marie-Paule Cani is a Professor of Computer Science at the Institut National Polytechnique de Grenoble (INPG), France. A graduate from the Ecole Normale Supérieure, she received a PhD in Computer Science from the University of Paris Sud in 1990 and the "habilitation" degree from INPG in 1995. She has been nominated at the "Institut Universitaire de France" in 1999. Her main research interests cover physically-based simulation, implicit surfaces applied to interactive modelling and animation, and the design of layered models incorporating alternative representations and LODs. Recent applications include pattern-based texturing, the animation of natural phenomena such as lava-flows, vegetation and human hair, real-time virtual surgery and immersive virtual sculpting.

Marie-Paule Cani co-chaired the Eurographics work-

shops on Implicit Surfaces in 1995 and on Computer Animation and Simulation in 2001. She has been in the programme committees of Eurographics'96, Computer Animation'99, Shape Modelling International since 1999, NPAR, ACM SCA, Pacific Graphics and SIGGRAPH in 2002. She belongs to the editorial board of GMOD since 2001.

Pere Brunet
(Universitat Politecnica de Catalunya, Barcelona, Spain)

Discrete Models for Geometric Objects

This lecture presents and discusses the use of discrete models for modeling geometric objects. Discrete models (voxel representations, octrees, KD-trees, interval solids or even point representations) are emerging as a flexible tool for geometric modeling. These algorithms exploit the trade-off between robustness and memory. The availability at low cost of large amounts of memory affords thus completely robust models. Discrete bands can be used for instance for reconstructing valid closed models from point clouds, and to obtain different kinds of smooth Boundary Representations. On the other hand, discrete representations are specially well suited for error-bounded geometry and topology simplification, being also useful for occlusion culling in the inspection and navigation of very large virtual environments. Basic tools for modeling, surface extraction and visualization, simplification and relaxation will be described, and a number of potential applications will be presented.

Curriculum Vitae of Pere Brunet:
Pere Brunet is professor of Computer Science at the Polytechnical University of Catalonia in Barcelona. He received an engineering degree and a PhD. in the same University in 1976. He is responsible for the Computer Graphics Group in the department of software, and he has been vice-president for research of the Polytechnical University of Catalonia from 1988 to 1992. His research interests include Computer-Aided Geometric Design, Solid Modeling, Octree Representations and Virtual Reality. His group is working in different research activities and projects including CAD and piping for ship design, free form surface design, rendering algorithms and volume modeling and visualization for medical applications. He promoted the Virtual Reality Center of Barcelona and is presently the UPC responsible of the Center. He is a member of the editorial board of the international journals Computer-Aided Design, Computer-Aided Geometric Design, IEEE Transactions on Visualization and Computer Graphics and Computers & Graphics. He has published refereed papers in well-known international research journals and has participated actively in many International Conferences. He has been the chairman of the Spanish Chapter of Eurographics since its creation in 1986 until 1990, and a member of the Eurographics Executive Committee since 1989. He was the Chairman of the Eurographics '93 Conference, Vice-Chairman of the Eurographics Association from 1990 to 1995, co-chair of tutorials at Eurographics '97, co-chair of the International Programme Committee at Eurographics '99 and member of the Siggraph '2000 courses committee. He is presently the chairman of the Eurographics Association and a member of the Spanish Academy of Engineering.

Poster Sessions

There will be two poster presentation session during the afternoon breaks on Wednesday and Thursday. In this time the authors will be available for questions and discussion in the lobby of the Max-Planck-Institute.

- R. Bönning, H. Müller:
  Interactive Sculpturing and Visualization of Unbounded Voxel Volumes

- M. P. Carroll, C. M. Hawkins
  Web Based Analysis

- Y.-S. Chang, K. T. McDonnell, H. Qin
  A New Solid Subdivision Scheme based on Box Splines

- F. Danesi, L. Denis, Y. Gardan, E. Perrin
  Basic Components of the DIJA Project

- J.-F. Dufourd, S. Luther
  Interacting with parametrized geometric objects using lambda-terms

- N. Frisch, T. Ertl
  Deformation Of Finite Element Meshes Using Directly Manipulated Free-Form Deformation

- M. Garber, M. C. Lin
  Constraint-Based Motion Planning for Virtual Prototyping

- S. Green, G. Turkiyyah, D. Storti
  Subdivision-Based Multilevel Methods for Large Scale Engineering Simulation of Thin Shells

- C. Y. Ip, D. Lapadat, L. Sieger, W. C. Regli
  Using Shape Distribution to Compare Solid Models

- F. Kahlesz, Á. Balázs, R. Klein
  Multiresolution Rendering By Sewing Trimmed NURBS Surfaces

- H. Lopes, J. Rossignac, A. Safanova, A. Szymczak, G. Tavares
  Edgebreaker: A Simple Compression for Surfaces with Handle

- P. Michalik, D. H. Kim, B. D. Brüderlin
  Sketch- and Constraint-based Design of B-Spline Surfaces

- G. Patané, M. Spagnuolo
  Multi-resolution and Slice-oriented Feature Extraction and Segmentation of Digitized Data

- M. Ramesh, N. Belludi, D. Yip-Hoi, D. Dutta, P. Wascher
  Application of Feature Technology to Modeling and Dimensioning the InterOediate Geometry of Automotive Powertrain Components

- E. Schömer, J. Reichel, T. Warken, C. Lennerz
  Efficient Collision Detection for Curved Solid Objects

- H. Shin, S. K. Cho
  Directional Offset of a 3D Curve

- D. Steiner, A. Fischer
  Cutting 3D Freeform Objects with Genus-n into Single Boundary Surfaces Using Topological Graphs

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