determining the optimal weights and knots along with the control net. An algorithm will be described for determining the best control net, weights, and knots for a NURBS surface approximation of a surface grid. The effect of the surface parameterization on the approximation will also be examined. Examples will show that a smooth surface grid can often be accurately approximated using a very sparse control net.

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Delaunay's Tetrahedronalization an Efficient Method of Triangulation of Surfaces

Several schemes for two-dimensional (2-D) and three- dimensional (3-D) objects have been developed to represent both interior regions and bondauries of qbjects. Existence and therefore the possibility of building the Delaunay tetrahedronalization, is the fact that it is the geometric dual of Dirichlet (or Veronoi, or Thiessen tessellization). The method has the natural advantages of Delaunay triangulations. The improved algorithm is competitive with existing linear-time algorithms even for relatively large problems (O nlogn) operations and behaves well with comparison with well known and used algo- rithms for surface reconstruction from slice-organized data with the advantage of being more general.

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Tool Positioning Techniques in Dual Contact NC Milling

Dual Contact NC Milling is used in part manufacturing process to remove material remaining in valleys formed by free form parametric surfaces. Depending on geometric configurations, different systems of non-linear equations need to be solved to have the tool follow the shape of the valley. We will demonstrate methods to formulate and solve such systems of equations in regular and degenerate cases.

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Skeleton/Medial Axis Generation for 3-Dimensional Implicit Solids

Skeletons provide lower dimensional characterizations of surfaces or solids and are useful for shape recognition and mesh generation. We consider the 2D skeleton of a 3D solid whose surface is defined by the kernel of an implicit function. Skeletons are composed of centers of maximal inscribed spheres, but computations are typically based on surface point samples, and centers of spheres circumscribing Delaunay tetrahedra serve as approximate skeleton points. The convergence of this straightforward approach is slow, but we demonstrate that an optimization procedure utilizing curvature information produces accurate skeletons for implicit solids with significant geometric complexity.

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Multiresolutional Polygonal Approximation of Planar Curves

Polygonal approximation of planar curves has applications in computational morphology, robotic vision and industrial automation. Current methods fix distance error or number of vertices of the polygon and adjust the other parameter. They are computationally inefficient and do not directly consider the morphological significance of points. We present an O(NlogN) algorithm for polygonal approximation of planar curves. The approximate exterior angle along the curve as a function of arclength is analyzed multiresolutionally for significant points. Compression ratios between 10 and 25 to 1 are typical.

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Modeling With Subdivision Surfaces

We present an interactive modeling system for quickly creating complex shapes. Our piecewise smooth surface representation is a generalization of the Doo-Sabin subdivision scheme. We have developed new subdivision rules to model surface features such as corners, creases, darts, and fillets. The user introduces these features by specifying fillet radii along edges of the control mesh. Boolean operations (CSG) on the control meshes are used to alter the topology of the object or to combine multiple objects. We will demonstrate the system, and present several shapes that would be tedious to realize using conventional patch representations.

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Salient Assemblage Representation of Multidimensional, Recursive, Deforming Geometry

A multidimensional curvilinear coordinate net allows an asymptotic C^{∞} salient that depends on local geometric properties, like principal directions. Metric tensor evaluations compensate for parameter stretching, coordinate curve nonlinearity, and obliquity. A series of orthogonal functions approximates a given salient shape. Successive salients are assembled recursively with rules on shape, size, alignment, and dihedral. These rules determine invariant attributes during assemblage deformation. The resulting patch can be folded, yet remains homeomorphic to one parameter space. That simplifies geodesic calculation. Representation algebra is complex, but allows efficient evaluation because parameter arguments are effective predictors of negligible terms. Visualization examples are presented.

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A Graphical Editor for TCAD Purposes

For use in a framework for simulation of semiconductor devices and processes an interactive graphical editor has been developed. It is a comprehensive tool for geometric modeling in one, two, and three dimensions as well as for manipulating attributes defined on computational grids. An integrated LISP interpreter facilitates the implementation of complex functions from geometric primitives. Nevertheless, a development environment supports the coding of time-critical LISP functions in C. The editor can be run in both interactive and batch mode to perform modeling steps within extended simulation flows or optimization loops. Externally invoked executables can be integrated on the interpreter level without recompiling any tools.

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