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MADALGO seminar by Jonathan Richard Shewchuk, University of California at Berkeley

Tetrahedral Meshes with Good Dihedral Angles

We develop two new methods for creating high-quality tetrahedral meshes: one with guaranteed good dihedral angles, and one that in practice produces far better dihedral angles than any prior method. The isosurface stuffing algorithm fills an isosurface with a uniformly sized tetrahedral mesh whose dihedral angles are bounded between 10.7 degrees and 165 degrees. The algorithm is whip fast, numerically robust, and easy to implement because, like Marching Cubes, it generates tetrahedra from a small set of precomputed stencils. Our angle bounds are guaranteed by a computer-assisted proof. Our second contribution is a mesh improvement method that uses optimization-based smoothing, topological transformations, and vertex insertions and deletions to achieve extremely high quality tetrahedra.

Joint work with Francois Labelle and Bryan Klingner