Cleaver (Adaptive Unstructured Mesh Generation)

Jonathan Bronson (University of Utah), Shankar Sastry (University of Utah), Mark Kim (University of Utah), Joshua Levine (Clemson University), and Ross Whitaker (University of Utah)

A fast, combinatorial unstructured mesh generation algorithm for multi-material volumetric data.

Motivation
A fast, combinatorial unstructured mesh generation algorithm for multi-material volumetric data.

Adaptivity

Feature Size Computation
- Defined on the boundary of a domain as the distance from a point on the boundary to the closest point on its medial axis.
- Distinguishes “thin” features from larger features.

Sizing Field Computation
- Compute the distance transform starting from the boundary voxel elements
- Voxels with discontinuous distance transform field contain the medial axis surface
- Compute the distance transform starting from these voxels. Feature size values are given by the distance field values on the boundary vertices.
- Recompute the distance transform from the boundary voxels.

Feature Size Computation
Locus of points that have at least two closest points on the boundary of a domain.
“Skeletonization” of an object

Results

Warp/Cleave Background Mesh

A Sphere and a Torus

Three Spheres

Methodology (Pipeline)

Sizing Field Computation
Vertex Distribution

Unstructured Background Mesh
Warp/Cleave

Future Work
Prove the bounds on the quality of the output mesh as a function of the quality of the background mesh.

Accelerate the n-body simulation to determine vertex location using the octree-based Barnes-Hut technique.

Publication

ACKNOWLEDGEMENTS: This project was supported by grants from the National Institute of General Medical Sciences (8 P41 GM103545-15) and from DOE NET DE-EE0004449.