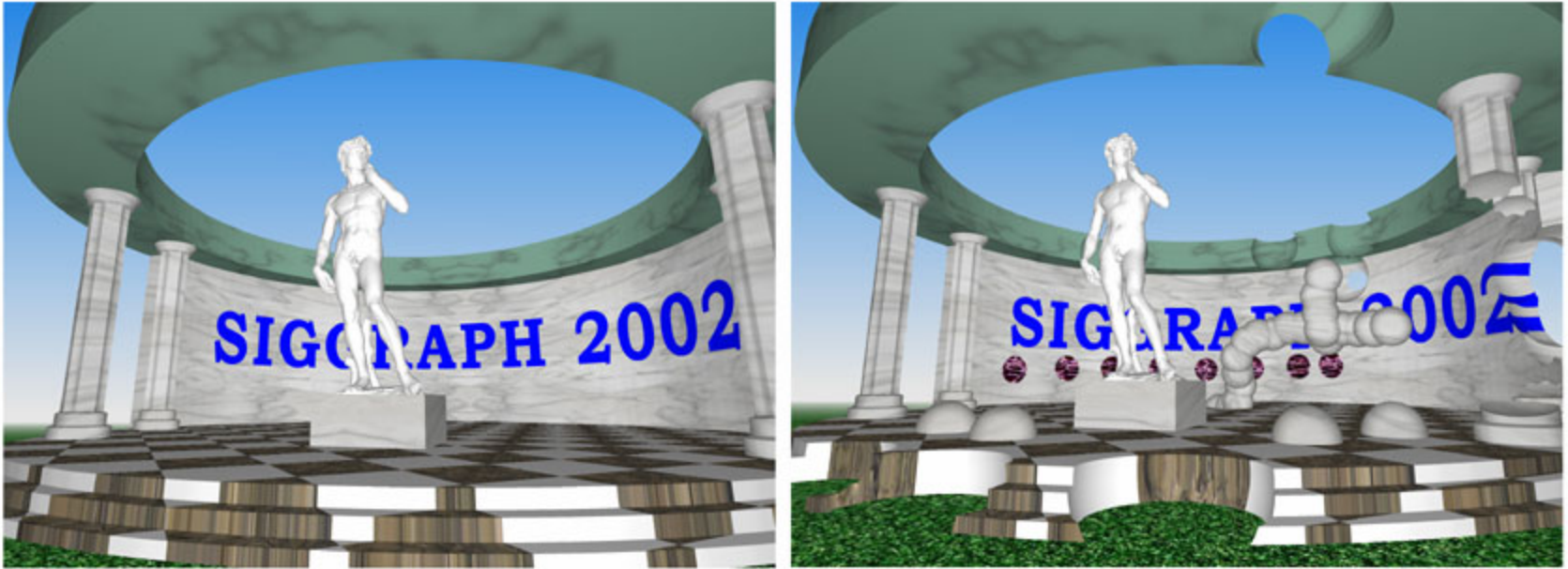


Dual Contouring of Hermite Data



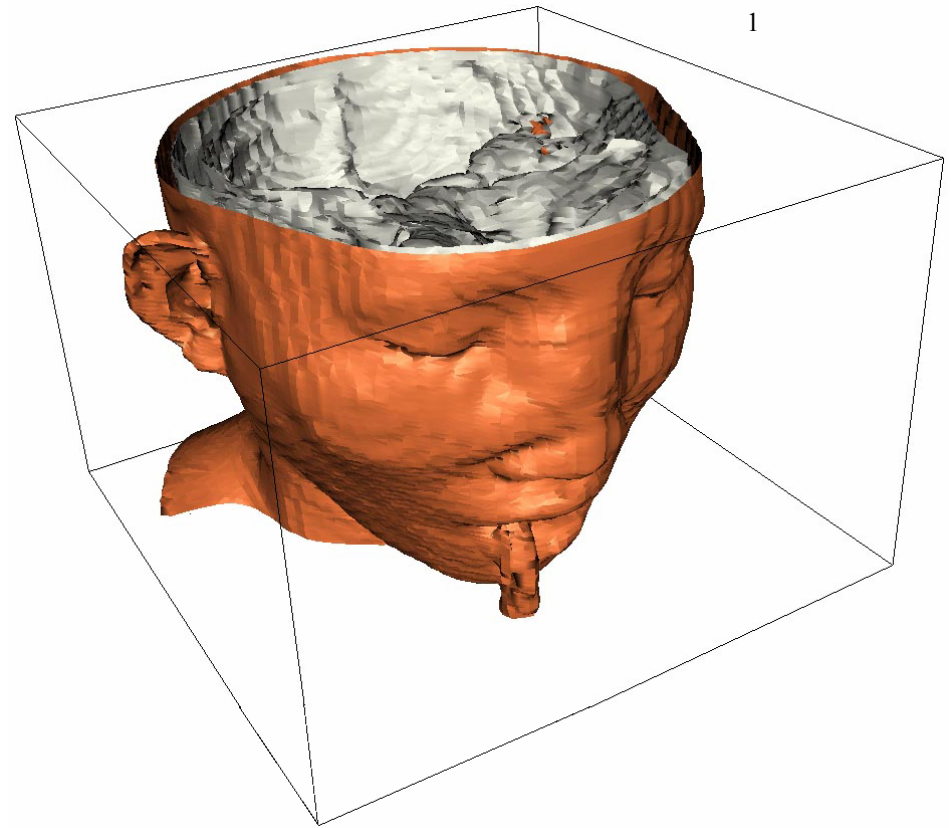
Scott Schaefer,

Tao Ju, Frank Losasso, Joe Warren

Rice University

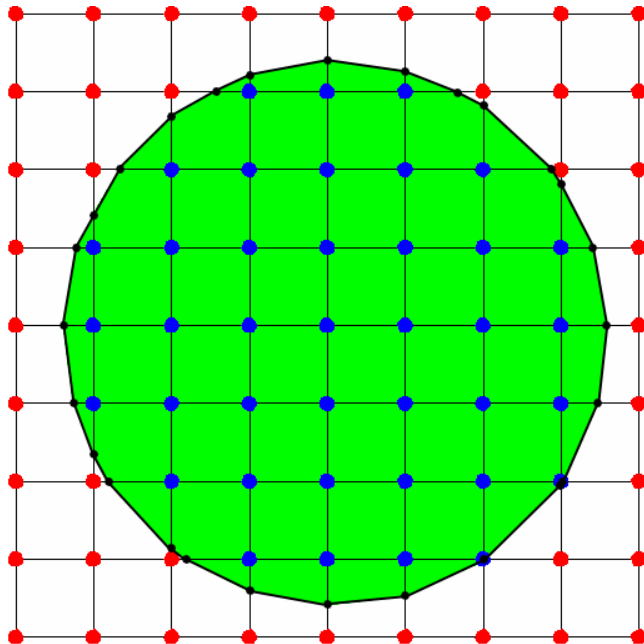
Implicit Modeling

- Generate surface from 3D grid of data
- Typically used to visualize geological and MRI data



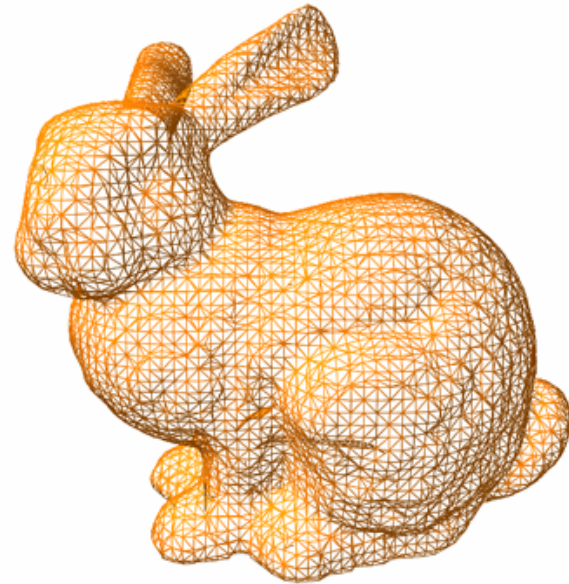
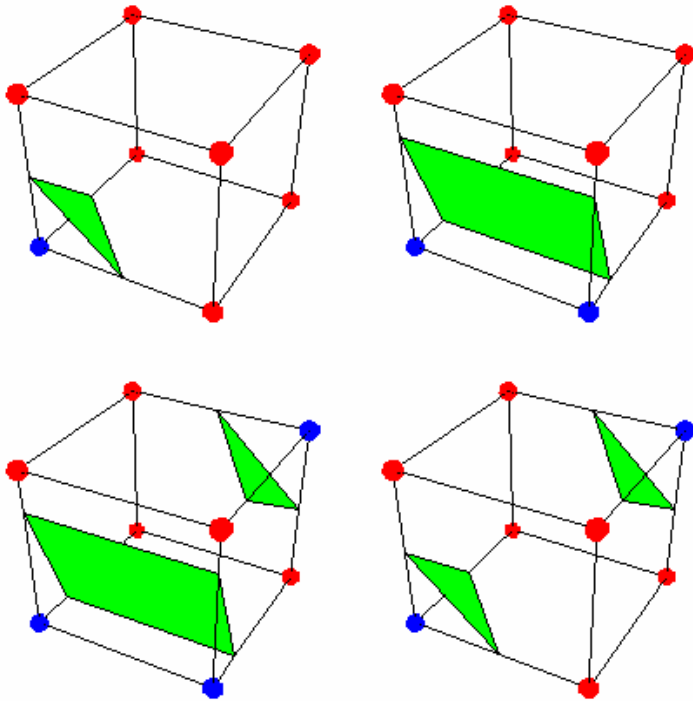
Contouring Grids of Data

- Grid of data is sample of function $f[x, y]$
- The contour is level set $f[x, y] = c$



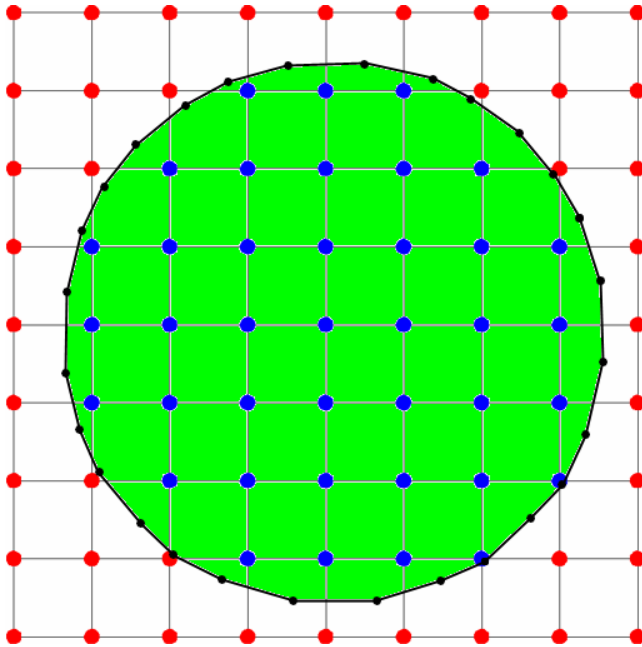
3D Contouring: *Marching Cubes*

- Process each cube individually
- Table driven method



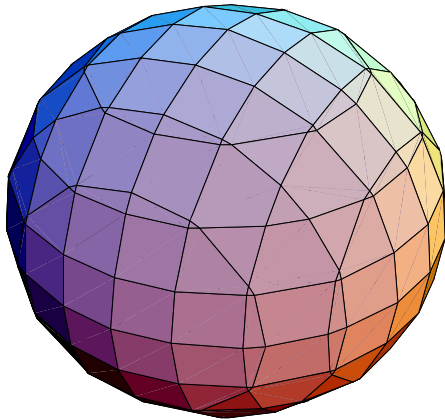
Dual Method: *SurfaceNets*

- Place vertices inside of square
- Generate segments across edges with zero
- Dual to polygons produced by MC

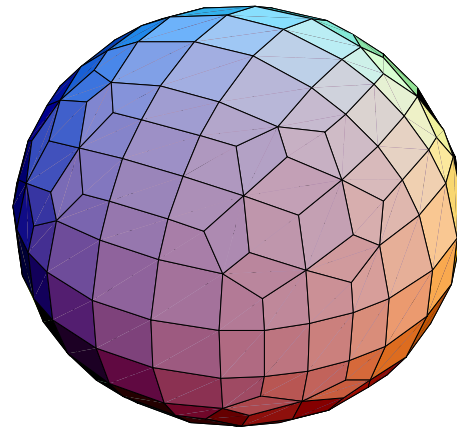


Comparison of Primal/Dual

- Produces well-shaped quads
- Allows more freedom in positioning vertices



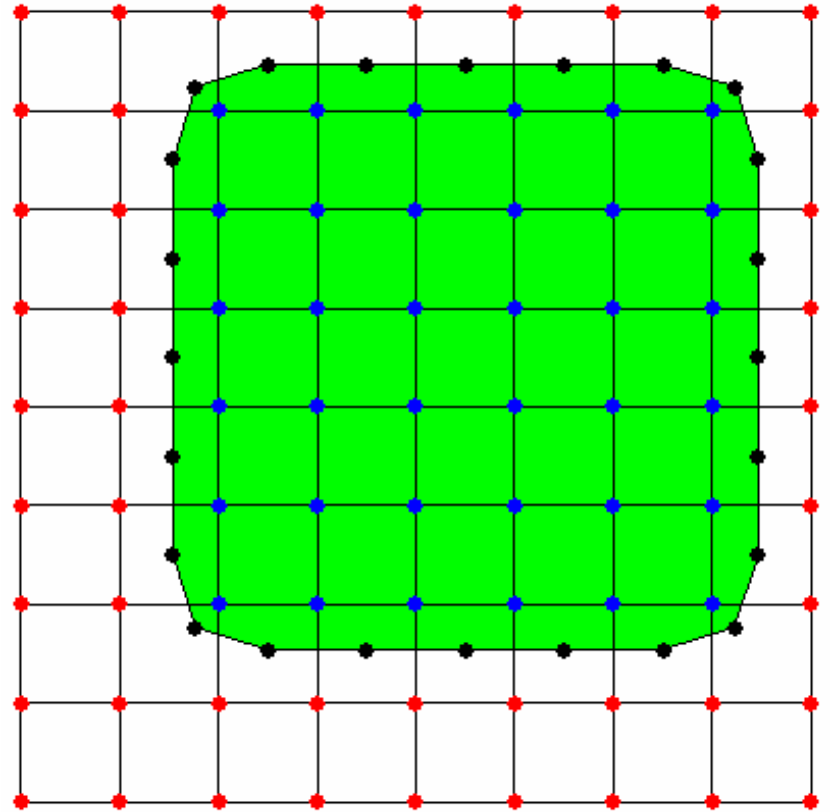
MC (Primal)



SurfaceNets (Dual)

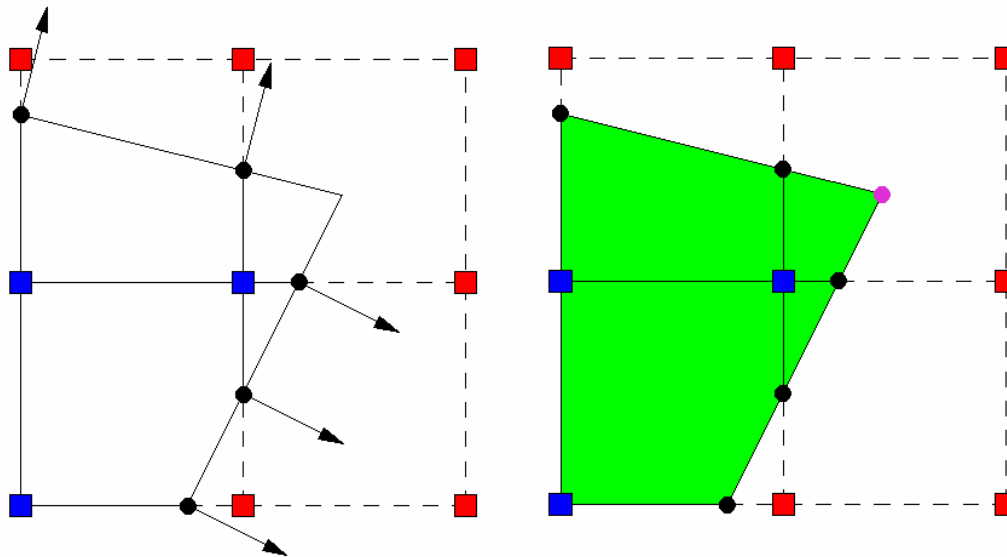
Problems With Implicit Surfaces

- Sharp features cannot be reproduced
- Need more information to do a better job



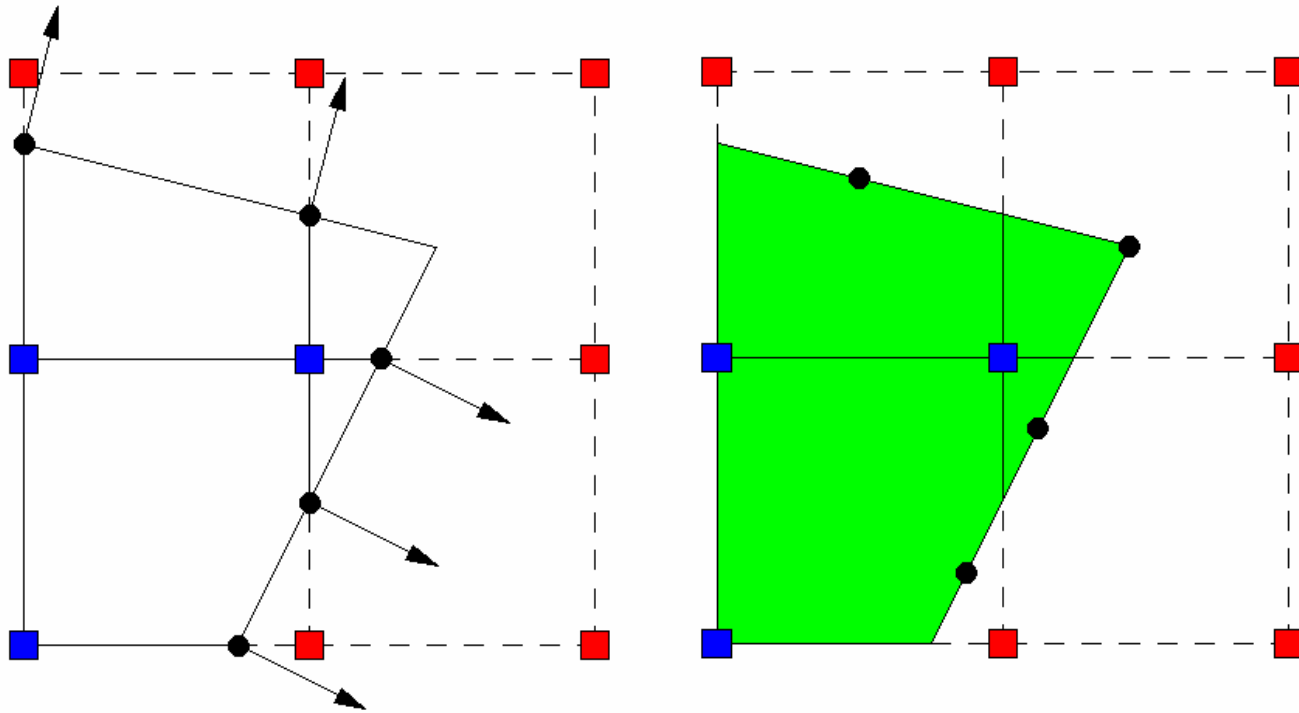
Modeling Sharp Features

- Standard implicit surfaces are blobby
- Feature sensitive contouring (Kobbelt et al.)
 - ◆ Add normals to scalar data
 - ◆ Place extra vertices at sharp features



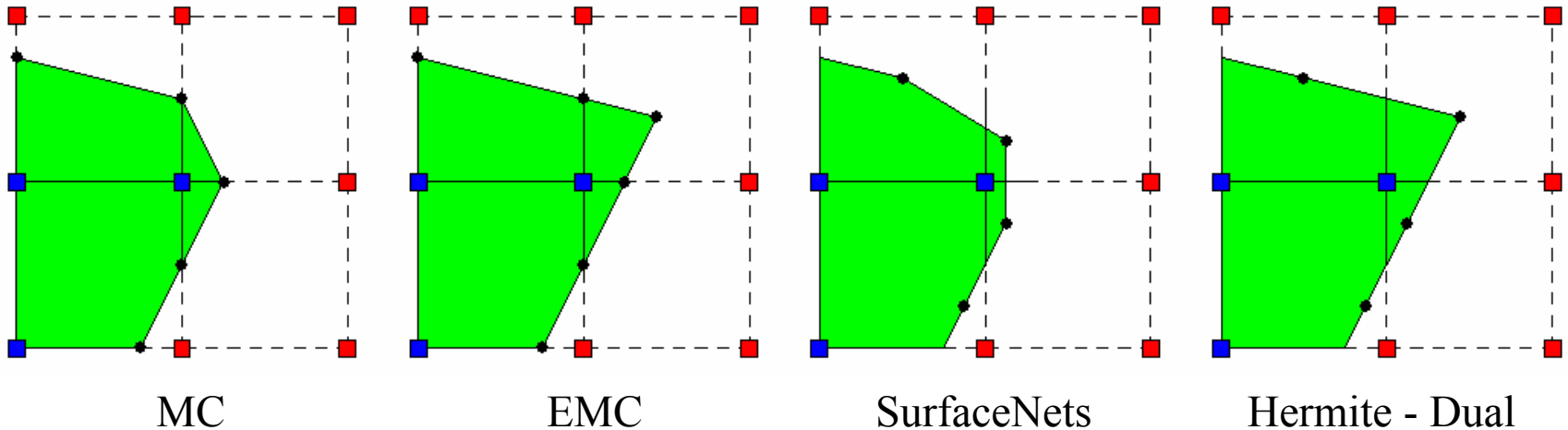
Dual Contouring With Hermite Data

- Place vertices at minimizer of QEFs
- Generate segments across edges with zeros

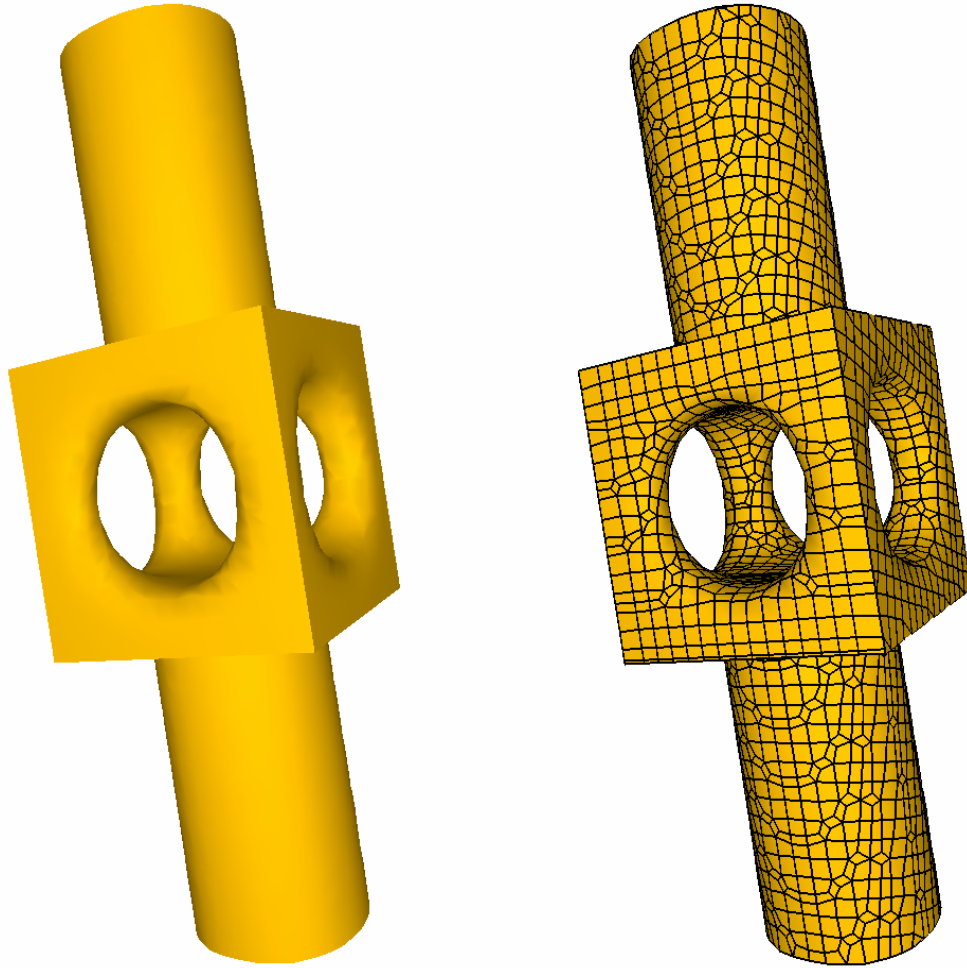


Comparison of Methods

- Scalar methods fail to reproduce sharp features
- Hermite methods reproduce sharp features

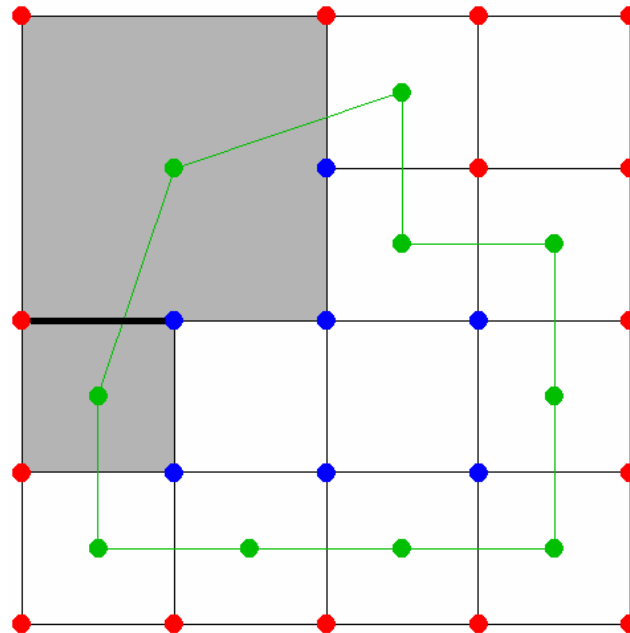


Example: Hermite Dual Contouring



Contouring Signed Octrees

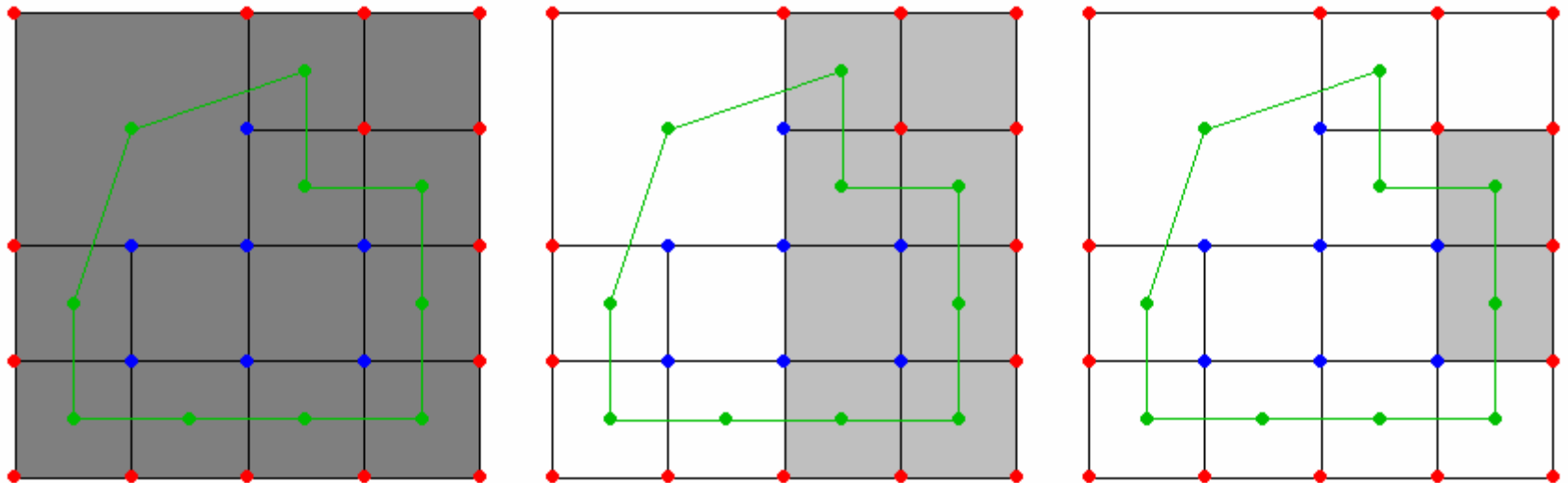
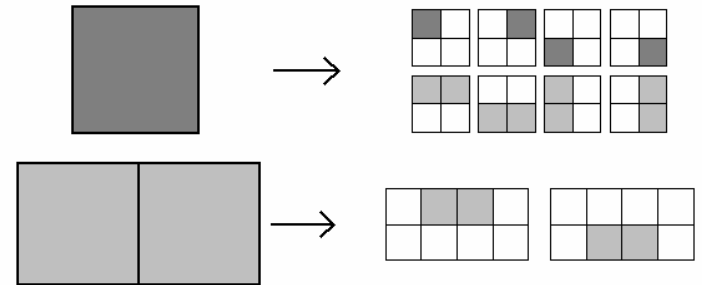
- For each minimal edge with zero,
 - ◆ Connect vertices of cubes containing edge
- Constructs closed surface mesh for any octree



Fast Polygon Generation

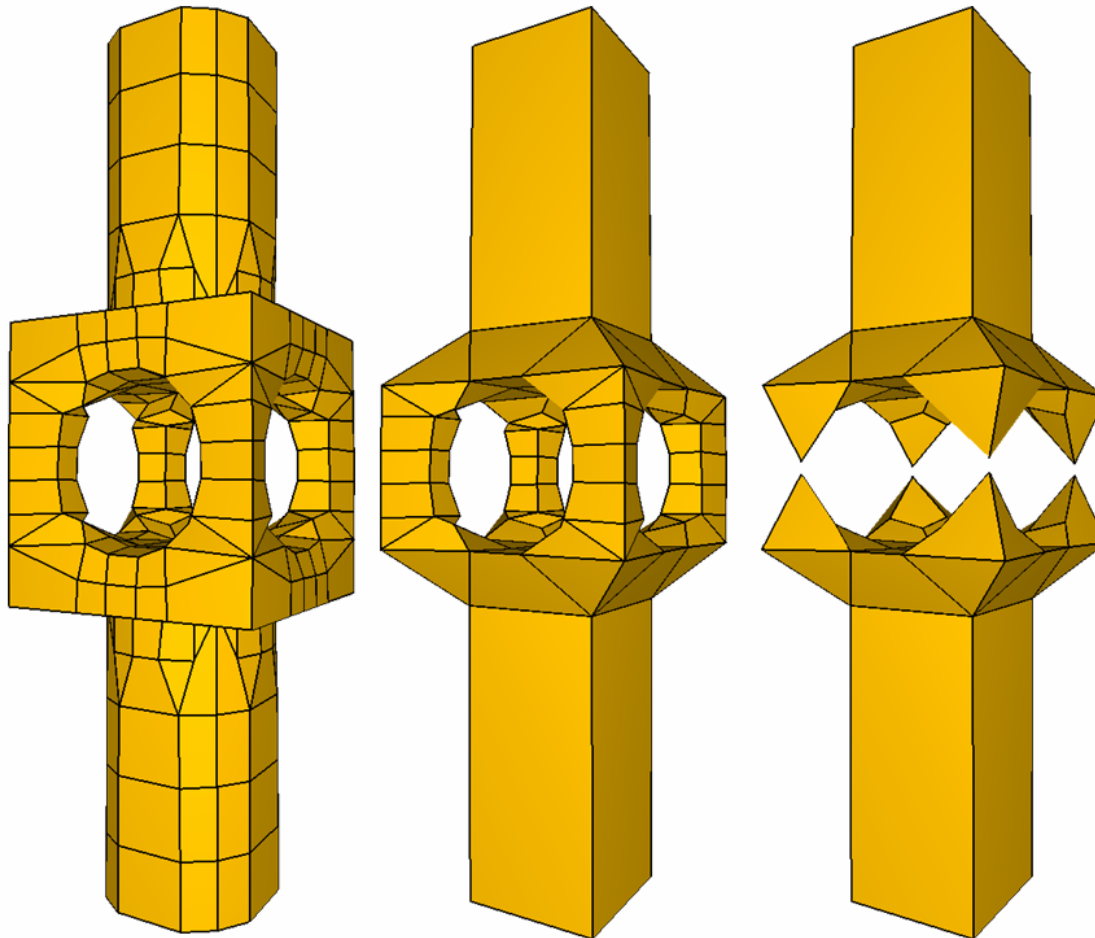
- Recursive octree traversal

- Linear time in size of octree



Example of Adaptive Contouring

- Use QEFs to control level of simplification



Extensions

- Multiple materials
- CSG operations
- Simplification via QEFs
 - ◆ Numerically stable
- Topological safety

