Introduction to VTK: Volume/Grid Data

Types of Data

- Unstructured
  - `vtkPolyData`, `vtkUnstructuredGrid`
- Structured
  - `vtkImageData`, `vtkRectilinearGrid`, `vtkStructuredGrid`

Unstructured Data

- No expected/required connectivity
- `vtkPolyData`
  - 0D (vertex), 1D (line), or 2D (polygon) “cells”
- `vtkUnstructuredGrid`
  - `vtkPolyData` + 3D “cells” (tetrahedra)

Structured Data

- `vtkImageData`
  - Axis aligned
  - Equally spaced
- `vtkRectilinearGrid`
  - Axis aligned
  - Not equally spaced
- `vtkStructuredGrid`
  - Arbitrary coordinates
  - Regular connectivity

Isocontours

- “iso-” (from Greek word meaning ‘equal’)
- Determine everywhere in a data set that the data equals a specified value

(This is an animation. It shows isocontours of increasing values over time.)
Isosurfaces
• Isosurface = 1D object (contour) on 2D data
• Isocontour = 2D object (surface) on 3D data

(These are animations. They show an isosurface and a slice through the volume/isosurface of increasing values over time.)

Isocontours and Isosurfaces in VTK
• vtkContourFilter
• Examples:
  - http://www.vtk.org/Wiki/VTK/Examples/Cxx/Visualization/DisplayQuadraticSurfaces

Marching Cubes
• Determine which one of a pre determined set of configurations neighboring points are in

Streamlines
• A curve that is tangent to a velocity field
• Used to show the path a particle will travel if injected into the field

Streamlines in VTK
• http://www.vtk.org/Wiki/VTK/Examples/Cxx/Visualization/StreamLines

Volume Rendering
• Try to display a 3D data set (the whole thing, not just a surface)
• Must determine the opacity of every pixel (voxel)
• Often called the “transfer function”
• Almost always medical images
Surface Reconstruction From Unorganized Points

• “Splat” techniques

• Embed the unorganized points into an organized grid and then use an isosurface

Examples

• http://www.vtk.org/Wiki/VTK/Examples/Cxx/Filters/GaussianSplat

• http://www.vtk.org/Wiki/VTK/Examples/Cxx/Filters/TriangulateTerrainMap

• http://www.vtk.org/Wiki/VTK/Examples/Cxx/Filters/SurfaceFromUnorganizedPoints