

# Introduction to VTK: Volume/ Grid Data

## Outline

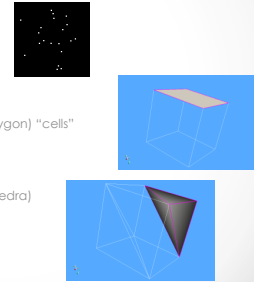
- Structures of data
- Isocontours and isosurfaces
- Streamlines
- Volume rendering

## Types of Data

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

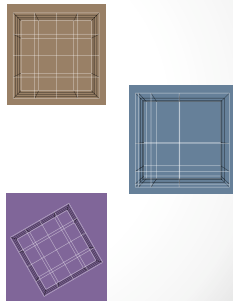
## Unstructured Data

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



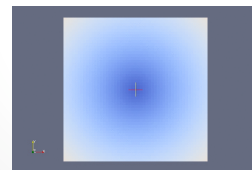
## Structured Data

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



## Isocontours

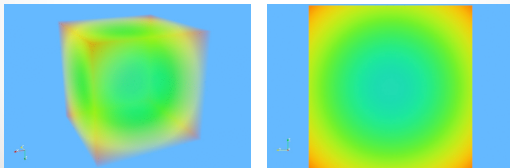
- "iso-" (from Greek word meaning 'equal')
- Determine everywhere in a data set that the data equals a specified value



(This is an animation. It shows isocontours of increasing values over time.)

## Isosurfaces

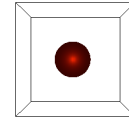
- Isosurface = 1D object (contour) on 2D data
- Isocontour = 2D object (surface) on 3D data



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

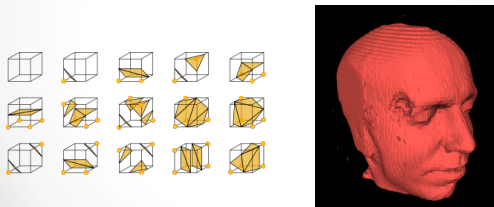
## Isocontours and Isosurfaces in VTK

- vtkContourFilter
- Examples:
  - <http://www.vtk.org/Wiki/VTK/Examples/Cxx/Visualization/DisplayQuadraticSurfaces>



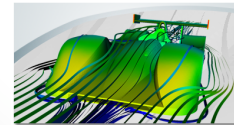
## Marching Cubes

- Determine which one of a pre determined set of configurations neighboring points are in



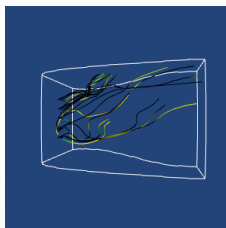
## Streamlines

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



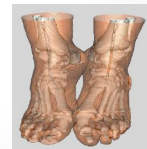
## Streamlines in VTK

- <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

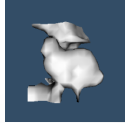


## Surface Reconstruction From Unorganized Points

- "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>