Terrain Visualization

3-D Visualization & Terrain Visualization

• 3-D vis. is based on 3-D data model
• Terrain vis. can be based on 2.5 or 3-D data model

Environmental Visualization System (EVS)
http://www.ctech.com/
Visualization

Table 12.1 Variables at the Different Stages of Visualization

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<th>Stage</th>
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**Variables**
- Visual: size, shape, orientation, color, texture...
- Screen: blur, focus, transparency
- Dynamic: duration, rate of change, order
- Exploratory: drag, click, zoom, pan, blink, highlight...
- Web: hyperlink, cyberspace

Types of Terrain Visualization

- **2D**
  - Topographic symbols
  - Contours
  - Elevation coloring
  - Slope (vertical) & hill (oblique) shading
- **3D**
  - Height, volume, profile
  - Perspective view & 3D rendering
  - Animation (walk-through, fly-through)
  - 3D symbol, graphics, & text
Examples of Terrain Visualization

ArcScene Fly-through

The Geometry of 3D Rendering

3D Ground Coordinate System (X, Y, Z)

2D Screen Coordinate System (u, v)

3D Eye Coordinate System (Xe, Ye, Ze)
Screen Coordinates & ECS

\[ u = \frac{X_e}{Z_e} \times f \]

Oe: Initial viewpoint location

3D Rendering (Computer Graphics)

1. Construct a discrete 3D model of the surface
2. Set a viewpoint and view direction and transform 3D GCS into 3D ECS
3. Determine hidden surfaces
4. Calculate illumination models
5. Shade the visible surfaces
6. 3D texture mapping (or image draping)
7. Render the objects in 2D screen coord
Terrain Animation Primitives

- View-point animation
  - Zoom
  - Pan
  - Rotate
  - Walk-through & Fly-through

Animation

- Picture frame
- Dynamic variables
  - Duration (e.g., 30 fps)
  - Rate of change
  - Order
- Animation
  - Frame-by-frame
  - Bit-boundary-block-transfer (bitblt)
  - Compressed digital data (e.g., MPEG)
3D Terrain Visualization Products

- Google Earth (http://www.google.com/earth/learn/)
- Microsoft Virtual Earth
- ESRI: ArcScene, ArcGlobe
- Leica: ERDAS Imagine Virtual GIS, Leica Virtual Explorer

ArcScene Interface

Base Heights
ArcScene Interface

Extrusion

ArcScene Interface

Rendering
ArcScene Interface

Animation

ArcScene Animation Control

3d-analyst-tutorial.pdf
I:\Students\Data\GIS\ArcTutor\10\ArcGIS_10_Tutorial_PDFs\extensions\%

Tutorial data:
I:\Students\Data\GIS\ArcTutor\10
ArcScene Interface

Steepest Path

Create 3D Features

Creating 3D features by digitizing over a surface:

1. Add the 3D feature class—an existing feature class with one of the following geometries: pointZ, polygon2Z, polygon2—to which you want to add features to the map.
2. Add the surface that you want to use as the source for the feature height to the map.
3. On the Editor toolbar, click Start Editing.
4. If you have more than one feature class on the map, identify the workspace of the feature class in which you will be creating new 3D features. Click OK.
5. Click the Interpolate Point, Interpolate Line, or Interpolate Polygon button, depending on the geometry of the feature class you are creating.
6. Click on the surface and create the edit sketch for the feature just as you would for a 2D feature.
7. When you are finished digitizing, click Start Editing and click Save Edits.
8. Click Editor and click Stop Editing.
9. Click Yes to save your edits.
ArcGIS 3D Multipatch Features

- Are stored in the geodatabase or shapefiles
- Can be point, line, or polygon multipatch
- Can have attributes
- Contain 3D models (vertical/overhanging faces)
- Can contain texture information

Enclosed Multipatch

- Multipatch features that completely enclose a volume of space (i.e., no gaps among patch surface)
- Allow for 3D analysis (e.g., “overlay”)

11/20/2012
New 3D tools introduced at 10.1

• **Buffer 3D**: Creates a 3D buffer around point or line features.

• **Enclose Multipatch**: Creates closed multipatch features in the output feature class using the features of the input multipatch.

• **Intersect 3D Line With Surface**: Computes a geometric intersection of input 3D line features and one or more surfaces to return the intersection as segmented line features and points.

• **Stack Profile**: Creates a table and optional graph denoting the profile of line features over one or more multipatch, raster, TIN, or terrain surfaces.

• **Sun Shadow Volume**: Creates a model of the shadows cast by the sun for each input feature on a given date and time.