Overview of 3D Analysis

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Outline

- Overview of 3D GIS & Analysis
- 3D Data Basics
- Surface Creation & Analysis
- Lidar Visualization in Pro
- Lidar Classification
- Data Management & Conversion
- 3D Operators
- Conclusion | Q & A
Why use 3D GIS?  
... because our world is 3D!

**Improve understanding**  
3D visualization is intuitive

**Solve 3D problems**  
Many spatial questions can only be answered in 3D space

**Better communication**  
3D makes it easier to articulate ideas
3D GIS Features…

- ArcGIS for 3D Cities
- Multiscale 3D Models
- Integrated 3D
- Asset Management
- Surface modeling
- 3D Analysis
- Lidar support
- Share 3D scenes
- 3D Geodesign
3D Analyst Features...

**Data Management**
- Data Creation
- Data Conversion
- Lidar QA/QC
- Lidar Classification
- Lidar Management
- Surface Interpolation

**Surface Derivatives**
- Contours
- Slope
- Aspect
- Statistics
- Identify Outliers
- Interpolate Geometry
- Perform Math Operations
- Building Footprint Regularization

**Overlay**
- 3D Statistics
- 3D Proximity
- 3D Intersections
- Visualization
- Profile Graphs
- Interpolate Features
- Extrude Between Surfaces

**Area & Volume**
- Detect Change
- Determine Cut/Fill
- Calculate Surface Area & Volume

**Visibility**
- Sight Line Analysis
- Viewshed Determination
- Skyline Analysis
- Shadow Modeling
- Hillshade

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Geoprocessing Tools
Framework for Analyzing & Managing Data

- **3D Features**: Overlay, proximity, and geometric analysis of 3D features.
- **Data Management**: Lidar classification & analysis, TIN & terrain management.
- **Data Conversion**: Robust interoperability.
- **Functional Surface**: Surface analysis.
- **Raster toolsets**: Interpolation, mathematic operations, reclassification & surface derivatives.
- **Triangulated Surface**: TIN based analysis.
- **Visibility**: Sightline, viewshed, & skyline analysis.

**Recommended Session**: ModelBuilder – Getting Started, Wed 10:00 Exhibit Hall A
Exploratory Analysis
Interactive Tools in ArcMap

Steepest Path: Determines steepest path from select point.

Target Surface Layer: Surface layer in document that will be processed by interactive tools.

Contour: Creates a single isoline at the selected point.

Interpolate Geometry: Creates 3D features based on surface Z.

Profile: Creates profile graph of surface or point cloud.

Line of Sight: Determines visibility of sight line & identifies possible obstructing point.
Representing XYZ
Understanding the Data Types
How is XYZ Information Represented?

3D Features
- Points
- Lines
- Polygons
- Multipatch
- LAS Dataset
- NetCDF

Surface
- Raster
- TIN
- Terrain
- LAS Dataset
- NetCDF
Understanding the Surface

Any continuous measurement with one value for a given x-y location \( z = f(x,y) \)

- Temperature
- Gravity
- Soil studies
- Epidemiology
- Chemical concentrations
- Many diverse applications...

More than just topography!
Surface Data Types

**Raster Surface**
- Made by interpolation, generalize source measurements to cell size
- Fast to process, support robust math operations

**TIN Based Surfaces**
- Created by triangulation, maintain source measurements
- Support robust surface definitions & data
Triangulated Irregular Network (TIN) Based Surfaces

**TIN**
Well-suited for engineering applications and analysis of study areas that are not exceedingly large, provides interactive editing options.

**Terrain**
Multi-resolution, scalable, offers robust support for handling large amounts of data.

**LAS Dataset**
Rapidly visualize, filter, perform QA/QC and analyze lidar data. Well suited for aerial collections, supports compressed lidar in ZLAS format.
Surface Feature Types

TIN Based Surface Concepts

- **Mass points**: Measurements used for triangulation
- **Erase polygon**: Interior areas of no data
- **Replace polygon**: Assigns a constant z value
- **Clip polygon**: Defines the interpolation zone

**Also supports:**
- Break lines
- Tag values

**Note:** Tag values are only supported by the TIN dataset.
Breaklines & Hard/Soft Designation
TIN Based Surface Concepts
Editing a TIN Surface in ArcMap

**TIN Editors**: Add, modify, or remove nodes, edges, triangles & tag values

**Grading Tool**: Modify surface using line with slope properties.
Surface Creation & Analysis

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What’s New for Lidar in ArcGIS Pro

- Enhanced lidar rendering
- Support for ZLAS & LAS file version 1.4
- Extract LAS: New tool for projecting, filtering, clipping and rearranging LAS points
- Create LAS Dataset: Supports the creation of PRJ overrides for spatial reference
Interacting with Lidar in ArcMap

**Target Layer:** LAS dataset layer in document that will be processed by interactive tools.

**Symbology:** Shortcuts to commonly used symbology options.

**Filters:** Shortcuts to commonly used LAS classification filters.

**Profile View:** Provides profile view of LAS points, enables interactive classification editing.

**3D View:** Provides 3D view of LAS points within ArcMap.
Inverse Distance Weighted (IDW)

Consider using when source data measurements are dense enough to capture the local surface variation required for analysis, and interpolation barrier enforcement is needed.

Natural Neighbor

A better version of IDW, but takes longer to process due to its "smarter" method of applying weights. Consider using if you do not want your surface to exceed the min/max values in the sample measurements.

Recommended Sessions: Creating Surfaces from Various Data Sources Tue 10:15 – 11:30 Room 17B
Surface Interpolation Wed 4:30 – 5:15 Demo Theater 13
Raster Interpolation
Trend Interpolators

Spline
Consider when needing to capture sinks and peaks that are not part of sparsely sampled measurements.

Trend
Use when looking for trends in source measurements that represents data with gradual variation (e.g. wind speed, temperature)

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**Raster Interpolation**  
Deterministic & Hydrologic Surface Interpolators

**Kriging**  
Widely used when working with sparse measurements if trends in data are well understood. Consider Kriging with Geostatistical Analyst.

**Topo To Raster**  
Generates hyrdologically correct surface that connects drainage structures, eliminates localized sinks, and captures ridges & streams.

Recommended Sessions:  
*Intro to Geostatistical Analyst* Wed 1:30 – 2:45  Room 5A  
*Empirical Bayesian Kriging* Tue 3:30 – 4:15  Demo Theater 13
Choosing the Most Appropriate Surface Model

- What is the nature of data being modeled?
- How is the data distributed?
- How will the data be used?
What’s New for Feature Analysis in ArcGIS Pro 1.1

- **Layer 3D To Feature Class**: New to Pro with enhanced 3D layer exporting
- **Minimum Bounding Volume**: Find the minimum bounding volume of a collection of 3D features
- **Regularize Building Footprint**: Eliminate the distortions of unwanted artifacts in footprints extracted from a surface
3D Set Operators
Geometric Operations with Multipatch Features

• Intersect 3D
• Union 3D
• Difference 3D
• Inside 3D
• Intersect 3D
• Union 3D
Viewshed Analysis
Raster Surface Visibility

- Determine how many observers can see a given location
- Determine which observers see a specific location
- Find the height a non-visible location must be raised to become visible
Line of Sight
Visibility Along 2-Point Sightlines

- Determine visibility along a line
- Identify the obstructions preventing the end point’s visibility
- Use Construct Sight Lines to generate 2-point lines between observer points and target features
Skyline Analysis
Studying the Horizon

- Delineate the horizon for each observer
- Segment the horizon by each contributing feature
- Graph the percent of possible sky that is obstructed by observers
Shadow Modelling
Shadows from the Sun and Localized Light Sources

- Shadows cast by sunlight for a given date/time
- Find the shadows cast by localized light sources
3D Community on ArcGIS Resource Center
http://resources.arcgis.com

- **Helpful Utilities**: Many custom tools and useful applications

- **Solution Templates**: Guides and sample data to illustrate best practice applications for tasks in 3D

- **News**: Learn about what’s new in 3D GIS.
At the UC
- Product Island
  main conference hall
- Tech Support
  follow up assistance

Online
- GeoNet
  http://geonet.esri.com/welcome
- 3D GIS Resource Center
  http://resources.arcgis.com/communities/3d
- ArcGIS Desktop Help
  http://help.arcgis.com
Thank You!

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Understanding our world.