Tips and Tricks for Using the 3D Interpolation Tool

This document describes how to download the 3D interpolation tool and use it for the purpose of performing multidimensional analysis on Marine, Atmospheric, Petroleum, Geological, and Groundwater point data. The 3D interpolation tool leverages new methods to solve problems related to multidimensional modeling.

The 3D interpolation tool;
The source data for many industries that work with 3D points at varying scales, is often not continuous.

Although many 3D interpolation methods are available, one of the major problems is searching for the neighboring points before applying the 3D interpolation algorithm. One of the approaches that can help to speed up the search for neighboring points is to perform 3D tessellation to find values between neighboring points to be used for interpolation. Voronoi tessellation is an algorithm that divides space based on the influence zone of each point in space. In 2D, Voronoi neighbors help to form a triangulated network (TIN), while in 3D they help to form a tetrahedral network.

The Tetrahedral Network:

The 3D interpolation engine performs a fast 3D Voronoi tessellation using a raster approach to create a (Delauney) tetrahedral network (TetNet), which is formed in order to maintain a relationship between neighboring points in 3D space to cut down time needed to search for neighboring points.

The TetNet facilitates quick interpolation for a 3D point set. This can then be used to create a raster stack, Voxels, and isosurfaces. Currently only the linear interpolation algorithm is used.
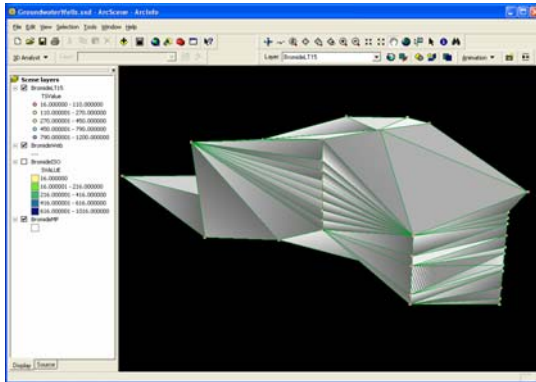
The 3D object is stored as a multipatch in either a feature class in the geodatabase, or as a shapefile, as shown below.

Both triangulated networks and tetrahedral networks are made of simple geometric primitives in 2D and 3D respectively. A triangle or a tetrahedral can be used as an interpolation unit. Each vertex of these geometric shapes carry coordinates of the measurement location and one or more measurement values. Given a location without the measurement value anywhere within the interpolation unit (a triangle or a tetrahedral), one can calculate the new attribute value, in the same domain of the measurements, using various algorithms like linear interpolation, inverse distance weighting (IDW), etc. Depending on the distribution and format of the output, the results may yield, e.g. a point set or regular grid. Given an attribute value, one can also calculate the location associated with the given value (e.g. isolines, isosurfaces). Isosurfaces:
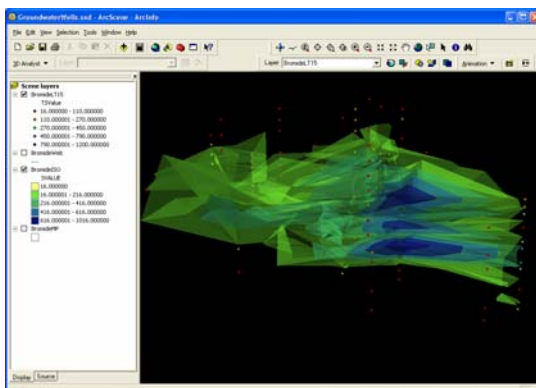
How to Download and Operate the 3D Interpolation Tool

The 3D interpolation tool file can be downloaded from the Data Model websites under *Downloads - Design Template* for selected relevant data models.

Click on the 3D Interpolation Tool file. Unzip and save the files to a folder on your local drive.

Note: No spaces between words for the file name. Standard naming conventions should be adhered to for implementation with this tool.

Note: This tool is designed to run with ArcGIS 9.1 (not a prior release).

Register the *TetrahedralEngine.dll*
For more information on how to do this please see:
http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=17621

Double click the *Interpolate 3D* file.

A *3D interpolation* window will pop up with the following contents: *Input*, *Tetrahedral Network Generation*, and *3D Interpolation*.

For *Input* section
Browse to a point file and select your *Dataset Name*.

Double click the file.

The Dataset Name as well as *Feature Class* will be set automatically.

Choose the field you would like to input for *Value Field* and *Z Field*. These will be based on the parameter that you would like to interpolate in the point data set.

<u>For *Tetrahedral Network Generation* section</u>
If you would like to create a new shapefile, check the box next to *Save to Shapefile*.

It will activate the options of MultiPatches and Polylines check boxes.

Copy and paste your path name of the selected file to *Output Name*.

Click the *Generate* button only if you are working with *Polylines* and creating Tetrahedral network.

Note: If you are working with *MultiPatches*, you will click on *Interpolate* button in the next section.

Open ArcCatalog and browse to the new feature class that was created.

<u>Using the *Query Filter*</u>
User can enter a where clause that will be applied to query subset of data based on range of attribute values, for example: 'temp > 20 and temp < 50'. This subset of data will be used to form the tetrahedral network that allows performing further analysis on that specific part of the entire dataset.

<u>For *3D Interpolation* section</u>
Check the box next to *Derive Isosurface*.

Choose the value you want for *Increment*. This value is based on the range of data values and increment you choose

Choose the value you want *Base Value*.

Choose the value you want for *Maximum Value*.

Note: Open the attribute table for the field you selected in ArcCatalog and see what the values are for minimum (*Base Value*) and maximum (*Maximum Value*).

Note: Do not check the box next to *Derive 3D Grid (voxles)* since the tool is not supported yet.

Click the *Interpolate* button to create 3D interpolation.

Open ArcCatalog and browse to the new feature class that was created.

Tips for viewing this data:

To view the Tetrahedral network, multipatches, and 3D isosurfaces you will need the 3D analyst extension. They are best manipulated in ArcScene.

You may also need to adjust the base heights, and the vertical exaggeration to display the data in the 3D environment. Making the layers semi- transparent can also help.

Copy and paste your path name of the
selected file to *Output Name*.