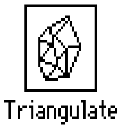
Triangulate User Notes



Version 1.5

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Written by
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Introduction

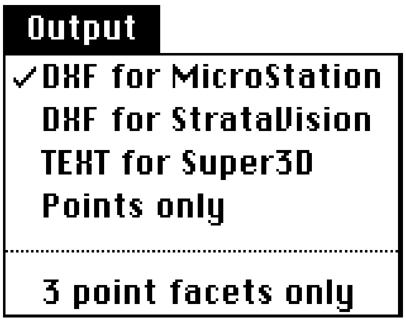
TRIANGULATE is a utility program that takes randomly distributed spot heights on a three dimensional surface and generates either a triangulated or gridded representation of that surface. It has been developed primarily for terrain modelling but can be used to create representations of any surface for which surface samples can be generated.

The input text file is simply a list of x,y,z values (samples lying on the surface), the program generates a model file in the most common formats used by 3D computer graphics applications.

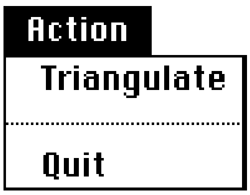
Operation

The output dialog contains any options regarding the type of output file generated. There are two versions of DXF file generated which are optimised for different applications. Super3D files are generated because that format is supported by many 3D packages. The points only format can be used to generate a text file containing the samples lying on the interpolated grid, this may be useful for specialised processing requirements.

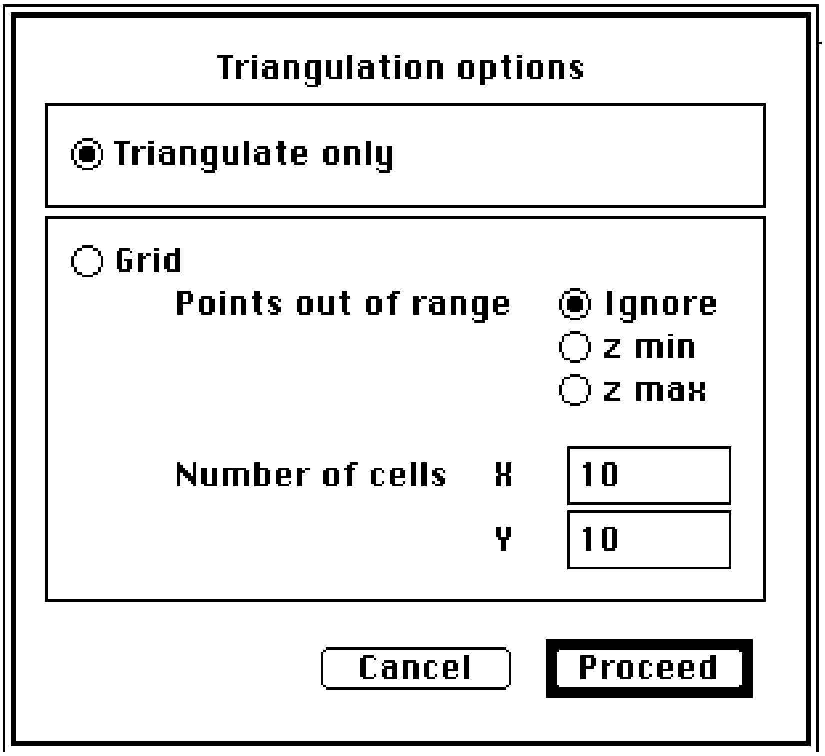
These output file format must be set before proceeding with the triangulation.



The action menu simply contains two items as shown below. Triangulate may be chosen as soon as the output file specification has been made. The user will be prompted for the various options relating to the algorithm, the sample file name and location, and finally the name and location of the output model file.



The various options required for the triangulation and gridding algorithm are displayed in the following dialog box



Triangulate only, will simply create a Delauney triangulated mesh of the data. The Delauney triangulation is closely related geometrically to the Direchlet tesselation also known as the Voronoi or Theissen tesselations. These tesselations split the plane into a number of polygonal regions called tiles. Each tile has one sample point in its interior called a generating point. All other points inside the polygonal tile are closer to the generating point than to any other. The Delauney triangulation is created by connecting all generating points which share a common tile edge. Thus formed, the triangle edges are perpendicular bisectors of the tile edges.

Gridding will resample the triangulated data at samples lying on a regular grid. The number of grid cells can be specified, the x and y range will be split by the number of cells indicated. If the samples are not bounded by a rectangular area then resampling onto a grid will result in grid cells for which data is not available. These grid cells may be treated in one of the three methods shown. It should be noted that gridded surfaces are almost always preferable for visualisation purposes, however it is a good idea to view the triangulated surface first in order to check for errors in the sample points.

The Delauney algorithm has been extensively optimised and the time taken rises almost linearly with the number of samples. This is not the case for the gridding algorithm where the processing time increases as the square of the number of samples and linearly with the number of grid cells required. For this reason it is important to use the smallest number of grid cells possible. The size of the grid cells is just the appropriate range (x or y axis) divided by the number of cells along that axis. For example: a 1km by 2kn parcel of terrain sampled with a 20 by 40 grid results in 800 cells each 100m square. In order to sample at 50m square it would be necessary to generate a 40 by 80 grid resulting in 3200 cells.

If the gridded terrain is being generated for rendering purposes if may be necessary with some packages to generate only 3 point facets, see OUTPUT menu. This arises because in general the 4 points of a grid cell will not be coplanar and some rendering packages will object to such "illegal" planes. The disadvantage is that this will result in twice the number of facets in the model.

Input file example

The following shows the recommended format of an input sample file.

```
-2.356503      2.703062     0.4786511
1.223221       0.1911843    1.898253E-02
2.826969      -1.074403    -0.4807091
2.736767       2.607091    -7.454497E-02
0.2096204      0.3865285    0.4906835
1.027313       1.215433    -0.4101266
1.444651       1.001261    -0.4993228
-.2763566     -.9951403     0.2415182
-2.058882      1.417621     0.4997017
0.2572771     -0.444186     0.4827431
     :             :            :
```

In general the separators between the x,y,z values and each sample may be any "white" character, that is a space, tab, or carriage return. The format shown above is recommended since it is the most suitable for human inspection. Tha sample files can easily be generated by spreadsheets, BASIC programs, word processors, and by other user written applications (for example: software is available to semi-automatically acquire samples though a digitiser)

The file format generated by the points only output option is of the same format as shown above.

Reading the DXF file with MicroStation

- Open a 3D model document. It is important to correctly set the precision of the working units.
- In the command window type UC=DXFIN, this invokes the DXF input user command.
- Reply YES to the prompt regarding conversion to master units
- Specify the file name when required with the usual Macintosh GetFile dialog.

Reading the DXF file with StrataVision

- Open a StrataVision model document
- Use the PLACE menu item
- Position the imported data in the TOP view window
- Note: the imported object is grouped and can optionally be made into a part
- It is recommended that triangular facets be used when gridding

Reading the Super3D file with Super3D

- Open a Super3D model document
- Use the IMPORT menu item
- It may be necessary to generate DUPLICATE surfaces for rendering purposes.

What is DXF?

DXF is an pseudo-standard way of storing CAD files thus allowing data transfer between many different software packages. The DXF specification was originally designed primarily for 2D data but has been "extended" to include 3D elements. Unfortunately it does not support very powerful 3D elements. This application uses just one DXF primitive, namely 3DFACE which supports 3 and 4 point polygons. Note that the 4 point polygons generated by this utility will not necessarily be planar.

What is the Super3D text format?

The Super3D text file format has been designed by the authors of the popular Super3D modelling and animation package. While it is not an industry standard it has become a very widely supported format on the Macintosh family of computers.

Hardware Requirements

This application requires a machine in the Mac II family. The default memory allocation for MultiFinder is 4MBytes. The number of samples which can be handled is limited only by memory.

Development History

This surface triangulation algorithm was originally developed in 1988 to support terrain modelling within the VISION-3D software package. It has been separated from that application for performance reasons, it is now faster, contains more error checking, and can handle a larger number of samples (the exact number is limitied only by the memory available).

The original algorithm was written in FORTRAN-77, this version has been translated into C and compiled with the Semantec C compiler version 4.0. Source code available on request.

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