

GeoTerrain by GEOPAK

1.1 Overview

GeoTerrain by GEOPAK offers Digital Terrain Modeling components that employ advanced state-of-the-art algorithms and are rich in functionality. GEOPAK DTM features are not limited to triangulated models. Features include: lattice models, contours, interactive editing of TIN files, integrated pads, merged models, surface-to-surface volumetric analyses, thematic analyses, drainage tools, and various utilities. The following sections briefly describe each primary feature.

1.2 Extraction of Input Data

Digital Terrain Models can be generated from a wide range of data sources including MicroStation elements, survey data, GeoTerrain cross sections, and GeoGraphics project data. An Extract utility is included to facilitate the retrieval and formatting of MicroStation graphical elements. These elements can be classified as contours, random points, break lines, islands, voids, drape voids, and boundary points.

One of the GeoTerrain Extract utilities analyzes the MicroStation elements and formulates interpretations. For example, 2D circular arcs can be segmented with elevations interpolated from spot elevations located on the circular arcs and/or upon adjacent elements. Text strings can be interpreted in terms of either the text origin or in terms of the value represented by the text string. A "765.71" text string can be interpreted such that the X and Y coordinates are derived from the origin of the text string and the elevation derived from the "765.71" value represented by the text string.

Another GeoTerrain Extract utility utilizes MicroStation GeoGraphics information within a design file. The user selects which elements are to be included via Feature Types, providing maximum flexibility enabling the user to determine what is and is not included within the DTM.

Another GeoTerrain Extract utility can create DTM input files from various types of ASCII files including: TEX, THD, RT40 and CAiCE.

The GeoTerrain Survey Manager dialog can prepare an input file for DTM processing directly from survey data. This input file will

distinguish between random spot elevations, contours, voids, boundary polygons, and break lines. Points stored in a GeoTerrain coordinate geometry database may also be utilized via the Survey Manager to create a DTM input for spot elevations.

In total, GeoTerrain provides the capability to create DTMs from a wide array of data sources.

1.3 Triangulated Models

The advanced algorithms employed by GEOPAK are apparent the first time you see the triangulated model display on the screen. Triangles appear from left-to-right in an ordered array; not in a randomized manner as is typical with standard Delauney based algorithms. You will also notice how fast the DTM is calculated. Processing time takes no longer than a few seconds, even for a set of data points numbering in the thousands.

The triangulated model is stored in a binary file as a triangulated topological network. For each generated triangle, polynomial coefficients can be calculated and also stored in the binary file.

Voids defined during the extraction or editing process can be utilized within a model. No triangles are drawn within the void areas. There is no limit as to the number of voids supported per model.

Several routines for interactively editing the triangulated model are provided in the Edit mode. These include editing spot elevations, adding and deleting break lines, all seen on the screen, and, by the push of a button, changed in the binary file, at the user's request.

When large models are utilized, the user may select an area of interest (with a Fence placement), displaying only that area. Models, which require additional review or editing, may also be "clipped" to a smaller size model while the original model integrity remains intact. If desired, the "clipped" model may be merged back into the original model, as the user dictates.

1.4 Editing

Several options are available within the Editing mode, some of which utilize the extracted data file, while others utilize the triangulated model. Utilizing the extracted data file, two reports may be generated: the first will identify duplicate points while the second identifies and optionally displays crossing features, such as break lines or contours.

Neither of these reports make any adjustments to the model, they are for informational use only.

However, two other features, which do change the extracted data file, are joining and filtering linear features. The joining process is useful when the source break lines or contour lines consist of several elements containing numerous vertices. In these cases, the end of one break line is the beginning of the next break line, so the software utilizes this as two separate break lines. During the joining process, GEOPAK changes these from the beginning and end of individual elements to the beginning and subsequent shots of one element. In addition to making a small sized model, the best advantage is a more accurate model. The filtering process compares each pair of adjoining vertices on linear features, i.e. break lines or contours. If the horizontal distance between two vertices is less than the tolerance, the software compares the initial two points to the next vertex on the element. If this third vertex is also within the tolerance, the middle vertex is filtered out.

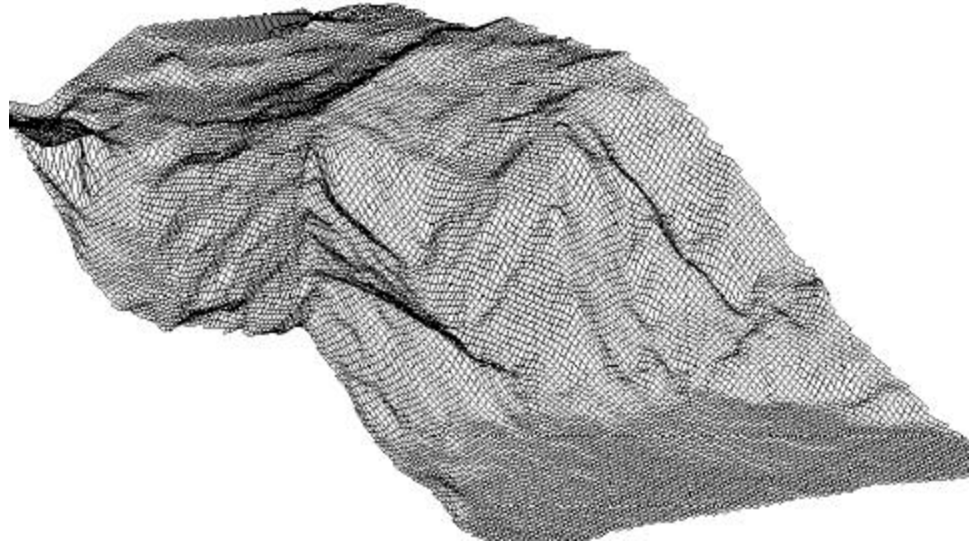
The other editing features utilize the triangulated model and include:

- Edit spot elevations - change x, y or z value of a spot elevation, delete or add a spot.
- Edit lines - this includes deleting a break line, as well as inserting a break or drape line
- Edit triangles - deletion of triangles optionally creating a void, or re-triangulating.

All these editing features dynamically show the changes as they occur. In addition, the changes are not made permanently to the triangulated model until the user selects the **Save** button, so the user decides when to change the original model, not the software.

1.5 Lattice Models

The lattice model represents a grid mesh draped over the triangulated topological network. As can be seen in the image below, this creates a very clear visualization of existing ground.

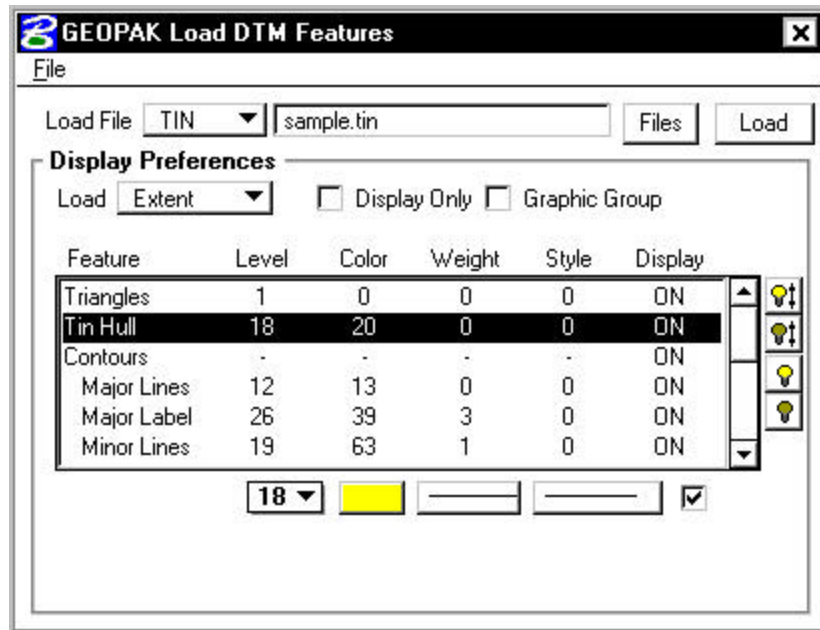


The user controls the density of the lattice grid as well as range and registration of the lattice. The process requires very little processing time. A 1,000,000-point lattice can be created on a Pentium PC in less than 30 seconds.

1.6 Contours

Contours may be drawn as strings or color filled shapes in a thematic manner. As can be ascertained on the dialog depicted below, for string contours the following features may be defined: major and minor contour intervals, maximum and minimum z-ranges, registration, text labels for both major and minor contours including the level, symbology, and intervals.

Contours may be displayed only or written into a 2-D or 3-D MicroStation file. When written, they can be placed in a single graphic group for easy deletion. Areas of interest may be identified with any of the MicroStation Fence commands wherein the software can load contours.



A variety of other features can also be drawn or displayed. These include the hull, or outline of the model, triangles, spot elevations, break lines, etc. Each feature has its own unique symbology, and any combination of features can be drawn or displayed. Utilizing MicroStation fence commands, features for a specified area, rather than the entire model, can be drawn.

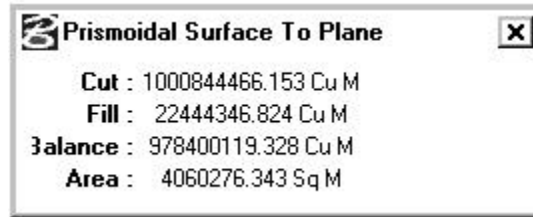
1.7 Merged Models

Any two models may be merged into a third model as long as the two models overlap at a minimum of one point. Both the original and the merged model remain intact. Typical applications of merged models include the superimposition of a proposed roadway onto the existing terrain, or merging of updated terrain onto void areas of the existing terrain.

1.8 Volumetric Analyses

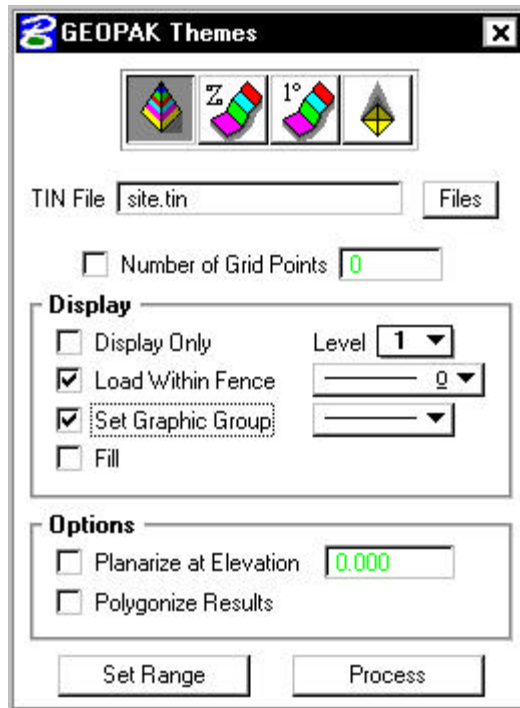
Six volume options are available in the Volume Analyses. Three prismatic volumes are supported, which calculate prismatic volumes between two surfaces or a surface and a plane. In the prismatic routines, TIN topology is utilized to determine the triangle intersections on the fly and therefore does not require the time and/or memory resources of the other volume modules. In other modules, cut and fill volumes between two surfaces can be calculated, as well as between one surface and a fixed elevation. Lattice volumes may be computed by utilizing TIN files, then specifying the number of grid points.

GEOPAK first lattices, then computes volumes. These volume calculations can be performed across the entire DTM model or on localized portions of the model. One volume dialog is shown below.

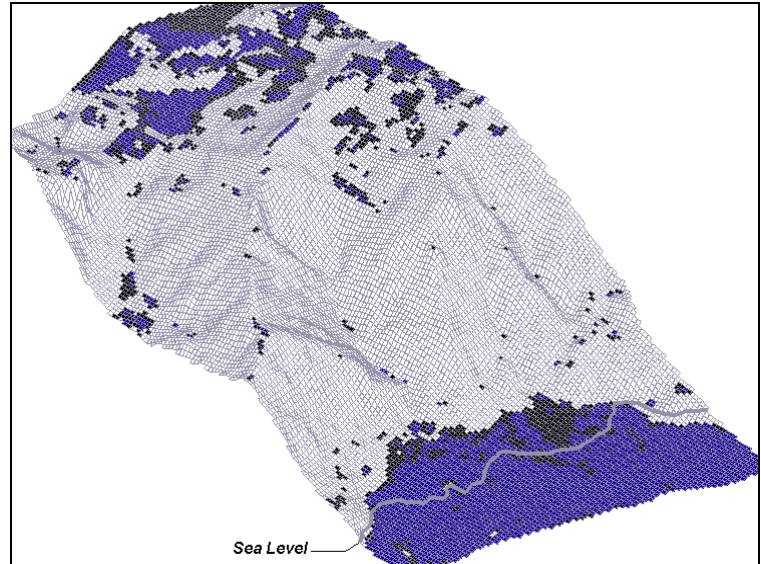


Depending on the option utilized, reports can be created in addition to the volume display window above.

1.9 Thematic Analyses



Color-coded shading of elevations, slopes and aspects can be applied to either the DTM or lattice models with the Themes dialog. Elevation thematics display elevation ranges. Slope aspects display the steepness of the terrain. For example, the image below depicts the slope thematic where the shaded portion of the model indicates the areas of terrain with a slope less than 25 degrees.



Aspect thematics, on the other hand, permit color-coded displays of portions of the model facing certain directions. Since zero degrees denotes due north, an angle range between 45 and 135 degrees would provide a shaded model of easterly facings.

1.10 Draping

The draping tool sets the Z-coordinate values of MicroStation elements to correspond to the surface of the triangulated model. Graphic elements can be selected individually or collectively via a MicroStation fence.

1.11 Utilities

The GEOPAK DTM component also includes several utilities to query height, view profiles, review model statistics (number of points, high/low elevations, etc.) as well as interactively review the elevation, slope, and aspect of a given coordinate point.

Other Utility features include the ASCII to Binary and Binary to ASCII file conversions utilizing GEOPAK .dat files.

1.12 Drainage Tools

A myriad of drainage tools is supported on the Drainage Tools palette. These include Delineating Watersheds, Sump Lines, Ridge Lines, High Points, Low Points, and Flow Direction. In addition, both Upstream and Downstream Trace are supported.

