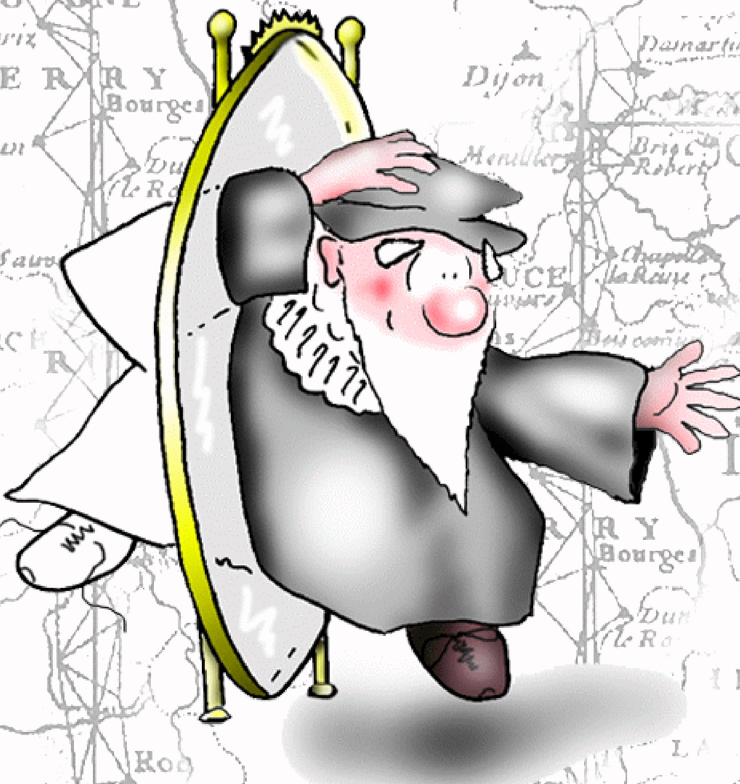
PERSPECTIVES

Getting Started

3D Perspective Visualization



in

TNTmips®

TNTedit™

TNTview®

Before Getting Started

This booklet introduces techniques for constructing and manipulating 3D views in TNTmips®, TNTedit™, and TNTview®. 3D data may consist of raster objects whose cells contain elevation values, TIN objects whose nodes consist of x, y, z, coordinates, or 3D vector and CAD objects. This booklet introduces you to the basic 3D visualization tools in the Display / Spatial Data process.

Prerequisite Skills This booklet assumes that you have completed the exercises in *Getting Started: Displaying Geospatial Data* and *Getting Started: Navigation*. The exercises in those booklets present basic skills for selecting and viewing objects stored in Project Files, and getting around in TNTmips. Please consult those Getting Started booklets and the TNT Reference Manual for any review you need. In addition, the exercises on using 3D Groups in display and hardcopy layouts require familiarity with *Getting Started: Making Map Layouts.*

Sample Data The exercises presented in this booklet use sample data that is distributed with the TNT products. If you do not have access to a TNT products CD, you can download the data from MicroImages' web site. In particular, this booklet uses objects in the CB_TM, CB_DLG, and CB_COMP Project Files in the CB_DATA data collection. Make a read-write copy of these files on your hard drive; you may encounter problems if you work directly with the read-only sample data on the CD-ROM.

More Documentation This booklet is intended only as an introduction to 3D visualization. Consult the TNT Reference Manual, which includes over 25 pages on the 3D features of the Display process, for more information.

TNTmips and TNTlite® TNTmips comes in two versions: the professional version and the free TNTlite version. This booklet refers to both versions as "TNTmips." If you did not purchase the professional version (which requires a software license key), TNTmips operates in TNTlite mode, which limits object size, and enables data sharing only with other copies of TNTlite.

The 3D perspective display features are also available in TNTedit and TNTview. All the exercises can be completed in TNTlite using the sample data provided.

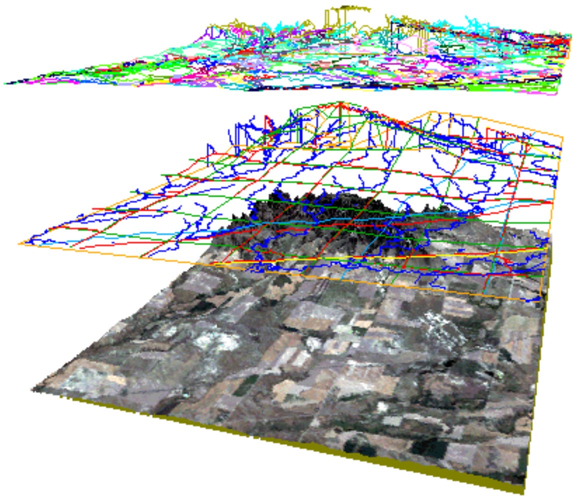
Keith Ghormley, 20 September 2000

It may be difficult to identify the important points in some illustrations without a color copy of this booklet. You can print or read this booklet in color from MicroImages' web site. The web site is also your source for the newest Getting Started booklets on other topics. You can download an installation guide, sample data, and the latest version of TNTlite:

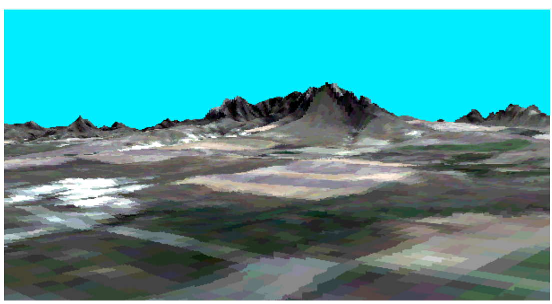
http://www.microimages.com

3D Visualization

The Display Spatial Data process in TNTmips provides a number of flexible tools for 3D and stereo 3D visualization of many kinds of project materials. You can use the process with raster, vector, CAD, and TIN objects. You can use a large array of drape objects over a wide-area surface to define a complex view.



Above: Crow Butte elevation with composite TM satellite image, DLG vector themes, and soil polygons. *Below* Crow Butte elevation with composite TM.



An essential concept underlies every feature in the process: the distinction between surface objects and drape objects. A **surface** object is a raster object whose cell values are used as elevation values to define a surface, or hull, viewable as a wireframe mesh. (A future version of the process will support the use of TIN objects as surface objects.) A **drape** object is a raster, vector, or CAD object that takes its 3D shape from a surface object below it in the layer list. One surface object can support any number of drape objects above it. When multiple surface objects are used in the layer list, the top-most surface object cancels the effect of the surface objects below it.

Many 3D possibilities are not introduced in this booklet. Refer to the booklet *Getting Started: Operating the 3D Simulator* for information on creating fly-through animations.

The exercises on pages 4-10 introduce basic 3D viewpoint controls. Pages 11-16 show how different object types are used. Pages 17-23 introduce more advanced features: floating layers, complex visualizations, and 3D stereo views.

Select Surface and Drape Layers

STEPS

- ☑ start the display process and select 3D / New 3D Group
- ☑ select Add Surface / Quick Add Surface and choose CB_TM / ELEVATION as a surface raster
- ☑ add CB_TM / ELEVATION as a drape
- ☑ select Edit Colors from the tools icon menu to select the Earth tones color palette for the drape layer
- ☑ keep this group open for the next exercise

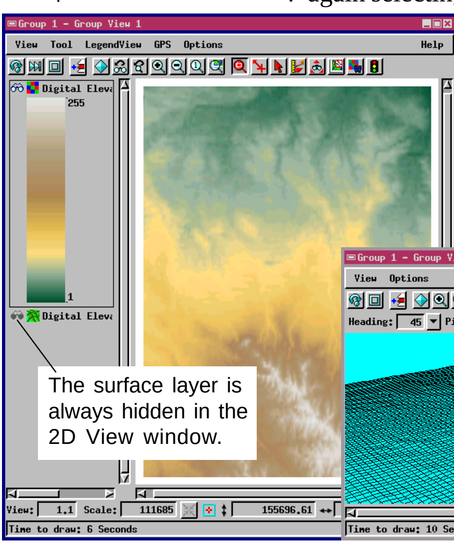
The ELEVATION drape object shows in the 2D View window. Here, the standard layer controls have been used to select an Earth Tones color palette.

The TNT display process supports 3D groups and views. For 3D visualization, you select a **surface object**, which defines the shape of the 3D surface, and one or more **drape objects**, which provide the spatial data that is projected onto the surface.

Launch the display process and open a new 3D group (3D / New 3D Group). The process opens three windows: (1) a Controls window, (2) a 2D View window (both familiar to you from 2D display), and (3) a Perspective View window, which shows 3D wireframe and solid renderings.

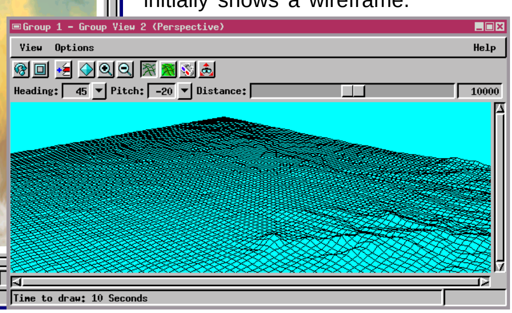
Add a surface layer by selecting Quick Add Surface from the Add Surface icon menu the in the Group Controls window. Use the standard Select Object process to choose the ELEVATION raster object from the CB_TM Project File in the Crow Butte data collection. The surface layer does not display in the 2D View window. An initial wireframe view appears in the Perspective window.

Add a drape layer with the Add Layer icon button, again selecting CB_TM / ELEVATION. Select Edit Colors from the drape layer's Tools icon menu to open the color palette and choose the Earth Tones palette.



The surface layer is always hidden in the 2D View window.

The Perspective View window initially shows a wireframe.



3D Perspective Window

The 3D Perspective View window can show either a wireframe view of the surface, or a solid view that renders the drape layer onto the surface layer. Initially, the window shows the wireframe view.

You can change the background color from the 3D Perspective window's Options menu. You can change the wireframe color from Options tab in the Layer Display Controls dialog that opens when you click an object icon in the layers list (or select Controls from a layer's menu in the LegendView). Note that the surface and the drape layers each have their own wireframe colors. Since the topmost layer is the drape layer, its wireframe color is the one that shows.

The 3D Perspective window initially shows a wireframe view because the Wireframe View icon button is selected. After you make adjustments to the controls, you can click the Solid View icon button to switch to a solid view.

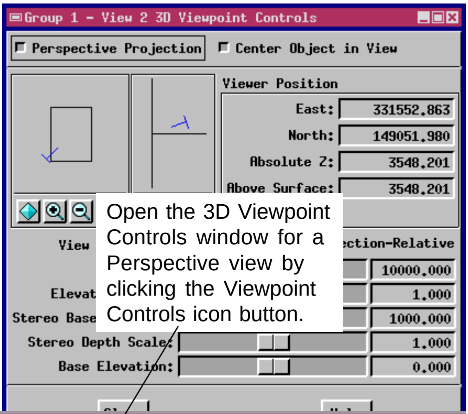
The 3D Viewpoint Controls window offers viewpoint and scale controls.

STEPS

☑ (optional:) open the drape and surface layers' Layer Display Controls windows and select wireframe colors  

☑ click the Viewpoint Controls icon button to open the 3D Viewpoint Controls window 

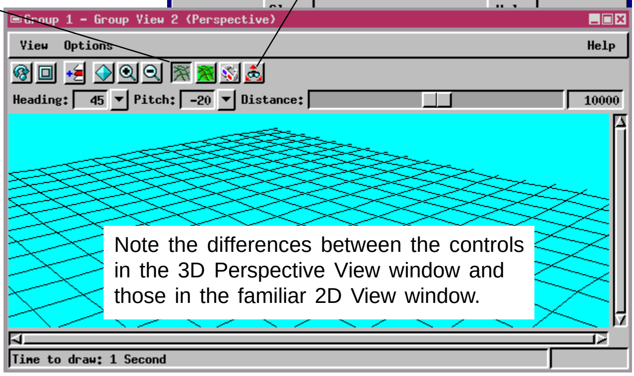
The controls in the 3D Viewpoint Controls window are used to adjust the view position, direction, and distance for the 3D Perspective View window.



Open the 3D Viewpoint Controls window for a Perspective view by clicking the Viewpoint Controls icon button.

The 3D Perspective window shows wireframe or solid renderings of the spatial data. Note that in this illustration, the Wireframe View icon button is depressed at the top of the window.

In wireframe mode, the Perspective View window shows the wireframe of the topmost layer (in this example, the ELEVATION drape object).



Note the differences between the controls in the 3D Perspective View window and those in the familiar 2D View window.

3D Perspective View Controls

STEPS

☑ click the zoom and redraw buttons in the 3D Perspective view window

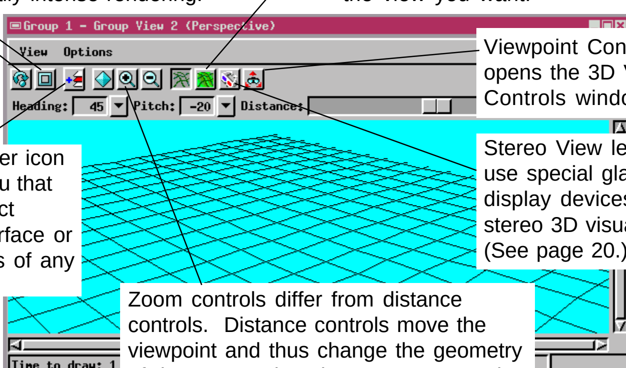
☑ survey the other control features of the 3D Perspective View window

The 3D Perspective window's wireframe view is best for preliminary visualization, since the wireframe can be rendered and manipulated quickly. By contrast, rendering a complex set of drape layers requires more processing time. Therefore, postpone solid rendering until after you have defined the view you want with the wireframe.

Icons in the button row at the top of the 3D Perspective window offer zoom and redraw controls that you should recognize from the 2D display process. You can also add more surface and drape objects, switch to stereo 3D mode (see page 20), and open the 3D Viewpoint Controls window. Notice that the 3D Viewpoint Controls window has a Close button. If your screen becomes crowded, you can close that window and later use the Viewpoint Controls icon button to get it back. A 3D Perspective View window always has its own 3D Viewpoint Control window. When you open multiple 3D Perspective views, it can become difficult to keep track of which Control window goes with which View.

Redraw and Stop icon buttons let you trigger or interrupt 3D renderings. You may want to use the Stop icon at some point to halt a long, computationally intense rendering.

Wireframe View and Solid View icons switch display modes. Solid View rendering is slower and should be delayed until after you have defined the view you want.



Viewpoint Controls opens the 3D Viewpoint Controls window.

Stereo View lets you use special glasses and display devices for stereo 3D visualization. (See page 20.)

The Add Layer icon opens a menu that lets you select additional surface or drape objects of any type.

Zoom controls differ from distance controls. Distance controls move the viewpoint and thus change the geometry of the perspective view. Zoom controls simply enlarge and reduce the view.

Rotation and Elevation Controls

The first controls to learn in the 3D Viewpoint Controls window are the rotation and elevation controls.

The Rotation control consists of a T-shaped graphic that you can drag around an extents box which shows the relative position of the ELEVATION raster object. Move your mouse cursor to the rotation control and drag it around the extents box. As you do, the wireframe in the 3D Perspective View window moves to show the change in your viewpoint.

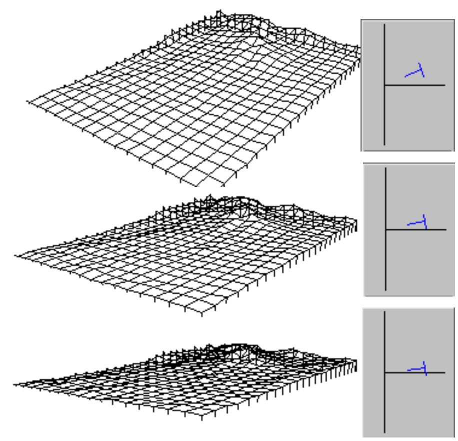
The Elevation control works the same way. It swings through a semicircular arc and lets you change the viewpoint from straight above, to edge-on, to straight below the surface.

The controls have a different behavior when the Center Object in View toggle is out (see page 10).

The Rotation controls are duplicated by the Heading control in the Perspective View window.

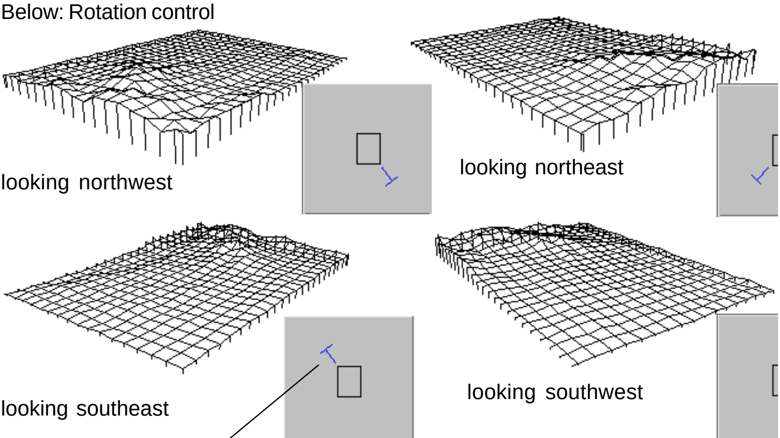
STEPS

- ☑ drag the Elevation control through its arc and observe the effect on the wireframe
- ☑ drag the Rotation control around the extents box and observe the effect on the wireframe



Above: three positions of the Elevation control.

Below: Rotation control



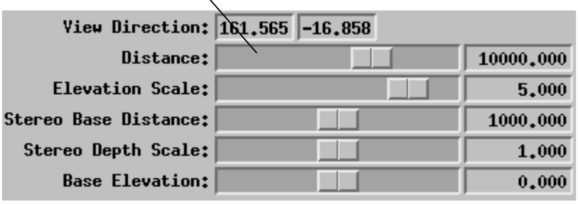
Drag the control in a circle around the extents box.

Distance and Elevation Scale

STEPS
☑ adjust the Distance slider and observe its effect on the wireframe
☑ adjust the Elevation Scale slider and observe its effect on the wireframe

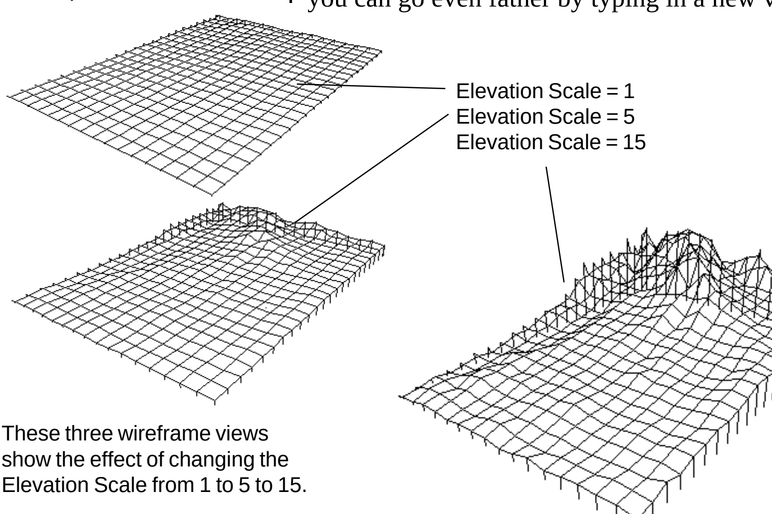
Sliders in the lower half of the 3D Viewpoint Controls window let you change the values that control the distance and elevation scale of the Perspective view. A larger Distance value moves the viewpoint away from the surface. A smaller Distance value moves the viewpoint closer to the surface; even moving it into the extents of the scene so that portions of the surface are outside the view.

The Distance slider is duplicated in the Perspective View window.



The Elevation Scale value acts as a multiplier for the elevation. When the scale value is 1, the surface may not show much variance. Increase the scale value to exaggerate the elevation variance. You can also decrease the scale value to fractional values to reduce the visual variance in a surface that has many abrupt and extreme variations. Moreover, you can change the slider values by typing new values directly into the associated numeric fields. Thus if you pull a slider all the way to the end of its trough, you can go even father by typing in a new value.

Note: The Stereo sliders are discussed on page 20. The Base Elevation slider is not discussed in this booklet (refer to the Reference Manual).



These three wireframe views show the effect of changing the Elevation Scale from 1 to 5 to 15.

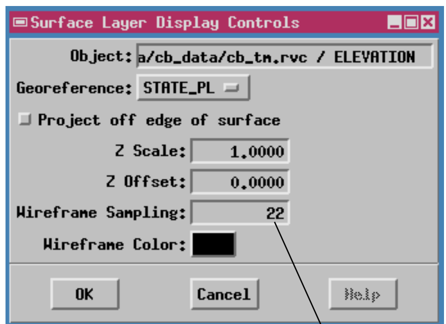
Wireframe Sampling

The sampling value for the wireframe determines how dense the wireframe appears. The ELEVATION surface layer for Crow Butte has a default sampling rate of 22. That means that the lines in the wireframe are derived from values in every 22nd row and every 22nd column of the ELEVATION raster object.

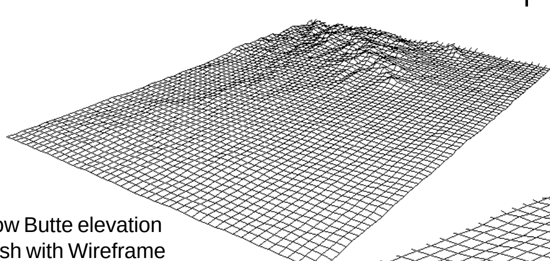
To see more lines in the wireframe, change the sampling value to a smaller number. To see a sparser mesh, increase the sampling value. The denser the mesh, the more detail you can see in the surface. A sparse mesh does not show much local detail in the surface. However, a dense mesh places more processing demands on your computer, so (depending on the speed and power of your machine) you may notice a jerky or delayed animation effect as you manipulate the controls to change the scale or viewpoint on a denser wireframe.

Always change the wireframe sampling rate with the surface layer controls. The wireframes for drape layers use the same sampling rate as the surface layer.

STEPS
- ☑ click the surface layer's object icon in the layer list 
- ☑ in the Surface Layer Display Controls window, change the Wireframe Sampling value and click [OK]

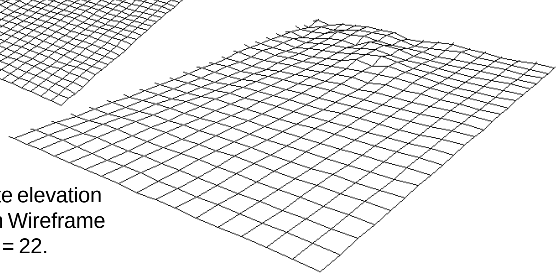


Change the Wireframe Sampling value in the Surface Layer Display Controls window to see a denser or sparser mesh.



Crow Butte elevation mesh with Wireframe Sampling = 8

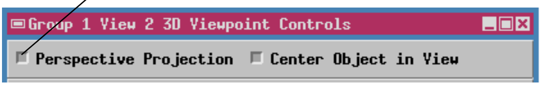
You can see more local surface detail in the wireframe mesh by decreasing the Wireframe Sampling value.



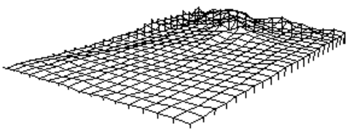
Crow Butte elevation mesh with Wireframe Sampling = 22.

Perspective and Center Object Toggles

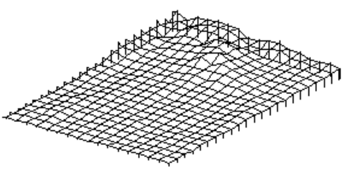
The Perspective Projection toggle switches between parallel and perspective modes.



Perspective views have a more natural appearance of depth and distance when rendered with a perspective projection. In perspective projection, parallel lines converge towards a vanishing point on the horizon. The display process also lets you choose a parallel projection for 3D views, which renders the surface so that parallel lines are truly parallel and do not converge. Use the Perspective Projection toggle in the 3D Viewpoint Controls window to change between Perspective and Parallel views.



In **Perspective Projection**, parallel lines converge towards a vanishing point.



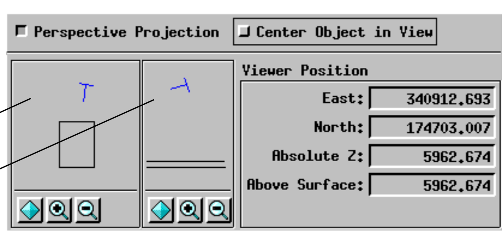
In a **Parallel Projection**, parallel lines remain parallel throughout the view.

The Center Object in View toggle determines the mode of the rotation and elevation tools. When the toggle is on, the 3D objects stay centered in the 3D Perspective View window and the tools rotate around a fixed center point. When the toggle is off, you can slide the tools in any direction. Be careful when the Center Object in View toggle is off, because you can easily point the view away from the surface and see nothing but an empty window. (You can always recover a “lost” surface by pushing in the Center Object in View toggle.)

When the Center Object in View toggle is off, the viewpoint tools move two ways: normal dragging to change their position, and dragging while holding down the shift key to pivot in place.

STEPS

- ☑ toggle the Perspective Projection toggle off and back on and observe the effect on the wireframe
- ☑ turn off the Center Object in View toggle
- ☑ hold down the shift key and drag / pivot the viewpoint tools
- ☑ turn on the Center Object in View toggle again



When the Center Object In View toggle is out, the viewpoint tools slide in any direction, and pivot in place when you hold down the Shift key while dragging them.

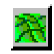
Drape Layers in Solid View

In the exercises so far, we have used only the wireframe view. In the wireframe view, the top-most drape layer is used for the wireframe. (The wireframe takes its 3D shape and sampling rate from the surface layer, and its wireframe color from the topmost drape layer.)

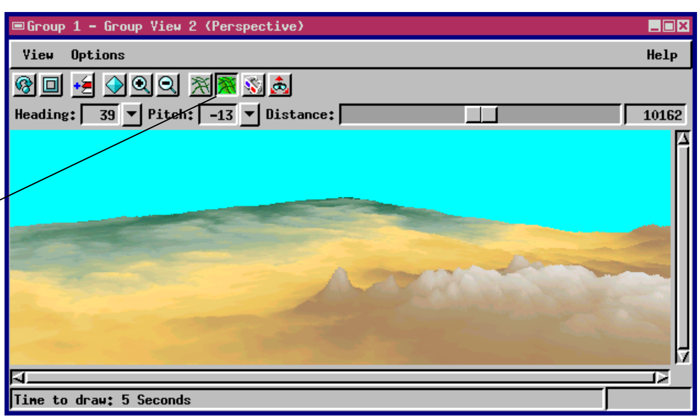
Use the viewpoint, elevation and scale tools to adjust your wireframe view, and then click the Solid View icon button in the 3D Perspective View. The process renders the solid surface in the Perspective View window.

On all except the fastest computers, the solid rendering of complex, multi-layer drape objects can take several seconds. Therefore, rather than remaining in the solid view mode, the process automatically switches back to the wireframe mode whenever you adjust any of the viewpoint controls. When you grab a slider or viewpoint tool in solid view, the process immediately reverts to wireframe mode. Once you finish making your adjustments, click the Redraw icon button in the Perspective View window to render the solid view again.

STEPS

- ☑ click the Solid View icon button in 3D Perspective View 
- ☑ resize the 3D Perspective view window and try the effects of its zoom and position tools 
- ☑ grab and hold a viewpoint tool in the 3D Viewpoint Controls window and make two or three adjustments to the wireframe
- ☑ click the Redraw button in the Perspective View window to render the solid view again 

The ELEVATION raster is used for both surface and drape.



The Solid View icon button switches off the wireframe.

Ground-level View

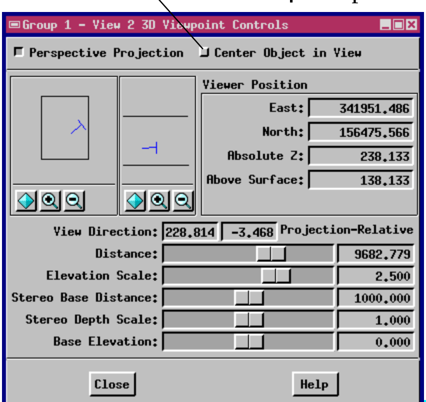
STEPS
- ☑ remove the CB_TM / ELEVATION drape raster
- ☑ add CB_COMP / _8_BIT  as a drape raster
- ☑ turn off the Center Object in View toggle
- ☑ use the viewpoint tools to move into the scene close to ground level

You may want to use the 3D Perspective process to see the big picture, the entire extents of a surface, as the exercises so far have shown. But you can also use the process to zoom in for something that begins to look like a local, ground-level view. Of course the fidelity and detail that a close-up view offers is limited by the resolution of the image used as the drape object, but the effect can give you a reasonable approximation of a ground-level view.

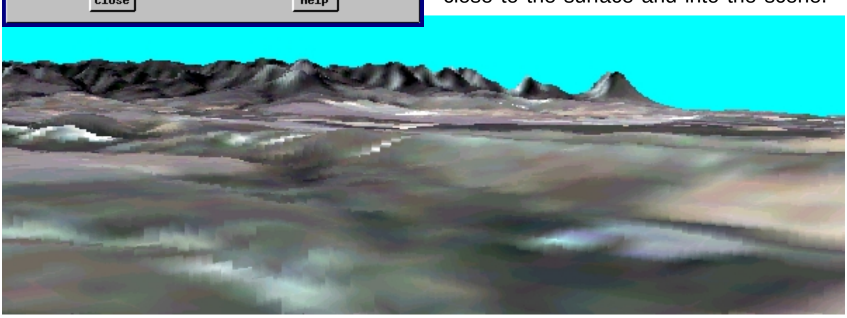
Remove the ELEVATION drape object from the layer list (retaining the ELEVATION surface layer), and then add a new drape object: _8_BIT from the CB_COMP Project File. Turn off the Center Object in View toggle button and use the viewpoint tools to move into the image, close to the surface. Remember, when the Center Object in View toggle is out, you can pivot the viewpoint tools by holding down the shift key as you drag the mouse.

You may also turn off the Center Object in View toggle button and try typing in the values illustrated at left to achieve the view pictured. (You may need to adjust the viewpoint tools in addition to entering the values illustrated.)

With Center Object in View toggled off, you can adjust the view position near the surface and move around in the scene.

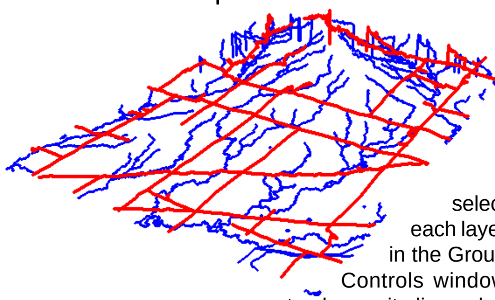


Turn off the Center Object in View toggle and use the viewpoint controls to move close to the surface and into the scene.



Vector Layers

A 2D vector object can be used as a drape layer over a surface object. (The exercise on page 14 shows how to view a 3D vector object.) The process renders the vector lines onto the surface. If you have a raster drape layer under the vectors, then, for example, vector hydrology lines would follow the surface drainages, and roads would follow the contours of the surface.



select each layer in the Group Controls window to choose its line color.

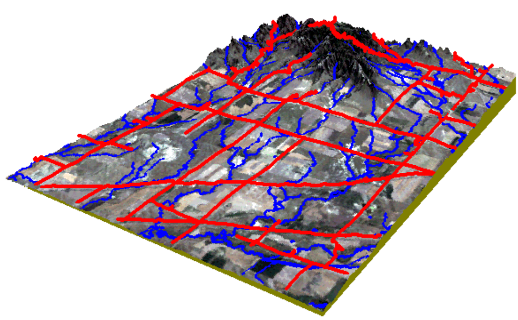
In this exercise, retain the ELEVATION raster object from CB_TM for the surface, and hide the _8_BIT drape layer. Then add drape objects of HYDROLOGY and ROADS from the CB_DLG Project File. Adjust the position of your view with the viewpoint tools in wireframe mode, and then click the Solid View icon button in the 3D Perspective View window to render the vectors.

A more interesting effect is achieved when the vector layers are on top of a raster drape layer so that the vectors appear to rest on the image surface. Unhide the _8_BIT raster object. Since the Solid View icon button is still pushed in, the view is rendered again as soon as you unhide the layer. Now, the vector layers appear to be plotted onto the raster image.

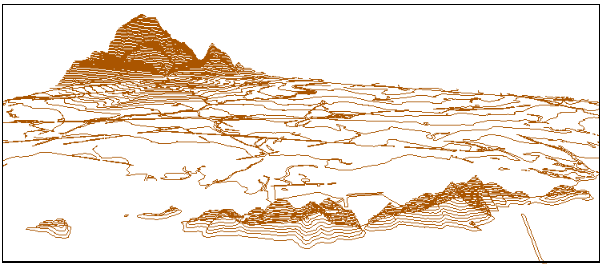
STEPS

- ☑ hide the CB_TM / _8_BIT surface layer
- ☑ add CB_DLG / HYDROLOGY and CB_DLG / ROADS as drapes on top of the hidden _8_BIT layer
- ☑ adjust the wireframe view and click Solid View
- ☑ unhide the CB_COMP / _8_BIT layer

The exercise on page 17 describes how to select a small offset value for vector objects so that line elements “float” a few feet above the surface and thus avoid local variations that might otherwise cause them to overlap incorrectly and appear broken in some places.



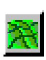
3D Line and Polygon Elements



3D elevation contours from the Newark map quadrangle

A vector object that has z coordinate values with each element can be displayed by itself in 3D (though it can not be used as a surface object). The process uses the vector's z-coordinate values for elevation, and renders the object in 3D apart from any other surface object.

STEPS

- ☑ remove all layers from the previous exercise
- ☑ add NEWARK / HYPSOGRAPHY from the SFDATA collection 
- ☑ Note that the "wireframe" view is not a regular mesh as when a raster object is used as a surface
- ☑ use the viewpoint tools to manipulate the HYPSOGRAPHY object
- ☑ note that when you click Solid View, the rendered view is essentially the same, except for line styles 

In this exercise, we will display the hypsography elevation contours from the Newark map quadrangle in the San Francisco area.

First, remove all surface and drape layers used in previous exercises. Then click the Add Layer icon button to add a single 3D vector object: HYPSOGRAPHY from the NEWARK Project File in the SF_DATA data collection. Note that a 3D vector object is manipulated as a vector layer, not as a surface, so it does not appear in wireframe as a surface object does. Moreover, a 3D vector layer does not accept any raster or vector drape layers of its own, as a surface object would.

Since there is no surface object, and no wireframe view, the NEWARK / HYPSOGRAPHY 3D vector object is rendered immediately in the 3D Perspective View window. For the same reason, when you are viewing a 3D vector object, the Solid View icon button effects the viewing mode only insofar as it renders the selected line styles.

Use the viewpoint tools to manipulate the HYPSOGRAPHY object. Since it is a complex vector object, the rendering takes a bit longer than a simple wireframe view takes.

3D Point Elements

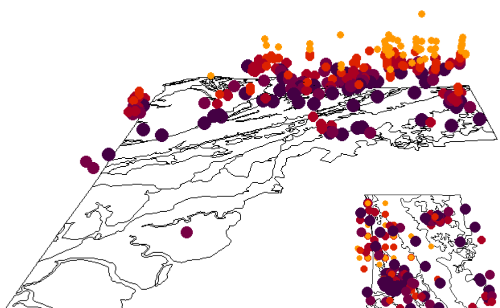
You can select a 3D vector object that contains only 3D point elements. 3D point elements may help you visualize geographic surfaces, such as 3D coordinates collected from a survey, or your 3D points may represent other values. For example, the x,y coordinates may represent map coordinates, while the z value represents not elevation, but some other spatial variable, such as saturation level, artifact count, signal strength — any variable that yields itself to spatial visualization.

For this exercise, use the SANMATEO data collection and add SANMATEO / GEOLMAP as a background layer, and the MAGNITUDE object from the QUAKE Project File as the 3D vector. These 3D points represent the magnitude of earthquakes recorded for a number of sites in the San Francisco area.

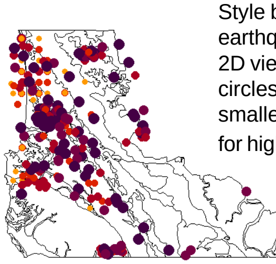
3D point data can be viewed like this in the display process, or it can be manipulated with a surface fitting process to create a surface raster object. Some 3D point data is also well suited for display and manipulation as a TIN object. Of course creating a continuous surface from 3D points implies a functional quality that should not be assumed for many types of study variables.

STEPS

- ☑ remove the HYPSOGRAPHY layer from the previous exercise
- ☑ add SANMATEO / GEOLMAP from the SANMATEO data collection
- ☑ add QUAKES / MAGNITUDE from the SANMATEO data collection as a 3D vector
- ☑ turn on the Solid View toggle
- ☑ use the viewpoint tools to adjust the view, trying different effects



The same point styles in 3D give a more dramatic visualization of quake location and magnitude.

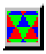


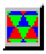
3D vector points help visualize point-specific observations that do not imply a continuous surface.

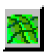
Style by theme shows earthquake magnitude in the 2D view window: larger dark circles for lower magnitude; smaller red and orange circles for higher magnitude.

TIN Layer

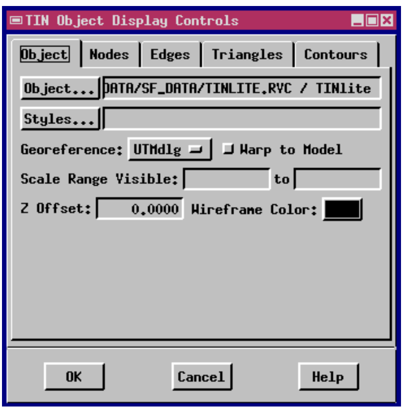
STEPS

☑ clear the layer list and add SF_DATA / TINLITE / TINLITE as a TIN object 

☑ click on the TIN object in the Layers List and select style options for nodes, edges, triangles, and contours 

☑ click the Solid View icon button to see the effects of the current style settings 

Tabbed panels in the Display Controls window present style controls.

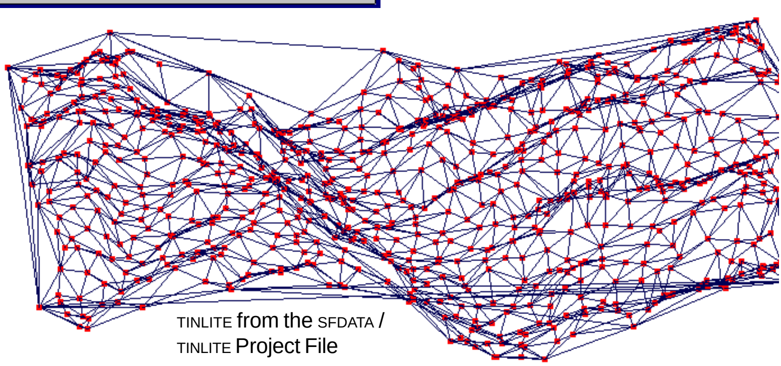


A TIN object, like 3D vector objects, can be viewed as a 3D layer, but not used as a surface object. (Planned enhancements to the display process will support using TIN objects as surfaces.) Thus, to view a TIN object in 3D, you add it with the Add Layer or Add TIN icon buttons, not with the Add Surface icon button.

Click the Add Layer icon button and select the TINLITE object from the TINLITE Project File in the SFDATA collection. Since TINs are handled as layers and not as surfaces, the TIN is rendered in the 3D Perspective View window for the wireframe view as soon as you complete the selection. When you switch to Solid View the TIN is redrawn with the selected styles. Open the TIN Object Display Controls window to set the drawing style for nodes, edges, triangles, and contours.

Note that you can set the triangle drawing style to solid fill. You can use solid fill to eliminate some of the visual confusion that is characteristic of wireframe viewing when hidden lines "show through" the holes in the mesh.

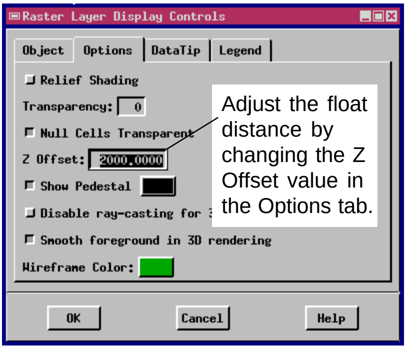
The Contours tab lets you select a primary and secondary interval for major and minor contour lines.



TINLITE from the SFDATA / TINLITE Project File

Floating Layers

The 3D perspective features in the Display process let you use multiple surfaces and multiple layers in a stacked, complex view. This exercise along with the next two introduces basic techniques for creating complex 3D visualizations.



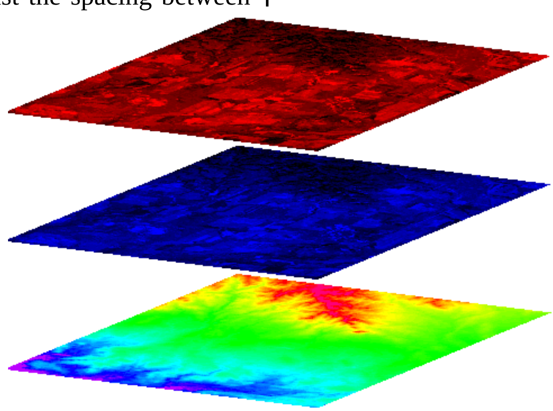
Floating layers take their 3D shape from a surface layer, but are rendered with a selected offset value so they appear above (or even below) the surface layer.

For a simple case, select three drape layers, each with a different offset value, and no surface raster. The drape layers will appear as planes in perspective. Use the Add Layer icon button to select ELEVATION, BLUE and RED from the CB_TM Project File. When you return, the view shows a single, flat wireframe.

To separate the wireframes, and "float" the top two layers, change the z offset value for BLUE and RED (leave the ELEVATION z offset zero). Open the Raster Layer Display Controls window for each object, entering the value 1000 in the Z Offset field for the BLUE layer, and 2000 for the RED layer. Now the wireframe view shows the three layers in a separated stack. You can adjust the spacing between each layer by changing its z offset value, or by changing the Elevation Scale slider in the 3D Viewpoint Controls window.

STEPS

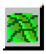
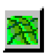
- ☑ clear the layer list and add CB_TM / ELEVATION, BLUE and RED as drape rasters (no surface raster at all)
- ☑ open the Raster Layer Display Controls window for BLUE and change the Z Offset to 1000 in the Options tab
- ☑ likewise change RED's Z Offset value to 2000
- ☑ use the Elevation Scale slider to adjust the space between the objects



This illustration shows a parallel view in which Edit Colors was used to change the color map for each layer.

Surface Rasters with Floating Layers

STEPS

- ☑ clear the layer list and add CB_TM / ELEVATION as a surface raster 
- ☑ add BLUE, _8_BIT, ROADS, and HYDROLOGY as a drape objects 
- ☑ set the specified Z Offset values
- ☑ turn off the Perspective Projection toggle
- ☑ use the Elevation Scale slider to adjust the space between the objects
- ☑ click Solid View to render the result 

Just as a surface raster can have any number of drape objects on it, so each drape object can have a Z offset value assigned to it. Thus, by experimenting with different offset values, you can create a complex stacked view in which one surface raster supports several floating layers above (or even below) it.

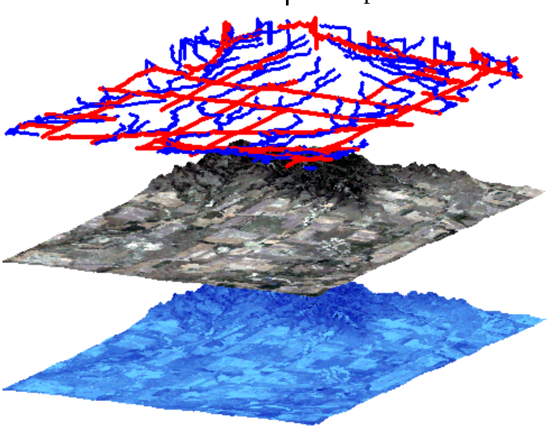
For this exercise, add the ELEVATION raster object from the CB_TM Project file as a surface raster. Then add these objects as drape layers:

CB_TM / BLUE
CB_COMP / _8_BIT
CB_DLG / HYDROLOGY
CB_DLG / ROADS

Open the layer display controls for each layer and change its Z offset value as follows:

CB_TM / BLUE	Z offset = 0
CB_COMP /_ 8_BIT	Z offset = 1000
CB_DLG / HYDROLOGY	Z offset = 2000
CB_DLG / ROADS	Z offset = 2000

Notice that ROADS and HYDROLOGY have the same Z offset values and therefore appear to float in the same plane.



One surface object (CB_TM / ELEVATION) determines the shape for all the drape objects above it.

The CB_TM / BLUE drape object was selected and Edit Palette was used to give it a bluescale display.

Multiple Surface and Drape Objects

The display process supports the use of multiple surface objects. Thus, you could view and compare elevation surfaces derived from different sources in the same scene, perhaps comparing a USGS elevation raster with the DEM created in TNTmips from stereo airphotos. Each surface layer in the stack cancels the influence of all suface layers below it.

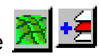
When using multiple surface objects, remember that *layer* objects always take their 3D shape from the closest *surface* object in the layers below them. Thus, inserting a new surface object into a list "cancels" the influence of any surface objects below it in the list. The offset values refer to the base of the entire construct. In this exercise, the RED object needs no offset, because it floats with DISTANCE, its surface layer.

Create a layer list, adding objects in this order (from bottom to top: the layer list appears inverted in the Group Controls window):

surface: CB_TM / ELEVATION	
layer: CB_COMP / _8_BIT	
surface: CB_DIST / DISTANCE	offset = 1000
layer: CB_TM / RED	
layer: CB_DLG / HYDROLOGY	offset = 1800

STEPS

☑ clear the layer list and add the surface and layer objects specified in the text, *in the order they are listed*



☑ set the Z offset value for the DISTANCE layer to 1000

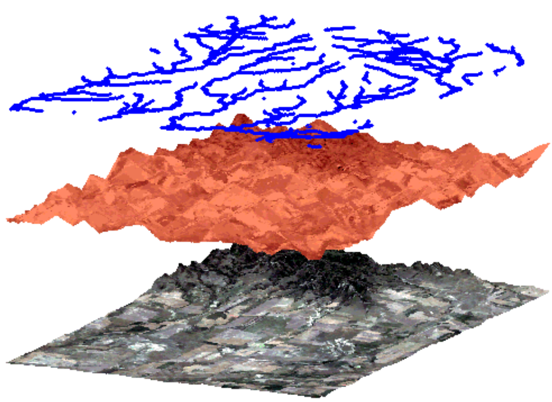
☑ set the Z offset value for the HYDROLOGY layer to 1800

☑ turn on the "Disable ray-casting for 3D rendering" toggle in the Options tab of the Raster Layer Display Controls for CB_TM / RED

The ELEVATION surface raster gives shape to the _8_BIT composite drape. Then the DISTANCE raster intervenes and gives shape to the RED drape raster and the HYDROLOGY drape vector object.

Observe how the DISTANCE surface layer cancels the influence of the ELEVATION raster object and defines the 3D surface and offset base for the RED and HYDROLOGY layers.

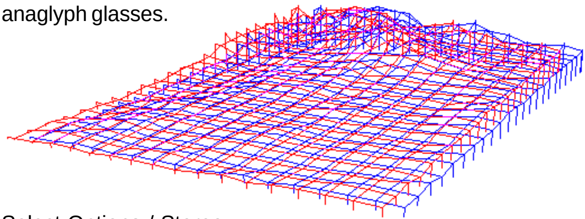
The DISTANCE surface object is a functional surface whose raster cell values represent the distance to the nearest hydrology feature.



Stereo 3D Views

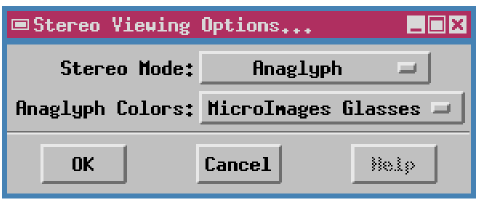
The display process also supports stereo viewing of 3D objects. Stereo 3D viewing requires additional equipment that may be sophisticated as special display hardware and electronically shuttered glasses, or as simple as a mirrored viewing hood, or two-color anaglyph glasses, like those used for 3D movies.

A red-blue wireframe pair that appears in stereo 3D when viewed with anaglyph glasses.

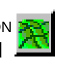
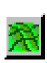


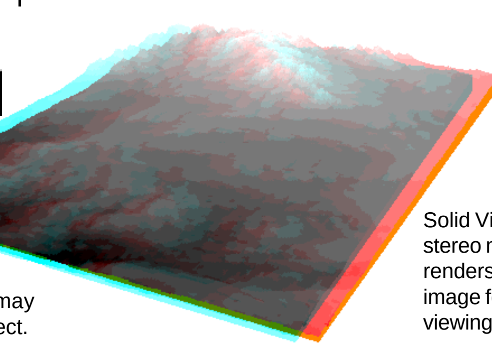
This exercise assumes you have a pair of the two-color anaglyph glasses that come with the TNTlite CD kit. Select CB_TM / ELEVATION as a surface object and then choose Options / Stereo Setup from the 3D Perspective View window. Choose Stereo Mode: Anaglyph and Anaglyph Colors: MicroImages Glasses from the Stereo Viewing Options Window. Click [OK] to return to the View window, and click the Stereo View icon button. Use the Stereo Base Distance and Stereo Base Scale sliders in the 3D Viewpoint Controls window to adjust the stereo separation and improve the 3D effect for you. When you have an effect you like in the wireframe display, click the Solid View icon.

Select Options / Stereo Setup in the 3D Perspective View window.



STEPS

- ☑ add CB_TM / ELEVATION as both surface and drape raster 
- ☑ choose Anaglyph and MicroImages Glasses under Options / Stereo Setup
- ☑ click Stereo View 
- ☑ open the Viewpoint Controls and adjust the Stereo Depth Scale and Stereo Base Distance sliders 
- ☑ click Solid View to observe the result 



Choosing black as the background color for the 3D Perspective View window may help you see the stereo effect.

Solid View in the stereo mode renders a double image for stereo viewing.

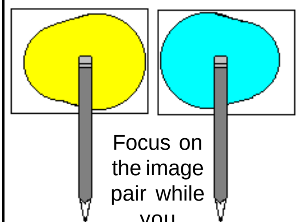
"Cross-eyed" Stereo

"Cross-eyed" stereo viewing is similar to the optical trick used in viewing the popular "magic eye" posters and books. It requires no special glasses, but it takes some patience to learn. Some people never get the knack, or find cross-eyed viewing uncomfortable. But if you have not tried the technique before, these instructions may help.

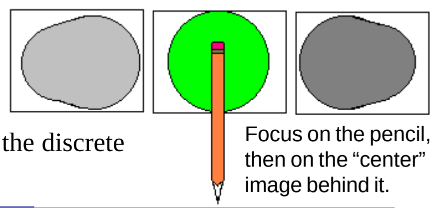
Use the standard display process to view two side-by-side 2D groups: SF_DATA / TINLITE / LEFTLITE and TINLITE / RIGHTLITE. Hold a pencil in front of the images, a few inches from your nose. Move the pencil forward and backward until its unfocused image appears centered in front of each image. Then refocus your eyes on the pencil. The two unfocused images will appear to have a third between them. Concentrate on the "middle" image. When your eyes adjust, the image should resolve into 3D and you can move the pencil away. The trick is to hold the features in the "middle" image together against the tendency of your eyes to re-focus and let the stereo view slide apart into the discrete component pair again.

STEPS

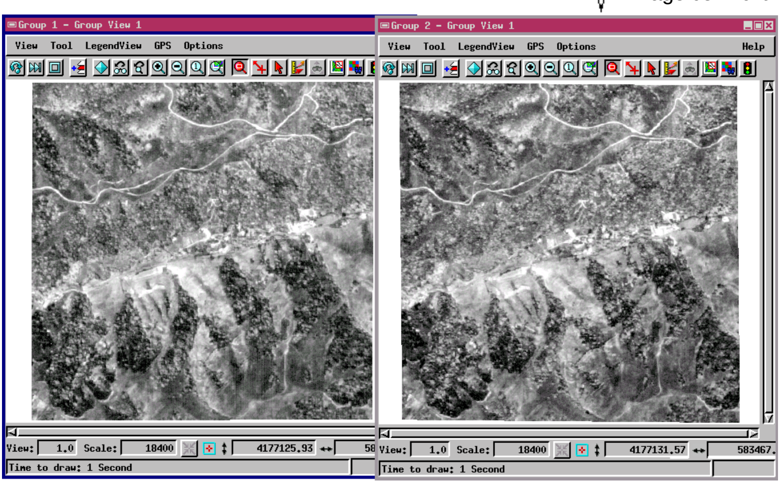
- ☑ add SF_DATA / TINLITE / LEFTLITE to a 2D display group
- ☑ open a second group and add RIGHTLITE
- ☑ position the windows as illustrated and try cross-eyed stereo



Focus on the image pair while you position a pencil.



Focus on the pencil, then on the "center" image behind it.



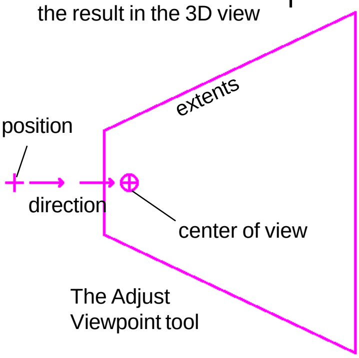
Turn off the LegendView and match the size and scale of each window.

Adjust Viewpoint Tool

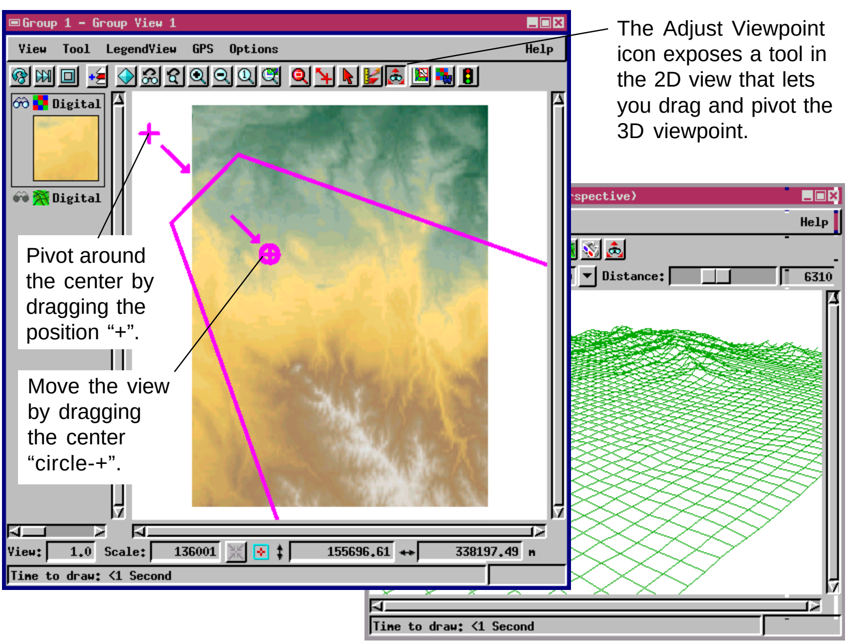
STEPS

- ☑ use CB_TM / ELEVATION for both surface and drape layers 
- ☑ click the Adjust Viewpoint tool icon 
- ☑ drag and rotate the tool in the 2D view and observe the result in the 3D view

The 2D View window has an Adjust Viewpoint tool that lets you manipulate the position and viewing direction of the associated 3D Perspective View. Of course the controls are linked, so as you adjust controls in the 3D Viewpoint Controls window, the Adjust Viewpoint tool in the 2D View window also moves.



Use the ELEVATION raster object for both the surface and drape layers. Click the Adjust Viewpoint icon in the 3D Perspective view window. The tool appears with a "+" marking the view position and a circled "+" marking the center of the view. An irregular extents box shows the area that is included in the view. Note that the near and distant edges of the box are not visible at some viewing distances. You can use the mouse to drag and rotate the the tool.



The Adjust Viewpoint icon exposes a tool in the 2D view that lets you drag and pivot the 3D viewpoint.

Multiple 3D Views in a Group

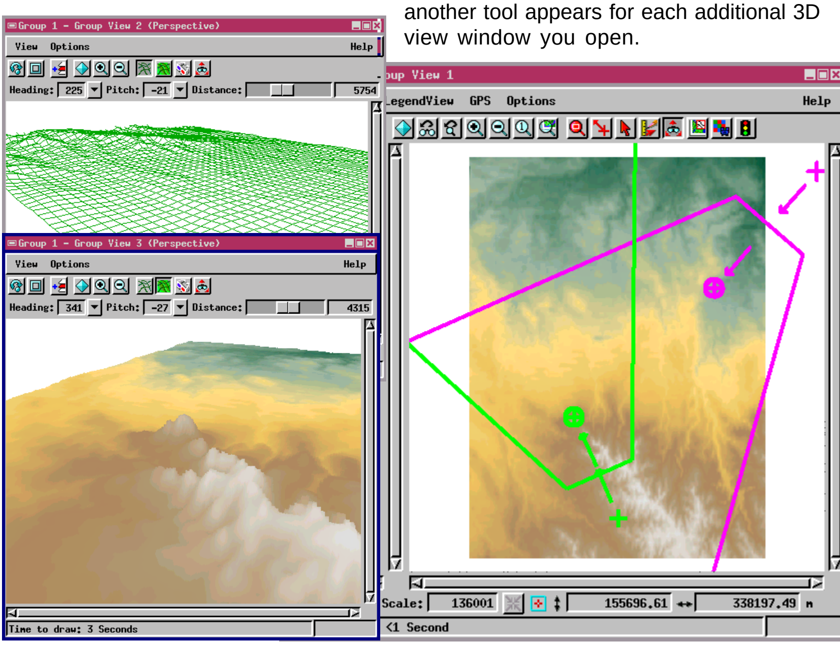
You can open multiple 3D views and control all of them from the Adjust Viewpoint tools in one 2D view window. Thus for example you could use the same surface and drape objects in each 3D view, and use the two Adjust Viewpoint tools to visualize the same scene from different angles. Alternatively, you could have a common viewpoint in both views, but choose different view directions in order to construct a wide, panoramic vista from a site of interest.

Use the ELEVATION raster object for both the surface and drape layers. The Adjust Viewpoint icon in the 3D Perspective view window should already be selected from the previous exercise. To open a second 3D view window and add its tool to the 2D view, select Group / Open 3D from the Group Controls window. The Adjust Viewpoint tool changes color when you move the cursor to the associated 3D view window.

STEPS

- ☑ retain the group and layers from the previous exercise
- ☑ select Group / Open 3D View from the Group Controls window to open a second 3D view
- ☑ initially, the new tool has the same position as the existing tool, so use the mouse to "unstack" the tools
- ☑ use the second Adjust Viewpoint tool in the 2D view to drag and pivot the associated 3D view

When the Adjust Viewpoint tool is active, another tool appears for each additional 3D view window you open.



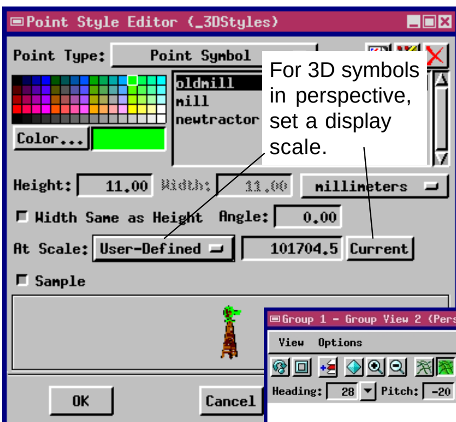
3D Perspective Symbols

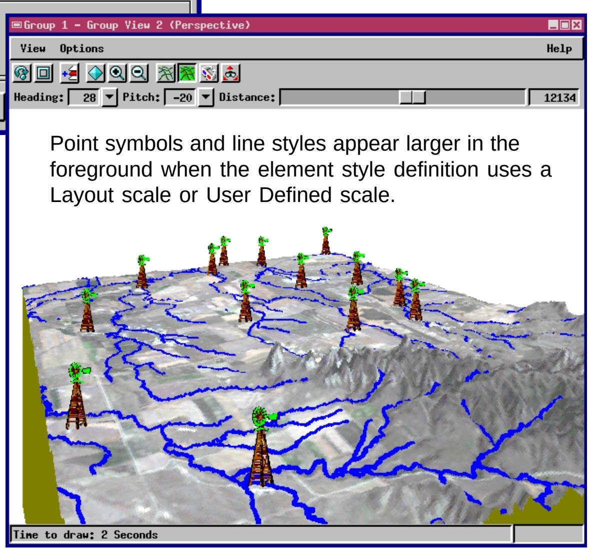
STEPS

- ☑ select Open / Open Group from the Display Spatial Data menu bar
- ☑ select the CB_DATA / LAYOUTS / _3DSYMBOLS group
- ☑ add the layer CB_DATA / CB_WELLS / WELLS
- ☑ open the Display Controls dialog for the WELLS object and select the Points panel

Point symbols can be designed especially for 3D display. Of course you can use any point symbol for 2D and 3D perspective views, but it is particularly effective to select point symbols that have been designed with 3D perspective display in mind. A selection of 3D point symbols, such as the windmill symbol used in this exercise, have been prepared with the TNT symbol editor.

3D symbols can be displayed with a uniform size or in perspective, so that point symbols and line styles farther from the viewpoint are smaller. In order to display 3D symbols in perspective, you must set the scale in the style controls for each element's symbology. The simple hydrology line style in the _3DSYMBOLS layout used here is predefined to display in perspective. Follow the step list for this exercise to use the Point Style Editor to have the point symbols display in 3D perspective as illustrated.



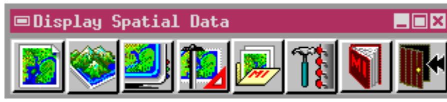


Point symbols and line styles appear larger in the foreground when the element style definition uses a Layout scale or User Defined scale.

- ☑ set Style to All Same and click Specify ...
- ☑ change At Scale to User-Defined and click [Current]
- ☑ close the dialogs and view the results

NOTE: if your 3D symbols do not appear in the Perspective View window, it is probably because the default scale value makes them too small to render.

2D / 3D Layouts

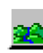
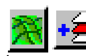
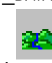


After you have learned the basics of 3D visualization in the 3D display process, you will find it easy to apply those techniques in the Layout processes. You can create both display and hardcopy layouts that include a combination of 2D and 3D groups. (Before you proceed with this exercise, be sure you are familiar with the material presented in *Getting Started: Making Map Layouts*, and the *Hardcopy Layout* section of the TNT Reference Manual.)

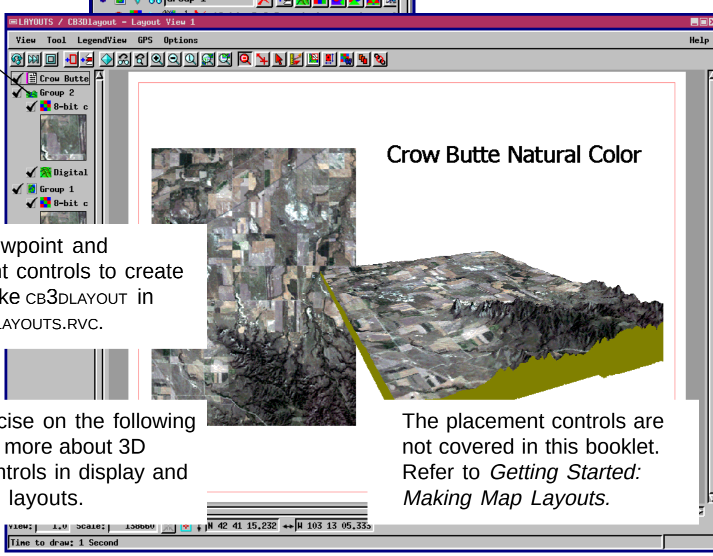
The Layout Controls window for display and hardcopy layouts includes an icon button for adding a 3D group. Follow the steps in this exercise to open an existing layout, and add a 3D group as instructed. The group tools for your 3D group let you open the familar controls for 3D viewpoint selection, and the layout tools for group placement.

The Display and Hardcopy Layout processes both support 3D groups.

STEPS

- ☑ select Open / Open Layout from the Display Spatial Data menu bar 
- ☑ select CB_DATA / LAYOUTS / _2D_3DLAYOUTS
- ☑ click the Add 3D Group icon button 
- ☑ add surface and drape layers CB_ELEV / DEM_16BIT and CB_COMP / _16BIT_BGR from CB_DATA 
- ☑ use the viewpoint and placement controls to adjust the layout 

Access placement and viewpoint controls from the Layout Controls window or from the layer's right mouse button menu in the LegendView.



Apply viewpoint and placement controls to create a layout like CB3DLAYOUT in CB_DATA / LAYOUTS.RVC.

The exercise on the following page has more about 3D group controls in display and hardcopy layouts.

The placement controls are not covered in this booklet. Refer to *Getting Started: Making Map Layouts.*

3D Viewpoint Selection Window

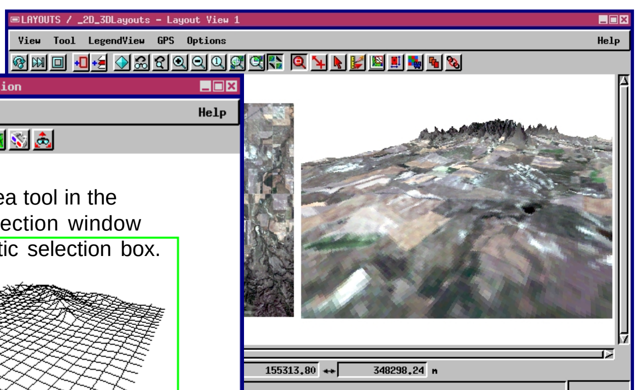
STEPS

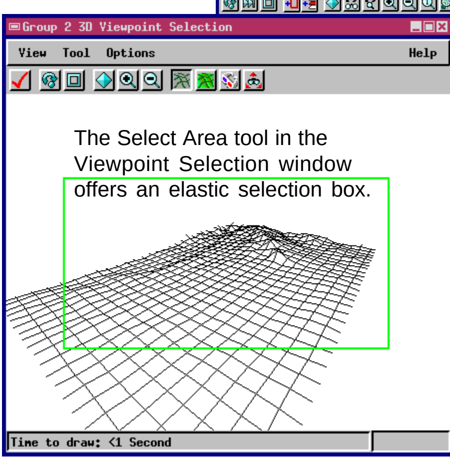
- ☑ select Open / Open Layout from the Display Spatial Data menu bar
- ☑ select CB_DATA / LAYOUTS / _3DLAYOUT
- ☑ select Placement Settings from the mouse menu in the layer list
- ☑ draw an elastic Select Area box in the Viewpoint Selection window
- ☑ click Apply Changes and view the result
- ☑ experiment with several different box sizes and positions

You can apply the standard Viewpoint controls to each 3D group in your layouts. Open the Viewpoint Controls either from the right-button mouse menu in the layer list of the LegendView or from the Layout Controls window. The controls are presented in two windows: the 3D Viewpoint Controls window (which is already familiar to you) and the 3D Viewpoint Selection window.

The 3D Viewpoint Selection window offers an elastic Select Area box that you use to select which part of the group you want included in the layout. Use the box to trim and crop the view as desired. Click the Apply Changes icon button to see the results of the current selection in the Layout View window.

Observe that the size and proportions of the 3D Viewpoint Selection window reflect the extents of the3D group in your layout. For example, any "empty space" at the top of the Viewpoint Selection window acts as padding at the top of the 3D group for placement control. So if you exclude that empty area with the selection box, the group position will move up in the layout.





The Select Area tool in the Viewpoint Selection window offers an elastic selection box.

When you have defined the area you want, click the Apply Changes button to see the result in the Layout View.

Printing 3D Layouts

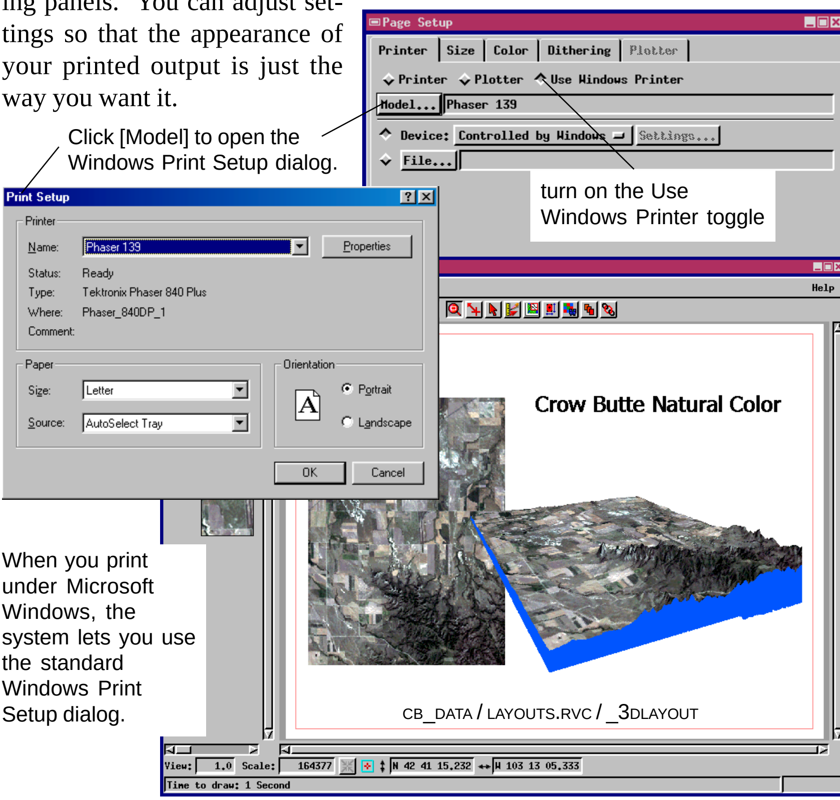
The TNT products support printing from UNIX, Macintosh, and Windows platforms. You can print to a file, to a local printer, or across a network. (Refer to the *Hardcopy Layout* section of the TNT Reference Manual.)

In Microsoft Windows, TNT can print using the latest drivers for any number of printers. If you want to print to very large format devices, you will usually find that the specialized drivers from MicroImages are faster than the Windows drivers. But the drivers from Microsoft or from your printer's manufacturer will normally be your first choice.

Examine the controls in the Size, Color, and Dithering panels. You can adjust settings so that the appearance of your printed output is just the way you want it.

STEPS

- ☑ open the layout CB_DATA / LAYOUTS / _3DLAYOUT
- ☑ select Print from the Layout menu in the Layout Controls window
- ☑ (in MS Windows) turn on the Use Windows Printer toggle
- ☑ (in MS Windows) click [Model] and use the Windows Print Setup dialog to select a printer
- ☑ click [Run] to print the layout



When you print under Microsoft Windows, the system lets you use the standard Windows Print Setup dialog.

Advanced Software for Geospatial Analysis

MicroImages, Inc. publishes a complete line of professional software for advanced geospatial data visualization, analysis, and publishing. Contact us or visit our web site for detailed product information.

TNTmips TNTmips is a professional system for fully integrated GIS, image analysis, CAD, TIN, desktop cartography, and geospatial database management.

TNTedit TNTedit provides interactive tools to create, georeference, and edit vector, image, CAD, TIN, and relational database project materials. TNTedit can access geospatial data in a wide variety of commercial and public formats.

TNTview TNTview has all the same powerful display features for complex visualization and interpretation of geospatial materials as TNTmips. TNTview is perfect for those who need flexible access to the TNT project materials but do not need the technical processing and preparation features of TNTmips.

TNTatlas TNTatlas lets you publish and distribute your spatial project materials on CD-ROM at low cost. TNTatlas CDs contain multiple versions of the TNTatlas software so that a single CD can be used on any popular computing platform.

TNTserver TNTserver lets you publish TNTatlases on the Internet or on your intranet. Navigate through massive geodata atlases with your web browser by using the free, open-source TNTclient Java applet (or any custom applet you create) to communicate with TNTserver.

TNTlite TNTlite is a free version of TNTmips, TNTedit, and TNTview for students and professionals with small projects. You can download TNTlite for your computer (about 100MB) from MicroImages' web site, or you can order TNTlite on CD-ROM with the current set of *Getting Started* tutorial booklets (shipping and reproduction charges apply).

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