TNTsim3D

Tutorial

Using TNTsim3D™

for Windows

Before Getting Started

TNTsim3D™ for Windows provides you with the ultimate way to explore your geospatial data: real-time, interactive, 3D viewing. Use your joystick, keyboard, or mouse to move over and around a simulated 3D landscape and view your geospatial data from any vantage point. Open different views of the landscape and view different landscape textures. You prepare data for use in TNTsim3D with the Landscape Builder process in TNTmips®. Each landscape file contains texture raster objects precisely matched to a terrain raster; the texture raster layers can include any visual combination of geospatial data.

Prerequisite Skills TNTsim3D is easy to use even if you have no previous experience with geospatial analysis software. If you have used a flight simulator software program and have a joystick, you are already familiar with moving through a simulated 3D scene. But even those without a joystick can use the keyboard to easily control movement, speed, and attitude.

Sample Data The exercises presented in this booklet use sample data 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 sample files BIGPINE3.SIM and PALMYRA.SIM in the SIMDATA directory on the TNT V6.7 products CD. Many other sample landscape files are available for download from MicroImages' web site.

More Documentation This booklet is intended only as an introduction to the features of TNTsim3D for Windows. For information about creating Landscape Files for use in TNTsim3D, consult the Tutorial booklet entitled *Building 3D Landscapes*.

TNTmips and TNTlite® TNTmips comes in two versions: the professional version and the free TNTlite version. 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. TNTsim3D is a free product that works identically with either TNTmips or TNTlite, but it can be used only on Windows computers.

Randall B. Smith, Ph.D., 29 July 2002

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

Welcome to TNTsim3D

Most geospatial data that you work with is a selective representation of a complex three-dimensional landscape, but flat maps and images frequently convey little sense of the vertical dimension. Contours and relief shading can be included with the map data for this purpose, but the ideal way to visualize the true shape of your geospatial data is to combine the data with an elevation model and "fly" over and around a 3D scene, examining features from any vantage point in real time.

TNTsim3D for Windows provides this capability, allowing you to move over 3D terrains using joystick, keyboard, or mouse controls. You can control all aspects of the viewer orientation (attitude), height above the surface, and speed. Special visual effects are also available, such as automatic texture smoothing and atmospheric effects (fog / haze).

You create the data for TNTsim3D using the Landscape Builder process in TNTmips, which creates terrain and texture raster objects that are specially optimized for real-time interactive 3D rendering. These objects are stored together in a Landscape File, a specialized type of TNT Project File with the file extension *.sim.

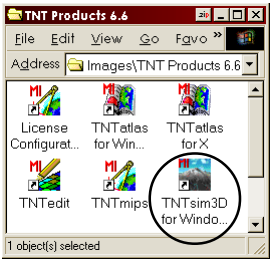
TNTsim3D is similar in many respects to flight simulator software products. It uses similar 3D rendering principles and techniques and provides the same real-time 3D movement. But the purpose of flight simulator software is to mimic the experience of flight, including different weather conditions and the flight characteristics of different types of aircraft; the background landscape is secondary. The purpose of TNTsim3D, on the other hand, is to allow you to view your geospatial data as a landscape. Its emphasis is on allowing you to move around and over the simulated landscape in real time while maintaining high-quality rendering of the landscape.

☑ Copy the files in the SIMDATA folder on the TNT V6.7 products CD to your local drive

The exercises on pages 4-9 cover hardware and software requirements, launching TNTsim3D, and configuring input device controls. Use of multiple texture layers is covered on pages 10-11. Pages 12-15 discuss the tools for keeping track of your flight position and attitude. The use of different types of additional view windows is presented on pages 16-21. Texture smoothing, fog, and other special effects are discussed on pages 21-23. The final section (pages 24-27) covers how to manage the performance tradeoff between terrain quality and frame rate, use of vertical exaggeration, and launching an atlas from TNTsim3D.

Launching TNTsim3D

TNTsim3D is installed automatically when you install TNTmips. A shortcut to the program is created in the MicroImages \ TNTproducts folder shown in the Windows Start menu. You can launch TNTsim3D from the Start menu, or copy this shortcut to the Windows desktop. You can also double-click on any TNTsim3D landscape file to launch the program and load the data from that file.



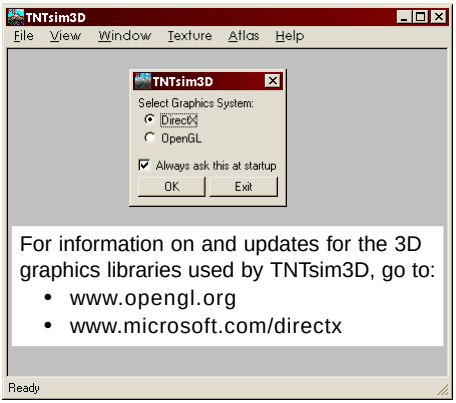
STEPS

☑ launch TNTsim3D

☑ if a Select Graphics System window opens, select either DirectX or OpenGL and click [OK]

Before running TNTsim3D, make sure that either OpenGL v1.1 or Microsoft DirectX 8.0 (or a later version) is installed in your Windows system. OpenGL is a cross-platform program library for 3D rendering and 3D hardware acceleration. Support for OpenGL v1.1 is included with Windows98, NT 4.0, and later versions of the Windows operation system. DirectX is a suite of Microsoft multimedia program libraries that include Direct3D for 3D rendering and hardware acceleration and DirectInput for configuring motion controls for input devices (such as keyboard and joystick). The TNTsim3D page on the MicroImages web site provides links to instructions on how to determine what version of DirectX is installed and how to download and install updates.

If only DirectX or OpenGL is installed on your computer, TNTsim3D opens directly using that graphics system. If both DirectX and OpenGL are installed, before TNTsim3D opens you are presented with a window asking you to select which graphics system to use. In principle, DirectX and OpenGL provide similar capability and performance in 3D rendering. Both systems can take advantage of any 3D rendering capabilities built into your display board to accelerate performance, which means higher frame rates and smoother movement. However, some display boards and drivers may not provide equal support for DirectX and OpenGL, so one may perform better than the other on your computer. You will need to experiment to determine which system works best for you. For best performance, make sure that you have the most recent Windows-certified driver for your video display board and follow the manufacturer's instructions to adjust hardware acceleration settings.



Loading a Landscape File

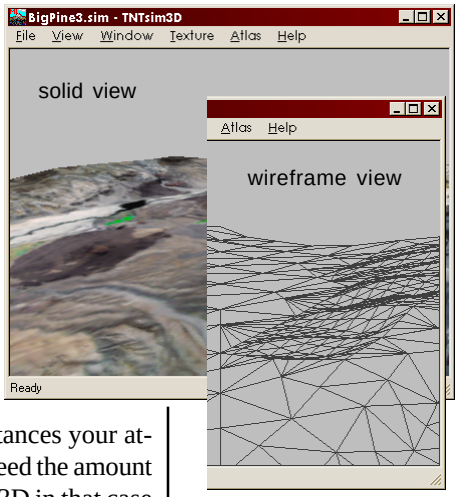
TNTsim3D opens by default with a single window on your desktop. The File menu is used to open a Landscape File and to exit the program. This menu also shows the last four landscape files you have used, providing easy loading of recently-used data.

When you open a landscape file, TNTsim3D reads the terrain raster in the file and constructs a 3D model of the terrain surface. The surface model is a mesh of interlocking 3D triangles that provides an efficient approximation of the terrain surface. The first texture raster in the file is then draped over this surface model. To see the surface model alone, choose View / Wireframe; this menu option acts as a toggle between solid and wireframe view modes. The state you have set when you exit the program is used by default when you next open it.

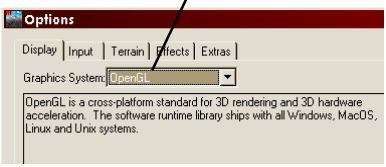
You can resize the TNTsim3D window by dragging any edge or corner, or use the standard Windows maximize/restore button on the right side of the window title bar. Keep in mind, though, that increasing the window size puts a larger demand on video memory and may reduce the speed and smoothness of movement through the simulation. In some instances your attempt to enlarge the window may exceed the amount of available video memory. TNTsim3D in that case returns to the previous window size and displays an error message explaining the problem. DirectX appears to be more demanding of video memory than OpenGL. If both graphics systems are available on your computer, you can switch between them using the Graphics System menu on the Display panel of the Options window.

STEPS

- ☑ choose Open from the File menu
- ☑ navigate to the directory into which you copied the Landscape Files (*.SIM) from the TNTproducts 6.7 CD
- ☑ select BIGPINE3.SIM
- ☑ choose Wireframe from the View menu
- ☑ repeat the previous step to return to solid view
- ☑ select Options from the View menu and examine the Display panel, then click [OK]



You can switch between DirectX and OpenGL on the fly using the Graphics System menu on the Options / Display panel.



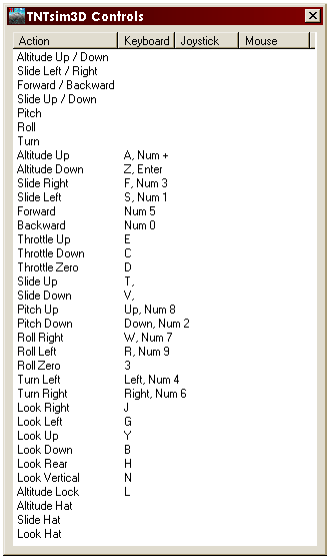
First Flight: Using Keyboard Controls

STEPS
- ☑ choose Show Controls from the View menu
- ☑ using the keyboard motion controls shown, experiment with moving through the 3D scene

The normal view direction is straight ahead in the direction of flight. Use the Look Right/Left/Up/Down keys to temporarily look in other directions.

Although you may already have a joystick or other flight control device installed on your computer, let's use the keyboard for your first flight, because a number of actions have been pre-assigned to specific keys. These default input control settings are shown the first time that you open the TNTsim3D Controls window. You can keep this window open on your desktop as a quick reference to the keyboard controls while you try them out.

The keyboard controls allow you to move in various directions through the scene, control forward and backward speed, and change your viewing orientation (attitude). The attitude controls use the same motions that would apply to an aircraft: pitch, roll, and turn. If you are not familiar with these terms, pitch affects the vertical angle in the direction of flight, roll affects the angle of the wings relative to the horizontal, and turn affects the heading (the horizontal direction of flight).



Default input control settings. If DirectX is installed there are no Num key assignments.

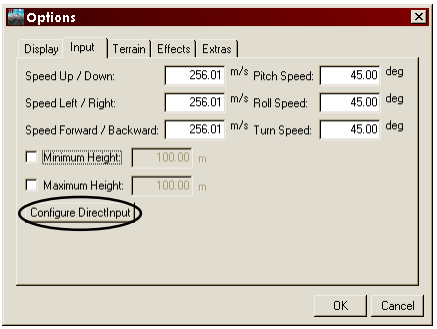
The way in which you use a key on the keyboard depends upon which control is assigned to it. The general motion controls (Altitude Up/Down, Forward/Backward, Slide Right/Left/Up/Down, Pitch Up/Down, Roll Right/Left, Turn Left/Right) move you at a specified speed (discussed later) as long as the key is held down. To move forward without having to continue holding a key down, use the Throttle Up Key, which increases your speed by a fixed amount each time it is pressed. The Throttle Down key slows your forward speed and, if you slow down to a stop, moves you backward at increasing speed. The Throttle 0 key stops the motion begun by the other Throttle keys, while Roll 0 levels the wings of the virtual plane. The Look Right/Left/Up/Down keys direct your view in a particular direction as long as they are held down. The Altitude Lock key acts as an on/off toggle for maintaining the current altitude.

Configuring Input Controls

TNTsim3D uses the DirectInput software component of DirectX to allow you to configure the flight controls for your keyboard or other input device. You can reconfigure the controls while operating the simulator in either DirectX or OpenGL, but DirectX must be installed on your system in order for you to do so. (OpenGL does not provide an input configuration utility.) If you do not have DirectX installed, there will be no DirectInput push button on the Options window Input panel, and you will be limited to using the default keyboard controls. If so, this would be a good time to download and install the latest version of DirectX from Microsoft (see page 4).

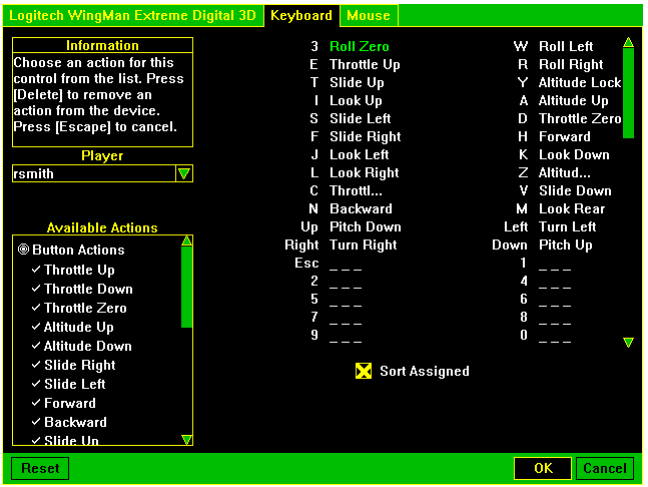
STEPS

- ☑ from the View menu select Options
- ☑ click on the Input tab
- ☑ if you have a Configure DirectInput button at the bottom of the panel, press it
- ☑ click on the Keyboard tab and edit the keyboard controls if you wish
- ☑ click [OK] on the DirectInput window and the Options window



DirectInput control window

The DirectInput window has a tabbed panel for a joystick or other game controller (if one is installed in your system), the keyboard, and the mouse. The right side of the keyboard panel lists the keys and the currently assigned action for each. To change the assignment for a key, click on its entry in the list or press the key on the keyboard. Either action highlights the control entry and shows a scrolling list of available actions in the lower left portion of the panel. To activate the action list, press Enter (or double-click on the control entry) and select a new action from the scrolled list.



Configuring a Joystick

STEPS
If you have a joystick or other game controller, make sure that it is:

- ☑ plugged into your computer
- ☑ set up and calibrated in Microsoft Windows

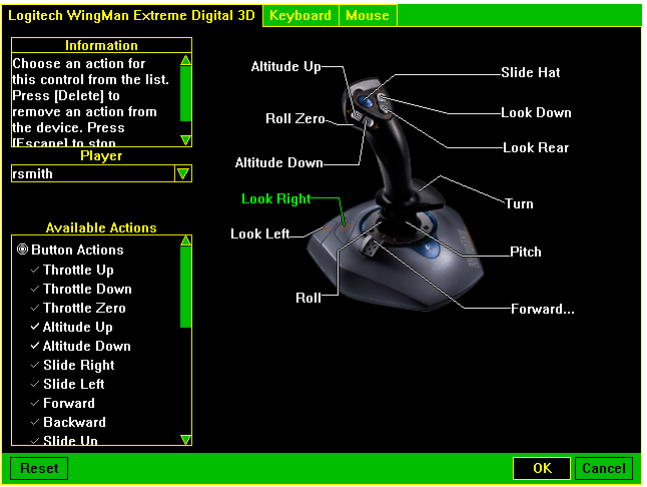
Then proceed to:

- ☑ press the Configure DirectInput button on the Options window Input panel
- ☑ select the tabbed panel for your controller
- ☑ configure the stick (axis) controls and the button controls
- ☑ close the DirectInput and Options windows
- ☑ practice moving with the joystick, supplemented by keyboard controls as needed

A joystick, yoke, or similar game controller gives you more realisitic, intuitive control over your movements in TNTsim3D. The lowest-cost joysticks have only two rotation axes, so you must change roll and pitch (bank the plane) to make turns. Higher-priced (but still inexpensive) joysticks allow the stick to twist, providing three axes of rotation and independent control of turn, roll, and pitch. They also have a separate throttle control that can be operated with your other hand, as well as a number of buttons that can control other motions.

You can also use the mouse as a motion control, but only in a very limited way. The mouse is better used to interact with the data in the TNTsim3D window, as described later.

TNTsim3D allows simultaneous use of different input devices. So even if you have a joystick, you may still want to use the keyboard to control some actions. For example, if your joystick does not have a throttle control, you can use the throttle up, throttle down, and throttle 0 controls on the keyboard to control your speed.



Sample action assignments that I have set for the 3-axis joystick I use at Micro-Images. I move the stick forward or back to change pitch, side to side to roll, and twist it to turn.

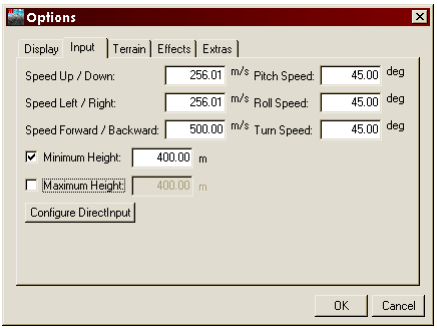
Setting Other Input Options

The Input panel on the Options window also provides other settings that affect your movement through the simulation. In the upper left part of the panel are three linear speed settings: Up / Down, Left / Right, and Forward / Backward. All are initially set to the same velocity (in meters per second), which is based on the areal dimensions of the landscape. The default speed is computed to traverse the maximum extent (height or width) of your landscape in 120 seconds. Each of these linear speed values sets the speed used by the associated motion control. When you use the throttle controls to increment speed, the Speed Forward / Backward value sets an upper velocity limit. You can change any of these linear speeds to move more quickly. But keep in mind that at faster speeds the scene changes rapidly, forcing TNTsim3D to read more data more quickly, and the image information held in memory must be updated more frequently. Your movements may become less smooth, and you may see more transient rendering artifacts.

The settings in the upper right part of the panel control the angular speeds (in degrees per second) for pitch, roll, and turn. The default values are independent of the landscape characteristics, and any changes you make are retained for use in later sessions. You can also set both minimum and maximum height values, which are also retained until reset. Setting a minimum height prevents you from flying through and then under the terrain surface. If you set the same value for minimum and maximum height, you can maintain a constant height above the surface while flying in any direction.

STEPS

- ☑ from the View menu select Options
- ☑ click on the Input tab
- ☑ change the value in the Speed Forward / Backward field to 500
- ☑ turn on the Minimum Height check box and change the height value to 400
- ☑ click [OK] on the Options window
- ☑ use any controls to move closer to the terrain surface until you reach the minimum height you have set

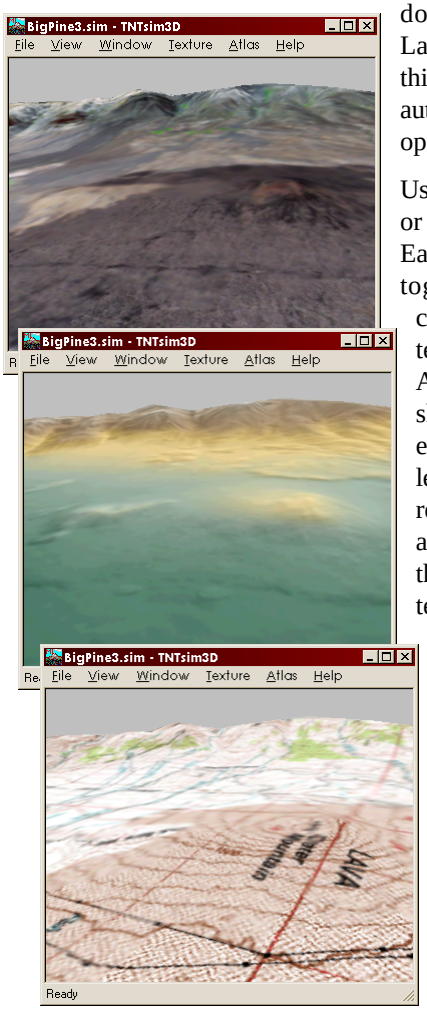


Flight following the ups and downs of terrain at minimum height of 400 m.

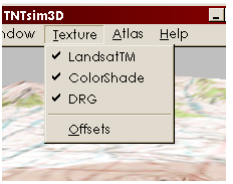
Selecting Textures

STEPS
- ☑ click on the Texture menu
- ☑ note the check mark next to the LandsatTM menu entry
- ☑ select ColorShade from the Texture menu
- ☑ select DRG from the Texture menu

A single Landscape File can include any number of texture objects showing different aspects of the landscape. For example, the BIGPINE3 file includes three textures: a "natural color" pan-sharpened Landsat Thematic Mapper image (LANDSATTM), a color shaded relief texture (COLORSHADE), and a scanned topographic map (DRG). The available textures are shown on the Texture menu in the TNTsim3D window. The first texture written to the Landscape File is the first menu entry (in this case, the LANDSATTM texture) and is automatically selected by default when you open the Landscape File in TNTsim3D.



Using the Texture menu, you can select any or all of the textures in the file for viewing. Each entry on the Texture menu acts as a toggle to turn the corresponding texture on or off. A check mark is shown next to the entry for each selected texture. Under DirectX, textures are rendered by TNTsim3D in the same order as their menu listing. With all textures in the the BIGPINE3 file selected, for example, texture LANDSATTM is rendered first and DRG is rendered last. (OpenGL renders textures in the opposite order.) In this case each texture image covers the full extent of the landscape, and each is rendered directly over the terrain model, so only the last texture is visible in the window. To find out how to visualize multiple textures simultaneously, proceed to the next page.

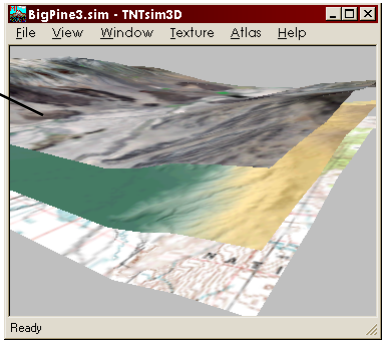


Keep the current settings and proceed to the next page.

Texture Offsets and Inset Textures

The Texture Offsets window lets you set a vertical offset from the surface model for any texture. You can use these settings to create a stack of "floating" textures, allowing you to see all textures for the same area at the same time. You can even fly through or in between the floating textures.

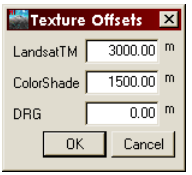
Floating textures for the BIGPINE3 Landscape File



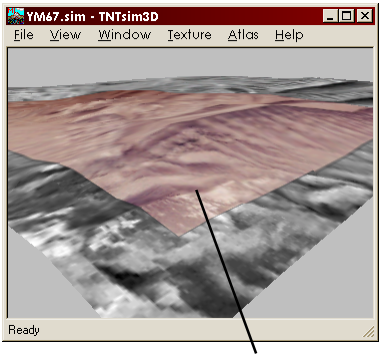
Flying between floating textures

STEPS

- ☑ select Offsets from the Texture menu
- ☑ enter an offset value of 3000 for the LANDSATTM texture
- ☑ enter an offset value of 1500 for the COLORSHADE texture

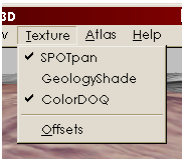


- ☑ click [OK] on the Texture Offsets window
- ☑ use the flight controls to move beyond the edge of the landscape, then turn to look back toward the center of the scene



The YM67 sample Landscape File includes a COLORDOQ texture whose image covers only the central part of the landscape.

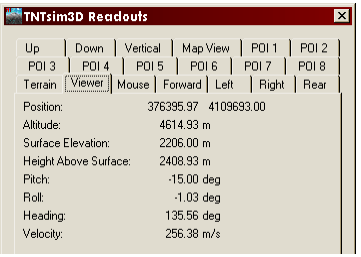
If a texture is created from an image that covers only part of the landscape area, the remaining parts of that texture are transparent in TNTsim3D, allowing an underlying texture to be visible. You can thus simultaneously view (without offsets) a high-resolution (perhaps color) image texture that appears to be "inset" into a lower resolution (perhaps grayscale) texture covering a larger portion of the landscape (see the illustration above right).



Keeping Track of Where You Are

STEPS

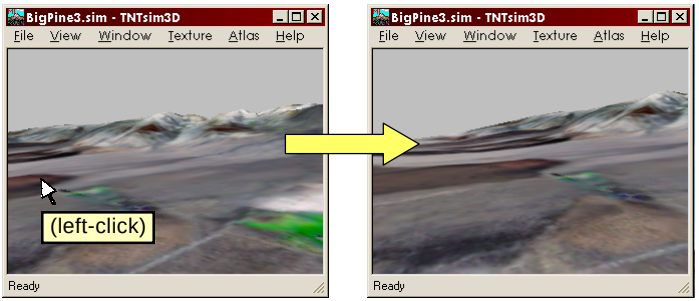
- ☑ reopen the Texture Offets window and reset all offets to 0
- ☑ use the Texture menu to deselect the ColorShade and DRG textures
- ☑ select Readouts from the View menu
- ☑ click on the Viewer tab in the TNTsim3D Readouts window
- ☑ note how the listed values are updated as you move through the landscape



- ☑ to redirect the view to a particular feature in the landscape, move the mouse cursor to that feature and press the left mouse button
- ☑ select Recenter from the View menu
- ☑ select Restore Initial Viewpoint from the View menu

A simulation opens with a default viewer position above the upper left corner of the scene, pointing toward the scene center. As you fly around, information on your viewing position is shown on the Viewer panel of the TNTsim3D Readouts window. This panel shows your horizontal (x y) position (in map coordinates if the simulation objects are georeferenced), altitude above sea level and height above the terrain surface (both in meters), and angles in degrees for pitch, roll, and heading. By monitoring these dynamically updated readings as you move through the landscape, you can easily keep track of your position and attitude.

The TNTsim3D window always shows a forward (pilot's) view in the direction of flight. You can use the movement controls to change your direction of flight to bring any feature of the landscape into the view. But there are also several shortcuts that let you instantly change the viewer attitude. You can reorient toward any terrain feature in the view by placing the mouse cursor on the feature and pressing the left mouse button; the feature is then centered in the view. If your flight leaves you pointed away from the landscape, the Recenter option on the View menu reorients the viewer toward the center of the scene, while the Restore Initial Viewpoint option on the same menu jumps the viewer back to the default starting position and orientation.



Left-click in the view to reorient the flight toward a particular landscape feature.

Using the Compass Graphic

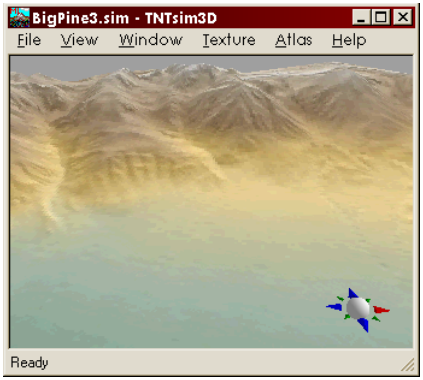
An optional compass graphic in the lower right corner of the TNTsim3D window provides an additional aid to 3D navigation. This graphic, which is turned on by default, is controlled by settings on the Extras panel of the Options window.

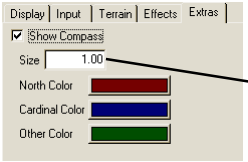
The compass graphic consists of a central sphere, arrows that point in the four cardinal directions (north, east, south, and west), and arrows for the four intermediate directions (northwest and so on). The north arrow, other cardinal arrows, and intermediate arrows are shown in separate colors. (Color controls let you change the arrow colors if you wish.) If the landscape objects are georeferenced, the north arrow points in the north direction; otherwise it points parallel to the column direction in the rasters.

The compass points are drawn to lie in the horizontal plane, so the compass image provides a visual cue to your attitude relative to the horizontal. This attitude information is enhanced by shading effects on the points and central sphere, which are illuminated from a point above the compass and to the north.

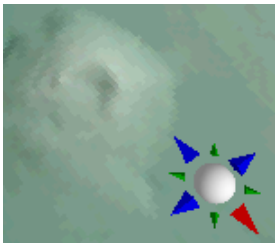
STEPS

- ☑ from the Texture menu select the COLORSHADE texture
- ☑ choose Options from the View menu and click on the Extras tab
- ☑ if the Show Compass checkbox is not checked, click in it to turn it on
- ☑ notice how the compass rotates as you move through the landscape

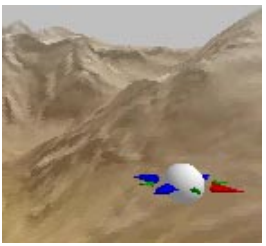




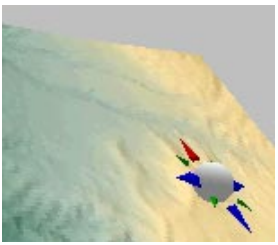
Enter a new Size value to change the size of the compass graphic.



View nearly straight down



View nearly horizontal



Banked turn

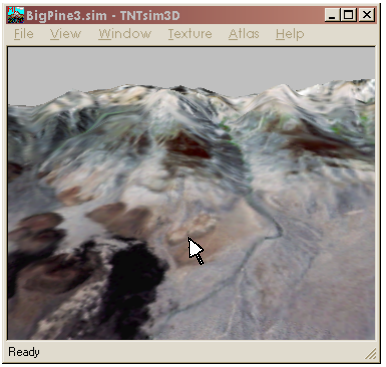
Find Surface Coordinates with the Mouse

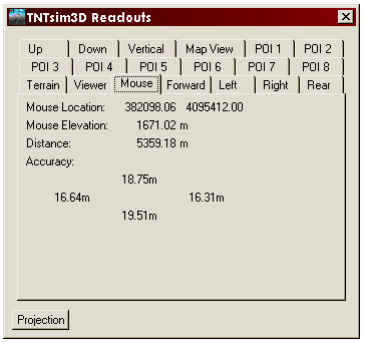
STEPS

- ☑ use the Texture menu to deselect the ColorShade texture
- ☑ click on the Mouse tab in the TNTsim3D Readouts window
- ☑ move the mouse cursor within the TNTsim3D window
- ☑ note how the values on the Mouse panel continuously update

As we have seen, knowing your viewing position in the simulation is important. But TNTsim3D enables you to view georeferenced spatial data, so you may be more interested in finding the map coordinates and surface elevation of particular locations on the landscape surface. With TNTsim3D you can use the mouse to determine point coordinates for any visible portion of the scene.

When you place the mouse over some point on the scene in the TNTsim3D window, the program projects a sight line from the viewer position through the screen position of the cursor and on to the corresponding position on the landscape surface. The horizontal (x y) map coordinates of this position are reported as the Mouse Location item on the Mouse panel of the TNTsim3D Readouts window. (If the landscape objects are not georeferenced, the line and column numbers of the corresponding terrain raster cell are shown.) The Mouse Elevation entry shows the corresponding surface elevation, which is interpolated from the closest terrain raster cells along the sight line.





Mouse position readout for a sample mouse cursor location.

The four Accuracy values give you estimates of the positional accuracy limits for the mouse cursor position. Each of the four values is measured from a screen pixel immediately adjacent to the cursor's screen location; the reported value is the 3D distance between the surface locations of the neighboring and center screen pixel. These values vary due to differences in viewing angle and the direction and angle of surface slope.

Terrain Information

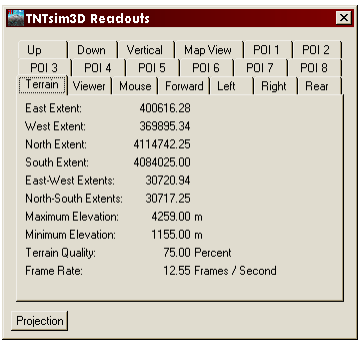
The Terrain panel provides general geographic information about the landscape, including its geographic extents and minimum and maximum terrain elevations. The panel also reports the current Terrain Quality and Frame Rate values (discussed on a later page entitled Terrain Quality and Frame Rate).

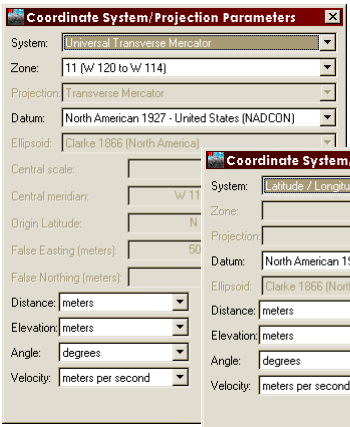
The Projection button at the bottom of the TNTsim3D Readouts window opens the Coordinate System / Projection Parameters window. The controls on the upper part of this window allow you to select the coordinate system and datum (and zone, projection, and ellipsoid where appropriate) for the position and extents values in all of the readout panels. In the BIGPINE3 landscape file, the stored georeference information is in Universal Transverse Mercator Zone 11 coordinates, but you can choose to report positions in Latitude / Longitude or any other available coordinate system.

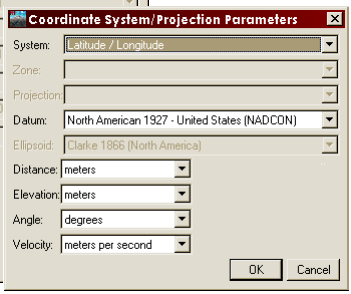
The controls on the lower part of the Coordinate System / Projection Parameters window let you select the units for all readouts of distance, elevation, angle, and velocity. Any unit changes you make here are also shown automatically on the Input panel of the Options window.

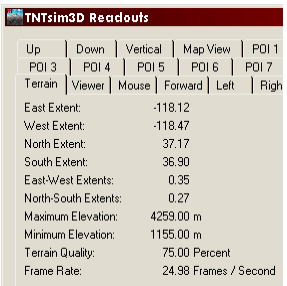
STEPS

- ☑ click on the Terrain tab on the TNTsim3D Readouts window
- ☑ examine the values listed on the panel
- ☑ click on the Projection button
- ☑ from the System menu box on the Coordinate System / Projection Parameters window, select Latitude / Longitude, then click [OK]
- ☑ note that positions and extents are now reported in degrees of Latitude / Longitude
- ☑ set the coordinate system back to Universal Transverse Mercator







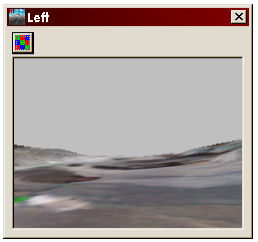


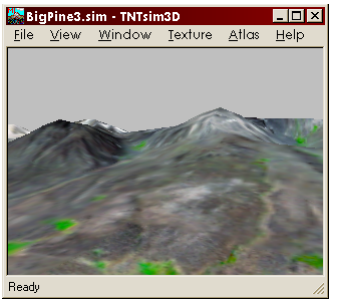
Directional View Windows

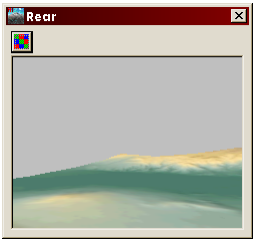
STEPS

- ☑ use the Window menu to open Left, Right, Rear, and Vertical windows
- ☑ click the Texture  icon button on the Rear window and select COLORSHADE from the menu

The main TNTsim3D window shows the pilot's view in the current direction of flight. But to gain a wider perspective on the landscape, you can open additional windows that provide views in other predefined directions. These selections are available from the Window menu. You can also select textures for viewing independently in each directional window using the Texture icon button.







The Left, Right, Rear, Down, and Up windows show views that are oriented relative to the current attitude of the viewer "aircraft". The Left and Right windows look to either side of the flight path (parallel to the wings), while the Rear window shows the view backward along the flight line. The Up and Down windows show views perpendicular to the wings and the direction of flight. To illustrate this attitude-dependence, fly a level course and roll 90 degrees to the left; the Left view shows a view of the ground and the Right views shows nothing but sky (background color).

The Vertical window works differently; its view direction is absolute, not relative to the atttitude of the viewer. The Vertical window shows a vertical view toward the surface (downward if the viewer is above and upward if the viewer is below the surface).

- ☑ fly through the 3D landscape and note how the views relate to each other
- ☑ close all of the directional view windows you have opened

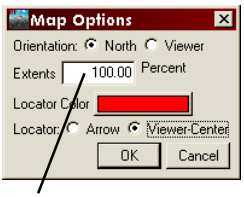
Map View Window

The optional Map View window provides you with an easy way to keep track of your position visually, along with graphic controls that let you quickly change your viewing geometry. This window provides an overhead view that does not vary in scale as the viewer's altitude above the terrain changes. The Map View window opens at Full View (displaying the full geographic extents of the landscape), but you can use the icon buttons at the top of the window to zoom in or out (or return to Full View). Once you have zoomed in, the Map View remains centered on the ground position that is currently directly beneath the viewer, except when you are close to the edge of the landscape.

You can select any single texture layer in the Landscape File to display in the Map View. A topographic map texture is a natural choice, since it combines labeled map information with a representation of the terrain. The texture shown in the Map View is oriented by default with north at the top. You can use the Orientation setting in the Map Options window to orient to the current flight direction instead (Viewer radio button). In this mode, the Map View image reorients as the flight direction changes.

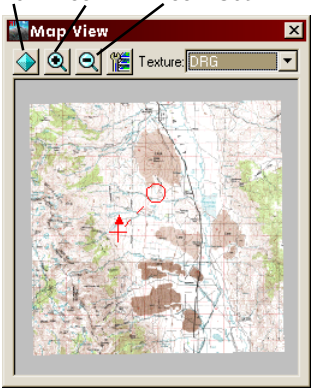
STEPS

- ☑ select Map View from the Window menu
- ☑ from the Map View window's Texture menu, select DRG
- ☑ press the Options icon button on the Map View window 
- ☑ in the Map Options window, make sure that the Locator option is set to Viewer-Center

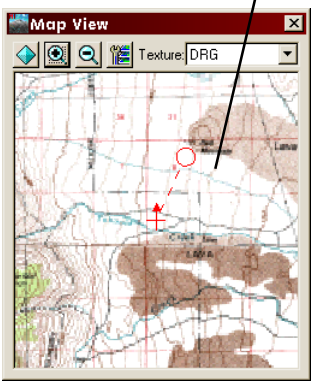


The Extents field shows the approximate percentage of the landscape area that is visible in the Map View at the current zoom level (100 percent equals full extents).

Full Zoom In Zoom Out



The texture detail shown in the Map View varies automatically as you change zoom levels.



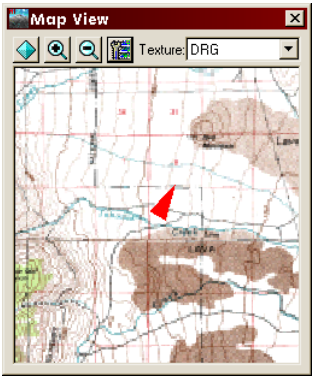
Map View Locator Controls

STEPS

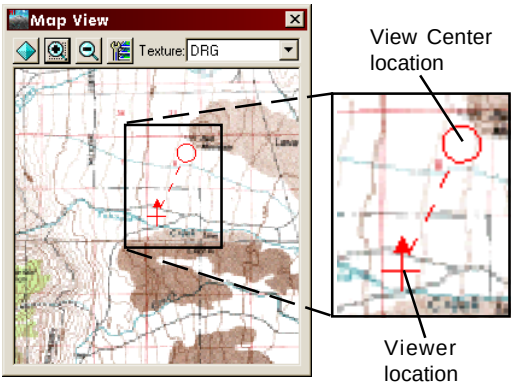
- ☑ use the flight controls to move through the landscape and note how the locator graphic updates to keep track of your position
- ☑ click and drag on the Viewer location graphic and note how the view updates in the main TNTsim3D window
- ☑ click in the Map View window at a location away from the locator graphic and note how the View Center snaps to that location

The Map View window shows a locator graphic that indicates the map position of the current viewer location. The form of the locator is set by your selection in the Map Options window. The Arrow graphic is a simple arrowhead whose base is at the viewer position and which points toward the current view center of the main TNTsim3D window (center of the pilot's view). The Viewer-Center graphic indicates the viewer position with a cross and an arrowhead pointing north, and also marks the exact location of the view center with an open circle; the viewer and view center positions are connected by a dashed line.

With either locator graphic, you can use the left mouse button to drag the viewer position indicator to a new location within the Map View. This action changes the viewer position and heading, but does not affect pitch or roll. All open view windows update automatically to reflect the new position.



Map View with Arrow locator



Viewer-Center locator

If the viewer is close to the terrain in an area with significant relief, hills or ridges in the foreground may move in or out of the line of sight to the view center as you move. As a result, you may see the view center indicator jump in or out along the line connecting it to the viewer location.

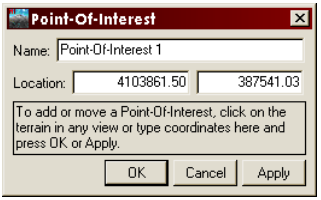
With either graphic, if you left-click with the mouse away from the viewer position, the view center jumps to that location. You can also drag the view center to a new position. All open view windows again update automatically.

Point-of-Interest Windows

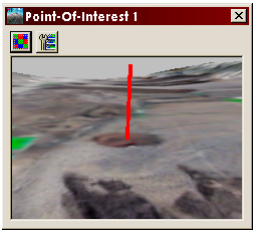
There may be special locations (points-of-interest or POI) in your simulated landscape that you want to keep track of as you move through the scene. The Point-Of-Interest option on the Window menu creates a view that remains centered on a designated POI as you fly, even if the POI is no longer visible in the main TNTsim3D window. When the Point-Of-Interest control window opens, you can identify the POI simply by left-clicking with the mouse at the appropriate terrain position in any view window. A Point-Of-Interest window then opens centered on that location (as seen from the current viewer location). You can designate up to eight POIs, with each tracked in its own window. Each POI is shown by a differently-colored bar marker in all windows.

STEPS

- ☑ choose Point-Of-Interest from the Window menu
- ☑ use the mouse to left-click on a distinctive feature in the TNTsim3D window or any other open view
- ☑ click [OK] in the Point-Of-Interest control window

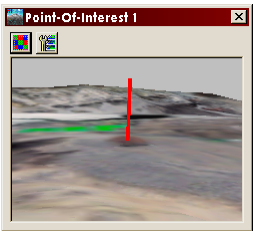


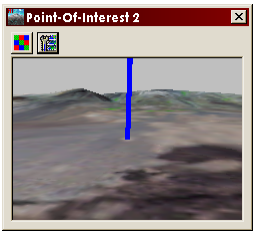
- ☑ repeat the above steps if you want to add additional points-of-interest



With the Point-Of-Interest control window open, left-click in any view window to designate the POI location and open the associated Point-Of-Interest window.

Keep at least one Point-Of-Interest window open and proceed to the next exercise





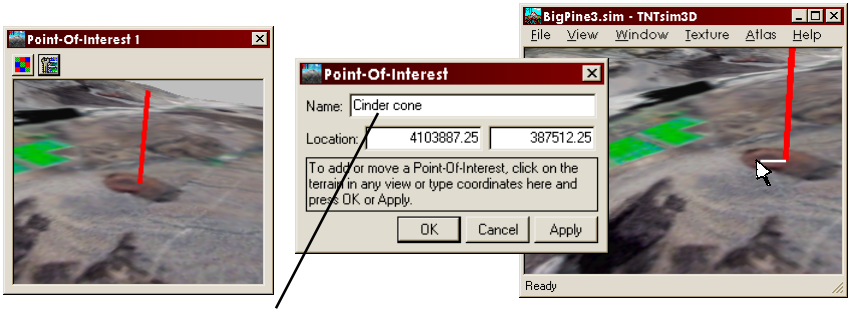
Open as many Point-Of-Interest windows as you need. Different-colored markers allow you to keep track of the POI locations in all windows.

Editing and Naming a Point-of-Interest

STEPS

- ☑ click on the Edit  icon button on the Point-Of-Interest window
- ☑ enter a name for the POI in the Name field of the Point-Of-Interest control window
- ☑ with the control window still open, drag the POI marker in the main window to adjust its position
- ☑ click [OK] in the Point-Of-Interest control window

You can change the position of a POI only when its Point-Of-Interest control window is open. To re-open this window, press the Edit icon button on the Point-Of-Interest view window. You can then use any view window (including its Point-Of-Interest window) to reposition the POI. Simply drag the POI marker to a new location with the mouse, or left-click at the new location. (If the Point-Of-Interest control window is not open, these mouse actions simply recenter the view window at the new location). You can also manually enter map coordinates in the control window to set the POI at a predetermined map location.



Edit the Name field to enter a name for the POI. This title of the Point-Of-Interest window changes to this text when you click [OK] or [Apply] on the control window.

Left-click or drag the POI marker in any view window to reposition the POI.

Keep the Point-Of-Interest view window open and proceed to the next exercise

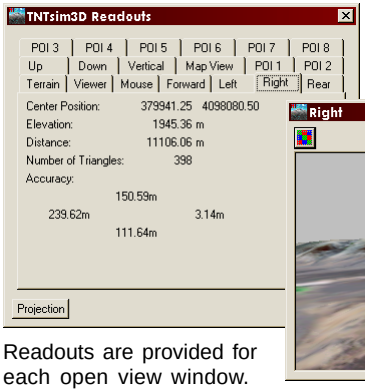
Window Readouts

The TNTsim3D Readouts window provides positional information about each open view, including any Point-of-Interest views. Each potential view is represented by its own tabbed panel. (The Forward panel provides readouts for the main TNTsim3D view window.)

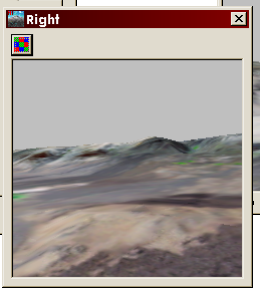
Each window readout panel lists the map coordinates and elevation for the view center position along with the distance from the viewer to the view center. Estimates of the positional accuracy of the center coordinates are shown using the same system as for mouse cursor position. If the view center moves outside the extents of the landscape, position readouts are blank for that view.

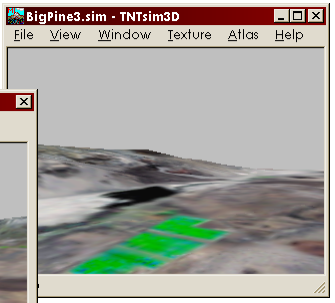
STEPS

- ☑ if the TNTsim3D Readouts window is not open, select Readouts from the View menu on the TNTsim3D window
- ☑ click on the POI 1 tab to view the readouts for the Point-Of-Interest window
- ☑ click on the Forward tab to view the readouts for the main view window

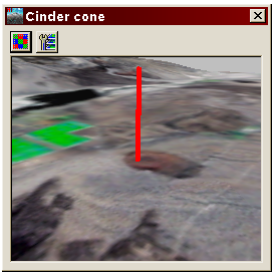


Readouts are provided for each open view window.

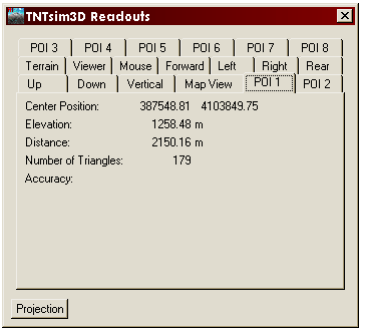




Readouts for the main TNTsim3D window are provided on the Forward panel.



Readouts for any open Point-of-Interest windows are provided on the numbered POI panels.



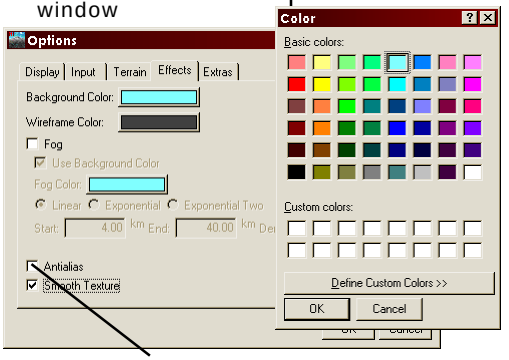
Background Color and Texture Smoothing

STEPS

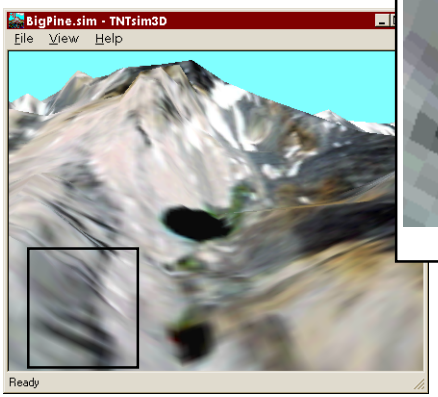
- ☑ select Options from the View menu and click on the Effects tab
- ☑ left-click on the Background Color color sample button
- ☑ use the resulting Color window to select a light blue background color and click [OK]
- ☑ if the Smooth Texture checkbox on the Effects panel is active (not dimmed), turn it on
- ☑ click OK on the Options window

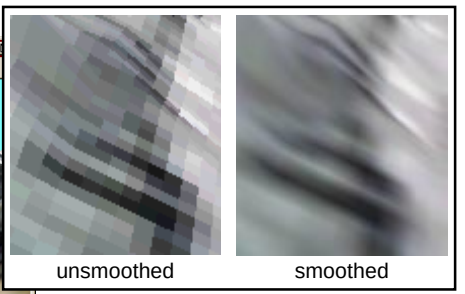
The Effects panel of the Options window lets you control a number of visual effects for your simulations, including background color, fog, and texture smoothing. The Background Color control allows you to pick the background color from a standard palette or define one or more custom colors for use as backgrounds.

The Smooth Texture option is available only when you are using DirectX as the graphics rendering system for TNTsim3D. Smoothing has two major advantages: it reduces the blocky appearance of foreground texture cells viewed at close range, and it reduces "sparkle" in the more distant portions of the moving image. If you have a modern graphics board with 3D acceleration, the smoothing is performed by the graphics hardware itself, so there is minimal impact on frame rate. (If your board does not support hardware smoothing, the DirectX software performs the smoothing, though more slowly).



Turning on the Antialias option (only in DirectX) enables TNTsim3D to use a feature of some graphics cards that smoothes color edges in the rendered screen image.





TNTsim3D window with new background color and DirectX texture smoothing enabled. Magnified views of boxed area are shown above with and without texture smoothing.

Using Fog

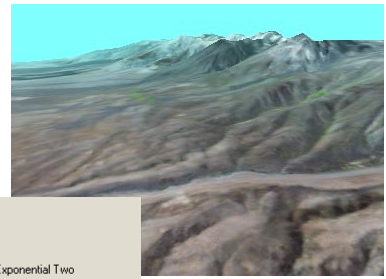
When you view a natural landscape, detail and color become less distinct in more distant parts of the scene because of the effects of water vapor and particulates in the atmosphere. Haze is almost always present to some extent, and fog is an extreme example.

To add realism to a landscape in TNTsim3D, you can simulate the reduction of visibility with distance by using the Fog controls. The fog effect is achieved by blending texture colors with varying amounts of a designated fog color. The background color is the default fog color, which lets the hazy or foggy terrain blend naturally into the sky. For special effects you can turn off the Use Background Color check box and use the Fog Color control to select any color for the color blending.

Three methods are available to control the variation in fog density with increasing distance from the viewer. In the Linear method, the Start value defines the distance at which the fog effect begins, the End value defines the distance at which fog no longer increases, and the variation is linear between these limits. Since the start and end distances are in meters, the same pair of values will produce differing effects for landscapes of different areal extents.

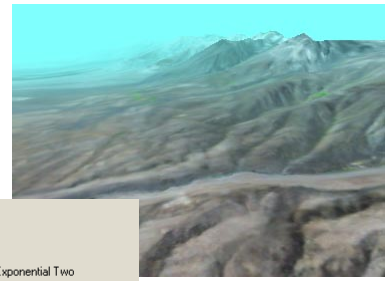
STEPS

- ☑ select Options from the View menu and click on the Effects tab
- ☑ turn on the Fog check box, accept the default settings, and click [OK]
- ☑ note the change in scene visibility
- ☑ reopen the Options window Effects panel, change the Start value to 2000 and the End value to 20000, then click [OK]
- ☑ note the change in scene visibility
- ☑ reopen the Options window Effects panel and change the Fog method to Exponential Two
- ☑ set the Density value to 7.0 and click [OK]



Fog: Linear

In the Exponential method fog increases exponentially with distance. In the Exponential Two method, fog increases exponentially with the square of the distance. In both methods the Density parameter is a multiplier applied to the distance exponent. Increasing the Density parameter makes the fog thicken more rapidly with increasing distance.

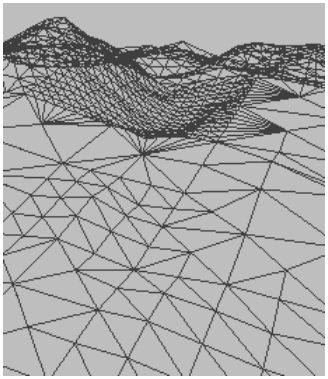


Fog: Exponential Two

Terrain Quality and Frame Rate

STEPS
- ☑ turn on the Wireframe view mode (View / Wireframe)
- ☑ select Options from the View menu
- ☑ click on the Terrain tab
- ☑ increase the Quality setting to 90 and click [OK], and note the increased detail in the wireframe
- ☑ reset the Quality percentage to 75

A new terrain model is built for each frame using only the visible part of the terrain. The level of terrain detail varies spatially in each frame: more detail is shown (by smaller terrain triangles) in the foreground and in areas of greater local relief. As you move through the simulation, the amount of detail for a particular area may change, but height values are automatically adjusted to produce gradual rather than abrupt visual changes in local detail. As a result, you may notice gradual upward or downward movements of portions of the terrain as you fly.



As you use TNTsim3D, you will likely want to move through each landscape smoothly and realistically and at the same time see the maximum possible scene detail. But achieving these twin goals may exceed the resources available on your computer, so you may need to choose which of them is more important to you for a particular simulation session.

You can make that choice in TNTsim3D by using the settings on the Options window's Terrain panel, where a pair of radio buttons allow you to give preference to either quality or frame rate. Quality refers to the amount of detail in the surface model created from the terrain raster in the landscape file. Quality is expressed numerically as a percentage; setting a higher percentage produces a surface model that shows more of the detail in the terrain raster. Frame rate is the number of times the scene is redrawn each second. A higher frame rate produces smoother, more natural movement through the landscape.

If you choose the Quality preference, TNTsim3D uses available resources to maintain your target terrain quality and reduces the frame rate if necessary. If you choose the Frame Rate preference, the program instead attempts to maintain your target frame rate and lets the terrain quality vary as needed. The effects of these selections depend greatly on the hardware capabilities of your computer; they are more significant for newer, faster computers and graphics cards.

To improve both quality and frame rate, try the following:
- ☑ shut down other programs to free computer resources for TNTsim3D
- ☑ make your TNTsim3D windows smaller
- ☑ make sure your graphics card's 3D acceleration options are turned on
- ☑ get a graphics card with faster 3D acceleration and more video memory
- ☑ get more random access memory (RAM) for your computer

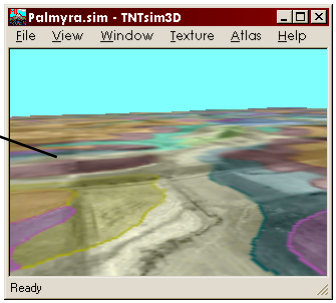
Using Vertical Exaggeration

Simulations of low-relief areas can reveal more information about relationships between map data and the terrain if the vertical terrain scale is changed to exaggerate the topographic relief. The Terrain panel on the Options window allows you to set a vertical exaggeration value (default is 1.00) to rescale all of the Z-values in the terrain model.

When you increase the Vertical Exaggeration value, the viewer's height above the surface is automatically increased by the same factor to ensure that the viewer remains above the rescaled surface. However, coordinate readouts for mouse position and view center points always report elevation values from the original unscaled surface, regardless of the vertical exaggeration that has been selected.

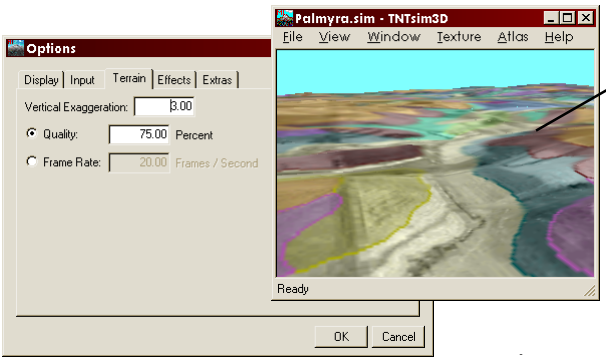
STEPS

- ☑ turn off the Wireframe view mode (View / Wireframe)
- ☑ in the main TNTsim3D window, choose File / Open
- ☑ navigate to the directory into which you copied the Landscape Files (*.SIM) from the TNTproducts 6.7 CD
- ☑ select the PALMYRA Landscape File
- ☑ fly through landscape and note the low relief of the terrain
- ☑ select View / Options
- ☑ click on the Terrain tab
- ☑ enter 3 in the Vertical Exaggeration field and click [OK]



Palmyra landscape with no vertical exaggeration. This texture shows soil map polygons overlaid with partial transparency over a grayscale digital orthophoto quadrangle mosaic.

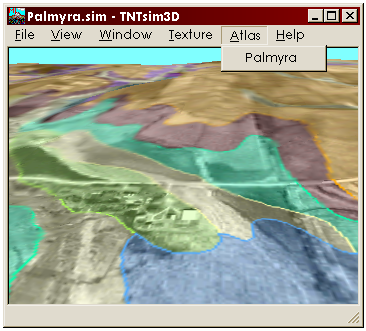
NOTE: The last vertical exaggeration value you set is retained until reset. Therefore, remember to check this field when you open a new Landscape File to make sure the current value is appropriate for the data.

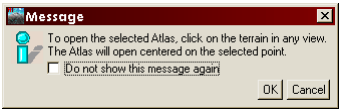


Same area with a vertical exaggeration factor of 3. The association of different soil types with topography is more evident than in the original scene.

Launching an Atlas

TNTsim3D can be used in conjunction with TNTatlas to freely distribute your geospatial data prepared in TNTmips. TNTsim3D provides a real-time, interactive 3D view of the data, while TNTatlas provides the ability to view different combinations of the original data layers, access to associated database information through datatips or directly viewing tables, and measurement tools.



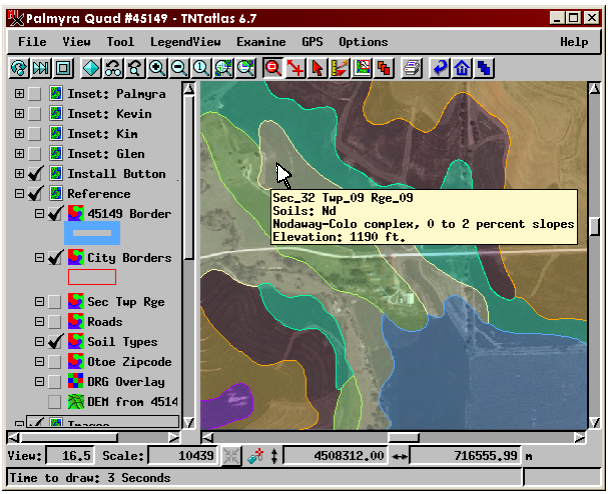


You can prepare your data so that you can launch one or more atlases while viewing their related Landscape File in TNTsim3D. To do so, place the atlas startup files (*.atl) in the same directory as the Landscape File. When you open the Landscape File in TNTsim3D, the names of the available atlases appear on the Atlas menu. As you fly over the landscape and encounter a feature of interest, select the name of the atlas, then click on the terrain at the desired location in any TNTsim3D view. The atlas opens in TNTatlas showing the designated area at a scale determined by the viewer's current height above the surface.

Entries on the Atlas menu in TNTsim3D are created from the names of the atlas startup files (.atl) in the same directory as the open Landscape File, so be sure to give your startup files distinctive names.

To reduce duplication of data, the layouts in your atlas can utilize any of the raster objects in the Landscape File (textures or the terrain raster).

You can also create hyperlinks in an atlas to automatically launch TNTsim3D and open the appropriate Landscape File.



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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 in a wide variety of formats.

TNTview TNTview has the same powerful display features as TNTmips and is perfect for those who 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 can be used on any popular computing platform.

TNTserver TNTserver lets you publish TNTatlases on the Internet or on your intranet. Navigate through geodata atlases with your web browser and the TNTclient Java applet.

TNTlite TNTlite is a free version of TNTmips for students and professionals with small projects. You can download TNTlite from MicroImages' web site, or you can order TNTlite on CD-ROM.

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MicroImages, Inc.

11th Floor - Sharp Tower
206 South 13th Street
Lincoln, Nebraska 68508-2010 USA

Voice: (402) 477-9554
FAX: (402) 477-9559

email: info@microimages.com
internet: www.microimages.com