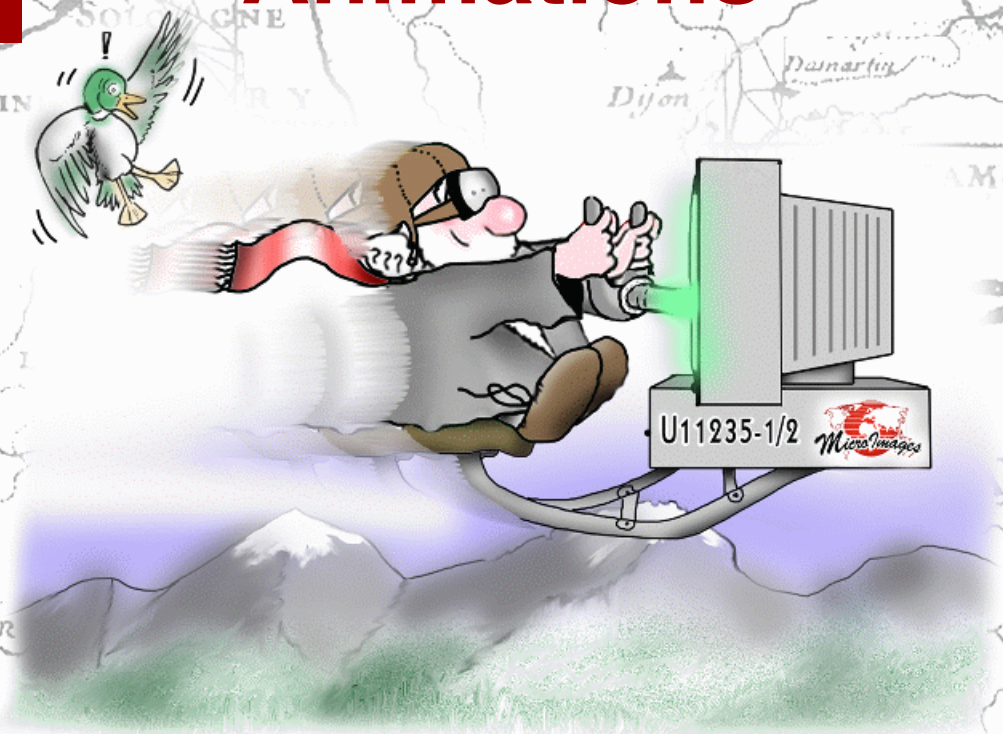
3D ANIMATION

Tutorial

Creating 3D Animations



in

TNTmips®

TNTedit™

TNTview®

Before Getting Started

This booklet introduces techniques for constructing and manipulating animated 3D perspectives in TNTmips®, TNTedit™, and TNTview®. Animated 3D perspectives are constructed from a surface object, one or more drape objects, and a selected path through the terrain. After you define the 3D animation, you can view a wireframe preview, render the solid surface animation in the view window (only a very fast computer will give satisfactory solid renderings in real time), or create an MPEG file for later viewing and wider distribution.

Prerequisite Skills This booklet is a companion volume to *Getting Started: 3D Perspective Visualization*. Take up the exercises in this booklet only after you are familiar with the concepts in that booklet. This booklet also 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 and techniques that are not covered again here. Please consult those booklets for any review you need.

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_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 animation. Consult the TNT Reference Manual 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 process is available in TNTmips, TNTedit, and TNTview. All the exercises can be completed in TNTlite using the sample geodata.

Keith Ghormley, 28 June 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

Visualization with 3D Animations

The Display Spatial Data process in the TNT products provides a number of flexible tools for 3D and stereo 3D visualization of many kinds of project materials. One of the most powerful visualization features is 3D animation, which lets you create an animated fly-by of any 3D surface. You can fly over elevation surfaces (or sail over bathymetric surfaces) for realistic animations, or you can use non-physical surfaces: any kind of raster object generated by TNT's analytical processes that lends itself to 3D visualization. Your animation can follow a linear path or a complex line, it can orbit a central point, or it can remain at a fixed point and pan the view.

You can define complex overlays that include raster, CAD, vector, TIN, and database pinmap layers.

The general sequence of steps is:

1. select a surface object and first drape layer
2. define a flight path
3. add drape layers
4. record the result

Steps 2 and 3 can be mixed, but generally it is quicker to define the flight path on a single drape layer while working with the surface object in 3D wireframe preview. Even moderately powered computers can render a 3D wireframe animation in real time, while only very fast computers can give satisfactory results rendering a 3D animation in solid view. To view a solid 3D animation, it is more practical to create an output animation file.

The 3D Animation process in TNTmips can produce MPEG and AVI files that can be played on any computer. **Below**: a 3D animation that orbits Mount Whitney in California. WHITORB4.MPG is available from the MicroImages Web site.

A 3D Animation

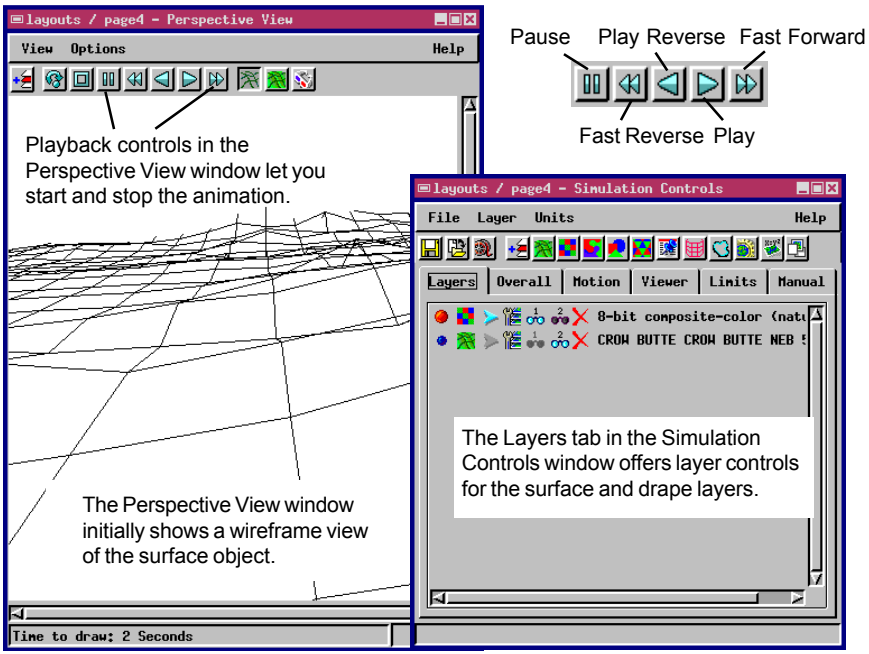
STEPS

- ☑ open the Display Spatial Data process
- ☑ select Open / Open 3D Animation 
- ☑ select 3DSIM / LAYOUTS / PAGE4 from the TNT sample data
- ☑ select the Layers tab in the Simulation Controls window
- ☑ click the Play button in the Perspective View window 

The sample data distributed with the TNT products includes a simple 3D animation layout. Launch the Display Spatial Data process and select Open 3D Animation from the Open menu. Use the standard selection tools to get the PAGE4 layout from the LAYOUTS project file in the 3DSIM folder.

TNT opens three windows: an Overhead View window (a familiar 2D view), a Perspective View window (familiar from the 3D Perspective Visualization Getting Started booklet), and a Simulation Controls window. The Perspective View window contains a wireframe preview of the Crow Butte map quadrangle elevation surface.

Examine the playback controls in the Perspective View window. Click the Play button and watch the wireframe animation. The faster your computer's processor and video subsystem, the smoother the animation appears.



3D Animation Controls

The Overhead View window contains the 2D display controls familiar to you from other display and visualization processes. Likewise, except for its playback controls, the Perspective View window contains controls that should already be familiar to you. Most of the controls unique to the 3D Animation process are found in the Simulation Controls window.

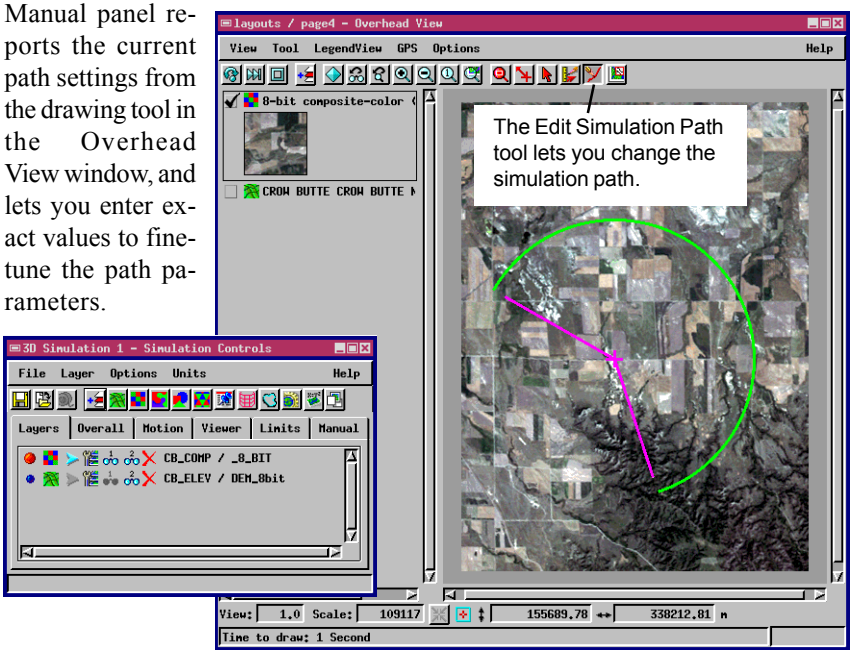
In the Simulation Controls window, select each of the tabbed panels in turn and examine their contents. The Layers panel offers standard layer controls. The Overall panel lets you select the map projection and also reports the distance and fly time for the current path. The Motion panel lets you select the type of animation: path, orbit, or pan. The Viewer panel gives height and pitch controls. The Limits panel lets you set maximum values for velocity, acceleration, deceleration, and turn rate. The Manual panel reports the current path settings from the drawing tool in the Overhead View window, and lets you enter exact values to fine-tune the path parameters.

STEPS

- ☑ in the Simulation Controls window, select each of the tabbed panels in turn
- ☑ after you have surveyed the controls, close the PAGE4 layout with File / Close in the Simulation Controls window

The Edit Simulation Path tool in the Overhead View window lets you apply standard drawing tools to the simulation path.

Subsequent exercises will treat the simulation controls individually.



Add Surface and Drape Layers

STEPS

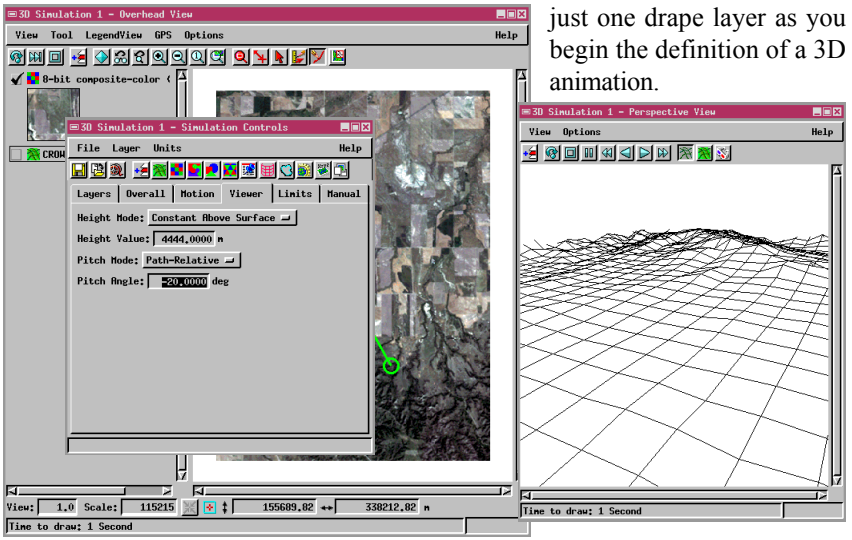
- ☑ Select 3D / New 3D Animation from the Display Spatial Data menu
- ☑ add CB_ELEV / DEM_16BIT as a surface layer 
- ☑ add CB_COMP / _8_BIT as a drape layer 

NOTE: As with the 3D Perspective visualization process, some control parameters can cause you to lose sight of the layers in the Perspective View window. Some values may place you beneath the surface, or looking away from it. If your view "goes blank," select the Viewer tab in the Simulation Controls window. Try a different Height Value or a different Pitch Angle in order to recover the view.

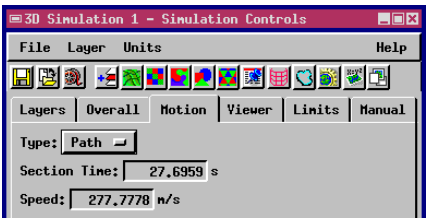
Select New 3D Animation from the 3D menu in the Display Spatial Data process. TNT opens the Overhead View, Perspective View, and Simulation Controls windows.

The first thing to do in a new animation is always to add a surface layer. Click the Add Surface icon button in the Simulation Controls window and select Quick-Add Surface. Use the standard selection process to select the raster object CB_ELEV / DEM_16BIT from the CB_DATA folder in the sample litedata. Notice that the Perspective View window shows a wireframe as soon as you complete the selection, but that the Overhead View window is empty: you must select a drape layer in order to see anything in the Overhead View.

Click the Add Layer(s) icon button in the Simulation Controls window and select the CB_COMP / _8_BIT raster object from the CB_DATA folder in the sample litedata. For now, add just one drape layer. A subsequent exercise will show how to enhance your 3D animation with creative layer effects. But it is a good practice to limit yourself to just one drape layer as you begin the definition of a 3D animation.



Define a Simple Path



The Motion tab in the Simulation Controls window offers three types of simulation: path, orbit, and pan. Select the Path value on the Type option button. Since the Edit Simulation Path tool in the Overhead View window is pre-selected, TNT opens the standard Line / Polygon Edit Controls palette. If you are unfamiliar with these drawing tools, refer to *Getting Started: Editing Vector Geodata*. If some other tool has been selected in the Overhead View window, click the Edit Simulation Path tool icon.

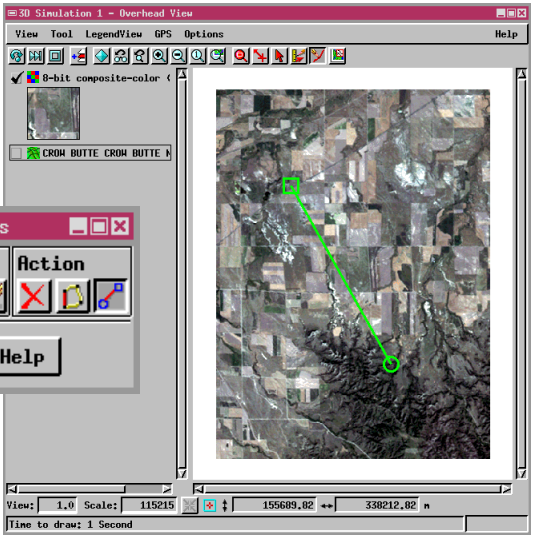
Draw a simple one-segment path on the Overhead View. Notice that TNT updates the wireframe in the Perspective View window to show the starting point and orientation you have selected. You may wish to visit the Viewer tab in the Simulation Controls window and try different Height and Pitch values.

Click the clear button in the Line/Polygon Edit Controls palette to remove your line, and then draw another. Experiment with different starting points and path directions.

STEPS

- ☑ select Path in the Type option button of the Motion tab in the Simulation Controls window
- ☑ use the Line/Polygon Edit Controls tool palette to draw a simple line segment as illustrated
- ☑ visit the Viewer panel in the Simulation Controls window and try different Height and Pitch values

The Line/Polygon Edit Controls are presented in more detail in *Getting Started: Editing Vector Geodata.*

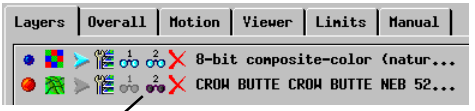


Wireframe Animation

STEPS

☑ use each of the playback buttons in the Perspective View window

☑ use the layer controls  in the Simulation Controls window to turn off the Hide/Show icon for the surface layer

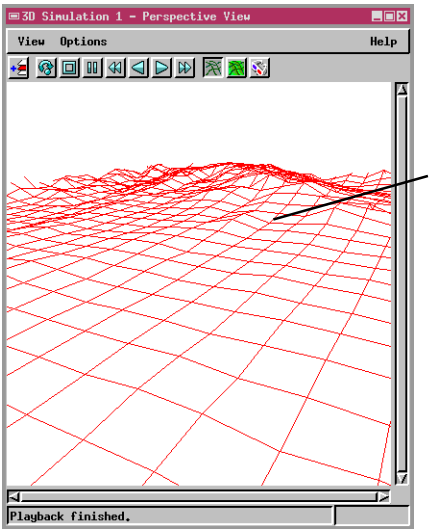


Turn off the Hide/Show icon for View 2 for the surface layer so that you work with only the drape layer wireframe.

If the Hide/Show icon for the drape layer is on, the drape layer's wireframe hides the surface layer in the Perspective View window.

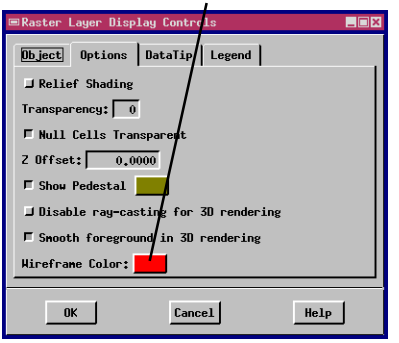
Use the wireframe mode for all interactive setup and testing of your animation. Wireframe renderings require much less processing than solid view renderings, and thus even moderately-powered computers can give you a reasonable wireframe animation effect.

Familiarize yourself with the operation of each of the playback buttons in the Perspective View window. First click the Play button, which runs the animation from the first position to the last. Then click the Play Reverse button, which runs the same animation backwards. Try the Fast Reverse and Fast Forward buttons which drop frames to render the animation at 4X speed. The Pause button stops the animation at its current position so than any of the Play or Fast buttons resume the animation from that position. The Stop button also stops the animation at its current position, but thereafter, the Play and Fast buttons restart the animations from their initial positions.



Recall from your work in *3D Perspective Visualization* that each layer has its own wireframe representation. Use the standard layer controls to examine the color assignments for each layer.

The drape layer wireframe color is red.



Improve Rendering Speed

Only the fastest computers will be able to render a 3D animation so that you will be able to view it in solid view mode. Normally, you should define your 3D animation in wireframe mode and then use the Record Movie button to create an MPEG or AVI file for later viewing. A long complex animation that uses multiple surface layers may take an hour or more to process into an output animation file (see page 14).

If you have a very fast computer, you may want to see solid renderings of your 3D animations. The process attempts to maintain the specified velocity for viewing, and when the computer is not fast enough, the process drops frames. In the most severe case, the process may render only the initial and final frames, dropping everything in between.

You can take some measures to relieve some processing burden and produce a smoother 3D animation:

- Resize the Perspective View window. The smaller the window, the lower the demands on processing power.
- Turn off foreground smoothing. Foreground smoothing blurs the blocky, discrete image pixels near the viewer. It improves the appearance, but it increases the processing load.
- Use constant altitude instead of constant height above the surface (Viewer panel in the Simulation Controls window).
- Hide the drape layers with the layer controls in the Layers tab of the Simulation Controls window
- Even the wireframe animation can be improved if you use a lower wireframe sampling rate

Many other general optimization tricks apply to the 3D Animation process and to all TNT processes:

- get a faster computer
- pre-process 24-bit color if you work in 8-bit color mode
- add more RAM
- get a faster video subsystem

To get a preview of the solid view before recording, you can pause the wireframe animation at various points along the way and temporarily turn on the Solid View. Check the appearance of the fully rendered “snapshot,” and then resume the animation in wireframe mode.

Define a Complex Path

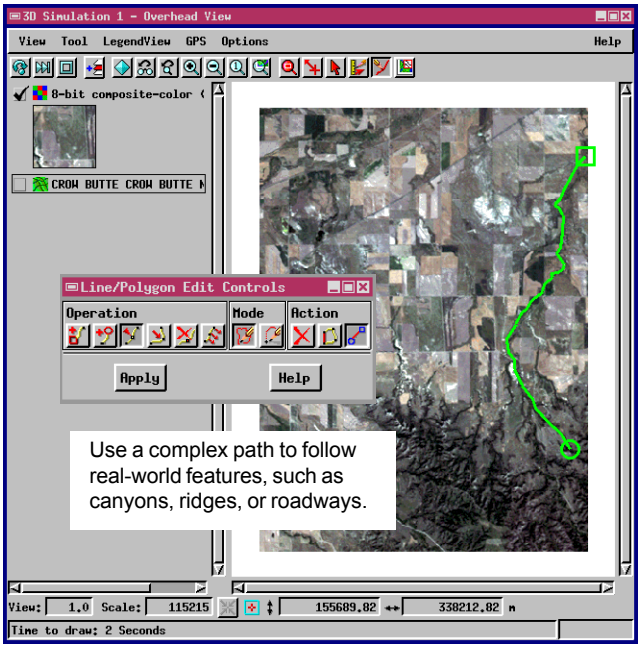
STEPS

- ☑ trace the Crow Butte drainage path as illustrated
- ☑ play the wireframe animation
- ☑ clear the drainage path and draw an arbitrary path with extreme zig-zags
- ☑ play the wireframe animation
- ☑ adjust the Maximum Turn Rate in the Limits tab and run the wireframe animation again (try values 10 deg/s, and 100 deg/s)

The simple straight-line path you defined in the previous exercise has limited real-world usefulness. More often, your 3D animations will be designed to follow some real-world feature such as a mountain ridge, a canyon, or a pipeline. You can use the Line/Polygon Edit Controls to define a path of any complexity. Your path can cross itself many times and return to its point of origin. Any 3D animation that forms a closed path can be shown continuously with the loopback feature of your animation viewer software.

For this exercise, trace the drainage in the Crow Butte map quadrangle as illustrated.

When you define a complex path, TNT automatically smooths the turns so that the corners in the line do not cause a jerky animation effect. The Limits panel in the Simulation Controls window lets you adjust the parameters that control how the process handles corners. Test several control values in wireframe mode on an extreme zig-zag path.



Use the standard TNT line drawing tools to define a complex path, such as the one illustrated, which follows a drainage along its course.

Orbit a Central Point

A special type of circular path in the 3D Animator is called an orbit. In orbit mode, the animation keeps a central point as the focus of the view and moves through an arc or circle around it. Because it keeps the same point at the center of the animation, an orbit gives an especially strong visual sense of the 3D features of the surrounding terrain.

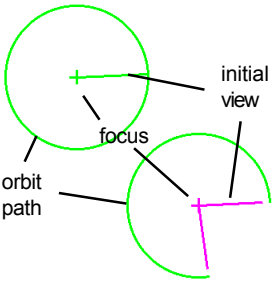
Select Orbit in the Type option button in the Motion panel of the Simulation Controls window. The Edit Simulation Path tool becomes a simple circle tool. Drag the center of the circle to the point you want as the central focus. Drag the edge of the circle to move the orbit path closer or farther away from the center. Drag the radius of the circle to select the initial viewpoint.

Other controls in the Motion tab let you select a full-circle or just an arc, and choose the direction of the orbit (clockwise or counter-clockwise).

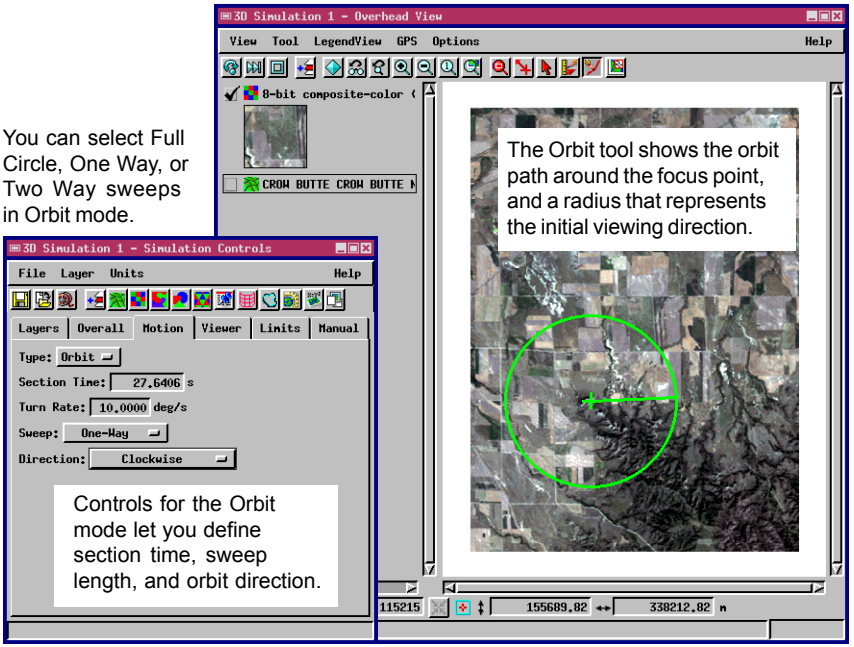
STEPS

- ☑ select Orbit in the Type option button in the Motion panel
- ☑ drag and resize the circle tool
- ☑ play the wireframe animation

full-circle orbit



You can select Full Circle, One Way, or Two Way sweeps in Orbit mode.



Pan from a Single Viewpoint

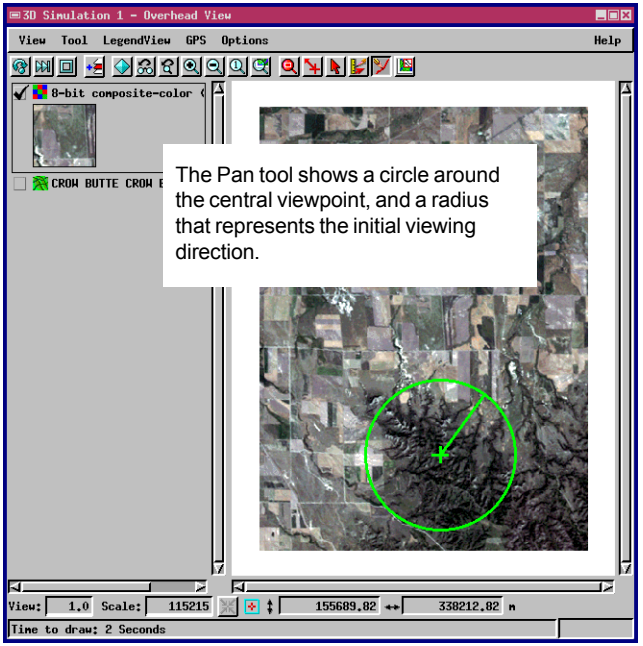
STEPS

- ☑ select Pan in the Type option button in the Motion panel
- ☑ drag and redirect the circle tool
- ☑ play the wireframe animation

The Pan tool could be used in conjunction with output from the TNTmips Viewshed process (Process / Raster / Elevation / Viewshed). You could drape the viewshed output raster on the 3D Simulation View.

The final type of path in the 3D Animator is not really a path at all: the Pan mode. In pan mode, the viewpoint remains fixed and the animation pans around it. The animation is created by sweeping the direction of view through an arc or circle that pivots around the viewpoint. Because it remains on one point at the center of the animation, a pan gives a weaker visual sense of the 3D features of the surrounding terrain. Pan views are useful for viewshed simulations and any applications where line-of-sight is important.

Select Pan in the Type option button in the Motion panel of the Simulation Controls window. The Edit Simulation Path tool becomes a simple circle tool. Drag the center of the circle to the point you want as the center. Drag the radius of the circle to select the initial view direction. You can drag the edge of the circle to enlarge or reduce its size, but the Pan tool's circle size has no effect on the animation.



Other controls in the Motion tab let you select a full-sweep or just an arc, and choose the direction of the pan (clockwise or counter-clockwise).

Altitude, Pitch, and Limits

Most default control values in the 3D Animation process produce good animation results. Nevertheless, you can access many specific parameters for exact control of the animation.

The Motion panel lets you specify a length of time for the animation; the process automatically adjusts the relative speed. Or, you can specify a speed and the process adjusts the time required.

The Viewer panel lets you set the height and pitch. Be careful: some combinations of height and pitch can move the surface out of the view.

The Limits panel changes the speed and smoothness for starts, stops, and turns.

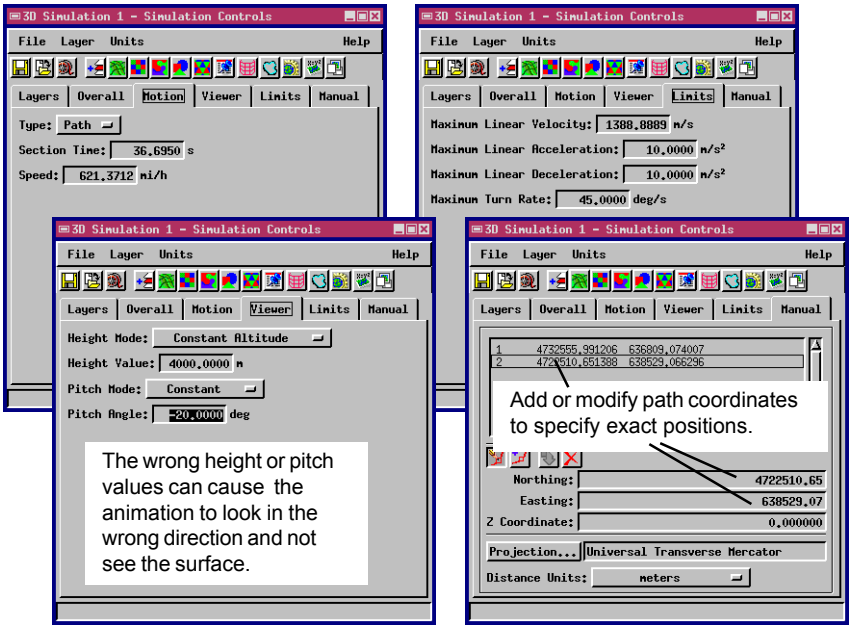
The Manual panel lets you add and modify path coordinates to achieve exact positions.

STEPS

- ☑ visit each of the panels in the Simulation Controls window
- ☑ examine the current control values and consider how those settings produce the current animation
- ☑ play with different control values and see if you can predict the effect on the animation

Change the time or speed and the associated value is updated automatically.

Values in the Limits panel change the speed and smoothness of the animation.



Record a Movie

STEPS

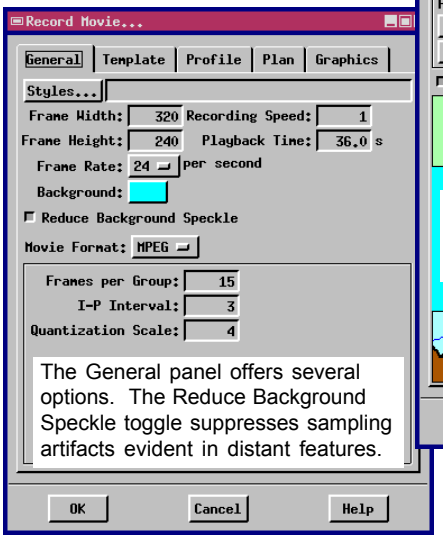
- ☑ click Record Movie 
- ☑ in the General panel, select MPEG Movie Format and turn on the Reduce Background Speckle toggle
- ☑ in the Template panel, select and position Profile, Plan, and North Arrow elements
- ☑ in the Profile and Plan panels, choose styles for path, viewer, and terrain elements
- ☑ in the Graphics panel, choose settings for the North Arrow
- ☑ click [OK] to create the animation file

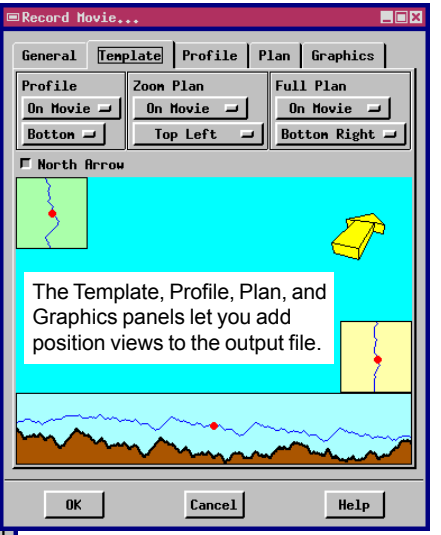
The movie output option lets you create an animation that can be viewed in real time and easily distributed. A number of animation viewers are available for all types of computers. Some have sophisticated, interactive controls that can be used to good effect for 3D animations created in TNT. Other viewers may not work as well, so if you have any problems viewing a movie, the first thing you should do is try a different viewer.

Start with a short movie. A 30-second MPEG movie makes a file of about 3 Mb. The AVI format is uncompressed, and files are much larger, though they do not run the risk of containing unwanted compression artifacts.

Click the Record Movie button in the Simulation Controls window. Apply the output options in the Record Movie window and click [OK] to create the output animation file.

The Record Movie window presents output options in two panels.





You can apply line styles, point symbols, and fill patterns to the elements in the profile and plan panels.

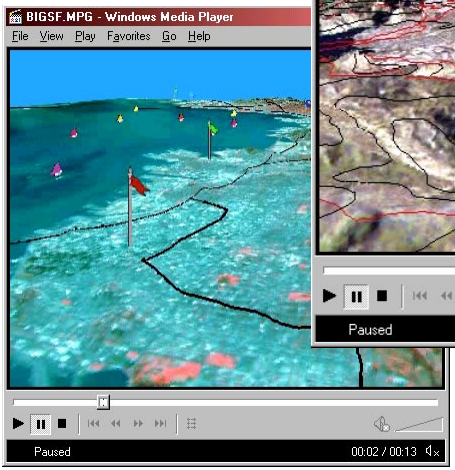
Creative Layer Effects

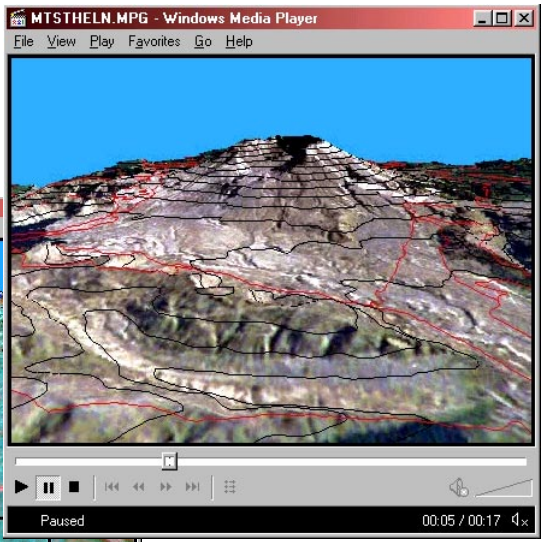
Design your animations by beginning with short, simple simulations. After you have established the basic look and have determined which parameters work best, you are ready to add multiple drape layers: images, vectors, CAD, TIN, and database pinmaps. You can even add GeoFormula and SML layers. Use styles for point, line, and polygon elements. Of course you may wish to experiment with other 2D and 3D visualization features in the Display Spatial Data process in order to find the look you want. In particular, consider using Shaded Relief effects by using the surface layer for shaded relief information also.

Several movie files created by the 3D animation process are distributed with the TNT products. Look in the /litedata/ mpeg folder, and also on the MicroImages Web site for sample animations.

Several sample animation files are distributed with the TNT products and also posted on MicroImages' Web site (www.microimages.com). Play those animations on your computer to see how many of the animation options can be selected and combined.

Below: The San Francisco Bay movie uses a mosaic of USGS DEMs, a SPOT drape image, road overlays, and 3D point symbols. The line and point symbols are dynamically resized for perspective.





Above: This movie of Mount Saint Helen uses a DEM, a drape image, and contour and road line overlays.

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 CD's 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. A free TNTclient applet (written in Java) gives any web browser the ability to communicate with TNTserver and navigate massive geodata atlases.

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 (shipping charges apply).

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