BIOOREO PRO 1.0.3 INSTRUCTIONS

V5/10/98

http://www.realtime.net/~pangea

INTRODUCTION

BioOreo Pro is the 3D character animation tool used to create the animated dinosaurs in Nanosaur. This tool's predecessor, BioOreo was used to do the animated characters in Weekend Warrior.

The main difference between BioOreo and BioOreo Pro is that BioOreo Pro uses "skinned" geometries instead of "jointed" geometries. What this means is that BioOreo Pro performs animation on a 3D model by deforming a single contiguous mesh. This results in a much more realistic looking animation than was previously possible using segmented models. When a leg moves, the skin is stretched and deformed just like the real thing.

BioOreo Pro is a fairly complex tool to use and does take patience. Creating an animated character involves the following steps:

1. Create the model in a good 3D modeling program. We recommend Form*Z.
2. Optimize the 3D model with 3DMF Optimizer.
3. Load the optimized model into BioOreo Pro's Bones Editor.
4. Create a skeleton under the source model.
5. Assign vertices to bones.
6. Create character animations with the keyframe animator.

This documentation is going to lead you through the process step by step, but the first thing we'll do is load up a sample "skeleton" to get a feel for the tool.

MANIPULATION AND ANIMATION

When you launch BioOreo Pro, you will see 3 windows:

- Articulation
- Skinned
- Animation Timeline

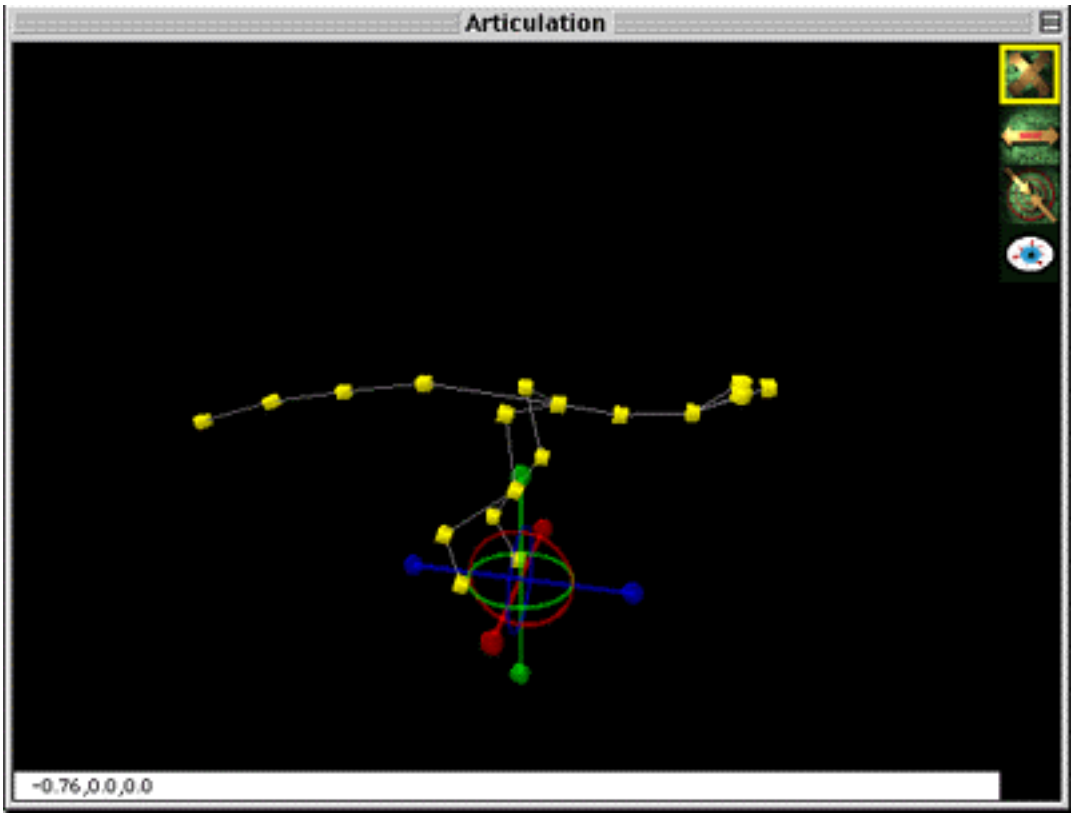
The Articulation window is where you will manipulate your 3D model. The skinned window will show you a rendered preview of the manipulated model. The Animation Timeline window shows you the currently selected animation and all of its keyframe data.

OPENING A SKELETON

The first thing we want to do is load in a sample model. Animated characters are stored as 2 files: a 3DMF file containing the actual 3D model, and a ".skeleton" file which contains the skeleton and animation data for the character. Skeleton files know which 3DMF file they need to use, so when we open a character to work with, we only need to open the skeleton file. Simply select **Open Skeleton** from the **File** menu and select "Diloph.skeleton" in the SampleFiles folder.

WHAT'S IN THOSE WINDOWS?

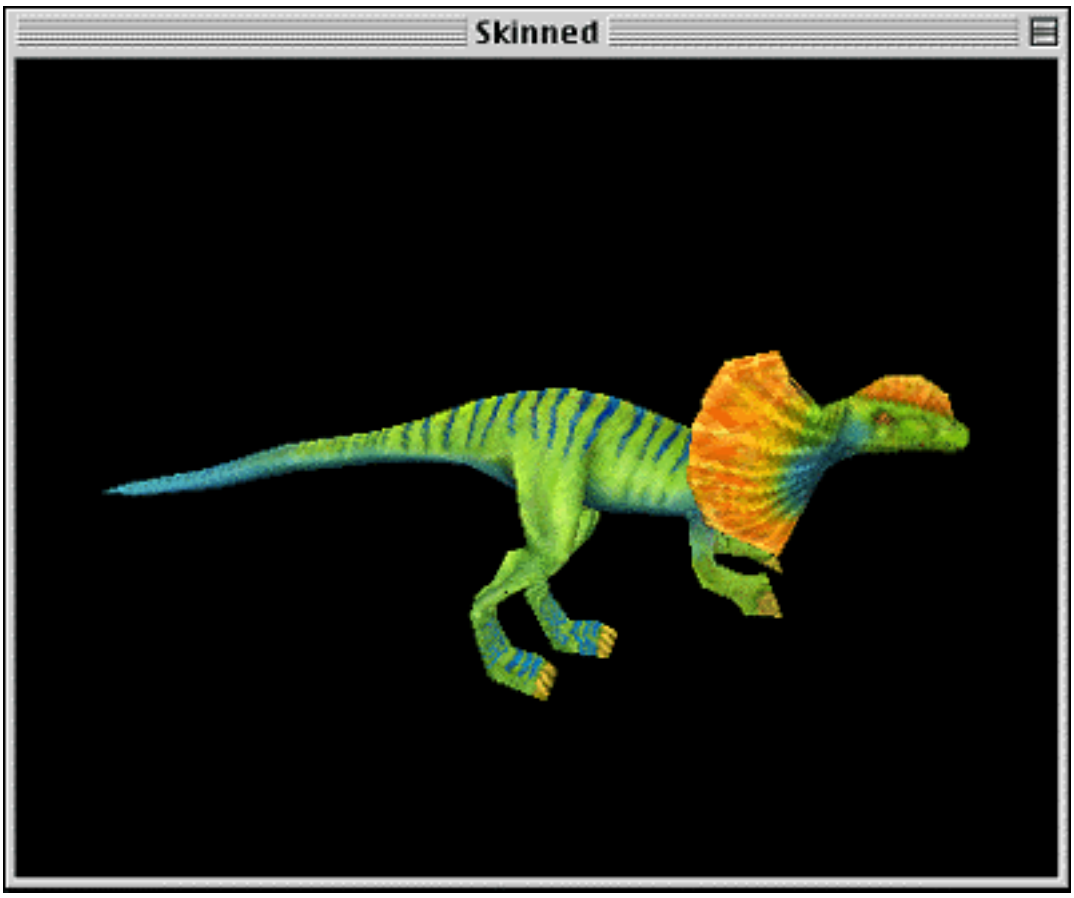
When you open the skeleton file, you will see all three of the display windows change. The Articulation window will show you the following:



The Articulation window showing the Dilophosaurus.

In this window you can see the skeleton of the dinosaur. In the upper right corner are the command buttons. You click on these buttons to select an editing mode. At the bottom of the window is the information bar. This will display information about the currently selected "joint."

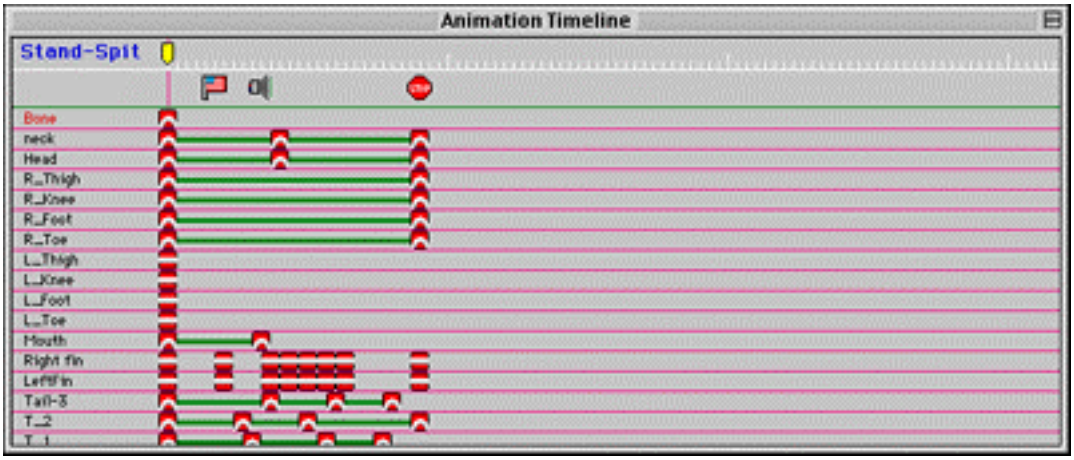
In the Skinned window, you will see a rendered image of the skeleton:



A rendered view of the skeleton

As you manipulate the skeleton in the Articulation window, the Skinned window will update showing you the current model. Also, when you run an animation, this window is where the animation will be viewed.

Finally, the Animation Timeline window will display the currently selected animation:



This character's Stand-Spit animation display

Characters can have any quantity of animations – an animation being a walk cycle, standing, jumping, dying, etc. When you open a skeleton file, the Animation Timeline displays the animation which was current when the skeleton file was saved. In the case of this demo, the "Stand-Spit" animation is what we see.

We will go into more detail on the icons in the Animation Timeline window later, but for now note that the icons across the top of the window are the "Animation Events." These indicated special animation events which perform certain tasks. The red icons (some connected with green lines) are the actual animation keyframes. The names of the skeleton's joints are listed in the left column, and across each row are the animation keyframes for each particular joint.

MANIPULATING THE SKELETON

Camera Navigation

All skeleton manipulation happens in the Articulation window. You can navigate the camera around this window by several means. First, click anywhere in the "black" space and drag the mouse. This causes the camera to orbit around the skeleton so you can see it from any angle. Next, press the up and down arrows to zoom in and out. Notice that as you navigate, the camera also updates in the Skinned window.

Skeleton Manipulation Icons

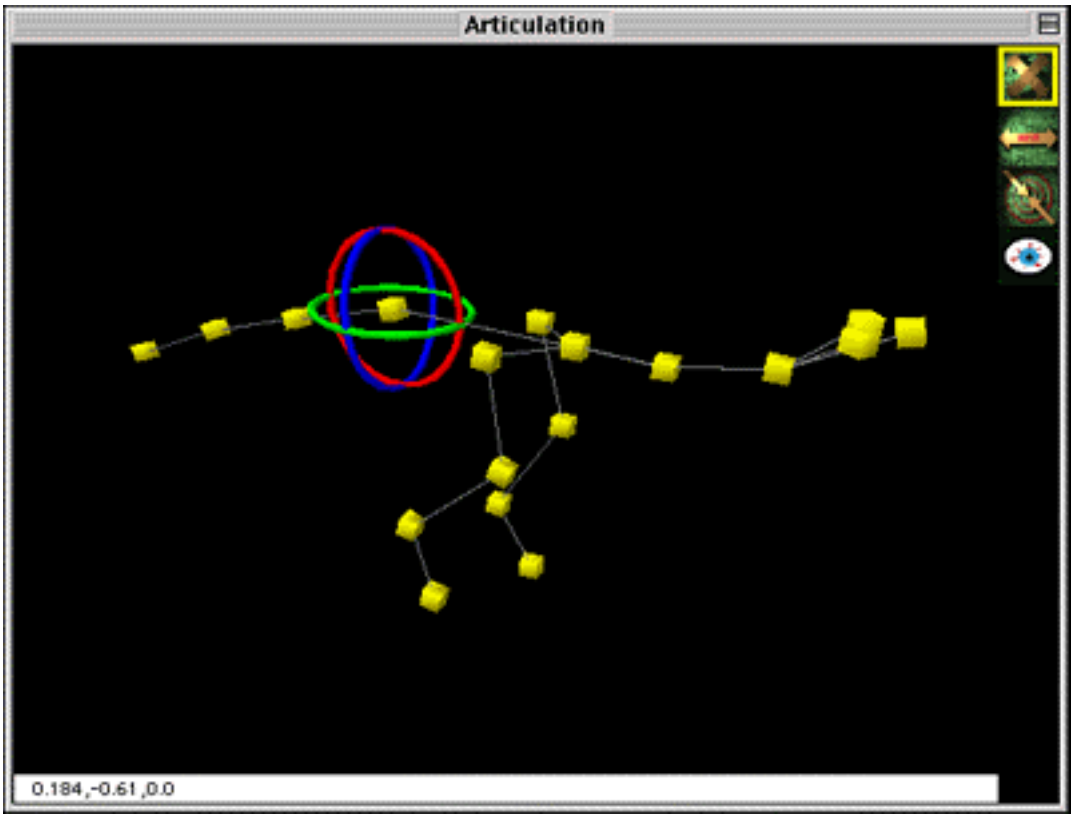
There are 4 icons in the Articulation window's command bar:

 Rotate  Move  Scale  Look-At

The last icon, isn't actually a skeleton manipulation mode. When this icon is selected, you can click anywhere on the skeleton to cause the camera to look at that point. It's just another navigation tool. You can also click anywhere on the model in the Skinned window to do a look-at without selecting the Look-At icon.

Rotating Joints

So, select the Rotate icon in the command bar. You are now in rotate mode which means that when you click on a skeleton's joint, you can rotate it. Select any of the yellow boxes in the Articulation window to select the joint. Notice that the joint is now surrounded by red, green, and blue rings:

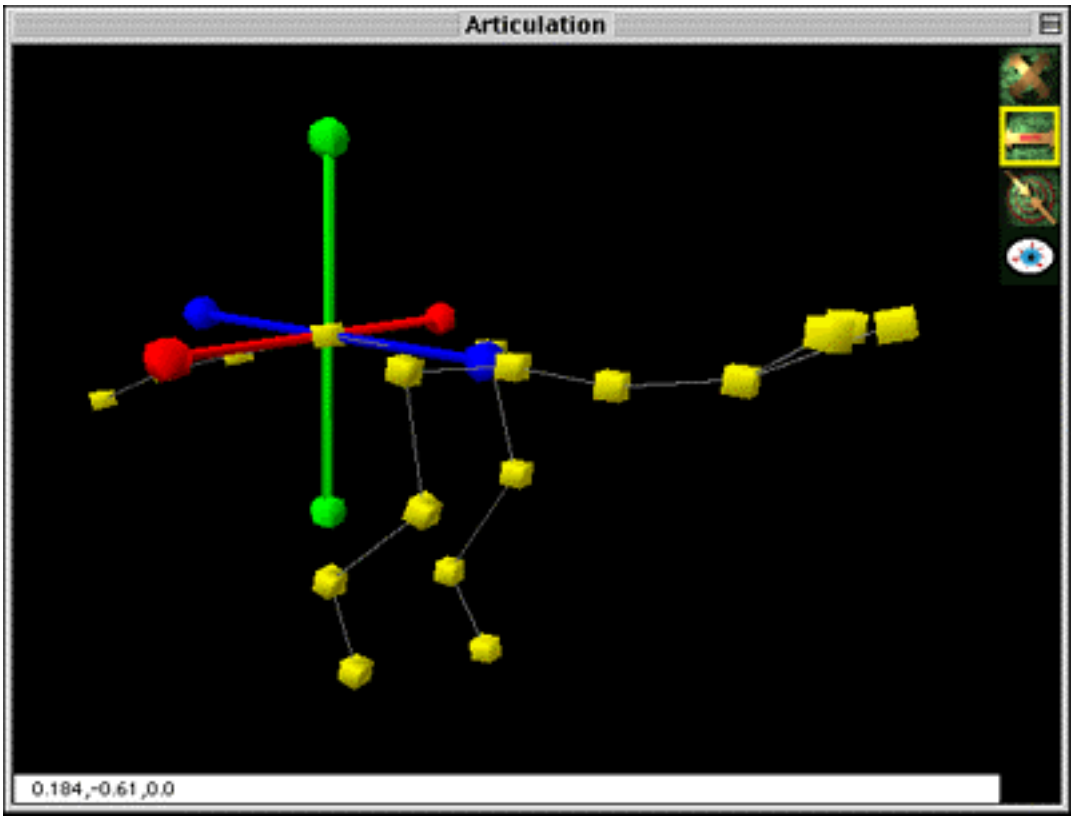


These colored rings are your rotation axes guides. Red is the x-axis, green is the y-axis, and blue is the z-axis. To rotate the joint, simply click and drag on one of these three axes to rotate the joint around that axis. You can free-form rotate the joint without axis lock by clicking and dragging directly on the joint itself, but this is not a recommended way to rotate joints because it is very difficult to control.

Try clicking on several different joints and rotating them with the axes to get a good feel for how this works. You will be using this mode quite a lot when creating your character animations.

Moving Joints

Now select the Move icon to go into Move mode. Note that the colored rings have turned into colored bars:



These colored bars also represent the x, y, and z axes, but the bars indicate that you are in Move mode instead of rotate mode. To move a joint along any of the axes, simply click and drag on the axis you want.

You won't be using Move mode as much as rotate mode, however, moving joints will give your animation that subtle touch of realism that just rotating joints cannot do.

Scaling Joints

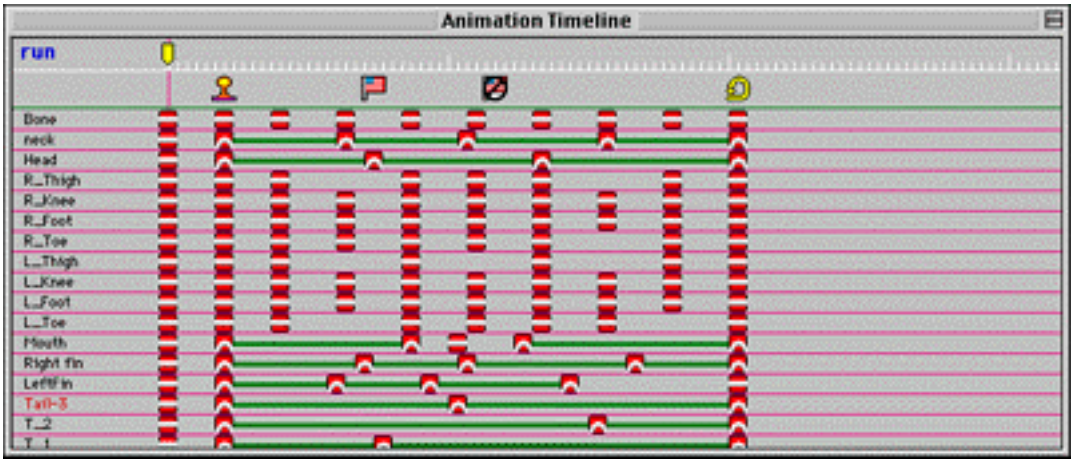
Finally, select the Scale icon to enter Scale mode. Scaling in BioOreo Pro is done uniformly on a joint, therefore, there are no colored axes guides. Simply click and drag on a joint to scale it bigger and smaller.

VIEWING ANIMATION SEQUENCES

Selecting An Animation

Now let's skip over to the Animation Timeline window. The sample model you have loaded has several animations applied to it. The name of the currently selected animation appears in the upper-left corner of the window. To select a different animation, simply click on the animation name and a pop-up menu will appear which has a list of all of the animations currently assigned to this character.

Click on the animation name and select "run" from the pop-up menu. The information displayed in the Animation Timeline window will change to show you the keyframe data for this character's run animation:



The Articulation and Skinned windows will also update to show the position of the character at “time zero” for this animation.

The Animation Time Index

The yellow icon at the top left of the Animation Timeline window is the Time Index. This indicates the current time position in the animation. Click and drag on this icon to move the time index to any point in the animation sequence. As you drag the icon, the Articulation and Skinned windows will update to the current position of the skeleton at the given time index.

Playing an Animation Sequence

Dragging the time marker is one way to view an animation sequence, but it isn’t very user friendly. To see how an animation will really look and behave when played back in the final application (like Nanosaur), select **Play Sequence** from the **Animation** menu. The animation will play real-time in the Skinned and Articulation windows. Looping animations will continue forever until you click the mouse.

Press the CTRL key to inhibit rendering in the Articulation window and only display rendering in the Skinned window. This will often improve the frame rate of the rendering since it doesn’t have to render two separate windows.

SETTING & EDITING KEYFRAMES

Let us suppose that you don't like how the tail is moving in the "run" animation sequence and you would like to change some of the keyframes. This is really easy to do.

First, move the time index to the point in the animation where you would like to edit the tail's keyframe. Now go to the Articulation window and change the orientation of the tail as explained above.

Once the tail (and everything else) is in a position that you are happy with, you can save the position as a keyframe in the animation. Select **Make Keyframe** from the **Animation** menu and new keyframes for all of the joints which you have modified will be placed at the current time index in the animation sequence.

You can move a keyframe in the timeline simply by clicking and dragging on it. Note, however, that you cannot drag a keyframe before any keyframes prior to it, nor can you drag a keyframe beyond any keyframes which are after it.

To delete a keyframe, simply click on it to select it and then press the Delete key.

Keyframe Types

You have probably noticed that there are various different icons for the keyframes. These icons represent how the animation accelerates into and out of a keyframe. The various keyframe icons and their meanings are as follows:

 Linear acceleration

 Ease In and Ease Out

 Ease In

 Ease Out

Linear acceleration means that interpolation of the animation from this keyframe to the next will be linear, meaning it will be somewhat mechanical looking. The speed of motion will be constant from start to finish.

Ease In and Ease Out indicates that the animation from the current keyframe to the next will be more natural looking. The animation will accelerate into the motion and decelerate out of the motion.

The other two "ease" modes are combinations of acceleration and linear animation. Ease In means the animation will accelerate into the animation, but no decelerate out of it. Ease Out means the opposite.

Animation Event Keyframes

As mentioned earlier, the icons across the top of the Animation Timeline window are special icons called "Animation Events". Each icon has a special purpose:

Indicates that the animation should stop running.


Indicates that the animation should loop.


Indicates that the animation should reverse direction and zig-zag or play backwards. When the animation gets back to the beginning it will reverse direction again and continue the zig-zag.


This is a "marker" animation event. This indicates the time index to which the loop and zig-zag events should loop back to. Use this if you do not want your animation to loop back to the beginning, but rather to another point in the animation.

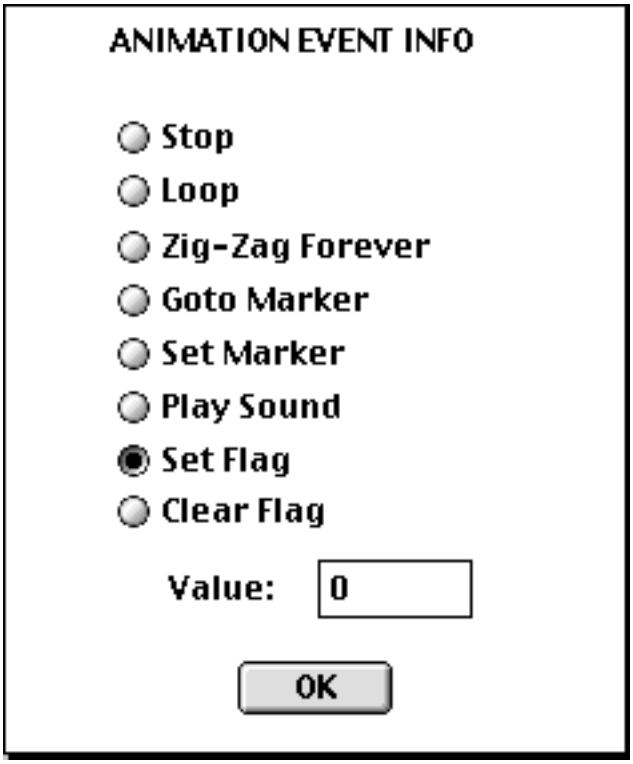

Play sound event. This animation event tells the target application (i.e. Nanosaur) to play a particular sound effect at this point in the animation. For example, when a character is walking you can use this

animation event to indicate that a footstep sound should be played at certain times.

 Set Flag event. This tells the target application to set a particular flag or to indicate that something special has happened. For example, in a jump animation, this flag is used to tell the game when the player should actually leave the ground. Or, in a basketball game this flag could indicate the exact moment the basketball should leave the player's hand during the throw animation.

 Clear Flag event. Used to tell the target application that a flag should be cleared.

To create a new Animation Event, simply move the time index to the point where you want to create the new event and select **Add Animation Event** from the **Animation** menu. This will invoke the following dialog box:



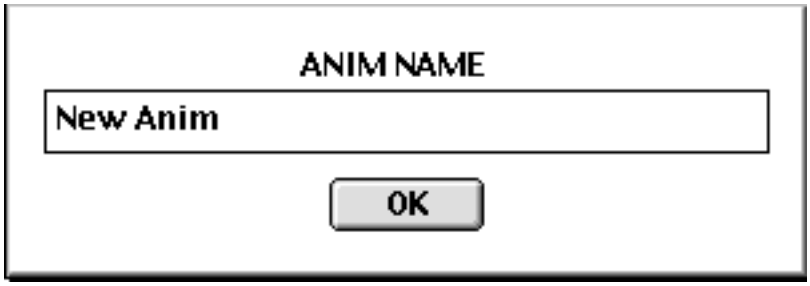
This dialog box lets you specify which Animation Event you would like to create. The "Value" field lets you specify values for Play Sound, Set Flag,

and Clear Flag events. In the case of a Play Sound event, this will indicate the sound number you wish to have played. For the flags, this value indicates which flag to set or clear.
To edit an existing Animation Event, simply double-click on it to invoke the Animation Event Info dialog box.

Note that the last Animation Event in any animation must be either a Stop, Loop, or Zig-Zag event. You cannot change the last event to anything else (for obvious reasons).

CREATING NEW ANIMATION SEQUENCES

You now know most of what there is to know about creating and editing animation sequences except for one thing: how to create a new animation sequence. No problem, just select **New Anim Sequence** from the **Animation** menu and you will get the following dialog box:



Simply enter the name of the new animation you are adding and then press OK. The Animation Timeline window will change to show your new animation which will be entirely blank except for a Stop Event Icon.

Note that you can rename an animation by double-clicking on the animation name in the Animation Timeline window. This is a little buggy, however, and you may have to fidget with it to get it to work.

ANIMATION EDITING MISCELLANY

Copy & Paste

Copy and past (from the Edit menu) work well for saving and restoring positions of the skeleton. Also, the Undo menu item will allow you to undo-redo the last change to the skeleton's orientation.

If you want to copy an orientation from one animation to another, simply Copy at the time index, select the other animation, then Paste at the desired time index. Then set the keyframe and you're done.

Adjust Across All Keyframes

This menu item in the Joint menu is very useful so read this carefully. When this menu item is selected, any changes made to a joint will change the same joint across all keyframes in all of the animations. In other words, if you rotate the head by 30 degrees on the x-axis while this feature is active, the head will be rotated by 30 degrees on the x-axis in every single keyframe that exists.

This comes in very useful when you change a 3D model such that the animation doesn't quite work anymore. For example, suppose you shorted the neck of a character, but the joints in the animation were all designed to work with the long neck. Now all of the animations look weird. To fix it, you can just move the neck joint to its new position. Rather than doing this for all ten zillion keyframes in your skeleton file, this will automatically move the neck for you.

Note that all changes are "relative offsets". This means that rotating the head to look up will not necessarily cause the head to look up in all of the keyframes. If the head was rotated 56 degrees to make it look up, then a rotation of 56 degrees will be applied to all the keyframes. It's the rotation delta that is applied, not the absolute rotation.

Zero Rotation

This menu item will reset a joint's x, y, and z rotations to 0.0. Sometimes you can rotate a joint out of control and you can't get it back to normal. This will help you out by resetting it to 0.0.

BUILDING THE SKELETON

Okay, so far I've shown you how to use BioOreoPro using an existing skeleton file. Now comes the difficult part: creating your own skeleton file.

THE 3D SOURCE MODEL

Building the Model

The first step to creating your skeleton file is to build the 3D model of your character. On the Macintosh, the only 3D modeling application capable of building good enough models to use in BioOreo Pro is Form*Z. You are more than welcome to attempt to use other modelers, but it has been my experience that it is impossible to do a good job with anything but Form*Z.

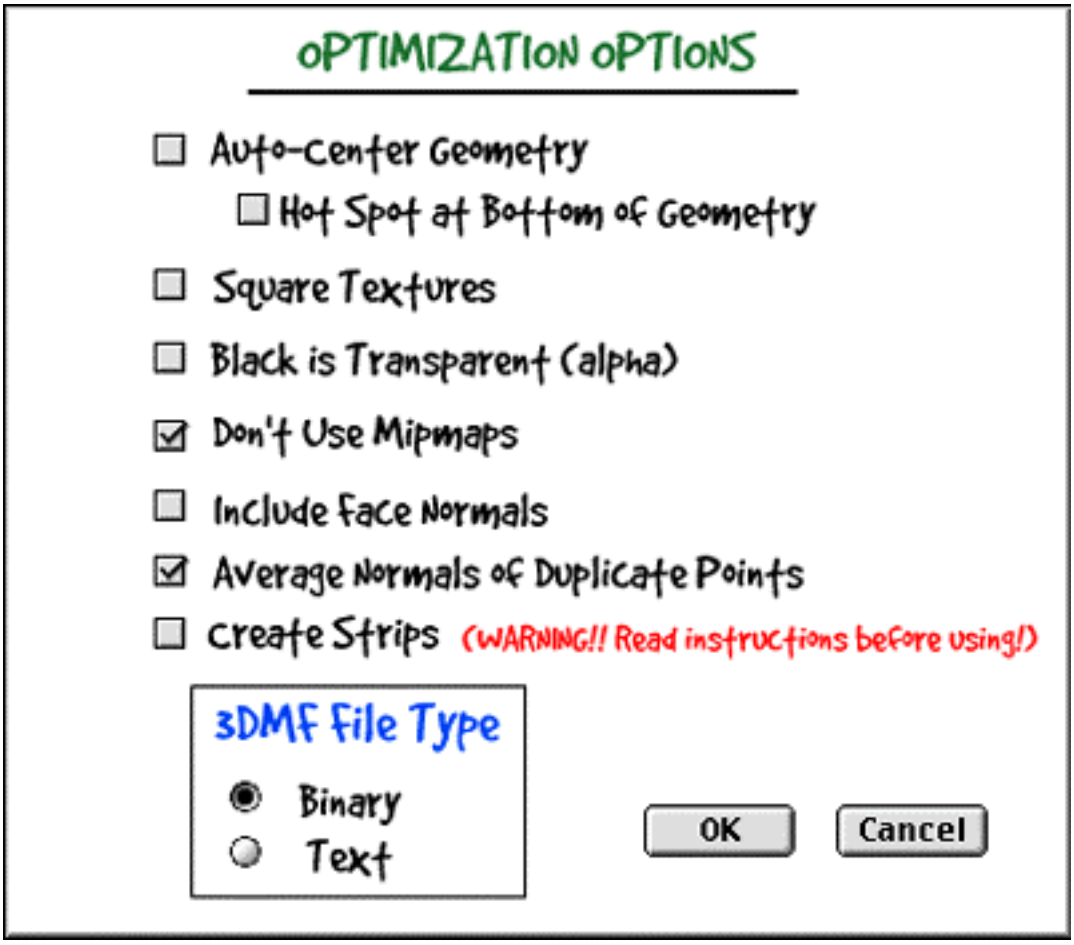
The 3D models that you need to create for BioOreo Pro are what we call "skinned" models. This means that the entire model consists only of the skin of the character. There should be no vertices inside the body of limbs of the character. All of the vertices should be on the skin.

You should avoid creating vertices where are extremely close to each other. Later, you are going to have to select each vertex in this model, and if two vertices are too close then it may be impossible to select one from the other. On the same note, the quantity of vertices is important as well. You really want to have as few vertices as possible to get the most out of the rendering performance.

Optimizing the Model

Once you have built your model and have exported it as a 3DMF file, you must optimize it with 3DMF Optimizer 2.5 or newer. This is not optional! You must do this, or BioOreo Pro will freak out.

When you optimize the model with 3DMF Optimizer, use the following settings:

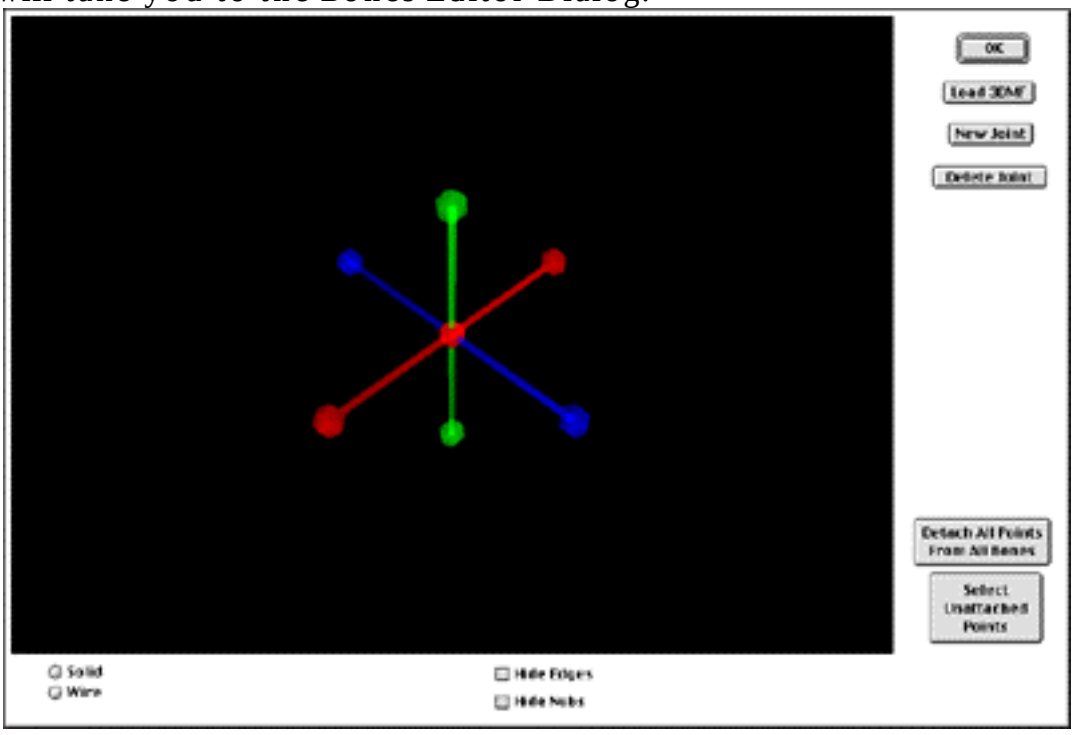


Take special note that you DO NOT WANT TO INCLUDE FACE NORMALS . This has to do with the way the 3D engine deforms the skinned models. If you include face normals, bad things will happen when the model is rendered. Trust me.

Once your 3DMF file has been optimized you are free to use 3DMF Mapper to texture map it, or you can go right back to BioOreo Pro and we can start building the skeleton.

THE BONES EDITOR

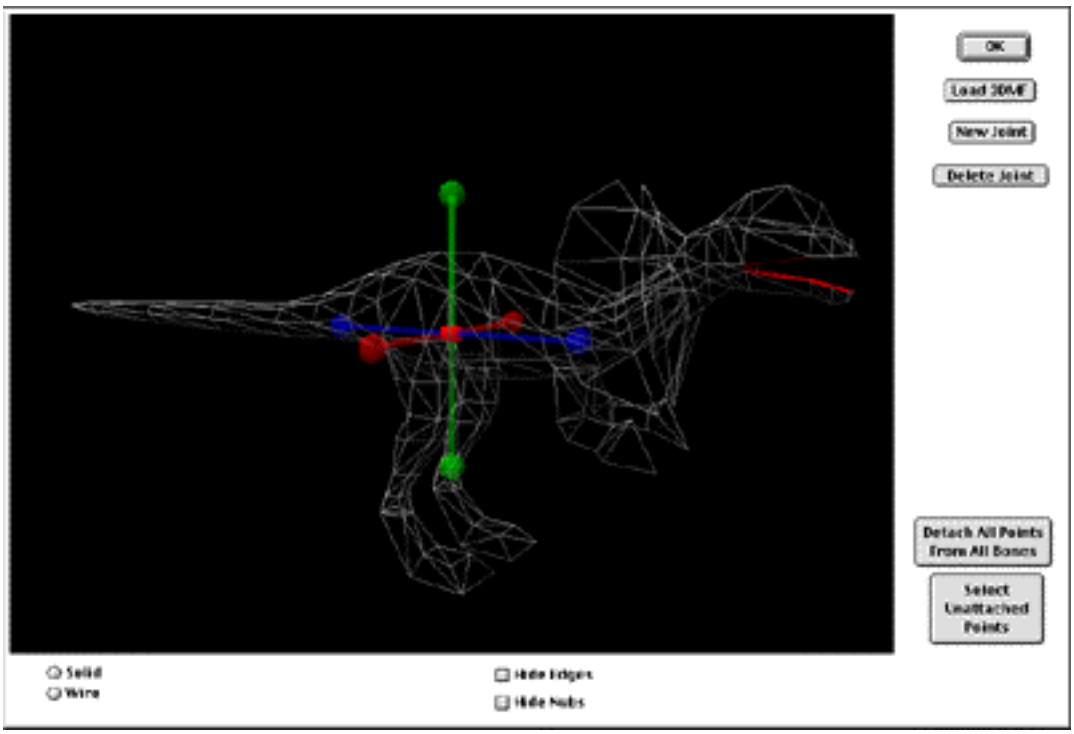
When you launch BioOreo Pro, select **Bones Editor** from the **Edit** menu. This will take you to the Bones Editor Dialog:



This is where you will build the skeleton for your character and where you will assign vertices to joints.

Loading the Source 3DMF File

The first thing we need to do is load our optimized 3DMF file which we want to use for our character. Click the **Load 3DMF** button in the upper right corner and then select the 3DMF file to use. Let's try loading the sample model "Diloph_Fin.3df" in the SameFiles folder:



You can navigate the camera in this dialog similarly to the Articulation window. Click anywhere in the black space to rotate the object, and use the up/down arrow keys to zoom in and out.

Moving A Joint

You will see a wireframe representation of your 3DMF file displayed. Also note the red, green, blue axes bars in the middle of the screen. This new skeleton always starts with one default joint. The default joint is the hot-spot or origin of the skeleton and should usually be placed in the center of the model. You can move a joint in the Bones editor just like moving a joint in the Articulation window. Just click on one of the axis bars and drag.

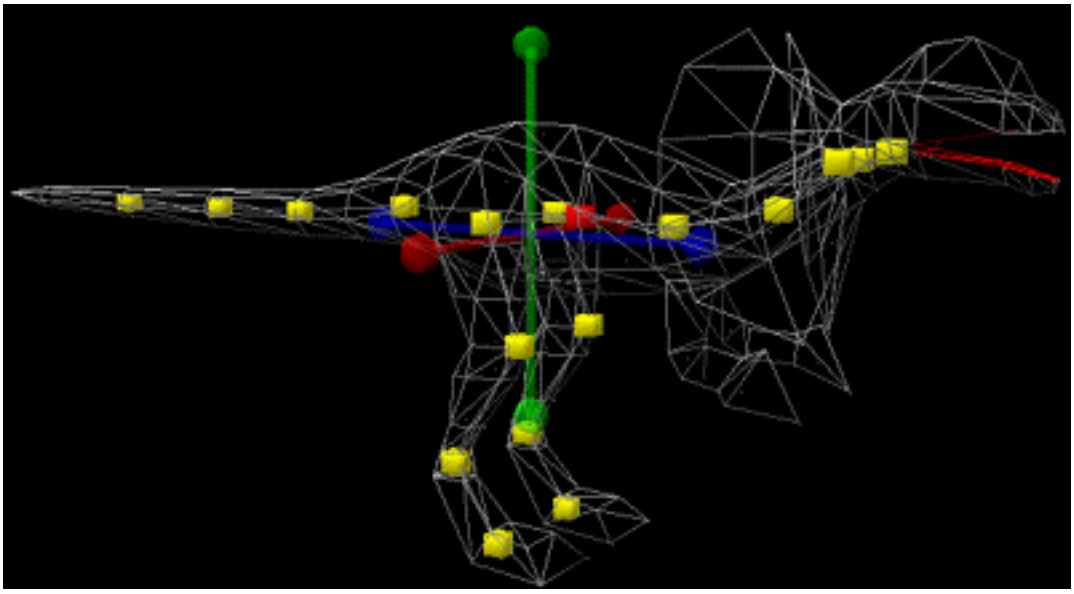
Creating New Joints

To create a new joint, click the New Joint button. This will create a new joint which is a “child” of the previously selected joint. A joint can have

any number of children joints. For example, the body joint (the default joint) will have children joints for the legs, tail, and neck. Thin white lines will show the connection among the various joints.

The general rule when creating and aligning joints is to create as few joints as you can get away with in your model. This version of BioOreo Pro has a limit of 20 joints in a skeleton. This isn't a technical limit, it is a limit written into the code to discourage you from using more than that since anything over 20 joints is questionably large. This sample skeleton has 16 joints.

Once you have created all of your joints and moved them to the appropriate locations, you should have something that looks like this:



Assigning Points to Joints

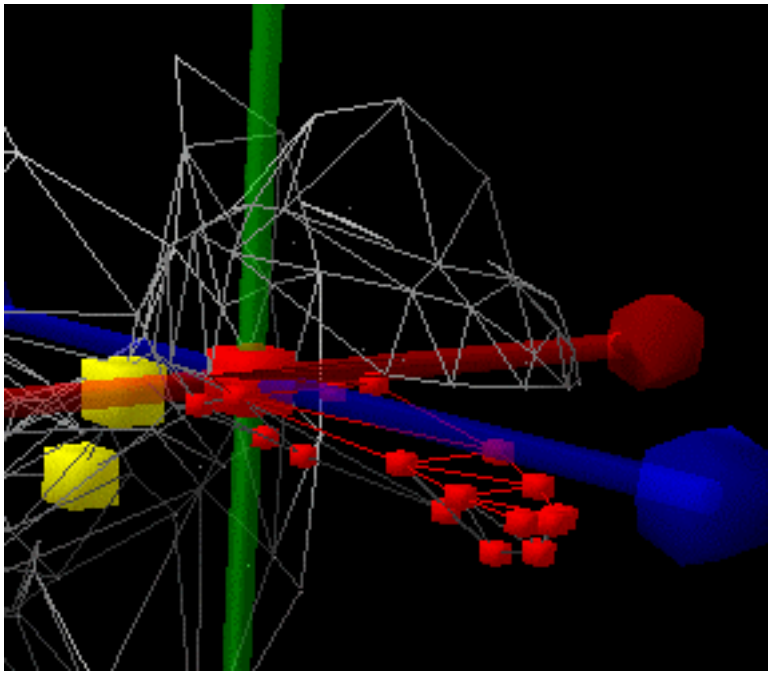
Now comes the most tedious and boring part to this whole process: assigning the model's points to joints in the skeleton. I apologize in advance for the mental torment I am about to put you through.

The way BioOreo Pro performs animation is by deforming the skinned 3DMF file based on the orientation of the various joints in the skeleton. The way it knows how to do this deformation is by looking at which

vertices (or points) in the 3DMF file are “attached” to which joints. The only way it knows this, is because you, the artist, have manually assigned each and every vertex in the model to one of the joints.

Once you get good at this, it only takes maybe 20 minutes to do an entire model, but that’s 20 minutes in Hell. Nonetheless, there are ways to make the process less painful. Here’s what I do:

Start at the extremities and work inward. Let’s start by selecting the jaw joint. When a joint is selected you only need to click on a vertex to toggle it on and off. You can press Command-Click to drag a bounding box around a set of points to assign multiple points to the current joint. Points which are assigned to the current joint will be marked with a red dot:



Continue doing this for all of the joints, but save the “body” joint for last. Since the body joint has the most vertices assigned to it, we can do a little shortcut at the end.

Since all of the other points have been assigned to other joints, we can click on the body joint to select it and then press the Select Unattached Points button to cause all of the remaining points to be assigned to the currently selected joint – the body joint.

Clicking this button will also make it easier to see if you missed any points in other places in the model. For example, if you suddenly see a red dot on the foot, then you know that you missed that point when assigning points to the foot. Simply click the red dot to unassign it from the body, select the foot joint, and re-click the point to reassign it.

Another way to detect that you have missed a point and it is not attached to any joint is to return to the Articulation window and try moving the whole model. Any points which are not attached to a joint will not move and the model will "tear" or "rip" when moved. Be very careful that all of the points are assigned to joints before attempting to use the skeleton in an application like Nanosaur. Nanosaur will likely crash if you give it a bad skeleton file like that.

Once you are done assigning points to joints, click OK to exit the dialog. If you decided to change your 3D model at some point, there is a fair chance that your point assignments will remain valid if the number of vertices in the 3DMF model do not change. If, however, you modify the number of vertices in your 3DMF model, then you will almost assuredly have to reassign all of the points to joints again. So, it is a good idea to make sure you like your 3D model the way it is before building a skeleton for it in BioOreo Pro. While creating Nanosaur, I probably had to reassign points to the joints in all of the dinosaurs half a dozen times. It's just something you get used to I guess.

FINAL NOTES

That pretty much covers it for BioOreo Pro. Just remember that this is an in-house tool, and as such you should save your work often and make backups. There are other menu items which I did not discuss in the documentation, but a little experimentation on your behalf will reveal the functions of those menu items.

The only other menu Item worth a small note is the **Change Editing Scale** menu item in the **Edit** menu. BioOreoPro assumes the source models are a particular size – that size is what Nanosaur likes to have. BioOreo Pro by default expects source models to be around 300 units in size. However, your specific application for which you are creating skeleton files may be

using a different scale factor. The **Change Editing Scale** menu item will allow you to change the scale of the system in BioOreo Pro. A scale value of 2 will double the size of the world such that a model of about 600 units in size will fit. Or a scale value of 0.1 will shrink the world by $1/10^{th}$ such that a model of 30 units will fit nicely. In general, however, I recommend you stick with the default scale for this tool.

Since this tool displays several 3D windows using QuickDraw 3D, it is highly recommended that you have between 4 and 8 Megs of VRAM on your ATI 3D card to use this tool. Cards with 2 Megs of VRAM will probably suffer texture and/or performance issues as that it simply not enough VRAM to have to many 3D windows active at one time.