

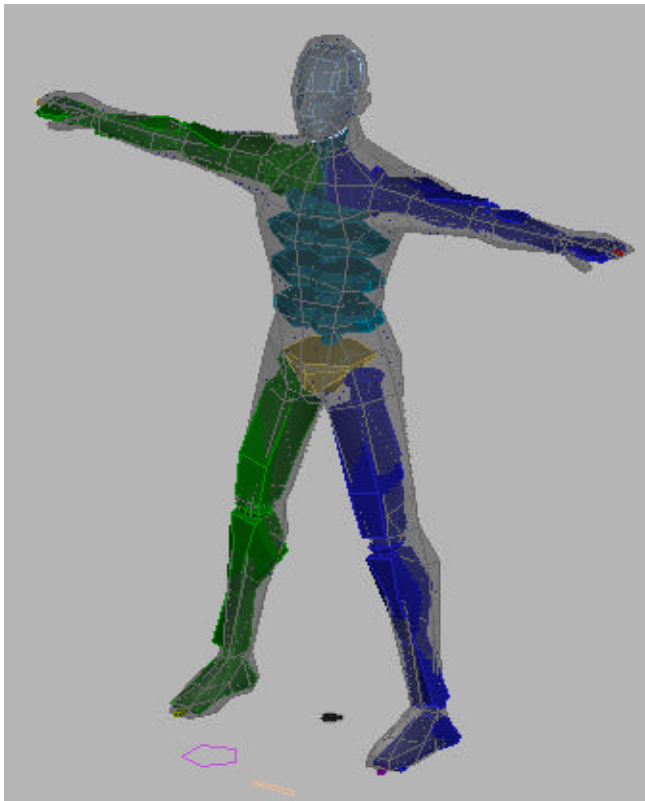
## IK Rigging and Skinning—A Review

### Bone Structures

To animate your character, you have to deform the mesh. You need a digital puppet to animate in the viewport. You use a hierarchical bone structure within the volume of the mesh. This bone structure can be made of 3ds Max bone objects, or of dummy objects or primitives linked together. Usually you will create a mix of bones and helper objects and control splines when you rig your character. Ensure that the bone objects fit closely within the mesh and that the bone joints match the mesh curvature. The bones will determine the envelope size. If you make skinny bones in fat characters, the envelopes would be too small to affect the mesh.

3ds Max has an automated bone system called Biped. It builds an entire rigged skeleton with one click on the mouse. It takes some time to scale the Biped components into the correct proportions for your character, but it's a lot faster than building your own bones.

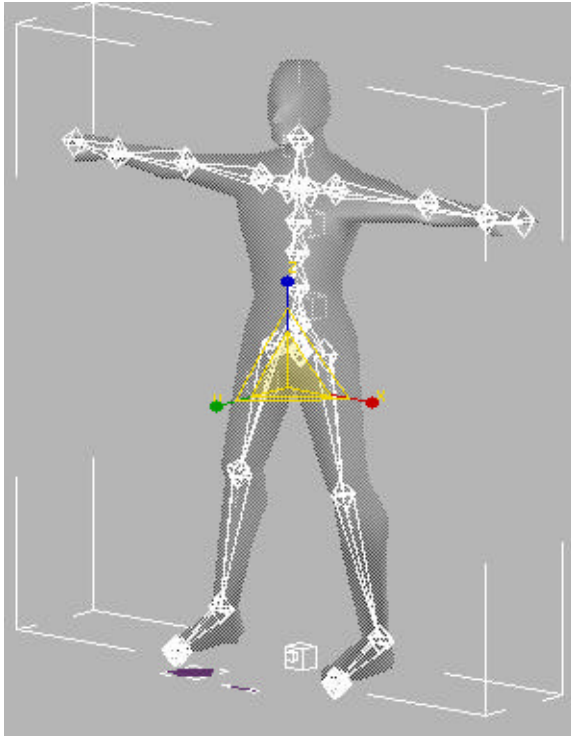
If you do build your own bones, use Bone Tools —> Bone Edit Mode to adjust the length of the bones.



Biped skeleton seen within the hero character mesh.

In *Object Properties*, make the character See-Through, then freeze it. This will help you in positioning the bones within the mesh.

**TIP:** You can take a Biped skeleton and export it as FBX, then import the FBX to create a new non-Biped bone structure. Here FBX import has created a skeleton of max bones based on the character studio Biped skeleton.



Max Bones can have fins that you can use to extend the bones through the mesh. See the legs in the illustration below. The fins extend through the mesh.



**TIP:** When to scale and when not to scale. Avoid using the *Scale* tool at the object level. If you build a bone structure using 3ds Max bone objects, don't be tempted to scale the bones to adjust their size. Use *Bone Tools -> Bone Edit Mode* instead. This turns on "Don't Affect Children" in the modify panel. Change the bone length by moving the neighboring bones. If you use scaling instead, the children could skew the object during animation.

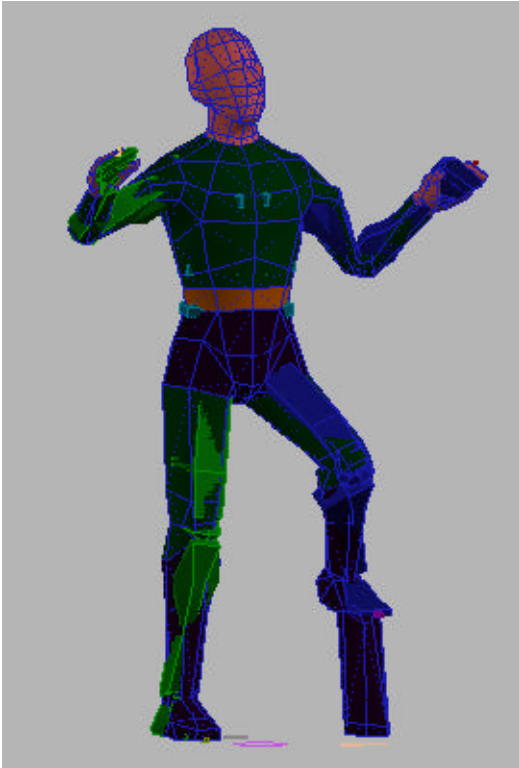
On the other hand, when you use Biped, employ the *Scaling* tools. Biped is designed to let the *Scale* tool control the bone length without any adverse effect during animation.

## Skinning

The mesh object uses a skinning modifier to associate the bones with the mesh. The skinning modifier lets the motion of the bones deform the vertices of the character. In 3ds Max offers a choice between two different modifiers, *Physique* or *Skin*. You can use either. *Skin* has had more development time, so it has newer features, *Physique* is much older software, but has some

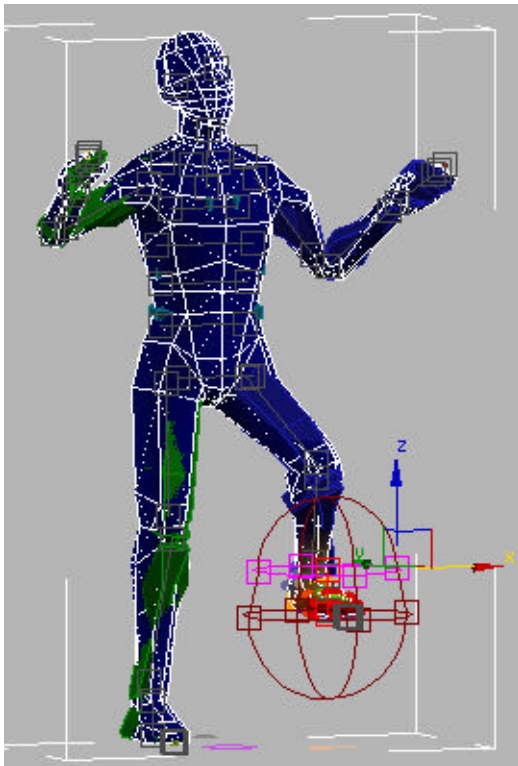
unique capabilities and people who use it tend to stick with it. The skinning modifier creates envelopes of influence around the bone objects.

After applying the skin, do a motion test. Quickly animate the bone structure and ascertain how well the skinning has worked.



Vertices left behind on the feet.

You will see which vertices remain behind and you can then adjust the envelopes.



Vertex influence can be adjusted using the vertex weight table. This is a good way to do exclusions. Or use the *Exclude Selected Vertices* button in the *Parameters* rollout.

**Skin Weight Table (Body Template Low)**

Edit Vertex Sets Options

| Vertex ID | S | M | N | R | H | Bip01 Pelvis | Bip01 Spine | B |
|-----------|---|---|---|---|---|--------------|-------------|---|
| #50       |   |   | X |   |   | -            | -           |   |
| #51       |   |   | X |   |   | 0.004        | 0.231       |   |
| #52       |   |   | X |   |   | 0.053        | 0.456       |   |
| #53       |   |   | X |   |   | -            | -           |   |
| #54       |   |   | X |   |   | -            | -           |   |
| #55       |   |   | X |   |   | -            | -           |   |
| #56       |   |   | X |   |   | -            | -           |   |
| #57       |   |   | X |   |   | -            | -           |   |
| #58       |   |   | X |   |   | -            | -           |   |
| #59       |   |   | X |   |   | 0.404        | 0.362       |   |
| #60       |   |   | X |   |   | -            | -           |   |

All vertices  
Copy Paste  
Right click on a cell to zero it out

Use *Mirror Mode* to copy the vertex envelopes and weights from one side of the mesh to the other.

## Skin Wrap Modifier

3ds Max has a skin wrap modifier. This lets a high resolution object pickup skin deformation from the vertices of a low-poly skinned mesh. You save a lot of time now when you animate high-poly models for cinematics, marketing pieces or just for a closeup. Skin the low poly model to the bones, then add the skin wrap modifier to the high-poly model, and point it to the low poly one. There's also a skin wrap *Patch* modifier that performs the same function except that it uses patch objects to deform the high-res mesh. Use this with spline cage models.

There is also a *Skin Morph* modifier that you can use to create bulges of muscles, and fix creasing. If you use max bones, you can also use the joint angle deformer to do this. The skin morph modifier is an improvement, since the joint angle deformer only keeps track of angles in one plane. *Physique* too has its own *Bulge Angle* mechanism. In each of these cases you set up target states based on the angle between two bones, so the mesh deforms when the bones find themselves at the angle.

## Guest Lecture – Skin or Physique

“I have often seen artists new to rigging ask whether they should use *Skin* or *Physique*. My standard response is to provide the pros and cons of each and let them make their own decision, as each modifier has certain strengths and weaknesses. *Physique*, for example, has robust deformation tools to handle skin sliding, joint twisting, and muscle bulging. However, these advanced features are generally not supported by game engines currently. I found this out the hard way when I exported characters for the latest *Elder Scrolls* game, *Oblivion*. All of the smooth deformations that I had achieved using *Physique* were not appearing in the game correctly. I later found out that only the most basic features of *Physique* would export correctly. From then on, I have used *Skin* and have had no problems.

So for a game artist, I whole-heartedly recommend *Skin*. It has far superior vertex weighting tools like the Weight Table and the ability to paint weights. It also is much more exposed to *MAXScript* than *Physique*, which has allowed technical artists to create many tools to speed up the rigging process. Some of its advanced deformation features like the *Skin Morph* modifier may not be supported by game engines, so you will want to check with your programming team to learn the limits of your toolset.”

**Josh Jones**

**Digital Artist and Game Developer**

## Inverse Kinematics (IK) Solvers

To add “strings” to your digital puppet, use inverse kinematic solvers. The IK solvers place IK control handles in the chain. These hold down the feet against the ground in a walk cycle, or they can be used to animate the hands interacting with objects. They are often used as a stop. You animate the root and the chain is held in place at the point of the IK handle.

**TIP:** Don’t try to make long bone chains for the entire character. Instead, make multiple IK Solvers chain, then link their IK Control objects together. You can also use *Parameter Wiring* or *Animation Constraints* on these IK helpers.

3ds Max comes with a variety of IK Solvers. The HI solver is intended for character animation. The HD solver is older technology that can be useful in certain mechanical animations that require mixing Sliding Joints with IK. Otherwise stay away from the HD Solver. The IK Limb Solver is a unique solver that should only be placed on 2 bone chains. This solves faster than any other solver, so it gives the best viewport performance. You’ll probably use the HI solver for most of your rigging needs.

## Control Objects

Additional helper objects are usually created for character placement and to create animation controls. Control splines are popular. For example, you can create a “hula hoop” around the waist of the character to control the rotation of the pelvis and the base of the spline. Entire control panels can be constructed with sliders set to adjust your animation by using *Custom Attributes*.

*Parameter Editor* and *Parameter Collector* tools on the Animation menu are used to create, manage, and assign custom attributes to scene objects.

The *Parameter Editor* lets you add parameters to individual animation tracks in *Track View*. New UI types, ComboBox and ListBox can be used to create additional UI elements in your control rollouts or floaters.

The *Parameter Collector* lets you put collections of controls in the scene into a floater that can be your animation cockpit. This lets you animate without clicking on things in the viewport and edit multiple tracks at once.



The *Expose TM* helper lets you get the transform information from non-keyed objects for use in scripts and expressions.

Visit the following link to learn more about skinning and rigging.

[http://www.cg-academy.net/dvds\\_menu\\_3dsmax.htm](http://www.cg-academy.net/dvds_menu_3dsmax.htm)