Mysteries of the Bone Tool

Adobe Animate CC includes a really interesting tool that not many users know about. In fact, this subject is way beyond the scope of a single tool – as it encompasses and entirely different way of assembling and animating content in the Timeline. Let's have a look at some of the ways you can use the Bone and Bind tools to create intricate Armatures in Animate using inverse kinematics!

Is the Bone Tool New in Animate CC?

Not exactly new, no. When Flash Professional (Animate's former identity) was updated from the CS6 version to CC – it was completely rewritten to modernize the codebase and make the program more powerful than ever. Unfortunately, certain features such as the Bone tool were not rewritten along with the core application. This meant that for a few years, the program did not include this tool.

However, Adobe had always stated that features that were left out would be added back in if there was enough of a desire for them. In 2015, we saw Flash Professional receive a revamped and reintegrated Bone tool and inverse kinematics system of animation – and this is now all available in Animate as well.

Inverse Kinematics

When first introduced to this method of creation content in Animate – the main thing users have trouble grasping is exactly what the term inverse kinematics (IK) means.

As stated on Wikipedia:

"*Inverse kinematics refers to the use of the kinematics equations of a robot to determine the joint parameters that provide a desired position of the end-effector. Specification of the movement of a robot so that its end-effector achieves a desired task is known as motion planning.*"

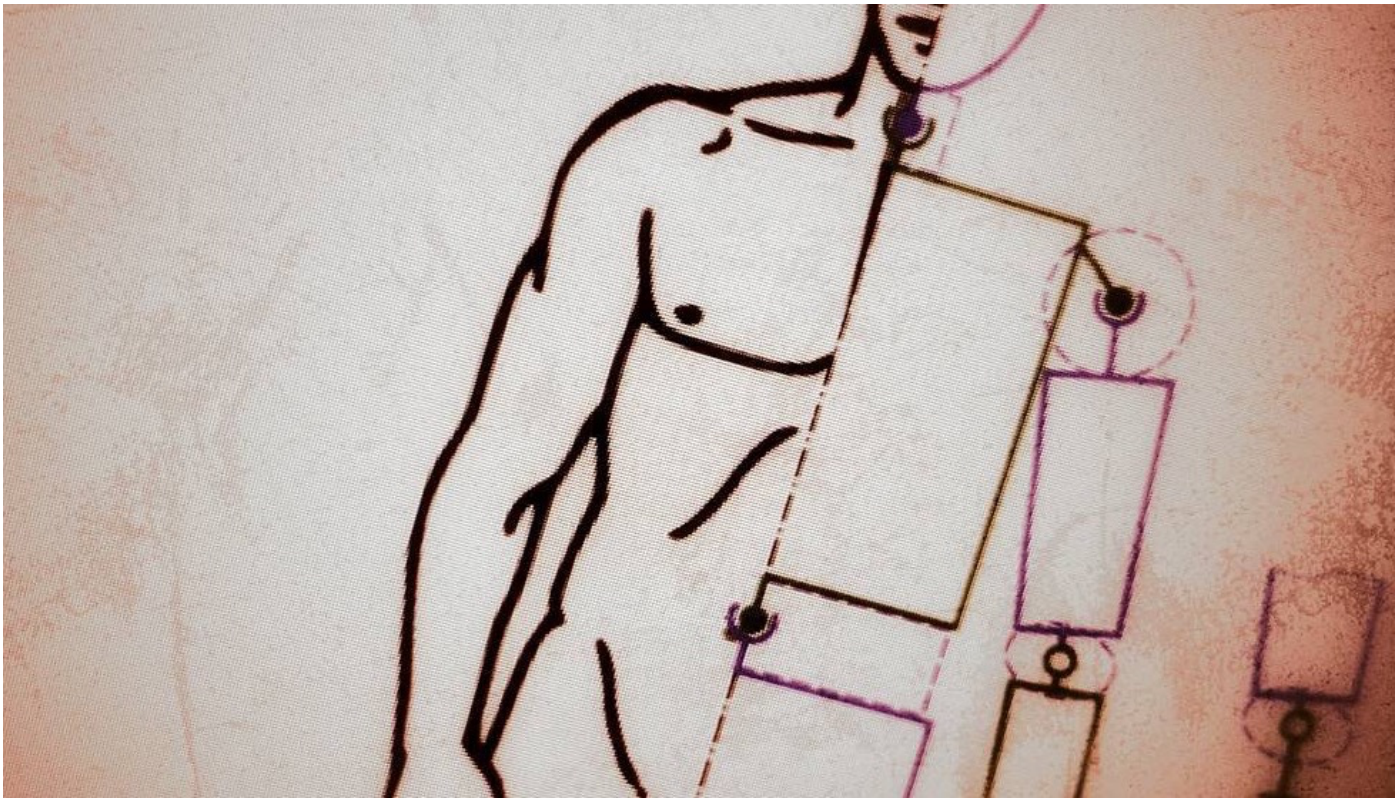

Figure 1. An illustration of IK created and distributed by NASA.

In Animate CC terminology, IK is used alongside a number of tools and and mechanisms to create, refine, and provide constraints to a skeletal structure which can be animated as a single, reactive entity through a series of poses. It's pretty slick! Of course, IK isn't limited to human or animal forms. You can use IK mechanics to animate machinery as well – and it does a great at that.

The Bone Tool and the Bind Tool

The first thing to mention is a set of tool that enable the creation and refinement of IK armatures within Animate – the Bone and Bind tools.

 The Bone Tool is the primary tool in Animate when dealing with IK. This tool is used to draw out bones within a shape to create an armature, or to draw out bones connecting Movie Clip symbol instances to build an armature. Either method generally works the same way; click and drag with the Bone Tool to draw the initial “tail” bone, then clack and drag new bones which branch off from the initial tail to form a complete IK structure.

 The Bind Tool is grouped along with the Bone Tool. Clicking upon either tool within the toolbar and holding the click for a few seconds will allow you to choose either tool. The Bind Tool itself is used to modify the connections between existing bones and the shape control points in a shape-based armature. Using the Bind Tool, you can refine how the stroke distorts when each bone moves for better results.

For more information on the use of these tools, have a look at the Animate Bone Tool documentation. <https://helpx.adobe.com/animate/using/bone-tool-animation.html>

Creating a Shape-based Armature

To give an example of using an IK armature on a shape, I’ve drawn out a simple slug-like creature with the Oval Tool, modifying the paths with the Selection Tool. When placing and extending bones, it’s often useful to to turn off snapping, as this can make the placement of your bones become forced to the grid – which often doesn’t work so well for armature creation. You can disable snapping by disabling the **View > Snapping** options from the application menu.

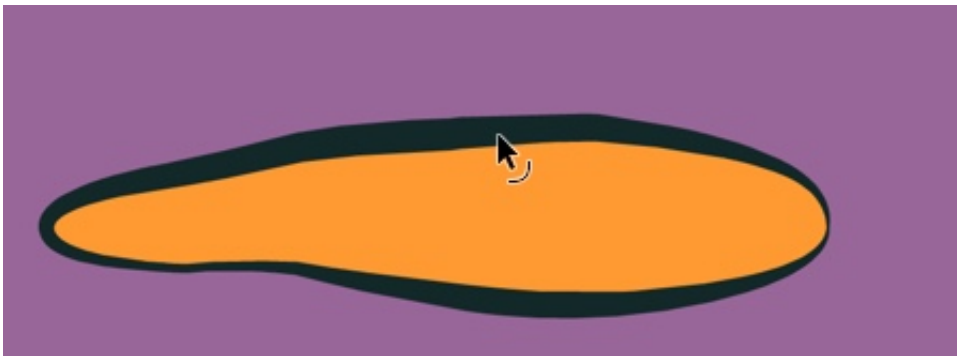

Figure 2. Hovering over the paths of a shape with the Selection Tool allows us to push and pull to modify the path.

With our basic shape created, we can now begin adding bones to it using the Bone Tool. With the Bone Tool selected, click within the slug and drag out a bone. When you release the cursor, the resulting bone will be created and remain at the chosen length. This initial bone is referred to as the "tail" and can always be located by the special red and white diamond shape at the point of inception. All other bones in the armature originate from this single tail.

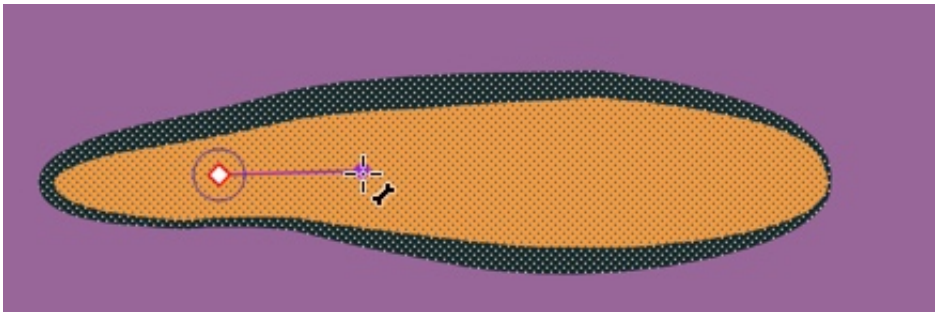

Figure 3. The initial "tail" bone of the armature is created.

Now that we have a tail to our structure, we can drag other bones out from here to create either a linear, or branched IK armature. Notice that the shape is no longer a shape at all – but is now a special type of object in Animate called an IK Shape. Therefore, we no longer see the shape selection pattern when this object is selected. In its place is a blue bounding box with all existing structural bones visible. To add additional bones to our existing IK Shape armature, click on either end of the existing bone with the Bone Tool

and drag out additional bones. We will do this until we have our IK Shape segmented with a number of bones as shown in the figure below.

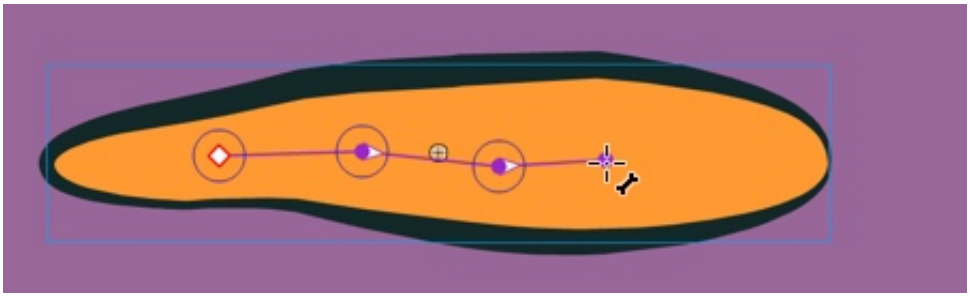

Figure 4. Drawing out additional bones to complete the armature.

At this point, we can test how the armature behaves by using the Selection Tool to move the slug around. The movements will be based upon the bone structures we have created – but they may be a bit rough when taken to extremes. This is where the Bind Tool comes into play. Selecting any of the bones with the Bind Tool allows us to adjust the control points which determine how the shape reacts to movements of specific bones. Spending some time to be sure all control points are positioned in an acceptable way will go far in making any movements behave as you intend.

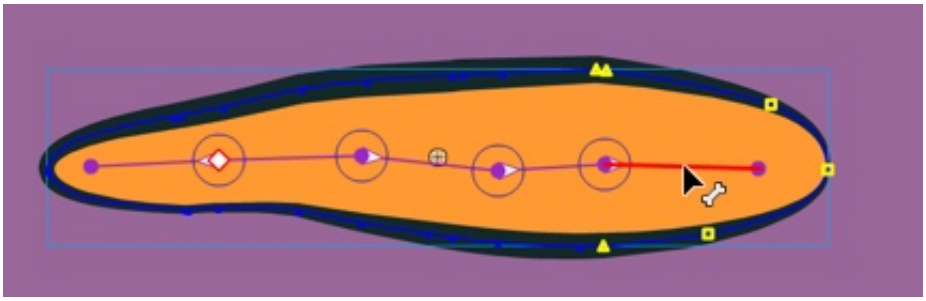

Figure 5. Adjusting control points with the Bind Tool.

Once the armature is completed, you'll notice that the layer within which the original shape existed is now empty (you can delete it, as I've done) and in its place is a new armature layer. The armature layer is signified with a special icon (a human-like figure) as well as having all frames within the armature

layer take on a greenish color. We now have a completed shape based armature.

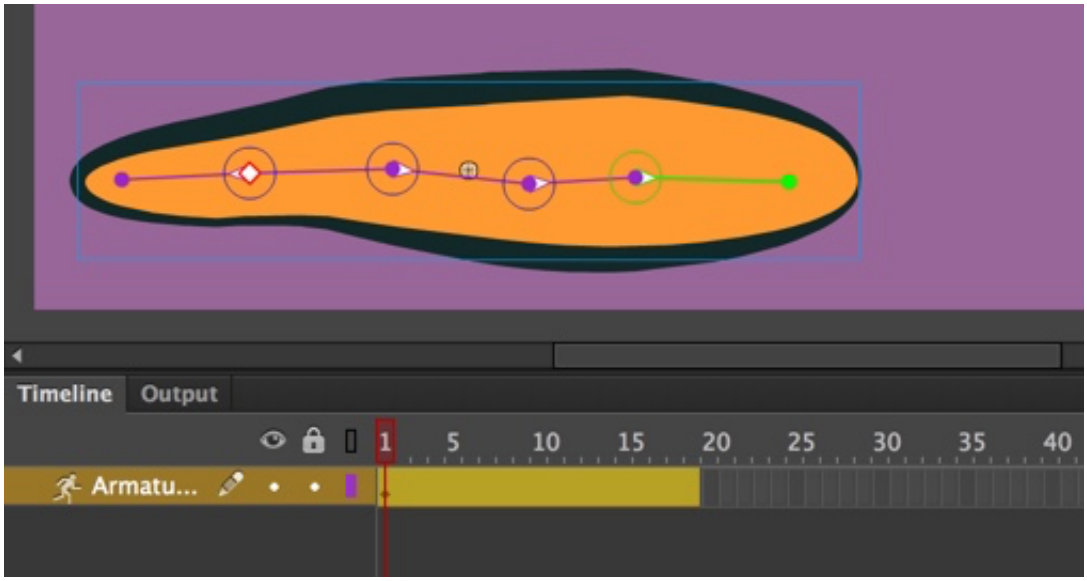

Figure 6. A completed IK armature.

With Animate CC, you can create both linear and branched armatures using IK. This example is a linear, shape-based armature. In the figure below, we are creating poses for our armature. Creating and managing poses is the same for both shape and symbol based armatures, so we will go over this concept after discussing symbol based armature creation.

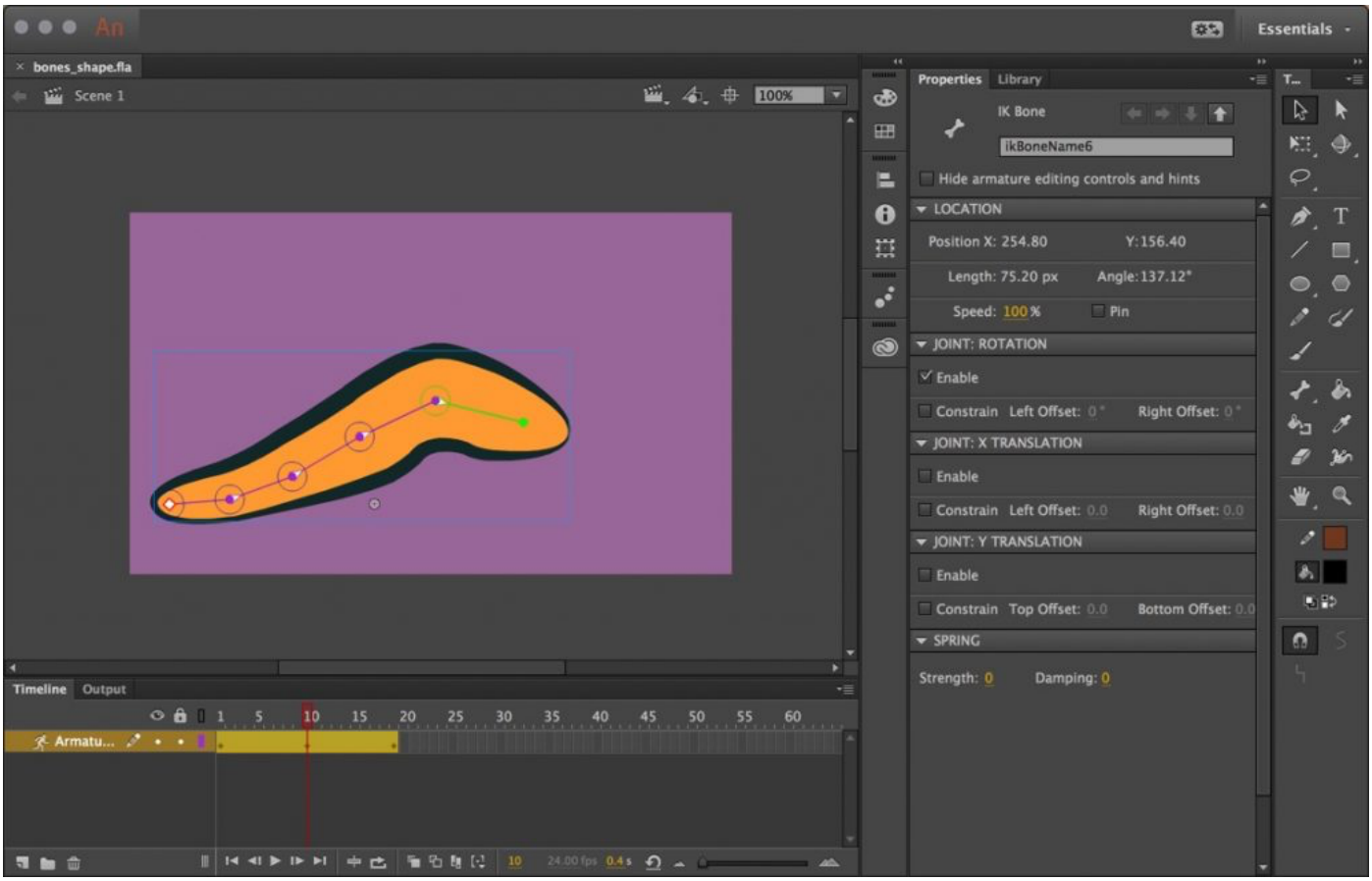

Figure 7. Creating Poses in a shape based armature.

Creating a Symbol-based Armature

A shape based armature can be neat to play with, and has useful applications, of course. If you want to create a more complex armature though – you'll want to build one with Movie Clip symbol instances.

In order to construct such an armature, you'll first need to build the individual members. The most useful illustration of this concept is the human form. Think about the different pieces in regard to a human skeleton; you have the head, upper arms and lower arms, hands, chest, pelvis, upper and lower legs, completing the whole form with two feet. This concept can be applied to any form which is constructed of joints and solid forms.

In this example, we draw out each of these shapes with the tools available to

us within Animate. One by one, convert each shape to a Movie Clip symbol by selecting it and choosing **Modify > Convert to symbol** from the application menu. Provide a useful name for each symbol and be sure to have Movie Clip as the symbol type. Hit OK for each and you'll have an assortment of parts to build your armature from.

Constructing the Armature

Building an armature from Movie Clip symbol instances is very similar to building an armature from a shape in that bones are drawn using the Bone Tool and branched out from a primary tail bone. The difference comes into play where we are dealing with multiple objects in place of a single shape.

I have created a set of Movie Clip instances to construct our armature based upon the human form; a head, torso, pelvis, upper and lower arms and legs, hands and feet, et cetera. They are arranged in the figure below as an inventory, though we will want to place each piece in relation to the other before we begin building our IK armature.

Figure 8. A set of Movie Clip instances.

To build an armature from multiple pieces like this, we must use the bones to connect them as they are drawn out across the various parts. This will allow

us to define the full armature based upon these individual pieces. With the assorted parts arranged in the way you want them, select the Bone Tool to begin creating the IK armature.

You'll want to first use the Bone Tool to create a tail just as we have done with the shape armature. The difference here is that when dealing with Movie Clip symbol instances instead of a shape, each bone must connect the instances to one another and multiple bones cannot exist within a single instance.

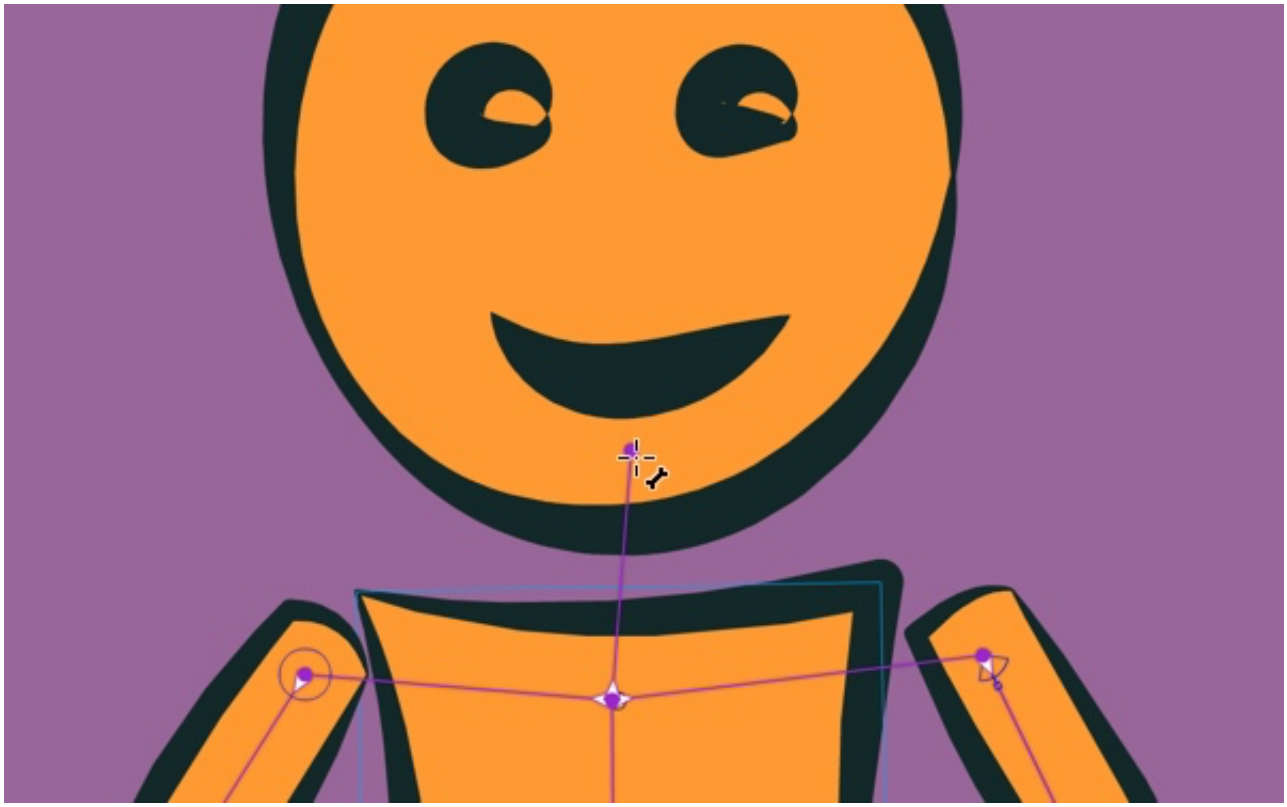

Figure 9. Connecting Movie Clip symbol instances with the Bone Tool.

For something like the human form, you might place the armature tail originating at the chest or pelvis. From there, draw out branching bones which connect to the head, arms, legs, and so on throughout all parts of the body.

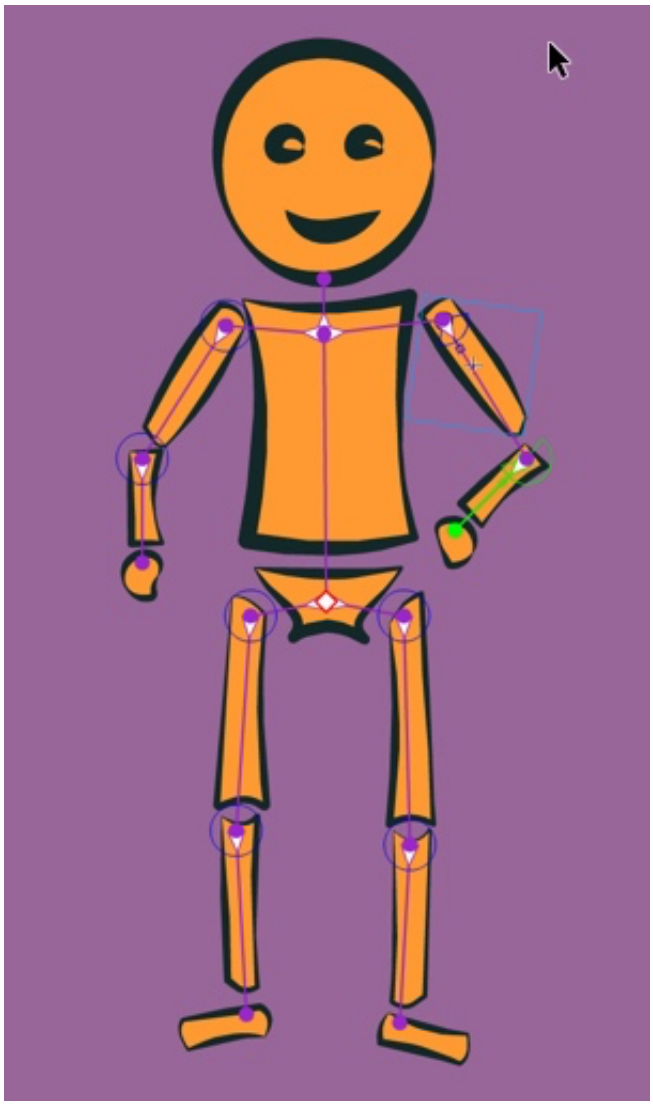

Figure 10. A completed IK structure representing the human form.

Constraining Joint Movement

You may have noticed at this point in our exploration of IK armatures that when a single bone is selected with the Selection Tool, we get a whole host of properties to manipulate within the Properties Panel. Specifically, joint rotation and translation across the X and Y axis – along with spring strength and damping. The strength and damping values control how much springiness there is to a specific bone and the rate of decay to that springiness.

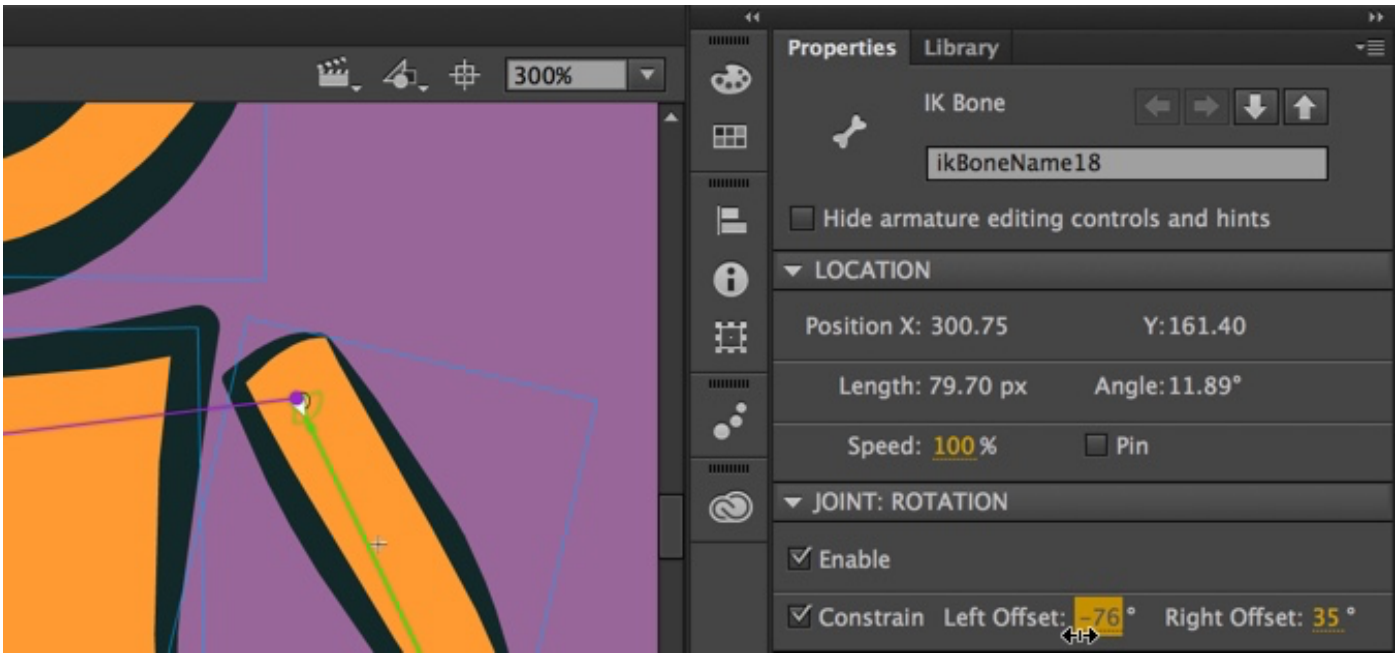

Figure 11. The arm instance has its joint rotation constrained to provide more realistic movement.

Making fine adjustments to the constraints of specific joints and the angles they are allowed to rotate against will go far in making a more believable armature – and result in more realistic poses. Additionally, setting these constraints will make it much easier to work with the armature since it will only move in ways which you have allowed it to move. A combination of joint constraints and bone spring strength and damping will allow a great deal of control in terms of how each individual bone behaves across poses.

Managing Poses

With a shape or symbol based armature assembled and completed, it's time to talk about animation. Animating an IK armature in Animate is completely different from other animation mechanisms you may be familiar with. For instance, you do not create any sort of shape or motion tween on the armature layer – simply existing as an armature layer automatically provides the IK armature animation mechanic within an Animate project.

With the armature created, all you need to do in order to design the animation is to extend the frames across the Timeline and change the pose across different frames. Poses within an armature layer are created in a similar way that keyframes are created in a Motion Tween. You simply move the playhead to the frame you'd like to create a new pose at – and make adjustments to the position of your armature.

Figure 12. Use Onion Skinning controls to preview the animation between Poses.

If you need to duplicate a pose for slight adjustments, or are creating a looping animation such as a character walk cycle… Animate has a really

simple way of managing poses. By bringing up the context menu from an armature layer, you will see a bunch of different options for dealing with armatures and poses.

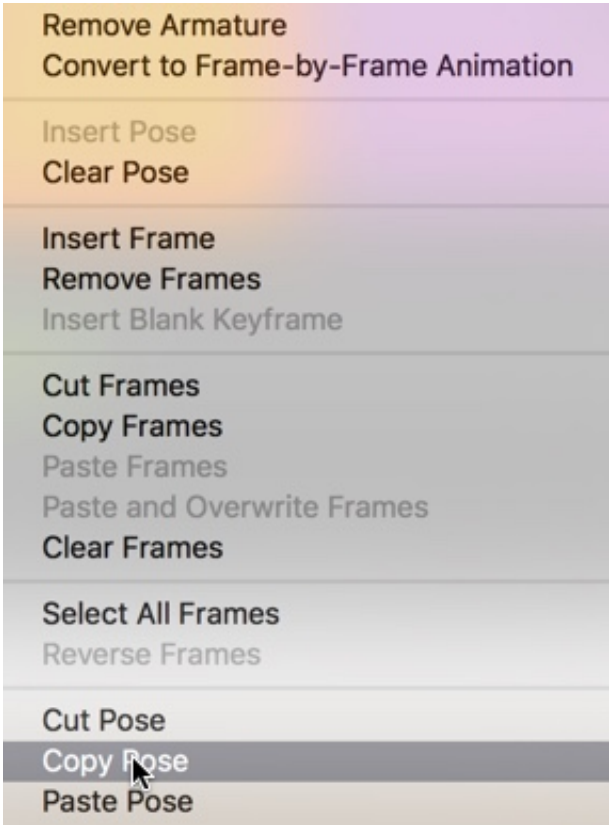

Figure 13. Managing poses from the contextual menu.

Most conveniently, this menu allows an easy way to copy and paste poses across frames. Note that in order to use this feature, you must have selected a frame which includes a pose in order to copy it from this menu.

Figure 14. The completed IK armature complete with poses.

Runtime Armatures

Whether building an armature from a shape or set of symbol instances, the option exists to use the armature as a “runtime” armature. What this means is that poses can be dynamically set at runtime by the user through interaction with the armature. To select this option, select any frame upon the armature layer and change it from the Properties panel.

Of course, you give away all control over the armature itself by allowing this… but it can be joyful for the user.

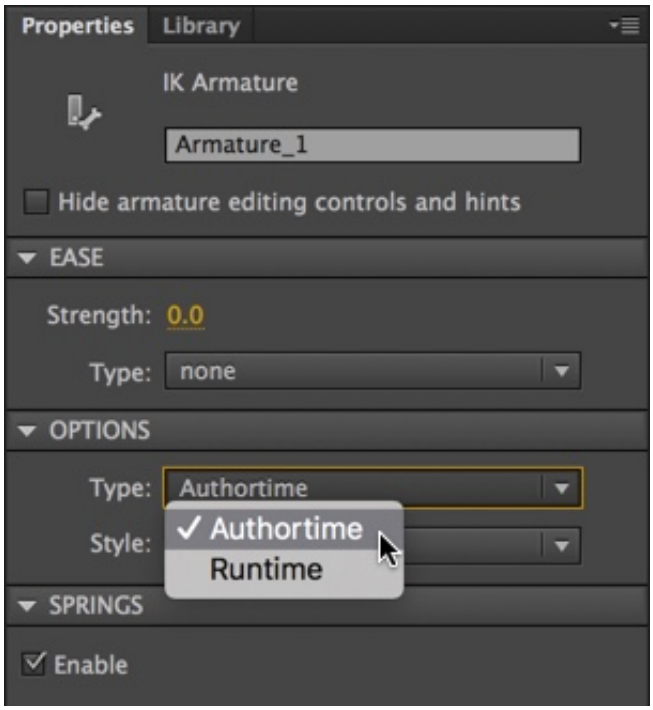

Figure 15. Selecting an armature type of Authortime or Runtime.

Note that you cannot use runtime armatures if the armature contains more than one pose.

Conclusion

While traditional frame-by-frame, shape tween, motion and classic tweens are all valid mechanisms to use within an Animate project… have a play at IK animation using the information presented here. It's a different way of animating – and one which can be both a fun way to explore a different animation mechanic and at the same time get a feel for IK physics. While it is a simple thing to create an IK armature in Animate, taking the time to finesse control points, joint rotation, springiness, and so on can really go far in making a believable armature.