

Biped Walk Cycle

(<http://www.alice.org/resources/how-tos/biped-walk-cycle/>)

Walk Overview

Alright! Let's talk Biped walk animation. When animating in Alice, it is important to know how the joints work. Please review the Manipulating Biped Joints how to for a break down of all of the joints and movements.

A Walk Cycle

When creating a walk animation you want to create something that can easily be looped since most times a person doesn't just take one step. In animation we call this a cycle.

When walking you don't return to a full standing position each time you take step. To avoid having your walk animation do this we first create an animation to bring the character into a pose that matches a position that a character would be in repeatedly while walking. We usually chose a point when the character is fully extended in a stride. This initial set up animation we call the Walk Start.

Once your character is in the starting pose you can create an animation that replicates a full movement that includes the limbs swinging/kicking to the opposite position and then returning to this initial pose. By doing a full cycle we insure that they are now ready to do the same animation again and the positions at the start of the animation will line up.

When you have completed your walk your character will find itself in a very unnatural position. Running the start walk animation would only continue to push the character into a weirder stance. You need to animate the character back to a standing position. To achieve this you can do the opposite animation of the Walk Start and your character will be back where they started at the very beginning.

For advanced implementations where the character is not in the base position to be able to use the Walk Start you can either use the `straightenOutJoints` procedure to first bring them to that position or create a new custom Walk Start that will animate the character to the proper starting position. Similarly if you want the character to end in a different position than standing you can create a custom Walk End to move the character to whatever the desired position would be.

A Natural Walking Motion

One way animators study for their work is to videotape themselves or others and break down what they see. If you want to create an animation that matches your walking style have a friend videotape you and try to break down what joints are moving when.

At the core of the walking motion are the movement of the legs and the swinging of the arms. The arms swing to counter to the leg motion. This means your right arm swings in sync with the opposite or left leg.

The Leg Kick

When you walk the basic leg motion is to straighten your leg as your foot comes forward and bend your knee as you kick your leg back. To achieve the movement of the leg you will want to focus on the turning of the hip joint forward and backward:

- Turning forward and backward - Turning the hip forward and backward is the natural forward and backward swing of the leg. Because of the orientation of the joint the direction may be opposite the intuitive direction relative to the character. A forward swing will rotate the leg towards the back for the character while a backward turn will bring the leg forward in front of the character.

We do not run with stiff legs. Your knee bends as you leg moves through the stride. For the knee bend you will want to focus on turning the knee forward and backward:

- Turning forward and backward - This will bend the knee in the natural way. Because of the joint orientation the turn direction may be counter to expected behavior with a forward turn bending the knee from straight to a natural bend behind the leg and a backward turn bending it back to straight or beyond if starting from a straightened position.

The ankle will pivot as the body moves over the planted foot to remain on the ground and to push depending on the form of the walk. In basic animations you can probably leave this out but for a more advanced walk animation you probably want to incorporate this motion. For the front to back pivot of the ankle you will want to focus on turning the ankle forward and backward:

- Turning forward and backward - This is the most common manipulation of the ankle and will bend the ankle to point the toes (forward) or bring the toes towards the shin (backward)

The Arm Swing

Most people don't walk perfectly stiff with just their legs. The arms generally swing to counterbalance the leg movements and stabilize you. For most people this motion has the arms swing in sync with the opposite leg. When the right leg is moving forward so is the left arm. For the forward and backward swing of the arm you will want to focus on the turning the shoulder left and right:

- Turn right and left - rotates the shoulder around the axis that runs across the body (through the two shoulders). This will achieve the natural arm swing forward and backward. The joints mirror each other so a left turn for the right shoulder will swing the arm in front of the body while a right turn for the left shoulder will achieve the same forward swing.

When the arm swings there is a natural tendency for the elbow to bend slightly on the forward swing and to straighten out on the back swing. This bending of the elbow is achieved by using the turn left and right:

- Turn right and left - Will bend the elbow joint to pull the arm in and to straighten or extend the elbow. Since the joints are mirrored turning the right elbow left will bend the elbow and turning it right will straighten it back out or overextend. The opposite turns will have the same effect for the left elbow.

Body Motion

When walking the body doesn't stay perfectly still. As you push off each step the body will naturally move up and down, the body will lean, and the head will bob slightly. There are many ways to achieve this. In our advanced example we focused on using the character move up and down to achieve the up and down spring of the step, manipulated the spine base joint to lean the upper body of the character forward and back, and turned the head joint to slightly nod the head to match these movements.

Example Walk Cycles

We have provided 3 different levels of walk cycle animations for you to use as reference in creating your own walk cycles or to import into your worlds as extensions of the biped class. To import them and add these custom procedures to your biped class you can look at the exporting and importing modified classes how to:

<https://www.alice.org/resources/how-tos/exporting-and-importing-modified-classes/> Each of these provided cycles is commented to help you understand how they work and to help you use

and modify them. You can look at the full Alice world for each example to see them implemented in myFirstMethod.

Basic Walk Cycle

This is a very easy to use and make walk cycle. It focuses only on the arm and leg movements. It includes a walkStart, WalkCycle, and walkEnd. The core walk cycle is made up of two major movements. The first segment has the arms and legs move to one extended position and the second segment swings them full in the opposite direction. This is a good first walk cycle to review and use and is easy to understand and modify. It uses default values and simple mechanics.

Advanced Walk Cycle

This walk cycle incorporates several added elements to the animation:

- The animation is broken down into 8 segments instead of 2 allowing for a more refined timing of when different parts of the body move. To achieve the same standard 1 second duration for the full cycle each of the 8 segments is .125 seconds long
- The animation has added the body motion, body lean, head nodding, and ankle bends.
- Instead of using the default value of .125 for the turn amounts the animator has used subtle differences to smooth out the motion.

Advanced Walk Cycle W/ Parameters

This walk cycle incorporates the use of parameters to allow you to change the speed and distance of the walk cycle.

Instead of setting a built in duration for each segment it passes the parameter variable walkCycleDuration. Walk cycle then has a variable that takes that parameter and does math to divide that number by the number of segments (8).

Instead of having the move be added in a doTogether in the myfirst method it passes a distance parameter into the cycle and reuses duration parameter to construct the move statements in the walkCycle procedure. This is broken into two move doTogethers to match the gait of the character.

This animation also makes use of the add detail begin and end abruptly begin and gently to adjust the cycle to try to smooth out the cycle.