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IK AND FK

But what the %&\$\$ is happening to my arm!!!

So you found some bugs in the software huh? That arm that was working great two minutes ago but has decided to completely freak out. Well we all flip out some times don't we? But why do perfectly good arms and legs have to flip at the most inopportune times. Let's explore the mechanics of joint systems and get to the bottom of joint flipping. In order to create the "hinge joint" type of motion found in elbows and knees, IK skeletal systems rotate on one axis and within one plane to mimic the motion of our own bones as in [Movie2](#). As you can see the joint always remains in the same plane no matter how the skeletal system orients itself. When we move the IK handle, however, we run the risk of creating situations where the IK solver cannot determine a solution. Joint flipping is caused by the IK handle moving near the chains preferred axis of rotation as seen in [Movie 3](#). The IK solver has no indication of where it's last position was when the angle is calculated. The solver is faced with a problem that it cannot solve based on the fact that there are two equal solutions to how the joint will orient itself. As the joint flips the computer cannot determine which angle is more appropriate and the joint flips on it's axis until the IK handle is moved away from the flipping plane. To see the joint flip as it crosses the flipping plane look at [Movie 3](#).

So how do I fix my flips?

The best solution that we have found is to create a node that the top chain in your characters arm or leg will always orient to. In most packages this is called an up or pole vector and is one of the most effective tools to fixing those pesky chain flips. Up Vectors are also great for quickly creating poses for arms and legs that you don't get automatically. The up vector allows the flipping plane to move out of the way of a IK handle. So when an IK handle nears the flipping plane we can move the up vector to change the orientation of the plane. Most of the time our up vectors move with the body of the character and will always remain close to the back of the character.

In newer packages like Maya and Softimage|XSI there are features built within the IK solver that allow the animator to keyframe a twist function that rotates the flipping plane automatically. This can be used in conjunction with a Up or Pole vector to allow for the utmost in control.

IK solvers are a great way to create motion that otherwise would take a long time to animate. If you set your characters up correctly the benefits of using IK far outweigh the negatives. Enjoy and

happy animating.

**Special Thanks to Sylvia Wong and James Tooley at ILM for
help in putting this segment together.**

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