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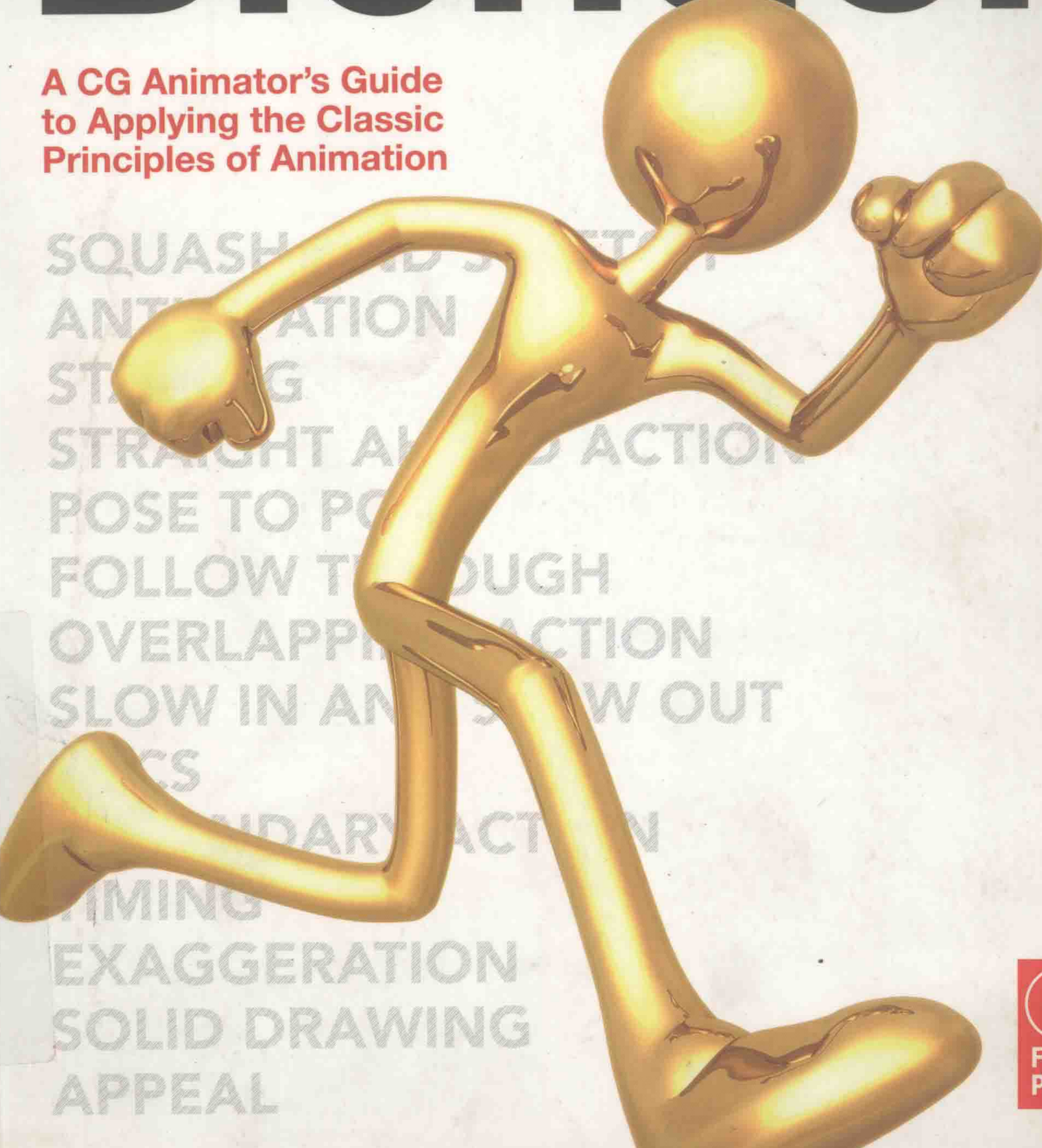
Blender

Roland Hess

A CG Animator's Guide to Applying the Classic Principles of Animation



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Focal Press

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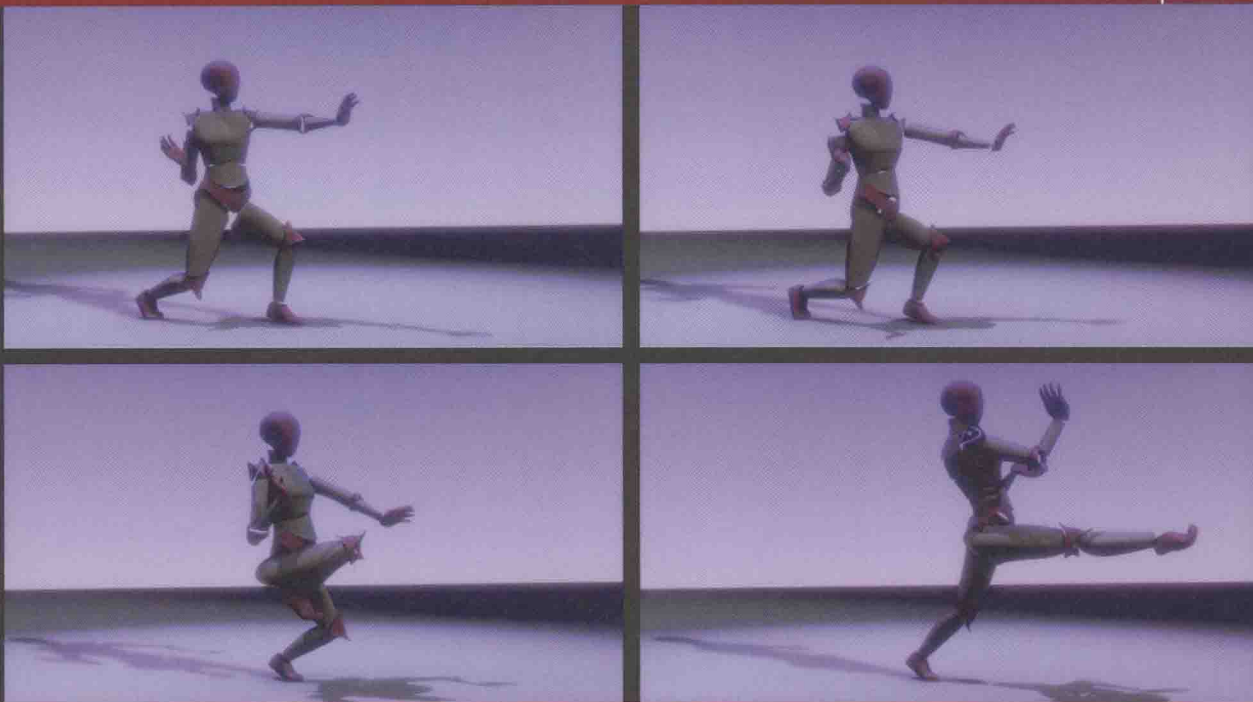


An Introduction to Character Animation in Blender

Animation as both an art form and popular entertainment has existed for almost a century now. The early attempts were received enthusiastically more for their novelty than for the quality of their craft. That even holds true today: animated movies often make it through the studio process not because of their true entertainment value, but based on the novelty of the technological innovation of the day. It turns out that the true core of quality animation as both art and entertainment lies in the joining of two elements: a compelling story and superior character animation.

Before we get too lofty though, let's take a little test.

Are you an animator at heart? Answer "True" of "False" to these questions!

1. I think I could have been an actor if only my face didn't look like this.
2. My techie friends think I'm a little too artsy.

3. My artsy friends think I'm a little too techie.
4. I can spend long hours pouring intensely focused attention into a single thing.

If you answered "True" to all of those questions, or simply found yourself nodding in depressed silence, then you probably have what it takes. If not, you can fake it, and I promise not to tell anyone.

Character Animation

To put it as simply as possible, character animation in computer graphics (CG) consists of posing a digital puppet, recording those poses along a time line, and then playing them back in real time as the computer interpolates between the poses. Later in this chapter, we'll take a look at the tools you can use to do this. Beyond the simple mechanics though, where do you begin? How do you know what pose to use, and when to use it?

The good news is that over the last hundred years, and particularly beginning with the 1950s, professional animators learned a lot about the language of character animation: what you can do, what you can't (or at least shouldn't) do, and what looks like life on the screen. A curious thing happens if you take real footage of a person engaged in some kind of action and trace over it, creating a kind of animation called *rotoscoping*. You would think that something traced from real life and motion would make the best animation, because all of its actions and reactions are perfectly true to life. The balance. The physics. The velocities.

To the contrary, rotoscoping gives you a fairly dead result. It looks okay, but there's clearly something missing, even though every line and jot is taken exactly from real life. The point is that, like with so many other art forms, the goal of an animator is *not* to exactly duplicate the real world, but to implement tools and techniques that give the *illusion* of reality when observed. In fact, once you learn the techniques and rules of animation, you can push the boundaries of reality quite a bit and get your viewer to accept as believable things that simply aren't possible.

Fortunately for all of us, the preceding generations of animators have already cracked this particular code. Through research, hard work, and a lot of trial and error, they determined a set of rules and tricks that when followed can help to give your own animations the feeling of life. Not all animators (or books, for that matter) agree on exactly what these rules are, or exactly how much emphasis you should put on one over the other. However, there is an acknowledged "core" set of rules that are generally used when teaching, and these are referred to as the "Twelve Principles of Animation."

The Twelve Principles

Throughout the rest of the book, we'll be animating a single shot using these principles. As we do that, you'll see exactly where and how they fit into the animation work flow. For now though, let's get an overview of the principles themselves. In order to demonstrate them, we need a model. The animation puppet that's included with this book will do. Say hi to "Junot" (**Fig. 1.1**). The character has four different skins, two female and two male, one each with a full skin (like in the figure) and another made of separate parts. You can see "Meyer" (the guy) in "tin can" mode in the other half of **Fig. 1.1**. Looking good, Meyer. Looking really good.

Squash and Stretch

In real life, when you jump from your porch and land on the ground, your knees and spine bend to absorb the impact. They only bend at the joints though, obviously. The bones themselves don't compress or flex in any noticeable fashion. If they did, it would be... bad. Likewise, if you were to slice your hand quickly through the air (*kiya!*), your hand would stay the same shape, no matter how fast you did it. In the world of animation, this is not the case. Depending on how stylized your animation will be, and how drastic the motions involved, actually squashing and stretching the otherwise rigid structures of the body can add life to the final result.

In **Fig. 1.2**, you can see Junot flying (or falling). Both the extended arm and the body itself have been stretched a bit. The effect isn't drastic, and in this case, you might not have even noticed due to the foreshortening

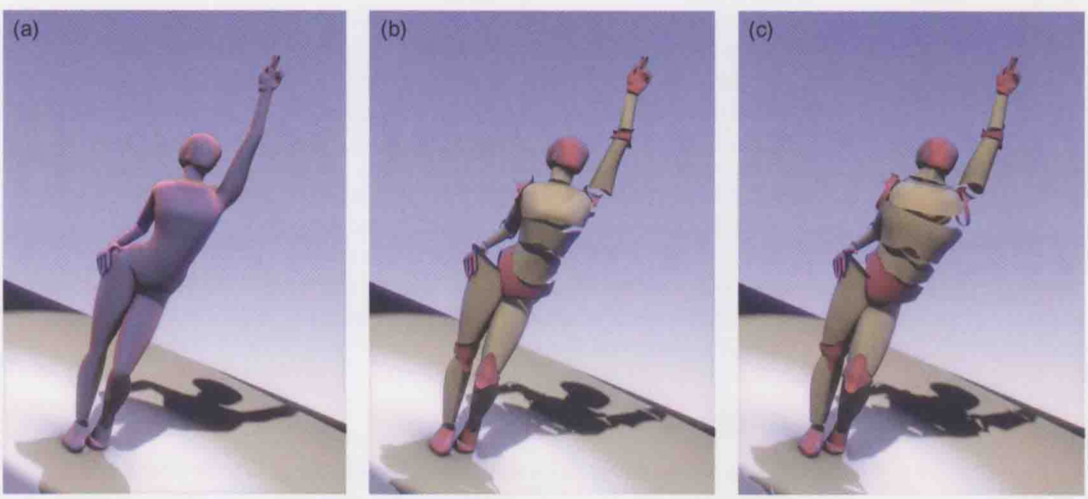


FIG 1.1 (a–c) Junot Strikes a Pose. Meyer Does the Same.

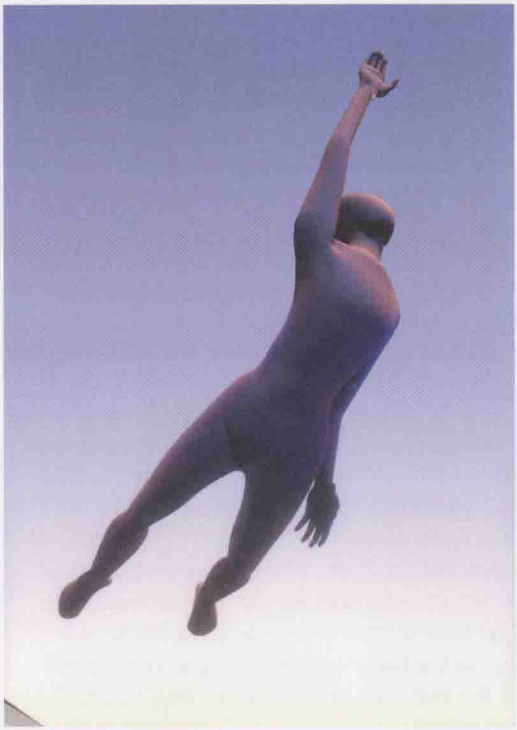


FIG 1.2 Junot Stretching as She Flies.

introduced by the camera angle. But it's in there, and if used for a brief moment in the middle of a fast action, it would add life to the animation, helping to emphasize her high forward velocity.

Let's meet one more character: Smith. Smith is the same basic puppet as Meyer and Junot, but he has been given cartoon-like proportions. A character like Smith can endure a lot more squash and stretch during animation than his more realistically proportioned siblings. **Fig. 1.3** shows Smith landing from a leap, with and without squash and stretch.

The rules are this: the faster the action, the more squash and stretch you need. The more realistic the character, the less you should use. So, a character like Smith who is bouncing around the room like Daffy Duck will most likely exhibit some extreme squash and stretch. If Junot and Meyer were sitting on a park bench playing a game of chess, they would have almost none.

Anticipation

In **Fig. 1.4**, Meyer is about to throw a devastating punch. What's that you say? He isn't? Clearly, Meyer does not look like someone who is about to strike. Myths about Bruce Lee being able to deliver a devastating blow from mere inches away without any kind of wind up aside, when one person—and thus,

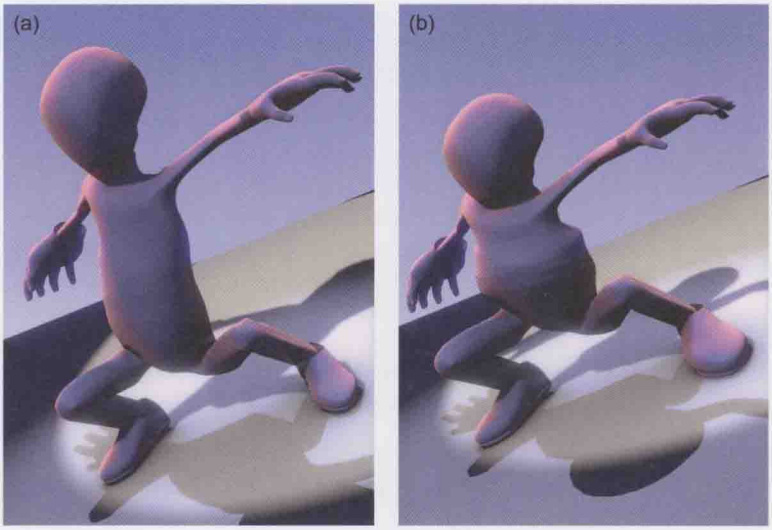


FIG 1.3 (a, b) Smith Just Fell Off the Roof. Don't Worry. He's Okay.

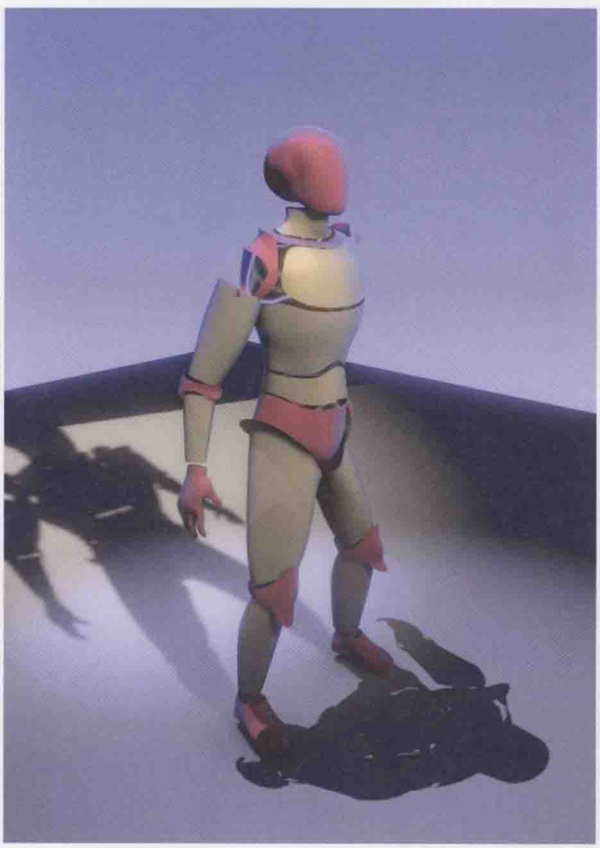


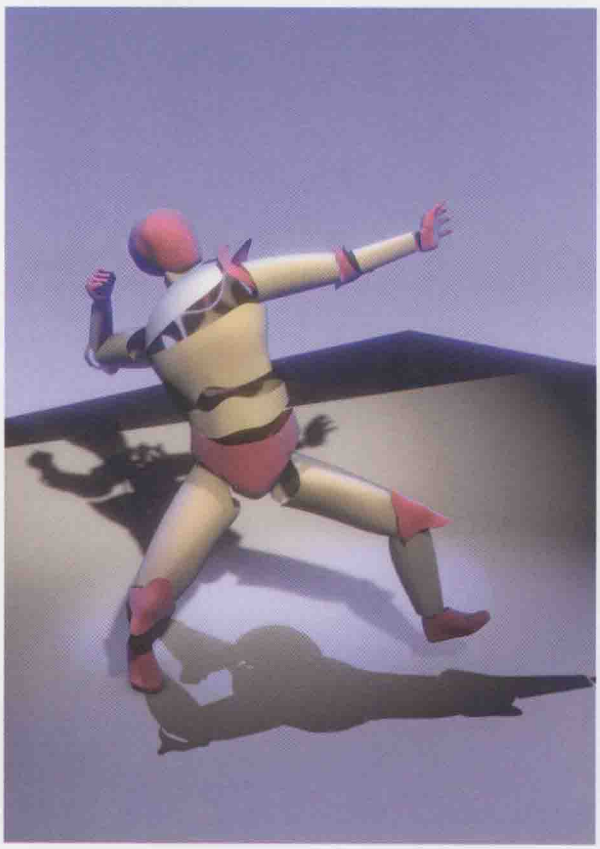
FIG 1.4 Are You Gonna Do Something, or Just Stand There and Bleed?

a character—does something, one almost always anticipates the action. The larger or more forceful the final action, the correspondingly big the anticipation must be to make it feel right.

Anticipation helps to bring balance to your animation, not in the sense of left-to-right or in making sure that the character's weight makes sense over its points of support, but balance in time. What comes *after* necessitates that something comes *before*. We don't think about it in those terms when we go about our daily lives, but that is only because our bodies are so good about planning ahead for us. Almost constantly, our bodies are one step ahead of us, preparing themselves for the next thing that they already know we are going to do. What happens when our bodies don't plan properly and that anticipation doesn't happen? We turn around and walk into the door (or flying ball, or car) we didn't see and a whole different branch of physics takes over.

Additionally, anticipation can be used to grab and direct the viewer's attention. Not only does it provide the proper physics, but it also shouts "Look what I'm about to do!" (**Fig. 1.5**).

FIG 1.5 Meyer Now Actually Ready to Heave-ho.



Admittedly, that's a drastic anticipatory pose. It is pushed to the point that his body is breaking up, and you almost can't read it. I'm not even going to show you the fully skinned version. There is lots of pinching and nastiness. However, this type of extreme anticipation pose wouldn't show for more than a couple of frames, and the human eye isn't fast enough to note it in detail. Coupled with some motion blur, it will give an impression of extreme motion, great force and life, just before impact.

Staging

My preferred term for this is "Composition" because I think more photographically (Get the shot!) than theatrically (Places everyone!), but it amounts to the same thing. Where is everything on "stage?" How does it actually look in the camera? Where is the viewer going to be focused? Cinematographers have developed an entire language for directing the viewer's attention to different elements on the screen, and we get to borrow heavily from them. While we can use all of their tricks—lighting, color, focus, contrast, etc.—the basics will have to come first.

Fig. 1.6 shows Junot feeling sad. Well, it does if you can find her. Nothing about this composition favors the subject or theme. The eye is directed far away from her by the lighting, which is too bright and cheery to begin with. She is too small in the frame compared to her surroundings, and the proportions of the piece are all off.

However, if we take the exact same objects, compose the shot differently, and apply a different lighting scheme, we get something like **Fig. 1.7** that is much more suggestive, and certainly more in keeping with the subject matter. There is no question what the focus of the shot is supposed to be and the visual lines of the light and the ground itself point us to Junot.

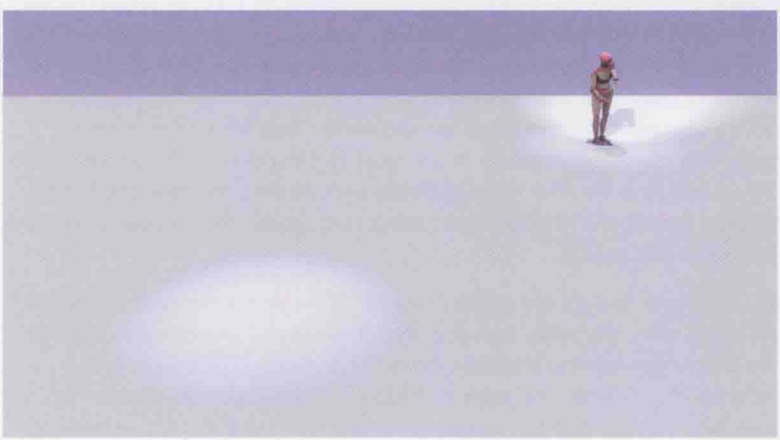


FIG 1.6 Citizen Kane This Is Not. Composition Matters.

FIG 1.7 Much Better.

Not every shot must be a stylistic masterpiece, but you at least need to make sure that your staging isn't fighting against your animation. Your animation will lose.

Overlap and Follow Through

Although they are used for different effects, both of these terms demonstrate the physical principle of inertia on the character. Remember Newton's first law of motion (paraphrased): stuff wants to remain at its current velocity (which could include zero velocity—standing still), unless something happens to it. Kind of obvious, but the implications in animation are immense. Inertia is simply an object's desire to just keep doing what it is that it was doing before. A block of wood on the ground isn't going anywhere by itself. Give it a kick, and it takes off.

Think about the foot that gave the kick for a moment. It was just happily planted on the ground a moment ago, when all of the sudden the hip rotated, which pulled the upper leg along with it, which put torque on the knee joint, which transferred that energy to the lower leg, on again to the foot which finally moved. In real time, it didn't take long for that chain of motion to reach the leg, only a fraction of a second, really. But each part of the leg experienced inertia and wanted to just stay where it was until something else made it move. If you were to slow down a karate kick with high speed film, the effect would be obvious. At first, the foot and lower leg drag behind the rotating hips and driving quads, only snapping forward at the end like a whip.

Fig. 1.8 shows Junot's leg doing just this. When you make your characters move this way, it is called overlap. One other aspect of overlap is to make sure that your character's limbs (and other assorted bits) do not move perfectly in sync with one another. Motion professionals like dancers or magicians may do this, but in general if you reach out to grab something

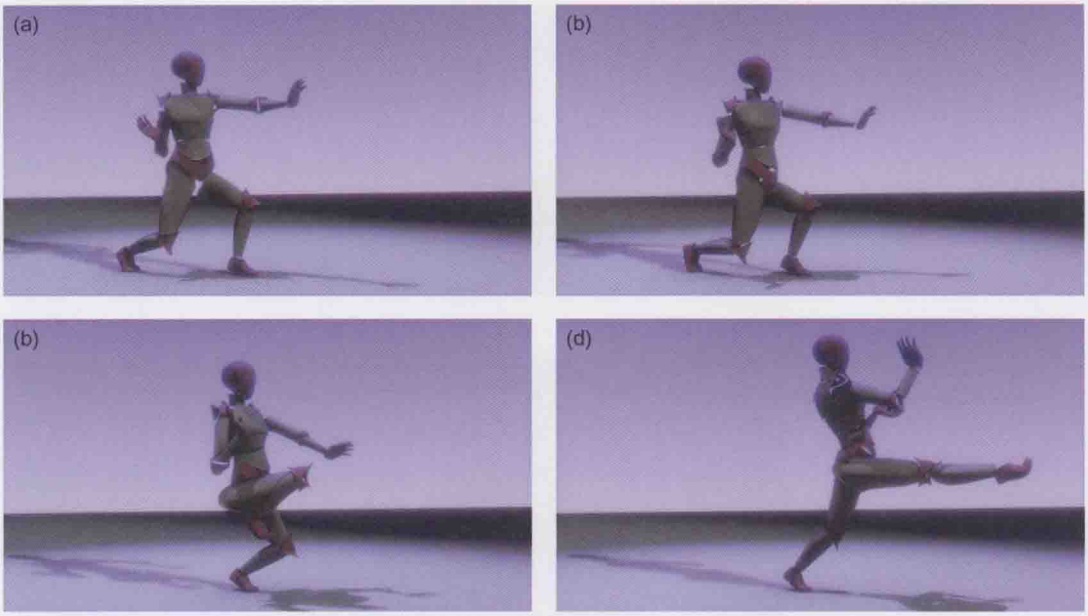


FIG 1.8 (a–d) A Leg with Overlapping Action Demonstrates the Inertia of the Body.

from a counter top with both hands, they will not hit the object at the same time. There will be only a fraction of a second of difference between the two, but in animation, you are responsible for those fractions. Only machines move in perfect synchronicity.

The second part of this principle comes into play after the motive force of the event is over. After the kick, what happens? The character doesn't simply withdraw its foot and return to a standing position. Weight shifts. Momentum probably carries the body forward into a new stance. If the character has long hair, loose clothing or pockets of fat, it will continue to move after the rest of the body has stopped. This is follow through. If you've ever played sports, you'll have heard your coaches encouraging you to follow through and finish your motion. You need to do that in CG as well.

Slow In and Out

CG animators often use the term "ease in" and "ease out" for this principle. It refers once again to the physical principle of inertia. If something is stopped, it can't just be moving rapidly in the next instant. It starts out slowly, gaining speed, until it has reached "cruising velocity." Then, before it stops, it slows down, unless it does something disastrous like smashing into a concrete wall, in which case it stops almost immediately and probably exhibits some extreme squash and stretch. Wiley Coyote, please call your doctor. This was a big deal in the days of hand-drawn animation, and many

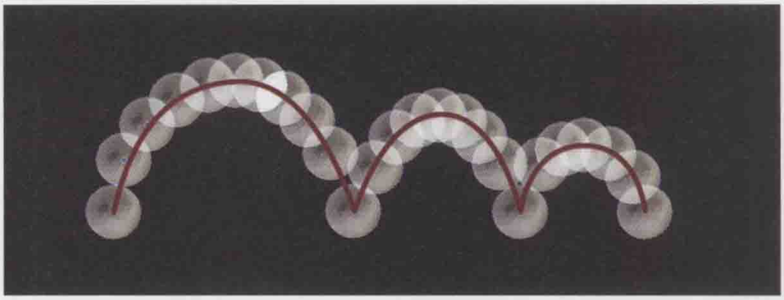


FIG 1.9 Two Balls, Moved in Time (Ball Bouncing along a Floor).

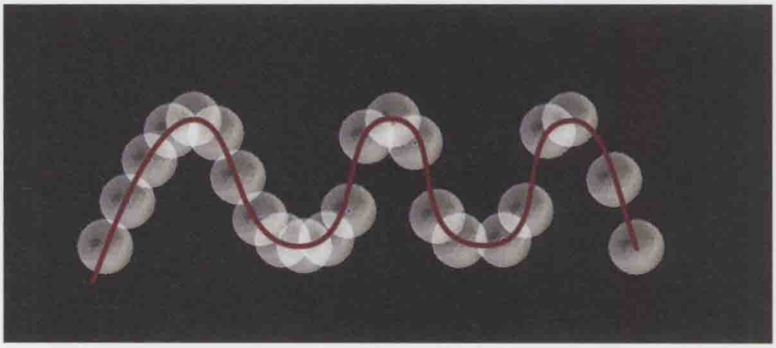


FIG 1.10 Two Balls, Moved in Time (Ball without a Bounce Point).

beginners think that since the computer handles this for you, it's not relevant any more.

While it's true that computer interpolation can generally handle ease in and out, the way that it does so encodes a lot of information for the viewer. Check the very standard "bouncing ball" diagram above in **Figs. 1.9 and 1.10**. The **Fig. 1.9** demonstrates a standard ease in/out for a moving ball. Note how the more widely spaced balls near the bottom of the figure suggest that the ball is moving rapidly there, while the closely spaced ones near the top of the arc indicate slower vertical motion. It looks like a ball bouncing along a floor. In contrast, **Fig. 1.10** shows a different motion path, one without a "bounce" point where our intuition tells us that a floor would belong in the other illustration. It certainly doesn't look right for a bouncing ball. Perhaps it's an overhead view of a ball weaving back and forth across a plane. Really though, the only difference between the two motion paths of the ball is the way that slow in/out has been handled. Properly handling this slow in/out is crucial to the perception that your motion is physically correct.

Arcs

This one's pretty simple, and not as much of a problem in 3D as it is in traditional animation. **Fig. 1.11** shows Smith's arm moving at the shoulder. Note the arc that the fingertips make. It's pretty obvious why this