Excerpts from the
Digital Filmmaking Handbook
“Camera”

WEB/MULTIMEDIA

The compressed video that is used for Web and multimedia projects might be of lesser quality, but this doesn't mean that you should just get that old VHS camcorder out of the closet and start shooting. Web video is good enough to reveal artifacts such as light flares and noise. Similarly, if you're planning on night shoots or special effects such as blue-screen compositing, you will need a higher-quality format. In addition, shooting better quality affords you the option of repurposing your footage later. Although the low quality of streaming Web video means you could get away with consumer VHS or Hi8, go ahead and spend a little extra money and shoot DV. The higher quality will yield a better image and provide more shooting and effects flexibility, while the camera's FireWire interface will make for an easier post-production workflow.

HOME VIDEO

If you're planning a "straight-to-video" release, or are preparing a corporate presentation or trade show video, you can count on your project being distributed and viewed on VHS. This means that you can get away with shooting in any tape format that's better than VHS; that is, all of them. As with Web video, you'll need to pick a quality that suits the type of shooting you plan to do.

BROADCAST TELEVISION

Almost any of today's digital formats pass the muster for being broadcast, although broadcasters all have different criteria for what they will accept. In general, if you ultimately want your project to be suitable for broadcast television, you should aim to shoot at the highest quality you can afford. In addition, you'll have to master your final project according to very exacting specifications. We'll talk more about this process in Chapter 18, "Output."

PROJECTION

Any format can be used for projection, but there is one important thing to keep in mind: people will be seeing your video footage at 10 to 50 times the size of your video monitor. Noise and digital compression artifacts can be enlarged to the size of someone's head. Consequently, you should try to work at the highest quality you can afford.

If you ultimately want your project to be projected from a film projector—in a movie theater, ideally—your final video will have to be transferred to film. In theory, you can shoot any video format for eventual film transfer. We've even seen a number of excellent documentaries shot on Hi8. However, if quality is your primary concern, you'll want to choose a higher-end digital format such as DigiBeta or one of the HD formats. DVCAM and DVCPro are the next step down, although it's not uncommon to see MiniDV transferred to film as well.

HD projection has come a long way in the last couple of years. Although only a few theatres use digital projection, it's common to see digital projection—or even just a normal, high-quality video projector—in film festivals for projects that haven't been transferred to film.

TRYING TO CHOOSE

Once you have a better idea of how you will deliver your final product, you can begin to think about the best video format for the job. If you read the last chapter, then you should have a better understanding of the technical characteristics of video recording. Hopefully, this will help you better understand the characteristics and capabilities of different formats.

In the following list, we discuss the advantages and disadvantages of many different video formats. Take a look at the list to get a better idea of how you can use each format. Some of the higher-end formats might require cameras that are more expensive than you can afford. However, because these cameras are readily available for rental, and because such formats are required for very high-quality work, we've chosen to include them.

- **Analog consumer formats.** Most people are familiar with VHS, S-VHS, Betamax, 8mm, and Hi8, all of which were developed for home video. These formats are very inexpensive, but their lack of image quality should deter most serious video producers. Spend a little more money and shoot DV.
- **Digital 8.** Digital 8 is an 8mm consumer format intended to replace analog Hi8. It can use Hi8 or its own Digital 8 tapes. It has a 25 Mbps data rate, a 4:1:1 color sampling ratio, and 5:1 DV-based compression, but is slightly lower resolution than DV. For longer projects, DV is a better choice.
- **DV.** Intended as a digital replacement for the home video formats mentioned previously, DV has far surpassed the manufacturers' expectations. It has a 25 Mbps data rate, a 4:1:1 color sampling ratio, and a 5:1 compression ratio. The image quality is frequently rated higher than Betacam SP and has the advantage of being less subject to generation loss.

- **DVCAM.** DVCAM by Sony offers a higher tape speed than DV, but not quite as high as DVCPro, and it uses the same metal tapes as DV. The resulting higher-quality image is aimed at industrial users, but appears to be quickly becoming the low-end format of choice for broadcast.
- **DVCPro.** With a faster tape speed than DV and DVCAM, JVC's DVCPro sports a more stable image that is less prone to drop-outs.

The Right Format for the Job

All of the 25 Mbps formats—Digital 8, DV, DVCPro, and DVCAM—use the same CODEC. Therefore, any differences in image quality are hardware dependent; in other words, due to camera technology, lenses, and so forth. DVCPro and DVCAM are considered superior formats because of their reliability in editing-intensive applications such as news gathering, and because of the higher quality cameras and lenses available for these formats.

- **Betacam SP (BetaSP).** Developed by Sony in the 1980s, Betacam SP is still the most popular format for broadcast television.
- **Digital Betacam (DigiBeta).** Sony introduced Digital Betacam in 1993 as a digital upgrade of Betacam SP. Its extremely high quality has made it the broadcast mastering format of choice. Many high-budget digital films, such as *The Buena Vista Social Club*, are shot on DigiBeta. Digital Betacam decks can also play (but not record) analog Betacam SP tapes.
- **HDCAM.** Sony's contender in the high-definition formats, HDCAM is NTSC/PAL switchable and has an optional 24-fps frame rate. It is aimed at high-end film to digital video uses.

Choose Carefully

The movie The Cruise *was shot on NTSC using a Sony VX1000 MiniDV format camera, but the director was so unhappy with the frame rate issues that resulted from the transfer to film that he ended up going back to his sources and remastering onto a Sony uncompressed HDTV format and then going to film. The process of changing from one digital video format to another is called* transcoding. *It is not a lossless process and should be avoided, if possible.*

Once you've selected a format, you're ready to choose a camera that can shoot that format. Unlike many high-tech industries, the digital video world is surprisingly stable. Where computers might be rendered obsolete every year, digital video cameras tend to have a bit of a shelf life. Although we mention a few cameras by name at the end of this chapter,

the goal of this section is to give you the information and techniques you need to evaluate a camera on your own.

Whether you're buying or renting, if you consider the questions raised here, you should be able to more easily make a shrewd camera choice.

EVALUATING IMAGE QUALITY

Portability and cool features are nice, but if that lightweight camera with the cool special effects produces images with lousy color and distracting artifacts, your audience will be less inclined to pay attention to your story.

Two factors contribute the most to your camera's image quality (or lack thereof): the camera's lens, and the number of chips the camera uses to create an image. Your first choice, then, will be to decide between single-chip and three-chip models.

CCD

In the old days, video cameras used vacuum tubes for capturing images. Today, video cameras use special imaging chips called *CCDs*, or *charge-coupled devices*. Just as their tube-based predecessors used either one or three tubes to capture an image, CCD-based cameras use either a single CCD to capture a full-color image, or three chips to capture separate red, green, and blue data, which is then assembled into a color image (Figure 4.2).

A CCD looks like a normal computer chip, but with a sort of light-sensitive "window" on the top. The imaging window is divided into a grid, and the circuitry controlling the CCD can determine the amount of light striking each cell of the grid. That data can be used by the camera to build an image. The finer the grid, the higher the resolution of the CCD.

Single-chip cameras have red, green, and blue filters arranged over clusters of cells in the CCD. These filter the light coming through the lens and allow the camera to record color images. A single-chip camera uses one chip to gather all of its color information; when compared to a three-chip camera, a single-chip image might show strange color artifacts or bleeding, smeary colors, as well as a softer, lower-resolution image.

In a three-chip camera, a series of prisms splits the incoming light into separate red, green, and blue components, and directs each of these components onto a separate CCD. Because the camera is dedicating an entire sensor to each color, color fidelity and image detail are much improved over single-chip cameras (Figures 4.3 and 4.4).

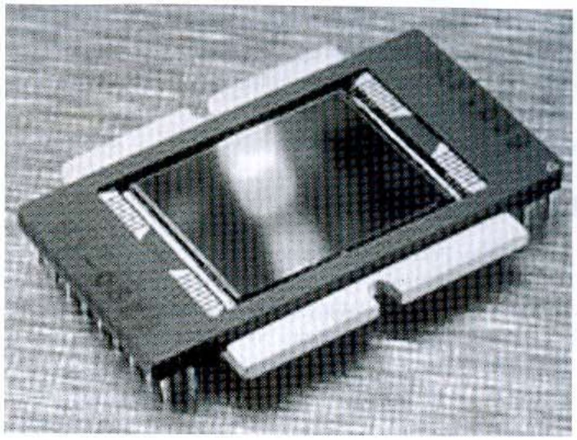

FIGURE 4.2 A Kodak KAF-1302E(LE) CCD.

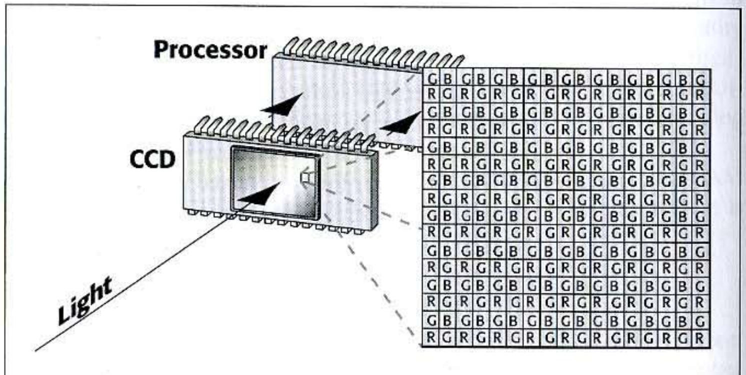

FIGURE 4.3 In a single-CCD camera, light is focused by the lens onto the CCD. Red, green, and blue filters placed over alternating cells of the CCD enable the camera to calculate color. The resulting data is passed on to the camera's processor. (Notice that there are far more green cells to accommodate your eyes' high sensitivity to green.)

The image data gathered by the CCD is passed to an on-board computer that processes the data and writes it to tape. How the computer processes the data can have a lot to do with how images differ from camera to camera. Some cameras tend to produce warmer images, with

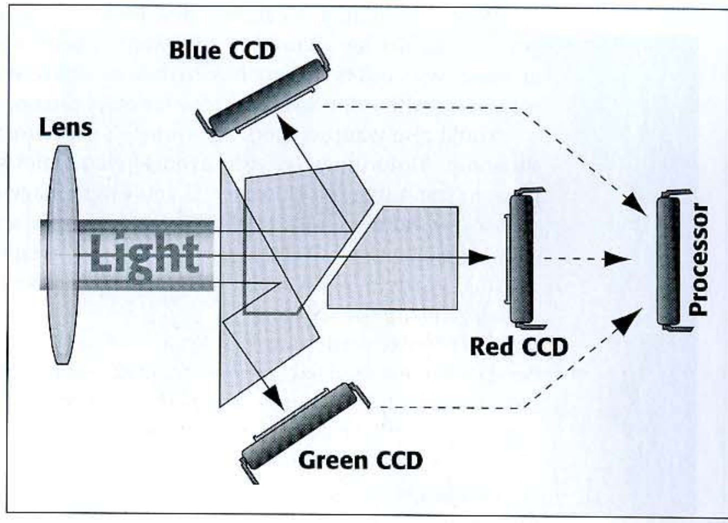

FIGURE 4.4 In a three-CCD camera, light is focused by the lens onto a series of prisms that split the light into red, green, and blue. Each component is directed toward its own CCD.

stronger reds and magentas, while others might produce cooler, less-saturated images with stronger blues. One approach is not better than the other, but you might find that you have a personal preference, or that one is better-suited to the tone of your project.

EVALUATING A CCD

You shouldn't have any trouble determining if a camera is a single- or three-chip device, as vendors tend to clearly tout their extra chips in writing on the side of the camera. Typically, three-chip cameras start at around $2,000 to $2,500.

Although three-chip cameras are definitely better than single-chip units, the difference is not as extreme as it used to be. If a single-chip camera is all you can afford, don't worry: there are plenty of good single-chip units out there. As an example, Thomas Vinterberg shot *The Celebration*—which went on to a wide theatrical release and a special jury prize at the Cannes Festival—using a Sony PC7, a $1,000 single-chip camera that has since been replaced by newer models.

When evaluating a camera, first look at its color reproduction. If you're a stickler for accuracy, you'll want to see if the camera can create an image with colors that are true to their originals. Whether or not you're concerned with color accuracy, look for color casts or odd shifts in color.

You'll also want to check the camera's response to different lighting situations. Unfortunately, your average electronics store is not the best place to test a camera. However, if you can manage to point the camera out of a window, or into the dark recesses of a shelf or cabinet, you should be able to get an idea of the CCD's color response under different lighting. In addition to color consistency, and casts or shifts in color, look for additional noise.

CCD-based cameras can have a tendency to create vertical white bands when exposed to bright elements in a scene. Different cameras employ different techniques to deal with this problem, and some are better than others. When evaluating a camera, point it at a bright light (but never at the sun!) and then quickly tilt the camera down. Look for vertical banding and smearing during the camera move. Vertical banding is not a reason to reject a camera, as you can always work around it, but it is important to know if your camera has this tendency.

STAY SHARP

Many cameras try to improve image detail by applying sharpening filters to each frame of video, just as you might apply a sharpen filter to an image in Photoshop. While these features are great for improving fine detail in a shot, they are often too much of a good thing. Apply too much sharpening, and diagonal or curved lines will appear jagged, or aliased.

Oversharpening is easiest to spot on moving objects or during camera movements. Areas of high-contrast—a car in front of a brightly lit wall, for example—are also prone to oversharpening artifacts. When testing a camera, pan it about and look at objects that have very high-contrast edges. Look for "moving," jagged edges. Next, point the camera at an object with a thin, high-contrast horizontal line across it. Look to see if the line is stable or if it flashes on and off. Tilt the camera off-axis and watch how much the edges of the horizontal line change and alias (Figure 4.5).

Sharpening can also be a good thing, so as you are watching for aliasing, also pay attention to how sharp the camera renders fine detail. If you are testing in an electronics store, shooting objects with buttons, switches, and LEDs make great tests.

Higher-end cameras such as the Canon GL-1 often have a sharpening control. If the camera in question has such a control, play with it and see if you can use it to resolve oversharpening problems. Pay attention to how

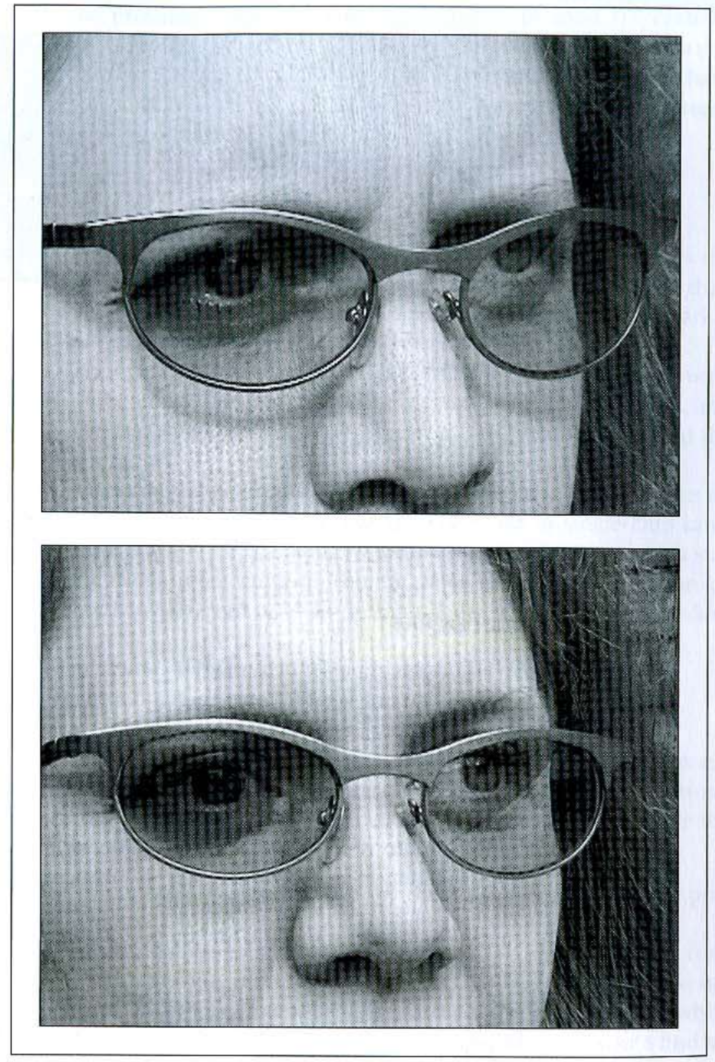

FIGURE 4.5 Oversharpening can create annoying artifacts that jump and slide around your image. In the upper image (shot with a Sony DCR-PC1), notice the strong aliasing around the top of the glasses. The bottom image (shot with a Canon GL-1) lacks the aliasing around the glasses.

fine detail changes as you adjust the sharpening. In addition, look for any color shifts or changes as you adjust sharpening controls (Figure 4.6).

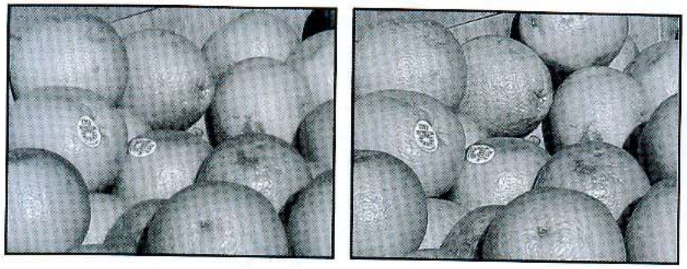

FIGURE 4.6 If your camera has a manual sharpness control, you can decide how much sharpening is appropriate for your image.

Blue-Screen Troubles

If you're planning to do any chroma key work (which we discuss in detail in Chapter 16, "Titling and Simple Compositing"), then you'll definitely want a camera with a sharpening control.

WHITE BALANCE

To accurately represent color, your camera needs to know what objects in your image are white. Once the camera is calibrated for white, it can more accurately reproduce other colors. Most cameras can automatically adjust their *white balance* once they've been told what type of light is being used to light the location. We discuss white balance in detail in Chapter 7. When evaluating a camera, though, see what white balance options are included. At the least, a camera should provide separate settings for indoor or outdoor. Better are cameras that provide presets for specific types of lights. The ideal white balance control is a fully manual control that takes a reading off of a white object that you hold in front of the camera.

Lenses

Just as a film camera works by using a lens to focus light onto a piece of film, a digital video camera uses a lens to focus light onto the imaging window of a CCD (or group of CCDs). And, just as the quality of lens on a film camera can mean the difference between good or bad footage, the quality of the lens on your video camera can mean the difference between sharp images with good color, and soft images with muddy color.

At the prosumer and low-end professional level, most DV cameras have fixed zoom lenses; that is, you can't change the camera's lens as you might on your 35mm SLR camera. At the higher end, DV cameras have interchangeable lenses that let you select from a variety of zoom ranges, wide angles, and telephoto options.

LENS QUALITY

When evaluating lens quality, look for changes in brightness across the image. Does the lens produce images that are brighter in the middle than at the edges? As you zoom the lens in and out, does the image get darker as the lens goes more telephoto?

Look for distortion around the edge of the image, particularly at wide angles. Does the image bow in or out as you zoom the lens back and forth? Similarly, look for changes in sharpness and detail throughout the lens' zoom range.

Chromatic aberration occurs when the lens does not equally focus all wavelengths of light. This problem is usually worse in single-chip cameras, although three-chip cameras with lower-quality lenses can also suffer from chromatic aberration. You can spot chromatic aberration by looking for fringes of red or green in high-contrast areas or around dark lines.

LENS FEATURES

Depending on the quality of their controls, some lenses are easier to use than others. To make sure your lens provides controls that let you get the type of camera movements and effects that you want, consider the following:

- **Zoom control.** Is the zoom control well-positioned, and does it provide for smooth zooming at variable speeds?
- **Manual focus.** If your camera has manual focus, where is the control? Whether electronic or mechanical, test the camera's manual focus for ease of use and reliability. Also be sure it holds focus when set. If the lens in question has a focusing *ring* (like what you'd find on a 35mm SLR camera), check to see if it has distances marked on it.
- **Aperture.** As with focus rings, some higher-end lenses have manual rings for controlling the lens aperture (we discuss apertures later in the chapter). Check for f-stop markings, ease of use, and accuracy.

Although lower-end cameras tend to have lenses built right in to the camera's body, this doesn't mean that they're necessarily low-quality lenses. Canon and Sony both include very high-quality lenses on cameras priced all the way down to $1,200. We discuss manual camera operation in more detail later in this chapter.

Never Mind the Reasons, How Does It Look?

At some point, you need to take a step back and look at the images produced by the cameras you are considering. You might find that you like one image better than another, and you might have no idea why. That's okay. If you prefer one image over another, but can't find a technical reason for your preference, don't worry about it. In the end, your subjective opinion is more important than any technical benchmarks or specifications.

> Most consumer video cameras include a digital zoom feature. When digital zoom is activated, the camera will begin to digitally enlarge the image after you have zoomed to the optical limit of the lens. The results of this "fake zoom" are often terrible. At extreme zooms, shapes become blobby mosaics of muddy color, and even a minor amount of digital zoom can introduce noise and ugly artifacts. Unless you are intentionally going for a grungy look, digital zoom is a useless feature—turn it off and leave it off! (If you are going for a grungy look, shoot non-grungy footage and grunge it up in post-production. You'll have much more flexibility.)

ES

You might find that you see little difference in quality between cameras. If this is the case, then you can make your buying decision based on the features that you need and want. As a filmmaker, your feature requirements are different from those of the casual home user, so examine each camera's features carefully.

Ergonomics

Currently, there are DV cameras ranging from the size of a personal stereo all the way up to large, shoulder-mounted units. Choosing a "style" of camera means balancing features and shooting style, with cost.

Smaller cameras typically lack high-end inputs such as XLR audio jacks (more about audio jacks in Chapter 8). They also usually don't have as many manual features and practically never include such niceties as lenses with aperture and focus markings.

On the other hand, small size makes a camera easier to carry, and ideal for surreptitious shooting. For documentaries, a low-profile camera might help you to get candid footage (nothing shuts up an interview faster than sticking a big lens in a person's face) or to shoot clandestinely in locations that wouldn't normally allow a camera (Figure 4.7).

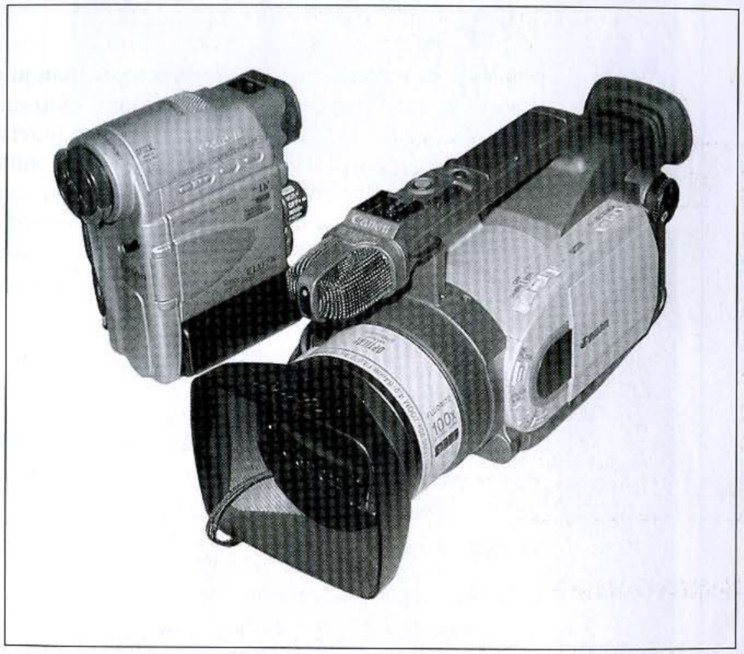

FIGURE 4.7 The design of your camera not only dictates how comfortable the camera is, but what types of shots you'll be able to get. While a small hand-held might be more portable, a larger camera will facilitate more complex cinematography.

Similarly, if you're shooting a feature, a smaller camera makes it easier to shoot scenes without being seen (drawing a crowd with your production can often slow things down). If you're shooting without a city permit or permission, the "tourist" look of a smaller camera might be just what you need to keep from getting hassled.

Larger cameras usually sport three CCDs for better image quality, while their heavier weight makes for easier shooting and smooth, steady camera moves. And, let's face it, they look cooler.

Don't ignore the camera's physical feel. To get the footage you need, you must be able to move the camera with great precision. If a camera is too heavy (or light) or too bulky for you to pan and tilt comfortably, you might not be able to get the shots you want. The camera's weight can also have budgetary consequences, as a heavier camera will require a more sturdy—and therefore more expensive—tripod.

Batteries

Having a battery die during a shoot is more than just an inconvenience, it's a time and money waster. Unfortunately, most cameras ship with batteries that won't last over a long shoot. When purchasing, find out what other batteries are available, and how long they will last.

Ideally, you'll want enough battery life for several hours of shooting. Battery cost should be factored into your assessment of final camera cost. Note that using an LCD viewfinder will consume your batteries faster. If you know you'll be using the LCD a lot, you'll need to assume shorter battery life.

Third-Party Batteries

For extra-long life, consider a battery belt such as those made by NRG Research. With enough juice to power a camera and light for several hours, a battery belt is a great—although bulky and costly—solution to short battery life.

Manual Override

The most important feature for the serious videographer is manual override. Controls for manually setting the camera's focus, aperture, shutter speed, audio levels, and white balance are essential for flexible shooting.

The problem with automatic mechanisms is that they're not too smart and they have no artistic flair. Rather, they are designed to produce a good picture under common, ideal shooting situations.

With manual focus controls, you can choose what to focus on, and compose your shots the way you choose. Similarly, manual aperture controls (sometimes referred to as *iris* or *exposure*) let you compensate for difficult lighting situations such as harsh backlighting (Figure 4.8).

Lower-end cameras typically provide electronic manual controls that are accessed through a menu system or from buttons on the camera's

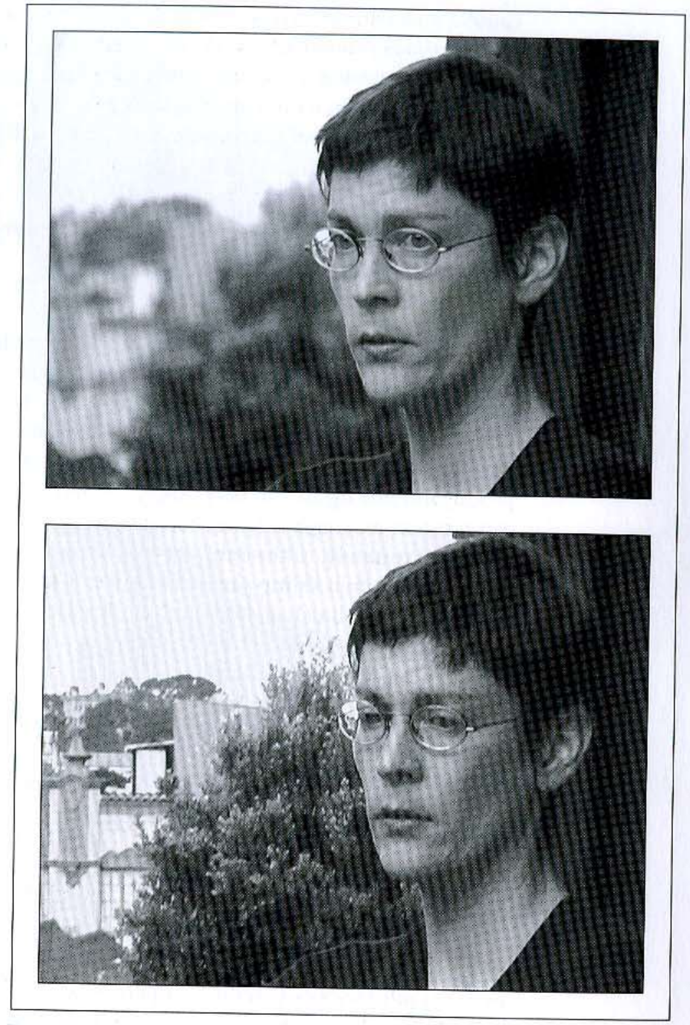

FIGURE 4.8 Manual controls give you more freedom for composition. In this example, we used manual focus and aperture controls to go from an image with a sharp, focused background to one with a soft, blurry background.

control panel. Higher-end cameras will have lens-mounted rings just like the rings on a 35mm still camera.

Lower-end cameras usually don't have values marked on their focus or aperture controls; instead, they display simple slider graphics in the camera's viewfinder. While this is effective, the lack of quantifiable settings can make it difficult to get the same settings from shot to shot. Such electronic controls are not necessarily suited to changing aperture or focus on-the-fly, making it difficult to do *rack focus* or *pull focus* shots (see Chapter 7, "Shooting Digital Video," for more on these types of camera moves).

Manual What?

We discuss the theory and use of manual iris and shutter speed in Chapter 7.

SHUTTER SPEED

Most cameras automatically select a shutter speed based on their aperture setting, a process called *shutter priority*. Many cameras also provide manual shutter speed control, which gives you another degree of creative control. By switching to a higher shutter speed—1/200th to 1/4000th—you can stop fast-moving action such as sporting events. A faster shutter is great for picking out fine detail, but faster speeds eliminate most motion blur, which can result in an image with very strobic, stuttery motion (Figure 4.9).

Unfortunately, although vendors frequently provide fast shutter speeds, they often skimp on slower ones. If you are ultimately planning to transfer your finished video to film, it's a good idea to look for a camera that can be forced to shoot at 1/60th of a second. At this speed, you'll tend to get a better film transfer.

Audio

After manual controls, your next concern should be the camera's audio facilities. It's pretty safe to say that the microphones included on all camcorders are terrible. Low-quality to begin with, their usefulness is further degraded by the fact that they often pick up camera motor noise, as well as the sound of your hands on the camera itself. Consequently, an external microphone jack and a headphone jack are essential for feature production. In addition to replacing the on-board mic on your camera, an external mic jack lets you mix audio from a number of mics, and feed the result into your camera. We discuss audio hardware more in Chapter 8. When evaluating a camera, first check what kind of mic connectors it has—XLR, or mini—and make sure the connectors are positioned so that mic cables and connectors won't get in the way of moving the camera and shooting (Figure 4.10).

A headphone jack is a must-have to ensure that you're actually recording audio (you'll be surprised at how easy it is to forget to turn on a microphone).

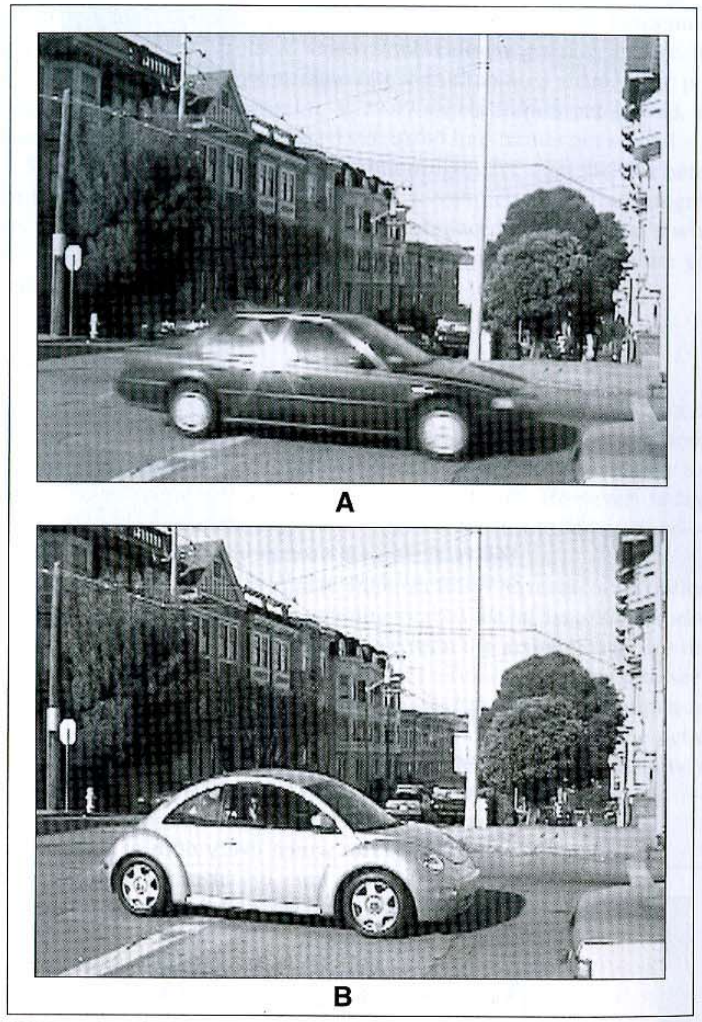

FIGURE 4.9 **(a)** At a somewhat "normal" shutter speed of 1/60th of a second, the moving car has a pronounced motion blur. **(b)** At 1/4000th of a second, moving objects in each individual frame are frozen. When played back, the video can have a somewhat "stroboscopic" look.

Manual audio gain controls let you adjust or *attenuate* the audio signal coming into the camera, making it easy to boost quiet voices, or lower the level on a roaring car engine.

FIGURE 4.10 Be sure to determine what jacks your camera provides. This Canon GL-1 provides a headphone jack (bottom) on its rear panel, and a mini mic jack on a side panel (not shown).

Progressive Scan

As we discussed in Chapter 3, "Video Technology Basics," current video standards such as PAL and NTSC are interlaced; that is, each frame of video consists of two sets of scan lines, or *fields*, which are separately painted onto the screen every 60th of a second. Progressive scanning—painting the scan lines on, in order, from top to bottom—is what your computer monitor does, and it typically produces a clearer, less-flickery image.

Because of interlacing, normal video effectively has a frame rate of 60 half-frames per second and is subject to motion artifacts such as jittery motion.

Some cameras can shoot in a non-interlaced, progressive scan mode, which presents frames that are much clearer than those of interlaced video. (Some companies refer to this as *Movie mode*.) However, on some lower-end cameras, the clarity of the frames also means that fast-moving images sometimes have a strange, stroboscopic quality to their motion. On these cameras, progressive-scan mode is really intended for still photo use.

On higher-end cameras, progressive-scanned video usually looks much more "film-like" than interlaced video. Not because of grain or texture, but because it is, in a way, a lower frame rate than interlaced video. Since progressive scanned video is running at 29.97 whole frames per second, it's closer to film's 24 fps than interlaced video's 60 half-frames per second.

Some film transfer houses claim that progressive scan yields a better film transfer, and many transfer houses recommend shooting progressive. Others are more comfortable with interlaced, because that's what they're used to transferring. Be sure to do a lot of test shoots before you commit to shooting in progressive-scan mode.

Image Stabilization

Because it's difficult to hold a one- or two-pound camcorder steady, most cameras now provide some type of image stabilization feature to smooth out bumpy, jittery camera movement. Five years ago we would have told you to deactivate these features and leave them off. However, today's image stabilization technology—although no substitute for a tripod—is very effective and (usually) has no ill side effects.

There are two types of image stabilization: electronic and optical. Electronic image stabilization (sometimes called *digital image stabilization*) requires a CCD with a larger imaging size than the actual image size that is displayed. EIS works by detecting camera motion, analyzing it to see if it's intentional or not, and then digitally moving the image to compensate for unwanted motion. Because the camera is overscanning the actual field of view, there are enough extra pixels around the edges to allow for this type of movement (Figure 4.11).

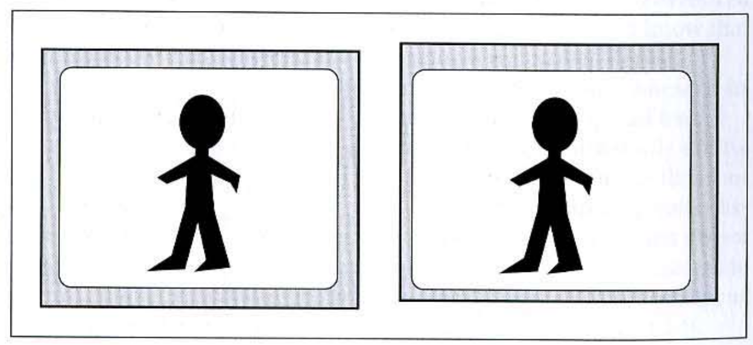

FIGURE 4.11 In electronic image stabilization, the camera scans an oversized area and then pans about that area to compensate for shake.

Since the camera is constantly moving the image about the screen to compensate for shake, electronic stabilization can often result in softer, slightly blurred images. We've also seen some cameras show a slight color shift when using EIS. However, most EIS functions in use today do an excellent job of stabilizing your image without noticeably degrading its quality.

Optical image stabilization doesn't alter your image, but instead, changes the internal optics of the camera to compensate for motion. Rather than solid prisms, cameras with optical stabilization use prisms composed of a transparent, refractive fluid sandwiched between two flat pieces of glass. Motors around this prism sandwich can move the glass panels to reshape the prism. Light passing through this mechanism can be redirected onto the correct part of the CCD to compensate for camera shake (Figure 4.12).

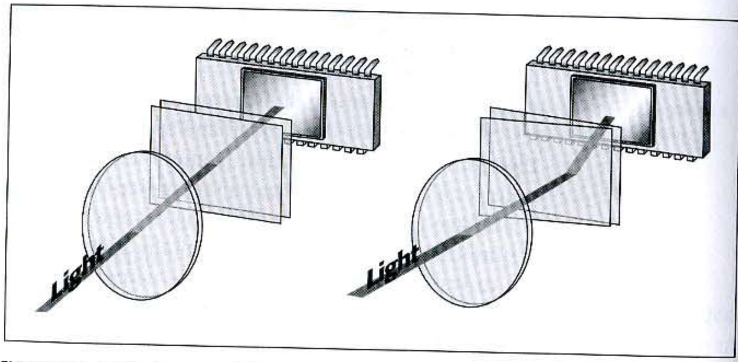

FIGURE 4.12 Optical image stabilization works by reshaping one of the lens elements on-the-fly to correct for camera movement.

Since OIS doesn't ever touch your image data, there's no chance that it will corrupt your image. On the downside, because it's more complicated, optical stabilization costs more than electronic stabilization. In addition, because the stabilization is tailored to a particular lens, if you add wide angle or other attachments that change the focal length of your lens, OIS will stop working.

When evaluating a camera, try some motion tests—both slow and smooth, and fast and jittery—to see how each camera's stabilization feature affects overall image quality.

Widescreen

Many cameras include a "widescreen" mode that lets you shoot in a 16:9 aspect ratio à la HDTV or wide-screen film. These features work by cropping the top and bottom of the frame to letterbox the image down to 16:9.

The downside to this "hacked" 16:9 effect is that you lose a lot of vertical resolution. If your CCD only has 360,000 pixels and you're using a third of them for black areas above and below your image, you're effectively shooting with much lower resolution than your camera is capable of (Figure 4.13).

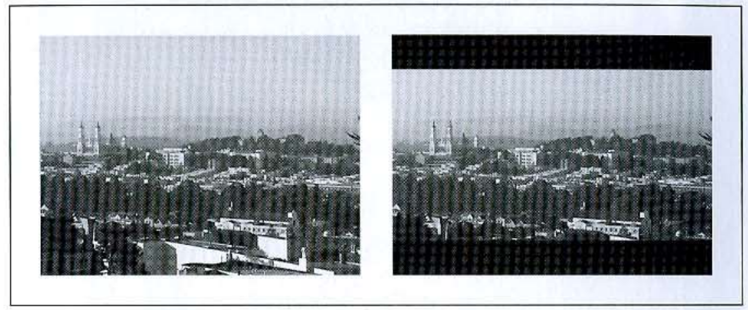

FIGURE 4.13 The "widescreen" feature on many cameras simply masks the top and bottom of your image, effectively wasting a third of your vertical resolution!

Some formats such as Digital Betacam can shoot a true 16:9 aspect ratio because they use rectangular CCDs that actually have a full 16:9 ratio's worth of pixels. DV, MiniDV, and other formats that don't provide a "true" 16:9 mode can usually output a wide-screen, non-letterboxed image to a widescreen TV, but this is hardly useful unless you know that your project will be delivered and viewed on a widescreen device.

Another route to shooting wide screen is to leave your camera in its normal shooting mode, and do what film users do: get a special lens.

An *anamorphic* lens optically squeezes the image horizontally to fit a wider image onto the CCD. If you look at an individual frame of film shot with an anamorphic lens, you'll see a squished image that's greatly distorted. However, project that image back through a projector that's been fitted with an anamorphic lens, and you'll get an undistorted, really wide picture. Similarly, you can use your editing software to unsqueeze your anamorphic footage to create a true widescreen image (Figure 4.14).

Several manufacturers make anamorphic attachments for camcorders. If you're determined to use one of these, however, you'll need to

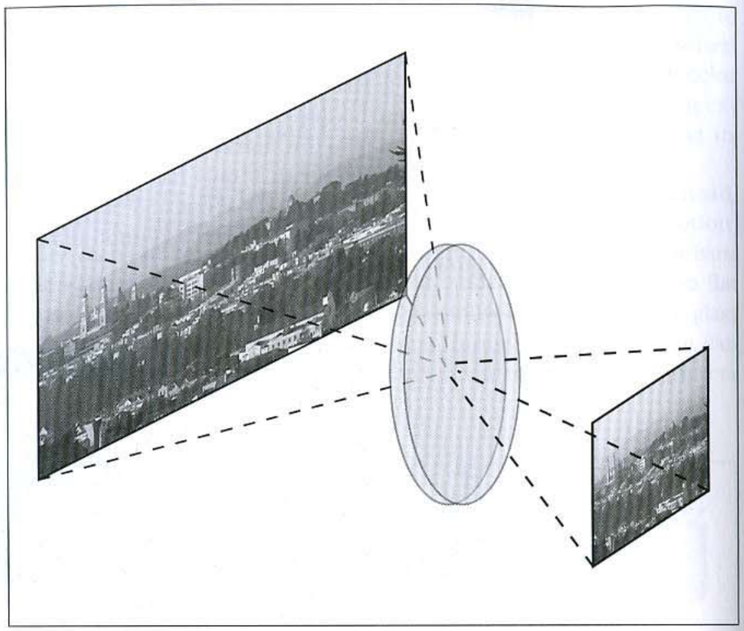

FIGURE 4.14 An anamorphic lens optically squeezes a wide image down to the aspect ratio of your CCD. To look right when viewed, it must be correspondingly de-squeezed.

make sure it works with your camera. Check with your vendor for compatibility. In addition, if you're planning on transferring to film, check with your service bureau.

Viewfinder

Most video cameras have two viewfinders, an eyepiece viewfinder and a flip-out LCD viewfinder. Curiously, some higher-end cameras such as the Sony Canon XL-1 have only eyepiece viewfinders.

Because you can tilt an LCD into different viewing angles, flip-out LCDs afford you a wider range of shooting options. However, because an LCD drains your battery quickly and can be difficult to see in bright light, you might not be able to use it all the time. Yes, you want a high-quality LCD, but don't let LCD quality weigh too heavily when choosing a camera.

Some higher-end cameras include a feature called *Zebra* that displays diagonal black and white lines in areas of your image that are overexposed. These lines are not recorded to tape, they only appear in the viewfinder. If you're manually setting your shutter and iris, Zebra is a must-have for situations when you don't have an external monitor to look at (Figure 4.15).

FIGURE 4.15 The diagonal lines in this viewfinder are the Zebra marks that indicate overexposure.

Special Effects

Most video cameras, especially lower-cost prosumer cameras, include a number of special effects and wipes ranging from sepia tinting to "arty" posterizing looks. We don't recommend using any of these features. It's better to shoot unprocessed video so as to have the greatest flexibility when you post.

Similarly, many cameras also provide a number of wipes and dissolves. If you plan on editing your entire project in the camera, or without using a computer (by hooking two cameras together), then these wipes and dissolves might be useful. However, as with effects, better to shoot clean footage and add transitions in post-production.