BLUESCREEN COMPOSITING

A Practical Guide for Video & Moviemaking

- Studio set-up, keying, and troubleshooting
- Real-world examples and tutorial lessons

JOHN JACKMAN

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Foreword

Compositing is the art of creating separate picture elements and then combining them in a seamless manner that creates a new image. Usually, that image is one that would not be possible in any other way. This book is sort of like that in that the talents, special gifts, and "push" of several people made it happen; and it certainly wouldn't have been possible without them.

Special thanks first to Paul Temme, now Acquisitions Editor for Focal Press, who talked me into doing this book; a special tip of the virtual hat to my friend and technical editor, Richard Clabaugh, who helped immensely in making sure that the text was both clear and accurate; and above all thanks to my wife Debbie, who puts up with all this crazy stuff.

Happy compositing!

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Lewisville, NC
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Introduction

I was seven years old when Dick Van Dyke and Julie Andrews danced with animated penguins in *Mary Poppins*, and I remember being obsessed with how the movie magic of combining live characters with animation had been accomplished. My father came up with some oversimplified explanation of the movie magic—one that kept me happy for the moment. A few years later, I was fascinated with the special effects in the *Star Trek* television series, effects that now seem so hokey and even quaint, but which at the time seemed quite amazing. But it was a movie thirteen years later and set in another galaxy that really set my head spinning about special effects. That movie, of course, was *Star Wars*, and unless you lived through the dismal cinema fare of the 70s you can hardly imagine what an impact that movie had on us all. Actual storytelling! Mythic themes! Spaceship fights! Corny dialogue! And best of all, the most astounding special effects that any of us had ever seen. For those of us that had grown up with the incredibly cheesy special effects of *Buck Rogers* serial reruns, *Star Wars* was an absolute revelation. Of course, in those pre–computer-graphics days, most of the *Star Wars* effects were created using the same basic technology that Petro Vlahos had perfected for *Mary Poppins*—the travelling matte, or what we often call *bluescreening* now.

Over the last twenty years, this technology has gone from being a rare specialty to the meat-and-potatoes of the filmmaking business. Particularly since the advent of the Cineon format and digital intermediates,
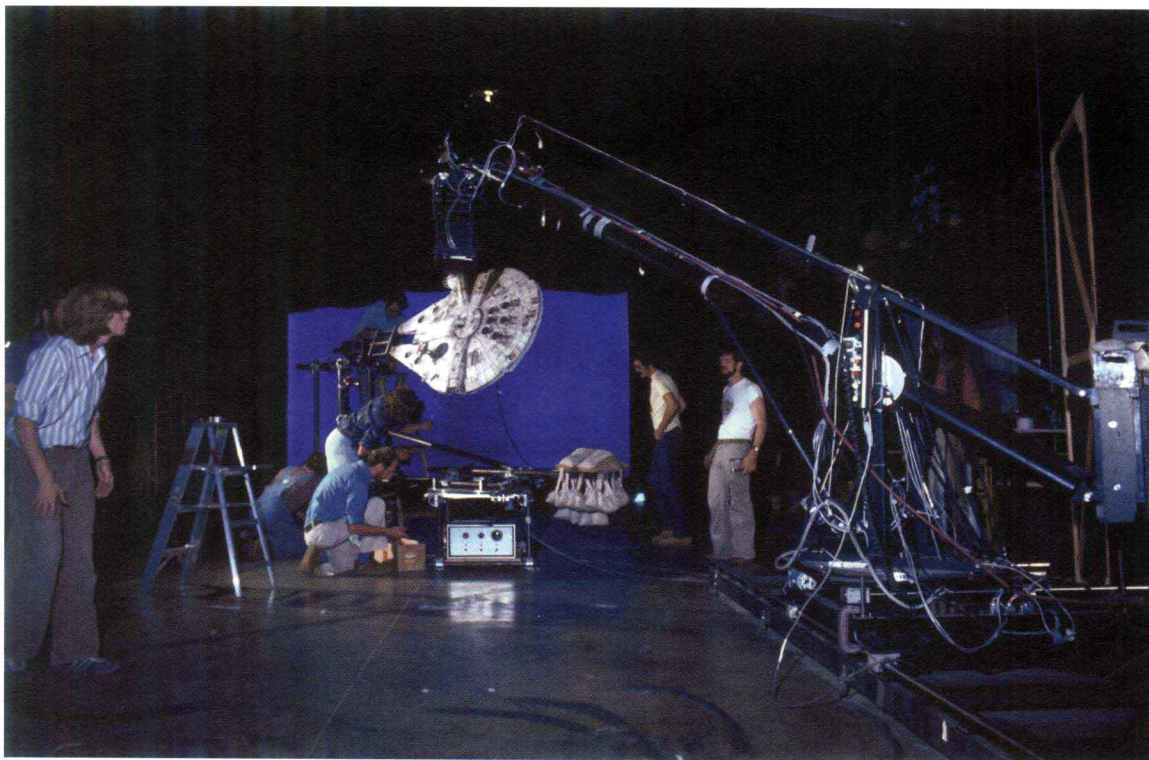
Figure 1.1 *Before the public ever heard the names of Darth Vader or Han Solo, the special effects team assembled by George Lucas created unparalleled movie magic for the 1978 movie* Star Wars *using bluescreens, handmade scale models, and motion-controlled cameras. Here the model of the Millennium Falcon is photographed in front of a bluescreen. Photo courtesy of LucasFilm.*

the use of blue and greenscreen in moviemaking has simply exploded, to the point that the technology is now used in all sorts of places where it wouldn't be expected. Shots that don't *seem* to be special effects may incorporate bluescreen compositing for budgetary reasons—for instance, to allow digital augmentation of a small and inexpensive set. All those automobile interior shots that used to be done with rear projection can now be done with blue or greenscreen—and they usually look the better for it! And while it's expected that *Spy Kids 8* would use a lot of greenscreen, the black-and-white movie *Sin City* (also directed by Robert Rodriguez) used the technology for every shot to provide the "comic novel" look.

Today, bluescreening and other forms of digital compositing are technologies available to anyone with a few bucks for a camcorder and a computer. To be sure, there are technological challenges to compositing with DV or HDV originated footage, but there are workarounds available that make this moviemaking magic economically accessible to more people than ever before.

But while the technology is easily available, making it work convincingly is still something of an art. Just as there is a huge gulf between home video and great cinema, there is an equally huge gulf between acquiring the technology for compositing and creating effective, believable composited scenes. In this book, my plan is to lead you through both the mechanics of the technology involved and the craft of actually creating a visual that "works" convincingly.

Like my earlier book on lighting, I've chosen to write for average users in the real world in a way that will move them toward expertise. There are other books available for specialty engineers whose entire working life is spent compositing. This book is aimed at the video professional who is already well versed in his or her basic craft, but would like to be able to delve further into this somewhat arcane field of special effects compositing. But even if you're a "just starting" beginner at video production or digital filmmaking, you should be able to read through this book and get started—and, I'm hoping, do a far better job than you would have been able to do through trial and error!

Because the book is not written for people who are already compositing specialists, we will be focusing primarily on the software that most "regular folks" in the business are using—most shops are using Macs or PCs, not SGI systems. And by an overwhelming margin, the software they are using are the Adobe products After Effects and Premiere Pro, and Apple's Final Cut Pro, and other software that operates on Windows XP or Mac OSX. So this will be our context! Illustrations and examples will come by and large from those software packages. I figure that tutorials based on software like Discreet Flame® (which runs on a quad processor SGI® Tezro™) will not be helpful to the majority of readers. And while we will touch on higher-end software like Apple Shake and eyeon Digital Fusion, illustrations and tutorials will be built around the more common software packages.

By the way, this also isn't a book on motion graphics. Though we'll touch on a few motion graphics techniques (such as motion tracking) we'll be looking at those only for circumstances of creating a realistic-looking finished shot, not flashy moving type and artistic effects. Besides, Chris and Trish Meyer have already written great books on motion graphics; you don't need another from me!

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We will focus on the process of creating apparent realities that didn't exist in front of the camera. Ideally, everything you'll learn to do in this book will be so seamless that your audience won't notice that it was a carefully constructed special effect!

And that brings me to an important point (one that you are free to disagree with, of course). In my opinion, most special effects need to be accomplished in such a manner that they seem completely realistic—at least in the context of the film. Obviously, films aren't always about realism—even when they are supposed to be on the surface. Films are always fakery, but they must be fakery that is convincing and does not disrupt the audience's suspension of disbelief. This doesn't just apply to compositing effects, of course, but to lighting, sound effects, in short every aspect of the movie experience. If one of those is jarring or noticeably different in continuity, the audience's immersion in the story is disrupted. It's amazing what small things will do this—and what major flaws the audience will overlook! But overall, your special effects really must be seamless enough that the audience "buys" them in the context of the film. As soon as the audience says "Wow, what a great special effect," you've lost the battle.

Sure, everyone knows intellectually that the insurance folks won't let James Blond (played by Bill Bigstar) actually swing on a loose electrical cable over a glowing vat of molten iron. But if they've bought into the movie, if they have suspended disbelief, then they will say "Wow," but the "Wow" will be that James Blond made it safely, not astonishment that the special effects folks did such a good job! My aim here is to talk you through the process of creating effects that will seamlessly enhance your storytelling, not interrupt it with fizz and sizzle.

In the movie business, finding this mysterious balance between applying acceptable fakery and seeming phony is just awarded with the simple comment "it works." What it takes to make it "work" is to a great degree what we will be discussing, especially in the first part of the book. Everything we're going to be discussing is carefully constructed artifice—but all the technology and digital horsepower is a waste if you don't hit that magic balance with it.

The Basics of How Compositing Works

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This chapter and the next one are the chapters lots of folks will be tempted to skip: "Hey, let's jump to the tutorials and the eye candy!" But I hope you won't skip them—or if you do at first, you'll come back to them later. If you don't understand how the process of compositing works, you won't be able to do much more than push buttons, and you'll be stuck with the most basic of effects. Understanding how various techniques work and which techniques work best for a particular situation will allow you to do better, more creative work.

Compositing is a sort of umbrella term we use to cover a number of different technologies that allow the creation of a new image (or *composite*) from multiple unrelated elements. These can usually be thought of as separate layers that are sandwiched together to create the new image. Anyone who has created a still graphic in Photoshop will be familiar with the concept of layers.

> Note: throughout the book, I will refer to bluescreen and greenscreen using the terms interchangeably for a color backing—which may actually be blue, green, or even red, depending on the color content needed in the foreground. This reflects the fairly casual usage of the terminology in the business.

But simply being able to combine separate layers isn't much use if you can't control what areas of each layer are "transparent." There must be some method of defining areas of transparency and opacity in the

foreground layers, so that sections of the background layers can "show through." There are numerous technical methods for accomplishing this. Whatever the specific method used, the foreground layer with transparent areas is called a *key* in the television world, and is said to be *keyed* over the background. The hardware (or software) that handles the compositing is called a *keyer*. This terminology originated from the idea that the transparent areas of the foreground were sort of like an old-fashioned keyhole that you could look through.

Probably the most common use of compositing (or keying) in television is superimposed titling. Any time words have to be inserted into an existing picture, there must be some technical method of combining the title with the existing picture. In the earliest days of television, there wasn't a way to do this, so titles were simply printed or painted cards that were shot separately, rather like the dialogue cards in old silent pictures. Pretty soon, the engineers figured out a way to combine text into the picture through the most basic of video compositing techniques: the *luminance key*. In this very simple sort of key, any dark area that fell below a certain voltage in the analog video signal would become transparent; anything above that voltage was opaque. This allowed the creation of white-on-black title cards that could be easily inserted over the background image. In the 60s and even into the 70s, scrolling credits were often done with a large black wheel with white lettering stuck onto it. A graphics camera would be pointed at a portion of the wheel, the signal fed to a luminance keyer, and a grip would turn the wheel to produce the credits scroll at the end of the show. This practice, which started in the old black-and-white days, carried over well into the color era in many game shows.

Figure 2.1 G. Méliès frame

In the film world, exactly the same idea was being pursued but through a different technology and with a different nomenclature. While the earliest film magicians such as Georges Méliès had created compositing magic through simple double exposure, this ap-

proach had definite limits. It wasn't long before filmmakers wanted a more refined and controlled method of superimposing pictures together.

Filmmakers came up with a simple technique to create transitions or superimpose portions of two images together: the *matte*. In its earliest form, this was simply a plate of glass in front of the camera lens, with the matte area painted in black paint. This prevented the matted areas from being exposed; then the negative was rewound and a glass plate with the reverse of the original painting was used to expose the previously matted area with another image—usually a painting (see Chapter 4 sidebar on page 34).

Soon the process moved from in front of the camera lens to the lab, where a negative matte was used. This was simply an opaque mask that would be used in the printing process that allowed a portion of the film frame to be printed from one negative, while the balance of the frame (using a reverse of the original matte) could be printed from a second negative. By using a sequence of progressive mattes, each one slightly different from the last, the lab could create a *wipe* transition from one picture to another.

While the technology we'll be discussing in this book is far advanced from these early keyers and film mattes, the basic concept hasn't changed at all from the original idea! No matter how complex the latest digital Ultimatte keyer is, its basic job is the same as those early luminance keyers or film mattes: to define an area of the foreground layer as either transparent or opaque.

For most of the twentieth century, these two technologies remained pretty separate. The television world used keyers to create live composited images electronically, and the film world used optical printing techniques of increasing complexity to create composites in movies. In the last decade, however, there has been a convergence of the technologies and today nearly everything in both worlds is done digitally—though differences in technique, practice, and of course jargon remain. Nearly all movies today have special effects created using a digital intermediate, even if the movie was originally shot on 35mm film.

As the world of digital still graphics emerged in the 90s, various deep

color file formats were defined (such as TARGA) that could include transparency information to facilitate compositing (or overlay) with other graphics. In the digital graphics world, this was known as an *alpha channel*. But it's basically the same as the film matte or the video key channel: a grayscale image that defines transparency and opacity.

Note this common basic concept for all composites, keys, or overlays! Though the jargon that grew up in each industry was different, the basic idea is the same. In addition to the basic visual that will be composited over the background, there is a separate and invisible graphic (whether it's referred to as a *key channel*, an *alpha channel*, or a *matte*) that determines what areas of the foreground are transparent. Generally, this separate channel will define white areas as opaque and black areas as transparent (or vice versa), while intermediate gray areas create various degrees of transparency in the foreground.

Figure 2.2 The **foreground plate** (top) is made partially transparent by the **matte** (middle) so that the **background plate** (bottom) shows through, creating the **composite** (right).
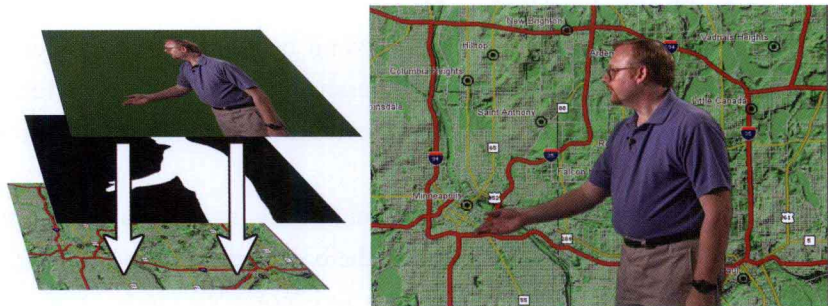
Now, this may at first seem confusing to those who have used built-in keyers in their editing software—because they never actually *see* the matte. It's invisible in the final composite, and often invisible to the editor as well! But trust me, the chroma key filter in Final Cut Pro is creating a matte internally based on the adjustments you make in the interface. Often you will not be able to "see" the matte unless you choose to. However, this basic concept of using a grayscale image to define layer transparency underlies nearly everything we will cover in this book, and so it's important to understand how it works. In each application, the specifics of how this transparency information is applied to the foreground graphic may be different, and there are a variety of means by which the matte may be created—but the underlying idea is the same.

Terminology

As you have already gathered, this basic idea has been used for many years in three different areas of production, each of which has developed its own jargon for the process. As these three previously discrete areas (video, film, graphics) have converged, the various nomenclatures have jumbled together to become a confusing mess for the neophyte. So before we go any further, we need to review the basic terminology that you'll run into and set out the terms we'll use for the rest of the book!

Video	Film	Graphics
Key	Foreground Plate	Foreground Layer
Key Channel	Matte	Mask / Alpha Channel
Background Video	Background Plate	Background Layer

Video keying technology is generally done live in hardware; and while there is a chapter later in the book on hardware keying, it really isn't the major focus of the book. And while we'll touch on issues of still graphics compositing, that also isn't the major focus here; there are plenty of fantastic Photoshop books already out there. The major emphasis in this book will be software compositing of digital video that is done in post-production (post), which is most similar to the techniques used in film production. For that reason, I'll lean more towards using the jargon of the film world for the rest of the book, unless we're specifically talking about live video keying or still graphic compositing:

- The various layers that form the composite are plates;

- The transparency information is the matte;

- The digital technique of defining the matte with the foreground plate is compositing;

- An image or image sequence saved with transparency information has an alpha channel;

- And the finished image is the composite.