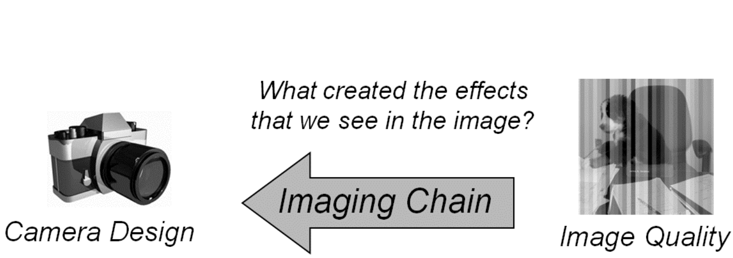
Chapter 10

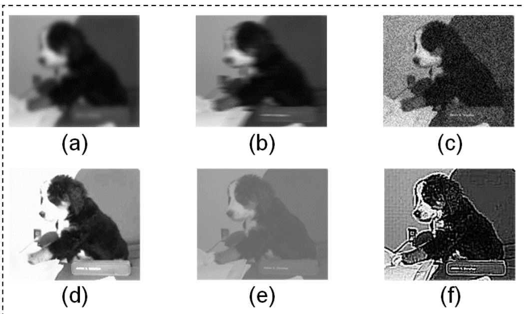
Afterword: Now What?

Now that we have walked through the imaging chain, what do we do with this information? Most importantly, we understand not only how to make better digital cameras, but also why a digital image is the way it is. We can properly design a digital camera that has the necessary image quality by properly linking the elements of the imaging chain. We can also relate the characteristics of an image to specific elements of a camera's design. This is very helpful when an image has features that we don't like, and we need to change the design to fix it.



Understanding the imaging chain is critical for understanding not only how a camera design produces the required quality, but also how image features relate back to a camera's design.

Without a proper understanding of the imaging chain, a camera will most likely have elements that are out of balance, resulting in a dominant weak link in the imaging chain. The image-quality effects will be different depending on the location of the weak link, but they will all result in an image with unacceptable image quality.



The imaging chains that produced these pictures all have a dominant weak link.

No single dominant weak link in the imaging chain that produced this picture.

Dominant weak links in the imaging chain can be avoided with a proper understanding of the imaging chain. These pictures show weak links by having (a) poor optics, (b) motion blur, (c) sensor noise, (d) overexposure, (e) low contrast, and (f) processing that oversharpened the image.

By mathematically modeling the imaging chain, a computer can produce digital images that are very accurate simulations of pictures a digital camera would produce if we built one. This is an extremely valuable tool, because it allows us to check out designs without spending money on hardware.

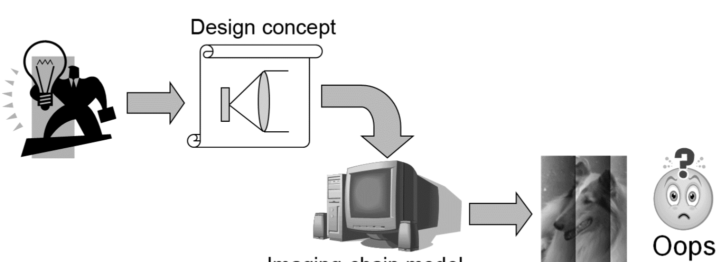
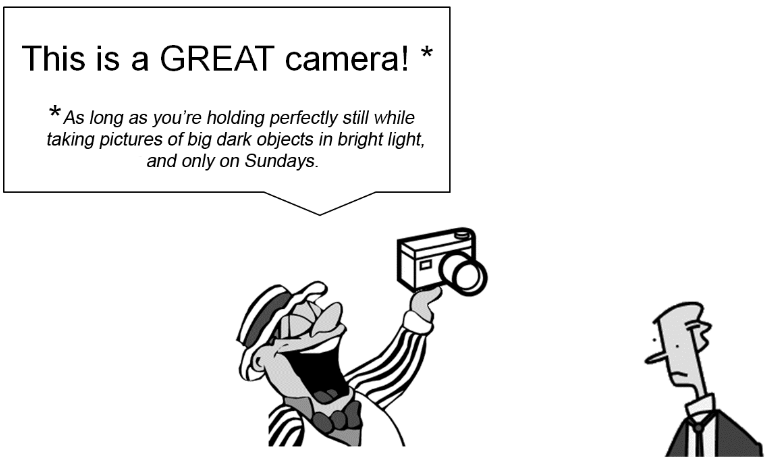


Image simulations can be produced to test a camera design before money is spent (perhaps wasted) on hardware.

Many times, a new camera design is proposed that is either crazy or ingenious, and it's difficult to tell which side of the fence to fall on. Imaging-chain models can be constructed in a computer to test out the idea first to see if it works without breaking the laws of nature. If it passes this test, we can see how well it works under various imaging conditions. More often than not, a clever new idea for a camera will fail this test because it only produces good image quality under a very restrictive range of imaging conditions, such as bright lights or a single color.



Modeling the imaging chain gives a great understanding of when a camera takes good pictures, but more importantly, when it does not.

So, there you have it. Understanding the imaging chain takes much of the mystery out of creating digital images, but not all of it. We still do not fully understand all of the random events that can influence an image, and we struggle to understand how our minds interpret all aspects of an image. Links in the imaging chain need to be redesigned and reassessed as novel camera concepts are brought forward, but this is good, because it keeps us on our toes. We will continue to build better cameras that meet a wide variety of needs, from pocket cell phones to satellites that whiz far above Earth. And even cameras that take great pictures of puppies, too.

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