High Resolution Images and Digital Cameras

Please note: This discussion is from our point of view here in the U.S. We know the terminology, units of measure, and (to some extent) technology may be different in your corner of the world. However, the basic principles should still apply and, hopefully, you will be able to make the necessary adjustments without too much difficulty.

If you have questions please contact Darrell McIntire (dmcintire@gso.uri.edu)

Why 300 dpi?

OMP's request for high-resolution (300 dpi or 300 dots per inch) images is based on what commercial printing firms require to reproduce photographic images on commercial, usually offset, printing presses. A print photograph captures an image with a virtually infinite range of grays or colors. It is called a "continuous tone" image. Offset printing creates the illusion of these continuous tones by breaking images down into a series of dots, producing what are known as "halftones." This creates the optical illusion of variations of gray or continuous color on the printed page. The screens used to create these dots have varying degrees of coarseness and are measured in lines per inch. Screens of 133 to 150 lines per inch are the standard for producing halftones for offset printing.

Digital photographic images must contain twice the number of pixels—or dots—per inch as the number of lines per inch of the halftone screens that printing companies use. This means that a digital image must be 266 to 300 dpi at the size it is to be reproduced to print properly on an offset press.

Sow's ears and silk purses

High-resolution images contain more, and therefore smaller, pixels than do low-resolution images. They can reproduce more detail and subtler color transitions because of the density of the pixels in the images than can low-resolution images. Images on the Web are low-resolution—typically 72 dpi. Images shot with a digital camera at Web resolution can never become high resolution images, regardless of how they are manipulated because they don't contain enough actual pixel data for high-resolution printing. Also, it is not possible to improve a low quality image by printing it at a higher resolution. Changing the print resolution of an image simply makes each pixel larger, which results in pixilation—output with large, coarse-looking pixels or dots. Increasing the print resolution of an image doesn't add any pixel information to the image. Adequate pixel information must be captured from the outset—it can never be added later.

Real Resolution

Image processing programs (of which Photoshop is the premier example) have built-in interpolation algorithms that will digitally enlarge a low resolution photo by guessing what the pixels would look like at a higher resolution and then adding them, but not without introducing noise and artifacts—for example, a decrease in the sharpness of the image. (Photoshop also has features that ameliorate some of these unwanted effects.) The digital imaging processor (DIGIC) of some digital cameras also interpolate resolution, but, generally speaking, this is not a desirable feature. It inflates the true capacity of the camera. The actual capacity of the camera is the information captured by the camera's CCD (charge-coupled device) when it converts the light entering the lens into electronic signals. Make certain your camera's capacity rating refers to this "native" CCD resolution and is not an "effective" resolution that is the result of an interpolation process in the camera's DIGIC.

Camera Capacity

You can ensure that your digital images can be used in the full range of CoML print applications by shooting digital photographs at 300 dpi from the outset. It is always possible to later downsample images for use on the Web, but is never possible to go in the other direction. All digital cameras can record images at high resolution, but the dimensions of the image vary with the pixel capacity (and price) of the camera. In general...

- a two megapixel camera will produce 4" x 6", 300 dpi images
- a three megapixel camera will produce 5" x 7", 300 dpi images
- a four megapixel camera will produce 8" x 10", 300 dpi images
- a five megapixel camera will produce very large prints and is generally the minimum choice of professional photographers.

Camera Class

Megapixels are not the only factor you must consider. There are two distinct classes of digital cameras: fixed lens or point-and-shoot (PnS) and single lens reflex (SLR). (Actually there are others, but unless you anticipate using the $20,000+ professional digital backs for studio cameras or the kind of cameras NASA sends into space, we will ignore them.) Fixed lens PnS cameras are what most people think of when it comes to digital cameras. This is largely because, until recently, the cost of digital SLRs was well beyond most people's means (in 1991 they were $20,000; in 1999, $5000).

As the name implies, fixed lens means that the lens of a PnS camera cannot be removed. Another defining feature is that they have an LCD viewfinder that continually displays the image falling on the camera's CCD. Generally, prices of fixed lens cameras range from $300 for three megapixel models up to $1,000 to $1,800 for the recently introduced, eight megapixel models. As you would expect, the image quality among models at any given price point is pretty much the same. However, and more important, there is very little real difference in image quality from the low- to high-end models. The more expensive models have more bells and whistles than the cheaper models, but do not have significantly better image quality. This is due to the limits of the basic technology, and that does not differ from one price level to another.

All SLR cameras (digital as well as film) have completely removable (and interchangeable) lenses, a reflex mirror that directs an optical image directly through the taking lens to the viewfinder, direct ground glass viewing, and much larger image sensors (about five times the linear dimension or 25 times the area) than those in PnS cameras. Even at high ISO "film" speed settings, digital SLR images are much cleaner than those of PnS cameras. You pay for this superior technology, however. The average cost of an eight megapixel digital SLR camera is around $1000.

Generally speaking, the PnS cameras have lower picture quality, with more noise (graininess) than SLR cameras. Also, they are slower. That is, there is a delay when they are turned on and again when the shutter button is pressed. Scanning through the menus also takes time, and the LCD viewfinder is delayed a fraction of a second and (in one reviewer's words) looks like a crummy 15-year-old TV. All of these fraction-of-a-second delays are cumulative, the result being that it is very difficult to photograph moving objects with a PnS digital camera. (See www.kenrockwell.com/tech/2dig.htm for a thorough, albeit opinionated, discussion of these issues with reference to specific cameras.)

Recommendations

If you're purchasing a camera for your project, be sure to select one that has a capacity of at least five megapixels. This resolution can satisfy all Web and print publishing requirements. Remember, images over 8" x 10" are not unusual in the print world. A five megapixel digital camera will ensure that your images are adequate for the entire range of print applications—brochures and journals up to posters, exhibits, and environmental-scale graphics.

Secondly, you should select a digital SLR camera rather than a fixed lens digital camera. The larger image sensors, greater speed, instant operation, real-time ground glass viewing, interchangeable lenses, greater ISO range, and other features combine to make a digital SLR camera by far the better choice.

If a digital SLR camera with the capacity to produce large, high-resolution images is not within your budget, and you opt for a PnS model, you should also document your work with a standard (i.e. film) SLR camera of the highest quality you can afford. Prints and slides from a film camera can be digitized by scanning to almost any size and resolution necessary. A small, 4" x 6" print can easily be scanned and output as a high resolution, 8" x 10" (or larger) print. Naturally, as with digital cameras, the quality of images from less expensive PnS film cameras will not be as good as those from higher-end SLR models.

Remember that handling film-based images—filing, storing, cataloging, mailing, digitizing, etc.—will incur additional expenses as you move forward. These on-going costs should be considered when weighing how much to spend on a digital camera. Eliminating these future expenses may well warrant investing more in a digital camera than you might originally have intended.