Topic no. 67

Camera Lens

Resolution & Contrast

Lens quality is more important now than ever, due to the ever-increasing number of megapixels found in today's digital cameras. Frequently, the resolution of your digital photos is actually limited by the camera's lens — and not by the resolution of the camera itself.

RESOLUTION & CONTRAST

Everyone is likely to be familiar with the concept of image resolution, but unfortunately, too much emphasis is often placed on this single metric. Resolution only describes how much detail a lens is capable of capturing — and not necessarily the quality of the detail that is captured. Other factors therefore often contribute much more to our perception of the quality and sharpness of a digital image.

To understand this, let's take a look at what happens to an image when it passes through a camera lens and is recorded at the camera's sensor. To make things simple, we'll use images composed of alternating black and white lines ("line pairs"). Beyond the resolution of your lens, these lines are of course no longer distinguishable:

Black and white line pair's → camera lens → unresolved line pairs

High Resolution Line Pairs Lens Unresolved Line Pairs

Example of line pairs which are smaller than the resolution of a camera lens.

However, something that's probably less well understood is what happens to other, thicker lines. Even though they're still resolved, these progressively deteriorate in both contrast and edge clarity (see sharpness: resolution and acutance) as they become finer:

Full contrast black and white line pairs → camera lens → black and white line pairs softened by camera lens

Progressively Finer Lines Lens Progressively Less Contrast

& Edge Definition

For two lenses with the same resolution, the apparent quality of the image will therefore be mostly determined by how well each lens preserves contrast as these lines become progressively narrower. However, in order to make a fair comparison between lenses we need to establish a way to quantify this loss in image quality.