



Resolution: 3-Shot vs Color Mosaic

Elements of Sensor Resolution

The smallest imaging element on an imaging sensor is the pixel. Specifically, the light sensitive aperture of the pixel is the area through which electrons that have been kicked into its potential well by incident photons during the exposure time. It then outputs a signal proportional to the number of electrons of the imaging system with a packet of charge.

In a non-color imaging system, the resolving element of the system is equal to the pixel (not considering any other factors). In a color imaging system, that an electron kicked into the well by a 550 nm photon looks no different to the digitizer than an electron kicked into the well by a 650 nm photon.

In digital RGB color camera systems, the color of the light is determined by sampling light intensity in three bands: red (~620 nm – 700 nm), green (~490 nm – 570 nm) and blue (~400 nm – 500 nm). The color RGB digital image is an array of data with three values for each pixel location corresponding to the red, green and blue color intensity. The methods in common use are Single Shot Color Mosaic Sampling and Three Shot Color Sampling:

Single Shot Color Mosaic Sampling

One method of color sampling is to apply a red, green, or blue color filter directly onto each pixel. The filters are arranged in a repeating four-pixel element called a Bayer Filter Pattern (see Figure 1).

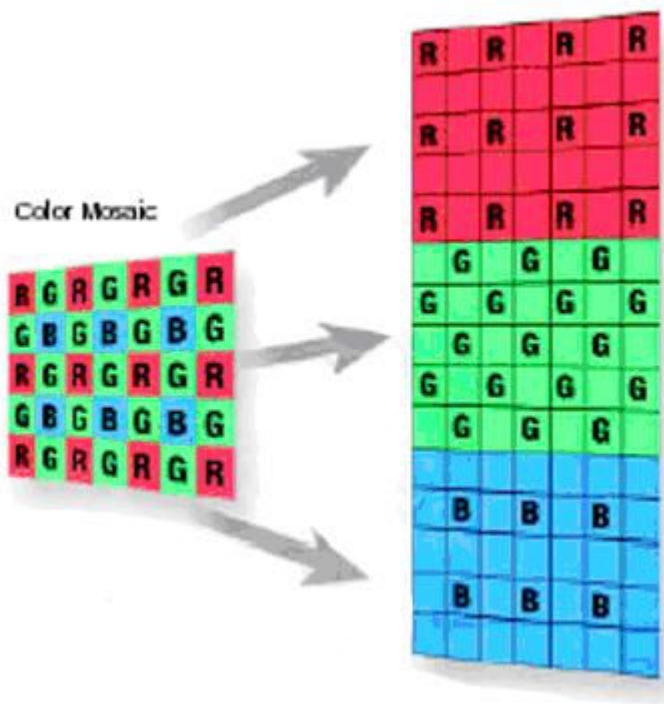


Figure 1 - Bayer Color Mosaic Sampling

To create a color image, a single exposure is taken, resulting in a sampling of only one of the primary red, green, or blue color at each pixel location. The two un-sampled colors are then interpolated from adjacent pixels that have values for the color.

other colors do not contribute anything to the color being calculated).

To construct a color RGB image from this sampling method, 66% of the intensity values must be calculated. The element is the 2 x 2 Bayer Filter Pattern that was used to sample the image. This means that an image captured actually has resolution of only 1024 x 1024. How does this happen? Envision that we create a perfectly small spot of light falling onto one red pixel with no other light falling on the sensor. What will the image look like? First, the red pixel accurately records its intensity value, and now the eight adjacent pixels that had no red light falling onto them are interpolated for them due to the interpolation. The resulting image will actually represent the one pixel ray as if our red ray fell onto a blue or green pixel; the resulting image would show nothing!

Other artifacts also result from this sampling method. Thin white lines and extreme brightness transition edge color stripes due to sampling and interpolation errors (see Figure 2).



Figure 2 - Color Mosaic, Pixel Level Resolution

Three Shot Color Sampling

Another method of color sampling is to position a color changing filter element in front of the sensor, then sequentially capture red, green, and blue images. The three sets of image data are then combined pixel by pixel to provide RGB sampled color (see Figure 3).

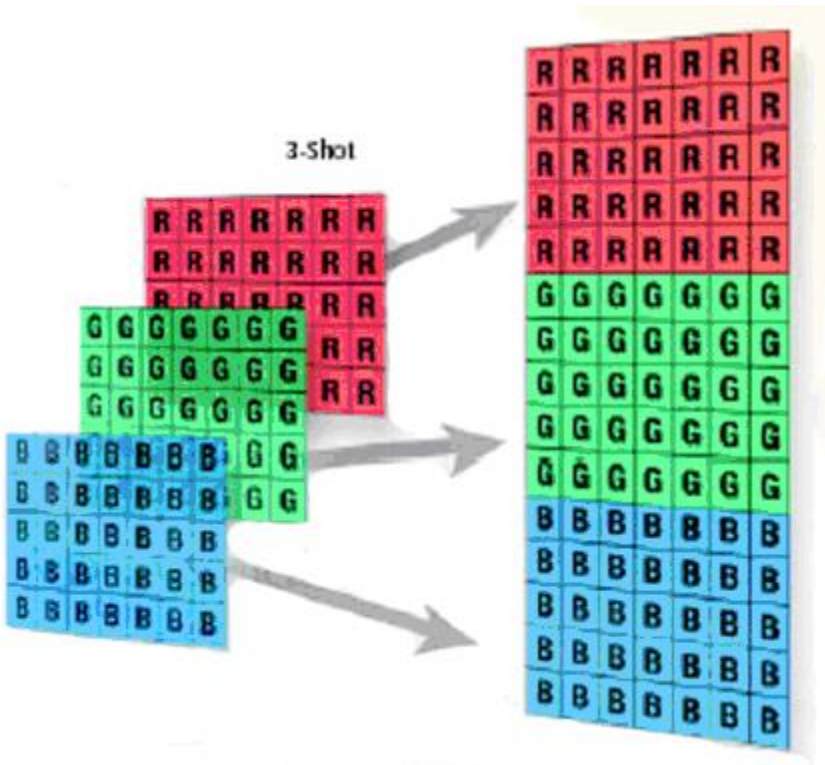


Figure 3 - 3-Shot Color Sampling

Since each color is sampled at each pixel, the resolving element of the system is the pixel, making the stated the resolution of the image sensor. This means that an image captured by a 2048 x 2048 sensor maintains its that the saved file size did not change, it just contains more measured data. The results are visibly noticeable

One drawback to this method is that if the image is changing with time, the sequential image capture will produce and blue ghosts of your subject as it moves across the scene. Another possible concern is image exposure as triples the time, so if it is an issue with a single shot, it will be more of an issue with the three shot method.



Figure 4 - 3-Shot Color, Pixel Level Resolution

Pick The Technology That Best Fits Your Application

As with any situation, the appropriate solution depends on your needs. If you have moving samples or need high resolution, color mosaic cameras would be most appropriate. If your sample is fixed and you have additional time, then you can get additional resolution from three shot color cameras.

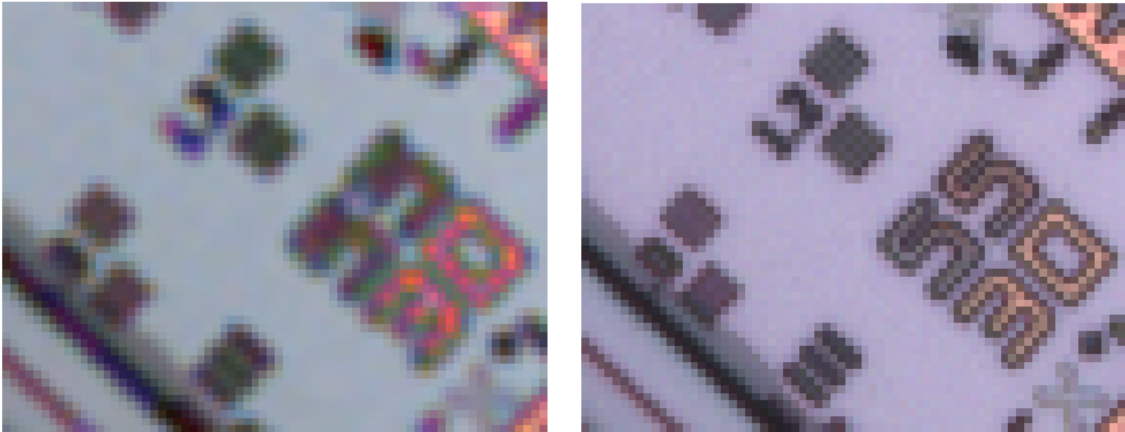


Figure 5 - Color Mosaic vs. 3-Shot Color, Side-by-side comparison, fixed sample