CCD vs. CMOS: Pro Camera Showdown

Canon's CMOS Sensor

Canon's D30 is the first high-quality camera to use a CMOS imaging sensor instead of a CCD. CMOS sensors have several advantages over CCDs. They use only 1/5 to 1/10 as much power as CCDs, making them a good choice for battery-powered cameras. CMOS sensors are made using the same techniques and equipment as more familiar CMOS circuits like CPUs and RAM memory, so they cost less to produce than CCDs, which require specialized fabrication equipment.

Like CCDs, CMOS sensors use an array of photodiodes to convert light into electronic signals. The weak electronic charge generated by the photodiode is stored in a small capacitor. The charge is too weak to be used by itself and must be amplified up to a useful level.

The major difference between CCDs and CMOS sensors is in the way the stored charges are converted into a usable signal. A CCD sensor scans its pixels consecutively. Stored charges from each row are actually shifted down to the next row (thus the term "charge-coupled"), and at the bottom of the array, the charges in the final row are output in a serial stream. The voltage levels of each pixel in the serial stream are amplified by an on-chip amplifier prior to output, and sent to either an external or internal analog to digital converter (ADC) where the signals are converted into an array of bytes that makes up the image.

Each pixel in a CMOS sensor has its own amplifier circuit, so the signal amplification is performed before the image is scanned. The resulting signal is strong enough to be used without any further processing. Unlike CCDs, CMOS sensors often contain additional image processing circuitry (including analog-to-digital converters and JPEG compression processors) directly on the chip, making it easier and faster to retrieve and process the picture information. This results in a lower chip count, increased reliability, reduced power consumption, and a more compact design.

Until the D30 arrived on the market, CMOS sensors were generally regarded as a low-cost, low-quality alterative to CCD sensors and were typically found in inexpensive Web cams and security cameras. A key problem in older CMOS sensors was that some pixels often had more or less sensitivity than their

neighbors. This unevenness translates into noise. Canon solved the noise problem in the D30 by scanning the sensor twice; once before the shutter opens, and again while the shutter is open. The "dark" image is electronically subtracted from the exposed image, which virtually eliminates the noise.

Looking Ahead

We've already had a preview of the next generation of 4, 5, and 6 megapixel image sensors from Kodak, Sony, and Philips. Canon is mum about future plans for their CMOS sensor, but it's a safe bet that Canon's next digital SLR will use a CMOS sensor.

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