Focal Point

The Newsletter from Southwest Precision Instruments

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In This Issue:

Digital Imaging: The Quest for Better Color and Higher Resolution

In the last issue we discussed the two types of digital imaging chips, CMOS and CCD. Each type of chip has certain advantages and disadvantages. CMOS chips are much faster than CCDs, but CCDs are the top dogs as far as sensitivity.

Your choice of imaging device will therefore depend on what you need the camera to do. Fluorescence and low light applications are best imaged with a CCD device, either cooled or non-cooled. Fast digital image generation and high frame rates are handled superbly by CMOS chips.

Some digital imaging devices can now produce images which are for all practical purposes the equivalent of film photography, and the search for higher resolution continues to evolve.

CCD and CMOS chips have stabilized somewhat in their evolution, and some very crafty engineering and technology is now driving the effort to get more accurate color rendition and higher resolution from these chips.

Alternatives: Make Bigger Chips with More Pixels, or Keep The Same Size Chips and Make Smaller Pixels?

At first blush, both of these seem to make sense. But beyond a certain point larger chips (especially CCDs) may not be the best choice.

Larger chips require special optics to project the image onto the chip, and depth of focus and flatness of field become critical. Also, larger CCDs would consume more power, run hotter and become slower in getting the signal off the chip.

From a manufacturing point of view, there isn't a linear relationship between the size of the chip and the cost of manufacture. Doubling the size of the chip doesn't double its cost. The multiplier would be more like 15 or 20! Chip size, speed and cost are discussed on this digital photographer's Blog.

Pixel size has its lower limits, but there's debate over how small the pixels should be. We mentioned in the last issue that Sony has recently developed a CMOS chip with 1.75 μm^2 pixels, but the chip is unique in several respects: it's designed to be back-illuminated, and the pixels have microlenses to help collect more light. Smaller pixels collect fewer photons, and this can cause signal-to-noise problems, especially in CMOS chips.

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The Most Current Technology uses "Pixel Shifting," sometimes called "Micro Scanning"

The latest advance in high-resolution digital cameras utilizes a single imaging chip which can be either a CMOS or a CCD.

These cameras make multiple exposures, moving the chip slightly between exposures. The newest systems move the chip less than one pixel's width, corresponding to just a few micrometers of movement. The resulting images are then merged to give a single high-resolution image with faithful color rendition.

Here's one scenario for how a pixel-shift camera would build up an image:

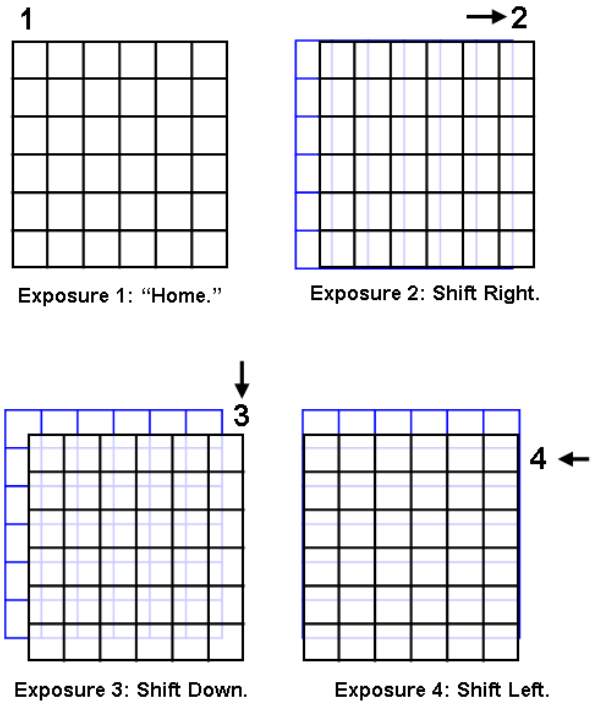

Figure 1. Pixel-shift camera. The chip is moved slightly after each exposure.

The technology to move the chip in highly accurate, very small steps is usually proprietary information and isn't shared by the manufacturers.

There are technologies available to make such highly accurate stepping movements. This can be accomplished by using very small motors and lead screws, or by using piezoelectric drivers.

MEMS devices (microelectromechanical systems) are the subject of intensive R&D these days, and it's not too much of a stretch to expect these devices to show up in digital cameras sooner or later. See the following article on MEMS.

After the capture of up to four individual images, the rest depends on computing horsepower. The four images must be merged into one high-resolution image. This takes some time, even with the best computers that are available for most laboratory work. You may have to wait 30-35 seconds for the final image.

Manufacturers are working on the time delay. For example, the PAXcam ARC (Adjustable Resolution Camera) from Midwest Information Systems has a CMOS chip and captures a 21 megapixel image in about 35 seconds; the ARC+ camera, with a CCD chip, captures a 32 megapixel image in less than 20 seconds.

If you are planning on routinely capturing and transferring images between computers, you can use a high-capacity, gigabyte USB Flash drive for such work.

Factlet: **18 million courses of antibiotics are prescribed for the common cold in the US per year. Too bad colds are caused by viruses. 50 million unnecessary antibiotics are prescribed for viral respiratory infections every year.**

Source: Centers for Disease Control and Prevention

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MEMS (MicroElectroMechanical Systems): Current State of the Art

Sandia National Laboratories in Albuquerque, NM is one of the premier sites for the design, production and packaging of MEMS devices. It is now possible to design and manufacture drive motors, gearboxes and transmissions, all from silicon wafers, on a micrometer scale.

"Monolithic integration" is one of the goals of MEMS: To integrate not only the micromechanical components (gears, transmission, motor, etc.) but also the driving, controlling and signal processing components, all on a single silicon chip.

Below are pictures of a few of these fascinating devices. To see how far micromachining has come in the past couple of years, go to Sandia's MEMS Home Page.

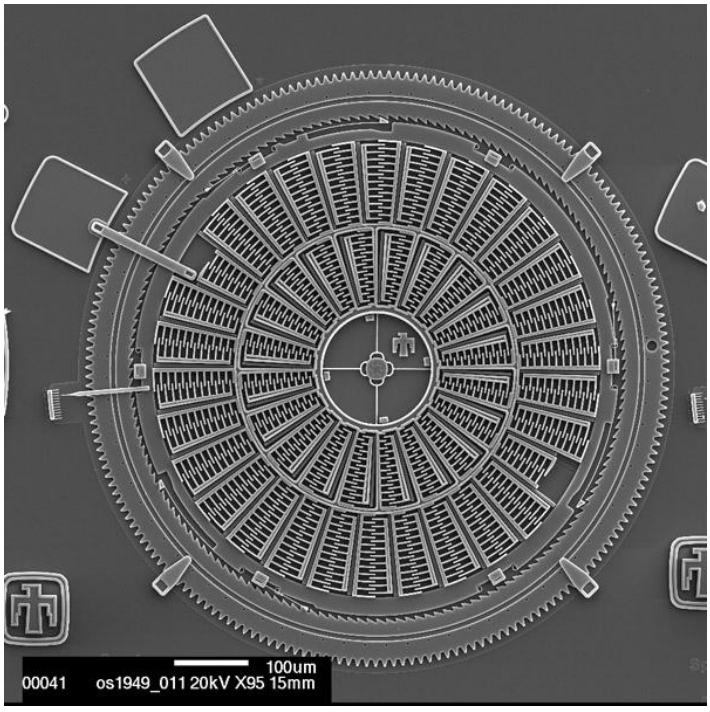

Figure 3. Torsional Ratcheting Actuator. Courtesy of Sandia National Laboratories, SUMMiT™ Technologies, http://www.mems.sandia.gov.

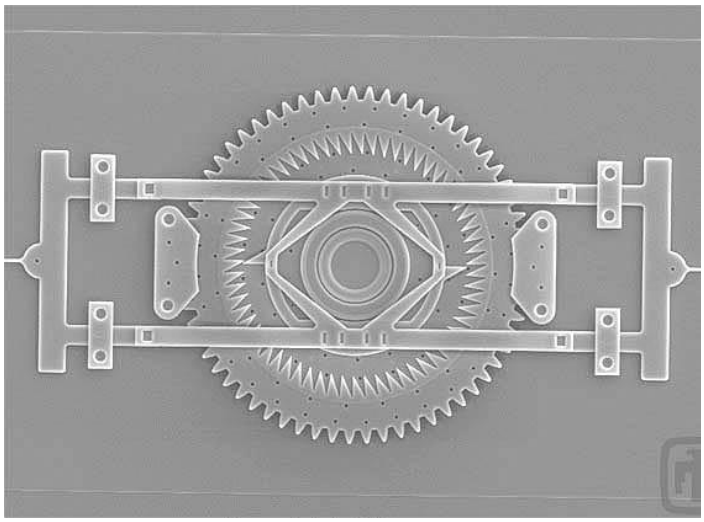

Figure 2. Indexing Drive Motor. Courtesy of Sandia National Laboratories, SUMMiT™ Technologies, www.mems.sandia.gov.

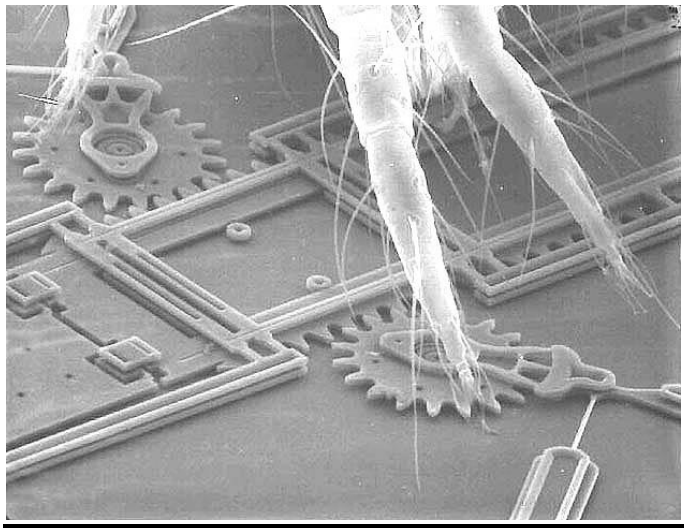

Figure 4. Spider mite on a mirror drive assembly. Courtesy Sandia National Laboratories, SUMMiT™ Technologies, www.mems.sandia.gov.

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Medical News

Nanotubes Destroy Kidney Tumors

By injecting multiwalled carbon nanotubes (MWCNTs) into tumors and heating them with a quick, 30-second zap of a laser, a multi-institutional team of researchers has developed a new type of therapy that effectively kills kidney tumors in nearly 80% of treated mice.

The research team has members from the Wake Forest University School of Medicine, Wake Forest University Center for Nanotechnology and Molecular Materials, Rice University and Virginia Polytechnic Institute and State University. Read more here.

First Evidence of Virus in Malignant Prostate Cells; XMRV Retrovirus Linked to More Aggressive Tumors

In a finding with potentially major implications for identifying a viral cause of prostate cancer, researchers at the University of Utah and Columbia University medical schools have reported that a type of virus known to cause leukemia and sarcomas in animals has been found for the first time in malignant human prostate cancer cells.

Prostate cancer is expected to strike nearly 200,000 U.S. males this year, making it the second most common form of cancer, outside of skin cancers, among men. Read more here.

U.S., Australian researchers say single H1N1 vaccine dose protects adults against virus

The results of clinical trials have shown one dose of the H1N1 (swine) flu vaccine is enough to offer adults protection against the virus, U.S. and Australian researchers said, the Associated Press reports (Neergaard, 9/11).

"That means it should be possible to vaccinate — well before the flu's expected midwinter peak — all the 159 million people that the Centers for Disease Control and Prevention estimate are in the high-risk groups: pregnant women, people under 24 years old or caring for infants, people with high-risk medical conditions and health-care workers," the New York Times writes (McNeil, 9/10).

In the clinical trial of the H1N1 vaccine, conducted by the Australian drug maker CSL, Ltd., and published in the New England Journal of Medicine, researchers tested the immune response of 240 adults, ages 18 to 64, who received a single, standard 15-microgram dose of the vaccine, CNN reports (9/10).

The test revealed "between 75 percent and 96 percent of vaccinated people should be protected with one dose — the same degree of effectiveness as the regular winter flu shot," according to the AP (9/11).

Factlet: The hottest place on the planet is… *Not* Death Valley in California!

On September 13, 1922 the thermometer in El Azizia, Libya reached 136° F (57.8° C). The highest recorded temperature in Death Valley was 134° F (56.7° C) on July 10, 1913.

Space:

Hubble Telescope Opens New Eyes on the Universe

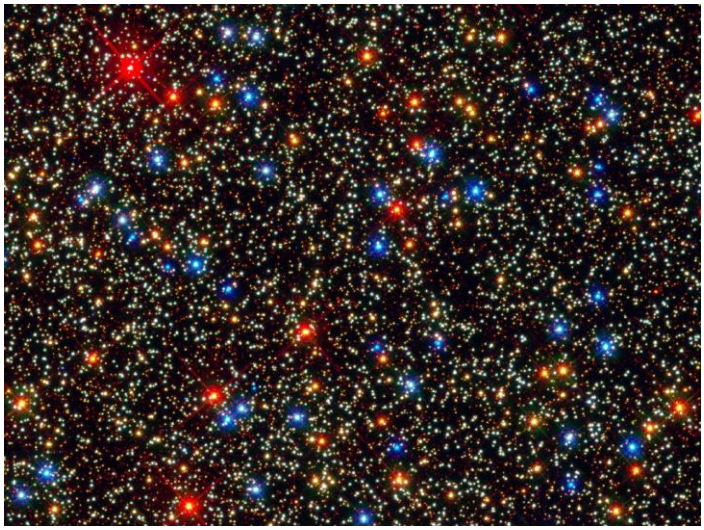

Figure 5. Dense star cluster in Omega Centauri. Image courtesy NASA and Space Telescope Science Institute (STScI).

NASA's Hubble Space Telescope is back in business, ready to uncover new worlds, peer ever deeper into space, and even map the invisible backbone of the universe.

The first snapshots from the refurbished Hubble showcase the 19-year-old telescope's new vision. Topping the list of exciting new views are colorful multi-wavelength pictures of far- flung galaxies, a densely packed star cluster, an eerie "pillar of creation," and a "butterfly" nebula.

With its new imaging camera, Hubble can view galaxies, star clusters, and other objects across a wide swath of the electromagnetic spectrum, from ultraviolet to near-infrared light. A new spectrograph slices across billions of light-years to map the filamentary structure of the universe and trace the distribution of elements that are fundamental to life.

Read more here, and visit the NASA Hubble Gallery Here. Many of the images may be downloaded and used as wallpaper.

Curiosities and Oddities:

OMG, uv got Chlamydia, srsly

Texting decreases the time to treatment for genital *Chlamydia trachomatis* infection.

"OBJECTIVE: To assess the effectiveness of a text message result service within an inner London sexual health clinic.... ...CONCLUSION: Patients with genital CT infection are diagnosed and receive treatment sooner since the introduction of a text message result service. The introduction of this service has resulted in a significant saving in staff time." Read the abstract on PubMed.gov here.

Things Invented by Monks

• **The blast furnace.** By Cistercian monks, North Yorkshire, England in 1350.

• **The pretzel.** Around 600 A.D., southern France or Northern Italy.

• **Muenster cheese.** By Benedictine monks, Alsace, northeastern France, around 700 A.D.

Noisy Planet

Figure 6. Blue whale. Wikimedia image (public domain).

What's the loudest animal sound ever measured? ***Blue whale*** communication has been measured at up to 188 decibels, making it the loudest recorded sound from a living source. These underwater sounds have been detected more than 500 miles from their source.

How loud is 188 decibels? Compare it with these other sound levels:

- Live rock music: 120 dB
- Aircraft carrier deck: 140 dB (pain threshold)
- Jet takeoff from 25 meters: 150 dB
- Space Shuttle lift-off *from 3 meters:* 180 dB

But Who Will Paint Her Picture?

The jury is apparently still out on who the lucky artist will be, but we note the following seismology faculty member at QAU University in Islamabad, Pakistan. You'll find her faculty profile here.

Thanks, but I'll Decline the Invitation to Participate in This Study…

The effect of antibiotic drugs on the volume and composition of intestinal gas from beans.

"Healthy men were confined to a metabolic unit and fed bean meals to stimulate intestinal gas formation while under antibiotic medication. Periodic samples of flatulus and breath were collected after the test meal for gas chromatographic analysis." Read the abstract on SpringerLink.com here.

Cheer Up, It's Not That Bad. Just Remember:

***Sharon Stone couldn't get a date for her high school prom.*

***Michael Jordan, arguably one of the greatest basketball players of all time, was cut from his high school basketball team because of his "lack of skill."*

***Winston Churchill failed the 6th grade.*

***Steven Spielberg dropped out of junior high school, came back and was placed in a learning-disabled class, then after a month he quit school forever.*

***Henry Ford's first two automobile companies failed miserably.*

***Nicole Kidman was nicknamed "Storky" in school because of her height, and no one asked her to dance at her first school dance.*

***Fred Astaire's first screen test report read: "Can't act. Slightly bald. Can dance a little."*

***Babe Ruth struck out 1,330 times.*