Focal Point

The Newsletter from Southwest Precision Instruments

132 North Elster Drive • Tucson, AZ • Tel./Fax 520.546.4986 • swpinet.com

November, 2009

In This Issue:

High Dynamic Range Imaging: A Balancing Act between Light and Dark

If you use photography in your work, you've undoubtedly been there before: Trying to balance an image, getting more detail out of the dark areas and toning down the light areas.

This is a common problem in film photography. If you've spent time in a darkroom, you undoubtedly remember trying to match the contrast grade of the paper to the negative, "burning in" the underexposed areas to increase details and "dodging" the overexposed areas to tone them down.

This has been an issue since the early days of photography. In the 1850's Gustave Le Gray (official photographer of Napoleon III) was experimenting with dual-negative photography for seascapes. Le Gray exposed one negative for the sky and a separate negative for the sea. He then combined the negatives to make a single positive print with a wider range of brightness (or luminosity) values.

Le Gray's dual-negative technique can rightfully be called "high dynamic range" imaging because it expands the range of brightness values above what the normal photographic medium can record with one exposure.

Gustave Le Gray, Brig in the Moonlight, ca. 1856. Dual negative photograph. Public domain image (Wikimedia).

Similar to film, a digital imaging chip can only capture images within a certain range of brightness values. Details can be lost in overly dark areas of the image, and they can be washed out in areas which are too bright. This range of brightness values for the camera is its dynamic range.

A single digital exposure is an "average" for the entire field of view, and while the camera's software can usually make a pretty good guess at the proper exposure, it's only a guess, and it may not convey all of the information we'd like.

There are numerous technical considerations and complex software algorithms to solve these exposure-related issues, but we won't go into them here. For a more technical discussion, we recommend starting at the Wikipedia page for "High Dynamic Range Imaging."

For our purposes, let's assume that we'd like to extract a little more information from the underexposed areas of a digital image, and to perhaps tone down some of the overexposed areas to give a more balanced overall image.

Photoshop, beginning with CS2, has provided a "Merge to HDR" function for this purpose. A bracketed set of exposures is made (some overexposed, some underexposed), you select the photos to merge, check their alignment, then run the "Merge to HDR" function. Intermediate steps provide user input to adjust the merged image.

Photoshop is highly versatile and is used for applications other than scientific imaging, so merging can be tedious. Besides the options during the HDR process, you'll have to make some choices for the format of the merged image. Also, you may have to downconvert it from 16 bit or 32 bit to 8 bit (thereby clipping the image) depending on how the final picture is to be used.

Much of the process can be automated with the proper camera and imaging system. For example, Midwest Information Systems (MIS) now has an automated HDR function in its PAXit! image processing software. The following images are from PAXit! software and a PAXcam scientific digital camera.

The camera, under control of the software, automatically makes a bracketed set of exposures, combines the images and merges them to produce a single HDR image.

First of 10 bracketed exposures for HDR Blending. Image courtesy of Midwest Information Systems.

Last of 10 bracketed exposures for HDR Blending. Image courtesy of Midwest Information Systems.

All 10 exposures blended for HDR. Image courtesy of Midwest Information Systems.

The HDR function is especially useful for objects which have highly reflective surfaces or other wide dynamic range information in them and are illuminated from above, such as printed circuit boards, electronic components, machined parts, etc.

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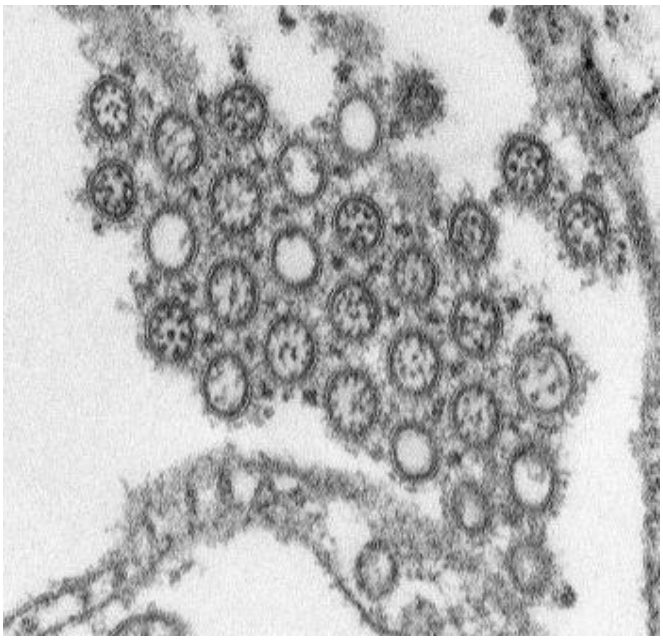
Public Health

CDC Update: Novel Influenza A (H1N1) Pandemic



Transmission electron micrograph of H1N1 virions in an isolate. Source: Cynthia Goldsmith, Centers for Disease Control and Prevention.

On June 11, 2009 the World Health Organization (WHO) advised that the H1N1 subtype of Influenza A had reached pandemic levels. This novel virus continues to spread worldwide in essentially the same manner that regular seasonal influenza viruses spread.

The Centers for Disease Control and Prevention (CDC) continues to monitor the spread of H1N1, as does the WHO.

How does the virus spread?

Flu viruses are spread person-to-person through coughing or sneezing, and occasionally by touching a surface that has the virus on it, then touching the nose or mouth.

What are the signs and symptoms of the virus?

H1N1 symptoms include fever, cough, sore throat, runny or stuffy nose, body aches, headache, chills and fatigue. Vomiting and diarrhea have also been reported. People may be infected with H1N1 and have respiratory symptoms without a fever. Severe illnesses and deaths have occurred as a result of H1N1.

How does the CDC track infections, and what do the latest results indicate?

Several key indicators are continuously monitored, including:

Visits to doctors for influenza-like illness (ILI) have increased steeply, and doctor visits are much higher than expected. ILI activity is now much higher than what is seen during the peak of the regular seasonal flu.

Hospitalizations for lab-confirmed flu are rising sharply and are higher than expected for this time of year.

Deaths from pneumonia and influenza (P&I) have increased, and are higher than expected. Since April 2009, 95 H1N1-confirmed pediatric deaths have been reported, and another 7 were lab-confirmed flu deaths although the subtypes were not identified.

Widespread influenza activity reported by states. Forty-six states are reporting high activity at this time.

A sneeze in progress. Aerosols from sneezing and coughing are primary ways for viruses to spread from person to person. Source: Brian Judd, Centers for Disease Control and Prevention.

Exercise caution, and remember to:

- **Cover your nose and mouth when you cough or sneeze.**
- **Wash your hands often.**
- **Avoid touching your eyes, nose or mouth.**
- **Stay home when you're sick!**

For more information and the most current status of H1N1, visit http://www.cdc.gov.

Survival of the Fittest? Charles Darwin and Albert Einstein married their first cousins.

Medicine

Prostate Cancer: Male Hormone May Trigger Gene Fusion, Leading to Prostate Cancer, Study Says

Researchers have discovered that the male hormone androgen may trigger the gene fusion that leads to the development of prostate cancer: they found that pieces of chromosome that normally sit far apart, relocate near each other after exposure to androgen, and this sets the scene for the genes to fuse.

Researchers at the University of Michigan Medical School in Ann Arbor studied prostate cancer cells which showed no evidence of gene fusion but were sensitive to androgen.

After androgen treatment the cells were exposed to gamma radiation to stress the cells. This caused gene fusion in the now adjacent regions of the chromosome.

The gene fusion event appears to be an "on" switch for triggering prostate cancer, and this latest research sheds light on how the fusion event occurs.

"Chromosomes can actually be induced in three-dimensional space to be close to each other," Dr. Ram-Shankar Mani, the lead author, said. "Then when an insult to the DNA occurs, the fusion happens."

Read a synopsis of the research here. Or read the original paper in Science:

"Induced Chromosomal Proximity and Gene Fusions in Prostate Cancer."
Ram-Shankar Mani, Scott A. Tomlins, Kaitlin Callahan, Aparna Ghosh, Mukesh K. Nyati, Sooryanarayana Varambally, Nallasivam Palanisamy, Arul M. Chinnaiyan.
Science, Published Online October 29, 2009.
DOI: 10.1126/science.1178124

Weird Fact:
Hawaii has three Interstate Highways.
(Think about it.)

Biomedical Research

Naked Mole Rats May Provide Cure for Cancer

Naked Mole Rat. Public Domain Image (Wikimedia)

Naked mole rats are unique in many ways. Besides being one of the ugliest creatures ever discovered, they're the only mammals with a hive mind, obeying their queen as if they were ants.

Also, they feel no pain, an adaptation still not fully understood. Their lips are behind their front teeth, they breathe mostly through their skin, they have a 30-year life span, and acid doesn't really burn them.

But most importantly, they are the only animals that don't get cancer.

According to researchers at the University of Rochester, the mole rat's cells express a gene that tells cells to stop dividing. The gene, *p16*, forms a second defense against cancer. Most mammals, including humans, only have one gene, *p27*, protecting cells from cancer. And while most cancers know a way around *p27*, *p16* stops them cold.

"It's very early to speculate about the implications, but if the effect of *p16* can be simulated in humans we might have a way to halt cancer before it starts," says lead investigator Vera Gorbunova, Associate Professor of Biology at the University of Rochester.

The research was recently published in The Proceedings of the National Academy of Sciences.

Read a synopsis of the research here.

Invented in Canada:
The Electric Range
The Electron Microscope
Standard Time
The Zipper

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Science and Society

Disturbing Trend in Colleges and Universities: Bargain-Basement Faculty

Things are tough all over these days, and the nation's higher education system is suffering in a major way. Costs are on the increase, tuition is creeping into the stratosphere and endowments are shrinking. What's a college or university to do? Cut costs, of course.

Tenure-track positions are disappearing at an alarming rate, and adjunct faculty positions are on the rise. Many of those adjunct faculty positions involve tenure-track workloads with embarrassingly small paychecks.

Adjunct faculty face precarious financial security despite their playing an increasingly pivotal role in many schools. A third of those polled in a survey by the *Chronicle of Higher Education* taught introductory courses, more than a quarter taught courses in a "major," and 21 percent taught upper-level advanced classes in their field.

Forty-five percent also helped develop courses, roughly one-quarter served on faculty committees and almost half were expected to attend faculty departmental meetings.

And the pay for doing this? Overall, the average salary is somewhere south of $20,000.

Read Janet Raloff's blog about the problem here.

Another article about disappearing tenure-track positions is located here.

Weirdness

2009 Ig Nobel Prize Winners Announced

The world has waited breathlessly for the announcement of the winners of the 2009 Ig Nobel Prizes, and the wait is now over. We present the following for your reading enjoyment. These are highlights of the most prestigious awards. The complete list may be found here.

Public Health Prize: Elena Bodnar et al., for her invention of a body garment (a.k.a., a brassiere) that converts into a pair of protective face masks, one for the brassiere wearer and one for a needy friend.

Veterinary Medicine Prize: Catherine Douglas and Peter Rowlinson, for showing that cows who have names give more milk than nameless cows.

Peace Prize: Stephan Bolliger et al. for determining which is the more effective weapon: An empty beer bottle or a full beer bottle.

Economics Prize: Icelandic banks, for showing that tiny banks can instantly become huge banks, and vice versa. And oh by the way, the same thing can happen to an entire national economy.

Physics Prize: Katherine Whitcome et al., for analyzing why pregnant women don't tip over. It's all about lordosis.

Biology Prize: Fumiaki Taguchi et al., for discovering how to reduce the mass of kitchen refuse up to 90% with bacteria from giant panda feces.