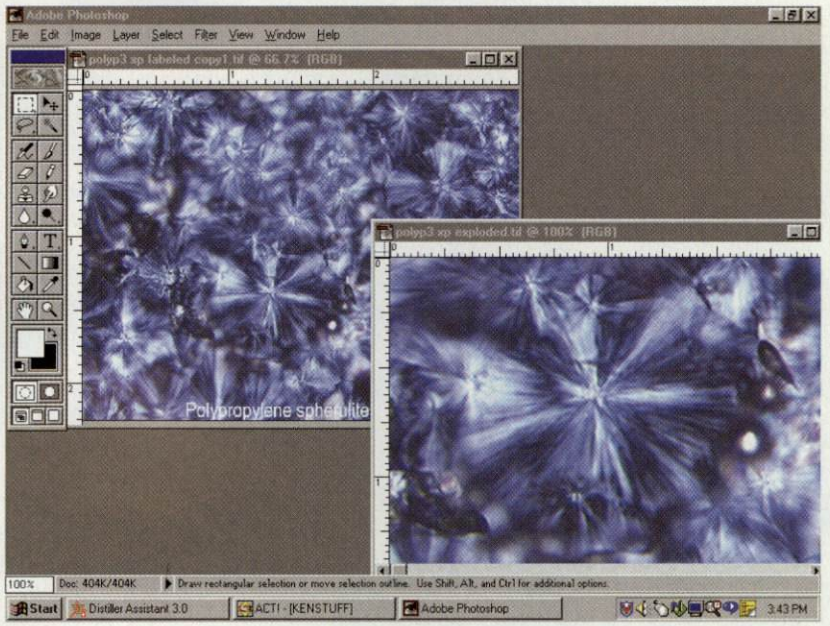
Adobe Photoshop:

The Surprise Scientific Image Processing Software of Choice?

Discussions of image processing software for the scientific laboratory and microscopy arenas tend to focus on the capabilities of information-extracting image analysis packages, as is understandable. But in the real world of software choices and usage, that's far from the complete picture!

A new trend is emerging in image processing for microscopy: the use of tried and trusted **Adobe** Photoshop, no less, as an adjunct or replacement for conventional image processing.

At **Microscopy/Marketing & Education** (MME), a technical marketing company serving microscopy and related imaging fields, we have been tracking this trend for several years now through research at key trade shows such as the American Society of Cell Biology and Microscopy and Microanalysis (M&M, the joint meeting of the Microscopy Society of America and the Microbeam Analytical Society).



Microscopists are using Photoshop for everything from resizing and annotating to montage and 3D reconstruction.

PHOTOSHOP USE APPROACHES 90%

This article is not, of course, intended to be a review of a specific software program. Rather, Photoshop's rapid and universal proliferation piqued this columnist's curiosity, particularly because it's a trend so little noted.

As with much technology evolution, academia and progressive government laboratories lead the way here: Approximately 80% of professors report using Photoshop and an amazing 90% of graduate students and post docs!

This year's M&M numbers showed increased use by laboratory managers (90%) over both the M&M '99 (84%) and Cell Bio '98 (80%) numbers. Use by researchers was also up significantly over the last year—to 80%.

Industrial facilities are showing significant growth, up from 63% in '99 to 75% this year. Data for clinical labs was too sparse in these studies for any statistically valid comment. Analysis by discipline at the M&M meetings reveals a slight edge by biologists over materials scientists; biologists report approximately 90% usage while materials scientists are hovering at 77% for both '99 and 2000.

WHAT ARE THEY DOING, ANYWAY?

Although Photoshop was, of course, built for the graphic arts and general digital photography world, a number of its key functions translate well into the scientific realm.

For instance, contrast is a major challenge in microscopy. We often need to pull hidden information out of shadow or highlights. Photoshop is a good tool for contrast enhancement. One caveat: If image analysis is part of your protocol, do your measurements before PS processing to preserve the validity of the scientific content.

Moreover, since the final destiny of many microscopy images is presentation, either in publication or as a poster at a professional conference, annotation is important. As discussed below, Photoshop's layering capability permits addition of text, arrow, and scale bars in a separate layer which can be independently changed or moved without affecting the image itself.

A third key function is image sizing. Most publications require their own specific XY dimensions and 150 lines per inch (lpi) resolution (equivalent to a resolution of 300 dots per inch (dpi) or pixels). PS makes resizing and resolution adjustment easy. Playing with these is an interesting self-generated tutorial in image quality and file size and is well worth the time. Important tip: If you are changing just the resolution of an image, check the "resampling" option to maintain the image size.

For those working with multiple sections, Photoshop offers the ability to handle groups of images in batch work, a great time saver for image compression. A reminder that TIFF is the only image format officially sanctioned by the Microscopy Society of America. The good news: For TIFF images, PS provides an option for LZW compression, a lossless algorithm

which maintains the integrity of the image. Additionally, multiple images can be montaged to form one, larger image.

Finally, for those looking for simplified and inexpensive image analysis, well-known imaging veteran John Russ provides his software as a Photoshop plug-in.

LAYERING: ONE SECRET TO PHOTOSHOP'S SUCCESS

Our graphic artist, Frank Mastromatteo of GA Communications (Springfield, MA), teaches a 15-week course in PS at a local college and invited the author to sit in. One lecture revealed two of Photoshop's strengths: layering and color balancing.

Layering is the ability to separate information in an image into discrete image planes for independent processing. As mentioned earlier, layering is a great approach for annotation and scale marking an image. Also, stereo pair can be independently colored (red/green, red/cyan, etc.), then layered to form anaglyphs.

SECRET #2: BALANCING COLOR FROM DEVICE TO DEVICE

The secret to balancing the color output from the camera to the monitor to the printer was an unexpected bonus of Frank's course. With so many components involved in digital imaging, accurately reproducing what you see in the microscope is a real challenge. The Photoshop 5.0 color management tutorial takes into account the monitor, the end use (Web, presentation, pre-press), the color regime (RGB vs. CMYK), the image mode (light microscopists will prefer full color while SEM, laser scanning confocal, and AFM users may prefer duotone or spot color), and even the brand and model of printer used for output. Our recommendation: Start with a well-behaved sample then move on to more delicately colored and difficult samples.

ADOBE EFFORTS FOR ACADEMIC INSTITUTIONS

Photoshop Version 6.0, previewed for users and set for release soon, features new Web capabilities, including the ability to convert text to PDF format and Adobe ReadyImage for creating Web-ready images.

Street price for the full version of Photoshop can run as high as $1600 with all the plug-ins, although a capable package is regularly sold by Mac or PC providers at about $600. And the light version (Photoshop LE) is in fact fine for most microscopists and, with a price tag of only $99, is well within even a student household budget.

Academic institutions receive a considerable price break, which is likely to create one of the driving factors for such high usage in that sector of the market. In a recent conversation with Dr. Tony Garrett-Reed of MIT, he pointed out that Adobe has now taken an "Apple-esque" approach to marketing to this sector.

The very attractive academic pricing insured rapid and extensive adoption of this software. In a related posting to the MSA listserver, Dr. Garrett--Reed noted that, "As a result, all our graduates go off to their jobs and immediately buy Photoshop."

PROS AND CONS IN BALANCE

On the positive side, PS handles both 16-bit B&W and color images, supports an extensive range of file formats, and conveniently bridges pesky image conversion between the Mac and PC world. Also, once familiar with key functions, the menus are clear and facile. As a matter of fact, Photoshop provides much more capability than most microscopists will ever use.

On the negative side of the ledger, some would find the extensive capabilities a mixed blessing. It is all too easy to get carried away with all the image processing, which can, of course, result in prettier pictures but a serious loss of scientific validity! Also, the program as a whole is not intuitive, still requiring an extended learning curve, although this is an area in which successive versions of the software have been showing considerable attention. On-site courses such as MME's are one solution, offering programs which integrate key PS functions with scientific imaging concepts, minimizing any of these negatives in actual practice.

AN EYE TO SCIENTIFIC ETHICS

As with any image processing, use of Photoshop raises some critical issues. Good science dictates that any modification to the image be cited in the discussion of method. Also, always store the original as a TIFF file. (An interesting comment overheard recently: Put the original in one file and the PS processed images in a different one). A reminder also to conduct all measurements prior to conducting any processing which affects a measured parameter.

And finally, a caution against processing to the extent that the inherent scientific information might be changed or misrepresented. As with all good experimental techniques, a little forethought goes a long way. ◆

HINDUS

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eight Care Stations and two Kodak LifeView Monitoring Stations were provided to Humana. Humana members utilizing the stations are high-risk patients of all ages who face long-term illness or recovery at home. The most common reasons for home care are diabetes, congestive heart failure, hypertension or chronic lung disease. Post-surgical patients, the disabled or even new mothers who require postpartum care, can also use the care stations.

"Any time we can improve patient satisfaction and the quality of care and lower the cost of care at the same time," Dr. Komet stressed, "that's a big win for everyone!" He added that so far, the pilot seems to be meeting these expectations.

THE FUTURE OF TELE-HEALTH

"We designed our first version of the LifeView Station to work over POTS lines, because that's what our first adopters wanted," Kodak's Zimic noted. "Obviously, this limits the quality of the teleconferencing part of the system." He continued, "The station is basically a computer, so we can add DSL or cable modem cards, if a customer requests them." However, he warned that as a patient care device, LifeView is approved by the FDA according to the UL2601 standard for a device with direct patient contact. This is a standard which is most concerned with issues such as basic safety and current leakage.

"Any time you change the hardware configuration inside the patient station you need perform what the FDA calls 'due diligence' to test the device." This is a rigorous process.

The next generation of the LifeView Station will have higher quality video and be more of a platform for clinical instruments. It will include one RS-232 and two USB ports which health care providers can use to attach additional instruments, depending upon the patient's needs. These instruments can range from blood oximeters for measuring the blood oxygen levels to glocometers for measuring blood sugar levels. "Out most frequent request has been for a scale to measure the patient's weight," Zimic added.

If tele-health stations are not a new idea, today's combination of new technology, changes of health care economics, and a great reduction in health care state costs have come together to make the approach seen in the Kodak LifeView system one to watch for growth. ◆