example, that the efficiency is still low: 100 to 150 eggs are required to obtain a single cell line. "If we were to apply it to humans, we would have to get that many eggs." To improve the efficiency, the investigators are studying reprogramming — the process by which the egg converts the somatic cells to stem cells. They investigate factors in the egg that are involved in this process and are exploring the mechanisms by which it occurs.

"Once we understand these," he added, "we hope to trace what proteins are actually responsible for reprogramming" and then to improve the efficiency of the technique by adding or overexpressing these proteins. □

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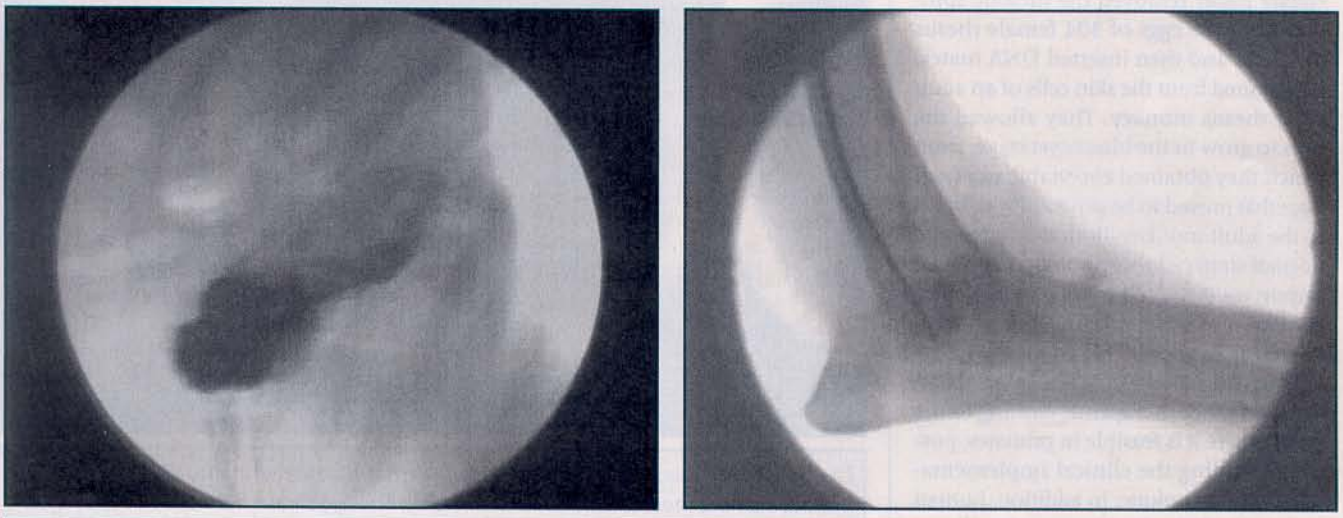
Low-cost module converts analog x-ray angiography systems to high-definition digital

Angiography enables scientists to visualize arteries, veins, organs and other tissues by injecting a contrast agent into the bloodstream and then acquiring x-ray images of the region of interest. Because these images also highlight surrounding features such as bones, researchers developed a technique known as digital subtraction angiography to remove them from the image. With this technique, an initial "clear" image is obtained prior to the injection of the contrast agent, and the second image is subtracted from the first.

Several years ago, investigators with Universidad Argentina de la Empresa in Buenos Aires were asked by a local medical device company to develop a fully digital acquisition and processing module for its analog angiography x-ray system. Now completed and on the market, the module enables clinicians to convert existing analog systems to high-definition digital ones for a fraction of the cost of purchasing a new digital system. This is tremendously important in developing economies, said Guillermo B. Sentoni, one of the developers of the module: It helps to close the technology gap where it might not otherwise have been possible.

The digital acquisition and processing module consists primarily of an embedded PC made with off-the-shelf hardware, running Windows XP Embedded, and a frame grabber board made by Matrox Imaging of Dorval, Quebec, Canada. The frame grabber can be either a Helios or a CronosPlus, depending on whether the user requires high- or low-resolution images, according to Sentoni. (The Helios is one of the company's high-end frame grabbers, offering powerful preprocessing capabilities; the CronosPlus is an entry-level frame grabber designed for standard analog monochrome or color video acquisition.)

Frame grabbers have evolved significantly since they were introduced. Originally, in the days before digital video cameras, they converted analog video to a digital format compatible with the image-processing software. Now, digital interface standards such as IEEE-1394, Camera Link and GigE Vision perform this function. A mechanism by which to arrange the image data into a format recognizable to image-processing software is still required, though, and frame grabbers have evolved to fill this need. Moreover, they usually offer additional features, such as specialized chips to accelerate image processing or general-



Researchers in Argentina have developed a digital acquisition and processing module for analog angiography x-ray systems, enabling clinicians to convert existing analog systems to high-definition digital ones for much less than the cost of a new digital system. The researchers demonstrated the module by imaging a dog swallowing (left) and a dog leg in a metal prosthesis (right). The improved contrast in the images showed that the module delivers the benefits of a high-definition digital angiography x-ray system, while using analog x-ray equipment.

purpose I/O to enable communication with outside devices.

Matrox introduced the Helios family of frame grabbers in 2002 to support higher-performance Camera Link cameras and to offer preprocessing capabilities to help the host CPU. All variations of the board feature a custom-designed chip that performs image formatting and preprocessing tasks.

The university researchers chose the frame grabbers in large part because of the strong integration of the company's products with leading hardware and software providers. Such integration was essential to the development of the digital subtraction angiography system, Sentoni said, because it depends on different off-the-shelf systems talking to one another (using various commercial systems helped to reduce the development costs considerably, relative to the proprietary architectures designed for other commercial systems).

Designing the system with affordability in mind was not without challenges, though. The system is based on the acquisition, multiprocessing, storing and displaying of images at 30 fps. Working with 1024 × 1024 images thus translates to dealing with 300 Mb/s of information — roughly 80 percent of the PCI bandwidth — and medical regulations require that the information be saved to disk without compression. They met these challenges through a well-designed software architecture, Sentoni said, taking advantage of the hardware-software integration of the frame grabber and the company's associated image processing libraries.

The acquisition and processing module, now handled by a company formed by one of the researchers, was released to the market in Argentina in 2006. About 15 systems have been sold thus far, Sentoni noted, and have been deployed in hospitals and in various other health care institutes. Plans are in place to export the systems to several other Latin American countries, after ensuring compliance with local regulations.

The investigators are working to improve the system, Sentoni said, by adding more functionality for a better diagnosis with digital subtraction angiography. First, they are working to achieve better control over the x-ray generation timing using the embedded PC. Also, upcoming releases will incorporate full Dicom capabilities. Dicom is a Digital Imaging and Communications in Medicine standard for distributing and viewing medical images. □

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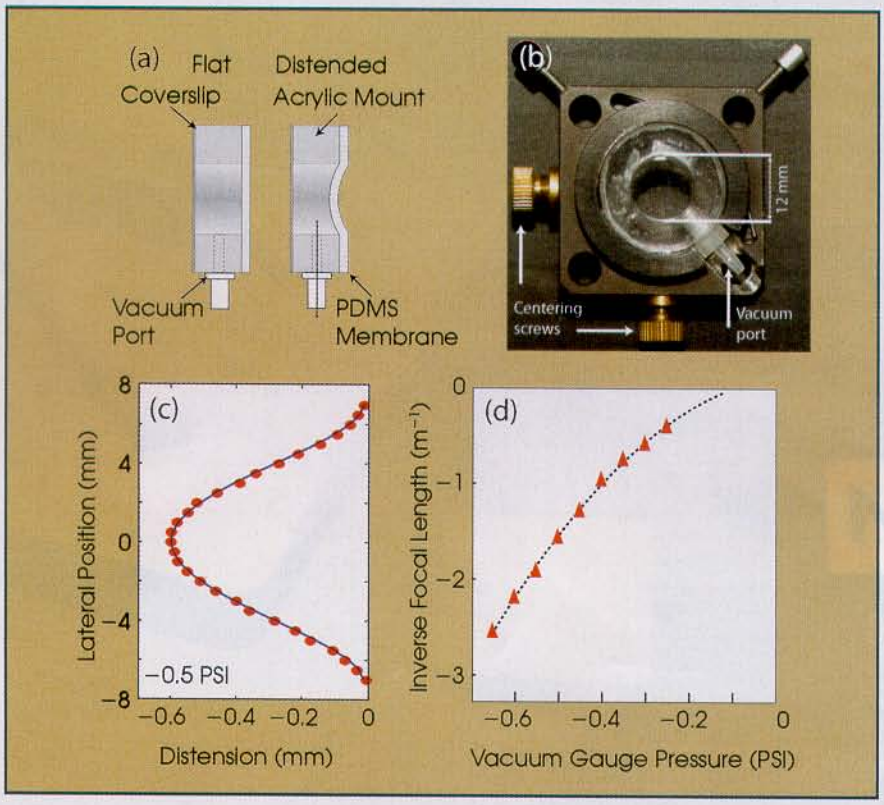
An adjustable corrective lens for two-photon microscopy

Those who use two-photon laser scanning microscopy could soon see better performance, thanks to a group of researchers from the University of California, San Diego, and from the Weizmann Institute of Science in Rehovot, Israel. The investigators designed and demonstrated a deformable membrane that improves the axial resolution of two-photon microscopes twofold.

The optical performance issue arises because the water-dipping objectives typically used in two-photon microscopes have a high numerical aperture and a long working distance, two important characteristics. However, because these lenses are designed to image at the surface of a sample and not deep within it, the resolution degrades with increasing depth. For material with an index of refraction



Researchers used a deformable polymer membrane that can be distended via a vacuum (a) for correction of the spherical aberration in two-photon laser microscopy (b). The measured distension averaged over three readings of the membrane as a function of the radial position at a gauge pressure of −0.5 psi is shown(c), as well as the effective focal length of the distended membrane vs. the vacuum pressure (d). The focal length was determined by imaging a filament with the membrane in tandem with a fixed lens. Images reprinted from Applied Physics Letters.