Can You Imagine . . .

. . . an imaging technology that offers medical researchers a less destructive way to look at samples under a microscope.

NEW METHOD ELIMINATES FIXING IN BIOLOGICAL ANALYSES

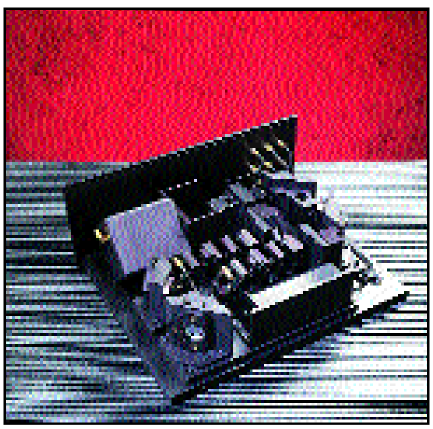
To look at some of life's smallest building blocks, many light-based imaging methods require physical alteration of the biological material before viewing. Preparing a sample for viewing often means stabilizing the cell with special chemicals and removing all the water, potentially distorting the image of the cell and its contents. Newer techniques can eliminate some fixative steps, but may also cause photo-bleaching, a phenomenon that can ruin parts of the image.

A new imaging method offers a less destructive means of biological analysis and of examining industrial and semiconductor materials. Essex Corporation (Columbia, MD) developed a synthetic aperture microscope (SAM), based on synthetic aperture radar. The device produces high-resolution, 3-D, complex-valued representations in a few seconds, with reduced alteration of the specimen. It also allows specimen viewing from a greater distance than many light-based imaging methods. Applications of the SAM include both macroscopic and microscopic imaging.

ESSEX'S TECHNOLOGY HAS SUCCESSFULLY IMAGED A VARIETY OF BIOLOGICAL SPECIMENS AND SEMICONDUCTOR MATERIALS.

The SAM, a coherent-light microscope, can resolve images as small as one-quarter the device's operating wavelength. Thus, using ultraviolet light (280 nanometers) allows visualization of sample features as small as 70 nanometers. Working with Dr. Lee Peachey, a biology professor at the University of Pennsylvania, Essex discovered that this resolution gives a sharp view of the complex eyes of fruit flies and the intricate exoskeletons of diatoms (microscopic algae). It also produces detailed images of carbon fibers and diffraction gratings.

Essex's device can operate at wavelengths from ultraviolet to visible and infrared. Independent of working distance, the device resolves very small features from several inches away. By changing the focal lens of the SAM, Essex expects to increase this distance to four to six inches or even more.



■ Essex's microscope works in tandem with ImSyn™ (pictured above), Essex's high-speed optical processor which forms images from a wide range of sensor inputs.

The SAM works in tandem with ImSyn™, Essex's high-speed optical processor which is capable of forming images from a wide range of sensor inputs. An outgrowth of BMDO-sponsored research in rapid optoelectronic processing of radar signals, the ImSyn processor significantly cuts data processing time in magnetic resonance imaging (MRI), ultrasound, and other diagnostic examinations. For example, the optoelectronic processor allows physicians to see a target tumor or other anatomical feature in real time, and its high speed increases the resolution of images and prevents blurring.

Dr. Peachey notes that when used to collect data digitally, the SAM may mimic different types of microscopes. Thus, a biological sample would be subjected to only one data collection event because the digital data could continually be rearranged to produce images in different formats. The SAM also could generate full phase and amplitude information for 3-D holographic imaging, allowing the viewing of images from different angles. Today's microscopes that use film or charge-coupled devices record only amplitude information.

ABOUT THE TECHNOLOGY

SAM's key, the ImSyn processor, takes data directly from any sensor, such as an MRI coil, and sends real-time imaging to the workstation for display. Standard workstation software performs image enhancement and manipulation, if desired. The system, a 2-D real-time Fourier transform processor with high-speed input and output, uses optoelectronic technology for speed and flexibility. The processor transforms the received data into images and then forwards those images to the image analysis workstation. The complex correlation with an appropriate pattern in a database forms the pattern recognition option.