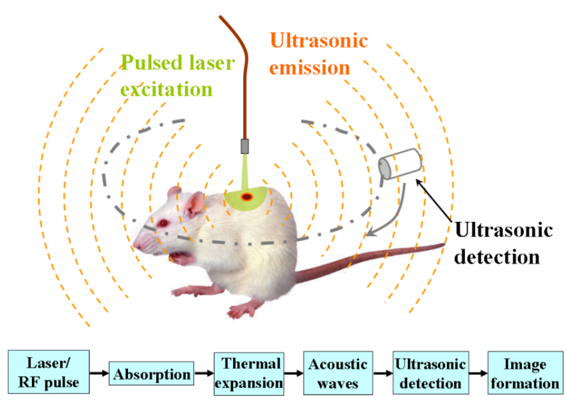
Photoacoustic Imaging

Kevin Sylvestre - Biomedical Engineer - University of Rhode Island

In the world of medical imaging, new developments are constantly being made. One of the latest and most promising advancements in medical imaging comes from a century-old discovery. The *photoacoustic effect* is the property of materials to absorb light energy, and convert it to kinetic energy through a process involving thermal expansion. The kinetic energy then manifests itself as a pressure change, which creates a sound wave.

Imaging modality	Primary contrast	Imaging depth	Resolution
Confocal microscopy	Fluorescence/scattering	~0.2 mm	~1-2 microns
Two-photon microscopy	Fluorescence	~0.5 mm	~1-2 microns
Optical coherence tomography	Optical scattering	~1-2 mm	~10 microns
Ultrasonography (5 MHz)	Ultrasonic scattering	~60 mm	~300 microns
Photoacoustic microscopy (50 MHz)	Optical absorption	~3 mm	~15 microns
Photoacoustic tomography (3.5 MHz)	Optical absorption	~50 mm	~700 microns

In 1880, Alexander Graham Bell discovered that if a beam of sunlight were filtered through a rapidly spinning slotted disc to strike thin discs, they would emit sound. Later, Bell demonstrated that materials exposed to the non-visible portions of the solar spectrum, such as the infrared or ultraviolet spectrums, also produce sounds. By measuring the sounds at varying wavelengths, one can then determine a photoacoustic spectrum, which can be used to determine the constituents of a sample.



Today, the beam of sunlight and slotted disc set-up has been rendered obsolete. Modern photoacoustic mechanisms rely on high intensity lasers (since a higher intensity light produces a proportionally more intense sound wave) and ultrasonic transducers. Chemists use photoacoustic spectroscopic techniques to study gases at the parts per billion or even parts per trillion levels. However, recently the photoacoustic effect has found new applications.

Photoacoustic imaging utilizes high intensity lasers and either a single ultrasonic transducer or an array or ultrasonic transducers to detect the structure and function of internal tissues. It has many advantages over other medical imaging techniques, without many of the potentially hazardous side-effects. For instance, the scalable resolution and depth of light penetration is unmatched, and since it uses non-ionized lasers, it doesn't carry the same dangers as traditional X-rays. While the technology is still fairly new, it shows great promise in the early detection of cancer, the detection of brain lesions, and other potentially invaluable applications.

Sources:
http://en.wikipedia.org/wiki/Photoacoustic_spectroscopy
http://en.wikipedia.org/wiki/Photoacoustic_imaging_in_biomedicine
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