Argonne NATIONAL LABORATORY

National Security

Portable imaging system to aid diagnosis of battlefield, emergency injuries

For use on battlefields and in emergencies, Argonne National Laboratory is developing a small portable instrument to quickly assess injuries. Other possible medical applications include evaluation of internal brain damage, noninvasive blood glucose monitoring, diagnosis and screening of cancer, assessment of vascular disease, and imaging of skin abnormalities.

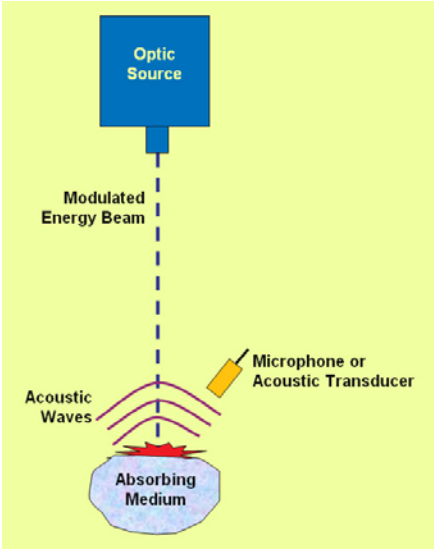
The technology uses non-invasive, non-radioactive and non-toxic methods to determine the extent of damage to soft tissue and to detect contamination by foreign particles. The technique, called "photoacoustic spectroscopy" (PAS), has a number of advantage over existing technologies.

- Standard ultrasound can be difficult to interpret by non-specialists.
- X-ray facilities are not readily portable, and continuous or repetitive use is limited by concerns about radiation exposure.
- Radiological methods can change the systems they measure.
- Clinical ultrasonic systems operating at high frequency have good resolution and penetration depth for soft tissues, but do not penetrate the skull to image brain tissue and have poor resolution for hard tissue.
- Optical spectroscopy techniques have problems with penetration depth, laser power, tissue damage or stability.

But most of all, these existing techniques are ill-suited for use in the field.

Argonne's PAS imaging technique fires a series of short laser pulses at the injured tissue, which warms it slightly and produces a short-lived thermal expansion. This expansion generates elastic acoustic waves that transmit through the tissue and are measured by a microphone. An array of frequency-variable acoustic transducers or a wideband microphone can be used to generate a two-dimensional image of the internal tissue's structure in real time during the scan. Resolution is comparable to that of standard ultrasound.

Because of its nondestructive nature, the PAS imaging system is expected to have many non-medical applications, such as leak or trace-gas detection, monitoring drying foods, and in-process characterization of industrial materials. It will also be capable of liquid- and solid- phase measurements, such as detecting defects in solids and characterizing liquids.



ACOUSTIC DIAGNOSIS – Argonne's photoacoustic spectroscopy technique fires a series of short laser pulses at the injured tissue, that slightly warm tissue, creating a thermal expansion. This expansion generates elastic acoustic waves that can be measured and used to generate a two-dimensional image of the internal tissue's structure in real time.

For more information

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