



Presents Research Seminar Speaker:

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Time: 3:00-4:00 p.m.

Loefler Room: BSB 3.03.02

Optoacoustic Imaging: from basic physics to clinical applications

In 1880 Alexander G. Bell heard “a pure musical tone” in a closed gas volume that had absorbed a modulated sunlight beam. Later discoveries revealed that detection of sound resulting from the optical absorption represents a very sensitive means for detection of absorbing molecules in gases and liquids. Biomedical applications of laser optoacoustics exploded after the discovery of the physical principles governing acquisition of spatially resolved images in the depth of live tissues.

This lecture will discuss physical principles, preclinical and clinical applications of the Laser Optoacoustic Imaging System. Ideas that made this system possible were that (1) laser pulses may be effectively used to produce acoustic pressure sources in absorbing biological tissues, (2) the resulting acoustic (ultrasonic) waves can propagate in biological tissues with minimal distortion and deliver information about optoacoustic pressure sources to the surface of tissue where they may be detected, (3) maps (images) of the absorbed optical energy can be reconstructed with high resolution under the illumination condition of pressure confinement in the course of the optical energy deposition into a voxel to be resolved [1].

Recently optoacoustic 2D and 3D imaging systems emerge as useful modalities for both, preclinical research in animals [2] and clinical applications [3]. This hybrid system provides optical contrast in tissue while mapping tissue structures with ultrasonic resolution. The main advantages of the optical contrast is the applicability of spectroscopic optoacoustic imaging to (1) map distributions of blood concentration and its oxygen saturation (functional imaging) in the given tissue, and (2) map distribution of molecules of interest, such as cancer receptors or other biomarkers (molecular imaging). For example, high optical contrast of blood (specifically hypoxic blood) makes visualization of the tumor angiogenesis possible, thereby providing functional information for differentiation of malignant and benign tumors. An additional niche for optoacoustic tomography in biomedical imaging is to provide high-resolution 3D maps of tissue molecular composition based on contrast agents utilizing plasmon resonance in gold nanoparticles [4]. We have demonstrated that gold nanorods conjugated to targeted antibodies may offer optoacoustic imaging not only enhanced molecular specificity, but also increased detection sensitivity of early tumors.

The idea that drives present developments in the field of optoacoustic imaging is that coregistration and correlation between optoacoustic and ultrasonic images would be a useful enhancement of almost every application of medical ultrasound. This dual contrast system provides morphological information about tissue structures coregistered with functional maps of blood concentration and its oxygen saturation in tissues. The two modalities use common detectors (probes) and electronics, making a combination system quite natural from the technical standpoint.

