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Foege Bioengineering Building N130A

Photoacoustic Tomography: High-Resolution in vivo Imaging of Optical Contrast at New Depths

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We develop biophotonic technologies for functional and molecular imaging by physically combining non-ionizing electromagnetic and ultrasonic waves via energy transduction. Key applications include early-cancer detection and functional imaging. Electromagnetic waves in the non-ionizing spectral region provide rich tissue contrast but do not penetrate tissue in straight paths as x-rays do. Consequently, high-resolution pure optical imaging (*e.g.*, confocal and two-photon microscopy, and optical coherence tomography) of biological tissue is limited to depths within one optical transport mean free path (~1 mm in the skin). Ultrasonic imaging, on the contrary, provides good image resolution but suffers from strong speckle artifacts as well as poor contrast in early-stage tumors. We have developed ultrasound-mediated imaging modalities by combining electromagnetic and ultrasonic waves synergistically to overcome the above problems. In photoacoustic tomography (PAT), a pulsed laser beam illuminates the biological tissue and generates a small but rapid temperature rise, which causes the emission of ultrasonic waves as a result of thermoelastic expansion. The short-wavelength ultrasonic waves are then detected to form high-resolution tomographic images. Thermoacoustic tomography (TAT) is similar to PAT except that low-energy radio-frequency pulses, instead of laser pulses, are used. Although the long-wavelength radio-frequency waves diffract rapidly, short-wavelength ultrasonic waves provide high spatial resolution.

Dr. Lihong Wang studied for his Ph.D. degree at Rice University, Houston, Texas under the tutelage of Drs. Robert Curl, Richard Smalley and Frank Tittel. He currently holds the Gene K. Beare Distinguished Professorship in the Department of Biomedical Engineering at Washington University in St. Louis. He has authored and co-authored two books, including one of the first textbooks in the field of biomedical optics. He is the editor for the first comprehensive book on biomedical photoacoustic tomography. He has published 190 peer-reviewed journal articles and delivered 210 keynote, plenary, and invited talks. He is a fellow of the American Institute for Medical and Biological Engineering, the Optical Society of America, the Institute of Electrical and Electronics Engineers, and the Society of Photo-Optical Instrumentation Engineers. He was appointed as Editor of the Journal of Biomedical Optics. He has reviewed for more than 30 scientific journals. He serves as the founding chair for the scientific advisory board of a company commercializing his invention. His research on non-ionizing biophotonic imaging has been funded by NIH, NSF, and other funding agencies (principal investigator for 21 research grants with a cumulative budget of >$25M). He was a recipient of the NIH FIRST award and NSF CAREER award.

References: Med. Phys. Volume 35, Issue 12, pp. 5758-57672 (2008); Nature Biotechnology. 24, 848-851, (2006)

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