ABSTRACT
Ultrasound imaging is a non-invasive technique to obtain morphological, physiological and functional information for disease diagnosis, understanding of pathological mechanism and treatment strategies. Micro-ultrasound (micro-US) utilizes ultrasonic waves at frequencies ~10 times higher than traditional usage to diagnose and detect tissue abnormality at a microscopic level (20-30µm). In this talk, the development of novel micro-US systems will be presented with detailed hardware implementation, signal processing algorithms development, and real-time image visualization. Biomedical utility of micro-US in diagnosing cardiovascular disease, cancer, glaucoma, etc. will be shown with in vivo examples. In addition, micro-US will also be demonstrated as a critical modality in study of small animal models (mice, rats, zebrafish, etc) of human diseases, e.g., heart regeneration. Finally, multi-modality techniques combining micro-US with other methods (e.g. fluorescence spectroscopy, near infrared tomography) to improve diagnosis sensitivity and specificity will be presented as current projects.

HIFU has been found useful in the treatment of cancerous and benign tumors, since ultrasound as a therapeutic modality has significant advantages of high energy concentrations, non-invasiveness, and controllable treatment volume. In this part, the implementation of a magnetic resonance imaging (MRI)
guided HIFU system will be demonstrated under adaptive temperature control. The fusion of MRI and HIFU allows for precise tumor localization and completely noninvasive therapy, resulting in minimal trauma and fast recovery time. Moreover, the adaptive temperature control and beam steering enables optimal thermal dose delivery and selective tissue necrosis in a well defined volume without impacting surrounding normal tissues or blood vessels.

Acoustic tweezers, motivated by optical tweezers, is hypothesized to be able to manipulate micro-particles (such as cells, strands of DNA, micro beads) using sound wave with the advantages of larger particles handling, larger force exertion, operation in light opaque media, less photodamage, cost-effectiveness and small size. A series of theoretical studies will be shown that under appropriate conditions acoustic manipulation of small particles is possible.

BIOGRAPHY

Lei Sun received the B.S. degree in 1996 from the University of Science and Technology of China (USTC), Hefei, China, the M.S. degree in 2000 from the Chinese Academy of Sciences, Beijing, China, both in electrical engineering, and the Ph.D. degree in bioengineering from the Pennsylvania State University, University Park, PA in 2004. From 2004 to 2008, he worked at the National Institute of Health (NIH) Resource Center for Medical Ultrasonic Transducer Technology, University of Southern California, Los Angeles, CA as Post-Doctoral Fellow and Research Associate. He is currently an Assistant Professor at the Department of Health Technology and Informatics, Hong Kong Polytechnic University, Hong Kong, China. His research interests include medical imaging, (ultrasound, magnetic resonance imaging, optical imaging), medical device/instrumentation, biomedical signal/image processing, micro-particle manipulations, cardiovascular disease, cancer.

Enquiry: 3442 8420

All are welcome!

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