SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

MEDICAL APPLICATIONS AND TECHNICAL DEVELOPMENT OF PHOTOACOUSTIC TOMOGRAPHY

DISSERTATION DEFENSE
By

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Abstract: Photoacoustic tomography (PAT) uses the photoacoustic effect to overcome the high scattering of electromagnetic waves in biological tissue, and can thus create multiscale, multicontrast images of living tissues. Here, we describe the advances PAT has made toward medical applications. The first part of this dissertation describes how using a contour map of biological tissue improved PAM's scanning speed.

The second part of this dissertation describes PAT applications in renal tumor modelling and pulse wave velocity measurement. For the tumor study, we investigated arteriovenous shunts and the metabolism rate of oxygen. Studying AV shunts in tumors is critical for understanding their development mechanism and metabolic basis. However, current imaging modalities cannot provide the high spatial resolution required to detect AV shunts, nor can they measure the hemoglobin landscape of AV shunts during tumor development. Here, using a high-resolution photoacoustic microscope, we report a new blood oxygenation (sO2)-based disease marker induced by the AV shunt effect in tumor angiogenesis. During our investigation, we discovered a striking biological phenomenon: There can be two dramatically different sO2 values in bloodstreams flowing side-by-side in a single vessel. By tracing abnormal sO2 values in the blood vessels, we can identify a tumor region at an early stage. We expect that this new discovery will find many applications, such as tracing sO2-based biomarkers in internal organs and the brain in humans.

The third part of the dissertation describes PAT for whole-body small-animal study. We have enhanced photoacoustic computed tomography with a dry acoustic coupling that eliminates water immersion anxiety and wrinkling of the animal, and facilitates incorporating complementary modalities and procedures. The dry acoustic coupler is made of a tubular elastic membrane enclosed by a closed transparent water tank. The tubular membrane ensures water-free contact with the animal, and the closed water tank allows pressurization for animal stabilization. The dry coupler was tested using a whole-body small-animal ring-shaped photoacoustic computed tomography system. Dry coupling was found to provide image quality comparable to that of conventional water coupling.

DATE: **Thursday March 3, 2016**
TIME: **9:00 am**
PLACE: **Green Hall, Room 0120**

Dissertation advisor:
Dr. Lihong Wang

This seminar is in partial fulfillment
of the Doctor of Philosophy degree

Washington University in St. Louis
SCHOOL OF ENGINEERING & APPLIED SCIENCE