DOCTORAL DISSERTATION ORAL DEFENSE

PHOTOACOUTSIC IMAGING FOR OVARIAN CANCER DIAGNOSIS

By

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Abstract:

Ovarian cancer has the highest mortality of all gynecologic cancers with a five-year survival rate of only 30% or less. Current clinical imaging techniques are limited by poor sensitivity and specificity, and lack the capability of detecting ovarian cancer prior to widespread metastasis. Hence, new imaging techniques that can provide functional and molecular contrasts are needed for improving the specificity of ovarian cancer detection. One such promising technique is photoacoustic imaging (PAI). PAI is an emerging biomedical imaging technique in which acoustic waves are generated by illuminating a tissue sample with a short-pulse laser beam. The acoustic waves are then measured outside the sample by ultrasound transducers. In this way it is possible to reconstruct, at ultrasound resolution, the light absorption distribution that reveals optical contrast, which is directly related to microvessel density of tumors or tumor angiogenesis.

This research has been primarily focused on investigating the potential of PAI as a future screening modality for ovarian cancer detection. In the course of this study I have been involved in the design and development of several PAI systems. The systems have been used to image the brain vasculature of small animals, tumors and ovarian tissue. *Ex-vivo* studies of human ovaries have been performed, revealing strong optical absorption from malignant ovaries and low optical absorption from normal ones. The demonstrated capability of PAI to differentiate between normal and malignant ovaries could be used to non-invasively screen postmenopausal women to improve the ultrasound diagnosis of ovarian cancer. Implementing this technique *in vivo* requires a co-registered ultrasound and photoacoustic probe that can image the ovaries transvaginally as in the standard transvaginal ultrasound. However, in an *in vivo* setup the effect of background tissue on light delivery and artifact generation could affect image quality. A prototype of such a probe has been evaluated and further investigation of the *in-vivo* issues has been also done in this study.