Florida Institute of Technology

OPTICAL TOMOGRAPHY SYSTEM USING SHORT PULSE LASER FOR EARLY CANCER DIAGNOSTICS

Summary

An advanced optical tomography (AOT) system is developed for in-vivo diagnosis of early cancer and tumors with high spatial and temporal resolution. The AOT imaging system using the time-resolved methods with pulsed excitation and gated detection is used to examine the response of tissue to an ultra-short incident pulsed laser source. For optical tomography, a short-pulse laser is focused on the region to be probed and the time-dependent scattered reflected and transmitted optical signals are measured at different locations using ultrafast detectors. The 3-D image of the tissue interior is reconstructed and optical properties of the tissue medium, which determines the state of tissues, will be determined in real time. The noninvasive, safe and compact nature of time-resolved optical tomography system using short pulse laser makes it most attractive for early diagnosis of cancer in real time, an important feature for medical application at the point of care.

Applications

- Skin cancer detection

Advantages

- Device for early cancer detection – it is non-invasive device with no ionizing radiation involved providing greater depth of penetration and high resolution.

The Technology

Currently cytology and excisional biopsy are considered as "gold standard" for detection of tumor and cancer. However, both of these diagnostic procedures require physical removal of specimens followed by tissue processing in the laboratory. As such, these procedures incur a relatively high cost because specimen handling is required and, more importantly, diagnostic information is not available in real time. MRI is a powerful technique with sub millimeter spatial resolution but the cost of superconducting magnets needed for its operation makes it highly expensive.

The scattered reflected and transmitted signals measured when short pulse lasers interact with scattering-absorbing media like tissues possess a unique feature compared to the conventional cw laser measurements. The distinct feature is the multiple scattering induced temporal signatures that persists for time periods greater than the duration of the source pulse and is a function of the source pulse width, the scattering and absorbing properties of the medium, and the location in the medium where the properties undergo changes. If the detection is carried out at the same short time scale (comparable to the order of the pulse width), the signal continues to be observed even at large times after the pulse has been off due to the time taken for the photons to migrate to the detector after multiple scattering in the tissue media.

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