Popular science paper

Lookup-table-based experimental inverse model for real-time skin tissue diagnostics

Nowadays, optics properties of a tissue become an important tool for both diagnostics and therapeutics applications. When light is emitted into a tissue, optical properties of that tissue can affect the penetration depth of light and the amount of light escaping from the tissue. This process includes both absorption and scattering of light, which are two main characteristics of optics properties. The absorption of light is due to different chromophores that absorbing light in tissue. The intensity of light will attenuate when passing through it. The scattering of light is due to some cells and fibers that scattering light and change the direction of light propagation [1]. It depends on the structure of tissue as well [2]. Specially, skin is a layered tissue. It can be divided into three layers: the epidermis, dermis and subcutaneous tissue layers [1]. In epidermis layer, melanin is the main absorber. It has thickness around 100 μm. Hemoglobin is the dominant absorption component for dermis layer, which has thickness around 1.5 mm. The subcutaneous tissue layer has thickness around few millimeters, consisting of a large number of fat cells. The penetration depth of visible light can reach the subcutaneous layer to some extent. In general, different tissues contain different chromophores, scattering components and structures. Furthermore, optical properties of healthy and diseased tissues are different as well. Therefore, it is important to measure the spectrum that reflecting optical properties of tissue, which can be further used to distinguish tumor tissue and therapeutics applications.

The spectra reflecting optical properties of tissue is diffuse reflectance spectrum, which detects the light escaping from tissue. To analyze optical properties in this spectrum, one method is to use the diffusion approximation of the transport equation, the other one is using lookup table [3, 4, 5]. The theoretical equation can analyze diffuse reflectance in limit situation. The lookup table contains diffuse reflectance, absorption and scattering properties which are already known. It can be obtained either by experimental measurement, or by Monte Carlo simulation [6]. Monte Carlo simulation has become a prevailed method. It can model complex structure of tissue. However, the long computing time is a disadvantage. Experiment measurement can capture complete behavior of phantoms and environment without approximation. Meanwhile, the accuracy of measurement depends on the investigator. In this project, lookup table based on experimental measurement is used to analyze the diffuse reflectance spectra ranged from 400 nm to 1300 nm. It is created by 35 phantom measurements, and further fitted to a polynomial expression by using standard routines in Matlab. Finally, modeled diffuse reflectance spectra are compared with the *in vivo* measurements of three types of pig skin, which are non-pigment, pigment and dark pigment skins.

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May.8th 2017

Reference

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