*ICCES, 2025, vol.34, no.1*

Tech Science Press

DOI: 10.32604/icces.2025.011080

**PROCEEDINGS**

# In-Vivo Chromophore Characterization of the Human Skin

**Qiaoyun Yu, Shibin Wang*, Zhiyong Wang, Chuanwei Li and Linan Li**

Department of Mechanics, School of Mechanical Engineering, Tianjin University, Tianjin, 300350, China

*Corresponding Author: Shibin Wang. Email: shbwang@tju.edu.cn

**ABSTRACT**

The concentration of chromophores in the human skin provides crucial information for non-invasive skin diagnostics, particularly in clinical and dermatological applications [1,2]. However, only a few studies have reported chromophore concentration measurements at different skin depths [3,4]. This paper introduces a method for the tomographic measurement of skin chromophore concentrations using reflectance spectra. By considering the variations in hemoglobin content at different skin depths, we developed a dual-band skin reflectance spectral model and employed a hyperspectral camera to measure the in vivo spectral reflectance of the human skin. Chromophores including oxyhemoglobin, deoxyhemoglobin, blood oxygen, and melanin were calibrated by fitting the dual-band reflectance spectral model to the reflectance spectra of the subject. Using this method, we analyzed chromophore concentrations at various skin depths and identified distinct variation patterns of oxyhemoglobin and deoxyhemoglobin in the dermis and subcutaneous tissue, as revealed by vascular occlusion experiments. Furthermore, melanin concentrations were measured in the forearm skin of individuals with various skin phototypes, yielding consistent results for the same subject based on the dual-band experimental data. Diffuse reflectance techniques utilizing visible and near-infrared light sources are effective for studying the hemodynamic properties of the dermis and subcutaneous tissue, demonstrating the effectiveness of the proposed dual-band skin reflectance spectral model for characterizing in vivo skin chromophore concentrations at varying depths.

**KEYWORDS**

Chromophore concentration; non-invasive; dual-band skin reflectance spectral model; skin depths; in vivo skin

**Funding Statement:** This work was supported by the National Natural Science Foundation of China (Grant number 12472184).

**Conflicts of Interest:** The authors declare that they have no conflicts of interest to report regarding the present study.

**References**

1. Liu, Z, Zerubia, J. (2015). Skin image illumination modeling and chromophore identification for melanoma diagnosis. *Physics in Medicine & Biology, 60(9),* 3415.
2. Ilișanu, M. -A., Moldoveanu, F., Moldoveanu, A. (2023). Multispectral imaging for skin diseases assessment—state of the art and perspectives. *Sensors, 23(8)*, 3888.
3. Tseng, S. -H., Bargo, P., Durkin, A., Kollias, N. (2009). Chromophore concentrations, absorption and scattering properties of human skin in-vivo. *Optics express, 17(17),* 14599–14617.
4. Huo, Z., Wang, S., Tan, K., Li, L., Li, C., Wang, Z. (2024). The coupling effect between skin strain and blood condition on its reflectance spectrum in-vivo. *Optics and Laser Technology, 176,* 110990.