Conference 12147

Tissue Optics and Photonics II

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Light Propagation in Tissues, Modelling, and Optical Phantoms I

5 April 2022 • 11:00 - 12:50 CEST | Salon 5, Niveau/Level 0

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reflectance spectroscopy and double integrating spheres methods

Author(s): Victor Colas, Marine Amouroux, Christian Daul, Walter Blondel, Univ. de Lorraine (France)

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Skin phototype relevance for individualized phototherapy dosimetry using Monte Carlo simulation

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The propagation of light through biological tissues depends on its optical properties. These properties vary between individuals, tissues, and location; however, they are not considered to establish light dosimetry for therapies in clinical practice. In this context, this work aimed to use Monte Carlo (MC) simulations to evaluate how different skin phototypes influence light propagation and, consequently, the penetration depth. We use the Monte Carlo Extreme (MCX) implementation to simulate the photon trajectory. The skin model was composed of the following layers: living epidermis, papillary dermis, upper blood network dermis, reticular dermis, deep blood network, and subcutaneous fat. The skin layers' optical properties were obtained directly from the literature, except for the absorption coefficient of the living epidermis, which was calculated based on the Petrov equation. This equation uses the wavelength, melanin and water concentrations, eumelanin/pheomelanin ratio, and other parameters to determine the absorption coefficient as a function of the melanin concentration. The melanin concentration value was varied from 0% to 50% to cover all six phototypes predicted on the Fitzpatrick scale. We also evaluated the effects at four different wavelengths: 410 nm, 630 nm, 780 nm, 850 nm. Our simulation results indicate that as the melanin concentration increases, the penetration depth decreases due to a higher absorption coefficient at the more superficial layers. This effect is more evident for lower wavelengths because biological components absorb more energy. They also show us that individual parameters can affect light propagation and need to be adjusted correctly. Thus, the development of individualized dosimetry can lead to a higher success rate for phototherapy. We also emphasize that skin phototype is not a parameter reported in most clinical studies papers, despite this being an important parameter that might influence clinical results, as this work shows. Thus, it is necessary to start paying attention to this characteristic and include it in phototherapy publications.

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