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TIME RESOLVED PHOTON MIGRATION IN LAYERED TISSUE STRUCTURES*

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Imaging and diagnostic in medicine using light rather than potentially harmful ionizing radiation is a rapidly growing field of interest. While reliable imaging methods still have to be found, techniques which detect diseased tissues or monitor physiological parameters have already started to enter the clinics. For example, it has been shown by our group that light which migrates through the brain can be used to monitor changes in the blood oxygenation status of the brain. In this way oxygen insufficiency , often the cause of death of preterm infants on intensity care units, can be detected non invasively.

However little attention has been paid to the fact that most biological tissues consist of layers with different optical properties. For example the brain is encapsulated by the meninges, the skull and the skin which in itself is composed by the epidermis, dermis and hypodermis. In this work we will report for the first time how layered tissue structures influence migration of photons in tissues. Experimental studies of the time dependent propagation are compared to Monte Carlo simulations and analytical expressions found from diffusion theory. In particular, it will be demonstrated, that accurate values for the blood oxygenation of the brain can be found despite the fact that it is enclosed by ~5-10 mm tissue with different optical properties.

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