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Study of the optical properties of solid tissue phantoms using single and double integrating sphere systems

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Abstract

Tissue simulators, the so-called tissue phantoms, have been used to mimic human tissue for spectroscopic applications. Phantoms' design depends on patterning the optical properties, namely absorption and scattering coefficients which characterize light propagation mechanisms inside the tissues. In this work, two calibration models based on measurements adopting integrating sphere systems have been used to determine the optical properties of the studied solid phantoms. Integrating sphere measurement results were fed into the calibration models using the multiple polynomial regression method and Newton–Raphson algorithm. The third-order polynomials have been used for optical properties predictions. Good agreement between the two models has been obtained. Role of solid phantoms' components, namely titanium dioxide as a scatterer and black carbon as an absorber, has been discussed. Both of the two components showed observable effects on the absorption and scattering of light inside the solid tissue phantoms.