Data Descriptor

Porous Phantoms Mimicking Tissues – Investigation of Optical Parameter Stability Over Time

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Abstract

In terms of optical parameters, optical phantoms can now replace live tissues and be used to validate optical measurement methods. Therefore, whether these parameters would be maintained after storage for 6 months was examined. The absorption and scattering coefficients were obtained from the measured transmittance and reflectance measurements taken 6 months apart and then compared. All of the measurements were conducted using the same experimental setup consisting of an integrating sphere, a light source with a wavelength of 635 nm and a detector. The optical phantoms on which the research was performed were prepared from silicone and glycerol in various proportions.

Keywords: absorption; coefficient stability; optical parameters; optical phantoms

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Specification table (data records)

Subject area	Metrology, Electronics, Biomedical engineering
More specific subject area	Optical parameters measurements
Type of data	Text
How the data was acquired	The data was collected at the Gdańsk University of Technology by the use of a dedicated measurement setup consisting of integrating sphere, light source and detector
Data format	xls file

Experimental factors	The data contained in the dataset were not processed
Experimental features	The measurement setup consisted of: 4P-GPS-053-SL integrating sphere (Labsphere Inc., North Sutton, NH, USA) with a Spektralon® coating, LDM635-03-08X25 laser diode module with a wavelength of 635 nm (red) and an optical power of 3 mW, L-100 lux meter with a dedicated measuring head (Sonopan, Białystok, Poland)
Data source location	MOST Wiedzy Open Research Data Catalogue, Gdańsk University of Technology, Gdańsk, Poland
Data accessibility	The dataset is accessible and is publicly and freely available for any research or educational purposes

Background

Phantoms, due to their optical properties, mimic the way light is scattered inside their structure, therefore they can effectively replace biological tissues. As a result, they are used in many fields of physics, engineering and medicine. They are used for the registration of reference measurements using optical devices and measuring techniques (Wróbel et al., 2016) (Karpienko et al., 2016)we highlight how the use of blood phantoms enables to investigate the phenomena that otherwise are almost impossible to be noticed.”,”container-title”:”Journal of Innovative Optical Health Sciences”,”DOI”:”10.1142/S1793545816500127”,”journalAbbreviation”:”Journal of Innovative Optical Health Sciences”,”source”:”ResearchGate”,”title”:”Blood equivalent phantom vs. whole human blood, a comparative study”,”volume”:”9”,”author”:[{„family”:”Karpienko”,”given”:”Katarzyna”},{„family”:”Gnyba”,”given”:”Marcin”},{„family”:”Majchrowicz”,”given”:”D.”},{„family”:”Wróbel”,”given”:”Maciej”},{„family”:”Szczerska”,”given”:”Malgorzata”}],”issued”:{„date-parts”:[[„2015”,11,1]]}}],”schema”:”https://github.com/citation-style-language/schema/raw/master/csl-citation.json”} , calibration of optical devices (Listewnik et al., 2021), and light distribution planning using the physical geometry of the tissue (Wróbel et al., 2016). They replace both porous tissues such as the brain or lungs (Listewnik et al., 2021) and those with an internal vascular system (Feder et al., 2016). Moreover, optical phantoms have a number of additional advantages such as relatively low manufacturing cost, easier storage, and durability.

Therefore, the study was performed to determine the stability of the optical parameters of phantoms after storage for 6 months in order to verify their reusability (Listewnik et al., 2021).

Methods

The absorption and scattering coefficient were obtained on the basis of transmittance and reflectance measurements using the experimental setup presented in Fig. 11.1 com-

posed of a 4P-GPS-053-SL integrating sphere (Labsphere Inc., North Sutton, NH, USA) with a Spektralon® coating, a laser diode module with a wavelength of 635 nm (red) and an L-100 lux meter with a dedicated measuring head (Sonopan, Białystok, Poland).

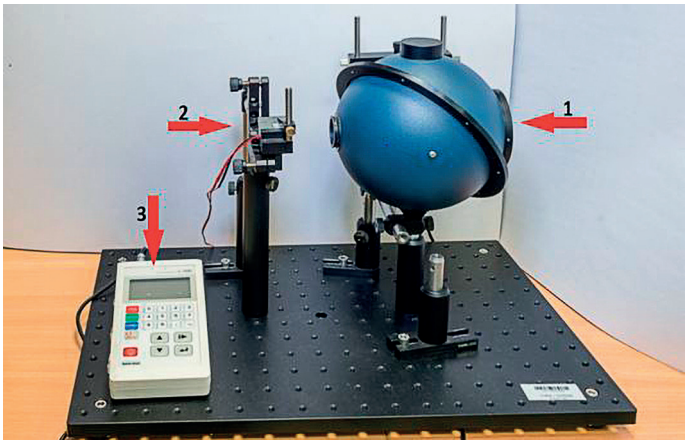

Fig. 11.1. Measurement setup: 1 – integrating sphere 2 – light source, 3 – lux meter

The integrating sphere has a rotation function which was enabled to investigate both optical parameters in one measuring system. The transmittance and reflectance were examined in a series of measurements performed with an interval of 6 months. In order to obtain the most accurate measurements results, the same conditions were recreated and the same experimental setup was used.

The optical phantoms, on which the research was performed, were prepared from polydimethyl-siloxane (PDMS, Sylgard®184, Dow Corning, Midland, MI, USA) and glycerol in various proportions. One of the samples contained 2 mL of glycerol while the second included 5 mL.

Data quality and availability

This dataset can be used by other research groups to validate their measurement process as well as compare their algorithms which are used to assess the stability of absorption and scattering coefficients of optical phantoms.

Dataset DOI
10.34808/85r2-yb55

Dataset License
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References

Feder, I. et al. (2016) 'Experimental results of full scattering profile from finger tissue-like phantom', *Biomedical Optics Express*, 7(11), pp. 4695–4701. DOI: 10.1364/BOE.7.004695.

Karpienko, K. et al. (2016) 'Blood equivalent phantom vs. whole human blood, a comparative study', *Journal of Innovative Optical Health Sciences*, 09 (02), 1650012. DOI: 10.1142/S1793545816500127.

Listewnik, P. et al. (2021) 'Porous Phantoms Mimicking Tissues—Investigation of Optical Parameters Stability Over Time', *Materials*, 14 (2), 423. DOI: 10.3390/ma14020423.

Wróbel, M.S. et al. (2016) 'Nanoparticle-free tissue-mimicking phantoms with intrinsic scattering', *Biomedical Optics Express,* 7(6), pp. 2088–2094. DOI: 10.1364/BOE.7.002088.