

PROGRESS IN BIOMEDICAL OPTICS AND IMAGING

Vol. 20 No. 59

# *Diffuse Optical Spectroscopy and Imaging VII*

Hamid Dehghani  
Heidrun Wabnitz  
*Editors*

23–25 June 2019  
Munich, Germany

*Sponsored by*  
The Optical Society (United States)  
SPIE

*Published by*  
SPIE

Volume 11074

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at [SPIDigitalLibrary.org](http://SPIDigitalLibrary.org).

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:

Author(s), "Title of Paper," in *Diffuse Optical Spectroscopy and Imaging VII*, edited by Hamid Dehghani, Heidrun Wabnitz, Proc. of SPIE-OSA Vol. 11074 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

ISSN: 1605-7422

ISSN: 2410-9045 (electronic)

ISBN: 9781510628410

ISBN: 9781510628427 (electronic)

Copublished by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445

[SPIE.org](http://SPIE.org)

and

The Optical Society

2010 Massachusetts Ave., N.W., Washington, D.C., 20036 USA

Telephone 1 202/223-8130 (Eastern Time) · Fax 1 202/223-1096

<http://www.osa.org>

Copyright © 2019, Society of Photo-Optical Instrumentation Engineers and The Optical Society

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$21.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at [copyright.com](http://copyright.com). Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 1605-7422/19/\$21.00.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.

**SPIE. DIGITAL  
LIBRARY**

[SPIDigitalLibrary.org](http://SPIDigitalLibrary.org)

---

Paper Numbering: *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

# Contents

|      |                             |
|------|-----------------------------|
| ix   | <i>Authors</i>              |
| xiii | <i>Conference Committee</i> |
| xv   | <i>Introduction</i>         |

---

## ADVANCES IN INSTRUMENTATION AND TECHNOLOGY I

---

|          |   |
|----------|---|
| 11074 02 | Large area SiPM and high throughput timing electronics: toward new generation time-domain instruments (Invited Paper) [11074-1]   |
| 11074 03 | Advances in wearable high-density diffuse optical tomography: first applications of a new commercial technology and development of an infant-specific research device [11074-2] |
| 11074 04 | A wearable time domain near-infrared spectroscopy system [11074-3]  |
| 11074 05 | Integrating motion sensing and wearable, modular high-density diffuse optical tomography: preliminary results [11074-4]   |
| 11074 06 | A new multichannel broadband NIRS system for quantitative monitoring of brain hemodynamics and metabolism during seizures [11074-5]   |

---

## THEORY, ALGORITHMS AND COMPUTATIONAL TOOLS I

---

|          |  |
|----------|--|
| 11074 07 | Time-domain diffuse optical tomography with $l_p$ sparsity regularization for thyroid cancer imaging [11074-6]                         |
| 11074 08 | Spectral approach to time domain diffuse optical tomography for breast cancer: validation on meat phantoms [11074-7]                   |
| 11074 09 | Time-resolved diffuse optical tomography: a novel method to compute datatypes allows better absorption quantification [11074-8]        |
| 11074 0A | Spatially-enhanced time-domain NIRS for determination of optical properties in layered structures [11074-9]                            |
| 11074 0B | Time-domain diffuse correlation spectroscopy quantifies path-length-resolved dynamical properties of a layered turbid media [11074-10] |
| 11074 0C | Simulation of fluorescence molecular tomography using a registered digital mouse atlas [11074-11]                                      |

---

#### CEREBRAL HEMODYNAMICS AND NEURAL ACTIVITY I

---

- 11074 0E Mapping hemodynamic changes during hypoglycemia in the very preterm neonatal brain: preliminary results [11074-13]
- 11074 0F Non-invasive optical assessment of intracranial pressure: pilot results in human patients [11074-14]
- 11074 0H Cortical activity underlying overt and covert language generation measured using high-density diffuse optical tomography [11074-16]

---

#### COMPUTATION SOFTWARE AND ANALYSIS TOOLS

---

- 11074 0L Cloud-based NIRFAST server for tissue parameters recovery: laser and ultrasound co-analyser of thyroid nodules (Invited Paper) [11074-25]
- 11074 0M NeuroDOT: an extensible Matlab toolbox for streamlined optical functional mapping (Invited Paper) [11074-26]

---

#### THEORY, ALGORITHMS AND COMPUTATIONAL TOOLS II

---

- 11074 0N Visual appearance of blood vessels [11074-27]
- 11074 0P A broadband multi-distance approach to measure tissue oxygen saturation with continuous wave near-infrared spectroscopy [11074-29]
- 11074 0Q Diffuse optical tomography with polarized light: a GPU-accelerated polarization-sensitive Monte Carlo simulations for efficient sensitivity kernel computation [11074-30]
- 11074 0R Modelling light propagation for fetal monitoring in utero [11074-31]
- 11074 0S Theoretical analysis of hemodynamic signal from the scalp in time-gated NIRS imaging using null source-detector separation [11074-32]

---

#### CEREBRAL HEMODYNAMICS AND NEURAL ACTIVITY II

---

- 11074 0T Time-resolved near infrared spectroscopy in ischemic stroke patients (Invited Paper) [11074-33]
- 11074 0V Short and mid-term reproducibility analysis of cerebral tissue saturation measured by time domain-NIRS [11074-35]
- 11074 0X Measurement of fetal cerebral blood flow of the lamb fetus in utero [11074-37]

---

## ADVANCES IN INSTRUMENTATION AND TECHNOLOGY II

---

- 11074 0Y New near-infrared spectroscopy method for local measurements of cerebral blood flow [11074-19]
- 11074 0Z Diffuse correlation spectroscopy for intracranial pressure estimation through cardiac pulse waveform analysis [11074-20]
- 11074 10 The LUCA device: laser and ultrasound co-analyzer for thyroid nodules [11074-21]
- 11074 11 In vivo time domain speckle contrast optical spectroscopy [11074-22]
- 11074 12 Compressive sensing based hyperspectral bioluminescence imaging [11074-23]
- 11074 13 A near-infrared hyperspectral imaging system for quantitative monitoring of hemodynamics and metabolism on the exposed cortex of mice [11074-24]

---

## NOVEL APPLICATIONS OF DIFFUSE OPTICS

---

- 11074 14 Multimodal measurements of brain tissue metabolism and perfusion in a neonatal model of hypoxic-ischaemic injury [11074-38]
- 11074 15 Towards depth-resolved characterization of hemodynamics and oxygenation in the rat kidney [11074-39]
- 11074 16 Diffuse reflectance bi-layer algorithm to enhance spoof detection of a TFT based biometry device [11074-40]
- 11074 19 Functionalized upconversion luminescent nanoparticles for theranostics [11074-43]

---

## PHANTOMS AND PERFORMANCE ASSESSMENT

---

- 11074 1A The BITMAP exercise: a multi-laboratory performance assessment campaign of diffuse optical instrumentation [11074-44]
- 11074 1B The BitMap dataset: an open dataset on performance assessment of diffuse optics instruments [11074-45]
- 11074 1C A solid phantom recipe for biophotonics applications: a step towards anatomically correct 3D tissue phantoms [11074-46]
- 11074 1E Blood-lipid liquid phantom for assessing time and frequency domain tissue oximeter performances [11074-48]

---

CLINICAL APPLICATION OF DIFFUSE OPTICS

---

- 11074 1G Deep variational autoencoders for breast cancer tissue modeling and synthesis in SFDI [11074-50]
- 11074 1I Deep neural networks improve diagnostic accuracy of rheumatoid arthritis using diffuse optical tomography [11074-52]
- 11074 1J The increase in amplitude of fluctuations of cerebral hemoglobin concentration in respiratory band related to increase in intra-abdominal pressure [11074-53]
- 11074 1K TD-fNIRS for diagnosing glaucoma: a clinical pilot study [11074-54]
- 11074 1L Pilot measurement of the microvascular blood flow of thyroid nodules by diffuse optics [11074-55]
- 11074 1M Diffuse reflectance spectroscopy for Onchocerca Volvulus nodules characterization [11074-56]

---

POSTER SESSION

---

- 11074 1O Towards to deep neural network application with limited training data: synthesis of melanoma's diffuse reflectance spectral images [11074-66]
- 11074 1P Monte-Carlo simulations of light transport in dense materials: dependent scattering and influence on sunscreen formulations [11074-58]
- 11074 1Q Optical estimation of the composition of bone implants during processing [11074-59]
- 11074 1R Scanning and analysis of the surface of the chondroplasty zone in rabbits using Raman spectroscopy [11074-60]
- 11074 1S Tissue fixation and substrate selection in hyperspectral imaging of murine models [11074-61]
- 11074 1T Modeling diffuse reflectance spectra of donated blood with their hematological parameters [11074-62]
- 11074 1V Non-invasive spectroscopic method of glucose concentration determination in human blood: mathematical description [11074-64]
- 11074 1W Investigation of skin conditions producing similar reflectance spectra but different point spread functions in Monte Carlo simulation [11074-65]
- 11074 1X Portable device to monitor skin condition with diffuse, multi-spectral illumination [11074-67]
- 11074 1Y Efficient Monte Carlo simulations of spatially resolved reflectance for detection schemes with low numerical apertures [11074-68]

- 11074 1Z Imaging of the optical properties of turbid media with integrated detection based on the Kubelka-Munk model [11074-69]
- 11074 20 Experimental investigation on the light transmission of a textile-based over-cap used in functional near-infrared spectroscopy [11074-70]
- 11074 21 Spatial-frequency-domain optical tomography in the radiative transport regime [11074-71]
- 11074 22 Multi-wavelength time-resolved NIRS measurements for estimation of absolute concentration of chromophores: blood phantom study [11074-72]
- 11074 23 Comparative spectral analysis of the component composition of bioimplants making in different ways for the treatment of gingival recession [11074-73]
- 11074 24 Preliminary vastus lateralis characterization with time domain near infrared spectroscopy during incremental cycle exercise [11074-74]
- 11074 25 Multimodal imaging platform for surgical guidance during epilepsy surgery [11074-76]
- 11074 26 Fitting a spectral model for component analysis in diffuse optical tomography [11074-77]
- 11074 27 Blood oxygenation in buried flaps: a bi-layer reconstruction [11074-78]
- 11074 28 Experimental assessment of sensitivity profiles in multidistance time-resolved near infrared spectroscopy measurements [11074-79]
- 11074 29 Robust calibration of reflectance acquired with optical fiber probes [11074-80]
- 11074 2A Direct determination of the spectrally resolved scattering phase function of suspensions and emulsions [11074-81]
- 11074 2C A new forward model for diffuse optical tomography [11074-83]
- 11074 2D Spectral parameter recovery of cerebral and extra-cerebral tissues using broadband near-infrared spectroscopy [11074-84]
- 11074 2E Reducing object curvature and height variation effects in hyperspectral images [11074-85]
- 11074 2G Spectral determination of  $\mu_a$ ,  $\mu_s$  and  $g$  of one thick turbid sample from three scattered light signals [11074-87]
- 11074 2H Frequency multiplexed intensity modulated diffuse reflectance system for quantification of tissue and arterial oxygen saturation [11074-88]
- 11074 2I An adaptive scheme for diffuse-optical tomography based on combined structured-light illumination and single-pixel camera detection [11074-89]
- 11074 2J Assessing extracerebral signal contamination in optical measurements of cerebral blood flow and oxygenation [11074-90]

- 11074 2K Pathlength distribution of (sub)diffusively reflected light [11074-91]
- 11074 2L Influence of optical path length on multi-wavelength measurement of oxy- and deoxy-hemoglobins in the skin [11074-93]
- 11074 2M Monitoring radiofrequency ablation of biological tissue using broadband time-resolved diffuse optical spectroscopy [11074-94]
- 11074 2N Extended Kalman Filtering for the recovery of the absorption coefficients in layered turbid media [11074-95]
- 11074 2O Construction of spectral reflectance database for estimation of absorption and scattering parameters in skin tissue [11074-96]
- 11074 2Q Time-Resolved multi-wavelength, dual-channel system for diffuse optical spectroscopy: performance assessment [11074-98]
- 11074 2R Instrument response function acquisition in reflectance geometry for time-resolved diffuse optical measurements [11074-99]
- 11074 2S Diffuse correlation tomography in the transport regime: a theoretical study of the sensitivity to Brownian motion [11074-100]
- 11074 2T Effects of ultrasound impedance matching fluids on diffuse optical measurements [11074-102]
- 11074 2U Compressive sensing time-domain Raman spectrometer for depth sensing of diffusive media [11074-103]
- 11074 2V In vivo time-domain diffuse correlation spectroscopy of the human muscle above 1000 nm [11074-104]
- 11074 2W Three-dimensional printed tissue-simulating phantoms for fluorescence imaging [11074-105]

Diffuse Optical Spectroscopy and Imaging VII. 2019. p. 110740M. 39. Muccigrosso D, Eggebrecht A. NeuroDOT: A new neuroimaging toolbox for DOT. Optical Tomography and Spectroscopy. 2018. pp. OW4Câ€”7. 40. Dehghani H, White BR, Zeff BW, Tizzard A, Culver JP. Depth sensitivity and image reconstruction analysis of dense imaging arrays for mapping brain function with diffuse optical tomography. Appl Opt. Optical Society of America; 2009;48: D137â€”D143. For the project we will be focusing on Diffuse Optical Imaging to identify an unknown solid, not its composition. The use of LabVIEW and MATLAB will be integrated to replicate a simplified Diffuse Optical Imaging system. First, a glass of an opaque medium, milk, will contain a an unknown object. An inexpensive webcam will be modified by removing the IR filter.