

PROGRESS IN BIOMEDICAL OPTICS AND IMAGING
Vol. 9, No. 18

Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues VI

Daniel L. Farkas
Dan V. Nicolau
Robert C. Leif
Editors

21–23 January 2008
San Jose, California, USA

Sponsored and Published by
SPIE

Volume 6859

Proceedings of SPIE, 1605-7422, v. 6859

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

The papers included 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. The papers published in these proceedings 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 this book:

Author(s), "Title of Paper," in *Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues VI*, edited by Daniel L. Farkas, Dan V. Nicolau, Robert C. Leif, Proceedings of SPIE Vol. 6859 (SPIE, Bellingham, WA, 2008) Article CID Number.

ISSN 1605-7422
ISBN 9780819470348

Published 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

Copyright © 2008, Society of Photo-Optical Instrumentation Engineers.

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 \$18.00 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. 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 1605-7422/08/\$18.00.

Printed in the United States of America.

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



SPIEDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four 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. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID number.

Contents

ix Conference Committee

SESSION 1 CELL AND TISSUE FUNCTIONAL IMAGING I

- 6859 02 **Characterization of dermal structural assembly in normal and pathological connective tissues by intrinsic signal multiphoton optical microscopy (Invited Paper) [6859-01]**
J. G. Lyubovitsky, Univ. of California, Riverside (USA); X. Xu, Univ. of California, Irvine (USA); C. Sun, Beckman Laser Institute, Univ. of California, Irvine (USA); B. Andersen, Univ. of California, Irvine (USA); T. B. Krasieva, Beckman Laser Institute, Univ. of California, Irvine (USA); B. J. Tromberg, Beckman Laser Institute, Univ. of California, Irvine (USA) and Univ. of California, Irvine (USA)
- 6859 03 **Multidimensional two-photon imaging of diseased skin [6859-02]**
R. Cicchi, S. Sestini, V. De Giorgi, D. Massi, T. Lotti, F. S. Pavone, Univ. of Florence (Italy)
- 6859 04 **Texture analysis of tissues in Gleason grading of prostate cancer [6859-03]**
E. Alexandratou, D. Yova, D. Gorpas, P. Maragos, National Technical Univ. of Athens (Greece); G. Agrogiannis, N. Kavantzias, Univ. of Athens Medical School (Greece)
- 6859 05 **Development of a direct Raman imaging system for rapid diagnosis of malignant tumor [6859-04]**
Y. Oshima, Aoyama Gakuin Univ. (Japan) and RIKEN - The Institute of Physical and Chemical Research (Japan); C. Furuhata, Aoyama Gakuin Univ. (Japan); H. Sato, RIKEN-The Institute of Physical and Chemical Research (Japan)
- 6859 06 **The role of autofluorescence colonoscopy in diagnosis and management of solitary rectal ulcer syndrome [6859-05]**
W. Latos, A. Kawczyk-Krupka, A. Ledwon, A. Kosciarz-Grzesiok, A. Misiak, K. Sieron-Stoltny, A. Sieron, Medical Univ. of Silesia (Poland)
- 6859 07 **Blood oxygen saturation of frozen tissue determined by hyper spectral imaging [6859-06]**
B. Braaf, A. Nadort, D. Faber, R. ter Wee, T. van Leeuwen, M. Aalders, Academic Medical Ctr., Univ. of Amsterdam (Netherlands)
- 6859 08 **Cellular discrimination based on spectral analysis of intrinsic fluorescence [6859-07]**
G. R. Goddard, J. P. Houston, J. C. Martin, S. W. Graves, J. P. Freyer, Los Alamos National Lab. (USA)
- 6859 0A **Accurate measurement of cellular autofluorescence is critical for imaging of host-pathogen interactions [6859-09]**
J. A. Timlin, R. M. Noek, J. N. Kaiser, M. B. Sinclair, H. D. T. Jones, R. W. Davis, T. W. Lane, Sandia National Labs. (USA)

SESSION 2 CELL AND TISSUE FUNCTIONAL IMAGING II

- 6859 0C **A fluorescence lifetime imaging microscopy (FLIM) system for the characterization of haematoxylin and eosin stained sample [6859-12]**
U. S. Dinish, C. Y. Fu, B. K. Ng, T. H. Chow, V. M. Murukeshan, L. K. Seah, Nanyang Technological Univ. (Singapore); S. K. Tan, Singapore General Hospital (Singapore)
- 6859 0E **Real-time monitoring of chemical and structural changes induced by light irradiation of cells and tissues [6859-14]**
V. V. Yakovlev, Univ. of Wisconsin/Milwaukee (USA); R. J. Thomas, Air Force Research Lab. (USA); G. Noojin, M. Denton, Northrop Grumman Corp. (USA)
- 6859 0F **Characterization of tumor cells and stem cells by differential nuclear methylation imaging [6859-15]**
J. Tajbakhsh, K. A. Wawrowsky, A. Gertych, Cedars-Sinai Medical Ctr. (USA); O. Bar-Nur, The Hebrew Univ. (Israel); E. Vishnevsky, E. H. Lindsley, D. L. Farkas, Cedars-Sinai Medical Ctr. (USA)
- 6859 0G **Large field of view scanning fluorescence lifetime imaging system for multimode optical imaging of small animals [6859-16]**
J. Y. Hwang, Univ. of Southern California (USA) and Cedars-Sinai Medical Ctr. (USA); H. Agadjanian, L. K. Medina-Kauwe, Cedars-Sinai Medical Ctr. (USA); Z. Gross, Technion Israel Institute of Technology (Israel); H. B. Gray, California Institute of Technology (USA); K. Sorasaenee, Univ. of Southern California Keck School of Medicine (USA); D. L. Farkas, Univ. of Southern California (USA) and Cedars-Sinai Medical Ctr. (USA)

SESSION 3 CYTOMICS

- 6859 0L **Cytomics in regenerative medicine [6859-20]**
A. Tárnok, A. Pierzchalski, Cardiac Ctr. Leipzig GmbH, Univ. of Leipzig (Germany)
- 6859 0M **A comparison of avalanche photodiode and photomultiplier tube detectors for flow cytometry [6859-21]**
W. G. Lawrence, G. Varadi, G. Entine, Radiation Monitoring Devices, Inc. (USA); E. Podniesinski, P. K. Wallace, Roswell Park Cancer Institute (USA)
- 6859 0N **Immunological changes following protein losing enteropathy after surgery total cavopulmonary connection (TCPC) by cytomics [6859-22]**
J. Bocsi, D. Lenz, A. Mittag, Heart Ctr. Leipzig, Univ. of Leipzig (Germany); U. Sauer, German Heart Ctr. Munich (Germany); L. Wild, Children's Hospital, Univ. of Leipzig (Germany); J. Hess, German Heart Ctr. Munich (Germany); D. Schranz, Univ. Hospital Giessen (Germany); J. Hampsch, P. Schneider, A. Tárnok, Heart Ctr. Leipzig, Univ. of Leipzig (Germany)
- 6859 0O **UV LED excited time-gated luminescence flow cytometry: evaluation for rare-event particle counting [6859-23]**
D. Jin, B. Ferrari, Macquarie Univ. (Australia); R. Leif, S. Yang, Newport Instruments (USA); L. M. Vallarino, J. Williams, Virginia Commonwealth Univ. (USA); J. Piper, Macquarie Univ. (Australia)

- 6859 0Q **Cytometry standards continuum** [6859-25]
R. C. Leif, XML_Med, Newport Instruments (USA); J. Spidlen, R. R. Brinkman, British Columbia Cancer Research Ctr. (Canada)
- 6859 0T **Endogenous fluorescence lifetime of viable cells by flow cytometry** [6859-28]
J. P. Houston, M. Naivar, J. C. Martin, G. Goddard, S. Carpenter, J. R. Mourant, J. P. Freyer, Los Alamos National Lab. (USA)

SESSION 4 MICROSCALE DEVICES AND MICROARRAYS

- 6859 0U **Examining the behaviour of fungal cells in microconfined mazelike structures** [6859-29]
M. Held, C. Edwards, D. V. Nicolau, Univ. of Liverpool (United Kingdom)
- 6859 0V **Design of a multi-stage microfluidics system for high-speed flow cytometry and closed system cell sorting for cytomics** [6859-30]
M. Grafton, L. M. Reece, P. P. Irazoqui, B. Jung, Purdue Univ. (USA); H. D. Summers, Cardiff Univ. (United Kingdom); R. Bashir, J. F. Leary, Purdue Univ. (USA)
- 6859 0Y **Optofluidic microscope: a complete on-chip imaging device** [6859-33]
X. Cui, X. Heng, C. Yang, California Institute of Technology (USA)

SESSION 5 OPTICAL MANIPULATION

- 6859 0Z **Turn-key calibration of counter-propagating multiple beam 3D trapping system** [6859-34]
J. Seidelin Dam, I. R. Perch-Nielsen, D. Palima, J. Glückstad, Technical Univ. of Denmark (Denmark)
- 6859 10 **An efficient method to produce clonal colonies of cancer cells using laser enabled analysis and processing (LEAP)** [6859-35]
M. Zordan, R. Fatig, L. Reece, V. J. Davisson, J. Leary, Purdue Univ. (USA)
- 6859 12 **Three-dimensional image and spatial spectrum analysis of behavior of small animal erythrocytes in optical tweezers** [6859-37]
H. C. Chen, W.-T. Shen, Y.-H. Kong, C.-H. Chuang, Fu-Jen Catholic Univ. (Taiwan)
- 6859 13 **Characterization of cells and bacteria by photophoretic velocimetry** [6859-38]
C. Helmbrecht, R. Niessner, C. Haisch, Technische Univ. München (Germany)
- 6859 14 **Nanolaser spectroscopy for studying novel biomaterials (Invited Paper)** [6859-78]
P. L. Gourley, D. Y. Sasaki, Sandia National Labs. (USA); R. K. Naviaux, Univ. of California, San Diego (USA)

SESSION 6 ADVANCES IN BIOIMAGING I: EXPERIMENTAL TECHNIQUES

- 6859 15 **Photonic calibration for fluorescence microscopy (Invited Paper)** [6859-39]
I. T. Young, M. el Morabit, G. L. Lung, Delft Univ. of Technology (Netherlands);
B. J. Vermolen, Delft Univ. of Technology (Netherlands) and Univ. of Twente (Netherlands)

- 6859 16 **Two-dimensional differential interference contrast microscopy based on four-hole variation of Young's interference** [6859-40]
M. Lew, X. Cui, X. Heng, C. Yang, California Institute of Technology (USA)
- 6859 17 **Calibration beads containing luminescent lanthanide ion complexes** [6859-41]
R. C. Leif, Newport Instruments (USA); D. Jin, J. Piper, Macquarie Univ. (Australia); L. M. Vallarino, J. W. Williams, Virginia Commonwealth Univ. (USA); S. Yang, Newport Instruments (USA); R. M. Zucker, Environmental Protection Agency (USA)
- 6859 19 **A high-content screening platform utilizing polarization anisotropy and FLIM microscopy** [6859-43]
D. R. Matthews, S. M. Ameer-Beg, King's College London (United Kingdom); P. Barber, G. P. Pierce, R. G. Newman, B. Vojnovic, Univ. of Oxford (United Kingdom); L. M. Carlin, M. D. Keppler, T. Ng, K. Suhling, M. Irving, King's College London (United Kingdom)
- 6859 1A **Anorganic fluorescence reference materials for decay time of fluorescence emission** [6859-44]
A. Engel, C. Ottermann, J. Klahn, T. Korb, Schott AG (Germany); U. Resch-Genger, K. Hoffmann, Federal Institute for Materials Research and Testing (Germany); U. Kynast, Univ. of Applied Science (Germany); V. Rupertus, Schott AG (Germany)
- 6859 1B **The use of a CMOS camera to resolve nanometer displacements of hair cell stereocilia in the bullfrog sacculus** [6859-45]
L. Fredrickson, A. Cheng, C. E. Strimbu, D. Bozovic, K. Arisaka, Univ. of California, Los Angeles (USA)

SESSION 7 ADVANCES IN BIOIMAGING II: COMPUTATION AND IMAGE ANALYSIS I

- 6859 1D **Analysis of inserts in prokaryote genomes** [6859-47]
P. D. Cristea, Polytechnical Univ. of Bucharest (Romania) and Vrije Univ. Brussel (Belgium); R. A. Tudec, Polytechnical Univ. of Bucharest (Romania)
- 6859 1E **The possibilities of improvement in the sensitivity of cancer fluorescence diagnostics by computer image processing** [6859-48]
A. Ledwon, Medical Univ. of Silesia (Poland); R. Bieda, Polish Japanese Institute of Information Technology (Poland); A. Kawczyk-Krupka, Medical Univ. of Silesia (Poland); A. Polanski, K. Wojciechowski, Polish Japanese Institute of Information Technology (Poland); W. Latos, K. Sieron-Stoltny, A. Sieron, Medical Univ. of Silesia (Poland)

SESSION 8 ADVANCES IN BIOIMAGING III: COMPUTATION AND IMAGE ANALYSIS II

- 6859 1H **Data fitting and image fine-tuning approach to solve the inverse problem in fluorescence molecular imaging** [6859-51]
D. Gorpas, K. Politopoulos, D. Yova, National Technical Univ. of Athens (Greece); S. Andersson-Engels, Lund Institute of Technology (Sweden)
- 6859 1I **Dimensionality reduction in nonlinear optical datasets via diffusion mapping: case study of short-pulse second harmonic generation** [6859-52]
D. Romanov, S. Smith, J. Brady, R. J. Levis, Temple Univ. (USA)

POSTER SESSION

- 6859 1L **Polychromatic flow cytometry with an avalanche photodiode array** [6859-56]
W. G. Lawrence, G. Varadi, G. Entine, Radiation Monitoring Devices, Inc. (USA);
E. Podniesinski, P. K. Wallace, Roswell Park Cancer Institute (USA)
- 6859 1M **The NANVID: a new device for cancer cell migration studies** [6859-57]
W. K. Raja, N. C. Cady, J. Castracane, Univ. at Albany (USA); B. Gligorijevic,
J. van Rheenen, J. S. Condeelis, Albert Einstein College of Medicine (USA)
- 6859 1N **Frequency-domain inverse Monte Carlo simulation for the diagnosis of the early cervical
cancer based on NIR diffuse measurement** [6859-58]
H. Zhao, S. Zhang, Z. Wang, H. Miao, Z. Du, J. Jiang, Tianjin Univ. (China)
- 6859 1O **The study of optimal condition of SPIO labeling human lung adenocarcinoma cell line
(SPC-A-1)** [6859-59]
M. Yu, W. Chen, South China Normal Univ. (China); Q. Zhou, First Affiliated Hospital of Jinan
Univ. (China); D. Xing, Y. Tang, South China Normal Univ. (China)
- 6859 1P **Changes of chlorophyll fluorescence emission spectra of different stages and different
position rice leaves during progressive senescence** [6859-60]
Z. Chen, W. Chen, L.-Y. Liao, South China Normal Univ. (China); Q. Zhou, First Affiliated
Hospital of Jinan Univ. (China); D. Xing, South China Normal Univ. (China)
- 6859 1Q **Optimizing the depth of field for short object distance of capsule endoscope** [6859-62]
M. Ou-Yang, S.-W. Huang, W.-K. Su, H.-M. Feng, Z.-Y. Chen, National Central Univ. (Taiwan);
H.-M. Wu, Chung-Shan Institute of Science & Technology (Taiwan); Y.-T. Kuo, Jen-The Junior
College of Medicine (Taiwan)
- 6859 1R **Analysis of RBC damage using laser tweezers Raman spectroscopy (LTRS) during
femtosecond laser optical trapping** [6859-63]
S. Ju, J. Pyo, J. Jang, S. Lee, B.-M. Kim, Yonsei Univ. (South Korea)
- 6859 1T **Automated tissue m-FISH analysis workstation for identification of clonally related cells**
[6859-66]
P. Dubrowski, W. Lam, V. Ling, S. Lam, C. MacAulay, British Columbia Cancer Agency
(Canada)
- 6859 1U **Study of melanoma invasion by FTIR spectroscopy** [6859-67]
Y. Yang, School of Medicine, Keele Univ. (United Kingdom); J. Sulé-Suso, School of
Medicine, Keele Univ. (United Kingdom) and Univ. Hospital of North Staffordshire (United
Kingdom); G. D. Sockalingum, Unité MéDIAN, CNRS, Univ. of Reims (France)
- 6859 1V **Quantification of telomere length by FISH and laser scanning cytometry** [6859-68]
J. E. Mahoney, E. Sahin, M. Jaskelioff, L. Chin, R. A. DePinho, A. I. Protopopov, Harvard
Medical School (USA)
- 6859 1Y **High throughput analysis of proteins using mid-infrared laser** [6859-72]
S. Yoshihashi-Suzuki, T. Fujita, I. Sato, K. Awazu, Osaka Univ. (Japan)

6859 1Z **Analysis of human tissue optical scattering spectra for the purpose of breast cancer diagnostics using multi-layer perceptron** [6859-74]

A. S. Nuzhny, S. A. Shumsky, A. G. Korzhov, Lebedev Physical Institute (Russia);
T. E. Lyubynskaya, Russian Federal Nuclear Ctr.-VNIIIEF (Russia)

6859 20 **Analysis of data obtained in clinical trials of optical biopsy system for breast cancer diagnostics** [6859-75]

S. A. Belkov, G. G. Kochemasov, S. M. Kulikov, N. V. Maslov, S. V. Bondarenko, BioFil (Russia) and Russian Federal Nuclear Ctr.-VNIIIEF (Russia); N. M. Shakhova, Institute of Applied Physics (Russia); I. Yu. Pavlycheva, Regional Oncology Ctr. (Russia); A. Rubenchik, Lawrence Livermore National Lab. (USA); L. B. Da Silva, BioTelligent Inc. (USA)

Author Index

Conference Committee

Symposium Chairs

James Fujimoto, Massachusetts Institute of Technology (USA)
R. Rox Anderson, Wellman Center for Photomedicine, Massachusetts General Hospital (USA) and Harvard School of Medicine (USA)

Program Track Chairs

Ammasi Periasamy, University of Virginia (USA)
Daniel L. Farkas, Cedars-Sinai Medical Center (USA)

Conference Chairs

Daniel L. Farkas, Cedars-Sinai Medical Center (USA)
Dan V. Nicolau, The University of Liverpool (United Kingdom)
Robert C. Leif, Newport Instruments (USA)

Conference Cochairs

J. Paul Robinson, Purdue University (USA)
Attila Tárnok, Universität Leipzig (Germany)
Ramesh Raghavachari, U.S. Food and Drug Administration (USA)

Program Committee

Christopher H. Contag, Stanford University (USA)
Paul Dan A. Cristea, Universitatea Politehnica Bucuresti (Romania)
Alberto Diaspro, Università degli Studi di Genova (Italy)
Erik G. Fällman, Umeå Universitet (Sweden)
Jesper Glückstad, Danmarks Tekniske Universitet (Denmark)
Ewa M. Goldys, Macquarie University (Australia)
James F. Leary, Purdue University (USA)
Charles P. Lin, Massachusetts General Hospital (USA)
Andreas Nowatzky, Cedars-Sinai Medical Center (USA)
Markus Sauer, Universität Bielefeld (Germany)

Session Chairs

- 1 Cell and Tissue Functional Imaging I
Daniel L. Farkas, Cedars-Sinai Medical Center (USA)
- 2 Cell and Tissue Functional Imaging II
Andreas G. Nowatzky, Cedars-Sinai Medical Center (USA)

- 3 Cytomics
Robert C. Leif, Newport Instruments (USA)
 - 4 Microscale Devices and Microarrays
J. Paul Robinson, Purdue University (USA)
 - 5 Optical Manipulation
Attila Tárnok, Universität Leipzig (Germany)
 - 6 Advances in Bioimaging I: Experimental Techniques
Dan V. Nicolau, The University of Liverpool (United Kingdom)
 - 7 Advances in Bioimaging II: Computation and Image Analysis I
Dan V. Nicolau, The University of Liverpool (United Kingdom)
 - 8 Advances in Bioimaging III: Computation and Image Analysis II
Dan V. Nicolau, The University of Liverpool (United Kingdom)
- Poster Session
Dan V. Nicolau, The University of Liverpool (United Kingdom)