Digital Holography and Three-Dimensional Imaging (DH)

Topical Meeting and Tabletop Exhibit

Technical Conference: April 12-14, 2010
Exhibition: April 12-14, 2010
The Deauville Beach Resort Hotel
Miami, FL, USA

Postdeadline Submission Deadline: March 16, 2010 12:00 p.m. noon, EDT (16.00 GMT)
NEW!! Housing Deadline: Extended through March 19, 2010
Pre-Registration Deadline: March 19, 2010

Part of Biomedical Optics and 3-D Imaging:

OSA Optics & Photonics Congress

Featuring Two Collocated Topical Meetings and a Special Workshop:

Biomedical Optics (BIOMED)
Digital Holography and Three-Dimensional Imaging (DH)
Workshop on Diffuse Optical Tomography NIRFAST software using MATLAB

New for 2010

Entrepreneurship in Holography – Special invited session with founders and entrepreneurs of companies producing holographic products. Featuring talks on digital holography from research to industry.

See program details for list of invited speakers

About DH

The topical meeting on Digital Holography and Three-Dimensional Imaging provides a forum for disseminating the fundamentals and applications of holographic and digital methods in optical science and technology, including holographic interferometry for deformation or contour measurement, new technologies for phase unwrapping, 3-D optical remote sensing, 3-D holographic microscopy, 3-D optical image processing, 3-D display, and digital holography for life science or nanophotonics applications.

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Mikael Sjödahl, *Luleå Univ. of Technology, Sweden*
Yasuhiro Takaki, *Tokyo Univ. of Agriculture and Technology, Japan*
Kelvin Wagner, *Univ. of Colorado at Boulder, USA*
Frank Wyrowski, *Friedrich-Schiller-Univ. Jena, Germany*

Topics to be Considered

- Digital holography theory and systems
- Diffractive optics
- Optical data storage
- Phase unwrapping and phase retrieval
- Computer generated holograms
- Spatial light modulators for holography
- Incoherent digital holography
- Holographic optical elements
- 2-D and 3-D pattern recognition
- Optical correlators
- Three-dimensional imaging and processing
- Three-dimensional display
- Stereo-matching and stereoscopic cameras
- 2-D–3-D content conversion
- Shape and deformation measurement
- Polarization analysis
- Holographic imaging and microscopy
- Holographic nanofabrication methods
- Holographic optical micro-manipulation

pecial Events

Joint Welcome Reception

Monday, April 12, 2010
6:30 p.m.–8:00 p.m.

Start the Congress excitement early by joining us on Monday, April 12th, for the Welcome Reception. This reception is the perfect kick-off to this year's congress. Free to all Technical Conference Attendees. Meet with colleagues from around the world. Light hors d'oeuvres will be served.

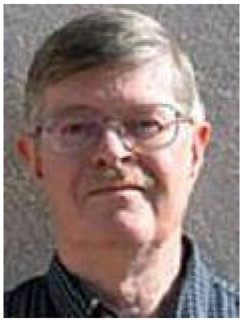
Meet the Editors of OSA's new journal, Biomedical Optics Express!

Editor in Chief Dr. Joseph Izatt of Duke University and Deputy Editor Dr. Gregory Faris of SRI International will be available at the end of the Welcome Reception to answer your questions and discuss their plans for OSA's new journal home for biomedical optics. Look for the Biomedical Optics Express table in the reception area.

Joint Poster Session

Monday, April 12, 2010
1:30 p.m.–3:30 p.m.

Poster presentations offer an effective way to communicate new research findings and provide an opportunity for lively and detailed discussion between presenters and interested viewers.



Keynote Speaker

John Caulfield; *Alabama A&M and Fisk Univ., USA*
The Principle of Good Enough (POGE) and the Use of Digital Holography in Sensors,
Monday, April 10, 2010
8:00 a.m.–8:30 a.m.

Biography: H. John Caulfield got his BA in Physics from Rice (1958) and his PhD in Physics from Iowa State (1962) and has spent his career since into 5-6 year stints in big company R&D labs, small R&D companies, academia, and (currently) mixtures of all of those as well as two companies of his own. His books, chapters, and refereed journal papers total about 300 in number. Also. he has done optics outreach curating exhibits, writing popular articles (including the 25 million reader cover story on holography in National Geographic), and speaking at non optics meetings. Professor Caulfield also works and publishes in cognitive science and evolution, and metrology.

Abstract: POGE (Principle Of Good Enough) is shown to yield dramatic new capabilities in optical pattern recognition, optical linear algebra, point source location, and Fourier pattern recognition. POGE has become a powerful template for invention.

Tutorials

Byoungho Lee; *Seoul Natl. Univ., Korea*
Digital Holography and Interferometry for Micro- and Nano-Photonics
Tuesday, April 13, 2010
4:00 p.m - 4:40 p.m.

Biography: Byoungho Lee received his PhD degree in Electrical Engineering from UC Berkeley in 1993. Since 1994, he has been with the School of Electrical Engineering, Seoul National University, Korea as a faculty member. Prof. Lee is a fellow of OSA and SPIE. He has served on the Board of Directors of OSA and is currently a topical editor of Applied Optics. His group has published more than 250 international journal papers and more than 410 international conference papers including more than 70 invited papers in the fields of diffractive optics, 3D display, fiber optics and plasmonics.

Abstract: General digital holography and interferometry technologies are explained. As their applications for micro- and nano- photonics, recent studies are reviewed.

Joseph Rosen; *Ben Gurion Univ., Israel*
Selected Topics in 3-D Electro-Optical Image Processing
Tuesday, April 13, 2010
4:40 p.m. - 5:20 p.m.

Biography: Joseph Rosen received his D.Sc. degree in electrical engineering from the Technion - Israel Institute of Technology in 1992. He is currently a professor in the Department of Electrical and Computer Engineering, Ben-Gurion University of the Negev. He is a fellow of the Optical Society of America and has coauthored more than 70 scientific papers in refereed journals. His research interests include holography, image processing, diffractive optics, interferometry, pattern recognition, optical computing, and statistical optics.

Abstract: We review three different methods of generating digital holograms of three-dimensional real-existing objects illuminated by incoherent light. The methods are: 1. Scanning holography. 2. Multiple-viewpoint projection holography. 3. Fresnel incoherent correlation holography.

Hiroshi Yoshikawa; *Nihon Univ., Japan*
Computer-Generated Hologram for 3-D Display–Point Oriented

Approach
Tuesday, April 13, 2010
5:20 p.m. - 6:00 p.m.

Biography: Hiroshi Yoshikawa received the B.S. degree, the M.S. degree and the Ph.D. from Nihon University, all in electrical engineering, in 1981, 1983 and 1985, respectively. He joined the faculty at Nihon University in 1985 where he currently holds the position of Professor of Electronics and Computer Science. From Dec. 1988 to Apr. 1990, he was a research affiliate of MIT Media Laboratory. He is a member of OSA, SPIE, ITE (Institute of Television Engineers of Japan), and OSJ (Optical Society of Japan). His current research interests are in electro-holography, computer generated holograms, display holography and computer graphics.

Abstract: Abstract not available.

Entrepreneurship in Holography Special Sessions

Wednesday, April 14, 2010,
1:30 p.m. - 3:30 p.m.
4:00 p.m. - 5:30 p.m.

The Entrepreneurship session is a newly instituted session, with brief presentations and a panel discussion by invited speakers only. The goal is to highlight the commercial impact of our community. The presentations will include the business opportunities that led to the formation of the companies, war stories from their inception and growth that the presenters may be willing to share with the audience, and their assessment of new spaces of topical interest where holography may have a future role to play (for example, energy and the environment.)

These presenters are recognized entrepreneurial leaders who founded and run holographic technology-based companies. Their experiences will inspire researchers of all generations, particularly young students and post-docs who may be pondering commercializing results of their own.

Invited Speakers

Entrepreneurship in Holography Special Session

DWC1, Holographic Displays for Future IT, Frank Chen Fan; *AFC Tech. Co. Ltd., China*

DWC2, The Way of the OPTOWARE, Hideyoshi Horimai; *Optoware Co. Ltd, Japan*

DWC3, Holographic Microscopy: From the Idea to the Market, Christian Depeursinge; *EPFL, Switzerland*

DWD1, The (long) Road to Commercializing Volume Holographic Devices, Christophe Moser; *Ondax, USA*

Keynote Speaker

DMA1, The Principle of Good Enough (POGE) and the Use of Digital Holography in Sensors, John Caulfield; *Alabama A&M and Fisk Univ., USA*

Invited Speakers

DMA2, Digital Road to Holography, Rajpal Sirohi; *Amity Univ., India*

DMB1, Holography and Photopolymer Recording Materials, John Sheridan; *Univ. College, Dublin, Ireland*

DMB2, Nonlinear Digital Holography, Jason Fleischer; *Princeton Univ., USA*

DTuA1, Digital In-Line Holographic Microscopy in 4-D, *S. K. Jericho, M. H. Jericho, **Jurgen Kreuzer**; Dalhousie Univ., Canada.*

DTuA2, Benefits of Spatial Partial Coherence for Applications in Digital Holographic Microscopy, Frank Dubois; *Univ. of Brussels, Belgium.*

DTuC1, Digital Phase Holography of Biological Cells, *Natan T. Shaked, Adam Wax; Duke Univ., USA.*

DTuC2, 3-D Identification and Tracking of Biological Microorganisms Using Computational Microscopy, ***Bahram Javidi***[1]*, Mehdi DaneshPanah*[1]*, Inkyu Moon*[2]*, Saeed Bagheri*[3]*, Arun Anand*[4]*;* [1]*Univ. of Connecticut, USA,* [2]*Chosun Univ., Korea, Republic of,* [3]*IBM T. J. Watson Res. Ctr., USA,* [4]*MS Univ. of Baroda, India.*

DWA1, Compressive Holography of Diffuse Scatterers, David Brady, Kerkil Choi, Ryoichi Horisaki, Joonku Hahn, Sehoon Lim; *Duke Univ., USA*

DWA2, Digital Holography at Ultimate Shot Noise Level, *F. Joud*[1], *M. Atlan*[2], ***Michel Gross***[1]*;* [1]*École Normale Supérieure, Univ. Paris, France,* [2]*ParisTech, Univ. Paris, France.*

DWB1, 3-D Display and Interface Based on Wavefront Synthesis, ***Osamu Matoba***, *Kouichi Nitta; Kobe Univ., Japan.*

DWB2, Avenues for Expanded Applicability in Photorefractive Based Holographic 3-D Displays, Cory Christenson[1], P. A. Blanche[1], R. Voorakaranam[1], A. Bablumian[2], J. Thomas[1], M. Yamamoto[3], R. A. Norwood[1], N. Peyghambarian[1]; [1]Univ. of Arizona, USA, [2]TIPD, LLC., USA, [3]Nitto Denko Technical, USA.

Tutorials

DTuD1, Digital Holography and Interferometry for Micro- and Nano-Photonics, Byoungho Lee; *Seoul Natl. Univ., Korea*

DTuD2, Selected Topics in 3-D Electro-Optical Image Processing, Joseph Rosen; *Ben Gurion Univ., Israel*

DTuD3, Computer-Generated Hologram for 3-D Display–Point Oriented Approach, Hiroshi Yoshikawa; *Nihon Univ., Japan*

Students

Student Members are an important and active part of the OSA community. Student benefits are built around the unique needs of those preparing to enter the professional world of optics. As an OSA Student Member, you join a worldwide community of optics and photonics scientists, engineers and business leaders. Join us today.

Student Members attend OSA conferences, exhibits and educational sessions at reduced rates. Frontiers in Optics (OSA's Annual Meeting), the Optical Fiber Communication Conference & Exposition and National Fiber Optic Engineers Conference (OFC/NFOEC), the Conference on Lasers and Electro-Optics (CLEO) and more than 20 topical meetings are among the many annual events hosted by OSA.

OSA Foundation Student Travel Grants

The OSA Foundation is pleased to offer travel grants to students working or studying in a qualifying developing nation who plan to attend Digital Holography and Three-Dimensional Imaging (DH).

Congratulations to the 2010 grant recipient:

Oscar Julián Rincón, Univ. Natl. de Colombia, Colombia

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

7:00 a.m.–6:00 p.m. Registration Open, *Napoleon Lobby*

Opening Remarks 7:30 a.m.–8:00 a.m.

BSuA • BIOMED Sunday Plenary

Sunday, April 11
8:00 a.m.–10:00 a.m.
Vasilis Ntziachristos; Technische Univ. Munchen, Germany , Presider

BSuA1 • 8:00 a.m. **Keynote**

Molecular Imaging of Living Subjects, *Sanjiv Sam Gambhir;* *Standford Univ., USA.* Molecular Imaging is a growing field in which molecular spies are introduced into subjects. Optical molecular imaging is rapidly growing and with the use of novel imaging agents has great potential to accelerate medical care.

BSuA2 • 9:00 a.m. **Plenary**

Biomedical Imaging and Optical Biopsy Using Optical Coherence Tomography, *Jim Fujimoto*; *MIT, USA*. OCT performs micron scale three dimensional imaging of tissue structure, enabling *in situ* and real time visualization of pathology. We describe the development of OCT technology and its applications in research, ophthalmology and cardiology.

10:00 a.m.–10:30 a.m. Coffee Break, *Richelieu Room*

NOTES

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

BSuB • Breast Cancer Imaging and Monitoring

Sunday, April 11
10:30 a.m.–12:30 p.m.
Brian Pogue; Dartmouth College, USA, Presider
Quing Zhu; Univ. of Connecticut, USA, Presider

BSuB1 • 10:30 a.m. **Invited**

Imaging Benign and Malignant Breast Lesions with Combined Optical Imaging and Tomosynthesis, ***Qianqian Fang****, Stefan A. Carp, Richard H. Moore, Daniel B. Kopans, David A. Boas; Massachusetts General Hospital, USA.* We have imaged over 170 patients over the past 3 years with a combined optical and tomosynthesis imaging system. The region-of-interest analysis of 23 malignant lesions, 15 benign solid lesions and 8 cysts is reported.

BSuB2 • 11:00 a.m.

Breast Cancer Therapy Monitoring with Diffuse Optical Tomography and Diffuse Correlation Spectroscopy, ***Regine Choe*****[1]**, *Turgut Durduran[1,2], So Hyun Chung[1], Soren D. Konecky[1], Saurav Pathak[1], Han Y. Ban[1], David R. Busch[1], Erin M. Buckley[1], Meeri N. Kim[1], Angela DeMichele[3], Carolyn Mies[3], Mark A. Rosen[3], Mitchell D. Schnall[3], Arjun G. Yodh[1]; [1]Univ. of Pennsylvania, USA, [2]ICFO, Spain, [3]Hospital of the Univ. of Pennsylvania, USA.* Preliminary results on breast cancer suggest early changes in optically accessible parameters (e.g. blood flow, total hemoglobin concentration) by diffuse optical tomography and diffuse correlation spectroscopy may be related to pathological outcome of chemotherapy.

BSuB3 • 11:15 a.m.

Fluorescence Imaging of Breast Cancer with ICG, ***Dirk Grosenick****[1], Axel Hagen[1], Herbert Rinneberg[1], Rainer Macdonald[1], Alexander Pöllinger[2], Susen Burock[3], Peter M. Schlag[3]; [1]Phys.-Techn. Bundesanstalt, Germany, [2] Dept. of Radiology, Germany, [3] Comprehensive Cancer Ctr., Charité - Univ. Medicine, Germany.* We have investigated twenty patients with suspicious breast lesions by fluorescence mammography using ICG as contrast agent. Differences in early and late fluorescence mammograms offer the chance to distinguish malignant from benign lesions.

BSuC • Optical Coherence Tomography I

Sunday, April 11
10:30 a.m.–12:30 p.m.
Joseph Izatt; Dept of Biomedical Engineering, Duke Univ., USA, Presider
Ruikang K. Wang; Oregon Health and Science Univ., USA, Presider

BSuC1 • 10:30 a.m. **Invited**

Multimegahertz Optical Coherence Tomography: High Quality Biomedical Imaging beyond 1 Million A-Scans per Second, *Wolfgang Wieser, Benjamin R. Biedermann, Thomas Klein, Christoph M. Eigenwillig,* ***Robert Huber****; Ludwig-Maximilians-Univ. München, Germany.* We demonstrate optical coherence tomography with line rates in excess of 1MHz and effective voxel rates >5GHz. Different setups to achieve these super fast line rates are presented and the image quality is compared.

BSuC2 • 11:00 a.m.

Ultrahigh Resolution Full-Field Optical Coherence Tomography for Visualizing Human Photoreceptor Cells *in vivo*, ***Masahiro Akiba****[1], John Yan[1], Charles Reisman[1], Zhenguo Wang[1], Yasufumi Fukuma[1], Masanori Hangai[2], Nagahisa Yoshimura[2], Kinpui Chan[1]; [1]TOPCON Advanced Biomedical Imaging Lab, USA, [2]Kyoto Univ. Hospital, Japan.* We present *in vivo* human retinal imaging by full-field (FF) OCT. A phase-locked dual-channel detection scheme was incorporated with a short duration illumination technique. Human retinal cone mosaic was clearly observed by FF-OCT.

BSuC3 • 11:15 a.m.

Interferometric Spectrally Encoded Confocal Scanning Laser Ophthalmoscopy, ***Yuankai K. Tao****, Joseph A. Izatt; Duke Univ., USA.* We present *in vivo* human fundus imaging using interferometric spectrally encoded confocal scanning laser ophthalmoscopy (iSECSLO). iSECSLO allows for video-rate fully confocal imaging with the interferometric advantage of optical coherence tomography though single-mode optical fiber.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

BSuB • Breast Cancer Imaging and Monitoring — Continued

BSuB4 • 11:30 a.m.
Optical Mammography at 635-1060 nm for Breast Density Assessment and Lesion Characterization, *Paola Taroni*[1], *Antonio Pifferi[1], Lorenzo Spinelli[1], Alessandro Torricelli[1], Rinaldo Cubeddu[1], Francesca Abbate[2], Anna Villa[2], Nicola Balestrieri[2], Giuseppe Bonfitto[2], Enrico Cassano[2]; [1]Dept. of Physics, Politecnico di Milano, Italy, [2]Dept. of Radiology, European Inst. of Oncology, Italy.* A clinical study is ongoing for breast density assessment and lesion characterization using our upgraded time-resolved 7-wavelength (635-1060 nm) optical mammograph. Correlation between mammographic density and optical parameters was observed over the first 34 subjects.

BSuB5 • 11:45 a.m.
A Dual-Mode Simultaneous Bilateral Optical Imaging System for Breast Cancer Detection, *Rabah M. Al Abdi*[1], *Christoph Schmitz[2], Rehman Ansari[1,3], Randall Andronica[1], Yaling Pei[3], Yong Xu[1,3], Harry Graber[1,3], Begum Noor[4], Meena Ahluwalia[4], Randall L. Barbour[1,3]; [1]SUNY Downstate Medical Ctr., USA, [2]NIRx Medizintechnik GmbH, Germany, [3]NIRx Medical Technologies LLC, USA, [4]Brooklyn Hospital Ctr., USA.* A dual-mode dynamic optical tomographic imaging system fitted with a programmable articulating sensing head that also performs pressure and displacement measurements is described. Measures of system performance and initial clinical findings are presented.

BSuB6 • 12:00 p.m.
Near-Infrared Spectral Tomography System for Measuring Dynamic Vascular Changes in Breast, *Shudong Jiang*[1], *Brian W. Pogue[1], Colin M. Carpenter[1], Peter A. Kaufman[2], Keith D. Paulsen[1]; [1]Thayer School of Engineering, Dartmouth College, USA, [2]Dartmouth Medical School, USA.* The dynamic vascular change in the breast due to the pressure-displacement kinetics and inspired gas dynamics are imaged by a frequency domain tomographic system with 20 second temporal resolution.

BSuB7 • 12:15 p.m.
Optical Tomography Using US Localization to Assess Response to Neoadjuvant Chemotherapy, *Quing Zhu*[1], *Patricia DeFusco[2], Susan Tannenbaum[1], Behnoosh Tavakoli[1], Yan Xu[1], Yasaman Ardeshirpour[1], Andrew Ricci Jr.[2], Poornima Hegde[1], Edward Cronin[2], Mark Kane[1]; [1]Univ. of Connecticut, USA, [2]Hartford Hospital, USA.*In this report, we demonstrate that optical tomography guided by ultrasound (Optical Tomography/US) can be used during neoadjuvant chemotherapy to repeatedly monitor tumor vascular changes. Optical tomography/US may also assess early pathological response during treatment.

BSuC • Optical Coherence Tomography I — Continued

BSuC4 • 11:30 a.m.
Enhancing Diagnosis of Bladder Cancer by 2-D and 3-D Optical Coherence Tomography (OCT), *Hugang Ren*, *Zhijia Yuan, Wayne C. Waltzer, Jingxuan Liu, Ruth A. Miles, Yingtian Pan; SUNY Stony Brook, USA.* We present the results on clinical diagnosis of bladder cancer *in vivo* with MEMS-based endoscopic OCT and the methods to enhance the detection of carcinoma *in situ* by 3-D OCT using SV40T transgenic mouse model.

BSuC5 • 11:45 a.m.
High Speed Polarization Sensitive Spectral Domain OCT by Spatial Heterodyning, *Rainer A. Leitgeb*; *Medical Univ. Vienna, Austria.* Polarization sensitive spectral domain optical coherence tomography is introduced, capable to retrieve with a single camera retardation and axis orientation at 100.000 A-scans/second. Orthogonal polarization channels are distinguished through spatial modulation by an electro-optic modulator.

BSuC6 • 12:00 p.m.
OCT Imaging with Discrete-Frequency Fourier Domain Mode-Locked Laser, *Li Huo*[1], *Jiefeng Xi[1], Kevin Hsu[2], Xingde Li[1]; [1]Johns Hopkins Univ., USA, [2]Micron Optics Inc., USA.* A uniform-k, discrete frequency FDML was demonstrated with much larger coherence length than conventional FDML. High quality OCT images with the discrete frequency FDML were presented.

BSuC7 • 12:15 p.m.
A Miniature Prototype Hybrid Intra-Operative Probe for Ovarian Cancer Detection, *Yi Yang*[1], *Nrusingh Biswal[1], Patrick Kumavor[1], Tianheng Wang[1], Mozafareddin Karimeddini[2], Melinda Sanders[2], Molly Brewer[2], Quing Zhu[1]; [1]Univ. of Connecticut, USA, [2]Univ. of Connecticut Health Ctr., USA.* We demonstrate a novel prototype intraoperative probe combining Optical Coherence Tomography and positron detection in investigating normal and abnormal ovarian tissues *ex vivo*. Also a miniature probe has been made and its performance has been demonstrated.

12:30 p.m.–1:30 p.m. Lunch Break (*on your own*)

BSuD • BIOMED Sunday Poster Session

Sunday, April 11
Richelieu Room
1:30 p.m.–3:30 p.m.

BSuD1
Random-Illuminating Compressed-Sensing Photoacoustic Imaging, *Dong Liang*, *Hao F. Zhang, Leslie Ying; Dept. of Electrical Engineering and Computer Science, Univ. of Wisconsin at Milwaukee, USA.* This paper reports a new method to address the artifacts in existing limited-view photoacoustic imaging techniques. The method employs random optical illuminations and compressed sensing to obtain artifacts-free images from only two view angles.

BSuD2
Photoacoustic Imaging Using a Multiple Piezoelectric Ring Detection System, *Klaus Passler*[1], *Robert Nuster*[1], *Sibylle Gratt*[1], *Peter Burgholzer*[2], *Günther Paltauf*[1]; [1]*Karl Franzens Univ. Graz, Inst. of Physics, Austria,* [2]*Dept. of Sensor Technology, Recendt, Austria.* Photoacoustic and acoustic imaging using ring shaped piezoelectric detectors leads to strong imaging artifacts. Using several ring detectors of different size image resolution is improved and image artifacts are reduced.

BSuD3
Quantitative Recovery of Absorption Coefficient Using DOT-assisted Photoacoustic Tomography for Breast Imaging, *Chen Xu*, *Patrick Kumavor, Andres Aguirre, Quing Zhu; Electrical and Computer Engineering Dept., Univ. of Connecticut, USA.* We introduce a fitting procedure which can quantitatively recover the absorption coefficient using DOT-assisted photoacoustic tomography. The background optical properties provided by DOT can significantly improve the accuracy of the fitting.

BSuD4
Withdrawn

BSuD5
Simultaneous Imaging of Speed-of-Sound, Acoustic Attenuation and Optical Absorption Using a Computed Tomography Photoacoustic Imager, *Jithin Jose*[1], *Rene Willemink*[1], *Steffen Resink*[1], *Daniele Piras*[1], *Johan C. G. Van Hespen*[1], *Ton G. Van Leeuwen*[1,2], ***Srirang Manohar***[1]; [1]*Univ. of Twente, Netherlands,* [2]*Academic Medical Ctr., Univ. of Amsterdam, Netherlands*. We present latest results on phantoms and biological specimens using an intrinsically 'hybrid' photoacoustic imaging system. This instrument permits the tomographic imaging of both optical absorption properties and acoustic transmission properties of object.

BSuD6
Enhanced Time-Domain Photoacoustic Tomography through Total-Variation Minimization, *Lei Yao*, *Huabei Jiang; Dept. of Biomedical Engineering, Univ. of Florida, USA.* A total variation minimization based iterative algorithm is described in this paper that enhances the quality of reconstructed images with time domain data over that obtained previously with a regularized least squares approach.

BSuD7
Reduction of Secondary Echoes Generated from Ultrasound Transducer Face in Photoacoustic Imaging Implemented in Reflection Geometry, *Patrick D. Kumavor*, *Andres Aguirre, Quing Zhu; Univ. of Connecticut, USA.* A method to reduce image artifacts arising from secondary ultrasound echoes during photoacoustic imaging is presented. Experimental results presented indicate a significant improvement in the image quality by the use this technique.

BSuD8
Spectroscopic Image Analysis with Pattern Recognition in Frequency Domain Optical Coherence Tomography, *Volker Jaedicke*[1,2], *Christoph Kasseck*[1], *Nils Gerhardt*[1], *Hubert Welp*[2], *Martin Hofmann*[1]; [1]*Ruhr-Univ. Bochum, Germany,* [2]*Georg Agricola Univ. of Applied Sciences, Germany*. We present a concept for analyzing spectroscopic information in multilayer samples using a frequency domain optical coherence tomography system. We apply a windowed Fourier transform in the spatial regime and analyze the data by pattern recognition.

BSuD9
Integrated Optical Coherence Tomography (OCT) and Fluorescence Laminar Optical Tomography (FLOT) for Depth-Resolved Subsurface Cancer Imaging, *Yu Chen*[1], *Shuai Yuan*[1], *Jerry Wierwille*[1], *Chao-Wei Chen*[1], *Tiffany Blackwell*[2], *Paul Winnard*[2], *Venu Raman*[2], *Kristine Glunde*[2]; [1]*Univ. of Maryland, USA,* [2]*Johns Hopkins Medical School, USA.* We developed a combined optical coherence tomography (OCT) and fluorescence laminar optical tomography (FLOT) system for co-registered depth-resolved structural and molecular imaging. Experimental results using a mouse model with human breast cancer xenograft are presented.

BSuD10
Gold Nanocages for Spectroscopic OCT Imaging with a Swept Source at 1060 nm, *Li Huo*[1], *Yongping Chen*[1], *Jiefeng Xi*[1], *Kevin Hsu*[2], *Xingde Li*[1]; [1]*Johns Hopkins Univ., USA,* [2]*Micron Optics Inc., USA*. Gold nanocages were synthesized to shift the surface plasmon resonance peak to ~900 nm. We demonstrate these nanocages can be used as contrast agents for conventional and spectroscopic OCT at 1060 nm.

BSuD11
Concentration Dependent Scattering Coefficients of Intralipid Measured with OCT, *Vitali Kodach, Nienke Bosschaart, Jeroen Kalkman, Ton G. van Leeuwen,* **Dirk J. Faber**; *Dept. of Biomedical Engineering and Physics, Univ. of Amsterdam, Netherlands*. The contribution of dependent and multiple scattering effects to the OCT-measured scattering coefficient was investigated at 800, 1300 and 1600 nm. The former plays a thus far overlooked role in quantitative mus measurements by OCT.

BSuD12
Speckle Decorrelation as a Method for Assessing Cell Death, *Golnaz Farhat*[1,2,3], *Adrian Mariampillai*[1,4], *Victor X. D.* Yang[5,4,5], *Gregory J. Czarnota*[1,2,3,6], *Michael C. Kolios*[1,5]; [1]*Dept. of Medical Biophysics, Univ. of Toronto, Canada,* [2]*Imaging Res., Sunnybrook Health Sciences Ctr., Canada,* [3]*Dept. of Radiation Oncology, Sunnybrook Health Sciences Ctr., Canada,* [4]*Ontario Cancer Inst., Canada,* [5]*Dept. of Physics, Ryerson Univ., Canada,* [6]*Dept. of Radiation Oncology, Univ. of Toronto, Canada*. A speckle decorrelation rate was measured in OCT images of cell spheroids at various stages of growth. The decorrelation rate was related to the extent of cell death observed in histological sections of spheroids.

BSuD13
Real-Time Resampling in FD-OCT Using a Graphics Processing Unit, *Sam Van der Jeught*, *Adrian Bradu, Adrian Gh. Podoleanu; Univ. of Kent, Canterbury, UK*. We demonstrated the implementation of the wavelength to wavenumber re-sampling process, required in FD-OCT, on a GPU and achieved a speed-up of more than 4X over the CPU in the calibration of high resolution images.

BSuD14
Doppler Optical Coherence Tomography for Flow Imaging with Optimized Digital Frequency Ramping Method, *Zhijia Yuan*, *Zhongchi Luo, Hugang Ren, Yingtian Pan, Congwu Du; SUNY Stony Brook, USA.*
We optimized the DFRM for Doppler optical coherence tomography to effectively improve flow image quality and minimize computation loads. Both 2-D and 3-D flow images were performed to demonstrate the efficacy of new algorithm.

BSuD15
Thermally Generated Second Order Correlations in OCT, Noise or Diagnostic Approach? *Mark E. Brezinski*; *Brigham and Women's Hospital, USA*. We have recently demonstrated that second order correlations (SOC) in-conventional OCT demonstrate quantum mechanical properties. This paper examines OCT SOC for diagnostic purposes, such as local refractive index measurements, rather than a noise source.

BSuD16
Using Image-Space Singular Mode Vectors to Assess the Spatial Resolution of Fluorescence Tomography Instruments, *Frederic Leblond*, *Brian W. Pogue; Thayer School of Engineering, Dartmouth College, USA.* Detailed singular mode analysis is used to define the spatial resolution of whole-body fluorescence tomography instruments. This proposed methodology provides image-space information that is complementary to singular values.

Sunday, April 11
Richelieu Room
1:30 p.m.–3:30 p.m.

BSuD17

Image Reconstruction in Optical Tomography Using the Finite Element Solution of the Radiative Transfer Equation, *Tanja Tarvainen[1,2],* ***Marko Vauhkonen**[1], Simon R. Arridge[2]; [1]Univ. of Eastern Finland, Finland, [2]Univ. College London, UK.* Optical tomography image reconstruction problem is solved using regularized least-squares method. Light transport is modelled with the frequency domain radiative transfer equation which is solved with the finite element method.

BSuD18

FPGA-Assisted Strategy toward Efficient Reconstruction (FAStER) in Diffuse Optical Tomography, *Yuanyuan Jiang, Sovanlal Mukherjee, James E. Stine, Charles F. Bunting,* ***Daqing Piao**; Oklahoma State Univ., USA.* The finite element computation of photon fluence and adjoint photon fluence necessary to image reconstruction in steady state DOT has been implemented on field programmable gate array (FPGA). Preliminary results encourage further exploration toward efficient DOT image reconstruction using FPGA.

BSuD19

"Reverse-Uptake" of Zinc-Specific Fluorophore in the Prostate by Trans-Rectal Florescence Diffuse Optical Tomography, ***Guan Xu**[1], Daqing Piao[1], Chris J. Frederickson[2], Hamid Dehghani[3]; [1]School of Electrical and Computer Engineering, Oklahoma State Univ., USA, [2]Andro Diagnostics Inc., USA, [3]School of Computer Science, Univ. of Birmingham, UK.* Using fluorophore specific to zinc, a well-established prostate cancer marker, to detect prostate cancer will be challenged by the "reverse-uptake" of the fluorophore. A sensitivity-adapted reconstruction method may improve the target recovery in axial-imaging geometry.

BSuD20

3-D Noncontact Time-Resolved Fluorescent Diffuse Optical Tomography Data Processing for Improving Image's Quality, ***Farouk Nouizi**[1], Murielle Torregrossa[2], Renee Chabrier[1], Patrick Poulet[1]; [1]Lab d'Imagerie et de Neurosciences Cognitives, Univ. de Strasbourg, France, [2]Lab des Sciences de l'Image, de l'Informatique et de la Teledetection, Univ. de Strasbourg, France.* A method improving the quality of 3-D images acquired with a noncontact time-resolved FDOT preclinical setup is presented. Special attention concerned the optimization step using simulated data convoluted with the impulse response of the scanner.

BSuD21

Optimization of 2-D Spatial Resolution for Diffuse Optical Imaging of Brain Function, ***Fenghua Tian**, Haijing Niu, Hanli Liu; University of Texas at Arlington, USA.* The 2-D spatial resolution of diffusive optical imaging is studied using a computational analyzing approach. Influences of geometrical structure, optode density, dynamic range and noise level on spatial resolution are investigated in details.

BSuD22

The Spread Matrix: A Method to Predict the Effect of a Non Time-Invariant Measurement System, ***Antonio Pifferi**[1], Davide Contini[1], Lorenzo Spinelli[1], Alessandro Torricelli[1], Rinaldo Cubeddu[1], Fabrizio Martelli[2], Giovanni Zaccanti[2], Alberto Dalla Mora[3], Alberto Tosi[3], Franco Zappa[3]; [1]IIT, Dept. di Fisica, ULTRAS and IFN-CNR Politecnico di Milano, Italy, [2]Dept. di Fisica, Univ. degli Studi di Firenze, Italy, [3]IIT, Dept. di Elettronica e Informazione, Politecnico di Milano, Italy.* Time-gated systems are described using a non time-invariant operator, permitting to quantify the time-spread of collected photons and the photon rejection efficiency. Application to a fast-gated Single Photon Avalanche system is presented.

BSuD23

Reconstruction in Diffuse Optical Tomography Using Genetic Algorithm, ***Qing Zhao**[1], Lorenzo Spinelli[2], Alessandro Torricelli[3,4], Rinaldo Cubeddu[3,4,5], Antonio Pifferi[3,4,5]; [1]Dept. of Robotics Brain and Cognitive Sciences, Inst. Italiano di Tecnologia, Italy, [2]Inst. di Fotonica e Nanotecnologie, Consiglio Nazionale delle Ricerche, Italy, [3]Dept. di Fisica, Politecnico di Milano, Italy, [4]Res. Unit Politecnico di Milano, Inst. Italiano di Tecnologia, Italy, [5]Natl. Lab for Ultrafast and Ultraintense Optical Science, Consiglio Nazionale delle Ricerche, Italy.* Diffuse optical tomography can be solved by global optimization method (genetic algorithm). For noise-free data, GA can find exact solutions with a probability of 80%. For noisy data, GA has better performance than Tikhonov regularization.

BSuD24

A Finite Volume Method for Fluorescence Diffuse Optical Tomography: Influence on Forward Model and Reconstruction, ***Ludovic Lecordier**[1,2], Lionel Hervé[1], Jean-Marc Dinten[1], Françoise Peyrin[2]; [1]CEA-LETI, MINATEC, France, [2]CREATIS, INSERM U 630, CNRS UMR 5220, France.* This paper presents a finite volume method to compute the forward model in fluorescence diffuse optical tomography. The method is compared to the finite element method in regards of both forward model and reconstruction accuracy.

BSuD25

Photon Diffusion Associated with a Cylindrical Applicator Boundary for Axial Trans-Lumenal Optical Tomography: Experimental Examination of the Steady-State Theory, *Anqi Zhang[1],* ***Daqing Piao**[1], Gang Yao[2], Brian W. Pogue[3]; [1]Oklahoma State Univ., USA, [2]Univ. of Missouri, USA, [3]Dartmouth College, USA.* A new approach for steady-state photon diffusion modeling associated with a cylindrical applicator boundary for trans-luminal optical tomography was evaluated numerically and experimentally. In the diffusion regime the theoretical predictions agree well with experimental findings.

BSuD26

Estimating Signal Detectability in a Model Diffuse Optical Imaging System, ***Stefano Young**, Matthew A. Kupinski, Abhinav K. Jha; Univ. of Arizona, USA.* Diffuse optical imaging (DOI) researchers need metrics for quantifying signal detectability to assess different hardware configurations. Using Monte Carlo and statistical model observers, we estimated DOI signal detectability to compare source, signal, and detector parameters.

BSuD27

An Online Modeling and Image Reconstruction Tool for Optical Imaging Based on NIRFAST, *Milan Malinsky[1], Michael Jermyn[2], Brian W. Pogue[2],* ***Hamid Dehghani**[1]; [1]School of Computer Science, Univ. of Birmingham, UK, [2]Thayer School of Engineering, Dartmouth College, USA.* An online imaging and Finite Element modeling tool for optical imaging has been developed which allows the user to run problem specific cases, as well as providing an online tutorial for light propagation in tissue.

BSuD28

Empirical Bayesian Regularization of the Inverse Problem for Diffuse Optical Tomography with Multiple Priors, *Farras Abdelnour,* ***Theodore J. Huppert**; Univ. of Pittsburgh, USA.* Image reconstruction of diffuse optical data is underdetermined inverse problem requiring regularization to obtain accurate images. We describe the application of empirical Bayesian methods to obtain optimal regularization levels based on maximizing the log-likelihood function.

BSuD29

Radiative Transfer Equation (RTE) Based Fluorescence Molecular Tomography (FMT) of Drosophila Pupae, ***Yiyong Tan**[1], Can Zhang[2], Lei Zhou[2], Huabei Jiang[1]; [1]J. Crayton Pruitt Family Dept. of Biomedical Engineering, Univ. of Florida, USA, [2]Dept. of Molecular Genetics and Microbiology, Univ. of Florida, USA.* RTE based FMT is implemented for *in vivo* imaging of drosophila pupae with DsRed reporter. *In vivo* DsRed images obtained are consistent with the *in vitro* images obtained using confocal microscope.

BSuD30

Robust Algorithm for Automated Source Placement in Near-Infrared Diffuse Imaging, ***Michael Jermyn**[1], Brian Pogue[1], Subhadra Srinivasan[1], Scott Davis[1], Hamid Dehghani[1,2]; [1]Dartmouth College, USA, [2]Univ. of Birmingham, UK.* A surface-shrinking algorithm is demonstrated for automated source position localization one scattering depth into discretized simulation domains, in near-infrared imaging. The algorithm allows users to accurately place source fiber locations with minimal guidance.

BSuD31

Large Dataset DOT Breast Image Reconstruction, *Saurav Pathak*, *Regine Choe, Han Y. Ban, So H. Chung, Arjun G. Yodh; Univ. of Pennsylvania, USA.* We present a computational framework to simulate and analyze a large dataset DOT breast imaging instrument.

BSuD32

Hybrid Level-Set Segmentation of MRI on Optical Properties, *Chunxiao Chen*[1], *Jiani Wu*[1], *Adam T. Eggebrecht*[2], *Brian R. White*[2], *Budong Chen*[3], *Samuel Achilefu*[2], *Joseph P. Culver*[2]; [1]*Nanjing Univ. of Aeronautics and Astronautics, China,* [2]*Washington Univ. in St. Louis, USA,* [3]*Beijing Friendship Hospital, China.* A hybrid level-set segmentation approach based on T1W, T2W and PDW head MR scans is developed to segment scalp-skull, CSF, and brain. Similarity index successfully demonstrated its segmentation with acceptable accuracy for DOT reconstruction requirements.

BSuD33

Time-Domain Diffuse Fluorescence Tomography: A Featured-Data Scheme and Experimental Validation, *Feng Gao*, *Limin Zhang, Jiao Li, Huijuan Zhao; Tianjin Univ., China.* This paper presents a featured data methodology for time-domain diffuse fluorescent tomography, including both the multi-channel TCSPC-based experimental setup and the image reconstruction algorithm. The feasibility of the proposed techniques is demonstrated using phantom experiments.

BSuD34

Diffuse Optical Tomogtaphy of Large Joints: A Phantom Study, *Qizhi Zhang*, *Zhen Yuan, Eric S. Sobel, Huabei Jiang; Univ. of Florida, USA.* We present a phantom study to show the ability of diffuse optical tomography for imaging the optical properties of the 'articular cartilage' in large 'joints'.

BSuD35

Transport-Based Three-Dimensional Image Reconstruction in Optical Tomography, *Lei Yao*, *Huabei Jiang; Dept. of Biomedical Engineering, Univ. of Florida, USA.* We implemented a reconstruction algorithm based on the three-dimensional radiative transfer equation (RTE). Reconstruction results obtained indicate that the algorithm can indeed accurately handle the problems with small tissue volumes.

BSuD36

Correction of Artifacts in Angular Domain Imaging, *Fartash Vasefi*[1,2], *Alireza Akhbardeh*[3], *Mohamadreza Najiminaini*[1,2], *Bozena Kaminska*[1], *Glenn H. Chapman*[1], *Jeffrey J. L. Carson*[2]; [1]*Simon Fraser Univ., Canada,* [2]*Lawson Health Res. Inst., Canada,* [3]*School of Medicine, Johns Hopkins Univ., USA.* Angular domain imaging (ADI) is defined by the use of an angular filter array as a collimator to restrict detection of multiply-scattered photons. The ADI artifact correction following with image enhancement analysis has been presented.

BSuD37

Artificial Neural Networks-Based Diffuse Optical Tomography, *Min-Chun Pan*[1], *Hsian-An Hong*[1], *Liang-Yu Chen*[1], *Min-Cheng Pan*[2]; [1]*Natl. Central Univ., Taiwan,* [2]*Tung-Nan Univ. of Technology, Taiwan.* A scheme is developed by applying the artificial neural networks techniques for the reconstruction of optical-property images instead of using forward and inverse procedures. The proposed scheme is verified by both numerical and experimental data.

BSuD38

Modeling Fluorescence Light Propagation in Arbitrarily Shaped Domains with the Equation of Radiative Transfer on Block-Structured Grids, *Ludguier D. Montejo*[1], *Alexander D. Klose*[2], *Andreas H. Hielscher*[1,2]; [1]*Dept. of Biomedical Engineering, Columbia Univ., USA,* [2]*Dept. of Radiology, Columbia Univ., USA.* We solve the frequency domain equation of radiative transfer on block-structured grids (BSG) that are adaptively refined only near boundaries. We compare solutions on BSG to solutions on single finely discretized grids.

BSuD39

Non-Negative Matrix Factorization to Unmix Several Fluorescence Spectra and Remove Autofluorescence from *in vivo* Spectrally Resolved Acquisitions, *Anne-Sophie Montcuquet*[1], *Lionel Hervé*[1], *Fabrice P. Navarro*[1], *Jean-Marc Dinten*[1], *Jérôme I. Mars*[2]; [1]*CEA LETI Minatec, France,* [2]*Gipsa-lab, DIS, France.* Plurality of specific fluorescent markers in multiplexing, and autofluorescence of biological tissues limit specific fluorescence detection. A spectroscopic approach and a blind source separation method are proposed to unmix multiple fluorescence spectra and remove autofluorescence.

BSuD40

Monte Carlo Analysis of Single Fiber Reflectance Path Length and Sampling Depth, *Stephen C. Kanick*, *Dominic J. Robinson, H.J.C.M. Sterenborg, Arjen Amelink; Erasmus Medical Ctr., Netherlands.* We utilize a Monte Carlo model to simulate single fiber reflectance measurement of a homogenous turbid medium and describe the dependence of photon path length and sampling depth on fiber diameter and optical properties.

BSuD41

Light Diffusion in Turbid Media of Different Geometries in the Steady-State, Frequency, and Time Domains, *Alwin Kienle*, *Andre Liemert; Inst. für Lasertechnologien in der Medizin und Meßtechnik, Germany.* Analytical solutions of the diffusion equation were derived for N-layered turbid media in the steady-state, frequency, and time domains having cylindric, cuboidal and semi-in finite geometries. As source a pencil and a flat beam were considered.

BSuD42

Fast Monte Carlo Simulations for Quantifying Optical Properties from Short Source-Detector Separation Geometries, *Jonathan T. Elliott*[1,2], *Mamadou Diop*[1,2], *Ting-Yim Lee*[1,2,3], *Keith St. Lawrence*[1,2], **Kenneth M. Tichauer**[1]; [1]*Lawson Health Res. Inst., Canada,* [2]*Dept. of Medical Biophysics, Univ. of Western Ontario, Canada,* [3]*Imaging Labs, Robarts Res. Inst., Canada.* Quantitative fluorescence lifetime imaging requires an accurate knowledge of imaging medium optical properties. The efficacy of a fast Monte Carlo to determine optical properties at short source-detector distances, required for depth-resolved epi-illumination FLI, is presented.

BSuD43

Optical Diffuse Reflectance in Anisotropic Media, *Ali Shuaib*, *Gang Yao; Univ. of Missouri at Columbia, USA.* We simulated optical diffuse reflectance in fibrous scattering media. We found the equi-intensity distribution of surface reflectance obtained using anisotropic diffuse equation is similar to Monte Carlo simulation results when fiber diameter is small.

BSuD44

Laplace-Domain Diffuse Optical Tomography System, *Nanguang Chen*; *Natl. Univ. of Singapore, Singapore.* We propose a novel design of Laplace-domain diffuse optical tomography. Laplace-domain measurement of diffuse photons can be obtained directly and data acquisition speed can be significantly improved.

BSuD45

Time-Resolved Broadband Diffuse Spectroscopy Using a Differential Absorption Approach, *Antonio Pifferi*, *Andrea Bassi, Lorenzo Spinelli, Rinaldo Cubeddu, Paola Taroni; Politecnico di Milano, Italy.* The ratio of time-resolved diffuse measurements at different wavelengths, interpreted with the Beer-Lambert law, provides the spectral changes in the absorption spectrum. The applicability of this approach is discussed with models, simulations and phantom measurements.

BSuD46

Monte Carlo Simulations of Time-Resolved Fluorescence in Two-Layered Model of Human Head, *Daniel Milej*, *Anna Gerega, Piotr Sawosz, Norbert Żołek, Michał Kacprzak, Roman Maniewski, Adam Liebert; Inst. of Biocybernetics and Biomedical Engineering, Polish Acad. of Sciences, Poland.* Monte Carlo simulations were applied for analysis of time-resolved fluorescence signals excited in dye distributed in two-layered tissue model mimicking human head. Obtained results allow for optimization of the time-resolved fluorescence detection setup.

BSuD47
A Real-Time Artifact Reduction Algorithm of Short-Separation Optical Probe Based on Precision Threshold, *Weitao Li*, *Zhiyu Qian, Di Xiao; Nanjing Univ. of Aeronautics and Astronautics, China*. Short-separation optical probe has "look-ahead distance", which makes boundary of different tissues blurred. A real-time algorithm based on instrument precision was proposed to reduce the artifact. The algorithm was validated by the multi-layer phantom models.

BSuD48
Approximation Error Approach for Compensating Modelling Errors in Optical Tomography, *Tanja Tarvainen*[1,2], *Ville Kolehmainen*[1], *Aki Pulkkinen*[1,3], *Marko Vauhkonen*[1], *Martin Schweiger*[2], *Simon R. Arridge*[2], *Jari P. Kaipio*[1,4]; [1]*Univ. of Eastern Finland, Finland,* [2]*Univ. College London, UK,* [3]*Sunnybrook Res. Inst., Canada,* [4]*Univ. of Auckland, New Zealand*. The applicability of the Bayesian approximation error approach to compensate for the discrepancy of the diffusion approximation in optical tomography close to the light sources and in weakly scattering sub-domains is investigated.

BSuD49
Optimized Wavelength Selection and Normalization in Spectral Near Infrared Tomography, *Hamid Dehghani*[1], *Iain B. Styles*[1], *Matthew E. Eames*[2], *Brian W. Pogue*[3]; [1]*School of Computer Science, Univ. of Birmingham, UK,* [2]*School of Physics, Univ. of Exeter, UK,* [3]*Thayer School of Engineering, Dartmouth College, USA.* Optimized bands of wavelengths in spectral optical imaging is presented showing improvement in cross talk between parameters. A normalization technique is presented which creates a more uniform update within a spectral image reconstruction model.

BSuD50
Diffuse Optical Tomography of Heterogeneous Fluorophore Lifetimes, *Ralph E. Nothdurft*, *Mikhail Y. Berezin, Samuel Achilefu, Joseph P. Culver; Washington Univ. School of Medcine, USA.* We examine the fractional contributions of individual fluorophore in heterogeneous samples, previously demonstrated in cuvette and FLIM, with diffuse optical tomography. Experimental results from phantoms are compared with simulations at multiple frequencies.

BSuD51
Hyperspectral Excitation-Resolved Fluorescence Tomography with the SP3 Equations, *Alexander D. Klose*; *Columbia Univ., USA*. The proposed image reconstruction method exploits the spectrally dependent optical properties of biological tissue for the purpose of three-dimensional fluorescent source reconstruction. Its light propagation model is based on the SPN equations with order N=3.

BSuD52
Time Resolved Diffuse Optical Tomography Using a Digital Light Processor, *Vivek Venugopal*[1], *Jin Chen*[1], *Frederic Lesage*[2], *Xavier Intes*[1]; [1]*Rensselaer Polytechnic Inst., USA,* [2]*École Polytechnique de Montréal, Canada.* We report on the development of a time-resolved diffuse optical imager based on patterned light illumination. The system allows for fast multi-spectral acquisition of spatially dense time-domain data sets for high-fidelity tomography.

BSuD53
Modeling Spectral Dependence of Reduced Scattering Coefficient for Continuous Random Media with the Born Approximation, *Jeremy D. Rogers*, *Ilker R. Capoglu, Valentina Stoyneva, Vladimir M. Turzhitsky, Vadim Backman; Northwestern Univ., USA.* The power law dependence of reduced scattering coefficient on wavelength is derived for continuous random media using a three parameter model of index correlation function by applying the Born approximation.

BSuD54
The Pain and Gain of DC-Based Diffuse Optical Tomography Reconstruction—New Insights into an Old-Like Problem, *Guan Xu*[1], *Daqing Piao*[1], *Charles F. Bunting*[1], *Hamid Dehghani*[2]; [1]*School of Electrical and Computer Engineering, Oklahoma State Univ., USA,* [2]*School of Computer Science, Univ. of Birmingham, UK.* For diffuse optical tomography reconstruction, DC-based method outperforms frequency-domain method in background artifacts, at the known cost of increased coupling between absorption and scattering. The differences of these methods diminish when spatial *priors* are available.

BSuD55
Solutions to the Radiative Transport Equation for Non-Uniform Media, *Abhinav K. Jha*, *Matthew A. Kupinski, Dongyel Kang, Eric Clarkson; College of Optical Sciences, Univ. of Arizona, USA.* A method for modeling the 3-D propagation of photons in non-uniform media based on the radiative transport equation is presented and demonstrated to work on homogeneous and heterogeneous tissue-like phantoms.

BSuD56
Quantitative Cerebral Blood Flow and Angiography with Optical Coherence Tomography, *Vivek J. Srinivasan*[1], *Dmitriy N. Atochin*[2], *James Y. Jiang*[3], *Harsha Radhakrishnan*[1], *Mohammed A. Yaseen*[1], *Svetlana Ruvinskaya*[1], *Weicheng Wu*[1], *Scott Barry*[3], *Alex E. Cable*[3], *Paul L. Huang*[2], *David A. Boas*[1]; [1]*Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital, USA,* [2]*Cardiology Div. and Cardiovascular Res. Ctr., Massachusetts General Hospital, USA,* [3]*Thorlabs, Inc., USA.* We perform regional cerebral blood flow measurements using Doppler OCT in the rat cortex and validate our results with hydrogen clearance. 3-D angiography of cortical microvasculature is demonstrated, enabling rapid assessment of perfusion and tone.

BSuD57
Development of a Microfluidic Method for Analysis of Circulating Tumor Cells, *Hanyoup Kim, Siarhei Vishniakou, Sanhita Dixit,* ***Gregory W. Faris***; *SRI Intl., USA.* Circulating tumor cells can provide important diagnostic information using blood samples instead of direct biopsy of a solid tumor. We report development of an optical microfluidics method for molecular analysis of circulating tumor cells.

BSuD58
Spectrally Encoded Fluorescence Imaging Based on a Wavelength-Swept Source, *Mathias Strupler*, *Etienne De Montigny, Dominic Morneau, Caroline Boudoux; École Polytechnique de Montréal, Canada*. A novel spectrally encoded fluorescence imaging system based on a wavelength-swept laser is presented. High resolution (1152x1160 pixels) images of a microfluidic system filled with quantum dots were acquired at 7fps.

BSuD59
Withdrawn

BSuD60
Mueller Matrix Microscopy, *Mircea Mujat*, *Nicusor Iftimia, Robert D. Ferguson, Daniel X. Hammer; Physical Sciences Inc., USA.* We describe here a new imaging technique, Mueller matrix microscopy, for investigating the anisotropic properties of the refractive index in biological samples. The system's capabilities are demonstrated first on mica, quartz and biological samples.

BSuD61
Vertical Cross-Sectional Imaging by a Miniature Dual-Axes Confocal Microscope, *Zhen Qiu*, *Zhongyao Liu, Katsuo Kurabayashi, Kenn Oldham, Thomas D. Wang; Univ. of Michigan, USA.* We present a miniature dual-axes confocal microscope with vertical cross-sectional (X-Z) imaging which is based on a 1-D MEMS scanner and a piezoelectric micro-motor. Images are acquired at 2 Hz (fps) with a large field-of-view.

BSuD62
Localized Surface Plasmon Microscope for Simultaneous Imaging of Refractive Index and Fluorescence Distributions: Fluorescence Enhancement by Annular Pupil Illumination, *Goro Terakado*, *Hiroshi Kano; Muroran Inst. of Technology, Japan.* We report on fluorescence enhancement in the localized surface plasmon microscopy for a simultaneous measurement of refractive index and fluorescence images. A theoretical calculation and an experiment reveal the efficacy of annular pupil illumination.

BSuD63

Fourier Transform-Second-Harmonic Generation Imaging of Collagen Fibers in Biological Tissues, ***Raghu Ambekar Ramachandra Rao***, *Monal R. Mehta, Scott Leithem, Kimani C. Toussaint Jr; Univ. of Illinois at Urbana Champaign, USA.* Fourier transform-second-harmonic generation imaging is presented to quantitatively describe the collagen fiber organization in biological tissues. Further, we use this technique to compare the information content in forward and backward SHG images.

BSuD64

Analytic Modeling of 3-D Structure of Biologic Cells Using a Gaussian Random Sphere Method, *Marina Moran[1], R. S. Brock[2], Xin-Hua Hu[1],* ***Jun Q. Lu***[1]; *[1]East Carolina Univ., USA, [2]Virginia Commonwealth Univ., USA.*
The 3-D structure of biologic a cell is modeled using Gaussian random sphere method with the shape statistical parameters extracted from processed z-stack confocal microscopic images of the cell in form of fitted ellipsoid.

BSuD65

Accuracy of Hemoglobin Recovery Using 3-D Image Guided Near Infrared Spectroscopy, ***Hamid R. Ghadyani***, *Subhadra Srinivasan, Michael M. Mastanduno, Brian W. Pogue, Keith D. Paulsen; Dartmouth College, USA.* Accuracy and resolution of image guided near-infrared spectroscopy for breast imaging is characterized through simulations of varying contrasts and sizes. Results show errors of %4 for sizes greater than 20mm, but higher for smaller sizes.

BSuD66

In vivo **Characterization of Myocardial Infarct Using Optical Spectroscopy,** ***Po-Ching Chen***, *Yalin Ti, Wei-Chiang Lin; Florida Intl. Univ., USA.* An animal study was carried out to validate the feasibility of developing an optical tissue characterization system, based on combined diffuse reflectance and fluorescence spectroscopy, to delineate and grade a myocardial infarct *in vivo.*

BSuD67

A Clinical Investigation on X-Ray Guided Three-Dimensional Diffuse Optical Imaging of Osteoarthritis in the Finger Joints, ***Zhen Yuan***[1], *Qizhi Zhang[1], E. Sobel[2], Huabei Jiang[1]; [1]Dept. of Biomedical Engineering, Univ. of Florida, USA, [2]School of Medicine, Univ. of Florida, USA.* X-ray guided diffuse optical imaging is used to investigate the typical findings that can detect osteoarthritis in the finger joints. The reconstruction results showed these functional imaging parameters can diagnose OA and monitor its progression.

BSuD68

Diffusion Approximation and Higher-Order Diffusion Equations for Optical Tomography of Osteoarthritis: A Comparable Study, ***Zhen Yuan***, *Huabei Jiang; Dept. of Biomedical Engineering, Univ. of Florida, USA.* A higher-order diffusion model is employed for optical tomography of osteoarthritis. The use of higher order model in a stand-alone framework provides significant improvement in reconstruction accuracy. However, this is not the case in the image-guided setting.

BSuD69

X-Ray Guided Three-Dimensional Diffuse Optical Tomography of Osteoarthritis and Psoriatic Arthritis in Finger Joints: A Comparable Study, ***Zhen Yuan***[1], *Qizhi Zhang[1], E. Sobel[2], Huabei Jiang[1]; [1]Dept. of Biomedical Engineering, Univ. of Florida, USA, [2]School of Medicine, Univ. of Florida, USA.* X-ray guided optical tomography is used to investigate the quantitative and typical optical findings that can distinguish between osteoarthritis, psoriatic arthritis and healthy joints. Reconstruction results show the optical properties between them are clearly different.

BSuD70

Non-Invasive Measurement of Skeletal Muscle Contraction with Time-Resolved Diffusing-Wave Spectroscopy, *Markus Belau, Markus Ninck, Gernot Hering,* **Thomas Gisler**; *Univ. Konstanz, Germany*. We use near-infrared diffusing-wave spectroscopy to non-invasively measure the contraction of skeletal muscle in humans with a temporal resolution of 6 ms. Muscle strain is determined by using the analytical solution of the correlation-diffusion equation.

BSuD71

Post-Surgical Cerebral Autoregulation in Neonates with Congenital Heart Defects Monitored with Diffuse Correlation Spectroscopy, ***Erin M. Buckley***[1], *Donna A. Goff[2], Turgut Durduran[1,3], Meeri N. Kim[1], Grady Hedstrom[2], Rickson C. Mesquita[1], Daniel J. Licht[2], Arjun G. Yodh[1]; [1]Univ. of Pennsylvania, USA, [2]Children's Hospital of Philadelphia, USA, [3]ICFO, Spain*. Following cardiac surgery, diffuse correlation spectroscopy measures cerebral blood flow changes in neonates with congenital heart defects. Using statistical correlations with mean arterial pressures, we explore an "autoregulation index" to define periods of impaired autoregulation.

BSuD72

EEG and Time-Domain fNIRS Co-Registration during a Divided Attention Task, ***Davide Contini***[1], *Erika Molteni[1], Rebecca Re[1], Matteo Caffini[1], Anna Maria Bianchi[1], Lorenzo Spinelli[2], Giuseppe Baselli[1], Sergio Cerutti[1], Rinaldo Cubeddu[1], Alessandro Torricelli[1]; [1]Politecnico di Milano, Italy, [2]IFN-CNR, Inst. di Fotonica e Nanotecnologie, Sezione di Milano, Italy*. We present preliminary results on 17 subjects regarding simultaneous acquisition of electroencephalography (EEG) and time-domain fNIRS during a divided attention task.

BSuD73

In vivo **Micron Scale Arthroscopic Imaging of Human Knee Osteoarthritis with Optical Coherence Tomography: Comparison with MRI and Arthroscopy,** *Kathy Zheng, Scott D. Martin, Chris H. Rashidifard, Bin Liu, Cara Stabile,* **Mark E. Brezinski**; *Brigham and Women's Hospital, USA.* A clinical need exists for a technology to identify early osteoarthritis. This study performs *in vivo* human arthroscopic OCT imaging with MRI and arthroscopic comparisons, demonstrating OCT as a promising method for identifying early OA.

BSuD74

The Effects of Acetic Acid on Mammalian Cells, ***Oana Marina***, *Antoinette Trujillo, Claire Sanders, Kassidy Burnett, James P. Freyer, Judith R. Mourant; Los Alamos Natl. Lab, USA.* Effects of the contrast agent, acetic acid, on mammalian cells are studied using light scattering measurements, viability and fluorescence pH assays. Results depend on whether cells are in PBS or are live and metabolizing.

BSuD75

Spatiotemporal Analysis Developed for Functional Diffuse Optical Imaging and Its Clinical Applications, ***Fenghua Tian***[1], *Sameer Dhamne[1], George Alexandrakis[1], Frank A. Kozel[2], Mauricio R. Delgado[2], Hanli Liu[1]; [1]Univ. of Texas at Arlington, USA, [2]Univ. of Texas Southwestern Medical Ctr. at Dallas, USA.* A spatiotemporal analysis method is developed for diffuse optical Imaging of brain functions. The approach is applied to the data measured from children with cerebral palsy and from normal adults during repetitive transcranial magnetic stimulation.

BSuD76

Optical Imaging of Transformed Breast Epithelial Cells and Breast Tumor Microenvironment, ***Veronica Leautaud***[1], *Vivian Mack[1], John N. Wright[1], Jing Lu[2], Dihua Yu[2], Rebecca R. Richards-Kortum[1]; [1]Rice Univ., USA, [2]U.T. M.D. Anderson Cancer Ctr., USA.* Optical imaging of endogenous fluorophores and exogenous contrast agents can be used to assess changes in cellular metabolism and tumor microenvironment that relate to breast cancer progression.

BSuD77

Multi-Modality Microendoscope, ***Houssine Makhlouf***[1], *Andrew R. Rouse[2], Arthur F. Gmitro[1]; [1]Dept. of Radiology and College of Optical Sciences, USA, [2]Dept. of Radiology, USA.* An innovative multi-modality microendoscope is described that combines a parallelized point scanning multi-spectral confocal microendoscope with optical coherence tomography imaging. The system is intended for *in vivo* diagnosis of early stage diseases. Preliminary results are provided.

BSuD78

Diffuse Optical Detection of Cerebral Ischemia During Carotid Endarterectomy, *Yu Shang*[1], *Ran Cheng[1], Lixin Dong[1], Sibu P. Saha[2], Guoqiang Yu[1]; [1]Ctr. for Biomedical Engineering, Univ. of Kentucky, USA, [2]Cardiothoracic Surgery, Univ. of Kentucky, USA.* Cerebral blood flow and oxygenation were monitored by diffuse optical spectroscopes during carotid endarterectomy (CEA). The results demonstrate high sensitivity of diffuse optical spectroscopes in detecting cerebral ischemia due to arterial clamping during CEA.

BSuD79

Time-Resolved Near-Infrared Technique for Quantitative Measurements of Cerebral Blood Flow, *Mamadou Diop*[1,2], *Kenneth Tichauer[1,2], Mark Migueis[1], Ting-Yim Lee[1,2], Keith St. Lawrence[1,2]; [1]Lawson Health Res. Inst., Canada, [2]Dept. of Medical Biophysics, Univ. of Western Ontario, Canada.* A time-resolved near-infrared method for absolute cerebral blood flow measurements was developed. To validate the time-resolved technique, we compare it to our established continuous-wave method for quantitative brain perfusion measurements in new born piglets.

BSuD80

Diffuse Optical Spectroscopies for Evaluation of Muscle Hemodynamic Enchantments by Electrical Stimulation, *Yu Shang*[1], *Youquan Zhao[1], Ran Cheng[1], Lixin Dong[1], Daniel Irwin[1], Karin R. Swartz[2], Sara S. Salles[3], Guoqiang Yu[1]; [1]Ctr. for Biomedical Engineering, Univ. of Kentucky, USA, [2]Dept. of Neurosurgery, Univ. of Kentucky, USA, [3]Dept. of Physical Medicine and Rehabilitation, Univ. of Kentucky, USA.* Muscle blood flow and oxygenation were continuously monitored by diffuse optical spectroscopies during electrical stimulation (ES). Muscle blood flow increased significantly during 5-minute ES and remained high for more than 15 minutes after ES.

BSuD81

Laser-Induced Breakdown (LIB) of Optically Trapped Nanoparticles for Gene Transfection, *Yoshihiko Arita*, *Maria Leilani Torres-Mapa, Woei Ming Lee, Tomáš Čižmár, Frank J. Gunn-Moore, Kishan Dholakia; Univ. of St. Andrews, UK.* A novel approach to gene transfection is demonstrated. It uses laser-induced breakdown of an optically trapped single nanoparticle to achieve a high transfection efficiency in a quasi-targeted manner, without cell lysis, using a nanosecond laser.

BSuD82

Fluorescence Bioimaging with Integrin-Targeting Block Copolymer Probes, *Sanchita Biswas, Xuhua Wang, Alma R. Morales, **Kevin D. Belfield**; Univ. of Central Florida, USA.* The synthesis of water soluble block copolymers conjugated with a hydrophobic 2PA fluorescent probe and RGD for bioimaging and toxicity studies for specifically target the $\alpha_v\beta_3$ integrin over-expressing human epithelial U87MG cell lines was demonstrated.

BSuD83

Double Negative Optical Trapping, *Leonardo A. Ambrosio*, *Hugo E. Hernández-Figueroa; Unicamp - Univ. of Campinas, Brazil.* Gradient forces in optical trapping for double-negative (DNG) particles are analyzed using full electromagnetic theory for both ordinary Bessel and focused Gaussian beams. Unusual and interesting behaviors reveal new potentialities for research in biomedical optics.

BSuD84

Correlation of Blood Flow and Systemic Physiology in Mice Tumor Models in Photodynamic Therapy, *Hsing-Wen Wang*[1,2], *Steven Schenkel[1], Rickson C. Mesquita[1], Arjun G. Yodh[1], Theresa M. Busch[3]; [1]Dept. of Physics and Astronomy, Univ. of Pennsylvania, USA, [2]Inst. of Biophotonics, Natl. Yang-Ming Univ., Taiwan, [3]Dept. of Radiation Oncology, Univ. of Pennsylvania, USA.* Blood flow in mice tumor models was measured with Diffuse Correlation Spectroscopy and compared to concurrent physiology monitoring. Positive correlations were (not) found between flow and heart (breath) rate during anesthesia periods.

BSuD85

Depth Resolved Size and Shape Measurement of Aspherical Scatterers Using Two Dimensional Angle Resolved Low Coherence Interferometry, *Michael G. Giacomelli*, *Yizheng Zhu, John Lee, Adam Wax; Duke Univ., USA.* We investigate the use of two dimensional angle resolved scanning fiber light scattering interferometry combined with T-matrix-based inverse analysis for measuring the size and shape of aspherical scatterers as a means of detecting dysplastic tissue.

BSuD86

Transport-Based Quantitative Photoacoustic Tomography, *Lei Yao*, *Yao Sun, Huabei Jiang; Dept. of Biomedical Engineering, Univ. of Florida, USA.* A method based on the radiative transfer equation (RTE) coupled with the photoacoustic equation is presented. It provides quantitatively and significantly improved image reconstruction for the cases where the photon diffusion approximation may fail.

BSuD87

Frequency-Domain Optical Tomography of Arthritic Joints, *Andreas H. Hielscher*[1], *Hyun K. Kim[1], Uwe Netz[2], Ludguier Montejo[1], Christian D. Klose[1], Sabine Blaschke[3], P. A. Zwaka[3], Gerhard A. Müller[3], Jürgen Beuthan[4]; [1]Columbia Univ., USA, [2]Laser- und Medizin-Technologie GmbH, Germany, [3]Georg-August-Univ., Germany, [4]Charite–Medical Univ., Germany.* Presenting data from the largest clinical trial on optical tomographic imaging of finger joints to date, we show that sensitivities and specificities better than 0.89 can be achieved, using frequency-domain techniques and advanced classification methods.

BSuD88

Exploiting the Potential of Hybrid FMT/XCT Imaging by Means of Segmentation, *Marcus Freyer*, *Angelique Ale, Ralf B. Schulz, Vasilis Ntziachristos, Karl-Hans Englmeier; Helmholtz Zentrum München, Inst. of Biological and Medical Imaging, Germany.* Hybrid FMT/XCT systems enable us to improve optical tomography image quality by using image priors in the reconstruction algorithm. We propose segmentation techniques to extract those priors and demonstrate their utilization in FMT image reconstruction.

BSuD89

Time-Correlation Data Analysis of Fluorescence Imaging Based Diagnosis of Rheumatoid Arthritis, *Thomas Dziekan*[1], *Carmen Weißbach[1], Jan Voigt[1], Alfred Walter[1], Bernd Ebert[1], Rainer Macdonald[1], Michael Berliner[2], Birgitt Berliner[3], Daniel Bauer[2], Jens Osel[4], Ilka Osel[4], Thomas Hirsch[4]; [1]Physikalisch-Technische Bundesanstalt, Germany, [2]Helios Klinikum Berlin-Buch, Germany, [3]Helios Res. Ctr., Germany, [4]Helios Klinikum Bad Saarow, Germany.* The dye ICG was investigated in a clinical study for evaluation of rheumatoid arthritis using fluorescence imaging. Second moments of correlated time series of fluorescence intensities were analysed to differentiate healthy subjects from diseased.

BSuD90

The Confounding Effect of Systemic Physiology on the Hemodynamic Response in Newborns, *Bernhard B. Zimmermann[1], Nadege Roche-Labarbe[1], Andrea Surova[1], David A. Boas[1], Ellen Grant[2], **Maria Angela Franceschini**[1]; [1]Massachusetts General Hospital, USA, [2]Children's Hospital Boston, USA.* In preterm newborns evoked hemoglobin responses to auditory stimulation are strongly affected by baseline hemodynamic physiology.

BSuD91

Simultaneous Optical Coherence Tomography and Electrophysiology Measurements to Investigate Neurovascular Coupling in Rats, *Harsha Radhakrishnan*[1], *Vivek J. Srinivasan[1], James Y. Jiang[2], Mohammed A. Yaseen[1], Weicheng Wu[1], Scott Barry[2], Alex Cable[2], David A. Boas[1], Maria Angela Franceschini[1]; [1]Athinoula A. Martinos Ctr. for Biomedical Imaging, USA, [2]Thor Labs, USA.* Simultaneous measurements with microelectrodes and frequency domain optical coherence tomography were done on rats to investigate neurovascular coupling. Neuronal and vascular responses to parametric forepaw stimulation were found to be in agreement under different anesthetics.

Sunday, April 11
Richelieu Room
1:30 p.m.–3:30 p.m.

BSuD92

Imaging Heterogeneous Absorption Distribution of Advanced Breast Cancers Using Optical Tomography Guided by Ultrasound, *Yan Xu*, *Quing Zhu; Univ. of Connecticut, USA.* The distribution of tumor vasculature in advanced cancers is complex. In this paper, we characterize the heterogeneous absorption distribution of large targets. A clinical example is given to demonstrate the complexity of tumor vasculature.

BSuD93

Photoacoustic Microscopy and Spectroscopy of Individual Red Blood Cells, *Min Rui[1], Wolfgang Bost[2], Eike Weiss[3], Robert Lemor[2], **Michael C. Kolios**[1]; [1]Ryerson Univ., Canada, [2]Fraunhofer Inst. for Biomedical Technology, Germany, [3]kibero GmbH, Germany*. Optoacoustic imaging relies on the ultrasonic detection of pressure waves created after optical absorption. In this work we demonstrate imaging single red blood cells using an ultrasonic detection system at 200 and 400 MHz.

BSuD94

Instrumentation and Methodology for Bedside Monitoring of Cerebral Perfusion by Optical Bolus Tracking, *Oliver Steinkellner*[1], *Heidrun Wabnitz[1], Alexander Jelzow[1], Clemens Gruber[2], Jens Steinbrink[2], Hellmuth Obrig[2], Rainer Macdonald[1]; [1]Physikalisch-Technische Bundesanstalt, Germany, [2]Klinik für Neurologie and Ctr. for Stroke Res. Berlin, Charité-Univ. Medizin Berlin, Germany.* We present a time-domain near-infrared reflectometer applied in a clinical study. Instrumentation was optimized pertaining to reliability and rapid applicability. Using signal analysis based on statistical moments, suppression of motion artifacts can be achieved.

BSuD95

Time Resolved Optical Imaging with Patterned Light for Pre-Clinical Studies, *Jin Chen,* *Xavier Intes; Rensselaer Polytechnic Inst., USA.* We investigated the performance of the time-gated Diffuse Optical Tomography based on Monte Carlo model with patterned wide-field illumination on a mouse model. The reconstructions outperform classical punctual excitation schemes for similar data sizes.

BSuD96

A Compact, Cost-Effective Spectral Imaging Device for Quantitative Tissue Absorption and Scattering, *Justin Y. Lo*[1], *Bing Yu[1], Henry L. Fu[1], Thomas F. Kuech[2], Nirmala Ramanujam[1]; [1]Duke Univ., USA, [2]Univ. of Wisconsin, USA.* A compact, cost-effective spectral imaging for breast tumor margin assessment is designed. The performance of a single-pixel version of the device is validated with phantom studies. Absorption and scattering coefficients are extracted with high accuracy.

BSuD97

Quantitative Imaging of Molecular Order in Lipid Membranes Using Two-Photon Fluorescence Polarimetry, A*licja Gasecka,* *Tsai-Jung Han, Cyril Favard, Sophie Brasselet; Inst. Fresnel - MOSAIC group, France.* Complex molecular orders in heterogeneous Giant Unilamellar Vesicle as well as cell membranes are investigated using polarization resolved two-photon fluorescence microscopy. This method provides local structural information that cannot be achievable using traditional anisotropy measurements.

BSuD98

Fiber Delivered Probe for Efficient CARS Imaging of Tissues, *Mihaela Balu,* *Gangjun Liu, Zhongping Chen, Eric Potma, Bruce Tromberg; Beckman Laser Inst., Univ. of California, Irvine, USA.* We present a fiber-based probe for maximum collection of the Coherent anti-Stokes Raman Scattering (CARS) signal of tissues. Design challenges are discussed and images of a variety of tissues using the hand-held probe are presented.

BSuD99

3-D Visualization of Intrinsic Contrast in Neoplastic Colon Tissue Using Hyperspectral Two-Photon Microscopy, *Lauren Grosberg,* *Andrew J. Radosevich, Samuel Asfaha, Xiangdong Yang, Timothy C. Wang, Elizabeth M. C. Hillman; Columbia Univ., USA.* Hyperspectral two-photon imaging of endogenous fluorescence and SHG allows 3-D visualization of gastrointestinal tissue without slicing or staining. A study of the morphological changes that occur in two mouse models of cancer is presented.

BSuD100

Multi-color Excitation Nonlinear Microscopy of Biological Tissue, *Dong Li*, *Wei Zheng, Jianan Y. Qu; Hong Kong Univ. of Science and Technology, Hong Kong.* A two-photon microscope of excitation sources from femtosecond laser and supercontinuum generation from a photonic crystal fiber was developed for the imaging of biological tissue. Its potentials for the diagnosis of tissue pathology are demonstrated.

BSuD101

Fiber Laser and Handheld Probe Based Multiphoton Microscope, *Gangjun Liu*[1], *Khanh Kieu[2], Frank W. Wise[2], Zhongping Chen[1]; [1]Beckman Laser Inst., USA, [2]School of Applied and Engineering Physics,Cornell Univ., USA.* A compact multiphoton microscopy (MPM) system with a femstosecond fiber laser and double clad photonic crystal fiber based handheld probe is designed and demonstrated. Multiphoton images of biological tissue were demonstrated.

BSuD102

Multicontrast Nonlinear Microscopy for Cancer Diagnostics Using H&E Stained Thick Histological Sections, *Adam Tuer[1], Richard Cisek[1], Jennifer Alami[2], John Rowlands[2], **Virginijus Barzda[1];** [1]Dept. of Chemical and Physical Sciences, Univ. of Toronto, Canada, [2]Sunnybrook Health Sciences Ctr., Dept. of Medical Biophysics, Univ. of Toronto, Canada.* Hematoxylin and eosin (H&E) stained histological sections were investigated with multicontrast second- and third-harmonic generation and multiphoton excitation fluorescence microscope. Three dimensional visualization of 50 microns thick histological sections may aid in early cancer diagnostics.

BSuD103

Digital Staining of Confocal Mosaics for Clinical Pathology, *Nathaniel Chen, Jordan Sensibaugh, Kevin White, Rodd Takiguchi, Steve Jacques, Anna Bar, **Daniel S. Gareau**; Dept. of Surgery and Biomedical Engineering, Oregon Health and Science Univ., USA.* Digital staining of multimodal confocal mosaics may be necessary for clinical acceptance. We determined the appropriate color and weight for transformation from grayscale to resemble hematoxylin and Eosin-stained fixed sections.

BSuD104

Determination of Burn Depth Based on Depth-Resolved Second-Harmonic-Generation Imaging of Dermal Collagen, *Takeshi Yasui,* *Kunihiko Sasaki, Ryosuke Tanaka, Shu-ichiro Fukushima, Tsutomu Araki; Osaka Univ., Japan.* We applied depth-resolved second-harmonic-generation imaging of dermal collagen fiber for estimating burn in fresh chicken skin. Depth and area of the burn was visualized by difference of image contrast between burned and sound area.

BSuD105

Identafi®3000 ultra A Multispectral Tool For Improved Oral Lesion Evaluation, *Andres F. Zuluaga*[1], *N. Vigneswaran[2], R. K. Bradley[1], A. M. Gillenwater[3], C. M. Nichols[4], C. Poh[5]; [1]Remicalm LLC, USA, [2]Univ. of Texas Dental Branch at Houston, USA, [3]Univ. of Texas M. D. Anderson Cancer Ctr., USA, [4]Bering Omega Dental Clinic, USA, [5]British Columbia Cancer Agency, Canada.* A novel multispectral, autofluorescence and reflectance tool has been developed to improve differentiation of lesions from normal tissues. We report excellent results on a multi-center referral cohort of 120 patients, and the screening implications.

BSuD106

Assessment of Wound Healing with DPDW Methodology in Obese Rats, *Michael Neidrauer, Leonid Zubkov, Michael S. Weingarten, Kambiz Pourrezaei, **Elisabeth S. Papazoglou**; Drexel Univ., USA.* Wound healing was monitored in obese rats using Diffuse Photon Density Wave (DPDW) methodology of Near Infrared spectroscopy. Changes in the measured optical absorption coefficients reflected the various stages of wound healing.

Sunday, April 11
Richelieu Room
1:30 p.m.–3:30 p.m.

BSuD107
Sentinel Lymph Node Detection by an Optical Method Using Scattered Photons, ***Franklin Tellier***[1], *Herve Simon*[2], *Renee Chabrier*[1], *Rasata Ravelo*[1], *Patrick Poulet*[1]; [1]*Lab d'Imagerie et de Neurosciences Cognitives, Universite de Strasbourg/CNRS, France,* [2]*Eurorad, France.* A near infrared optical method of sentinel lymph node detection, based on the recording of scattered photons is presented. Different wavelengths are used, to improve the detection threshold of injected Patent Blue Violet dye.

BSuD108
Feasibility Study of Volumetric Diffuse Optical Tomography in Small Animal Using CCD-Camera-Based Imaging System, ***Zi-Jing Lin,*** *Haijing Niu, Hanli Liu; Univ. of Texas at Arlington, USA.* We report the feasibility of 3-D volumetric diffuse optical tomography for small animals using a CCD-camera-based imaging system with the novel depth compensation algorithm. It allows 3-D localization of anomaly tissue non-invasively in small animals.

BSuD109
Multi-Channel, Light Reflectance Spectroscopy for Fast Detection of Hemodynamic Changes on the Spinal Cord and the Brain Induced by Electrical Stimulations in Rats, *Vikrant Sharma, Jiwei He, Sweta Narvenkar, Yuan Bo Peng, Hanli Liu; Univ. of Texas at Arlington, USA.* Multi-channel, light reflectance spectroscopy with thin needle probes is developed for fast detection of neuro-hemodynamic changes induced by electrical stimulations in rats, revealing hemo-neuro pathways and information processing between the spinal cord and the brain.

NOTES

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

BSuE • Imaging Theory

Sunday, April 11
4:00 p.m.–6:00 p.m.
Andreas H. Hielscher; Columbia Univ., USA, Presider

BSuE1 • 4:00 p.m.
Finite Element Solution of the Fokker-Planck Equation for Optical Tomography, *Ossi Lehtikangas*[1], *Tanja Tarvainen[1,2], Ville Kolehmainen[1], Aki Pulkkinen[1,3], Simon Arridge[2], Jari P. Kaipio[1,4]; [1]Dept. of Physics, Univ. of Kuopio, Finland, [2]Dept. of Computer Science, Univ. College London, UK, [3]Sunnybrook Res. Inst., Sunnybrook Health Sciences Ctr., Canada, [4]Dept. of Mathematics, Univ. of Auckland, New Zealand.* Light propagation is modeled with the Fokker-Planck equation which approximates the radiative transport equation when scattering is forward-peaked. The Fokker-Planck equation is solved with the finite element method.

BSuE2 • 4:15 p.m.
Fast 3-D Reconstruction in Highly Scattering Media Using Structured Light, *Cosimo D'Andrea*[1], *Andrea Bassi[1], Gianluca Valentini[1], Rinaldo Cubeddu[1], Simon Arridge[2]; [1]Politecnico di Milano, Italy, [2]Univ. College London, UK.* Fast 3-D reconstruction method, based on structured light, has been demonstrated and experimentally validated. Spatial information, resolution and selection of the optimal spatial frequencies are discussed.

BSuE3 • 4:30 p.m.
Fluorescence Tomography with a PDE-Constrained Algorithm Based on the Equation of Radiative Transfer, *Hyun Keol Kim*, *Jong Hwan Lee, Andreas H. Hielscher; Columbia Univ., USA.* We introduce the PDE-constrained fluorescence tomography algorithm with a sequential quadratic programming method based on the frequency-domain radiative transfer equation. We show that the PDE-constrained approach leads to 15-fold speedup compared to the unconstrained approach.

BSuE4 • 4:45 p.m.
In vivo* Fluorescence Resonance Energy Transfer and Optical Diffusion Tomography Imaging of Targeted Drug Delivery to Tumors, *Vaibhav Gaind, *Kevin J. Webb, Sumith A. Kularatne, Philip S. Low; Purdue Univ., USA.* Fluorescence resonance energy transfer (FRET) and optical diffusion tomography (ODT) are used for imaging a model for targeted anti-cancer drug delivery to a tumor in a mouse. Experimental and simulation results are presented.

BSuF • Optical Coherence Tomography II

Sunday, April 11
4:00 p.m.–6:15 p.m.
Xingde Li; Johns Hopkins Univ., USA, Presider

BSuF1 • 4:00 p.m. **Invited**
OCT Imaging of the Developing Heart, *Andrew Rollins*; *Case Western Reserve Univ., USA.* OCT imaging and analysis tools enable investigation of the early embryonic heart with resolution in time and space previously not possible, promising to aid in uncovering normal and abnormal mechanisms that govern early heart development.

BSuF2• 4:30 p.m.
Depth Resolved Imaging of Directional Vascular Perfusion within Retina and Choroid Using Optical Micro-Angiography, *Ruikang K. Wang*, *Lin An, Spencer Saunders, David Wilson; Oregon Health and Science Univ., USA.* We present functional images of microcirculation in different depth regions of retina and choroid, which results show superior performance of optical micro-angiography to image ocular blood perfusion with high resolution and high sensitivity.

BSuF3• 4:45 p.m.
Co-Registered Optical Coherence Tomography (OCT) and Fluorescence Molecular Imaging for Gastrointestinal Cancer Detection, *Yu Chen*[1], *Jerry Wierwille[1], Celeste Roney[2], Shuai Yuan[1], Chao-Wei Chen[1], Biying Xu[2], Gary Griffiths[2], Ronald Summers[2]; [1]Univ. of Maryland, USA, [2]NIH, USA.* We developed a co-registered optical coherence tomography (OCT) and fluorescence molecular imaging (FMI) system for simultaneous morphological and molecular imaging. Imaging of intestinal polyps of APC^{min} mouse model is presented with scattering and fluorescence parameters.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

BSuE • Imaging Theory— Continued

BSuE5 • 5:00 p.m.
A Hybrid Finite Element-Boundary Element Method for Modeling Light Propagation in Tissue in 3-D, ***Subhadra Srinivasan***, *Brian W. Pogue, Keith D. Paulsen; Thayer School of Engineering, Dartmouth College, USA.* A novel hybrid method combining 3-D FE and BE techniques has been implemented for modeling light diffusion combining homogeneous and heterogeneous regions. Results show less than 1% difference in boundary data between the different models.

BSuE6 • 5:15 p.m.
Sparse Image Reconstruction in Diffuse Optical Tomography: An Application of Compressed Sensing, *Mehmet Süzen, Alexia Giannoula, Peyman Zirak, Néstor Oliverio, Udo Weigel, Parisa Farzam,* ***Turgut Durduran****; ICFO-Inst. of Photonic Sciences, Spain.* We study Compressed Sensing (CS) framework for optical tomography. Simulations are performed in linear inverse diffuse optical image reconstructions. Potential benefits and shortcomings of CS is discussed.

BSuE7• 5:30 p.m.
A Hadamard Transform Approach towards Robust Fluorescence Molecular Tomography, ***Ali Behrooz***, *Ali A. Eftekhar, Pouyan Mohajerani, Ali Adibi; Georgia Tech, USA.* Inspired by Hadamard multiplexing technique, a method is proposed to improve noise robustness and minimize estimation error in fluorescence molecular tomography (FMT). Theoretical results are validated by numerical studies of 2-D simulated FMT data.

BSuE8• 5:45 p.m.
Diffuse Optical Tomography Based on Simplified Spherical Harmonics Approximation, *Michael Chu*[1], ***Hamid Dehghani***[2]; [1]*School of Physics, Univ. of Exeter, UK,* [2]*School of Computer Science, Univ. of Birmingham, UK.* Higher order equations to the diffusion approximation are presented. Reconstruction of diffuse optical parameters where only the forward model is based on these equations are shown to be more accurate reducing image artifacts.

BSuF • Optical Coherence Tomography II—Continued

BSuF4• 5:00 p.m.
Simultaneous Anatomical and Biochemical Imaging of Biological Tissue Using a Multimodal Optical Coherence Tomography and Fluorescence Lifetime Imaging System, *Sebina Shrestha, Jesung Park, Paritosh Pande, Fred Clubb, Brian Applegate,* ***Javier A. Jo****; Texas A&M Univ., USA.* We have developed a multimodal optical system for simultaneous optical coherence tomography (OCT) and fluorescence lifetime imaging microscopy (FLIM) imaging, and demonstrate its capability for high-speed co-registered micro-anatomical and biochemical tissue imaging.

BSuF5• 5:15 p.m.
Contrast to Labeled Rehydrated, Lyophilized Platelets Using Magnetomotive OCT, ***Amy L. Oldenburg***, *Thomas H. Fischer, Timothy C. Nichols, Caterina M. Gallippi, Raghav Chhetri, Frank Tsui; Univ. of North Carolina at Chapel Hill, USA.* Rehydrated, lyophilized platelets for hemostatic therapy are incorporated with commercial MRI iron oxide contrast agents. We demonstrate that magnetomotive OCT contrasts the platelets and propose this system for monitoring hemopathic sites targeted by platelets.

BSuF6• 5:30 p.m.
Multimodal Full-Field Optical Coherence Microscopy, *G. Moneron, K. Grieve, E. Guiot, J. Morea*[1]*, C. Boccara, D. Sacchet, P. Georges,* ***Arnaud Dubois****; Lab. Charles Fabry de l'Inst. d'Optique, Univ. Paris-Sud, France.* We present a full-field OCT system that measures the intensity, the spectrum, and the phase-retardation simultaneously. Imaging is also possible at two wavelengths. By producing multi-contrasted images with high resolution, this technology could replace histology.

BSuF7• 5:45 p.m.
Multimodal Retinal Imager, ***Mircea Mujat***, *Robert D. Ferguson, Nicusor Iftimia, Daniel X. Hammer; Physical Sciences Inc., USA.* We present a multimodal retinal imaging system that combines AO-corrected scanning laser ophthalmoscopy, swept source Fourier domain optical coherence tomography, wide field line scanning ophthalmoscopy, and retinal tracking in a single compact clinical prototype platform.

BSuF8• 6:00 p.m.
Skin Surgery and Light-CT, *B. de Poly*[1]*, S. Nadolny*[1]*, D. Salomon*[2]*, O. de Witte*[2]*, C. Brossollet*[3]*,* ***A. C. Boccara***[3]; [1]*LLTech, France,* [2]*Hôpitaux Univ. de Genève, Switzerland,* [3]*Inst. langevin, Lab d'Optique ESPCI, France.* Light-CT offers valuable diagnostics of skin pathologies. We show sections down to sub-nuclei sizes and images of patients' skins exhibiting Werner syndrome. Light-CT merits are compared to other OCT approaches, confocal and optical coherence microscopy.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

7:00 a.m.–6:30 p.m. Registration Open, *Napoleon Lobby*
10:00 a.m.–4:00 p.m. Exhibits Open, *Richelieu Room*

Opening Remarks 7:30 a.m.–8:00 a.m.

DMA • Fundamental Advances in Holography I

Monday, April 12
8:00 a.m.–10:00 a.m.
Ting-Chung Poon; Virginia Tech, USA, Presider

DMA1 • 8:00 a.m. **Keynote**

The Principle of Good Enough (POGE) and the Use of Digital Holography in Sensors, *John Caulfield*; *Fisk Univ., USA.* POGE (Principle of Good Enough) is shown to yield dramatic new capabilities in optical pattern recognition, optical linear algebra, point source location, and Fourier pattern recognition. POGE has become a powerful template for invention.

DMA2 • 8:45 a.m.

Speckle Correlation in Phase-Shifting Digital Holography, *Ichirou Yamaguchi*; *Toyo-Seiki Seisakusho, RIKEN, Japan*. Digital holography provides 3-dimensional distributions of complex amplitude whereas speckle patterns are highly contrasted everywhere. Cross-correlations of complex amplitude and intensity are derived from phase-shifting digital holography to merge holographic interferometry and speckle metrology.

DMA3 • 9:00 a.m.

One-Shot Digital Holography for Recording Wideband Complex-Amplitude Hologram, *Kunihiro Sato*, *Kohei Maejima; Hyogo Univ., Japan.* One-shot digital holography is developed for instantaneous recording of wideband complex-amplitude in-line hologram by using the spatial heterodyne modulation. It is possible to enlarge bandwidth of the hologram up to the theoretical upper limit.

DMA4 • 9:15 a.m.

Some Opportunities for Digital Color Holography Using a Stack of Photodiodes, *Patrice Tankam*[1], *Pascal PICART[1,2], Denis Mounie[2,3], Jean Michel Desse[4], Junc-chang Li[5]; [1] LAUM CNRS, Univ. du Maine, France, [2]École Nationale Supérieure d'Ingénieurs du Mans, France, [3]LPEC CNRS, Univ. du Maine, France, [4]ONERA, France, [5]Kunming Univ. of Science and Technology, China.* A simple set-up for digital color holography in which the reference beam has a unique shaping and recording uses a stacked color sensor is described. A dedicated algorithm allows color object to be fully reconstructed.

Opening Remarks 7:50 a.m.–8:00 a.m.

BMA • BIOMED Monday Plenary

Monday, April 12
8:00 a.m.–10:00 a.m.
Vasilis Ntziachristos; Technische Univ. Munchen, Germany, Presider

BMA1 • 8:00 a.m. **Plenary**

Nanotechnology for Molecular Imaging and Image-Guided Surgery, *Shuming Nie*[1,2]; *[1]Emory Univ., USA, [2]Georgia Tech, USA.* Recent development in bioconjugated nanoparticles opens new opportunities for *in vivo* molecular imaging and image-guided cancer surgery.

BMA2 • 8:40 a.m. **Plenary**

Development of Optical Imaging Biomarkers and Applications in Drug Discovery and Development, *Bohumil Bednar*; *Merck Res. Labs, USA.* Molecular imaging biomarkers play a critical role in efforts to increase the probability of success of drug candidates, supporting validation of novel drug targets early in the drug discovery and development process.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DMA • Fundamental Advances in Holography I—Continued

DMA5 • 9:30 a.m.
One-Shot Color Digital Holography Based on the Fractional Talbot Effect, *Lluís Martínez-León*[1], *María A. Araiza-Esquivel[2], Bahram Javidi[3], Pedro Andrés[4], Jesús Lancis[1], Vicent Climent[1], Raúl Martínez-Cuenca[1], Enrique Tajahuerce[1]; [1]Univ. Jaume I, Spain, [2]Univ. Autónoma de Zacatecas, Mexico, [3]Univ. of Connecticut, USA, [4]Univ. de València, Spain.* We present a method for recording on-axis color digital holograms in a single shot. Our system performs parallel phase-shifting interferometry by using the fractional Talbot effect for every chromatic channel simultaneously. Experimental results are shown.

DMA6 • 9:45 a.m.
20000-Frames-per-Second Phase-Shifting Digital Holography, *Yasuhiro Awatsuji*[1], *Kenichi Ito[1], Yuki Shimozato[1], Takashi Kakue[1], Motofumi Fujii[1], Tatsuki Tahara[1], Kenzo Nishio[1], Shogo Ura[1], Toshihiro Kubota[2], Osamu Matoba[3]; [1]Kyoto Inst. of Technology, Japan, [2]Kubota Holography Lab Corp., Japan, [3]Kobe Univ., Japan.* The authors demonstrated a phase-shifting digital holography at the rate of 20000 frames/second, for the first time. Thanks to parallel phase-shifting digital holography, the digital holography system succeeded in three-dimensional imaging for dynamically moving objects.

BMA • BIOMED Monday Plenary—Continued

BMA3 • 9:20 a.m. **Plenary**
Technology Development for Deep Tissue Multiphoton Imaging, *Chris Xu*; *Cornell Univ., USA.* Deep tissue multiphoton microscopy (MPM) of mouse brain using 1280-nm excitation is presented. Several practical issues and a promising new femtosecond fiber source for long wavelength MPM will be discussed.

10:00 a.m.–10:30 a.m. Coffee Break/Exhibits, *Richelieu Room*

NOTES

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DMB • Fundamental Advances in Holography II

Monday, April 12
10:30 a.m.–12:30 p.m.
Joseph Rosen; Ben Gurion Univ., Israel, Presider
Byoungho Lee; Seoul Natl. Univ., Korea, Republic of, Presider

DMB1 • 10:30 a.m. **Invited**

Holography and Photopolymer Recording Materials, ***John Sheridan****; Univ. College Dublin, Ireland.* Photopolymers act as drivers and enabler of fabrication technologies for applications including refractive/diffractive optical elements, hybrid 3-D optoelectronic circuitry, data storage recoding media and self-trapping. The need for and development of modeling tools is discussed.

DMB2• 11:00 a.m. **Invited**

Nonlinear Digital Holography, Christopher Barsi, ***Jason Fleischer****; Princeton Univ., USA.* We extend digital holography, and the techniques of computational imaging in general, to beam propagation in nonlinear media. Nonlinearity mixes high-frequency spatial modes with low-frequency ones, so that reconstruction results in super-resolution of the object.

BMB • Cancer Monitoring and Imaging

Monday, April 12
10:30 a.m.–12:30 p.m.
Regine Choe; Univ. of Pennsylvania, USA, Presider

BMB1 • 10:30 a.m.

Computer-Aided Detection of Tumors in 3-D Tomograms from Diffuse Optical Mammography, ***David R. Busch***[1]*, Wensheng Guo[1], Regine Choe[1], Turgut Durduran[1,2], Mark A. Rosen[3], Mitchell D. Schnall[3], Mary E. Putt[1], Arjun G. Yodh[1]; [1]Univ. of Pennsylvania, USA, [2]ICFO, Spain, [3]Hospital of Univ. of Pennsylvania, USA.* Diffuse optical Tomography provides multi-parameter 3-D images of breast cancer. We introduce a multi-parameter, position, subject analysis to identify signatures of cancer and utilize these signatures to locate cancers in additional subjects.

BMB2 • 10:45 a.m.

Multi-Modality Imaging of the Compressed Breast, ***Stefan A. Carp****, Nadege Roche-Labarbe, Qianqian Fang, Juliette J. Selb, David A. Boas; Massachusetts General Hospital, USA.* We use dynamic optical and MR imaging to characterize the hemodynamic behavior of breast tissue under external compression. Preliminary data shows spatial contrast in both optical blood volume time-courses and MR oxygenation dependent (BOLD) images.

BMB3 • 11:00 a.m.

Quantitative and Depth-Resolved Fluorescence Techniques for Intraoperative Guidance of Brain Tumor Resection Surgery, ***Anthony Kim****, Mathieu Roy, Brian C. Wilson; Ontario Cancer Inst., Univ. of Toronto, Canada.* We have developed a handheld fiberoptic probe for tissue fluorescence quantification and a technique to produce depth-resolved maps of sub-surface tumor fluorescence, to elaborate upon intraoperative fluorescence guided resection of brain tumor.

BMB4 • 11:15 a.m.

Endoscopic Polarized Scanning Spectroscopic Imaging of Barrett's Esophagus *in vivo*, *Le Qiu*[1]*, Douglas Pleskow[1], Ram Chuttani[1], Edward Vitkin[1], Sara Itani[1], Lianyu Guo[1], Jeffrey Goldsmith[1], Mark Modell[1], Irving Itzkan[1], Eugene Hanlon[2], Lev Perelman[1]; [1]Harvard Medical School, USA, [2]US Dept. of Veterans Affairs, USA.* Endoscopic polarized scanning spectroscopic imaging provides real time information about morphology of epithelial tissue in gastrointestinal tract. This technique could lead to *in vivo* detection of invisible dysplasia in Barrett's esophagus.

BMC • Advances in Non-Linear Microscopy

Monday, April 12
10:30 a.m.– 12:30 p.m.
Jerome Mertz; Boston Univ., USA, Presider

BMC1 • 10:30 a.m. **Invited**

Two-Photon Microscopy of Biological Organisms with Shaped Broadband Pulses, ***Guillaume Labroille***[1]*, Rajesh S. Pillai[1], Caroline Boudou[1,2], Nicolas Olivier[1], Xavier Solinas[1], Manuel Joffre[1], Emmanuel Beaurepaire[1]; [1]CNRS, École Polytechnique, France, [2] École Polytechnique, Canada.* We report multiplexed two-photon imaging *in vivo* with fast pixel rates and micrometer resolution. Using coherent control of the two-photon excited fluorescence, we performed selective microscopy of GFP and endogenous fluorescence in developing Drosophila embryos.

BMC2 • 11:00 a.m.

Third Harmonic Generation as a Novel Technique for Imaging Myelin in the Central Nervous System, ***Matthew J. Farrar****, William Renninger, Joseph R. Fetcho, Frank W. Wise, Chris B. Schaffer; Cornell Univ., USA.* We demonstrate that third harmonic generation provides a suitable modality for imaging myelination on axons in the mouse brain and spinal cord with micrometer resolution both *in vivo* and *ex vivo*.

BMC3 • 11:15 a.m.

Fiber-Optic Nonlinear Endomicrocopy for Intrinsic Imaging of Biological Tissues, ***Yicong Wu****, Jiefeng Xi, Xingde Li; Johns Hopkins Univ., USA.* We report on a fiber-optic scanning endomicroscopy system based on a customized double-clad fiber (DCF) and a miniature compound lens that enables two-photon autofluorescence imaging of biological tissues for the first time.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DMB • Fundamental Advances in Holography II—Continued

DMB3 • 11:30 a.m.
Multidimensional Optical Fractionation with Holographic Verification, *Ke Xiao*, *David G. Grier; Ctr. for Soft Matter Res., USA.* Using holographic microscopy to track colloidal particles' trajectories through designed optical trapping arrays and measure their radii and refractive indexes, we demonstrate the optical fractionation with exceptionally fine resolution in either size or refractive index.

DMB4 • 11:45 a.m.
Second-Harmonic Optimization Method of a Hologram, *Youhei Takahashi, Akihiro Takita,* ***Yoshio Hayasaki****; Utsunomiya Univ., Japan.* We propose a new optimization method of a hologram to improve a uniformity of the diffraction peaks in holographic femtosecond laser processing. The hologram is optimized on the basis of a second-harmonic pattern.

DMB5 • 12:00 p.m.
Direct Filtering in Phase Contrast Off-Axis Digital Holography, *Daesuk Kim*; *Chonbuk Natl. Univ., Republic of Korea.* We describe a novel direct filtering method which can provide a much faster solution than the conventional spatial filtering approach while maintaining a moderate reconstructed phase quality.

DMB6• 12:15 p.m.
Speckle-Free Holographic Microscopy, *Paul Petruck*[1], *Rainer Riesenberg[1], Mario Kanka[1], Richard Kowarschik[2]; [1]Inst. of Photonic Technology, Germany, [2]Inst. of Applied Optics, Univ. Jena, Germany.* Holographic micro-imaging setups commonly use high coherent laser light sources, which cause coherent noise. It is shown how a partially coherent illumination suppresses the coherent noise and optimizes the imaging quality.

BMB • Cancer Monitoring and Imaging—Continued

BMB5 • 11:30 a.m.
High-Frequency Ultrasound-Guided Fluorescence Tomography of Protoporphyrin IX in Subcutaneous Tumors, *Josiah D. Gruber*[1], *Akshat Paliwal[2], Hamid Ghadyani[1], Edward Maytin[2,3], Tayyaba Hasan[3], Brian Pogue[1,3]; [1]Thayer School of Engineering, Dartmouth College, USA, [2]Cleveland Clinic Lerner College of Medicine, USA, [3]Wellman Ctr. for Photomedicine, USA.* An automated ultrasound-guided fluorescence tomography system was created to image the Protoporphyrin IX production of subcutaneous tumors *in vivo*. Negative production and positive production tumors were compared to validate the system capability.

BMB6 • 11:45 a.m.
Simultaneous PET and 3-D Fluorescence Optical Tomography for Small Animal Imaging: *In vivo* Results and System Improvements, *Changqing Li*, *Julien Bec, Simon R. Cherry; Biomedical Engineering Dept., Univ. of California Davis, USA.* We have built a simultaneous positron emission tomography and three-dimensional fluorescence optical tomography system for small animal imaging, and performed *in vivo* experiments. System improvements and a new fluorescence scanning method are proposed.

BMB7 • 12:00 p.m.
Automated Confocal Detection of Malignant Melanoma, *Ricky Hennesy[1], Steve Jacques[1], Giovanni Pellacani[2],* ***Daniel S. Gareau*[1]**; *[1]Dept. of Surgery and Biomedical Engineering, Oregon Health and Science Univ., USA, [2]Univ. of Modena and Reggio Emilia, Italy.* Melanoma arises in the basal layer of the skin located within the penetration limits of confocal microscopy. From confocal pathological traits, we created a computer algorithm to render a diagnosis.

BMB8 • 12:15 p.m.
Multispectral Bioluminescence Tomography: Simulations and Phantom Studies with a Priori X-Ray CT Spatial Priors, *Julius Pekar*[1], *Michael S. Patterson[2]; [1]Juravinski Cancer Ctr. and McMaster Univ., Canada,* We describe the development an integrated X-ray CT and bioluminescence tomography imaging system. Reconstructions of optical properties using CT spatial priors are presented with simulated multispectral bioluminescence reconstructions. Experiments to confirm the simulations are underway.

BMC • Advances in Non-Linear Microscopy—Continued

BMC4 • 11:30 a.m.
Spectral Decomposition of Multicolor Imaging in Multifocal Multiphoton Microscopy, *Jae Won Cha*, *Jerry L. Chen, Elly Nedivi, Peter T. C. So; MIT, USA.* For imaging multiple fluorophores, spectral decomposition is often necessary due to the spectral overlap of emission signals. While decomposition techniques have been developed, further improvement in spectral separation may be possible with Poisson noise removal.

BMC5 • 11:45 a.m.
Optical Biomarkers Associated with the Invasive Potential of Tumor Cells in Engineered Tissue Models, *Joanna Xylas*[1], *Addy Alt-Holland[2], Martin Hunter[1], Jonathan M. Levitt[1], Jonathan Garlick[2], Irene Georgakoudi[1]; [1]Biomedical Engineering Dept., Tufts Univ., USA, [2]Div. of Cancer Biology and Tissue Engineering, School of Dental Medicine, Tufts Univ., USA.* Intrinsic two-photon excited fluorescence (TPEF) images of epithelial tumor cells embedded in collagen matrices reveal distinct morphologies and organization from the subcellular to the tissue level associated with motility and invasive potential of cells.

BMC6 • 12:00 p.m.
Femtosecond Laser Ablation to Induce Occlusions in Single, Targeted Venules in Rat Brain, *John Nguyen*[1], *Nozomi Nishimura[1], Costantino Iadecola[2], Chris B. Schaffer[1]; [1]Cornell Univ., USA, [2]Weill Cornell Medical College, USA.* Femtosecond laser induced photodisruption is used to clot single venules in live, anesthetized rats. Two-photon excited fluorescence imaging shows significant decreases in blood flow speeds and increases in diameter in capillaries upstream from the clot.

BMC7 • 12:15 p.m.
Microprisms for *in vivo* Multiphoton Microscopy of Mouse Cortex, *Thomas Chia,* ***Michael J. Levene****; Yale Univ., USA.* Microprisms inserted into the cortex of mouse enable *in vivo* multiphoton microscopy, rotating the field-of-view from parallel to perpendicular to the surface of cortex and allowing imaging of the full cortical thickness.

12:30 p.m.–1:30 p.m. Lunch Break *(on your own)*

JMA • BIOMED/DH Joint Poster Session

Monday, April 12
Richelieu Room
1:30 p.m.–3:30 p.m.

DH Posters

JMA1
Compressive Holographic Microscopy, ***Joonku Hahn***, *Sehoon Lim, Kerkil Choi, Ryoichi Horisaki, Daniel L. Marks, David J. Brady; Dept. of Electrical and Computer Engineering and the Fitzpatrick Inst. for Photonics, USA.* We demonstrate a snapshot 3-D holographic microscopy using decompressive inference to infer a tomographic image from a Gabor hologram and to remove autocorrelation and twin-image terms.

JMA2
Information Compression of Computer-Generated Hologram Using BP Neural Network, ***Guanglin Yang***[1], *Chao Zhang*[1], *Haiyan Xie*[2]; [1]*Peking Univ., China,* [2]*China Science Patent Trademark Agents Ltd., China.* A system is proposed to use BP neural network and Fresnel transform technique for computer-generated hologram compression. In experiments, this scheme is more robust and effective than DCT and DWT compression under low compression ratio.

JMA3
Depth Extraction with Sub-Pixel Resolution in Integral Imaging Based on Genetic Algorithm, ***Indeok Chung***, *Jae-Hyun Jung, Jisoo Hong, Keehoon Hong, Byoungho Lee; Seoul Natl. Univ., Republic of Korea.* We propose a new method of depth extraction in integral imaging with sub-pixel resolution. A genetic algorithm is employed to optimize the depth value through iteration with sub-pixel unit shift.

JMA4
Systematic Analysis of the Validity Regions of Scalar Diffraction Integral and Angular Spectrum Method, ***Aykut Koc***, *Yuzuru Takashima, Lambertus Hesselink; Stanford Univ., USA.* A systematic comparison of the accuracies of scalar diffraction integral and angular spectrum method with respect to FDTD are done. Validity regions of the methods are derived and optimal method for each region is determined.

JMA5
Multidimensional Metrology Based on Multicolor Digital Fresnel Holograph, ***Patrice Tankam***[1], *Pascal Picart*[2,1], *Denis Mounier*[3,2], *Jean Pierre Boileau*[2], *Vincent Tournat*[1,2], *Vitali Goussev*[3]; [1]*LAUM CNRS, Univ. du Maine, France,* [2]*École Natl.e Supérieure d'Ingénieurs du Mans, France,* [3]*LPEC, CNRS, Univ. du Maine, France.* Multidimensional metrology is made possible using multicolor digital holography. Adapted algorithm allows deformation maps to be reconstructed. Examples include bringing out existence of in-plane swirling vibrations in granular material and investigation of electronic component cracking.

JMA6
Improved Reconstruction of Partially Occluded 3-D Objects Using Recursive PCA Algorithm in Computational Integral Imaging, *Choi Nam-Seok*[1], *Shin Dong-Hak*[1], *Byung-Gook Lee*[1], ***Piao Yongri***[2], *Kim Eun-Soo*[2]; [1]*Dept. of Visual Contents, Dongseo Univ., Republic of Korea,* [2]*3DRC, Dept. of Electronics Eng., Kwangwoon Univ., Republic of Korea.* We propose an enhanced 3-D image reconstruction using the recursive PCA algorithm for the partially occluded 3-D object. To show the usefulness of the proposed system, we carry out the computational experiments for face recognition.

JMA7
High-Speed Phase Recovery Using Chromatic Transport of Intensity Computation in Graphics Processing Units, ***Nick Loomis***[1], *Laura Waller*[1], *George Barbastathis*[1,2]; [1]*MIT, USA,* [2]*Singapore-MIT Alliance for Res. and Technology, Singapore.* Quantitative phase measurements are derived from the wavelength-dependent transport of intensity equation. A dispersive optical system is used with a Bayer-filtered detector and graphics processing units to record and calculate the phase in real-time.

JMA8
Publishing Title:
Digital Holographic Microscopy Study of Early Morphological Changes during Apoptosis, ***Alexander Khmaladze***, *Rebecca Matz, Tamir Epstein, Chi Zhang, Mark Banaszak Holl, Raoul Kopelman, Zhan Chen; Univ. of Michigan, USA.* We present a digital holographic study of cellular volume changes during apoptosis. The reconstruction is performed by the angular spectrum method. The phase unwrapping is done in software using our varying reconstruction distance algorithm.

JMA9
Observation of a CdSe/ZnS Quantum Dot-Incorporated PMMA Nanofiber with NSOM, ***Kyoung-Duck Park***, *Ho-Youl Lee, Seung-Yong Kim, Hyun-Shik Lee, Dae-Chan Kim, In-Joo Chin, Beom-Hoan O, Se-Geun Park, El-Hang Lee, Seung Gol Lee; Inha Univ., Republic of Korea.* A CdSe/ZnS quantum dot-incorporated PMMA nanofiber is measured with a collection-mode NSOM having an exceptionally high Q value. Its topography, the propagtion of light, and the light emission from quantum dots are observed and analyzed.

JMA10
Novel Techniques Introduced into Polygon-Based High-Definition CGHs, ***Kyoji Matsushima***[1], *Masaki Nakamura*[1], *Sumio Nakahara*[2]; [1]*Dept. of Electrical and Electronic Engineering, Kansai Univ., Japan,* [2]*Dept. of Mechanical Engineering, Kansai Univ., Japan.* Three techniques, the shifted angular spectrum method, texture mapping, and light shielding by partial field propagation are newly introduced into polygon-based large-scale CGHs. CGHs created by using these techniques are demonstrated.

JMA11
Direct Recording of Phase Plates in Holographic Material with Using of Probabilistic Amplitude Masks, ***Sergiy Mokhov***, *Marc SeGall, Daniel Ott, Vasile Rotar, Julien Lumeau, Boris Zeldovich, Leonid Glebov; CREOL, College of Optics and Photonics, Univ. of Central Florida, USA.* Recording of robust permanent phase plate in photosensitive glass is proposed via contact method with probabilistic computer-generated amplitude mask with varying random binary transmission grid of micron size. Spatial light modulation is a possible application.

JMA12
Holographic Screens in Photo-Thermo-Refractive Glass, ***Vasile Rotar***[1], *Julien Lumeau*[1], *David Roberts*[2], *Leon Glebov*[1]; [1] *CREOL, College of Optics and Photonics, Univ. of Central Florida, USA,* [2]*Georgia Tech Res. Inst., USA.* Holographic screens were recorded in Photo-Thermo-Refractive glass. Those screens were recorded in two beams and reference-free configurations. High efficiency screens were used for imaging, low efficiency for measurement of laser beam parameters.

JMA13
Digital Holographic Method to Characterize Spatial Light Modulator Devices, ***Oscar J. Rincon***[1], *Ricardo Amezquita*[2], *Yaneth M. Torres*[2], *Viviana A. Agudelo*[2], *Omar E. Olarte*[2]; [1]*Univ. Nacional de Colombia, Colombia,* [2]*Combustion Ingenieros Ltda, Colombia.* Digital holography is a frequently used characterization tool. In this article, we propose a holographic method to reconstruct phase and intensity of the optical field modulated by a Spatial Light Modulator using a Michelson interferometer.

JMA14
Sparse Fourier Sampling in Millimeter-Wave Compressive Holography, ***Christy A. Fernandez***[1], *David Brady*[1], *Joseph N. Mait*[2], *David A. Wikner*[2]; [1]*Duke Univ., USA,* [2]*US ARL, USA.* We analyze the impact of sparse sampling on millimeter-wave (MMW) two-dimensional (2-D) holographic measurements for three-dimensional (3-D) object reconstruction. Simulations address 3-D object estimation efficacy. We present 3-D object reconstructions from experimental data.

JMA15
Fast Numerical Wave-Optics Library Using a Graphics Processing Unit: GWO Library, and Its Applications to Holography, ***Tomoyoshi Shimobaba***[1], *Naoki Takada*[2], *Yasuyuki Ichihashi*[1], *Nobuyuki Masuda*[1], *Tomoyoshi Ito*[1]; [1]*Chiba Univ., Japan,* [2]*Shohoku Univ., Japan.* In this paper, we report on a new GWO library running on the NVDIA and AMD graphics processing units, and its performance and applications to holography.

Monday, April 12
Richelieu Room
1:30 p.m.–3:30 p.m.

JMA16

Reconstruction Simulations from Large-Scale and Color Holograms Using a Computer-aided Design Tool for Electroholography, ***Tomoyoshi Shimobaba****, Nobuyuki Masuda, Tomoyoshi Shimobaba; Chiba Univ., Japan*. In this paper, we report on a computer-aided design (CAD) system to optimize the development of an electro-holography system. Our CAD system can evaluate a reconstructed image without having to develop an actual optical system.

JMA17

3-D/2-D Convertible Projection-type Integral Imaging System by use of Half Convex Mirror Array, ***Jisoo Hong***[1]*, Youngmin Kim*[1]*, Soon-gi Park*[2]*, Sung-Wook Min*[2]*, Byoungho Lee*[1]*;* [1]*School of Electrical Engineering, Seoul Natl. Univ., Republic of Korea,* [2]*Dept. of Information Display, Kyunghee Univ., Republic of Korea.* We propose a novel structure that is composed of transparent material with half convex mirror array inside it. With the proposed structure, projection-type integral imaging can provide 3-D/2-D convertible feature.

JMA18

Optical Fibre Characterization through Digital Holographic Microscopy, *Freddy Alberto Monroy Ramírez,* ***Jorge Garcia-Sucerquia****; Univ. Nacional de Colombia, Colombia.* Refractive index and dimensions of a partially stripped optical fibre are measured via digital holographic microscopy-(DHM). These parameters are unscrambled from phase information retrieved by DHM. Results are alike to the specifications from the manufacturer.

JMA19

Binary Depth Detection Based on Cross-Spectral Density, ***Se Baek Oh***[1]*, George Barbastathis*[1,2]*;* [1]*MIT, USA,* [2]*Singapore-MIT Alliance for Res. and Technology (SMART) Ctr., Singapore.* We have developed an optical system for discriminating depth between two uniformly illuminated featureless objects based on cross-spectral density. With volume holograms, we encode the lateral and axial dimensions in wavelength and spatial coherence, respectively.

JMA20

Accurate Lens Lattice Extraction in Distorted Elemental Image Set, ***Keehoon Hong***[1]*, Jae-Hyun Jung*[1]*, Jae-Hyeung Park*[2]*, Byoungho Lee*[1]*;* [1]*Seoul Natl. Univ., Republic of Korea,* [2]*Chungbuk Natl. Univ., Republic of Korea.* We propose an accurate lens lattice extraction in distorted elemental image set. Geometrical distortion in the elemental image set is recovered by using projective information. Experimental results show the lattice structures are extracted accurately.

JMA21

Using Phase Retrieval to Obtain the Complete Spatiotemporal Electric Field of Ultrashort Pulses, ***Pamela R. Bowlan***[1,2]*, Rick Trebino*[1,2]*;* [1]*School of Physics, Georgia Tech, USA,* [2]*Swamp Optics LLC, USA.* Using a phase-retrieval algorithm, we recover the only undetermined quantities—the phase vs. transverse position in spectral-interferometric ultrashort-laser-pulse measurements, to yield complete spatiotemporal measurements of the electric field of focusing ultrashort pulses.

JMA22

Single-Shot Optical-Path-Length-Shifting Color Digital Holography, ***Takashi Kakue***[1]*, Mitsuo Kuwamura*[1]*, Yuki Shimozato*[1]*, Tatsuki Tahara*[1]*, Yasuhiro Awatsuji*[1]*, Shogo Ura*[1]*, Kenzo Nishio*[2]*, Toshihiro Kubota*[3]*, Osamu Matoba*[4]*;* [1]*Graduate School of Science and Technology, Kyoto Inst. of Technology, Japan,* [2]*Advanced Technology Ctr., Kyoto Inst. of Technology, Japan,* [3]*Kubota Holography Lab Corp., Japan,* [4]*Dept. of Computer and Systems Engineering, Kobe Univ., Japan.* We propose an optical-path-length-shifting digital holography with single-shot exposure for capturing three-dimensional images of color object. The proposed technique was numerically simulated and its validity was confirmed by evaluating root mean square errors.

JMA23

Quantitative Analysis by Digital Holography of the Effect of Optical Pressure on a Biological Cell, ***David C. Clark****, Leo Krzewina, Myung K. Kim; Univ. of South Florida, USA.* Digital Holographic Microscopy produces quantitative phase analysis of a specimen with nanometric (sub-wavelength) precision. The deformation caused by optical pressure can be observed and used to calculate physical properties of a biological cell.

JMA24

Single Beam Dynamic Holographic Interferometry, ***Nickolai V. Kukhtarev****, Tatiana Kukhtareva; Alabama A&M Univ., USA*. Single beam dynamic holographic recording is realized in the photorefractive crystals. Different photorefractive mechanisms of holographic recording are discussed. Feasibility of single beam holographic interferometry with opaque (reflective) and transparent objects is demonstrated.

JMA25

Profilometry and Reflectmetry Using Low-Coherent Digital Holography, ***Takanori Nomura****, Kohei Yoshino, Takuhisa Numata, Eiji Nitanai; Wakayama Univ., Japan*. The both profilemotry and reflectmetry of a 3-D object by use of digital holography with low coherent light source is proposed. For noise reduction, integration of digital holograms is introduced.

JMA26

Study of Intracellular Ion Dynamics with a Multimodality Approach Combining Epifluorescence and Digital Holographic Microscopy, ***Nicolas Pavillon***[1]*, Alexander Benke*[1]*, Daniel Boss*[1]*, Corinne Moratal*[1]*, Pascal Jourdain*[1]*, Yves Emery*[2]*, Christian Depeursinge*[1]*, Pierre J. Magistretti*[1]*, Pierre Marquet*[1]*;* [1]*École Polytechnique Fédérale de Lausanne, Switzerland,* [2]*Lyncée Tec SA, Switzerland.* We present combined measurements of quantitative phase through digital holographic microscopy (DHM) and epifluorescence for cells dynamics study. We concentrate our investigation on intracellular ion concentration monitoring with both techniques for comparison.

JMA27

Reliable Data Search in a Holographic Search Engine with Defocused Recording, ***Bhargab Das****, Joby Joseph, Kehar Singh; Indian Inst. of Technology Delhi, India.* The holographic search engine based on defocused recording is investigated under rational conditions. New data page modulation coding schemes are introduced for removing the ambiguous correlation characteristics and performing a reliable data search.

JMA28

Low Complexity Compression of Hologram Sub-Lines, ***Peter Tsang***[1]*, Ting Chung Poon*[2]*, Jung Ping Liu*[3]*, Wai Keung Cheung*[1]*, Wuchao Situ*[1]*;* [1]*City Univ. of Hong Kong, Hong Kong,* [2]*Bradley Dept. of Electrical and Computer Engineering, Virginia Tech, USA,* [3]*Feng Chia Univ., Taiwan.* In this paper we propose a low complexity scheme for compressing hologram sub-lines based on Predictive coding. Our method can attain a compression ratio of 16 times with only slight artifacts on the reconstructed images.

JMA29

Hologram Synthesis from Defocused Images Captured under Incoherent Illumination, ***Jae-Hyeung Park****, Seung-Woo Seo, Ni Chen, Nam Kim; Chungbuk Natl. Univ., Republic of Korea.* An incoherent method to synthesize holography of the three-dimensional objects is proposed. The objects are captured at a fixed camera position with varying focal planes under incoherent illumination and processed to generate its Fourier holography.

JMA30

Burch Computer-Generated Hologram Watermarking Resilient to Strong Cropping Attack, ***Ke Deng****, Guanglin Yang, Chao Zhang; Peking Univ., China.* A watermarking scheme is proposed. A Burch CGH is generated to record the amplitude and phase information of original watermark and embedded into DFT domain of a cover image to effectively resist strong cropping attack.

Monday, April 12
Richelieu Room
1:30 p.m.–3:30 p.m.

JMA31
Modelling High-NA In-Line Holograms, *John F Restrepo,* ***Jorge Garcia-Sucerquia****; Univ. Nacional de Colombia, Colombia.* A diffraction-based approach is presented for modelling high-NA in-line holograms. This approach circumvents the limitations on size and shape of the modelled samples. The computation load is reduced by using Bluestein approach to DFTs.

JMA32
Real Time Digital Holographic Interferometry of Reflective Objects, *Georges Nehmetallah[1],* ***Partha P. Banerjee****[1], Nicolai V. Kukhtarev[2], Sarat C. Praharaj[3]; [1]Univ. of Dayton, USA, [2]Alabama A&M Univ., USA, [3]DMS Technologies Inc., USA.* We illustrate the application of digital holographic interferometry to determine the surface deformation of sample reflective objects. The recording can be performed in real time, limited by the speed of the CCD camera.

JMA33
Diffractive Pulse-Front Tilt for Low-Coherence Digital Holography, ***Raúl Martínez-Cuenca****[1,2], Lluís Martínez-León[1,2], Jesús Lancis[1,2], Gladys Mínguez-Vega[1,2], Omel Mendoza-Yero[1,2], Enrique Tajahuerce[1,2], Pere Clemente[2,3], Pedro Andrés[4]; [1]Univ. Jaume I, Spain, [2]Inst. de Noves Tecnologies de la Imatge, Spain, [3]Servei Central d'Instrumentació Científica, Spain, [4]Univ. de València, Spain.* We use a diffractive lens to generate the proper pulse-front-tilt to record full-field off-axis holograms with a 10fs laser source. We experimentally demonstrate optical sectioning of three-dimensional samples with a resolution of about 5 microns.

JMA34
Accuracy Enhancement of Fringe-Projection Based 3-D Imaging, ***Thang Hoang****, Zhaoyang Wang, Dung Nguyen; Catholic Univ. of America, USA.* In this paper, we present a simple yet robust scheme to enhance the accuracy of fringe-projection-based 3-D imaging. With the proposed scheme, the relative 3-D imaging accuracy can reach 1/20,000.

JMA35
Three-Dimensional Tracking of Optically Trapped Particles by Digital Gabor Holography, *Mariana Potcoava, Leo Krzewina, Jiankun Liu,* ***Myung K. Kim****; Univ. of South Florida, USA.* A new technique for 3-D position detection of optically trapped particle by digital Gabor holography is demonstrated with accuracy of ~100 nm. The particle complex optical field is reconstructed via the angular spectrum method.

JMA36
Comparison of Laplacian Differential Reconstruction of In-Line Holograms Recorded at Two Different Wavelengths and Planes, *James P. Ryle, Dayan Li,* ***John T. Sheridan****; Univ. College Dublin, Ireland.* We record two holograms using two different illuminating wavelengths. Subtracting these holograms, the resulting reconstruction is an approximation to the second order Laplacian differentiation of the object wave.

JMA37
Real-Time Interferometric Microscopy in Liquids, ***Marc Jobin****, Raphael Foschia; Univ. of Applied Sciences, Switzerland.* We have made a Phase Shift Interferometric Optical Microscope operating in liquid and in real time. As a proof of concept, we show the nano-evolution of a surface profile of Cu in sulphuric acid.

JMA38
A Simple, Inexpensive Holographic Microscope, ***Thomas G. Dimiduk****, Ekaterina A. Kosheleva, David Kaz, Ryan McGorty, Emily J. Gardel, Vinothan N. Manoharan; Harvard Univ., USA.* We have built a simple holographic microscope completely out of consumer components. We obtain at least 2.8 μm resolution and depth of field greater than 200 μm from an instrument costing less than $1000.

JMA39
Low-Resolution Motion Analysis in a 3-D Model, ***Diego Pava****, William T. Rhodes; Florida Atlantic Univ., USA.* Motion analysis combined with a 3-D scene model allows the identification as humans of moving objects at extremely low resolution. Basic concepts and results of analyses are presented.

JMA40
Improved Holographic Beam Coupling through Selective Harvesting of Single Domain Ferroelectric Nanoparticles, ***Gary Cook****[1,2], Victor Reshetnyak[3], Arturo Ponce[4], Ron F. Ziolo[4], Sergey A. Basun[1,2], Dean R. Evans[1]; [1]AFRL, USA, [2]Universal Technology Corp., USA, [3]Natl. Taras Shevchenko Univ. of Kyiv, Ukraine, [4]Ctr. de Investigación en Química Aplicada, Mexico.* We describe methods for significantly improving the holographic beam coupling efficiency of liquid crystal based hybrid photorefractive media through the selective harvesting and incorporation of single ferroelectric domain nanoparticles.

BIOMED Posters

JMA41
Imaging of Rapid Flows Using Zero-Crossing DOCT, ***Richard Villey****, Lionel Carrion, Dominic Morneau, Caroline Boudoux, Roman Maciejko; École Polytechnique de Montréal, Canada.* This paper presents a novel Doppler OCT system capable of imaging flow velocities of up to 3.1 m/s in real-time without phase-aliasing artifacts well above current systems limited to a few cm/s.

JMA42
Real-Time Calibration for High-Speed Swept-Source OCT, ***Jiefeng Xi****, Li Huo, Jiasong Li, Xingde Li; Dept. of Biomedical Engineering, Johns Hopkins Univ., USA.* We demonstrated a real-time calibration method for high-speed SS-OCT. An external clock was generated to trigger the high-speed data acquisition system point by point and enable uniform data sampling in frequency domain (K-space).

JMA43
Detecting Hemoglobin Concentration Using the Dual Window Method for Processing Spectroscopic Optical Coherence Tomography Signals, ***Shwetadwip Chowdhury****, Francisco E. Robles, Adam Wax; Duke Univ., USA.* We present a technique utilizing parallel frequency-domain OCT with the dual window method for processing SOCT signals to determine hemoglobin concentration. Preliminary data show our system's ability to quantitatively determine hemoglobin concentration from a phantom.

JMA44
Analysis of Soft-Tissue Contrast in Optical Coherence Tomography Images by Using Box-Counting and Signal Attenuation, ***Dan P. Popescu****[1], Costel Flueraru[2], Michael G. Sowa[1]; [1]Inst. for Biodiagnostics, Natl. Res. Council Canada, Canada, [2]Inst. for Microstructural Sciences, Natl. Res. Council Canada, Canada.* Optical coherence tomography images are analyzed using the attenuation of the OCT signal and its fractal dimensions. Two classes of samples are investigated: Arterial samples from WHHL-MI rabbits and pieces of porcine coronaries.

JMA45
Novel Calibration Method for Swept Source OCT with Improved Resolution and Dynamic Range, *Ehsan Azimi, Bin Liu,* ***Mark E. Brezinski****; Brigham and Women's Hospital, USA.* For a swept source OCT, a real-time calibration process is necessary. Using Genetic Algorithm and precise interpolation, a novel calibration process is developed. When compared with existing approaches, axial resolution and dynamic range are increased.

JMA46
Quantitative Analysis of the Human Cornea Using High-Speed Swept Source OCT, ***Karol M. Karnowski****, Michalina Gora, Bartosz J. Kaluzny, Daniel Ruminski, Slawomir Orlowski, Andrzej Kowalczyk, Maciej Wojtkowski; Nicolaus Copernicus Univ., Poland.* We present applicability of the high speed swept-source optical coherence tomography for quantitative corneal analysis. The detailed analysis of the influence of eye misalignment, optical distortions or raster density on the corneal topography is presented.

JMA47
Quantitative Optical Coherence Tomography Imaging of Cell Death, *Golnaz Farhat*[1,2,3], *Victor X. D. Yang[2,4,5], Michael C. Kolios[1,4], Gregory J. Czarnota[1,2,3,6]; [1]Dept. of Medical Biophysics, Univ. of Toronto, Canada, [2]Imaging Res., Sunnybrook Health Sciences Ctr., Canada, [3]Dept. of Radiation Oncology, Sunnybrook Health Sciences Ctr., Canada, [4]Dept. of Physics, Ryerson Univ., Canada, [5]Ontario Cancer Inst., Canada, [6]Dept. of Radiation Oncology, Univ. of Toronto, Canada.* A quantitative technique measuring OCT backscatter power is used to detect three modes of cell death in acute myeloid leukemia cells. Changes in backscatter are correlated with structural differences observed in histological staining of cells.

JMA48
Comparison of Sensitivity for High Speed Fourier Domain OCT Systems, *Daniel Szlag*, *Maciej Szkulmowski, Andrzej Kowalczyk, Maciej Wojtkowski; Nicolaus Copernicus Univ., Poland.* We discuss an impact of noise sources and technological limitations of swept source OCT and spectral OCT and estimate the optimal conditions of operation for ultrahigh speed OCT imaging.

JMA49
Simultaneous Recovery of Tissue Physiological and Acoustic Properties and Uniqueness in Multi-Spectral Photoacoustic Tomography, *Zhen Yuan*, *Huabei Jiang; Dept. of Biomedical Engineering, Univ. of Florida, USA.* We present an algorithm to directly reconstruct chromophore concentrations and acoustic velocity by multi-spectral photoaocoustic tomography. We derive conditions for the unique and simultaneous recovery of chromophore concentrations and acoustic velocity using multi-spectral photoaocoustic data.

JMA50
Three-Dimensional Quantitative Photoacoustic Tomography of Osteoarthritis: Initial Clinical Results in the Finger Joints, *Yao Sun*, *Eric Sobel, Huabei Jiang; Univ. of Florida, USA.* We report the first application of three-dimensional quantitative photoacoustic tomography for detecting osteoarthritis. Apparent differences, in both the reconstructed size and optical absorption coefficient of the joint cavity, are observed between osteoarthritic and normal joints.

JMA51
Photoacoustic Imaging with a Large, Cylindrical Detector, *Sibylle Gratt*, *Klaus Passler, Robert Nuster, Guenther Paltauf; Inst. of Physics, Karl-Franzens-Univ. Graz, Austria.* This work is engaged in the investigation of a cylindrical shaped piezoelectric detector for photoacoustic imaging. This detector gives a plane detection area. Simulations and experiments with such a detector are shown and discussed.

JMA52
Quantified Reconstruction Methods in Optoacoustic Tomography, *Daniel Razansky*, *Amir Rosenthal, Thomas Jetzfellner, Vasilis Ntziachristos; Technical Univ. of Munich and Helmhotz Ctr. Munich, Germany.* Quantification of optoacoustic images is a long-standing yet important challenge. To improve tomographic reconstruction accuracy under heterogeneous realistic tissues conditions, we suggest and experimentally test correction algorithms based on iterative modeling and sparse image representation.

JMA53
Ophthalmic Photoacoustic Spectroscopy in the Aqueous Humor, *Adi Sheinfeld*[1], *Sharon Gilead[1], Arieh S. Solomon[2], Avishay Eyal[1]; [1]School of Electrical Engineering, Faculty of Engineering, Tel Aviv Univ., Israel, [2]Goldschleger Eye Res. Inst., Tel Aviv Univ., Sheba Medical Ctr., Israel.* The use of photoacoustic spectroscopy for detection of disease related proteins in the aqueous humor is proposed. Experimental results demonstrating detection of absorbing particles in isolated ovine eyes along with eye-safety considerations are presented.

JMA54
A Quantitative Evaluation of High-Density Diffuse Optical Tomography: *In vivo* Resolution and Mapping Performance, *Brian R. White*, *Joseph P. Culver; Washington Univ. in St. Louis, USA.* Despite the unique brain imaging advantages of fNIRS, widespread neuroimaging acceptance has been hampered by low spatial resolution and image localization. We present a quantitative and *in vivo* compari-son of HD-DOT and two fNIRS geometries.

JMA55
Transcranial Time-Resolved Measurements of Fluorescence of an Exogeneous Dye Circulating in Human Brain, *Michal Kacprzak*[1], *Daniel Milej[1], Piotr Sawosz[1], Anna Gerega[1], Adam Liebert[1], Roman Maniewski[1], Joanna Mączewska[2], Katarzyna Fronczewska[2], Leszek Królicki[2], Wojciech Weigl[3], Ewa Mayzner-Zawadzka[3], Tomasz Łazowski[3]; [1]IBIB PAN, Poland, [2]Dept. of Nuclear Medicine, Medical Univ. of Warsaw, Poland, [3]Dept. of Anesthesiology and Intensive Care, Medical Univ. of Warsaw, Poland.* Time-resolved imager was used for monitoring of inflow of exogenous dye into the brain. We observed variation of fluorescence signals caused by changes of dose of the dye and position of optode on the head.

JMA56
Multi-wavelength Time-resolved Detection of Fluorescence of Indocyanine Green Circulating in the Human Head, *Anna Gerega*[1], *Daniel Milej[1], Michal Kacprzak[1], Piotr Sawosz[1], Norbert Zolek[1], Wojciech Weigl[2], Ewa Mayzner-Zawadzka[2], Roman Maniewski[1], Adam Liebert[1]; [1]Inst. of Biocybernetics and Biomedical Engineering, Polish Acad. of Sciences, Poland, [2]Dept. of Anesthesiology and Intensive Care, Medical Univ. of Warsaw, Poland.* Multi-wavelength detection of time-resolved fluorescence signal on the surface of the human head was carried out. Pattern of inflow and washout of indocyanine green in the head after intravenous injection of the dye was analyzed.

JMA57
Application of Correlation Analysis Tools for the Classification of Mental Workloads in Functional Near-infrared Spectroscopy, *Angelo Sassaroli, Feng Zheng, Audrey Girouard, Erin Treacy Solovey, Krysta Chauncey, Leanne H. Hirshfield, Evan Peck, Robert J. K. Jacob, Sergio Fantini; Tufts Univ., USA.* We discuss some ideas for improving the discrimination of mental workloads by using correlation analysis tools and machine learning algorithms that eventually can be used with real time acquisition and processing.

JMA58
A Head Phantom for Use in near Infrared Topography for Brain Function Measurements, *Hirokazu Kakuta*[1], *Hiroshi Kawaguchi[2], Eiji Okada[1]; [1]Keio Univ., Japan, [2]Natl. Inst. of Radiological Sciences, Japan.* A design of a head phantom for near infrared topography is proposed. In the phantom, multiple absorption changes which mimic brain activation can be occurred to evaluate spatial resolution and contrast of near infrared topography.

JMA59
High-Density Optical Mapping of the Human Somatosensory Cortex, *Christoph H. Schmitz*[1,2], *Stefan P. Koch[1], Jan Mehnert[1,3], Susanne Holtze[1], Christina Habermehl[1], Arno Villringer[1,3,4,5], Hellmuth Obrig[1,3,4,5]; [1]Charite, Dept. of Neurology, Germany, [2]NIRx Medizintechnik GmbH, Germany, [3]Max-Planck-Inst. for Cognitive and Brain Sciences, Germany, [4]Univ. Hospital, Day Care Clinic for Cognitive Neurology, Germany, [5]Berlin School of Mind and Brain, Germany.* We use a high-density diffuse-optical sensing array in conjunction with optical tomographic reconstruction to map the moto-somatosensory organisation of the human cortex at high resolution. Optical results are co-registered to individual anatomical brain anatomy.

JMA60

Two Approaches for Using Anatomical Atlas Information for Image Reconstruction in Optical Tomography of Neonates, *Juha K. P. Heiskala*[1], *Marjo Metsäranta[2], P. Ellen Grant[3], Mika Pollari[4], Ilkka T. Nissilä[4]; [1]Dept. of Computer Science, Univ. College London, UK, [2]Dept. of Pediatrics, Helsinki Univ. Central Hospital, Finland, [3]Div. of Newborn Medicine and Dept. of Radiology, Children's Hospital Boston, USA, [4]Dept. of Biomedical Engineering and Computational Science, Helsinki Univ. of Technology, Finland.* Using atlas-based prior anatomical information for image reconstruction in optical tomography of neonates was studied using simulations. Results from two different atlas approaches are compared with results obtained using individual anatomical information and simpler models.

JMA61

NIRS-Specific Adaptation of the General Linear Model for Statistical Mapping of Brain Activity, *Farras Abdelnour, **Theodore J. Huppert**; Univ. of Pittsburgh, USA.* Analysis methods such as Statistical Parametric Mapping were developed for functional MRI and require subtle but important modifications for proper application to optical NIRS data. We describe the NIRS formulation of the general linear model.

JMA62

Application of Subject Specific Models for Mapping Brain Function with Diffuse Optical Tomography, *Yuxuan Zhan*[1], *Hamid Dehghani[1], Brian R. White[2], Joseph P. Culver[2]; [1]School of Computer Science, Univ. of Birmingham, UK, [2]Washington Univ. in St. Louis, USA.* This work demonstrates the benefits of using subject specific models for image reconstruction in neuro-imaging of humans. It also investigates depth related information available from the increased number of tomographic measurements.

JMA63

Combined EEG and Time-Resolved NIRS to Study Neuro-Vascular Coupling in the Adult Brain, *Alexander Jelzow*[1], *Stefan Paul Koch[2], Heidrun Wabnitz[1], Jens Steinbrink[3], Hellmuth Obrig[4], Rainer Macdonald[1]; [1]Physikalisch-Technische Bundesanstalt, Germany, [2]Berlin NeuroImaging Ctr., Charité-Universitätsmedizin Berlin, Germany, [3]Ctr. for Stroke Res., Charité-Universitätsmedizin Berlin, Germany, [4]Dept. of Cognitive Neurology, Max-Planck-Inst. for Human Cognitive and Brain Sciences, Germany.* Concurrent electroencephalography (EEG) and time-resolved near-infrared spectroscopy (trNIRS) was applied non-invasively to healthy adult subjects during motor task and visual stimulation. The temporal relationship between neuronal and vascular responses was investigated.

JMA64

Quantitative Effects of the Sagittal Sinus Vein on Occipital Cortex Measurements in Diffuse Optical Imaging, *Mathieu Dehaes*[1,2,3], *Louis Gagnon[4], Alexandre Vignaud[5], Romain Valabrègue[6], Mélanie Pelegrini-Issac[1], Frédéric Lesage[2,7], Reinhard Grebe[3], Fabrice Wallois[3], Habib Benali[1,2]; [1]Univ Paris 06, France, [2]Univ. de Montréal, Canada, [3]Univ. de Picardie Jules Verne, France, [4]Harvard-MIT Div. of Health Sciences and Technology, MIT, USA, [5]Siemens Healthcare, France, [6]CRICM (CENIR), UPMC, France, [7]École Polytechnique de Montréal, Canada.* We use Monte Carlo simulations to investigate the influence of the sagittal sinus vein on diffuse optical imaging measurements. Effects are characterized by quantitative additional partial volume errors computed with respect to a cerebral activation.

JMA65

Group Analysis for Functional Optical Brain Imaging Using a Random Effects Model, *Farras Abdelnour, **Theodore J. Huppert**; Univ. of Pittsburgh, USA.* To date, group analysis methods in diffuse optical imaging have been largely restricted to analysis of region-of-interest information. We describe a random-effects imaging (inverse) model for calculating group statistics.

JMA66

3-D DOT Brain Imaging: An Anatomical Atlas-Based Method, *Yong Xu*[1,2], *Yaling Pei[2], Randall L. Barbour[1]; [1]SUNY Downstate Medical Ctr., USA, [2]NIRx Medical Technologies LLC, USA.* An anatomical atlas-based method for 3-D DOT brain imaging is presented. Numerical simulations and phantom experiments show that the method is computation-efficient in generation, registration and anatomical labeling of 3-D image findings with high fidelity.

JMA67

Neurovascular Coupling Observed at Upper Alpha and Lower Gamma Bands, *Muge Ozker*[1], *Zubeyir Bayraktaroglu[2], Deniz Nevsehirli[1], Basri Erdogan[2], Itir Kasikci[2], Ahmet Ademoglu[1], Tamer Demiralp[2], Ata Akin[1]; [1]Bogazici Univ., Turkey, [2]İstanbul Univ. Medical Faculty, Turkey.* Steady state human visual evoked potentials that are generated in response to visual stimulation and its corresponding hemodynamic response are investigated for the frontal cortex via electroencephalography (EEG) and functional near infrared spectroscopy (fNIRS).

JMA68

Cellular Diffuse Optical Tomography of Breast Cancer, *Xiaoping Liang*[1], *Qizhi Zhang[1], Stephen R. Grobmyer[2], Huabei Jiang[1]; [1]Dept. of Biomedical Engineering, Univ. of Florida, USA, [2]Dept. of Surgery, Univ. of Florida, USA.* We found that malignant tumor can be separated from benign lesion using cellular diffuse optical tomography since the difference in mean diameter and volume fraction between tumors/lesions and their normal surrounding tissues is significant.

JMA69

DOT Guided Fluorescence Molecular Tomography of Tumor Cell Quantification in Mice, *Yiyong Tan*[1], *Lily Yang[2], Huabei Jiang[1]; [1]J. Crayton Pruitt Family Dept. of Biomedical Engineering, Univ. of Florida, USA, [2]Dept. of Surgery, Emory Univ., USA.* DOT guided fluorescence molecular tomography (FMT) is used to image tumor cells in mouse. FMT reconstruction results with and without DOT guided are presented. Cell quantification and tumor localization are improved with DOT guidance.

JMA70

Monitoring Therapy Response with Fluorescence Imaging, *Ulas Sunar*, *Anurag Gupta, Dan Rohrbach, Weirong Mo, Scott Galas, Murat Turgut, Intae Lee, Ravindra K. Pandey; Roswell Park Cancer Inst., USA.* We quantified fluorescence photobleaching of bifunctional agent (HPPH-CD) during PDT with fluorescence imaging. HPPH-CD exhibit preferential uptake in tumors compared to surrounding normal tissue and longer wavelength emitting CD allowed monitoring photobleaching in deep tumors.

JMA71

Evaluation of Cerebral Energy Demand during Graded Hypercapnia and Validation of Optical Blood Flow Measurements against ASL fMRI, *Stefan Carp*, *Maria A. Franceschini, David A. Boas, Young R. Kim; Massachusetts General Hospital, USA.* We validate optical cerebral blood flow measurements against functional MRI in a rat model during graded hypercapnia. We test the iso-metabolic assumption and demonstrate an apaprent increase in brain metabolism at higher inhaled CO_2 levels.

JMA72

Characterization of Blood Flow, Oxygenation and Metabolism under Hypercapnia in Swine, *Wesley Baker*, *R. C. Mesquita, R. S. Beesam, K. V. Babu, J. H. Greenberg, A. G. Yodh, J. A. Detre, R. Reddy; Univ. of Pennsylvania, USA.* We employed diffuse reflectance and correlation spectroscopies to monitor the response of cerebral oxygenation and blood flow to hypercapnia in swine, and compared the oxygen consumption optically estimated to direct MRI measurements.

JMA73

Microvascular Blood Flow Mapping from Wide-Field Optical Fluctuations Measurements, *Benjamin Samson[1], M. Gross[2], I. Ferezou[3], T. Vitalis[3], A. Rancillac[3], **Michael Atlan**[1]; [1]CNRS, Fondation Pierre-Gilles de Gennes, Inst. Langevin, France, [2]Lab Kastler-Brossel de l'Ecole Normale Superieur, France, [3]ESPCI, Lab de Neurobiologie, France.* We report new results in angiographic mapping of microvessels *in vivo* with a wide field optical detection scheme, enabling blood flow contrast measurements in minimally invasive conditions without exogenous marker.

Monday, April 12
Richelieu Room
1:30 p.m.–3:30 p.m.

JMA74
Dynamic Fluorescence Imaging for the Detection of Vascular Changes in Anti-Angiogenic Drug Therapy, ***Jonghwan Lee***[1], *Thomas Pöschinger[2], Sonia Hernandez[1], Jianzhong Huang[1], Tessa Johung[1], Jessica Kandel[1], Darrell J. Yamashiro[1], Andreas H. Hielscher[1]; [1]Columbia Univ., USA, [2]Friedrich-Alexander-Univ. Erlangen-Nürnberg, Germany.* We show that dynamic fluorescence imaging with indocyanine green can be used to detect changes in the the vasculature of a small-animal Ewing sarcoma model in response to anti-angiogenic drug treatments.

JMA75
Improved Methods for Optical Determination of Uptake of Dye *in vivo* Rabbit Brain and *in vitro* Tissue Phantoms, ***Aysegul Ergin***[1], *Mei Wang[2], Jane Y. Zhang[1], Shailendra Joshi[2], Irving J. Bigio[1]; [1]Boston Univ., USA, [2]Columbia Univ., USA.* Momentary saline flushes help differentiate the optical signals due to contrast agent in vasculature from that in tissue, enabling optical measurement of tissue uptake of dye in an animal model and in dynamic tissue phantoms.

JMA76
A Prototype Mammograph for Simultaneous Acquisition of Tomographic and Time-Resolved Data in Slab Geometry, ***Axel J. Hagen***[1], *Dirk Grosenick[1], Meike Stindt[1], Rainer Erdmann[2], Herbert Rinneberg[1], Rainer Macdonald[1]; [1]Physikalisch-Technische Bundesanstalt, Germany, [2]PicoQuant GmbH, Germany.* We have developed a prototype mammograph for simultaneous acquisition of tomographic and time-resolved data at fluorescence and laser wavelengths in slab geometry. System performance was tested on phantoms and on a volunteer.

JMA77
2-D Spectral Imaging Approach to Optical Mammography for Enhanced Resolution and Quantitative Oximetry, ***Yang Yu***[1], *Ning Liu[2], Angelo Sassaroli[1], Sergio Fantini[1]; [1]Tufts Univ., USA, [2]Univ. of California, Irvine, USA.* We present a spectral imaging system for 2-D breast mapping and quantitative *in vivo* oximetry. It acquires broadband spectra (650-900 nm) with a spectral density of 2 points/nm and a spatial density of 25 pixels/cm^2.

JMA78
Three-Dimensional MR-Guided Optical Spectroscopy of the Breast: Optimizing Probe Placement for Improved Image Quality, ***Michael A. Mastanduno***[1], *Colin M. Carpenter[2], Subhadra Srinivasan[1], Shudong Jiang[1], Brian W. Pogue[1], Keith D. Paulsen[1]; [1]Dartmouth College, USA, [2]Stanford Univ., USA.* MRI-guided near infrared spectroscopy has been implemented with a user-positioned three-dimensional fiber interface, allowing acquisition of multiple planes of data and targeting of suspect regions from within the MR exam.

JMA79
Improvement of NIR Diffuse Optical Tomography in Patients with a Small Amount of Breast Tissue by Using Exogenous Contrast Agents, ***Yasaman Ardeshirpour***, *Nrusingh Biswal, Quing Zhu; Univ. of Connecticut, USA.* In this paper, we have introduced a new method based on absorption contrast agents to reduce the effect of chest-wall on NIR diffuse light measurements in patients with a small amount of breast tissue.

JMA80
Implementation of MR-Guided Multi-Frequency NIR Diffuse Optical Tomography for Breast Imaging, ***Ning Liu***, *David Thayer, Yuting Lin, Min-Ying Su, Werner W. Roeck, Orhan Nalcioglu, Gultekin Gulsen; Univ. of California at Irvine, USA.* We describe the implementation of a multi-modality imaging platform, which integrates a multi-frequency, multi-wavelength optical tomography system with a 3.0 T MRI scanner to obtain the additional diagnostic information of suspicious breast lesions.

JMA81
Multispectral and Phase-Contrast Diffuse Optical Tomography of Breast Cancer During Neoadjuvant Chemotherapy, ***Xiaoping Liang***[1], *Qizhi Zhang[1], Stephen P. Staal[2], Stephen R. Grobmyer[3], Huabei Jiang[1]; [1]J. Crayton Pruitt Family Dept. of Biomedical Engineering, Univ. of Florida, USA, [2]Div. of Hematology and Oncology, Univ. of Florida, USA, [3]Dept. of Surgery, Univ. of Florida, USA.* Multispectral and phase-contrast DOT are used to track treatment progress in a cancer patient. Tumor shrinkage as well as significant changes of optical parameters was observed during the course of neoadjuvant chemotherapy from optical images.

JMA82
Development of a Frequency-Domain Multi-Spectral Breast Diffuse Optical Tomography Instrument, ***Han Y. Ban***[1], *Soren D. Konecky[2], David R. Busch[1], So Hyun Chung[1], Saurav Pathak[1], Regine Choe[1], Arjun G. Yodh[1]; [1]Univ. of Pennsylvania, USA, [2]Beckman Laser Inst. and Medical Clinic, USA.* We describe the current state and development of a 3rd generation Diffuse Optical Tomography breast imaging device. Preliminary data and results will be presented.

JMA83
Enhanced Phase-Contrast Diffuse Optical Tomography for *in vivo* Breast Imaging, ***Ruixin Jiang***[1], *Xiaoping Liang[1], Qizhi Zhang[1], Stephen Stephen Grobmyer[1], Laurie Fajardo[2], Huabei Jiang[1]; [1]Univ. of Florida, USA, [2]Univ. of Iowa, USA.* We present a two-step reconstruction method that can qualitatively and quantitatively improve the reconstruction of tissue RI distribution by PCDOT. The method is validated by phantom experiments and data from 42 human subjects.

JMA84
Multispectral Phase-Contrast Diffuse Optical Tomography for Breast Cancer Imaging, ***Ruixin Jiang***[1], *Xiaoping Liang[1], Qizhi Zhang[1], Stephen Grobmyer[1], Laurie Fajardo[2], Huabei Jiang[1]; [1]Univ. of Florida, USA, [2]Univ. of Iowa, USA.* We present a multispectral phase-contrast diffuse optical tomography method that is able to simultaneously reconstruct tissue refractive index and functional parameters such as hemoglobin concentration and oxygen saturation. We validate the method using numerical simulations.

JMA85
Bedside Monitoring of Cerebral Oxygenation Using DOT, ***Silvina L. Ferradal***[1], *Brian R. White[2], Ronny Dosenbach[2], Joseph P. Culver[2]; [1] Dept. of Biomedical Engineering, Washington Univ. in St. Louis, USA, [2] Dept. of Radiology, Washington Univ. in St. Louis, USA.* We report use of high-density DOT imaging to obtain quantitative maps of OEF measured on the human occipital cortex. Analyses of pulse and respiration waveforms are used to separate arterial and venous weighted tissue compartments.

JMA86
Effects of Transcranial Magnetic Stimulation on Cerebral Hemodynamics Measured by Diffuse Correlation and Optical Spectroscopies, ***Rickson C. Mesquita***[1], *Meeri N. Kim[1], Erin M. Buckley[1], Peter Turkeltaub[2], Amy L. Thomas[2], Olufunsho K. Faseyitan[2], Mari Tobita[3], John A. Detre[2,4], Arjun G. Yodh[1], Roy H. Hamilton[2]; [1]Dept. of Physics and Astronomy, Univ. of Pennsylvania, USA, [2]Dept. of Neurology, Univ. of Pennsylvania, USA, [3]Dept. of Physical Medicine and Rehabilitation, Univ. of Pennsylvania, USA, [4]Dept. of Radiology, Univ. of Pennsylvania, USA.* Diffuse optical and correlation spectroscopies were employed to determine oxygenation and blood flow changes before/during/after 20-minutes of transcranial magnetic stimulation. A localized increase in oxygenation and CBF on the ipsilateral side of stimulation is found.

JMA87
Validating an Anatomical Brain Atlas for Analyzing NIRS Measurements of Brain Activation, ***Matteo Caffini***[1], *Alessandro Torricelli[1], Rinaldo Cubeddu[1], Anna Custo[2], Jay Dubb[3], David A. Boas[3]; [1]Politecnico di Milano, Italy, [2]CEMEX, Switzerland, [3]Athinoula A. Martinos Ctr. for Biomedical Imaging, USA.* We are validating the use of a brain atlas for analyzing NIRS data of brain activation to guide anatomical interpretation of the NIRS results when the subject's true head anatomy is not available.

JMA88

Improvement of NIR Diffuse Optical Tomography in Patients with a Small Amount of Breast Tissue by Using a Two-Layer Finite-Element Model, *Yasaman Ardeshirpour*, *Quing Zhu; Univ. of Connecticut, USA.* In this paper, we have studied the improvement obtained by two-layer finite element based optical tomography in a group of patients who have a small amount of breast tissue.

JMA89

MRI-Guided Fluorescence Molecular Tomography to Image Epidermal Growth Factor Receptor Status in Brain Tumors, *Scott C. Davis*[1], *Kimberley S. Samkoe[1], Julia A. O'hara[1], Keith D. Paulsen[1], Summer L. Gibbs-Strauss[2], Brian W. Pogue[1]; [1]Dartmouth College, USA, [2]Beth Israel Deaconess Medical Ctr., USA.* The diagnostic potential of MRI-coupled fluorescence tomography of epidermal growth factor receptor (EGFR) status in brain cancer was demonstrated. Perfect diagnostic performance was observed between mice inoculated with EGFR(+) or EGFR(-) tumor cells.

JMA90

Portable Optical Tissue Flow Oximeter for Evaluation of Revascularization Effect on Ischemic Muscle Hemodynamics, *Guoqiang Yu*[1], *Yu Shang[1], Youquan Zhao[1,2], Ran Cheng[1], Lixin Dong[1], Irwin Daniel[1], Sibu P. Saha[1]; [1]Univ. of Kentucky, USA, [2]Tianjin Univ., China.* A portable diffuse optical tissue flow-oximeter has been developed for evaluation of revascularization effects on ischemic muscle blood flow and oxygenation. The revascularization repairs of macro-circulation result in acute blood flow improvements in muscle microvasculature.

JMA91

Near-Infrared Functional Brain Imaging of Prefrontal and Motor Regions During a Step-Reaction Stroop Test, *Benjamin T. Schmidt*, *Nancy H. Beluk, Patrick Sparto, Theodore J. Huppert; Univ. of Pittsburgh, USA.* Functional near-infrared spectroscopy was used to examine the interaction between prefrontal and premotor regions to a decision-based stepping task. Subjects were given instructional cues in a congruent and incongruent fashion and responded by stepping.

JMA92

Nitroimidazole-Indocynine Green Conjugates for Breast Cancer Hypoxia Imaging, *Nrusingh C. Biswal*[1], *Christopher Pavlik[2], Michael Smith[2], Liisa T. Kuhn[3], Kevin P. Claffey[4], Quing Zhu[1]; [1]Dept. of Electrical and Computer Engineering, USA, [2]Dept. of Chemistry, Univ. of Connecticut, USA, [3]Dept. of Reconstructive Sciences, Univ. of Connecticut Health Ctr., USA, [4]Dept. of Cell Biology, Univ. of Connecticut Health Ctr., USA.* We present the optical properties of new nucleophilic imidazole compounds synthesized for tumor hypoxia imaging. The photophysical and hypoxic properties of these new molecules are evaluated and targeted for imaging breast cancer hypoxia.

JMA93

Stimulus-Evoked Calcium Transients in Somatosensory Cortex are Inhibited After a Nearby Microhemorrhage, *Flor A. Cianchetti*, *Nozomi Nishimura, Chris B. Schaffer; Cornell Univ., USA.* We use femtosecond laser pulses to hemorrhage brain arterioles and then study changes in cell-resolved calcium transients using two-photon microscopy. We find that microhemorrhages lead to a loss of stimulus-evoked response in nearby neurons.

JMA94

Quantification of Adipocytes Development in a Micro-Fluidic Reactor, Using 2-Photon Fluorescence Microscopy Imaging, *Nikolaos Fourligas*, *Ning Lai, William Rice, Kyongbum Lee, Irene Georgakoudi; Tufts Univ., USA.* Intrinsic fluorescence based redox ratio calculations are used to assess the differentiation of Adipocytes that are grown in an innovative micro-fluidic reactor and they are subject to a gradient of adipogenic hormone cocktail supply.

JMA95

Autofluorescence Imaging of Fallopian Tube Carcinogenesis, *Pierre Lane*[1], *Sylvia F. Lam[1], Jessica McAlpine[2], Blake Gilks[2], Steve Kalloger[1], Dianne Miller[2], David Huntsman[3], Calum MacAulay[1]; [1]British Columbia Cancer Res. Ctr., Canada, [2]Univ. of British Columbia, Canada, [3]British Columbia Cancer Agency, Canada.* The lumen of the human fallopian tube is accessible via endoscopy. We present fluorescence images from freshly resected fallopian tubes with corresponding pathology to support autofluorescence imaging for the early detection of intraepithelial lesions.

JMA96

Novel Clinical Technology for Rapid Detection of Tissue Fluorescence Wavelength-Time Matrices, *William Lloyd*[1], *Ching-Wei Chang[1], Robert Wilson[1], Gregory Gillispie[2], Mary-Ann Mycek[1]; [1]Univ. of Michigan, USA, [2]Fluorescence Innovations, Inc., USA.* Clinically-compatible technology was developed to measure wavelength- and time-resolved fluorescence intensities from biological tissues. Validation studies were conducted on tissue-simulating phantoms and the results were consistent with theoretical predictions with < 4% deviation.

JMA97

Precise Comparisons of 3-D Bronchial OCT Images with Histology, *Zhilin Hu*[1], *Wei Kang[1], Rana Hejal[2], Jeffrey Kern[3], Andrew M. Rollins[1]; [1]Case Western Reserve Univ., USA, [2]Univ. Hospitals of Cleveland, USA, [3]Natl. Jewish Health, USA.* A precise comparison between three dimensional OCT image and the microscope histology image *in vitro* with fixed human tissue results in a better understanding to the diagnosis of the bronchial diseases by the OCT image.

JMA98

Modeling of Zernike Optical Aberrations by MTF and PSF, *Hossein Masalehdan*[1], *Erik Lotfi[2,3], Afshin Lotfi[4], Kazem Jamshidi-Ghaleh[5]; [1]Physics Dept., Smithsonian Inst., Islamic Azad Univ. of Bonab, USA, [2]Optics and Laser Engineering Group of Bonab Univ., USA, [3]Physics-Chemistry Dept., Rice Univ., USA, [4]Tabriz Univ., USA, [5]Physics Dept., Tarbiat Moalem Univ., USA.* There is considerable interest in correcting the higher-order optical aberrations of the human eye, this type of capability could be used to eliminate the higher-order aberrations that have been caused by a prior surgical procedure.

JMA99

Cerebral Blood Flow Imaging during Neurosurgery with Laser Speckle Contrast Imaging, *Ashwin B. Parthasarathy*[1], *Erica L. Weber[1], Lisa M. Richards[1], Mark G. Burnett[2], Douglas J. Fox[2], Andrew K. Dunn[1]; [1]Univ. of Texas at Austin, USA, [2]NeuroTexas Inst., USA.* We present CBF images acquired during neurosurgery in humans, with Laser Speckle Contrast Imaging. Our images were obtained through an existing surgical microscope, adapted to acquire speckle images with minimum disturbance to the surgical procedure.

JMA100

Do Low-Density Cerebral Oximetry Measures Accurately Detect Variability of Cerebral Perfusion during Cardiac Surgery? *Sergio A. Ramirez*[1,2], *LeRone Simpson[1,2], Harry Graber[1], Yong Xu[1], Yaling Pei[2], Douglas Pfeil[1], Vinay Tak[1,3], Joshua Burack[1,2], Wilson Ko[1], Randall L. Barbour[2], Daniel C. Lee[1,3]; [1]SUNY Downstate Medical Ctr., USA, [2]Brooklyn Hospital Ctr., USA, [3]Interfaith Medical Ctr., USA.* Neurocognitive deficits due to inadequate cerebral perfusion are prevalent sequelae of cardiac surgery. FDA approved non-invasive cerebral oximetry devices based on low-density arrays, are unlikely to yield accurate representation of complex heterogeneous cerebral perfusion.

JMA101

A Multichannel Medical Device for Brain Imaging by Time-Domain fNIRS, *Davide Contini*[1], *Lorenzo Spinelli[2], Matteo Caffini[1], Lucia M. G. Zucchelli[1], Alberto Tosi[1], Rinaldo Cubeddu[1], Alessandro Torricelli[1]; [1]Politecnico di Milano, Italy, [2]IFN-CNR, Inst. di Fotonica e Nanotecnologie – Sezione di Milano, Italy*. We developed and characterized on tissue phantoms a multichannel time-domain fNIRS medical device. Preliminary *in vivo* measurements during motor tasks are reported to test the ability of the system to noninvasively measure brain cortex hemodynamics.

Monday, April 12
Richelieu Room
1:30 p.m.–3:30 p.m.

JMA102

Brain Connectivity Study in Verbal Fluency Task Using Near-Infrared Spectroscopy, *Ujwal Chaudhary*[1], *Joseph DeCerce*[1], *Gustavo Rey*[2], *Anuradha Godavarty*[1]; [1]*Florida Intl. Univ., USA,* [2]*Miami Children's Hospital, USA.* Near-infrared optical spectroscopy is employed in the frequency-domain, to map the pre-frontal brain activity in response to cognitive task(s). Brain activation and connectivity studies were performed on 15 normal adults during verbal fluency task.

JMA103

Noninvasive Optical Evaluation of Cerebral Autoregulation in Patients with Obstructive Sleep Apnea, *Ran Cheng*[1], *Yu Shang*[1], *Daniel S. Kameny*[1], *Don Hayes, Jr.*[2], *Guoqiang Yu*[1]; [1]*Ctr. for Biomedical Engineering, Univ. of Kentucky, USA,* [2]*College of Medicine, Univ. of Kentucky, USA.* A diffuse correlation spectroscopy and a frequency-domain tissue oximeter were combined to evaluate cerebral autoregulation in patients with obstructive sleep apnea. Differences in cerebral hemodynamics were found between the patients and healthy controls.

JMA104

Monte Carlo Simulation of Spatially Resolved Stead-State Diffuse Reflectance in Intralumenal Geometry, *Marc E. Vallee*, *Thomas J. Farrell, Michael S. Patterson; McMaster Univ., Canada.* Monte Carlo simulations were used to investigate steady-state diffuse reflectance from tissue in an intralumenal geometry. Results were compared to Monte Carlo data for semi-infinite geometries. A significant divergence from flat geometry reflectance was found.

JMA105

Thermo/pH-Responsive and Reversible NIR Fluorescent Probes for Optical Molecular Imaging, *Yongping Chen*, *Xingde Li; Johns Hopkins Univ., USA.* We developed near-infrared fluorescent probes responsive to local temperature and pH change/modulation. The probes are based on cross-linked pluronic/PEI nanocapsules loaded with ICG which can be used for DNA or siRNA delivery and imaging.

JMA106

Exploratory Study on Laser Induced Hyperthermia Effected by Local Delivery of Gold Nanoshells in Laboratory and Animal Tissue Phantoms, *Yajuvendra Rathore, Nimit L. Patel, Hanli Liu, **Alexandrakis George**; Univ. of Texas at Arlington, USA.* We have explored the possibility of using locally delivered gold nanoshells as a means for effecting locally confined thermal ablation treatments. Feasibility of the proposed method has been tested through laboratory and animal tissue phantoms.

JMA107

Folate Receptor Targeting Probes for Two-Photon Fluorescence Bioimaging, *Alma R. Morales, **Xuhua Wang**, Kevin D. Belfield; Univ. of Central Florida, USA.* Two approaches to design folic acid conjugates for specific intracellular uptake against folate receptor-over expressing cancer cells are reported along with two-photon fluorescence microscopy imaging of HeLa cells demonstrated their uptake and folate receptor binding.

NOTES

Napoleon I
Digital Holography and Three-Dimensional Imaging (DH)

DMC • Metrology by Digital Holography and Profilometry

Monday, April 12
4:00 p.m.– 6:00 p.m.
Myung K. Kim; Univ. of South Florida, USA, Presider
John Sheridan; Univ. College Dublin, Ireland, Presider

DMC1 • 4:00 p.m.
Enhanced Optical Depth Converter Based on Integral Imaging, ***Youngmin Kim***[1], *Keehoon Hong*[1], *Jae-Hyun Jung*[1], *Jisoo Hong*[1], *Yunwon Lee*[1], *Sung-Wook Min*[2], *Byoungho Lee*[1]; [1]*School of Electrical Engineering, Seoul Natl. Univ., Republic of Korea,* [2]*Dept. of Information Display, Kyung Hee Univ., Seoul, Republic of Korea.* Improved optical depth converter by using a pair of curved lens array and convex mirror array is proposed. The proposed system is capable of orthoscopic/pseudoscopic image conversion with enhanced optical power efficiency.

DMC2 • 4:15 p.m.
Digital Holographic Interferometry of Translucent Objects, *Georges Nehmetallah*[1], ***Partha P. Banerjee***[1], *Nicolai V. Kukhtarev*[2], *Sarat C. Praharaj*[3]; [1]*Univ. of Dayton, USA,* [2]*Alabama A&M Univ., USA,* [3]*DMS Technologies Inc., USA.*We use a variation of digital holographic interferometry, viz., an inverse reconstruction method, to determine the 3-D shape and deformation of translucent objects such as water droplets.

DMC3 • 4:30 p.m.
Pattern Matching Estimator for Precise 3-D Particle Localization with Engineered Point Spread Functions, ***Sean Quirin***[1], *Sri Rama Prasanna Pavani*[2], *Rafael Piestun*[1]; [1]*Univ. of Colorado at Boulder, USA,* [2]*Caltech, USA.* We present a 3-D particle localization estimator that uses phase retrieval to interpolate the calibration images of the point-spread-function and finds the best fit to the measured data. We analyze the application to double-helix microscopy.

Napoleon II
Biomedical Optics (BIOMED)

BMD • Novel Approaches in Microscopy

Monday, April 12
4:00 p.m.– 6:15 p.m.
Caroline Boudoux; Ecole Polytechnique Montréal, Canada., Presider
Alexander Egner; Max Planck Inst. for Biophysical Chemistry, Germany, Presider

BMD1 • 4:00 p.m. **Invited**
Developments in Fluorescence Nanoscopy, ***Alexander Egner***; *Max-Planck-Inst. for Biophysical Chemistry, Germany*. The resolution of conventional light microscopy is limited by diffraction. The principles of common methods to overcome the diffraction barrier and examples about their implementation and operation will be presented.

BMD2 • 4:30 p.m.
Polarization Sensitive Three-Dimensional Nanoscopy with a Double-Helix Microscope, ***Sri Rama Prasanna Pavani***[1,2], *Jennifer G. DeLuca*[3], *Rafael Piestun*[2]; [1]*Caltech, USA,* [2]*Univ. of Colorado, USA,* [3]*Colorado State Univ., USA.* We demonstrate polarization sensitive detection with 3-D super-localization of single-molecules and unveil 3-D polarization specific characteristics of single-molecules within the intracellular structure of PtK1 cells expressing photoactivatable green fluorescent protein.

Napoleon III
Biomedical Optics (BIOMED)

BME • Imaging and Spectroscopy Theory

Monday, April 12
4:00 p.m.– 6:00 p.m.
Hamid Dehghani; School of Computer Science, UK, Presider
Amir H. Gandjbakhche; Natl. Inst. of Health, USA, Presider

BME1 • 4:00 p.m.
Light Propagation in Biological Media by Time-Domain Parabolic SP_N Equations with Ray Divergence Effects, *Jorge Bouza Dominguez,* ***Yves Berube-Lauziere***; *Univ. de Sherbrooke, Canada.* We present a novel time-dependent low-transport approximation to the radiative transfer equation. For several values of the optical parameters we compare its numerical solution with analogous calculations for the diffusion equation and Monte Carlo simulations.

BME2 • 4:15 p.m.
Rapid Spectral Analysis for Spectral Imaging, ***Steven L. Jacques***; *Oregon Health and Science Univ., USA.* A rapid algorithm has been developed that uses matrix inversion to solve for the absorption spectra of a tissue using a lookup table for photon path length based on numerical simulations.

BME3 • 4:30 p.m.
An Empirical Method for Measuring Optical Properties with Structured Illumination beyond the Diffusion Regime, ***Timothy A. Erickson***, *James W. Tunnell; Univ. of Texas at Austin, USA.* Sinusoidally-structured illumination is used in concert with a phantom-based lookup-table (LUT) to map wide-field optical properties in turbid media with reduced albedos as low as 0.44. The LUT uses a single calibration standard.

Napoleon I
Digital Holography and Three-Dimensional Imaging (DH)

DMC • Metrology by Digital Holography and Profilometry—Continued

DMC4 • 4:45 p.m.
Digital Holography Applied to Quantitative Measurement of Oil-Drop in Oil-Water Two-Phase Flows, *Lei Tian*, *George Barbastathis; MIT, USA.* We present a digital holography system applied to quantitative measurement of oil-drops in oil-water two-phase flows. Statistical analysis on measured size distributions shows that the distribution follows a lognormal distribution.

DMC5 • 5:00 p.m.
Depth Resolution of Phase Gradients Using Pulsed Digital Holography, *Mikael Sjödahl*, *Erik Olsson, Eynas Amer, Per Gren; Luleå Univ. of Technology, Sweden.* A technique to gain depth information from a single pair image-plane Digital Holographic recording of a transient phase object positioned between a diffuser and an imaging system has been demonstrated.

DMC6 • 5:15 p.m.
Surface Shape Measurement of a Concave Mirror by Doppler Phase-Shifting Digital Holography, *Daisuke Barada*, *Yuichi Kikuchi, Shigeo Kawata, Toyohiko Yatagai; Utsunomiya Univ., Japan.* The surface shape of a concave mirror was measured by Doppler phase-shifting digital holography. The surface shape measurement was performed in an environment with external disturbances in order to confirm the robustness of the system

Napoleon II
Biomedical Optics (BIOMED)

BMD • Novel Approaches in Microscopy—Continued

BMD3 • 4:45 p.m.
***In vivo* Fluorescence Cellular Imaging by Side-View Endomicroscopy, *Pilhan Kim*[1,2],** *Euiheon Chung[1,2], Hiroshi Yamashita[1,2], Kenneth E. Hung[3], Atsushi Mizoguchi[1,2], Raju Kucherlapati[1,4], Dai Fukumura[1,2], Rakesh K. Jain[1,2], Seok H. Yun[1,2,5,6]; [1]Harvard Medical School, USA, [2]Massachusetts General Hospital, USA, [3]Tufts Medical Ctr., USA, [4]Brigham and Women's Hospital, USA, [5]KAIST, Republic of Korea, [6]Harvard-MIT Health Sciences and Technology, USA.* We describe a rotational side-view endomicroscope for imaging gastrointestinal tracts in mice with single cell resolution. We demonstrate non-invasive comprehensive visualization of fluorescently labeled cells and microvasculature *in vivo.*

BMD4 • 5:00 p.m.
Topography and Refractometry of Biological Nanostructures Using Spatial Light Interference Microscopy (SLIM), *Zhuo Wang*, *Gabriel Popescu; Univ. of Illinois at Urbana-Champaign, USA.* We demonstrate Spatial Light Interference Microscopy's (SLIM's) ability to perform topography at a single atomic layer in graphene, refractometry of neurites of a live hippocampal neuron in culture and dynamic imaging of glial membranes.

BMD5 • 5:15 p.m.
A Hybrid Strategy for the Detection of Cell Membrane Potential Using Electromotility, *Zahid Yaqoob*[1], *Toyohiko Yamauchi[2], Seungeun Oh[1], Wonshik Choi[3], Ramachandra R. Dasari[1], Micahel S. Feld[1]; [1]MIT, USA, [2]Hamamatsu Photonics, K. K., Japan, [3]Korea Univ., Republic of Korea.* Cell membrane electromotility, which is nanometer-scale membrane motion driven by changes in membrane potential, is measured using a hybrid quantitative phase microscopy scheme with features such as high detection sensitivity and multi-point measurement capability.

Napoleon III
Biomedical Optics (BIOMED)

BME • Imaging and Spectroscopy Theory—Continued

BME4 • 4:45 p.m.
Multi-Layered Models for Prediction of Diffuse Reflectance Spectra of Skin and Lip, *Shoji Takano*, *Wakana Fujita, Eiji Okada; Keio Univ., Japan.* The multi-layered realistic models are designed to simulate the difference in diffuse reflectance spectra between skin and lip. The predicted reflectance spectra are compared with experimental results of five volunteers to evaluate the models.

BME5 • 5:00 p.m.
GPU Accelerated Monte Carlo Simulation for 3-D Photon Migration, *Qianqian Fang*, *David A. Boas; Massachusetts General Hospital, USA.* We report a massively parallel Monte Carlo algorithm that can be run on Graphics Processing Units (GPU). Using a low-cost graphics card, it is over 300x faster than the traditional CPU-based simulations.

BME6 • 5:15 p.m.
Reconstruction-Free Imaging of Kaposi's Sarcoma Using Multi-Spectral Data, *Jana M. Kainerstorfer*[1], *Franck Amyot[2], Moinuddin Hassan[1], Martin Ehler[3], Robert Yarchoan[4], Kathleen M. Wyvill[4], Thomas Uldrick[4], Victor Chernomordik[1], Christoph K. Hitzenberger[5], Amir H. Gandjbakhche[1], Jason D. Riley[1]; [1]Natl. Inst. of Health, Eunice Kennedy Shriver Natl. Inst. of Child Health and Human Development, PPB/LIMB/SAFB, USA, [2]Natl. Inst. of Health, Natl. Inst. of Neurological Disorders and Stroke, Clinical Neuroscience Program, USA, [3]Natl. Inst. of Health, Eunice Kennedy Shriver Natl. Inst. of Child Health and Human Development, PPB/LIMB/SMB, USA, [4]HIV and AIDS Malignancy Branch, Ctr. for Cancer Res., Natl. Cancer Inst., Natl. Inst. of Health, USA, [5]Medical Univ. of Vienna, Ctr. for Biomedical Engineering and Physics, Austria.* Multi-spectral imaging was used for Kaposi's sarcoma lesion follow-up. Reconstruction of blood volume and oxygenation as well as Principal Component Analysis was performed and we demonstrate the relationship between the first principal component and blood.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DMC • Metrology by Digital Holography and Profilometry—Continued

DMC7 • 5:30 p.m.
Broadband 3-D Digital Holography for Depth Structure Visualization, *Dmitry V. Shabanov*, *Grigory V. Gelikonov, Valentin M. Gelikonov; Russain Acad. of Sciences, Russian Federation*. Acquiring 3-D OCT images of strongly scattering media internal structure with units of microns resolution by means of 2-D holographic recording at scattered light interference reception at tens nanometers wavelengths range using digital image reconstruction.

DMC8 • 5:45 p.m.
Wake Flows Analysis by Digital Color Holographic Interferometry, *Jean-Michel Desse*[1], *Pascal Picart[2,3], Patrice Tankam[2]; [1]Office Natl. d'Etudes et de Recherches Aérospatiales, France, [2]Lab d'Acoustique de l'Univ. du Maine, France, [3]Ecole Natl. Supérieure d'Ingénieurs du Mans, Univ. du Maine, France.* Digital 3λ holographic interferometry is shown for analyzing the variations in the refractive index induced by the wakeflow around a circular cylinder.

BMD • Novel Approaches in Microscopy—Continued

BMD6 • 5:30 p.m.
Logarithmic Output Active Illumination Microscopy, *Kengyeh K. Chu, Daryl Lim, **Jerome Mertz**; Boston Univ., USA.* We present an improved technique to enhance the dynamic range of multiphoton microscopy using real time feedback to control illumination power. Our system provides simultaneous improvement in weak-signal sensitivity and immunity to strong-signal saturation.

BMD7 • 5:45 p.m.
Comparison of Fluorescence Lifetime Correlation Spectroscopy and Background Corrected Fluorescence Correlation Spectroscopy, *Steffen Ruettinger*[1], *Peter Kapusta[2], Matthias Patting[2], Michael Wahl[2], Rainer Macdonald[1]; [1]Physikalisch-Technische Bundesanstalt, Germany, [2]PicoQuant GmbH, Germany*. Practical limits of Fluorescence-Lifetime Correlation Spectroscopy (FLCS) were explored. It shown that FLCS yields correct concentration values down to the picomolar range and that different signal components can be separated in a single detector setup.

BMD8 • 6:00 p.m.
Snapshot Image Mapping Spectrometer (IMS) for Hyperspectral Fluorescence Microscopy, *Liang Gao, Robert T. Kester, **Tomasz S. Tkaczyk**; Rice Univ., USA.* Principle and prototype of high sampling (285x285x60 data cubes) Snapshot Image Mapping Spectrometer for Fluorescence Microscopy is presented. Preliminary imaging results of cell samples stained with multiple dyes are demonstrated and discussed.

BME • Imaging and Spectroscopy Theory—Continued

BME7 • 5:30 p.m.
Frequency-Domain Diffuse Optical Tomography Implemented with Edge-Preserving Regularization, *Liang-Yu Chen*[1], *Min-Cheng Pan[2], Min-Chun Pan[1]; [1]Natl. Central Univ., Taiwan, [2]Tung-Nan Univ. of Technology, Taiwan.* To overcome the unwanted edge smoothing occurred in DOT, the use of edge-preserving regularization as a priori information in the reconstruction procedure is presented and verified by a variety of test cases in frequency domain.

BME8 • 5:45 p.m.
User-Friendly Monte Carlo Code for Time-Resolved Fluorescence Models of Tissues with Irregular Interfaces, *Robert H. Wilson*, *Viola Schweller, Mary-Ann Mycek; Univ. of Michigan, USA.* Monte Carlo (MC) simulations can model photon propagation in biological tissues, but often neglect effects from irregular boundaries. We developed a time-resolved MC-algorithm in MATLAB with arbitrarily-shaped surface mesh interfaces for quantitative fluorescence lifetime sensing.

Conference Reception, *Le Jardin*

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

7:30 a.m.–6:00 p.m. Registration Open, *Napoleon Lobby*

10:00 a.m.–4:00 p.m. Exhibit Open, *Richelieu Room*

DTuA • Holographic Microscopy

Tuesday, April 13
8:00 a.m.– 10:00 a.m.
David Brady; Duke Univ., USA, Presider

DTuA1 • 8:00 a.m. **Invited**

Digital In-Line Holographic Microscopy in 4-D, *S. K. Jericho, M. H. Jericho,* ***Jurgen Kreuzer****; Dalhousie Univ., Canada.* Digital in-line Holography with spherical waves has been developed into a new microscopy for microfluidic, biological and marine applications, that routinely achieves both lateral and depth resolution at the submicron level in 4-D imaging.

DTuA2 • 8:30 a.m. **Invited**

Benefits of Spatial Partial Coherence for Applications in Digital Holographic Microscopy, ***Frank Dubois,*** *Catherine Yourassowsky, Chrsitophe Minetti, Patrick Queeckers; Universté Libre de Bruxelles, Belgium.* We investigate the use of partially spatial coherent illuminations for digital holographic microscopes (DHM) working in transmission. The major advantage is reduction of the speckle noise making it possible high image quality for biomedical applications.

DTuA3 • 9:00 a.m.

Quantitative Study of Cellular Dynamic Response to Femtosecond Laser Photoporation Using Digital Holographic Microscopy, ***Maciej Antkowiak****, David J. Stevenson, Frank J. Gunn-Moore, Kishan Dholakia; Univ. of St Andrews, UK.* Digital Holographic Microscopy is used to study dynamic responses of living cells to femtosecond laser membrane photoporation. The results give new insight into the efficiency and toxicity of this novel optical method of drug delivery.

DTuA4 • 9:15 a.m.

Quantitative Characterization of Cellular Adhesions with Total Internal Reflection Holographic Microscopy, ***William M. Ash III****, David Clark, Chun Min Lo, Myung K. Kim; Univ. of South Florida, USA.* Total Internal Reflection Holographic Microscopy (TIRHM) uses near-field phase shifts to quantitatively image cellular adhesions. Cell-substrate interfaces cause relative index of refraction and frustrated TIR to modulate the specimen's phase profile. Dictyostelium Discoideum imagery presented.

Opening Remarks 7:50 a.m.–8:00 a.m.

BTuA • BIOMED Tuesday Plenary

Tuesday, April 13
8:00 a.m.– 10:00 a.m.
Vasilis Ntziachristos; Technische, Univ. Munchen, Germany. Presider
Lihong V. Wang; Texas A&M Univ., USA, Presider

BTuA1 • 8:00 a.m. **Keynote**

Breeding and Building Molecules to Spy on Cells and Tumors, ***Roger Tsien****; Univ. of California at San Diego, USA.* New flavoproteins photogenerate singlet oxygen, enabling genetically encoded correlative light and electron microscopy. Synthetic peptides provide an amplifying mechanism for targeting fluorophores, MRI contrast agents, and drugs to sites of protease activity (e.g. tumors) *in vivo.*

BTuA2 • 9:00 a.m. **Plenary**

Clinical Translation of Optical Imaging: Global Prospects to Improve Early Cancer Detection, ***Rebecca Richards-Kortum****; Rice Univ., USA.* Multi-modal optical-imaging has potential to improve early detection of cancer in underserved populations. This talk will present a vision to expand the role of optical-imaging in global cancer management, highlighting recent widefield and high-resolution imaging-technologies.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DTuA • Holographic Microscopy—Continued

DTuA5 • 9:30 a.m.
Real Time 3-D Cytomorphological Imaging Using Digital Holographic Microscopy and Fluorescence Microscopy for Space Biology, ***M. Fatih Toy***[1], *Jonas Kühn*[1], *Jérôme Parent*[1], *Christophe Pache*[1,2], *Marcel Egli*[2], *Christian Depeursinge*[1]; [1]*Advanced Photonics Lab, École Polytechnique Fédérale de Lausanne, Switzerland*, [2]*Eidgenössische Technische Hochschule Zurich, Space Biology Group, Switzerland*. A microscope operating in Digital Holographic Microscopy (DHM) and classical widefield epi-fluorescence microscopy in a time sequential manner is developed to study morphological alterations of mouse myoblast cells under simulated microgravity in real time.

DTuA6 • 9:45 a.m.
Wide Range Coherence Digital Holographic Microscope, *Radim Chmelik*[1], *Hana Uhlirova*[1], *Pavel Kolman*[1], *Pavel Vesely*[2]; [1]*Inst. of Physical Engineering, Faculty of Mechanical Engineering, Brno Univ. of Technology, Czech Republic*, [2]*Inst. of Molecular Genetics, Acad. of Sciences of the Czech Republic, Czech Republic*. Off-axis achromatic DHM. Light sources from partially-coherent to completely spatially and temporally incoherent. High-quality (speckle-free) imaging, optical sectioning by coherence gating, half lateral resolution limit for incoherent compared to coherent illumination; quantitative phase contrast, numerical 3-D reconstruction.

10:00 a.m.–10:30 a.m. Coffee Break/Exhibits, *Richelieu Room*

NOTES

Napoleon I
Digital Holography and Three-Dimensional Imaging (DH)

DTuB • Diffractive Optics and Imaging
Tuesday, April 13
10:30 a.m.–12:30 p.m.
Cory Christenson; Univ. of Arizona, USA, Presider

DTuB1 • 10:30 a.m.
Volume Diffractive Optics, *Tim D. Gerke,* ***Rafael Piestun****; Dept. of Electrical Engineering, Univ. of Colorado at Boulder, USA*. A new type of volume diffractive optical element is computer designed and experimentally fabricated. The volume elements are designed to perform diffractive functions including pattern generation and multiplexing.

DTuB2 • 10:45 a.m.
Resolution-Enhanced Curving-Effective Integral Imaging System for far 3-D Objects Using Direct Pixel Mapping, ***Zhang Miao*****,** ***Piao Yongri****, Kim Eun-Soo; 3DRC, Dept. Electronics Eng., Kwangwoon Univ., Republic of Korea.* We propose a resolution-enhanced method for far 3-D objects in the curving-effective integral imaging system using direct pixel mapping. Experimental results can prove the feasibility of the proposed method.

DTuB3 • 11:00 a.m.
Enhancement of Pinhole Type Integral Imaging System Using Color Filters of Liquid Crystal Display Panel, ***Jae-Hyun Jung****, Younghoon Kim, Yunwon Lee, Byoungho Lee; School of Electrical Engineering, Seoul Natl. Univ., Republic of Korea.* In pinhole type integral imaging, the viewing angle and resolution are limited by pinhole interval. For enhancement of viewing angle and resolution, we propose the pinhole type integral imaging using color filters of LCD panel.

Napoleon II
Biomedical Optics (BIOMED)

BTuB • Brain Monitoring and Imaging I
Tuesday, April 13
10:30 a.m.–12:30 p.m.
Turgut Durduran; ICFO-The Inst. of Photonic Sciences, Spain, Presider

BTuB1 • 10:30 a.m. Invited
Functional Connectivity DOT: Development and Clinical Implications in Infants, *Brian R. White, Steve M. Liao, Silvina L. Ferradal, Terrie E. Inder,* ***Joseph P. Culver****; Washington Univ. in St. Louis, USA*. Resting-state functional connectivity is a powerful tool for assessing brain networks in the absence of cognitive asks (ideal for clinical and infant populations). We demonstrate fc-DOT and use it to assess infants.

BTuB2 • 11:00 a.m.
Concurrent MRI and Diffuse Correlation and Near-Infrared Spectroscopic Measurement of Cerebral Hemodynamic Response to Hypercapnia and Hyperoxia, ***Turgut Durduran***[1,2,3]*, David L. Minkoff*[3]*, Meeri N. Kim*[3]*, Dalton Hance*[3]*, Erin M. Buckley*[3]*, Mari Tobita*[4]*, Jiongjiong Wang*[2]*, Joel H. Greenberg*[4]*, John A. Detre*[2,4]*, Arjun G. Yodh*[3]*;* [1]*ICFO, Inst. of Photonic Sciences ,Spain,* [2]*Dept. of Radiology , Univ. of Pennsylvania, USA,* [3]*Dept. of Physics and Astronomy, Univ. of Pennsylvania, USA,* [4]*Dept. of Neurology, Univ. of Pennsylvania, USA*. We study effects of hypercapnia and hyperoxia in cerebral hemodynamics of adults using concurrent ASL/BOLD-MRI, diffuse-correlation-(DCS) and near-infrared-spectroscopies (NIRS). We validate ASL vs DCS, compare BOLD to NIRS and compare estimates of CMRO$_2$ by two methods.

Napoleon III
Biomedical Optics (BIOMED)

BTuC • Nanomaterials and Molecular Probes
Tuesday, April 13
10:30 a.m.–12:30 p.m.
Eva M, Sevick-Muraca; Univ. of Texas, USA, Presider

BTuC1 • 10:30 a.m.
Development of Novel Fluorescence Probes Based on Rational Design Strategies: Real-Time Visualization of Various Cellular Responses and *in vivo* Tumor Imaging, ***Yasuteru Urano****; Graduate School of Pharmaceutical Sciences, Univ. of Tokyo, Japan*. We have succeeded in selective cancer imaging based on highly activatable strategies with using precisely designed novel fluorescence probes.

BTuC2 • 10:45 a.m.
VEGFR-2 Selective Two-Photon Absorbing (2PA) Bioconjugate, ***Carolina D. Andrade****, Ciceron O. Yanez, Hyo-Yang Ahn, Kevin D. Belfield; Univ. of Central Florida, USA*. We present a new 2PA fluorescent bioconjugate with good nonlinear optical properties that selectively binds the vascular endothelial growth factor receptor 2 (VEGFR-2) in porcine aortic endothelial cells that express this receptor (PAE-KDR).

BTuC3 • 11:00 a.m.
Application of NIR Fluorescence Optical Imaging for Quantification of HER2 Receptors Expression *in vivo*, ***Victor V. Chernomordik***[1]*, Moinuddin Hassan*[1]*, Rafal Zielinski*[2]*, Jacek Capala*[2]*, Amir Gandjbakhche*[1,2]*;* [1]*Natl. Inst. of Child Health and Human Development, USA,* [2]*Radiation Oncology Branch, Natl. Cancer Inst., USA*. A novel method to characterize HER2 expression in breast carcinomas *in vivo* is proposed. Analysis of variations in fluorescent intensity at the tumor site (mouse model) after injection of HER2-specific fluorescent probes substantiates our approach.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DTuB • Diffractive Optics and Imaging—Continued

DTuB4 • 11:15 a.m.
Reconfigurable Shack-Hartmann Sensor without Moving Elements, *Raúl Martínez-Cuenca*[1,2], *Vicente Durán[1,2], Vicent Climent[1,2], Enrique Tajahuerce[1,2], Salvador Bará[3], Jorge Ares[4], Justo Arines[4], Manuel Martínez-Corral[5], Jesús Lancis[1,2]; [1]Univ. Jaume I, Spain, [2]Inst. de Noves Tecnologies de la Imatge, Spain, [3]Univ. de Santiago, Spain, [4]Univ. de Zaragoza, Spain, [5]Univ. de València, Spain*. We demonstrate wavefront sampling with variable measurement sensitivity and dynamic range by means of a programmable microlens array implemented onto a liquid-crystal spatial light modulator and a liquid lens with electronically tunable optical power.

DTuB5 • 11:30 a.m.
Polarization-Sensitive Diffractive Optical Elements, *Daisuke Barada*[1], *Hiroyuki Kurosawa[1], Takashi Fukuda[2], Shigeo Kawata[1], Toyohiko Yatagai[1]; [1]Utsunomiya Univ., Japan, [2]AIST, Japan.* Polarization gratings were formed on a write-once type polarization-sensitive medium and their polarization characteristics were evaluated. A circularly polarized beam splitting function was observed in an orthogonally circular polarization grating.

DTuB6 • 11:45 a.m.
Color-Coded Volume Holographic Filters for Spatial-Spectral Imaging Systems, *Yuan Luo*, *Se Baek Oh, George Barbastathis; MIT, USA*. We present the design and performance characterization of color-coded multiplexed holographic filters. Image data demonstrate the filters' ability to obtain information from multiple depths using illumination by multiple broadband LEDs.

BTuB • Brain Monitoring and Imaging I—Continued

BTuB3 • 11:15 a.m.
Cortical and Superficial Responses to Motor Activation Retrieved by Time-Domain Optical Brain Imaging, *Heidrun Wabnitz*[1], *Tilmann H. Sander[1], Alexander Jelzow[1], Frank Peters[1], Frederik Geisler[2], Michaela Wachs[2], Stefanie Leistner[2], Bruno-Marcel Mackert[3], Lutz Trahms[1], Rainer Macdonald[1]; [1]Physikalisch-Techn. Bundesanstalt, Germany, [2]Charité - Univ.-Medizin Berlin, Germany, [3]Vivantes Auguste-Victoria-Klinikum, Germany*. Two multimodality group studies in healthy subjects included simultaneous recording of time-resolved diffuse reflectance, broadband magnetoencephalography and peripheral physiological signals. The cerebral and systemic responses to stimulation were investigated by combined analysis of all signals.

BTuB4 • 11:30 a.m.
Simultaneous EEG and Near-Infrared Imaging for Investigation of Neurovascular Coupling and Neonatal Seizure, *R. J. Cooper*[1], *Topun Austin[2], N. L. Everdell[1], A. P. Gibson[1], Jeremy C. Hebden[1]; [1]Univ. College London, UK, [2]Rosie Hospital, UK*. We describe a study of neurovascular coupling in the visual cortex of neonates using simultaneous, co-located EEG and near-infrared imaging. We also discuss the application of this technology to the study of neonatal seizure.

BTuB5 • 11:45 a.m.
Clinical Trial on Bedside Monitoring of Cerebral Perfusion in Acute Stroke by Time-Domain Near-Infrared Reflectometry, *Oliver Steinkellner*[1], *Clemens Gruber[2], Heidrun Wabnitz[1], Jens Steinbrink[2], Peter Brunecker[2], Heiko Müller[2], Gerhard Jan Jungehülsing[2], Jochen B. Fiebach[2], Hellmuth Obrig[2], Rainer Macdonald[1]; [1]Physikalisch-Technische Bundesanstalt, Germany, [2]Klinik für Neurologie and Ctr. for Stroke Res. Berlin, Charité - Univ. Berlin, Germany*. We use optical tracking of an indocyanine green bolus to monitor cerebral perfusion on patients suffering an acute ischemic stroke. Intermediate results of an ongoing clinical trial are presented and compared to established imaging techniques.

BTuC • Nanomaterials and Molecular Probes—Continued

BTuC4 • 11:15 a.m.
Characterization of Plasmon Coupling between Gold Nanospheres Using Polarization Control, *Matthew J. Crow*, *Kevin C. Seekell, Adam Wax; Duke Univ., USA*. Single gold nanospheres sense local dielectric environment but are influenced by plasmonic coupling of proximal pairs. Polarization control separates these two effects, allowing both RI sensing and measurement of interparticle distance, with potential biological applications.

BTuC5 • 11:30 a.m.
Characterization of Fullerol Fluorescence Incorporated in Human Lens and Retinal Pigment Epithelial Cells, *Paola Taroni*[1], *Cosimo D'Andrea[1], Gianluca Valentini[1], Rinaldo Cubeddu[1], Dan-Ning Hu[2], Joan E. Roberts[3]; [1]Dept. of Physics, Politecnico di Milano, Italy, [2]Tissue Culture Ctr., New York Eye and Ear Infirmary, USA, [3]Dept. of Natural Sciences, Fordham Univ., USA*. Time-resolved fluorescence spectroscopy and imaging was performed on fullerol incorporated in human lens and RPE cells after incubation at doses in the range 1-500 µm to investigate correlation with intracellular distribution and toxicity.

BTuC6 • 11:45 a.m.
Bioconjugated ICG/Dox-Micellar Nanocapsules for Optical Molecular Imaging and Targeted Therapy, *Yongping Chen*, *Toufic G. Jabbour, Xingde Li; Biomedical Engineering, Johns Hopkins Univ., USA*. We reported on an approach to encapsulate indocyanine green and anticancer drug with polymeric micelles which can be bioconjugated for near-infrared molecular fluorescence imaging and potentially targeted therapy.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DTuB • Diffractive Optics and Imaging—Continued

DTuB7 • 12:00 p.m.
Time-Domain Fluorescence Lifetime Optical Projection Tomography, *James McGinty*, *Daniel Stuckey, Romain Laine, Khadija B. Tahir, Mark A. A. Neil, Jo V. Hajnal, Alex Sardini, Paul M. W. French; Imperial College London, UK.* We present a platform for measuring the fluorescence lifetime distribution in mesoscopic samples (~0.1-1cm) based on optical projection tomography and time-gated imaging. This is applied to optically cleared embryos expressing a calcium sensing FRET probe.

DTuB8 • 12:15 p.m.
Tomographic Fourier Telescopy, *Daissy H. Garces[1], **William T. Rhodes**[2], Nestor Peña Translaviñia[1]; [1]Univ. of the Andes, Colombia, [2]Florida Atlantic Univ., USA.* Fourier telescopy is usually applied to objects that can be modeled as planar. Tomographic principles, however, can be exploited to extend the realm of application to 3-D objects.

BTuB • Brain Monitoring and Imaging I—Continued

BTuB6 • 12:00 p.m.
Correlation Analysis during Resting State of the Whole Head with Near-Infrared Spectroscopy, *Rickson C. Mesquita*[1], *Maria A. Franceschini[2], David A. Boas[2]; [1]Dept. of Physics and Astronomy, Univ. of Pennsylvania, USA, [2]Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital, USA.* Functional correlation analysis was performed on near-infrared data of the whole head during baseline. We generated correlation images that reflect coherent fluctuations across the brain, mainly in the contralateral side of the seed arbitrarily defined.

BTuB7 • 12:15 p.m.
Multi-Wavelength, Depth Resolved, Scattering and Pathlength Corrected *in vivo* Near-Infrared Spectroscopy of Brain Tissue. *Ilias Tachtsidis*[1], *Terence S. Leung[1], Arnab Ghosh[2], Martin Smith[2], Chris E. Cooper[3], Clare E. Elwell[1]; [1]Dept. of Medical Physics and Bioengineering, Univ. College London, UK, [2]Neurocritical Care, Natl. Hospital for Neurology and Neurosurgery, UK, [3]Dept. of Biological Sciences, Univ. of Essex, UK.* We report a novel methodology that combines NIR multi-distance frequency and broadband spectrometers to quantify brain tissue haemodynamics, oxygenation and metabolism. We show preliminary results in a young healthy adult during a CO_2 challenge.

BTuC • Nanomaterials and Molecular Probes—Continued

BTuC7 • 12:00 p.m.
Random Lasing in Bone Tissue: Potential as Novel Spectroscopy for Dynamical Analysis of Nanostructures, *Qinghai Song*, *Shumin Xiao, Zhengbin Xu, Jingjing Liu, Xuanhao Sun, Vladimir Drachev, Vladimir M. Shalaev, Ozan Akkus, Young Kim; Purdue Univ., USA.* We, for the first time, demonstrate coherent random lasing action in bone tissue infused with laser dye. This could potentially be used to probe structural alterations at nanoscales in real-time as a novel spectroscopic modality.

BTuC8 • 12:15 p.m.
Imaging Cells with Second-Harmonic Generation Active Nanocrystals, *Chia-Lung Hsieh*[1,2], *Rachel Grange[1], Ye Pu[1], Demetri Psaltis[1]; [1]École Polytechnique Fédérale de Lausanne, Switzerland, [2]Caltech, USA.* We developed second-harmonic generation (SHG) active nanocrystals as cell imaging probes. Highly specific labeling of the nanocrystals on the HeLa cell membrane proteins was achieved by covalently coupling antibodies onto the nanocrystals.

12:30 p.m.–1:30 p.m. Lunch Break *(on your own)*

NOTES

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DTuC • Biological Applications

Tuesday, April 13
1:30 p.m.– 3:30 p.m.
Toyohiko Yatagai; Utsunomiya Univ., Japan, Presider

DTuC1 • 1:30 p.m. Invited

Digital Phase Holography of Biological Cells, ***Natan T. Shaked****, Adam Wax; Duke Univ., USA*. Interferometric phase microscopy has the potential of becoming a widely-used tool for quantitative measurements of biological cells. We introduce the current state of the art, the open questions, and solutions experimentally developed in our laboratory.

DTuC2 • 2:00 p.m. Invited

3-D Identification and Tracking of Biological Microorganisms Using Computational Microscopy, ***Bahram Javidi***[1]*, Mehdi DaneshPanah*[1]*, Inkyu Moon*[2]*, Saeed Bagheri*[3]*, Arun Anand*[4]*;* [1]*Univ. of Connecticut, USA,* [2]*Chosun Univ., Korea, Republic of,* [3]*IBM T. J. Watson Res. Ctr., USA,* [4]*MS Univ. of Baroda, India.* We briefly overview applications of digital holographic microscopy (DHM) for real-time non-invasive three dimensional sensing, tracking, and recognition of living microorganisms such as single/multiple cell organisms, bacteria, etc. Analytical frameworks and experimental results are presented.

DTuC3 • 2:30 p.m.

Off-Axis Self-Interference Based DIC Imaging of Living Cells, ***Dan Fu***[1]*, Seungeun Oh*[1]*, Toyohiko Yamauchi*[2]*, Wonshik Choi*[3]*, Ramachandra R. Dasari*[1]*, Michael S. Feld*[1]*;* [1]*MIT, USA,* [2]*Hamamatsu Photonics K.K., Japan,* [3]*Korea Univ., Republic of Korea.* We developed a new DIC imaging method based on off-axis sample wavefront self-interference. It provides quantitative phase gradient imaging and is extremely simple to implement on any standard microscope. Live cell imaging is demonstrated.

DTuC4 • 2:45 p.m.

Volume Holographic Imaging of Biological Tissue Samples, ***Raymond Kostuk***[1]*, Jennifer K. Barton*[1]*, Yuan Luo*[2]*;* [1]*Univ. of Arizona, USA,* [2]*MIT, USA.* Volume holographic filters incorporated into optical microscopy systems can extend imaging capability by providing wavefront selectivity and spectral information. These features are explored in the context of viewing biological tissue samples.

BTuD • BIOMED Tuesday Poster Session

Tuesday, April 13
1:30 p.m.– 3:30 p.m.
(Abstracts on following page)

BTuD • BIOMED Tuesday Poster Session

Tuesday, April 13
Richelieu Room
1:30 p.m.–3:30 p.m.

BTuD1

A Novel Hybrid Imaging System for Simultaneous Fluorescence Molecular Tomography and Magnetic Resonance Imaging, *Florian Stuker*[1], *Christof Baltes[1], Katerina Dikaiou[1], Divya Vats[1], Lucio Carrara[2], Edoardo Charbon[2], Jorge Ripoll[3], Markus Rudin[1,4]; [1]Inst. for Biomedical Engineering, Univ. Zürich, Switzerland, [2]AQUA Group, École Polytechnique Fédérale de Lausann, Switzerland, [3]Inst. for Electronic Structure and Laser, Foundation of Res. and Technology Hellas, Greece, [4]Inst. of Pharmacology and Toxicology, Univ. Zürich, Switzerland*. An *in vivo* hybrid imaging system for simultaneous magnetic resonance and fluorescence molecular tomography imaging, providing adequate spatial resolution and quantification capabilities, is described. Imaging performance *in vivo* is demonstrated using a murine tumor model.

BTuD2

Optoacoustic Imaging of Adult Zebrafish, *Daniel Razansky*, *Martin Distel, Rui Ma, Reinhard Koster, Vasilis Ntziachristos; Technical Univ. of Munich, Germany*. Adult zebrafish is an important model organism not accessible by current optical imaging methods due to intense light scattering. Here selective-plane optoacoustic tomography yields high resolution whole-body reconstructions of the animal at late developmental stages.

BTuD3

Fluorescence Imaging Setup with Lifetime Resolution for Detection of Red Fluorescent Protein Expressed Tumors in Small Animals, *Ilya Turchin*[1], *Michail Kleshnin[1], Anna Orlova[1], Ilya Fiks[1], Alexander Rusanov[2], Alexander Savitsky[2]; [1]Inst. of Applied Physics, Russian Acad. of Sciences, Russian Federation, [2]A.N. Bakh Inst. of Biochemistry, Russian Acad. of Sciences, Russian Federation*. We present the setup for small-animal fluorescence imaging which combines reflectance technique with lifetime resolution and diffuse fluorescence tomography. The results of *in vivo* study with red fluorescent protein expressed tumors will be reported.

BTuD4

Fluorescence Tomography of Red-Shifted Fluorescent Proteins, *Nikolaos C. Deliolanis*[1,2], *Thomas Wurdinger[2], Bakhos A. Tannous[2], Vasilis Ntziachristos[1,2]; [1]Technische Univ. and Helmholtz Zentrum München, Germany, [2]Harvard Medical School and Massachusetts General Hospital, USA*. We report on a novel mutli-spectral tomographic method that allows the 3-D visualization of fluorescence protein activity in small animals. We demonstrate the method imaging mCherry fluorescent protein expressing glioma tumors in mice.

BTuD5

Novel Near-Infrared Fluorescent Agent for Imaging Human Prostate Carcinoma in an Athymic Mouse Model, *Kenneth M. Tichauer*[1], *Jennifer L. Hickey[2,3], Lisa Hoffman[1], Keith St. Lawrence[1,4], Leonard G. Luyt[2,3,4,5], Ting-Yim Lee[1,4,6]; [1]Lawson Health Res. Inst., Canada, [2]London Regional Cancer Program, Canada, [3]Dept. of Chemistry, Univ. of Western Ontario, Canada, [4]Dept. of Medical Biophysics, Univ. of Western Ontario, Canada, [5]Dept. of Oncology, Univ. of Western Ontario, Canada, [6]Imaging Div., Robarts Res. Inst., Canada*. New near-infrared fluorescent agents have improved the depth sensitivity of fluorescence molecular imaging. Preliminary results from preclinical use of a near-infrared emitting, prostate cancer marker displayed adequate tumor contrast by 1 h after intravenous injection.

BTuD6

Accurate Study of FosPeg® Distribution in a Mouse Model Using Fluorescence Imaging Technique and Fluorescence White Monte Carlo Simulations, *Haiyan Xie*[1], *Haichun Liu[1], Pontus Svenmarker[1], Johan Axelsson[1], Susanna Gräfe[2], Jesper Holm Lundeman[3], Haynes Cheng[3], Maria Kyriazi[4], Niels Bendsoe[5], Peter Andersen[3], Katarina Svanberg[6], Stefan Andersson Engels[1]; [1]Dept. of Physics, Lund Univ., Sweden, [2]Biolitec AG, Res. and Development, Germany, [3]DTU Fotonik, Denmark, [4]Biomedical Optics and Applied Biophysics Lab, Dept. of Electrical Engineering and Computing, Natl. Technical Univ. of Athens, Greece, [5]Dept. of Dermatology and Venereology, Lund Univ. Hospital, Sweden, [6]Dept. of Oncology, Lund Univ. Hospital, Sweden*. Fluorescence imaging is used for quantitative *in vivo* assessment of drug concentration. Light attenuation in tissue is compensated for through Monte-Carlo simulations. The intrinsic fluorescence intensity, directly proportional to the drug concentration, could be obtained.

BTuD7

The Dynamic Change of NADH Fluorescence Lifetime in PARP-1 Induced Cell Death, *Han Wen Guo*[1], *Yau-Huei Wei[2], Hsing Wen Wang[1]; [1]Inst. of Biophtonics, Natl. Yang Ming Univ., Taiwan, [2]Inst. of Biochemistry and Molecular Biology, Natl. Yang Ming Univ., Taiwan*. We imaged NADH fluorescence lifetime in HeLa cells treated with a PARP-1 activating agent, N-methyl-N'-nitro-N-nitrosoguanidine, and then pytuvate to prevent cell death. NADH lifwtime may be a potential diagnostic/therapeutic biomarker in PARP-1 induced cell death.

BTuD8

Optical Discrimination of Intracellular Ca^{2+} Changes of Brain Induced by Cocaine and Ischemia, *Rubing Pan*[1,2], *Zhijia Yan[3], Zhongchi Luo[3], Congwu Du[1,4]; [1]Brookhaven Natl. Lab, USA, [2]Dept. of Biology, Univ. of Illinois at Urbana-Champaign, USA, [3]Dept. of Biomedical Engineering, SUNY Stony Brook, USA, [4]Dept. of Anesthesiology, SUNY Stony Brook, USA*. We use microscopic fluorescence imaging to study the effect of chronic cocaine exposure on the intracellular calcium concentration ($[Ca^{2+}]_i$) of cortical brain, and to compare with the brain $[Ca^{2+}]_i$ changes induced by ischemic insults.

BTuD9

Handheld Video Rate Fluorescence Diffuse Optical Tomography, *Metasebya Solomon*[1], *Brian R. White[2], Adam Q. Bauer[2], Gavin Perry[2], Joeshp P. Culver[2]; [1] Dept. of Biomedical Engineering, USA, [2] Dept. of Radiology, Washington Univ. in St. Louis, USA*. We developed a fiber-based video-rate fluorescence diffuse optical tomography that measures both fluorescence emission and reference transmission signals simultaneously. This design permits visualization of rapidly occurring physiological events in real time.

BTuD10

Early Detection of Tumor Vascular Response to Anti-Angiogenic Drugs with Optical Tomography, *Molly L. Flexman*, *Sonia L. Hernandez, Jianzhong Huang, Tessa Johung, Hyun Keol Kim, Jonghwan Lee, Fotis Vlachos, Darrell J. Yamashiro, Jessica Kandel, Andreas H. Hielscher; Columbia Univ., USA*. Using optical tomography we have imaged early vascular responses to anti-angiogenic treatments in a small animal tumor model. Optical images acquired from 1 to 7 days after drug administration show measurable changes in hemoglobin concentration.

BTuD11

Quantification of Fluorescence Target in Tissue Phantoms by Time-Domain Diffuse Optical Tomography with Phantoms—Total-Light Approach, *Goro Nishimura*[1], *Kamlesh Awasthi[1], Kitsakorn Locharoenrat[1], Shinpei Okawa[2], Yukio Yamada[2]; [1]Hokkaido Univ., Japan, [2]Univ. of Electro-Communications, Japan*. We conducted time-domain fluorescence measurements with tissue phantoms. We could successfully apply total-light algorithm to reconstruct the absorption image of fluorescence target. This algorithm is potentially useful in the quantification of fluorophores in tissues.

BTuD12

Signal-Locking Fourier Transform SPR: A New Low-Noise Detection Technique for Biomolecular Interactions, *Layne D. Williams*, *Tridib Ghosh, Renny E. Fernandez, Carlos H. Mastrangelo; Univ. of Utah, USA*. A new frequency domain SPR technique for quantitative measurement of biomolecular interactions is presented with the goal of improved signal-to-noise ratio. The technique uses a microfluidic chemical modulator chip with Au sensing sites.

Tuesday, April 13
Richelieu Room
1:30 p.m.–3:30 p.m.

BTuD13

Screening Small Molecule Compounds for Protein Ligandswith Label-Free, Optically Detected Microarray, *Xiangdong Zhu*, *Y. Y. Fei, J. P. Landry, Y. S. Sun; Univ. of California at Davis, USA*. Using a high-throughput label-free optical scanner we measured endpoints and binding kinetics of human vascular endothelial growth factor (VEGF) protein against 8,000 small molecule compounds (in microarray format) from NCI Developmental Therapeutics Program.

BTuD14

Optical Coherence Microscopy (OCM) and Full Field OCT (FFOCT) for Wavefront Correction in Dense Tissues, *Claude A. Boccara*, *Sylvain Gigan, Michelle Roth, Jonas Binding; Inst. Langevin, France*. Optical resolution is degraded by biological tissue-induced aberrations. To correct them wavefront measurements are performed either by measuring the wavefront distortion at the focus using OCM or by working on image quality optimization using FFOCT.

BTuD15

An Edge Detection Algorithm for Improving Optical Coherence Tomography Images of the Prostate Nerves, *Shahab Chitchian, **Nathaniel M. Fried**; Univ. of North Carolina at Charlotte, USA*. The cavernous nerves, responsible for erectile function, are at risk of injury during prostate cancer surgery. An edge detection algorithm is presented here for improved OCT prostate imaging, and identification and preservation of the nerves.

BTuD16

Forward-Viewing Endoscope of Appropriate Scanning Speed for 3-D OCT Imaging, *Li Huo*, *Jiefeng Xi, Yongping Chen, Xingde Li; Johns Hopkins Univ., USA*. A forward-viewing fiber-optic endoscope was developed with the scanning speed appropriate for 3-D real-time OCT imaging when using a high-speed swept source. The scanning speed was systematically analyzed. *In vivo* 3-D oral cavity imaging was performed.

BTuD17

Multiple Scattering Effects in Intralipid and Whole Blood Measured with Doppler Optical Coherence Tomography, *Jeroen Kalkman*[1], *Alexander V. Bykov*[2], *Dirk J. Faber*[1,3], *Ton G. van Leeuwen*[1,4]; [1]*Dept. of Biomedical Engineering and Physics, Academic Medical Ctr., Netherlands*, [2]*Optoelectronics and Measurement Techniques Lab, Univ. of Oulu, Finland*, [3]*Ophthalmology Dept., Academic Medical Ctr., Netherlands*, [4]*Biophysical Engineering Group, MIRA Inst. for Biomedical Technology and Technical Medicine, Univ. of Twente, Netherlands*. Doppler Optical Coherence Tomography (OCT) measurements on flowing Intralipid and whole blood are performed. The effect of multiple scattering on the Doppler OCT attenuation and flow is analyzed and compared to Monte Carlo simulations.

BTuD18

Velocity Resolution and Minimum Detectable Velocity in Joint Spectral and Time Domain OCT, *Ireneusz Grulkowski*, *Maciej Szkulmowski, Iwona Gorczynska, Daniel Szlag, Andrzej Kowalczyk, Maciej Wojtkowski; Nicolaus Copernicus Univ., Poland*. We present the analysis of the accuracy of velocity measurement by means of joint Spectral and Time domain Optical Coherence Tomography (STdOCT) method. Additionally, we determine the minimum detectable velocity.

BTuD19

Improvement in Dynamic Range of SS-OCT by Using True Logarithmic Amplifier, *Bin Liu, Ehsan Azimi, **Mark E. Brezinski**; Brigham and Women's Hospital, USA*. A new method to increase the dynamic range of a swept source optical coherence tomography (SS-OCT) by using a true logarithmic amplifier is studied theoretically and tested experimentally.

BTuD20

Image Feature Identification for Optical Coherence Tomography of Colorectal Neoplasm, *Chih Wei Lu*[1], *Wei Cheng Huang*[1], *Han Mo Chiu*[2], *Chia Wei Sun*[3]; [1]*Industrial Technology Res. Inst., Taiwan*, [2]*Natl. Taiwan Univ. Hospital, Taiwan*, [3]*Natl. Yang Ming Univ., Taiwan*. Optical coherence tomography has potential for colorectal neoplasm detection. We develop three algorithms to identify the image feature of colorectal neoplasm. Preliminary results indicate that the image features are different between normal and abnormal tissues.

BTuD21

Quantized Optical Field Analysis in OCT: Deeper Insights and Future Directions, *Mark E. Brezinski*; *Brigham and Women's Hospital, USA*. To date, the optical field in OCT has been treated primarily classically. This work examines the OCT interferometer in full quantization, identifying often ignored effects as vacuum fluctuations, indistinguishable paths, radiation pressure, and photon statistics.

BTuD22

Performance of the Red-Shifted Fluorescent Proteins in Multispectral Optoacoustic Tomography (MSOT), *Nikolaos C. Deliolanis*, *Jürgen Glatz, Ralf Schulz, Daniel Razansky, Vasilis Ntziachristos; Technische Univ. and Helmholtz Zentrum München, Germany*. We report on the optoacoustic performance of red-shifted FPs in deep-tissue mouse multispectral optoacoustic tomography, that in particular cases can be more than 3 orders of magnitude better.

BTuD23

In vivo* Photoacoustic Imaging of Tumor Using Gold Nanoparticles as Contrast Agent, *Qizhi Zhang, *Nobutaka Iwakuma, Parvesh Sharma, Brij M. Moudgil, Stephen R. Grobmyer, Huabei Jiang; Univ. of Florida, USA*. In this study, we demonstrate that following intravenous administration of PEGylayted gold nanoparticles to tumor bearing mice, accumulation of gold nanoparticles in tumors can be effectively imaged with photoacoustic tomography.

BTuD24

Correcting for Heterogeneous Fluence Profiles in Photoacoustic Imaging with Diffuse Optical Tomography, *Adam Q. Bauer*[1], *Ralph E. Nothdurft*[1], *Changhui Li*[2], *Lihong V. Wang*[2], *Joseph P. Culver*[1]; [1]*Washington Univ. School of Medicine, USA*, [2]*Washington Univ. in St. Louis, USA*. Diffuse optical tomography and photoacoustic tomography were combined to measure the optical absorption coefficient of a tissue mimicking phantom. Heterogeneous fluence maps were calculated from DOT absorption reconstructions and used to correct PAT reconstructions.

BTuD25

***In vivo* Photoacoustic Mapping of Sentinel Lymph Nodes Using Perfluorocarbon-Based Nanoparticles, *Chulhong Kim*[1]**, *Walter Akers*[2], *Kevin Guo*[2], *Ralph W. Furhop*[2], *Cai Xin*[1], *Gregory M. Lanza*[2], *Samuel Achilefu*[2], *Lihong V. Wang*[1]; [1]*Washington Univ. in St. Louis, USA*, [2]*Washington Univ. School of Medicine, USA*. We have developed perfluorocarbon nanoparticles loaded with near-infrared light absorbing dyes for photoacoustic tomography. We have successfully imaged nanoparticles in sentinel lymph nodes in rats *in vivo* using photoacoustic tomography.

BTuD26

In vivo* Imaging of the Proximal Interphalangeal (PIP) Finger Joint with Three-Dimensional Photoacoustic Tomography, *Yao Sun, *Eric Sobel, Huabei Jiang; Univ. of Florida, USA*. We study optimal scanning geometry for imaging finger joints by three-dimensional photoacoustic tomography using tissue phantom experiments, and the PIP finger joint in a human subject can be three-dimensionally imaged in our optimized spherical scanning.

BTuD27

A Triple Endoscope System for Alignment of Multispectral Images of Moving Tissue, *Neil T. Clancy*, *Danail Stoyanov, Vincent Sauvage, David James, Guang-Zhong Yang, Daniel S. Elson; Inst. of Biomedical Engineering, Imperial College London, UK*. A three-channel rigid endoscope allowing simultaneous recording of stereoscopic and multispectral images has been developed. With appropriate calibration, the system allows for registration of multispectral images where the tissue or camera is moving.

BTuD28

Interplay of Chromatic Aberration and Scattering in Depth-Resolved Two-Photon Fluorescence Endospectroscopy, ***Yicong Wu***, *Xingde Li; Johns Hopkins Univ., USA*. The influence of chromatic aberration of an objective lens and tissue scattering on depth-resolved two-photon fluorescence spectra measured by a fiber-optic endomicroscope is investigated. Proper calibration is proposed to restore the true depth-dependent fluorescence spectra.

BTuD29

Polarization Characterisation of Laparoscope Systems for Polarization Resolved Tissue Imaging, ***Tobias C. Wood***, *Daniel S. Elson; Imperial College London, UK*. Polarization resolved imaging techniques must be incorporated into standard imaging instruments to be used in the clinic. We present a characterisation of the polarization properties of two commercial laparoscopes and detail the inherent difficulties.

BTuD30

Measurements of Wavelength Dependent Scattering Coefficients by Low Coherence Spectroscopy, ***Nienke Bosschaart***, *Maurice C. G. Aalders, Dirk J. Faber, Ton G. van Leeuwen; Dept. of Biomedical Engineering and Physics, Biomedical Photonics, Univ. of Amsterdam, Netherlands*. Scattering coefficients of weakly scattering polystyrene sphere solutions were measured by Low Coherence Spectroscopy (LCS) from 460 to 680 nm. The coefficients agree with Mie theory and can be measured independent of scattering anisotropy.

BTuD31

Optical Characterization of Coral Skeleton with Low-Coherence Enhanced Backscattering Spectroscopy, ***Vladimir Turzhitsky***, *Andrew Fang, Jennifer Fung, Jillian Henss, Margaret Siple, Valentina Stoyneva, Jeremy D. Rogers, Hannah Wolfman, Andrew Radosevich, Vadim Backman, Luisa A. Marcelino; Northwestern Univ., USA*. We have implemented Low-coherence Enhanced Backscattering (LEBS) as a tool for non-invasively measuring optical properties. We observe that coral skeletons that are susceptible to bleaching have smaller reduced scattering coefficients and fractal dimensions.

BTuD32

High Throughput Vibrational Cytometry Based on Coherent Anti-Stokes Raman Scattering Microspectroscopy, ***Vladislav V. Yakovlev***, *Georgi Petrov, Rajan Arora; Univ. of Wisconsin at Milwaukee, USA*. We demonstrate a feasibility of a high-throughput (>1,000 cells/s) vibrational cytometry using nonlinear Raman microspectroscopy.

BTuD33

Using Fluorescence Lifetime Imaging Microscopy to Monitor Photofrin Uptake, Re-Distribution, and Intracellular Microenvironment, *Shu-Chi Ye, Tony J. Collins, Regina W. Leung, Kevin R. Diamond,* ***Qiyin Fang***; *McMaster Univ., Canada*. Real-time dosimetry is important to photodynamic therapy treatments. In a cellular microscopy study, we measured the fluorescence lifetime changes of Photofrin® when it bonds to specific intracellular components at specific stages of the cellular uptake.

BTuD34

Assembly of a Widefield Imaging Device and Segmentation of Multispectral Images for Cancer Screening, ***Sebastiao Pratavieira***, *Cristina Kurachi, Vanderlei Bagnato; Sao Paulo Univ., Brazil.* A simple widefiled imaging device based on fluorescence and reflectance for cancer screening was assembled. A digital image processing combining both modes is proposed to objectively enhance lesion discrimination.

BTuD35

High Frame-Rate Dual-Wavelength Near-Infrared MR-Guided Dynamic Oximetry Imaging System, ***Zhiqiu Li***, *Venkataramanan Krishnaswamy, Scott C. Davis, Shudong Jiang, Keith D. Paulsen, Brian W. Pogue; Dartmouth College, USA*. A NIR diffuse optical tomography system with spectrally-encoded sources at two wavelength bands allows simultaneous detection at high speed. It works with MR to provide images of high-contrast, fast changes in tissue oxygen saturation.

BTuD36

Quantitative Results of a Bi-Modal X-Ray fDOT System in a Cylindrical Geometry, ***Anne Planat-Chrétien***, *Anne Koenig, Jean-Guillaume Coutard, Lionel Hervé, Ludovic Lecordier, Marco Brambilla, Jean-Marc Dinten; CEA - LETI, France*. We develop a new instrument that couple cylindrical fluorescence diffuse optical tomography to a micro XCT system. We focus on the effective coupling between both modalities via the fDOT algorithm. Quantitative results are provided.

BTuD37

In vivo **X-Ray Guided Diffuse Optical Tomography of Osteoarthritis in the Knee Joints,** ***Qizhi Zhang***, *Zhen Yuan, Eric S. Sobel, Huabei Jiang; Univ. of Florida, USA*. This pilot clinical study shows for the first time that X-ray guided diffuse optical tomography is a potential tool to image osteoarthritis in large joints such as the knee.

BTuD38

Fluorescent Mediated Tomography Using SPECT and CT Prior Information from Simultaneous Tri-Modal Imaging, ***Liji Cao***, *Wolfhard Semmler, Joerg Peter; German Cancer Res. Ctr., Germany*. A multi-modal image reconstruction strategy is presented aimed at improving FMT by intrinsically co-registering SPECT-CT priors. Results from phantom experimental data illustrate that the strategy does suppress reconstruction artifacts and also facilitates quantitative analysis.

BTuD39

Trans-Rectal Ultrasound-Coupled Spectral Optical Tomography at 785nm and 830nm Detects Elevation of Total Hemoglobin Concentration in Canine Prostate Associated with the Development of Transmissible Venereal Tumors, *Zhen Jiang*[1], *Kenneth Bartels*[1], *Gilbert R. Holyoak*[1], *Jerry W. Ritchey*[1], *Jerzy S. Krasinski*[1], *Charles F. Bunting*[1], *Gennady Slobodov*[2], ***Daqing Piao***[1]; [1]*Oklahoma State Univ., USA*, [2]*Univ. of Oklahoma Health Sciences Ctr., USA*. Spectral trans-rectal ultrasound-coupled optical tomography at 785nm and 830nm has revealed non-invasively longitudinal elevation of total hemoglobin concentration associated with development of transmissible venereal tumors in canine prostate over a 6-week time-course.

BTuD40

Imaging Molecular Signatures for Detection of Osteoarthritis by Combining Spectral and Spatial a-Priori Information, ***Zhen Yuan***[1], *Qizhi Zhang*[1], *E. Sobel*[2], *Huabei Jiang*[1]; [1]*Dept. of Biomedical Engineering, Univ. of Florida, USA*, [2]*College of Medicine, Univ. of Florida, USA*. The multi-wavelength spectroscopy of the joints using X-ray-guided spatial constraints provides 3-D images of oxygen saturation and water content with high resolution and improved quantitative capability.

BTuD41

A Low-Cost, Portable System for High-Speed Multispectral Optical Imaging, ***Ryan Sun***, *Matthew B. Bouchard, Sean A. Burgess, Andrew J. Radosevich, Elizabeth M. C. Hillman; Columbia Univ., USA*. A simple new approach to multispectral optical imaging is presented that utilizes camera-synchronized LED illumination for high-speed acquisition. The developed system is also portable and very low-cost compared to conventional implementations of multispectral imaging.

BTuD42

Reconstruction of Raman Spectra Using Diffusive Light Propagation in 3-D, ***Jennifer-Lynn H. Demers***[1], *Subhadra Srinivasan*[1], *Martin Isabelle*[1], *Brian W. Pogue*[1], *Michael D. Morris*[2]; [1]*Dartmouth College, USA*, [2]*Univ. of Michigan, USA*. Simulations were completed to determine the effect of the propagation of Raman signal through a rat tibia. Reconstructed data show a shift in the Raman Spectra of less than 1nm as compared to original signal.

Tuesday, April 13
Richelieu Room
1:30 p.m.–3:30 p.m.

BTuD43

Improved Detection Limits Using a Hand-Held Optical Imager with Coregistration Capabilities, *Sarah J. Erickson*, *Sergio Martinez, Lizeth Caldera, Anuradha Godavarty; Florida Intl. Univ., USA*. A hand-held optical imager has been developed with coregistration facilities. Summation of multiple scans (fluorescence intensity images) enabled deeper target detection under perfect and imperfect (100:1) uptake conditions in tissue phantoms and *in vitro*.

BTuD44

Diffraction Imaging Flow Cytometric and 3-D Morphological Analysis of Three Cell Lines, *Kenneth M. Jacobs[1], Junhua Ding[1], Li V. Yang[1], Carissa L. Reynolds[1], Andrew E. Ekpenyong[1], Yuanming Feng[2], Mary A. Farwell[1], Jun Q. Lu[1],* ***Xin-Hua Hu**[1]; [1]East Carolina Univ., USA, [2]Tianjin Univ., China*. Three cell lines were used to examine the capability of a recently developed diffraction imaging flow cytometer for cell differentiation. Comparison of the diffraction images with the confocal imaged based 3-D structures yields positive results.

BTuD45

Development of a Non-Contact Diffuse Optical Spectroscopy Probe for Extraction of Tissue Optical Properties, *Sheldon Bish,* ***James W. Tunnell**; Univ. of Texas at Austin, USA*. We developed a non-contact diffuse optical spectroscopy probe for extraction of tissue optical properties to mitigate the effects of probe contact pressure. Auto-focusing and cross polarization mechanisms improve depth of focus and reduce specular reflection.

BTuD46

Time-Domain Elliptical Localization of Point-Like Fluorescence Inclusions with Early Photons Arrival Times, *Julien Pichette,* ***Yves Berube-Lauziere**; Univ. de Sherbrooke, Canada*. We introduce a novel approach for localizing a plurality of discrete fluorescent inclusions embedded in a thick scattering medium. It exploits time-domain experimental data and intersections of ellipses where inclusions are likely to be found.

BTuD47

Towards the Definition of Accurately Calibrated Liquid Phantoms for Photon Migration at NIR Wavelengths: A Multi-Laboratory Study, *Lorenzo Spinelli*[1,2], *Antonio Pifferi[2], Alessandro Torricelli[2], Rinaldo Cubeddu[2], Paola Di Ninni[3], Fabrizio Martelli[3], Giovanni Zaccanti[3], Florian Foschum[4], Alwin Kienle[4], Mikhail Mazurenka[5], Heidrun Wabnitz[5], Michal Kacprzak[6], Norbert Zolek[6], Daniel Milej[6], Adam Liebert[6]; [1]Inst. di Fotonica e Nanotecnologie, Italy, [2]Politecnico di Milano, Italy, [3]Univ. degli Studi di Firenze, Italy, [4]Inst. für Lasertechnologien in der Medizin und Messtechnik an der Univ. Ulm, Germany, [5]Physikalisch-Techn. Bundesanstalt, Germany, [6]Inst. of Biocybernetics and Biomedical Engineering, Poland*. A multi-laboratory study for the accurate calibration of diffusive liquid phantoms based on Intralipid and Indian ink has been performed. Different techniques, instrumental set-ups and analysis methods led to compatible values for optical properties.

BTuD48

Ultra-Fast Time-Gated SPAD for Multi-Wavelength Wide Dynamic Range Spectroscopy, *Alberto Tosi*[1], *Alberto Dalla Mora[1], Adriano Della Frera[1], Franco Zappa[1], Sergio Cova[1,2], Antonio Pifferi[2,3,4], Lorenzo Spinelli[5], Alessandro Torricelli[2,3], Davide Contini[3,4], Rinaldo Cubeddu[2,3,4,5]; [1]Dept. di Elettronica e Informazione, Politecnico di Milano, Italy, [2]IIT Res. Unit, Politecnico di Milano, Italy, [3]Dept. di Fisica, Politecnico di Milano, Italy, [4]ULTRAS-INFM-CNR, Natl. Lab for Ultrafast and Ultraintense Optical Science, Italy, [5]IFN-CNR, Inst. di Fotonica e Nanotecnologie – Sezione di Milano, Italy*. We present a novel instrumentation for wide dynamic-range optical investigations based on time-gated silicon single-photon avalanche diodes. We report measurements at multiple wavelengths with 10^8 dynamic range acquired in a very short measurement time.

BTuD49

Accessing Accuracy in the Determination of Solid Tissue Phantom Optical Properties: A Sample Geometry Study, *Jean-Pierre Bouchard*, *Israël Veilleux, Michel Fortin, Isabelle Noiseux, Rym Jedidi, Ozzy Mermut; Inst. Natl. d'Optique, Canada*. Accuracy of time resolved transmittance characterization of solid tissue phantoms is investigated by measuring samples of various geometries with non negligible boundary effects. Relative invariance to geometry provides confidence on absolute accuracy of characterization.

BTuD50

Non-Negative Matrix Factorization to Remove Autofluorescence of Tissues and Improve FDOT, *Anne-Sophie Montcuquet*[1], *Lionel Hervé[1], Jean-Marc Dinten[1], Jérôme I. Mars[2]; [1]CEA LETI Minatec, France, [2]Gipsa-Lab, DIS, France*. Autofluorescence of biological tissues limits deep fluorescent markers detection. A spectroscopic approach and a blind source separation method are explored to remove the autofluorescence signal. We show how this pre-processing improves Fluorescent Diffuse Optical Tomography.

BTuD51

Simultaneous Speckle Contrast and Functional Brain Tissue Imaging System, *Dene A. A. Ringuette, Hart Levy, Elizabeth A. Munro, Xiaofan Jin,* ***Ofer Levi**; Univ. of Toronto, Canada*. We demonstrate simultaneous *in vivo* reflectance and speckle contrast imaging system, utilizing VCSEL laser diode coherence modulation. By time multiplexing laser modes, VCSEL illumination noise is manipulated to enable a dual mode brain imaging operation.

BTuD52

Withdrawn

BTuD53

New Technique to Estimate Scattering Coefficient by Time-Resolved Measurement of Backscattered Light, *Masayuki Kawashima,* ***Takeshi Namita**, Yuji Kato, Koichi Shimizu; Graduate School of Information Science and Technology, Hokkaido Univ., Japan*. A new simple technique to estimate the scattering coefficient of diffuse medium was developed. The feasibility of the proposed technique was verified in the experiment using a liquid model phantom.

BTuD54

A Compact Time-Resolved near Infrared Spectroscopy Setup for Clinical Applications, *Patrick Poulet*[1], *Marine Amouroux[1], Wilfried Uhring[2], Thierry Pebayle[1], Renee Chabrier[1], Nelly Tessandier[1], Marion Sand[1], Luc Marlier[1]; [1]Lab d'Imagerie et de Neurosciences Cognitives, Univ. de Strasbourg, CNRS, France, [2]Inst. d'Electronique du Solide et des Systemes, Univ. de Strasbourg, CNRS, France*. A time-resolved NIRS instrument was assembled. The data analysis uses an initial fit to the Patterson's model followed by variations fitted with the microscopic Beer-Lambert law. *In vitro* and preliminary *in vivo* measurements are presented.

BTuD55

Sensitive Detection of Optical Discrete Absorption and Lasing of Fused Silica by the Depopulation of the, Fuat Bayrakçeken, *Şerife İpek Karaaslan; Yeditepe Univ., Turkey*. Ultraviolet light induced high resolution optical absorption spectra and resonance coherent fluorescence of spectroscopically pure fused silica have been studied, due to its potential applications in optoelectronics and flash and power optics and lasers.

BTuD56

Non-Contact Fluorescence Tomography: Sub-System Control Design for Exposure Control, ***Fadi El-Ghussein**, Dax Kepshire, Frederic Leblond, Brian Pogue; Thayer School of Engineering, Dartmouth College, USA*. Non-contact fluorescence tomography of small animals needs to be automated to balance gain control and laser intensity avoiding saturation or noisy signals. System workflow is identified and the concept of automatic exposure control is tested.

BTuD57

Spectral Distortions Due to a Finite Spectral Bandwidth Light Source in Time-Resolved Diffuse Spectroscopy, *Andrea Farina*, *Andrea Bassi, Paola Taroni, Daniela Comelli, Lorenzo Spinelli, Rinaldo Cubeddu, Antonio Pifferi; Dept. di Fisica, Politecnico di Milano, Italy*. We discuss the spectral distortions occurring when time-resolved diffuse spectroscopy is performed illuminating with a spectrally wide source. Theoretical and experimental investigations are given and a data analysis method to overcome the distortions is proposed.

Tuesday, April 13
Richelieu Room
1:30 p.m.–3:30 p.m.

BTuD58

Assessment of Tracking Devices towards Accurate Coregistration in a Hand-Held Optical Imager, *Sergio Martinez*, *Joseph DeCerce, Jean Gonzalez, Sarah J. Erickson, Anuradha Godavarty; Florida Intl. Univ., USA*. A hand-held optical imager with automated coregistration capabilities is developed towards 3-D tomographic imaging. Multiple tracking devices are currently assessed in order to improve the accuracies in coregistration, and eventually the quality of image reconstructions.

BTuD59

Improved Multichannel TCSPC System and High Power ps Lasers for a Time Resolved Fluorescence Mammography, *Michael Wahl[1], Tino Röhlicke[1], Hans Jürgen Rahn[1], Axel Hagen[2], Dirk Grosenick[2], Rainer Macdonald[2], Rainer Macdonald[2],* ***Rainer Erdmann****[1]; [1]PicoQuant GmbH, Germany, [2]Physikalisch-Technische Bundesanstalt, Germany*. We developed a multichannel TCSPC instrument capable of measuring 8 time-resolved fluorescence channels with count rates exceeding 10 million cps in combination with powerful lasers at 735nm offering up to 160mW of power in picosecond pulsed regime.

BTuD60

An Imaging Pulse Oximeter Based on a Multi-Aperture Camera, *Ali Basiri*, *Jessica Ramella-Roman; Catholic Univ. of America, USA*. We present an imaging pulse oximeter capable of capturing 16 spectral images at the peak and through of skin arterial pulse. Maps of arterial oxygen saturation agree with values obtained with a clinical pulse oximeter.

BTuD61

Widefield and High Resolution Fluorescence Imaging Using Vital Dye Contrast for Gastrointestinal Cancers, *Nadhi Thekkek*[1], *Timothy J. Muldoon[1], Alexandros D. Polydorides[2], Noam Harpaz[3], D. Maru[4], Sharmila Anandasabapathy[2], Rebecca Richards-Kortum[1]; [1]Rice Univ., USA, [2]Mount Sinai Medical Ctr., USA, [3]Mount Sinai School of Medicine, USA, [4]Univ. of Texas M.D. Anderson Cancer Ctr., USA*. This *ex vivo* study evaluates widefield and high-resolution fluorescence imaging with vital-dye enhancement to improve endoscopic evaluation of metaplasia, dysplasia, and cancer in the gastrointestinal tract. Differences in epithelial features were observed.

BTuD62

Skin Haemoglobin Mapping: Comparison of Multi-Spectral Imaging and Selective R-G-B Analysis, *Dainis Jakovels*, *Janis Spigulis; Bio-Optics and Fiberoptics Lab, Inst. of Atomic Physics and Spectroscopy, Univ. of Latvia, Latvia*. The multi-spectral imaging technique has been used for distant mapping of *in vivo* skin haemoglobin. Besides, potential of selective R-G-B analysis of skin images has been studied under bi-chromatic (532 nm and 635 nm) laser illumination.

BTuD63

Polarization-Sensitive Transmittance Imaging in Skeletal Muscle, *Ali S. Shuaib*, *Xin Li, Gang Yao; Univ. of Missouri at Columbia, USA*. We measured polarization sensitive transmittance images in skeletal muscles. The geometrical profiles of the transmitted images were quantitatively analyzed using a parametrical fitting method and showed significant polarization dependent trends.

BTuD64

Novel Multispectral Method for Simultaneous Color and Fluorescence Endoscopy, *George Themelis*[1], *Athanasios Sarantopoulos[1], Florian R. Greten[2], Valentin Becker[2], Alexander Meining[2], Gooitzen M. van Dam[3], Vasilis Ntziachristos[1]; [1]Inst. for Biological and Medical Imaging, Technische Univ. München and Helmholtz Ctr. Munich, Germany, [2]Medizinische Klinik, Klinikum rechts der Isar, Technische Univ. München, Germany, [3]Dept. of Surgery and BioOptical Imaging Ctr. Groningen, Univ. Medical Ctr. Groningen, Netherlands*. We present a novel multispectral imaging method that can easily be implemented in existing endoscopes to provide simultaneous color and fluorescence imaging. Results demonstrate increased performance and functionality over existing endoscopic systems.

BTuD65

Widefield Imaging and Point Spectroscopy for Noninvasive Diagnosis of Oral Precancer, *Richard A. Schwarz*[1], *Wen Gao[1], Mark C. Pierce[1], Rebecca Richards-Kortum[1], Ann M. Gillenwater[2], Vanda M. T. Stepanek[2], Tao T. Le[2], Vijayashree S. Bhattar[2], Darren M. Roblyer[3]; [1]Rice Univ., USA, [2]Univ. of Texas M.D. Anderson Cancer Ctr., USA, [3]Beckman Laser Inst. and Medical Clinic, USA*. The diagnostic potential and clinical utility of widefield imaging and point spectroscopy are examined based on measurements of patients with precancerous or cancerous oral lesions. Portable clinical instruments for widefield imaging and spectroscopy are described.

BTuD66

Instantaneous Spatial Light Interference Microscopy (iSLIM), *Huafeng Ding*, *Gabriel Popescu; Univ. of Illinois at Urbana-Champaign, USA*. We developed Instantaneous Spatial Light Interference Microscopy (iSLIM) as white light-based quantitative phase imaging method, which provides single-shot, speckle-free imaging at different colors (RGB) simultaneously. It is implemented as add-on module to phase contrast microscope.

BTuD67

Demonstration of Digital Optical Phase Conjugation, *Meng Cui*, *Changhuei Yang; Caltech, USA*. We demonstrate a digital optical phase conjugation method by combining phase-shifting holography with spatial phase shaping. Experimentally, we show that the system can compensate the wave-front distortion caused by a random scattering medium.

BTuD68

Spatial and Spectral Features of Optical Response to Peripheral Nerve Stimulation Suggest Vascular Origin, *Debbie K. Chen*[1], *Kelley Erb[2], Angelo Sassaroli[1], Peter R. Bergethon[2], Sergio Fantini[1]; [1]Tufts Univ., USA, [2]Boston Univ. School of Medicine, USA*. Electrical stimulation of the human sural nerve induces an optical response on a 100 ms timescale. On the basis of its spatial and spectral dependence, we hypothesize that it is generated by vascular motion.

BTuD69

Withdrawn

BTuD70

Dual-Beam Fluorescence Diffuse Optical Tomography Using Nonlinear Upconverting Nanoparticles, *Haichun Liu*, *Can T. Xu, Stefan Andersson-Engels; Dept. of Physics, Lund Univ., Sweden*. A method to exploit the nonlinearity of upconverting nanoparticles to increase information quantity in fluorescence diffuse optical tomography, by including excitation with two beams simultaneously, is demonstrated. The increased information resulted in more accurate reconstructions.

BTuD71

***In vivo* Characterization of Myocardial Tissue by Time-Resolved Diffuse Optical Spectroscopy in Open Chest Pig, *Andrea Farina*[1],** *Antonio Pifferi[1], Alessandro Torricelli[1], Lorenzo Spinelli[1], Davide Contini[1], Rinaldo Cubeddu[1], Luca Ascari[2], Luca Potì[2], Maria Giovanna Trivella[3], Antonio L'Abbate[3], Stefano Puzzoli[3]; [1]Dept. di Fisica, Politecnico di Milano, Italy, [2]Scuola Superiore Sant'Anna, Italy, [3]Inst. di Fisiologia Clinica del CNR, Italy*. We show that time-resolved diffuse optical spectroscopy is a valuable tool for the *in vivo* characterization of the myocardial tissue of a pig. Measurements were carried out on the beating heart of the open chest pig.

BTuD72

Transscleral Visible Near-Infrared Absorption Spectroscopy for Quantitative Characterisation of Intraocular Tumors in *ex vivo* Porcine Eyes, *Pontus Svenmarker*[1], *Jørgen Krohn[2,3], Can T. Xu[1], Dmitry Khoptyar[1], Stefan Andersson-Engels[1]; [1]Dept. of Physics, Lund Univ., Sweden, [2]Dept. of Clinical Medicine, Univ. of Bergen, Norway, [3]Dept. of Ophthalmology, Haukeland Univ. Hospital, Norway*. We present a study on 70 porcine eyes with intraocular tumours models for quantifying the melanin and haemoglobin concentrations. A correct concentration was obtained in 99.5% for haemoglobin and 84.4% for melanin of all measurements.

Tuesday, April 13
Richelieu Room
1:30 p.m.–3:30 p.m.

BTuD73

Determining Melanin Content of *in vivo* Skin Using the Diffusing Probe, *Sheng-Hao Tseng*[1,2]; [1]*Dept. of Electro-optical Engineering, Natl. Cheng-Kung Univ., Taiwan,* [2]*Advanced Optoelectronic Technology Ctr., Natl. Cheng Kung Univ., Taiwan.* We determined the melanin concentration of *in vivo* skin using our diffusing probe. This probe can also recover hemoglobin and water concentrations and will be employed to quantify the skin melanin variation stimulated by the UV-radiation.

BTuD74

Factors Affecting Retinal Reflectance, *Iain Styles*; *Univ. of Birmingham, UK.* We extend previous work on retinal reflectance modelling to examine the influence of additional parameters that have previously been omitted. The new parameters are shown to have a significant effect on the reflectance spectra.

BTuD75

Improved Lifetime Analysis Using Angular-Domain Fluorescence Imaging in a Tissue-Like Phantom, *Kenneth M. Tichauer*[1], *Mohamadreza Najiminaini*[2], *Fartash Vasefi*[1,2,3], *Ting-Yim Lee*[1,3,4], *Bozena Kaminska*[2], *Jeffrey J. L. Carson*[1,3]; [1]*Lawson Health Res. Inst., Canada,* [2]*School of Engineering Science, Simon Fraser Univ., Canada,* [3]*Dept. of Medical Biophysics, Univ. of Western Ontario, Canada,* [4]*Imaging Div., Robarts Res. Inst., Canada.* Angular-domain fluorescence imaging is defined by the use of an angular filter array to restrict detection of multiply-scattered photons for improved depth-spatial resolution. The benefits of its application to fluorescence lifetime imaging are presented.

BTuD76

A Time-Domain Non-Contact Fluorescence Diffuse Optical Tomography Scanner for Small Animal Imaging, *Yves Berube-Lauziere*, *Eric Lapointe; Univ. de Sherbrooke, Canada.* We introduce a novel time-domain multi-view (over 360°) non-contact fluorescence diffuse optical tomography scanner for localizing fluorescent dyes in scattering media, eventually in small animals. Localization results of fluorescent inclusions in 3-D are presented.

BTuD77

Multimodal Investigations of Biopolymers: Keratin and Cellulose, *Maxwell S. Zimmerley*[1], *David C. Oertel*[2], *Jennifer M. Marsh*[2], *Jimmie L. Ward*[2], *Eric O. Potma*[1]; [1]*Univ. of California at Irvine, USA,* [2]*Procter and Gamble Co., USA.* Nonlinear microscopy is used to develop a method for mapping the distribution of water and deuterated glycine in hair. A related method is also devised for monitoring the effects of water on cellulose-based fibers.

BTuD78

Cell Division Stage in *C. elegans* Imaged Using Third Harmonic Generation Microscopy, *Rodrigo Aviles-Espinosa*[1], *G. J. Tserevelakis*[2], *Susana I. C. O. Santos*[1], *G. Filippidis*[2], *A. J. Krmpot*[2], *M. Vlachos*[3], *N. Tavernarakis*[3], *A. Brodschelm*[4], *W. Kaenders*[4], *David Artigas*[1], *Pablo Loza-Alvarez*[1]; [1]*ICFO, Spain,* [2]*Inst. of Electronic Structure and Laser, Foundation of Res. and Technology-Hellas, Greece,* [3]*Inst. of Molecular Biology and Biotechnology, Foundation of Res. and Technology, Greece,* [4]*TOPTICA Photonics AG, Germany. C. elegans* embryogenesis, at the cell division stage, was imaged using third harmonic generation microscopy employing ultrashort pulsed lasers at 1028nm and 1550nm. This technique could be used for cell tracking studies without fluorescent markers.

BTuD79

Quantitative Orientation-Independent DIC Microscopy with High Speed Switching Shear Direction, *Michael Shribak*; *Marine Biological Lab, USA.* The principal scheme of assembly for rapid changing the beam shear direction is described. Two beam-shearing assemblies were used in orientation-independent DIC microscope to obtain high fidelity phase (phase gradient) images at high NAs.

BTuD80

Novel Cooled Sliding Chamber Elucidates Origins of Action Potential Modulated Birefringence, *Kurt J. Schoener*, *Lisa Cervia, Irving J. Bigio; Boston Univ., USA.* A specimen chamber for crustacean nerve experiments was newly designed to maintain physiological temperatures and allow observation along the length of the specimen. The resulting data elucidate the origins of action potential-induced changes in birefringence.

BTuD81

Real-Time Focal Modulation Microscopy Combined with Fluorescence Lifetime Imaging, *Nanguang Chen*, *Chee-Howe Wong, Shau Poh Chong, Colin Sheppard; Natl. Univ. of Singapore, Singapore.* We have developed a focal modulation microscope for real-time florescence imaging[3] of thick tissues. Fluorescence lifetime images and intensity images can be obtained in the same time.

BTuD82

Multiphoton Histology of Entire Intact Mouse Organs, *Sonia Parra, Thomas Chia, Joseph P. Zinter,* ***Michael J. Levene****; Yale Univ., USA.* We present multiphoton fluorescence microscopy and second harmonic imaging of entire intact, fixed and optically cleared mouse organs. We achieved imaging depths of several millimeters in mouse intestine, heart, lung, brain and other organs.

BTuD83

Simulating Second Harmonic Generation from Tendon - Do We See Fibrils? *Mathias Strupler*[1,2], *Marie-Claire Schanne-Klein*[2]; [1]*École Polytechnique de Montréal, Canada,* [2]*Lab for Optics and Biosciences, École Polytechnique, CNRS, France.* We simulated second harmonic generation microscopy images from Achilles tendon models and compared it with experimental images. We show that the characteristic striated pattern of these images is due to interferences between adjacent fibrils.

BTuD84

Is Image Cytometry Possible with Deconvolved Fluorescence Images? *Mahsa Ranji*[1], *Diego Calzolari*[2], *Ramses Augustin*[2], *Jeffrey H. Price*[2]; [1]*Univ. of Wisconsin at Milwaukee, USA,* [2]*Burnham Inst. for Medical Res., USA.* Deconvolution methods enhance contrast in 3-D fluorescence images by removing blur and restoring the out of focus light. Our research shows that relative flourescence intensities are rarely preserved in deconvolved images.

BTuD85

Angle-Resolved Light Scattering Study of NALM-6 and HL-60 Cells for White Blood Cell Differentiation, *Jun Q. Lu*[1], *Huafeng Ding*[1], *Carissa L. Reynolds*[1], *Yuanming Feng*[2], *Li V. Yang*[1], *Fred E. Bertrand*[1], *Tom J. McConnell*[1], ***Xin-Hua Hu***[1]; [1]*East Carolina Univ., USA,* [2]*Tianjin Univ., China.* FDTD modeling and angle-resolved measurement of Mueller matrix elements have been conducted with suspensions of two white blood cell lines at three wavelengths. We found that S12 exhibits the largest difference.

BTuD86

Withdrawn

BTuD87

Blood Screening Using Diffraction Phase Cytometry, Mustafa Mir, *Huafeng Ding, Zhuo Wang, Krishnarao Tangella, Gabriel Popescu; Univ. of Illinois at Urbana-Champaign, USA.* We demonstrate an automatic interferometry based blood smear analysis technique known as Diffraction Phase Cytometry (DPC) which provides detailed physiologically relevant information on the 2-D and 3-D morphology of individual blood cells.

BTuD88

Determination of Water and Lipid Concentrations by Diffuse Optical Spectroscopy in Lipid Emulsions in the Wavelength Range of 1000 to 1500 nm, *Rami Nachabe*[1], *Benno H. W. Hendriks*[1] *and H.J.C.M Sterenborg*[2]; [1]*Philips Res., Netherlands,* [2]*Erasmus Medical Ctr., Netherlands.* We demonstrate that water and lipid content can be determined accurately by applying the diffusion approximation solution to spectra in the wavelength range of 1000 to 1500 nm.

BTuD89

Incorporation of Single Fiber Reflectance Spectroscopy into Ultrasound-Guided Endoscopy (EUS-FNA) of Mediastinal Lymph Nodes, *Stephen C. Kanick*[1], *Cor van der Leest[2], Joachim Aerts[2], H.J.C.M. Sterenborg[1], Arjen Amelink[1]; [1]Erasmus Medical Ctr., Netherlands, [2]Amphia Hospital, Netherlands*. We have incorporated a single fiber reflectance spectroscopy device into the EUS-FNA procedure. Here, we present quantitative metrics that describe the vascular physiology within normal and metastatic lymph nodes in patients undergoing EUS-FNA.

BTuD90

Design and Implementation of Fiber Optic Probe for Measuring Field Effect of Carcinogenesis with Low- Coherence Enhanced Backscattering Spectroscopy (LEBS), *Nikhil N. Mutyal*[1], *Vladimir Turzhitsky[1], Jeremy D. Rogers[1], Andrew Radosevich[1], Hemant Roy[2], Micheal J. Goldberg[2], Mohammed Jameel[2], Andrej Bogojevich[2], Vadim Backman[1]; [1]Northwestern Univ., USA, [2]Northshore Univ. Health Systems, USA*. We have implemented a fiber optic probe with capability to measure the field effect of carcinogenesis using LEBS. We evaluated this probe in study using a cohort of patients, AOM rats and present diagnostic marker.

BTuD91

Parametric and Empirical Spectral Analysis for Non-Invasive Diagnosis of Basal Cell Carcinoma, *Jingjing Sun*[1,2], *Narasimhan Rajaram[1], Tianyi Wang[1], Xianpei Wang[2], Michael R. Migden[3], Jason S. Reichenberg[4], James W. Tunnell[1]; [1]Dept. of Biomedical Engineering, Univ. of Texas at Austin, USA, [2]School of Electronic Information, Wuhan Univ., China, [3]Dermatology Associates, Univ. of Texas Medical Branch, USA, [4]Dept. of Dermatology, Univ. of Texas M.D. Anderson Cancer Ctr., USA*. We compare parametric and empirical principle component analysis approaches to analyze diffuse reflectance spectra for the diagnosis of basal cell carcinoma and show that both approaches achieve comparable sensitivity and specificity of about 90%.

BTuD92

High Throughput Photoporation of Mammalian Cells Using Microfluidic Cell Delivery, *Yoshihiko Arita*, *Robert F. Marchington, David J. Stevenson, Frank J. Gunn-Moore, Kishan Dholakia; Univ. of St. Andrews, UK*. Photoporation (optical injection) of mammalian cells using a tightly focused femtosecond laser beam is demonstrated within a microfluidic chip, providing delivery of cells to the beam and thus automating the system for high cell throughput.

BTuD93

Clinical Evaluation of a High-Resolution Microendoscope for Early Diagnosis of Cancer, *Mark C. Pierce*[1], *Nadhi Thekkek[1], Kelsey Rosbach[1], Peter Thompson[2], Raymond Kaufman[2], Ann Gillenwater[3], Sharmila Anandasabapathy[4], Rebecca Richards-Kortum[1]; [1]Rice Univ., USA, [2]Methodist Hospital, USA, [3]Univ. of Texas M.D. Anderson Cancer Ctr., USA, [4]Mt. Sinai Medical Ctr., USA*. We have developed a high-resolution fluorescence microendoscope capable of imaging sub-cellular morphology *in vivo*, in real-time. We report our latest results in clinical studies for early cancer detection in the cervix, oral cavity, and esophagus.

BTuD94

Diluted Homogenized Tissue Phantoms as Contrast Optimization Tools for Fluorescence Endoscopy: Modeling the Effects of the Dilution on the Measured Fluorescence, *Mathieu Roy*, *Anthony Kim, Brian C. Wilson; Ontario Cancer Inst., Univ. of Toronto, Canada*. We present Monte Carlo models that predict the measured fluorescence of tissue phantoms as a function of their concentration. These models represent a key step towards using diluted homogenized tissues for fluorescence contrast optimization studies.

BTuD95

Intraoperative δ-Aminolevulinic Acid-Induced Protoporphyrin IX Spectroscopic Quantification Improves Clinical Margin Delineation of Intracranial Tumors, *Pablo A. Valdes*[1,2], *Frederic Leblond[1], Anthony Kim[3], Xiaoyao Fan[1], Brian C. Wilson[3], Brent T. Harris[4,2], Keith D. Paulsen[1], David W. Roberts[2,5]; [1]Thayer School of Engineering, Dartmouth College, USA, [2]Dartmouth Medical School, Dartmouth College, USA, [3]Dept. of Medical Biophysics, Univ. of Toronto, Canada, [4]Dept. of Pathology, Dartmouth-Hitchcock Medical Ctr., USA, [5]Section of Neurosurgery, Dartmouth-Hitchcock Medical Ctr., USA*. An intraoperative hand-held fiber-optics probe was used to estimate concentration of the fluorescent molecule protoporphyrin IX *in vivo* for different intracranial tumors, providing evidence that use of quantitative probe measurements improves clinical tumor margin delineation.

BTuD96

Identification of Abnormal Motor Cortex Activation Patterns in Children with Cerebral Palsy by Functional near Infrared Spectroscopy, *Bilal Khan[1], Fenghua Tian[1], Khosrow Behbehani[1], Mario Romero-Ortega[1], Nancy J. Clegg[2], Mauricio R. Delgado[2,3], Hanli Liu[1],* ***Alexandrakis George***[1]; *[1]Univ. of Texas at Arlington, USA, [2]Texas Scottish Rite Hospital for Children, USA, [3]Univ. of Texas Southwestern Medical Ctr. at Dallas, USA*. We have developed near-infrared image metrics for the quantification of spatiotemporal cortical activation patterns in children with cerebral palsy that differentiate from pediatric controls. These metrics could serve as biomarkers for prognosis and treatment monitoring.

BTuD97

Towards Depth-Resolved Fluorescence-Guided Surgery Using Multi-Spectral Near-Infrared Light, *Frederic Leblond*[1], *Zaven Ovanesyan[1], Scott C. Davis[1], Venkataramanan Krishnaswamy[1], Pablo A. Valdes[1], Anthony Kim[2], Brian C. Wilson[2], Alex Hartov[1], Brian W. Pogue[1], Keith D. Paulsen[1], David W. Roberts[3]; [1]Thayer School of Engineering, Dartmouth College, USA, [2]Ontario Cancer Inst., Canada, [3]Section of Neurosurgery, Dartmouth Hitchcock Medical Ctr., USA*. It is shown that an analytic expression of fluorescence ratio detection can provide a direct estimate of depth in multi-spectral sub-surface imaging. This is supported by preliminary fluorescence data acquired with a broad-beam multi-spectral system.

BTuD98

Monitoring Myocardial Tissue Hemodynamics during Open Chest Surgery in Pig by Time-Resolved NIRS, *Davide Contini*[1], *Lorenzo Spinelli[2], Alessandro Torricelli[1], Antonio Pifferi[1], Rinaldo Cubeddu[1], Luca Ascari[3], Luca Potì[4], Maria Giovanna Trivella[5], Antonio L'Abbate[6]; [1]Dept. di Fisica, Politecnico di Milano, Italy, [2]IFN-CNR Sezione di Milano, Italy, [3]Ctr. of Excellence for Information, Communication, and Perception Engineering, Scuola Superiore Sant'Anna, Italy, [4]Photonic Networks Natl. Lab, CNIT, Italy, [5]CNR Inst. of Clinical Physiology, Italy, [6]Scuola Superiore Sant'Anna, Italy*. Time-resolved NIRS measurements were performed on myocardial tissue during open chest surgery in pig to monitor tissue hemodynamics during ischemia and reperfusion periods.

BTuD99

Development of a Multi-Modality Imaging Platform for *in vivo* Tissue Assessment and Molecular Tracking, *Matthew T. Rinehart*, *Jeffrey LaCroix, Tyler Drake, Kyu Hyun Kim, Michael DeSoto, Marcus Henderson, Jennifer Peters, David Katz, Adam Wax; Duke Univ., USA*. We present a novel multimodality women's health imaging platform combining low coherence interferometry, endoscopic confocal microscopy, and Fourier-domain OCT. This optical platform will provide simultaneous information about microbicidal gel thickness, API distribution, and tissue integrity.

BTuD100

Fluorescence Visualization and Oral Lesion Risk, *Calum MacAulay*[1], *Catherine Poh[2], Lewei Zhang[3], Pierre Lane[1], Miriam Rosin[4]; [1]BC Cancer Agency, Canada, [2]Univ. of British Columbia, Canada, [3]Vancouver General Hospital, Canada, [4]Simon Fraser Univ., Canada*. Visualization of tissue autofluorescence has been used for the clinical detection, localization and extent determination for oral cancer and at risk lesions over the last four years. Presented is an update from over 6000 examinations.

Tuesday, April 13
Richelieu Room
1:30 p.m.–3:30 p.m.

BTuD101

Diffuse Optical Imaging of ICG Dynamics in the Diseased Breast with High Temporal Resolution, *Christoph H. Schmitz*[1,2], *Sophie Piper*[2], *Paul Schneider*[3], *Nassia Volkwein*[3], *Nils Schreiter*[3], *Alexander Poellinger*[3]; *[1]NIRx Medizintechnik GmbH, Germany, [2]Charité, Dept. of Neurology, Germany, [3]Charité, Dept. of Radiology, Germany*. Following intravenous ICG bolus injection, we obtained diffuse optical 3D images of the absorption contrast dynamics in the breast on 20 patients. We identified lesions based on local perfusion characteristics using a General Linear Model.

BTuD102

Time Resolved Study of Probe Pressure Effects on Skin Fluorescence and Reflectance Spectroscopy Measurements, *Liang Lim*, *Narasimhan Rajaram, Brandon Nichols, James W. Tunnell; Univ. of Texas at Austin, USA*. We conducted an *in vivo* experiment to study the effect of probe pressure on fluorescence and reflectance measurements. While these effects are minimal at low pressures, significant spectral distortions may occur at higher pressures.

BTuD103

Detectability of Hemodynamic Response to Thermal Pain in Pre-Frontal Cortex Using Diffuse Optical Tomography, *Venkatagiri Krishnamurthy*, *Venkaiah Kavuri, Fenghua Tian, Hanli Liu; Univ. of Texas at Arlington, USA*. We have explored the possibility of using diffuse optical tomography as a potential non-invasive clinical tool to monitor hemodynamic changes induced by neurophysiological and cognitive activities in response to conscious awareness of noxious pain.

BTuD104

Infrared Surface Plasmon Resonance Biosensor, *Robert E. Peale*[1], *Justin W. Cleary*[1], *Walter R. Buchwald*[2], *Oliver Edwards*[3]; *[1]Univ. of Central Florida, USA, [2]AFRL, USA, [3]Zyberwear Inc., USA*. An infrared surface plasmon resonance biosensor is capable of recognition based both on selective binding and on characteristic vibrational modes, thus providing enhanced sensitivity and selectivity. We present theoretical design considerations and first experimental investigations.

BTuD105

Optical Transmission Analysis of Nano-Hole Array as a Function of Incident Light Propagation Angles, *Mohamadreza Najiminaini*[1,2], *Fartash Vasefi*[1,2], *Bozena Kaminska*[1], *Jeffrey J.L. Carson*[2,3]; *[1]School of Engineering Science, Simon Fraser Univ., Canada, [2]Imaging Program, Lawson Health Res. Inst., Canada, [3]Dept. of Medical Biophysics, Univ. of Western Ontario, Canada*. In this paper, we present the Finite Difference Time Domain (FDTD) analysis on the optical transmission of nano-hole arrays illuminated at various incident angles relative to the normal to the plane of the array.

BTuD106

A Method to Assess the Scattering-Free Absorption Properties of Nanostructured Materials, *Cosimo D'Andrea*, *Andrea Farina, Paola Taroni, Antonio Pifferi, Katya Obraztsova, Calogero Sciascia, Guglielmo Lanzani; Politecnico di Milano, Italy*. A technique to measure scattering-free absorption of small amounts of powder nanostructured materials, based on time-resolved diffuse optical spectroscopy, has been demonstrated and experimentally validated on two carbon materials.

BTuD107

Role of Collagen Scattering for *in vivo* Tissue Characterization, *Paola Taroni*, *Andrea Bassi, Andrea Farina, Rinaldo Cubeddu, Antonio Pifferi; Dept. of Physics, Politecnico di Milano, Italy*. The scattering properties of collagen in tissue were derived from *ex vivo* measurements on bovine tissues, and recognized in *in vivo* data on the human knee, suggesting potential for tissue characterization and diagnosis of osteoarticular diseases.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DTuC • Biological Applications—Continued

DTuC5 • 3:00 p.m.
Phase-Sensitive Motility Imaging of Tumor Response to Drugs in Digital Holography, ***David D. Nolte***[1], *Kwan Jeong*[1,2], *John J. Turek*[3]; [1]*Dept. of Physics, Purdue Univ., USA,* [2]*Dept. of Phyiscs, Korea Military Acad., Republic of Korea,* [3]*Dept. of Basic Medical Science, Purdue Univ., USA.* We present the first time-course measurements of cytoskeletal anticancer drug action on osteogenic tumor spheroids through motility imaging based on the amplitude and phase information retrieved from digital holography.

DTuC6 • 3:15 p.m.
Doppler Optical-Microfluidic Approach for Red Blood Cell Aggregation Measurement: Principle and Method, *Xiangqun Xu*[1], *Lingfeng Yu*[2], ***Zhongping Chen***[2]; [1]*Zhejiang Sci-Tech Univ., China,* [2]*Univ. of California at Irvine, USA.* A novel platform that integrate microfluidic rheology and Doppler OCT technology is developed for quantifying red blood cell aggregation using variance/standard deviation of the Doppler frequency spectrum.

3:30 p.m.–4:00 p.m. Coffee Break/Exhibits, *Richelieu Room*

NOTES

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DTuD • DH Tutorials

Tuesday, April 13
4:00 p.m.– 5:20 p.m.
Partha P. Banerjee; Univ. of Dayton, USA, Presider

DTuD1 • 4:00 p.m. **Tutorial**

Digital Holography and Interferometry for Micro- and Nano-Photonics, *Byoungho Lee*; *Seoul Natl. Univ., Republic of Korea*. General digital holography and interferometry technologies are explained. As their applications for micro- and nano- photonics, recent studies are reviewed.

DTuD2 • 4:40 p.m. **Tutorial**

Selected Topics in 3-D Electro—Optical Image Processing, *Joseph Rosen*; *Ben Gurion Univ. of the Negev, Israel*. We review three different methods of generating digital holograms of three-dimensional real-existing objects illuminated by incoherent light. The methods are: 1. Scanning holography. 2. Multiple-viewpoint projection holography. 3. Fresnel incoherent correlation holography.

BTuE • New Ideas and Techniques

Tuesday, April 13
4:00 p.m.– 6:00 p.m.
Gabriel Popescu; Univ. of Illinois at Urbana-Champaign, USA, Presider

BTuE1 • 4:00 p.m.

Recovery of Diffused Images through Nonlinear Instability, *Dmitry V. Dylov*, *Jason W. Fleischer; Princeton Univ., USA*. We develop a method to recover diffused images by seeding spatial instability in a nonlinear medium. We observe the increase of image contrast and enhancement of signal resolution in noisy environments.

BTuE2 • 4:15 p.m.

Evaluation of Multiple Sclerosis-Like Lesions *in vivo* with Coherent Anti-Stokes Raman Scattering Microscopy, *Erik Bélanger*, *Sophie Laffray, Réal Vallée, Daniel Côté; Univ. Laval, Canada*. This study of multiple sclerosis is performed with an animal model called experimental autoimmune encephalomyelitis. After surgically exposing the spinal cord, demyelination is characterized using *in vivo* CARS microscopy and reflectance imaging.

BTuE3 • 4:30 p.m.

Quantifying Mitochondrial Dynamics in Apoptotic Cells with Optical Gabor-Like Filtering, *Robert M. Pasternack*, *Jing-Yi Zheng, Nada N. Boustany; Rutgers Univ., USA*. We demonstrate a rapid throughput optical scatter method based on Gabor-like filtering to measure subcellular dynamics within single apoptotic cells. The technique is sensitive to a decrease in particle orientation consistent with apoptosis-induced mitochondrial fragmentation.

BTuF • Biological and Drug Discovery Imaging

Tuesday, April 13
4:00 p.m.– 6:15 p.m.
Elizabeth M. Hillman; Columbia Univ., USA, Presider

BTuF1 • 4:00 p.m.

Improved *in vivo* Fluorescence Tomography and Quantitation in Small Animals Using a Novel Multiview, Multispectral Imaging System, *Craig Gardner*[1], *Joyita Dutta[2], Gregory S. Mitchell[3], Sangtae Ahn[2], Changqing Li[3], Peter Harvey[1], Russell Gershman[1], Stephen Sheedy[1], James R. Mansfield[1], Simon R. Cherry[3], Richard M. Leahy[2], Richard M. Levenson[1,4]; [1]CRi, Inc., USA, [2]Univ. of Southern California, USA, [3]Univ. of California at Davis, USA, [4]Brighton Consulting Group, USA*. We report on the design and initial experimental results of a multiview, multispectral preclinical fluorescence tomography instrument, designed to improve quantitation of fluorescence molecular imaging in disease research and drug development.

BTuF2 • 4:15 p.m.

Living Motion as Label-Free Imaging Contrast in Three-Dimensional Tissue-Based Drug Screening, *David D. Nolte*, *Kwan Jeong, John Turek; Purdue Univ., USA*. Motility contrast imaging (MCI) detects sub-cellular motion in living tissue as a fully endogenous imaging contrast agent. Three-dimensional imaging assays of anti-mitotic cancer drugs have extracted label-free functional signatures in tumors for the first time.

BTuF3 • 4:30 p.m.

Imaging the Bio-Distribution of Molecular Probes Using Multispectral Cryoslicing Imaging, *Athanasios Sarantopoulos*, *George Themelis, Ralf B. Schulz, Vasilis Ntziachristos; Inst. for Biological and Medical Imaging, Technische Univ. München and Helmholtz Ctr. Munich, Germany*. We report the development of a novel multispectral imaging system that is capable of creating µm-resolution three dimensional color and fluorescence volumes of optical agents bio-distribution in small animals and organs using epi-illumination fluorescence imaging.

Napoleon I
Digital Holography and Three-Dimensional Imaging (DH)

DTuD • DH Tutorials—Continued

DTuD3 • 5:20 p.m. Tutorial
Withdrawn

Napoleon II
Biomedical Optics (BIOMED)

BTuE • New Ideas and Techniques—Continued

BTuE4 • 4:45 p.m.
Structure and Dynamics of Live Cells Studied by Fourier Transform Light Scattering (FTLS), *Huafeng Ding*, *Gabriel Popescu; Univ. of Illinois at Urbana-Champaign, USA*. We studied static and dynamic light scattering from tissues and cells using Fourier transform light scattering (FTLS). And we also employed FTLS to measure actin-driven dynamics in live cells without fluorescence tagging.

BTuE5 • 5:00 p.m.
X-Ray Induced Fluorescence Optical Imaging Enabled by Injectable Nano-Scintillators, *Colin M. Carpenter*[1], *Lasitha Senadheera[1], Guillem Pratx[1], Conroy Sun[1], Padmanabha R. Ravilisetty[2], Lei Xing[1]; [1]Stanford Univ. School of Medicine, USA, [2]SRI Intl., USA*. Nanosized inorganic phosphor scintillators are being investigated for their potential to mediate X-ray activated optical imaging. This work investigates the feasibility of X-ray luminescence imaging using 50nm nano-phosphors.

BTuE6 • 5:15 p.m.
Cerenkov Luminescence Tomography for Small Animal Imaging, *Changqing Li*, *Gregory S. Mitchell, Simon R. Cherry; Biomedical Engineering Dept., Univ. of California at Davis, USA*. We have observed Cerenkov light emitted from beta-emitting radiotracers. Phantom and *in vivo* mouse imaging experiments demonstrate that sufficient Cerenkov photons are produced to allow reconstruction of radiotracer activity inside an object from surface measurements.

BTuE7 • 5:30 p.m.
Laser-Scanning Intersecting Plane Tomography (L-SIPT) for High Speed 3-D Imaging, *Matthew B. Bouchard*, *Lauren Grosberg, Sean A. Burgess, Elizabeth M. C. Hillman; Lab for Functional Optical Imaging, Dept. of Biomedical Engineering, Columbia Univ., USA*. We describe a new optical planar imaging geometry for high speed volumetric optical imaging. A diagram and raytracing simulations of the new imaging geometry as well as initial phantom and image reconstruction results are presented.

Napoleon III
Biomedical Optics (BIOMED)

BTuF • Biological and Drug Discovery Imaging—Continued

BTuF4 • 4:45 p.m.
Förster Resonance Energy Transfer Reconstruction from Optical Backprojections in Turbid Media, *Vadim Y. Soloviev*[1], *Surya P. Mohan[1], Simon R. Arridge[1], James McGinty[2], Romain Laine[2], Paul M. W. French[2], Daniel W. Stuckey[3], Alessandro Sardini[3], Joseph V. Hajnal[3]; [1]Univ. College London, UK, [2]Imperial College London, UK, [3]MRC Clinical Sciences Ctr., UK*. We demonstrate the feasibility of FRET lifetime imaging on the basis of wide-field tomographic time-gating technique. We present FRET localization in 3-D turbid medium by applying a variant of the backprojection algorithm.

BTuF5 • 5:00 p.m.
Time Gated Pptical Projection Tomography for 3-D Imaging of Highly Scattering Biological Models, *Andrea Bassi*, *Daniele Brida, Cosimo D'Andrea, Gianluca Valentini, Sandro De Silvestri, Giulio Cerullo, Rinaldo Cubeddu; Natl. Lab for Ultrafast and Ultraintense Optical Science, Dept. di Fisica, Politecnico di Milano, Italy*. An imaging technique that combines Optical Projection Tomography with ultrafast time gating is presented. The method provides high resolution reconstruction of scattering samples, which is suitable for 3-D imaging of biological models.

BTuF6 • 5:15 p.m.
Correction of Lateral Movement and Spherical Aberrations in Optical Projection Tomography, *Udo J. Birk*[1,2], *Alex Darrell[1], Nikos Konstantinidis[1], Jorge Ripoll[1]; [1]Foundation for Res. and Technology - Hellas, Greece, [2]Kirchhoff Inst. für Physik, Germany*. We present two post-acquisition correction methods for *in vivo* Optical Projection Tomography to reconstruct specimens embedded in arbitrary refractive index, and to correct for movements of the specimens. Results obtained from Parhyale hawaiensis are shown.

BTuF7 • 5:30 p.m.
Longitudinal Optical Imaging of Tumor Metabolism and Hemodynamics, *Melissa C. Skala*, *Andrew Fontanella, Lan Lan, Mark W. Dewhirst, Joseph A. Izatt; Duke Univ., USA*. Fluorescence redox ratio imaging of metabolic demand, absorption microscopy of hemoglobin oxygen saturation and Doppler optical coherence tomography of blood flow were combined to monitor oxygen supply and demand in a tumor model *in vivo*.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

BTuE • New Ideas and Techniques—Continued

BTuE8 • 5:45 p.m.
Non-Invasive Optical Measures of CBV, StO_2, CBF Index, and $rCMRO_2$ in Human Premature Neonates' Brains in the First 6 Weeks of Life, *Nadege F. Roche-Labarbe*[1], *Stefan A. Carp*[1], *Andrea Surova*[1], *David A. Boas*[1], *P. Ellen Grant*[2], ***Maria Angela Franceschini***[1]; [1]*NMR Ctr., USA*, [2]*Children's Hospital, USA*. FD-NIRS and DCS recordings in 11 premature neonates without brain injury (28 to 34 weeks GA) allowed for calculation of absolute HbT, CBV and StO_2, an index of CBF and a more accurate $rCMRO_2$.

BTuF • Biological and Drug Discovery Imaging—Continued

BTuF8 • 5:45 p.m.
Two-photon Imaging of the Oxygen Partial Pressure in Cerebral Microvasculature, *Sava Sakadzic*[1], *Emmanuel Roussakis*[2], *Mohammad A. Yaseen*[1], *Vivek J. Srinivasan*[1], *Emiri T. Mandeville*[1], *Anna Devor*[1,3], *Eng H. Lo*[1], *Sergei A. Vinogradov*[2], ***David A. Boas***[1]; [1]*Massachusetts General Hospital, USA*, [2]*Univ. of Pennsylvania, USA*, [3]*Univ. of California at San Diego, USA*. We report the first practical *in vivo* two-photon pO_2 measurements in cortical microvasculature, made possible by using a two-photon-enhanced phosphorescent nanoprobe. New method features ~250-µm measurement depth, sub-second temporal resolution and requires low probe concentration.

BTuF9 • 6:00 p.m.
Noninvasive Optoacoustic Monitoring of Multiple Physiological Parameters: Clinical Studies, ***Rinat O. Esenaliev***, *Yuriy Y. Petrov, Irina Y. Petrova, Donald S. Prough; Univ. of Texas Medical Branch, USA*. We have developed an optoacoustic technique for noninvasive monitoring of important physiological parameters and tested our optoacoustic systems in clinics. Our data indicate that the accuracy of this technique can approach that of invasive techniques.

NOTES

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

7:30 a.m.–5:00 p.m. Registration Open

10:00 a.m.–4:00 p.m. Exhibits Open

DWA • Holography: Techniques and Algorithms

Wednesday, April 14
8:00 a.m.–10:00 a.m.
Hiroshi Yoshikawa; Nihon Univ., Japan, Presider

DWA1 • 8:00 a.m. Invited

Compressive Holography of Diffuse Scatterers, ***David Brady***, *Kerkil Choi, Ryoichi Horisaki, Joonku Hahn, Sehoon Lim; Duke Univ., USA.* We image the incoherent 3-D scattering density of objects from the covariance of 2-D scattered speckle field measurements using forward model regularization and constrained optimization. 3-D resolution consistent with spatial bandlimits is demonstrated.

DWA2 • 8:30 a.m. Invited

Digital Holography at Ultimate Shot Noise Level, *F. Joud[1], M. Atlan[2],* ***Michel Gross***[1]; *[1]École Normale Supérieure, Univ. Paris, France, [2]Paris Tech, Univ. Paris, France.* We present an off-axis phase-shifting digital holographic technique able to make digital holography at shot noise level. We discuss the advantages of this technique and we give application examples.

BWA • Brain Monitoring and Imaging II

Wednesday, April 14
8:00 a.m.–10:00 a.m.
Adam Gibson; Dept Medical Physics, UK, Presider

BWA1 • 8:00 a.m.

Quantification of Cerebral Blood Flow in the Adult Using Near-Infrared Spectroscopy Assisted by Subject-Individualized Monte Carlo Modeling, ***Jonathan T. Elliott***[1,2], *Mamadou Diop[1,2], Kenneth M. Tichauer[1], Ting-Yim Lee[1,2,3], Keith St. Lawrence[1]; [1]Lawson Health Res. Inst., Canada, [2]Dept. of Medical Biophysics, Univ. of Western Ontario, Canada, [3]Imaging Labs, Robarts Res. Inst., Canada.* In the adult, quantification of cerebral blood flow (CBF) using near-infrared spectroscopy requires the ability to properly account for extracerebral contamination. Accurate measurements of CBF were achieved using subject-individualized Monte Carlo assisted near-infrared spectroscopy.

BWA2 • 8:15 a.m.

Phase Synchronization Approach to Cerebral Hemodynamics Assessment by Near-Infrared Spectroscopy, ***Feng Zheng***, *Angelo Sassaroli, Sergio Fantini; Biomedical Engineering Dept., Tufts Univ., USA.* We show phase synchronization between oxy and deoxy-hemoglobin concentrations in the prefrontal cortex of a human subject at rest. This method has potential for studying cerebral connectivity and brain auto regulation in real time.

BWA3 • 8:30 a.m.

Imaging Blood Flow and Cellular Morphology in Epilepsy with Diffuse Optical Tomography, ***Ruixin Jiang***, *Zhen Yuan, Xiaoping Liang, Qizhi Zhang, Paul Carney, Huabei Jiang; Univ. of Florida, USA.* We present a method that is capable of imaging cerebral blood flow (CBF) and particle size/density in epilepsy using diffuse optical tomography. *In vivo* images during seizure onset are obtained using a multispectral DOT system.

BWB • Clinical Applications of Spectroscopy

Wednesday, April 14
8:00 a.m.–10:00 a.m.
Rebecca Richards-Kortum; Rice Univ., USA, Presider
Robert J. Nordstrom; Univ. of Illinois at Urbana-Champaign, USA, Presider

BWB1 • 8:00 a.m. Invited

Can Scattering Spectroscopy Detect Disease Earlier than Histopathology? ***Irving Bigio***; *Boston Univ., USA.* Elastic scattering spectroscopy, in various incarnations, is proving to be sensitive to subtle changes in ultrastructure and/or microperfusion that appear in histologically-normal tissue or microscopically-normal cells, but presage cellular changes or disease.

BWB2 • 8:30 a.m.

Pilot Clinical Study for Quantitative Spectral Diagnosis of Non-Melanoma Skin Cancer, ***Narasimhan Rajaram***[1], *Jason S. Reichenberg[2], Michael R. Migden[3], Tri H. Nguyen[4], James W. Tunnell[1]; [1]Univ. of Texas at Austin, USA, [2]Univ. of Texas Medical Branch, USA, [3]Univ. of Texas M.D. Anderson Cancer Ctr., USA, [4]Northwest Diagnostic Clinic, USA.* We report the results of a pilot clinical study using a combined diffuse reflectance/intrinsic fluorescence system on 40 patients with non-melanoma skin cancer and suggest a novel approach to analyze and spectrally diagnose skin lesions.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DWA • Holography: Techniques and Algorithms—Continued

DWA3 • 9:00 a.m.
Recovering of Complex Amplitude by Use of Bandwidth-Adapted Double FFT Algorithms, ***Pascal PICART***[1,2], *Patrice Tankam*[2], *Zu-jie Peng*[3], *Junc-chang Li*[2,3]; [1]*ENSIM, France,* [2]*LAUM CNRS, France,* [3]*Kunming Univ. of Science and Technology, China*. Double FFT convolution algorithms based on the use of spectrum scanning and spherical reconstruction wave allow complex amplitude of large objects to be reconstructed. Experimental results in color holography illustrate the advantages of the method.

DWA4 • 9:15 a.m.
Height Impulse Response Function Analysis of Multiple-Wavelength Digital Holography, ***Carl C. Aleksoff***[1], *Hao Yu*[2]; [1]*Coherix Inc., USA,* [2]*Univ. of Michigan, USA*. The height measurement characteristics of multiple-wavelength digital holography can be characterized by a height impulse response function. We consider via this function how the distribution of wavelengths affects the height measurement performance.

BWA • Brain Monitoring and Imaging II—Continued

BWA4 • 8:45 a.m.
Real-Time Functional Brain Imaging of Attention Using Near-Infrared Spectroscopy, ***Benjamin Schmidt***, *Nancy Beluk, Theodore J. Huppert; Univ. of Pittsburgh, USA*. In this study, we demonstrate the application of a real-time neural-network model to monitor attention in a reading task using near-infrared spectroscopy (NIRS).

BWA5 • 9:00 a.m.
Quantitative Cerebral Blood Flow Measurement of Ischemic Stroke in Mice with Multi Exposure Speckle Imaging, ***Ashwin B. Parthasarathy***, *S. M. Shams Kazmi, Anthony Salvaggio, Andrew K. Dunn; Univ. of Texas at Austin, USA*. We show that changes in cerebral blood flow can be accurately estimated using the new Multi Exposure Speckle Imaging instrument. We also show that these estimates are unaffected by the presence of thin skull.

BWA6 • 9:15 a.m.
Simultaneous Imaging of Cortical Blood Flow and Oxygenation Change or Cellular Calcium Dynamics Using Dual-Wavelength Laser Speckle Contrast Imaging, ***Zhongchi Luo***, *Zhijia Yuan, Yingtian Pan, Congwu Du; Stony Brook Univ., USA*. A dual-wavelength laser speckle contrast imaging technique (DW-LSCI) is presented for simultaneous imaging of cerebral blood flow and hemoglobin oxygenation changes or fluorescent labeled cellular calcium dynamics at high spatiotemporal resolutions.

BWB • Clinical Applications of Spectroscopy—Continued

BWB3 • 8:45 a.m.
Imaging Breast Pathology *in situ* Using Broadband Scatter Spectroscopy and a K-Nearest Neighbor Classifier, ***Ashley M. Laughney***[1], *Venkataramanan Krishnaswamy*[1], *Pilar B. Garcia-Allende*[2], *Wendy A. Wells*[3], *Olga M. Conde*[2], *Keith D. Paulsen*[1], *Brian W. Pogue*[1]; [1]*Thayer School of Engineering, Dartmouth College, USA,* [2]*Univ. of Cantabria, Photonics Engineering Group, Spain,* [3]*Dept. of Pathology, Dartmouth-Hitchcock Medical Ctr., USA*. A reflectance imaging system acquired spectra from breast tissue and scattering parameters were linked to morphological features identified by a pathologist in 75 ROIs. A KNN algorithm discriminated between tissue pathologies with nearly 84% accuracy.

BWB4 • 9:00 a.m.
Partial Wave Spectroscopy and Its Relation to Nanoscale Disorder in Nuclear Architecture, ***Hariharan Subramanian***[1], *Dhwanil Damania*[1], *Krishnapal Solanki*[2], *Yolanda Stypula*[1], *Lusik Cherkezyan*[1], *Ashish Tiwari*[2], *Prabhakar Pradhan*[1], *Dhananjay Kunte*[2], *Hemant K. Roy*[2], *Vadim Backman*[1]; [1]*Northwestern Univ., USA,* [2]*Northshore Univ. Health System, USA*. Partial-wave spectroscopic microscopy (PWS) provide insights into the internal architecture of biological cells in terms of nanoscale disorder strength. Here we study its relation to the changes in cytoskeletal and nuclear architecture during early carcinogenesis.

BWB5 • 9:15 a.m.
Broadband Scatter Spectroscopy Imager for Breast Tumor Margin Delineation, ***Venkataramanan Krishnaswamy***[1], *Ashley M. Laughney*[1], *Kimberley S. Samkoe*[1], *Wendy A. Wells*[2], *Keith D. Paulsen*[1], *Brian W. Pogue*[1]; [1]*Dartmouth College, USA,* [2]*Dartmouth-Hitchcock Medical Ctr., USA*. A broadband scanning scatter spectroscopy imaging system has been developed to allow intra-operative assessment of lumpectomy tumor margins based on localized tissue scatter measures. Results from preliminary phantom measurements are discussed.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DWA • Holography: Techniques and Algorithms—Continued

DWA5 • 9:30 a.m.
Physical Compensation of Spherical Phase in Digital Holographic Microscopy by Use of Spherical Recording Reference Wave, *Weijuan Qu*[1], *Lewis Rongwei Tan*[1], *Oi Choo Chee*[1], *Yingjie Yu*[2], *Anand Asundi*[3]; [1]*Ngee Ann Ctr. of Innovation, NgeeAnn Polytechnic, Singapore,* [2]*Dept. of Precision Mechanical Engineering, Shanghai Univ., China,* [3]*School of Mechanical and Aerospace Engineering, Nanyang Technological Univ., Singapore*. A spherical reference wave interferes with the object wave from a microscope objective or spherical illumination. A numerical plane reference wave is preferred for the numerical reconstruction of the phase introduced by the test specimen.

DWA6 • 9:45 a.m.
Spectral Aperture Code Design for Multi-Shot Compressive Spectral Imaging, *Peng Ye,* ***Henry Arguello****, Gonzalo Arce; Univ. of Delaware, USA*. In this paper, we propose the design of spectral aperture code patterns for CASSI admitting multi-shot measurements, which leads to improve imaging quality, as well as spectral band selectivity.

BWA • Brain Monitoring and Imaging II—Continued

BWA7 • 9:30 a.m.
Laser Speckle Imaging in the Spatial Frequency Domain, *Amaan Mazhar*[1], *Tyler B. Rice*[1], *David J. Cuccia*[2], *Bernard Choi*[1], *Anthony J. Durkin*[1], *David A. Boas*[3], *Bruce J. Tromberg*[1]; [1]*Univ. of California at Irvine, USA,* [2]*Modulated Imaging Inc., USA,* [3]*NMR, General Hospital, Harvard Medical School, USA*. We present model development to calculate speckle contrast in the spatial frequency domain and show experimental results to demonstrate the effects of gating long path length photons using this method.

BWA8 • 9:45 a.m.
Three-Dimensional Diffuse Optical Tomography in the Human Brain, *Haijing Niu*, *Zi-Jing Lin, Fenghua Tian, Sameer Dhamne, Hanli Liu; Univ. of Texas at Arlington, USA*. We report the three-dimensional tomographic localization of the functional activation in the human brain. To this end we developed a new depth compensation algorithm (DCA), and its validity is illustrated by simulation and experimental evidence.

BWB • Clinical Applications of Spectroscopy—Continued

BWB6 • 9:30 a.m.
Quantitative Optical Spectroscopy for Pancreatic Cancer Detection, *Robert H. Wilson*, *Malavika Chandra, William Lloyd, James Scheiman, Diane Simeone, Julianne Purdy, Barbara McKenna, Mary-Ann Mycek; Univ. of Michigan, USA.* We report novel optical diagnostic algorithms for clinical pancreatic tissue classification, including a photon-tissue interaction model developed to extract biophysical parameters from reflectance and fluorescence spectra to distinguish pancreatic adenocarcinoma from normal tissue and pancreatitis.

BWB7 • 9:45 a.m.
Fiber-Optic Spectrometer to Monitor Intra-Operative Hemodynamics, *Steve Jacques, Thai Pham, Kyle Perry, John Hunter, Frederick Treuffer,* ***Daniel S. Gareau****; Dept. of Surgery and Biomedical Engineering, Oregon Health and Science Univ., USA.* Diffuse reflectance spectroscopy enables noninvasive measurement of blood fraction content and hemoglobin oxygen saturation during surgery. We created a spectrometer and observed the hemodynamic dynamics during esophagectomy.

10:00 a.m.–10:30 a.m. Coffee Break/Exhibits, *Richelieu Room*

NOTES

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DWB • 3-D Imaging and Display

Wednesday, April 14
10:30 a.m.–12:30 p.m.
David Brady; Duke Univ., USA, Presider
Bahram Javidi; Univ. of Connecticut, USA, Presider

DWB1 • 10:30 a.m. **Invited**

3-D Display and Interface Based on Wavefront Synthesis, *Osamu Matoba*, *Kouichi Nitta; Kobe Univ., Japan*. A three-dimensional display system based on wavefront synthesis is presented. The system includes the detection of wavefront data of three-dimensional objects. Wide viewing zone with coherent amplification and wavefront manipulation are presented.

DWB2 • 11:00 a.m. **Invited**

Avenues for Expanded Applicability in Photorefractive Based Holographic 3-D Displays, *Cory Christenson*[1], *P. A. Blanche[1], R. Voorakaranam[1], A. Bablumian[2], J. Thomas[1], M. Yamamoto[3], R. A. Norwood[1], N. Peyghambarian[1]; [1]Univ. of Arizona, USA, [2]TIPD, LLC., USA, [3]Nitto Denko Technical, USA.* The first updatable three-dimensional holographic display based on a photorefractive polymer device, exhibiting a fast response, long persistency, and phase stability is discussed. Material and optical setup changes for new and broader applications are outlined.

BWC • Novel Probes and Tissue Studies

Wednesday, April 14
10:30 a.m.–12:30 p.m.
Sergio Fantini; Tufts Univ., USA, Presider
Hanli Liu; Univ. of Texas at Arlington, USA, Presider

BWC1 • 10:30 a.m.

Deep Tissue Temperature Measurements by Correcting for the Effect of Bound Water on the NIR Water Spectra, *So Hyun Chung*[1], *Albert E. Cerussi[2], Sean Merritt[3], Bruce J. Tromberg[2]; [1]Univ. of Pennsylvania, USA, [2]Univ. of California at Irvine, USA, [3]Masimo Corp., USA.* Using broadband Diffuse Optical Spectroscopy, deep tissue temperature was measured non-invasively by correcting bound water effect. Results from phantoms correlated with invasive thermal probe ($R^2=0.93$, $\Delta=1.1\pm0.91$°C, 28-48°C) and temperature in *in vivo* human forearms was measured.

BWC2 • 10:45 a.m.

Selective Excitation Light Fluorescence (SELF) Imaging, *Mehrnoush Khojasteh*[1,2], *Calum MacAulay[1]; [1]Cancer Imaging Dept., British Columbia Cancer Res. Ctr., Canada, [2]Electrical Engineering Dept., Univ. of British Columbia, Canada*. A system for SELF imaging is demonstrated. By using a multitude of illumination wavelengths or a weighted sum of illumination wavelengths, SELF imaging can highlight differences in the excitation spectra of fluorophores in the sample.

BWC3 • 11:00 a.m.

Gold Nanoshell Enhanced Fluorophores for Multi-Frequency near Infrared Fluorescence Optical Tomography, *Marc Bartels*[1], *Wenxue Chen[1], Rizia Bardhan[2], Naomi J. Halas[2], Amit Joshi[1]; [1]Dept. of Radiology, Baylor College of Medicine, USA, [2]Dept. of Chemistry, Rice Univ., USA*. We investigate reflectance mode multi-frequency domain optical imaging with novel theranostic silica core gold nanostructures with Indocyanine Green. From phase sensitive images from homodyne measurements we determine optimal measurement parameters for nanoshell enhanced fluorescent dyes.

BWC4 • 11:15 a.m.

Fluorescence Diffuse Optical Tomography Using Upconverting Nanoparticles, C*an T. Xu*, *Johan Axelsson, Stefan Andersson-Engels; Dept. of Physics, Lund Univ., Sweden*. In the fluorescence diffuse optical tomography (FDOT) problem, suppressing background is of utmost importance. We demonstrate autofluorescence-insensitive FDOT using upconverting nanoparticles and methods to exploit the nonlinearity to obtain reconstructions of higher resolutions.

BWD • Clinical Applications of Imaging

Wednesday, April 14
10:30 a.m.–12:30 p.m.
Yang Pu; CCNY,USA, Presider

BWD1 • 10:30 a.m. **Invited**

Near-Infrared Fluorescence Imaging and Tomography to Assess Lymphovascular Disorders, *Eva M. Sevick-Muraca*; *Univ. of Texas, USA*. Currently there are no methods available with the sensitivity, spatial or temporal resolution to image the lymphatics non-invasively. Herein, we present NIR fluorescence imaging of human lymphatic function and describe lymphangiography using NIR fluorescence tomography.

BWD2 • 11:00 a.m.

Quantitative Image Analysis to Predict the Neoplastic Region in Oral Squamous Cell Carcinoma Using Multiple Fluorescent Contrast Agents, *Kelsey J. Rosbach*[1,2], *Michelle Williams[2], Ann Gillenwater[2], Rebecca Richards-Kortum[1]; [1]Rice Univ., USA, [2] Univ. of Texas M.D. Anderson Cancer Ctr.,USA*. Three probes targeting molecular or morphologic characteristics of cancer were topically applied to freshly resected oral tissue. Optical contrast was used to predict the region of neoplasia; predicted regions agree well with histopathology maps.

BWD3 • 11:15 a.m.

A Fiber-Optic Fluorescence Microscope Using a Consumer-Grade Digital Camera for *in vivo* Cellular Imaging, *Dong Suk Shin*[1], *Mark Pierce[1], Ann Gillenwater[2], Rebecca Richards-Kortum[1]; [1]Rice Univ., USA, [2]Univ. of Texas M.D. Anderson Cancer Ctr., USA.* We demonstrate a fiber-optic fluorescence microscope using a consumer-grade camera for *in vivo* cellular imaging. This portable, inexpensive device may be useful as a diagnostic tool at the point-of-care in low-resources settings.

Napoleon I	Napoleon II	Napoleon III
Digital Holography and Three-Dimensional Imaging (DH)	Biomedical Optics (BIOMED)	Biomedical Optics (BIOMED)

DWB • 3-D Imaging and Display—Continued

DWB3 • 11:30 a.m.

CSpace- Static Volumetric Display, *Hakki H. Refai*; *3DIcon Corp., USA*. Single-color three-dimensional (3-D) images with natural depth cues and without flicker are generated by utilizing two digital micromirror devices (DMD) that provide fast scanning of the image space doped with upconversion materials.

DWB4 • 11:45 a.m.

Improvement of Image Quality of Horizontal Scanning Holographic Display, *Yasuhiro Takaki*, *Naoya Okada; Tokyo Univ. of Agriculture and Technology, Japan*. The horizontal scanning holographic display offers a wide viewing angle and a large screen size. The reconstructed image quality is improved by compensating the scanning error and the focusing error in the hologram calculation process.

DWB5 • 12:00 p.m.

Digital Holographic Binocular Stereopsis, *Takanori NOMURA*, *Yutaka Mori; Wakayama Univ., Japan*. The stereopsis binocular vision based on a digital holography is proposed. In this study, preliminary experimental results using digital holograms recorded by two imaging devices are presented.

BWC • Novel Probes and Tissue Studies—Continued

BWC5 • 11:30 a.m.

Using Optical Stretching to Explore Pluripotent Stem Cells: Mechanics Influences First Fate Decisions, *Kevin Chalut*, *Penelope Hayward, Franziska Lautenschlaeger, Chea Lim, Alfonso Martinez-Arias, Jochen Guck; Univ. of Cambridge, UK*. We measured the mechanical characteristics of pluripotent stem cells using the optical stretcher. We found dramatic differences between stem cells that retain their pluripotency and those that will eventually differentiate. We will discuss biological implications.

BWC6 • 11:45 a.m.

Changes of NADH and Collagen Contents as Biomarkers in Cancerous Prostate Tissue Analyzed by Selective Excitation Fluorescence, *Yang Pu*, *Wubao Wang, Guichen Tang, Robert R. Alfano; Inst. for Ultrafast Spectropscopy and Lasers, CUNY , USA*. The relative content changes of collagen and NADH in cancerous prostate tissue were demonstrated by selective excitation fluorescence (SEF) spectra with pump wavelength of 340nm. The changes may present fluorescent biomarker for prostate cancer detection.

BWC7 • 12:00 p.m.

Evaluation of an Ultra-Slim Objective for Second Harmonic Generation Imaging, *Sara M. Landau*[1], *Brenda Baggett[1], Urs Utzinger[1], Tomasz Tkaczyk[2], Michael Descour[1]; [1]Univ. of Arizona, USA, [2]Rice Univ., USA*. Non-linear microscopy has the potential to provide clinically useful information on the structure of biological tissue *in vivo*. By using a prototype, all-plastic, 0.8-mm diameter microscope objective, SHG images were acquired of rat-tail collagen fibers.

BWD • Clinical Applications of Imaging—Continued

BWD4 • 11:30 a.m.

Derivation and Validation of Metrics for Breast Cancer Diagnosis from Diffuse Optical Tomography Imaging Data, *Randall L. Barbour*[1], *Harry L. Graber[1], Yaling Pei[2,3], Yong Xu[1], Daniel C. Lee[1,2], Michael S. Katz[4,5], Naresh Patel[5], Kuppuswamy Jagarlamudi[3,6], Onyeoziri R. Nwanguma[6,7], William B. Solomon[4,7]; [1]SUNY Downstate Medical Ctr., USA, [2]NIRx Medical Technologies, USA, [3]Brooklyn Hospital Ctr., USA, [4]Drexel Univ. College of Medicine, USA, [5]Kaiser Permanente Modesto Medical Ctr., USA, [6]Penn State Hershey Medical Ctr., USA, [7]Maimonides Medical Ctr., USA*. Application of functional near infrared spectroscopic imaging to breast-cancer diagnosis is explored in a clinical pilot study. Examination of differences between image time series of the simultaneously examined breasts yields sensitivity and specificity > 95%.

BWD5 • 11:45 a.m.

NIR Fluorescence Imaging for *in vivo* Assessment of Normal and Diseased Lymphatics, *I-Chih Tan*[1], *John C. Rasmussen[1], Milton V. Marshall[1], Erik A. Maus[1,2], Caroline E. Fife[1,2], Latisha A. Smith[1], Eva M. Sevick-Muraca[1]; [1]Univ. of Texas Health Science Ctr. Houston, USA, [2]Memorial Hermann Ctr. for Lymphedema Management, USA*. Near-infrared fluorescence imaging with microdose indocyanine green was used to visualize the normal and diseased lymphatic structure and quantify the lymphatic function *in vivo*. Lymphatic function was significantly improved after manual lymphatic drainage.

BWD6 • 12:00 p.m.

Real-Time Intra-Operative Fluorescence Imaging with Targeted Fluorophores, *George Themelis*[1], *Athanasios Sarantopoulos[1], Niels J. Harlaar[1], Gooitzen M. van Dam[2], Vasilis Ntziachristos[1]; [1]Inst. for Biological and Medical Imaging, Technische Univ. München and Helmholtz Ctr. Munich, Germany, [2]Dept. of Surgery and BioOptical Imaging Ctr. Groningen, Univ. Medical Ctr. Groningen, Netherlands*. We present a multispectral imaging system for real-time measurement of fluorescence probes with molecular specificity to tumor biomarkers. Results demonstrate the capability to identify tumor with high specificity and provide real-time feedback to the surgeon.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DWB • 3-D Imaging and Display—Continued

DWB6 • 12:15 p.m.
Three-Dimensional Imaging of Light-Induced Refractive Index Gratings Using Digital Holographic Microscopy, *Chau-Jern Cheng*[1], *Yu-Chih Lin[1], Han-Yen Tu[2]; [1]Inst. of Electro-Optical Science and Technology, Natl. Taiwan Normal Univ., Taiwan, [2]Dept. of Electronic Engineering, St. John's Univ., Taiwan*. We propose and demonstrate a novel technique for *in situ* measuring light-induced refractive index gratings in εποξψ ρεσιν using digital holographic microscopy, which offers the possibility of direct observation of holographic recording in microscopic view.

BWC • Novel Probes and Tissue Studies—Continued

BWC8 • 12:15 p.m.
Diffuse Optical Perfusion and Oxygenation Monitoring in a Mouse Model of Hindlimb Ischemia, *Rickson C. Mesquita*[1], *Nicolas Skuli[2,3], Meeri N. Kim[1], Jiaming Liang[1,4], Amar J. Majmundar[2,5], M. Celeste Simon[2,3,6], Arjun G. Yodh[1]; [1]Dept. of Physics and Astronomy, Univ. of Pennsylvania, USA, [2]Abramson Family Cancer Res. Inst., Univ. of Pennsylvania, USA, [3]Howard Hughes Medical Inst., Univ. of Pennsylvania, USA, [4]Xi'an Jiaotong Univ., China, [5]School of Medicine, Univ. of Pennsylvania, USA, [6]Dept. of Cell and Developmental Biology, Univ. of Pennsylvania, USA*. We employ diffuse correlation and reflectance spectroscopies to monitor perfusion and oxygenation in mice after hindlimb ischemia. Perfusion results were compared with laser Doppler flowmetry and validated as new tools to assess limb perfusion.

BWD • Clinical Applications of Imaging—Continued

BWD7 • 12:15 p.m.
Limitations of Laser Surgery Navigation via Autofluorescence Imaging, *Alexandre Douplik*, *Azhar Zam, Angelos Kalitzeos, Ralph Hohenstein, Emeka Nkenke, Florian Stelzle; Friedrich-Alexander Univ. Erlangen-Nürnberg, Germany*. Laser surgery navigation via autofluorescence imaging was investigated and preliminary results are presented. The present study highlights the limitation of surgical navigation of cancer removal under conditions of high power effects in biological tissues.

12:30 p.m.–1:30 p.m. Lunch Break *(on your own)*

NOTES

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

DWC • Entrepreneurship in Optics I

Wednesday, April 14
1:30 p.m.–3:30 p.m.
George Barbastathis; MIT, USA, Presider
Michel Gross; CNRS, France, Presider

DWC1 • 1:30 p.m. **Invited**

Holographic Displays for Future IT, *Frank C. Fan*; *AFC Technology Co., Ltd., China*. Real time holographic display by simple aggregation of digital *camera-projector array* is demonstrated as the rudimentary *holographic TV* by holographic thoughts but getting rid of the necessity of coherent interference for conventional holography.

DWC2 • 2:00 p.m. **Invited**

The Way of the OPTWARE, *Hideyoshi Horimai*; *HolyMine Corp., Japan*. The concept that "Holographic Data Storage", "3D Display", "Holographic Printer", and "Fuzzy Search" link by light as a career defined "OPTWARE". In this presentation, latest progress will be introduced with real venture-challenging story.

BWE • Photoacoustic Imaging and Spectroscopy I

Wednesday, April 14
1:30 p.m.–3:30 p.m.
Paul C. Beard; Univ. College London, UK, Presider
Wiendelt Steenbergen; Univ. of Twente, Netherlands, Presider

BWE1 • 1:30 p.m. **Invited**

Three-Dimensional Optoacoustic Imaging System and Its Applications for Functional and Molecular Imaging, *Alexander Oraevsky*[1,2], *Sergey Ermilov[1], Richard Su[1], Hans-Peter Brecht[1], Andre Conjusteau[1], Vyacheslav Nadvoretsky[1], Chanda Nripen[3], Ravi Shukla[3], Ajit Zambre[3], Raghuraman Kannan[3]; [1]Fairway Medical Technologies Inc., USA, [2]Seno Medical Instruments, USA, [3]Univ. of Missouri, USA*. Optoacoustic system designed for three-dimensional whole body tomography of small animals is presented. Technical specifications, methods of signal and image processing and applications in functional imaging of vasculature and molecular imaging of cancer are discussed.

BWE2 • 2:00 p.m.

Simultaneously Imaging Oxygen Saturation and Blood Flow Using Optical-resolution Photoacoustic Microscopy, *Junjie Yao*, *Konstantin I. Maslov, Lihong V. Wang; Washington Univ. in St. Louis, USA*. By the use of dual-wavelength light excitation and bidirectional motor scanning, optical-resolution photoacoustic microscopy images oxygen saturation and blood flow of the mouse ear simultaneously.

BWE3 • 2:15 p.m.

Integrated Photoacoustic and Optical Coherence Microscopy and Its Biomedical Applications, *Li Li*, *Bin Rao, Vassiliy Tsytsarev, Lihong V. Wang; Washington Univ. in St. Louis, USA.* We have developed a fast-scanning reflection-mode dual-modality microscope integrating photoacoustic microscopy and optical coherence tomography for microcirculation studies. Its potential applications in ophthalmology and neuroscience studies were demonstrated.

BWF • Clinical Applications of Diffuse Optics I

Wednesday, April 14
1:30 p.m.–3:30 p.m.
David Boas; Harvard Medical School, USA, Presider
Brian Pogue; Dartmouth College, USA, Presider

BWF1 • 1:30 p.m. **Invited**

Clinical Metabolic Imaging Using Diffuse Optics, *Bruce Tromberg*; *Beckman Laser Inst., Univ. of California at Irvine, USA*. Abstract not available.

BWF2 • 2:00 p.m.

Comparison of Classification Methods for Detection of Rheumatoid Arthritis with Optical Tomography, *Ludguier D. Montejo*[1], *Julio D. Montejo[2], Hyun K. Kim[1], Uwe J. Netz[3,4], Christian D. Klose[1], Sabine Blaschke[5], P. A. Zwaka[6], Gerhard A. Müller[5], Jürgen Beuthan[3,4], Andreas H. Hielscher[1,7]; [1]Dept. of Biomedical Eng., Columbia Univ., USA, [2]Dept. of Mathematics, Harvard Univ., USA, [3]Laser- und Medizin-Technologie GmbH, Germany, [4]Inst. for Medical Physics and Laser Medicine, Charite –Medical Univ., Germany, [5]Dept. of Nephrology and Rheumatology, Georg August Univ., Germany, [6]Dept. of Radiology, Georg August Univ., Germany, [7]Dept. of Radiology, Columbia Univ., USA.* Using optical tomographic data from fingers affected by RA we compare the performance of 3 different classification methods. Linear discriminant and quadratic discriminant analysis methods yield high sensitivities while support-vector machine-based methods yield high specificities.

BWF3 • 2:15 p.m.

Diffuse Optical Spectroscopy and Tomography for Monitoring Chemotherapy Efficacy in Locally Advanced Breast Cancer, *Hany Soliman, Anoma Gunasekara, Martin Yaffe,* ***Gregory J. Czarnota****; Sunnybrook Health Sciences Ctr., Canada.* Tomographic diffuse optical spectroscopy parameters of Hb, HbO_2, %water and scattering power can be used as an early detector of final pathologic tumour response in women treated with neoadjuvant therapy for locally advanced breast cancer.

Napoleon I
Digital Holography and Three-Dimensional Imaging (DH)

DWC • Entrepreneurship in Optics I—Continued

DWC3 • 2:30 p.m. **Invited**
Holographic Microscopy: From the Idea to the Market, ***Christian Depeursinge***; *École Polytechnique Fédérale de Lausanne, Switzerland.* Abstract not available.

DWC4 • 3:00 p.m. **Invited**
Title to Be Announced, ***Kevin Curtis***; *InPhase Technologies, USA*. Abstract not available.

Napoleon II
Biomedical Optics (BIOMED)

BWE • Photoacoustic Imaging and Spectroscopy I—Continued

BWE4 • 2:30 p.m.
Naturally Combined Photoacoustic Microscopy and Optical Coherence Tomography for Simultaneous Multimodal, ***Hao Zhang***[1], *Shuliang Jiao*[2]; [1]*Univ. of Wisconsin at Milwaukee, USA,* [2]*Univ. of Southern California, USA*. A combined photoacoustic microscopy and spectral-domain optical coherence tomography is developed for simultaneous multimodal volumetric microscopic imaging of both optical absorption and scattering contrasts in biological tissues.

BWE5 • 2:45 p.m.
Optical-Resolution Photoacoustic Microscopy with Improved Sensitivity and Scanning Speed, ***Song Hu***, *Konstantin Maslov, Lihong V. Wang; Washington Univ. in St. Louis, USA*. We improved the sensitivity and the scanning speed of optical-resolution (3.8 μm in transverse direction) photoacoustic microscopy by 11.4 dB and 3 fold, respectively. *Ex vivo* and *in vivo* investigations are provided.

BWE6 • 3:00 p.m.
Dynamic High-Resolution 3-D Photoacoustic Microscopy with Cylindrically Focused Optical Illumination, ***Liang Song***[1], *Konstantin Maslov*[1], *K. Kirk Shung*[2], *Lihong V. Wang*[1]; [1]*Washington Univ. in St. Louis, USA,* [2]*Univ. of Southern California, USA*. We developed ultrasound-array-based photoacoustic microscopy capable of 2-D and 3-D imaging at 249 and 0.5 Hz, respectively. With cylindrically focused optical illumination, it achieved 28-micron elevational-resolution, enabling dynamic high-resolution 3-D imaging of microvasculature *in vivo*.

BWE7 • 3:15 p.m.
Photoacoustic Imaging of Transgenic Mouse Embryos, ***Jan Laufer***, *Jon Cleary, Edward Zhang, Mark Lythgoe, Paul Beard; Univ. College London, UK*. High resolution 3-D photoacoustic images were obtained in *ex vivo* transgenic mouse embryos for the study of the genetic origins of vascular malformation.

Napoleon III
Biomedical Optics (BIOMED)

BWF • Clinical Applications of Diffuse Optics I—Continued

BWF4 • 2:30 p.m.
Near-Infrared, Diffuse-Correlation-Spectroscopy Evaluation of Cerebral Hemodynamics with Acetazolamide Challenge in Healthy and Acute Ischemic Stroke Subjects, ***Peyman Zirak***[1], *Raquel Delgado-Mederos*[2], *Udo Weigel*[1], *Mehmet Suzen*[1], *Joan Marti-Fabregas*[2], *Turgut Durduran*[1]; [1]*ICFO, Spain,* [2]*Dept. of Neurology, Hospital de la Santa Creu i Sant Pau, Spain*. The effect of Acetazolamide on cerebral blood flow is studied on healthy and ischemic stroke patients to assess the cerebrovascular reactivity, by combined near-infrared-spectroscopy, diffuse-correlation-spectroscopy and transcranial Doppler techniques.

BWF5 • 2:45 p.m.
Fiber-Optic and Articulating Arm Implementations of Laminar Optical Tomography for Clinical Applications, ***Sean A. Burgess***[1], *Desiree Ratner*[2], *Brenda R. Chen*[1], *Elizabeth M. C. Hillman*[1]; [1]*Columbia Univ., USA,* [2]*Columbia Univ. Medical Ctr., USA*. We report on laminar optical tomography implemented through a fiber optic bundle and an articulating arm. The setup facilitates increased access to tissues in a clinical setting.

BWF6 • 3:00 p.m.
Diffuse Optical Measurements of Cerebral Blood Flow and Blood Oxygenation during Head Elevation in Healthy and Brain-Injured Adults, ***Meeri N. Kim***, *Turgut Durduran, Brian L. Edlow, Erin M. Buckley, Rickson C. Mesquita, M. Sean Grady, Joshua M. Levine, Joel H. Greenberg, John A. Detre, Arjun G. Yodh; Univ. of Pennsylvania, USA*. We employed near-infrared and diffuse correlation spectroscopies to investigate variation in cerebral blood flow and hemoglobin concentration during head elevation in both healthy and brain-injured cohorts.

BWF7 • 3:15 p.m.
Detection of Decreased Cerebral Blood Volume and Oxygen Saturation in Folate Deficient Rats Using Non-Invasive Near-Infrared Spectroscopy, ***Bertan Hallacoglu***[1], *Angelo Sassaroli*[1], *Irwin H. Rosenberg*[2], *Sergio Fantini*[1], *Aron Troen*[2]; [1]*Dept. of Biomedical Engineering, Tufts Univ., USA,* [2]*Nutrition and Neurocognition Lab, Jean Mayer USDA Human Nutrition Res. Ctr. on Aging, Tufts Univ., USA*. We report non-invasive, absolute measurements of cerebral hemodynamics with frequency-domain, near infrared spectroscopy on a rat model of vascular cognitive impairment. Folate deficiency was found to induce measurable hemodynamic changes.

3:30 p.m.–4:00 p.m. Coffee Break/Exhibits, *Richelieu Room*

Napoleon I
Digital Holography and Three-Dimensional Imaging (DH)

DWD • Entrepreneurship in Optics II
Wednesday, April 14
4:00 p.m.–5:30 p.m.
George Barbastathis; MIT, USA, Presider
Michel Gross; CNRS, France, Presider

DWD1 • 4:00 p.m. **Invited**

Title to Be Announced, *Christophe Moser*; *Ondax, Inc., USA*. Abstract not available.

Closing Remarks 4:30 p.m.– 5:30 p.m

Napoleon II
Biomedical Optics (BIOMED)

BWG • Photoacoustic Imaging and Spectroscopy II
Wednesday, April 14
4:00 p.m.–6:00 p.m.
Ben Cox; Univ. College London, UK, Presider
Roger Zemp; Univ. Alberta, Canada, Presider

BWG1 • 4:00 p.m.

Stimulated Raman Photoacoustic Imaging, *Vladislav V. Yakovlev*, *Hao Zhang; Univ. of Wisconsin at Milwaukee, USA*. We demonstrate a feasibility of molecular contrast imaging in deep tissue by successfully combining chemically-selective, stimulated Raman photoexcitation with ultrasound detection.

BWG2 • 4:15 p.m.

Optoacoustic Sensor with a Unique Open-Cavity Structure, *Colin M. Chow*[1], *Yun Zhou*[1], *Yunbo Guo*[1], *Theodore Norris*[1], *Xueding Wang*[1], *Cheri Deng*[1], ***Jing Yong Ye***[2]; [1]*Univ. of Michigan, USA*, [2]*Univ. of Texas at San Antonio, USA*. We demonstrate the feasibility of fabricating an open optical micro-cavity using a photonic crystal structure in a total-internal-reflection configuration. An optoacoustic sensor has been constructed based on this structure for sensitive, high-frequency ultrasound detection.

BWG3 • 4:30 p.m.

Quantitative Photoacoustic Tomography with Fluence-Dependent Absorbers, *Ben Cox*; *Univ. College London, UK*. In photoacoustic tomography, by using a contrast agent that absorbs only above or below a certain fluence threshold its concentration could be estimated using only singlewavelength images by varying the illumination intensity.

BWG4 • 4:45 p.m.

Quantitative Multiple-Source Photoacoustic Tomography, *Roger Zemp*; *Univ. of Alberta, Canada*. A technique for producing quantitative photoacoustic images is introduced when multiple optical sources are used. Simulations demonstrate that multiple-optical-source photoacoustic imaging can produce quantitative images of absorption perturbations in a known turbid background.

Napoleon III
Biomedical Optics (BIOMED)

BWH • Clinical Applications of Diffuse Optics II
Wednesday, April 14
4:00 p.m.–6:00 p.m.
Robert J. Nordstrom; Univ. of Illinois at Urbana-Champaign, USA, Presider
Go van Dam; Univ. Medical Ctr. Univ. Medical Ctr. Groninge, Netherlands, Presider

BWH1 • 4:00 p.m. **Invited**

Deep-Tissue Imaging of Morphology and Molecular Function with Multispectral Optoacoustic Tomography, *Daniel Razansky*; *Technical Univ. of Munich, Germany*. Multispectral optoacoustic tomography has been proving an excellent tool for simultaneous anatomical, functional and molecular interrogation of living tissues, owning to its versatile contrast and good spatial resolution. The talk deals with current applications, technical challenges and future perspectives of the method in biological research and the clinics.

BWH2 • 4:30 p.m.

Imaging the Binding State and Mobility of Water Molecules Using Diffuse Optical Spectroscopic Imaging (DOSI) and Diffusion-Weighted MRI, *So Hyun Chung*[1], *Hon Yu*[2], *Min-Ying Su*[2], *Bruce J. Tromberg*[2]; [1]*Univ. of Pennsylvania, USA*, [2]*Univ. of California at Irvine, USA*. Detailed tissue water property measurements were obtained in breast cancer patients using diffuse optical spectroscopic and diffusion weighted magnetic resonance imaging. Optical bound water index and apparent diffusion coefficients of MRI positively correlated ($R=0.8$, $p<0.01$).

BWH3 • 4:45 p.m.

Development of a Trans-Rectal Applicator toward Imaging Human Prostate-Cancer by Ultrasound-Coupled Near-Infrared Optical Tomography, *Daqing Piao*[1], *Zhen Jiang*[1], *Gennady Slobodov*[2]; [1]*Oklahoma State Univ., USA*, [2]*Univ. of Oklahoma Health Sciences Ctr., USA*. A trans-rectal optical tomography applicator for imaging human prostate is being developed. The optical applicator that contains 9 source and 13 detector channels is coupled to a bi-plane trans-rectal ultrasound probe with needle-biopsy assembly.

Napoleon I Digital Holography and Three-Dimensional Imaging (DH)	Napoleon II Biomedical Optics (BIOMED)	Napoleon III Biomedical Optics (BIOMED)

BWG • Photoacoustic Imaging and Spectroscopy II—Continued

BWG5 • 5:00 p.m.
Towards Quantitative Imaging of Absorption Coefficients in Turbid Media by Combining Photoacoustic and Acousto-Optic Imaging, ***Wiendelt Steenbergen***; *Univ. of Twente, Netherlands*. It is demonstrated by simulations that absolute absorption coefficient imaging is feasible by combining photoacoustic and acousto-optic imaging. The results give an outlook on truly quantitative chromophore imaging technology without use of computational models.

BWG56 • 5:15 p.m.
Deconvolution-Based Image Reconstruction for Photoacoustic Tomography in Circular Geometry, ***Chi Zhang***, *Changhui Li, Lihong Wang; Dept. of Biomedical Engineering, Washington Univ. in St. Louis, USA*. This paper introduces a deconvolution-based algorithm for photoacoustic tomography in circular geometry. As demonstrated by the *in vivo* experiment, this algorithm runs fast and provides good image quality when detection angles are sparse.

BWG7 • 5:30 p.m.
Integrated Photoacoustic Microscopy and Fiber-Optic Confocal Microscopy Using Signal Laser Source, ***Shuliang Jiao***[1], *Hao F. Zhang*[2]; [1]*Univ. of Southern California, USA,* [2]*Univ. of Wisconsin at Milwaukee, USA*. By employing a 2×2 fiber optical coupler in a laser-scanning optical-resolution photoacoustic microscope for delivering the illuminating laser light and collecting the back reflected photons, a fiber-optic confocal microscope is integrated with the photoacoustic microscope.

BWG8 • 5:45 p.m.
Multiphoton High-Resolution Photoacoustic Microscopy, *Ryan L. Shelton,* ***Brian E. Applegate***; *Texas A&M Univ., USA*. We have developed a novel photoacoustic microscopy technique, Transient Ultrasonic Absorption Microscopy, which achieves all optical spatial resolution by fusing pump-probe spectroscopy with photoacoustic microscopy. This technique has the potential to enable cellular/subcellular photoacoustic imaging.

BWH • Clinical Applications of Diffuse Optics II—Continued

BWH4 • 5:00 p.m.
Optical Pacing of the Embryonic Heart, ***Michael W. Jenkins***[1], *Austin R. Duke*[2], *Shi Gu*[1], *Hillel J. Chiel*[1], *Michiko Watanabe*[1], *E. Duco Jansen*[2], *Andrew M. Rollins*[1]; [1]*Case Western Reserve Univ., USA,* [2]*Vanderbilt Univ., USA*. We demonstrate the first optical pacing of an intact embryonic heart *in vivo*. Pulsed 1.875 μm infrared laser light was employed to lock the heart rate to the pulse frequency of the laser.

BWH5 • 5:15 p.m.
Assessment of Rotator Cuff Tendon Integrity with Single Detector PS-OCT, *Christopher Rashidifard, Scott D. Martin, Ehsan Azimi, Namita Kumar, Bin Liu,* ***Mark E. Brezinski***; *Brigham and Women's Hospital, USA*. A clinical need exists for superior technologies to assess the tendon intraoperatively. Polarization sensitive OCT imaging of human rotator cuff tendon can be utilized to assess tendon microstructure. PS-OCT Assessments are highly correlated with histopathology.

BWH6 • 5:30 p.m.
Assessment of Diabetic Foot Ulcers with DPDW Methodology: A Pilot Human Study, *Michael Neidrauer, Leonid Zubkov, Michael S. Weingarten, Kambiz Pourrezaei,* ***Elisabeth S. Papazoglou***; *Drexel Univ., USA*. Sixteen human diabetic foot ulcers were interrogated using Diffuse Photon Density Wave (DPDW) methodology of Near Infrared spectroscopy. Temporal changes of oxy- and total hemoglobin concentration were significantly different in healing vs. non-healing wounds.

BWH7 • 5:45 p.m.
Characterization of a Novel Biodegradable Photoluminescent Polymer for Lifetime Dependent Thermometry in Tissues, ***Nimit Patel***[1], *Ajay Chalukunnil*[1], *Jian Yang*[1], *Bumsoo Han*[2], *Hanli Liu*[1], *George Alexandrakis*[1]; [1]*Univ. of Texas at Arlington, USA,* [2]*School of Mechanical Engineering, USA*. We have characterized the biodegradable photoluminescent polymer (BPLP) for lifetime dependent thermometry in tissues. Temperature sensitivity of the polymer has been tested through laboratory experiments and Monte Carlo (MC) simulations.

Closing Remarks , *Napoleon II*

6:00 p.m.– 6:15 p.m

	DH **Napoleon I**	**BIOMED** Napoleon II	**BIOMED** Napoleon III
Saturday, April 10			
3:00 p.m.–6:00 p.m.	**Registration Open,** *Napoleon Lobby*		
Sunday, April 11			
7:00 a.m.–6:00 p.m.	**Registration Open,** *Napoleon Lobby*		
7:30 a.m.–8:00 a.m.		**Opening Remarks**	
8:00 a.m.–10:00 a.m.		**BSuA • BIOMED Sunday Plenary**	
10:00 a.m.–10:30 a.m.	**Coffee Break,** *Richelieu Room*		
10:30 a.m.–12:30 p.m.		**BSuB • Breast Cancer Imaging and Monitoring**	**BSuC • Optical Coherence Tomography I**
12:30 p.m.–1:30 p.m.	**Lunch Break (***on your own* **)**		
1:30 p.m.–3:30 p.m.	**BSuD • BIOMED Sunday Poster Session,** *Richelieu Room*		
3:30 p.m.–4:00 p.m.	**Coffee Break,** *Richelieu Room*		
4:00 p.m.–6:00 p.m.		**BSuE • Imaging Theory**	**BSuF • Optical Coherence Tomography II** (ends at 6:15 p.m.)
Monday, April 12			
7:00 a.m.–6:30 p.m.	**Registration Open,** *Napoleon Lobby*		
7:30 a.m.–8:00 a.m.	**Opening Remarks**	**Opening Remarks (7:50 a.m.–8:00 a.m.)**	
8:00 a.m.–10:00 a.m.	**DMA • Fundamental Advances in Holography I**	**BMA • BIOMED Monday Plenary**	
10:00 a.m.–10:30 a.m.	**Coffee Break,** *Richelieu Room*		
10:00 a.m.–4:00 p.m.	**Exhibits Open,** *Richelieu Room*		
10:30 a.m.–12:30 p.m.	**DMB • Fundamental Advances in Holography II**	**BMB • Cancer Monitoring and Imaging**	**BMC • Advances in Non-Linear Microscopy**
12:30 p.m.–1:30 p.m.	**Lunch Break (on your own)**		
1:30 p.m.–3:30 p.m.	**JMA • BIOMED/DH Joint Poster Session,** *Richelieu Room*		
3:30 p.m.–4:00 p.m.	**Coffee Break/Exhibits,** *Richelieu Room*		
4:30 p.m.–6:00 p.m.	**DMC • Metrology by Digital Holography and Profilometry**	**BMD • Novel Approaches in Microscopy** (ends at 6:15 p.m.)	**BME • Imaging and Spectroscopy Theory**
6:00 p.m.–8:00 p.m.	**Conference Reception,** *Le Jardin*		

Key to Shading	
BIOMED Sessions	░
DH Sessions	▒
Joint Sessions	▓

	DH **Napoleon I**	**BIOMED** Napoleon II	**BIOMED** Napoleon III
Tuesday, April 13			
7:30 a.m.–6:00 p.m.	**Registration Open,** *Napoleon Lobby*		
7:50 a.m.–8:00 a.m.		**Opening Remarks**	
8:00 a.m.–10:00 a.m.	**DTuA • Holographic Microscopy**	**BTuA • BIOMED Tuesday Plenary**	
10:00 a.m.–10:30 a.m.	**Coffee Break,** *Richelieu Room*		
10:00 a.m.–4:00 p.m.	**Exhibits Open,** *Richelieu Room*		
10:30 a.m.–12:30 p.m.	**DTuB • Diffractive Optics and Imaging**	**BTuB • Brain Monitoring and Imaging I**	**BTuC • Nanomaterials and Molecular Probes**
12:30 p.m.–1:30 p.m.	**Lunch Break** *(on your own)*		
1:30 p.m.–3:30 p.m.	**BTuD • BIOMED Tuesday Poster Session,** *Richelieu Room*		
1:30 p.m.–3:30 p.m.	**DTuC • Biological Applications**		
3:30 p.m.–4:00 p.m.	**Coffee Break/Exhibits,** *Richelieu Room*		
4:00 p.m.–6:00 p.m.	**DTuD • DH Tutorials** (ends at 5:20 p.m.)	**BTuE • New Ideas and Techniques**	**BTuF • Biological and Drug Discovery Imaging** (ends at 6:15 p.m.)
Wednesday, April 14			
7:30 a.m.–5:00 p.m.	**Registration Open,** *Napoleon Lobby*		
7:50 a.m.–8:00 a.m.		**Opening Remarks**	
8:00 a.m.–10:00 a.m.	**DWA • Holography: Techniques and Algorithms**	**BWA• Brain Monitoring and Imaging II**	**BWB • Clinical Applications of Spectroscopy**
10:00 a.m.–10:30 a.m.	**Coffee Break/Exhibits,** *Richelieu Room*		
10:00 a.m.–4:00 p.m.	**Exhibits Open,** *Richelieu Room*		
10:30 a.m.–12:30 p.m.	**DWB • 3-D Imaging and Display**	**BWC • Novel Probes and Tissue Studies**	**BWD • Clinical Applications of Imaging**
12:30 p.m.–1:30 p.m.	**Lunch Break** *(on your own)*		
1:30 p.m.–3:30 p.m.	**DWC • Enterpreneurship in Optics I**	**BWE • Photoacoustic Imaging and Spectroscopy l**	**BWF • Clinical Applications of Diffuse Optics I**
3:30 p.m.–4:00 p.m.	**Coffee Break/Exhibits,** *Richelieu Room*		
4:00 p.m.–6:00 p.m.	**DWD • Enterpreneurship in Optics II** (ends at 5:30 p.m.)	**BWG •Photoacoustic Imaging and Spectroscopy ll**	**BWH • Clinical Applications of Diffuse Optics II**
6:00 p.m.–6:15 p.m.		**Closing Remarks**	

Key to Authors and Presiders

(**Bold** denotes Presider or Presenting Author)

Biomedical Optics and 3-D Imaging: OSA Optics & Photonics Congress 2010
Update Sheet

Tutorial Update:

The following tutorial has been added to session **DTuD•DH Tutorials.**

Hiroshi Yoshikawa; *Nihon Univ., Japan.*

Computer-Generated Hologram for 3-D Display–Point Oriented Approach

Tuesday, April 13, 2010

5:20 p.m. - 6:00 p.m.

Biography: Hiroshi Yoshikawa received a B.S. degree, M.S. degree and Ph.D. from Nihon University. He joined the faculty at Nihon University in 1985 where he currently holds the position of Professor of Electronics and Computer Science. He was a research affiliate of MIT Media Laboratory from 1988–1990. He is a member of OSA, SPIE, ITE (Institute of Television Engineers of Japan), and OSJ (Optical Society of Japan). His current research interests are electro-holography, computer generated holograms, display holography and computer graphics.

Abstract: Algorithm for the computer-generated hologram is reviewed. Point oriented approach uses object data as a collection of self-illuminated points. It is a very simple and powerful method for practical holograms.

Presider Update:

Lev Perelman; *Harvard Medical School, USA*, will preside over session **BMB•Cancer Monitoring and Imaging**, on Monday, April 12, 10:30 a.m.–12:30 p.m. in Napoleon II.

Substituted Papers:

The following paper will be presented in the **DMC3** time slot: **Wake Flows Analysis by Digital Color Holographic Interferometry, *Jean-Michel Desse*[1]**, *Pascal Picart*[2,3], *Patrice Tankam*[2]; [1]*Office Natl. d'Etudes et de Recherches Aérospatiales, France*, [2]*Lab d'Acoustique de l'Univ. du Maine, France*, [3]*Ecole Natl. Supérieure d'Ingénieurs du Mans, Univ. du Maine, France.* Digital 3λ holographic interferometry is shown for analyzing the variations in the refractive index induced by the wakeflow around a circular cylinder.

The following paper will be presented in the **DMC8** time slot: **Pattern Matching Estimator for Precise 3-D Particle Localization with Engineered Point Spread Functions, *Sean Quirin*[1]**, *Sri Rama Prasanna Pavani*[2], *Rafael Piestun*[1]; [1]*Univ. of Colorado at Boulder, USA*, [2]*Caltech, USA.* We present a 3-D particle localization estimator that uses phase retrieval to interpolate the calibration images of the point spread-function and finds the best fit to the measured data. We analyze the application to double-helix microscopy.

Paper **BTuD26, *In vivo* Imaging of the Proximal Interphalangeal (PIP) Finger Joint with Three-Dimensional Photoacoustic Tomography, *Yao Sun***, *Eric Sobel, Huabei Jiang; Univ. of Florida, USA.* Will be presented in the **BSuD96** time slot.

The following paper will be presented in the **BWD7** time slot: **BWD7p**, **Simulated Measurements of Optical Tissue Properties from Breast Tomosynthesis Guided Diffuse Spectroscopy**, ***Kelly E. Michaelsen***, *Venkataramanan Krishnaswamy, Brian W. Pogue, Keith D. Paulsen; Dartmouth College, USA.* This work studies an approach to combine tomosynthesis breast imaging with near infrared spectroscopy to determine tissue chromphore concentrations using spatial prior tomosythesis data and correlated scatter information.

Presenter Changes:

JMA75, **Improved Methods for Optical Determination of Uptake of Dye *in vivo* Rabbit Brain and *in vitro* Tissue Phantoms,** will now be presented by ***Irving J. Bigio***; *Boston Univ., USA.*

DMC7, Broadband 3-D Digital Holography for Depth Structure Visualization, will now be presented by ***Alexander Aleksandrovich Moiseyev***; *Russian Acad. of Sciences, Russian Federation.*

BTuD12, Signal-Locking Fourier Transform SPR: A New Low-Noise Detection Technique for Biomolecular Interactions, will now be presented by ***Tridib Ghosh***; *Univ. of Utah, USA.*

DTuE3, Broadband 3-D Digital Holography for Depth Structure Visualization, will now be presented by ***Alexander Aleksandrovich Moiseyev***; *Russian Acad. of Sciences, Russian Federation.*

BWB7, Fiber-Optic Spectrometer to Monitor Intra-Operative Hemodynamics, will be presented by ***Steve Jacques***; *Oregon Health and Science Univ., USA.*

Biomedical Optics and 3-D Imaging: OSA Optics & Photonics Congress 2010

Update Sheet

Author Block Corrections:

Please note the following affiliation correction,
BSuA, **BMA** and **BTuA**, ***Lihong Wang****; Washington University in St. Louis, USA, Presider*

Please note the following affiliation correction,
BWB and **BWH**, ***Robert J. Nordstrom***; *Natl. Cancer Inst., Natl. Inst. of Health, USA, Presider*

The following paper's author block has been updated,
BTuD93, Clinical Evaluation of a High-Resolution Microendoscope for Early Diagnosis of Cancer, ***Mark C. Pierce*[1]**, *Nadhi Thekkek[1], Kelsey Rosbach[1], Peter Thompson[2], Raymond Kaufman[2], Ann Gillenwater[3], Sharmila Anandasabapathy[4], Doreen Ramogola-Masire[5], Rebecca Richards-Kortum[1]; [1]Rice Univ., USA, [2]Methodist Hospital, USA, [3]Univ. of Texas MD Anderson Cancer Ctr., USA, [4]Mt. Sinai Medical Ctr., USA, [5]Univ. of Botswana School of Medicine, Princess Marina Hospital, Botswana.*

Withdrawals:

BsuD4
BSuD85
BSuD96
JMA67
BTuD3
BTuD52
BTuD73
BTuD86
BTuD99
BWD7

Postdeadline Paper Programs:

Postdeadline Paper Programs are available at Registration.

Biomedical Optics (BIOMED) Exhibitor

Topical Meeting and Tabletop Exhibit

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Exhibition: April 12-14, 2010
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One Broadway
Cambridge, MA 02142 USA
Phone: +1 617.401.2195
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Axiom Optics

1 Broadway, 14th Floor
Cambridge, MA 02142
Phone: +1.617.401.2198
Fax: +1.425.930.9818
Email: pclemenceau@axiomoptics.com
www.axiomoptics.com

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Phone: +1.203.492.7200
Fax: +1.203.492.5618
Email: jessica.gould@covidien.com
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DMS Technology, Inc.

2905 Westcorp Blvd., SW
Suite 220
Huntsville, AL 35805 USA
Phone: +1.256.536.4346
Fax: +1.256.536.8642
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98 Spit Brook Road
Nashua, NH 03062-5737 USA
Phone: +1.603.891.9420
Fax: +1.603.891.9290
Email: katrinaf@pennwell.com
www.optoiq.com/index.html

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1852 Century Place, NE
Atlanta, GA 30345 USA
Phone: “1.404.325.0005
Fax: +1.404.325.4082
khsu@micronoptics.com
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Lady's Island, SC 29907 USA
Phone: +1.843.521.1108
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Author Block Corrections:

Please note the following affiliation correction,
BSuA, **BMA** and **BTuA**, ***Lihong Wang***; *Washington University in St. Louis, USA, Presider*

Please note the following affiliation correction,
BWB and **BWH**, ***Robert J. Nordstrom***; *Natl. Cancer Inst., Natl. Inst. of Health, USA, Presider*

The following paper's author block has been updated,
BTuD93, Clinical Evaluation of a High-Resolution Microendoscope for Early Diagnosis of Cancer, ***Mark C. Pierce*[1]**, *Nadhi Thekkek[1], Kelsey Rosbach[1], Peter Thompson[2], Raymond Kaufman[2], Ann Gillenwater[3], Sharmila Anandasabapathy[4], Doreen Ramogola-Masire[5], Rebecca Richards-Kortum[1]; [1]Rice Univ., USA, [2]Methodist Hospital, USA, [3]Univ. of Texas MD Anderson Cancer Ctr., USA, [4]Mt. Sinai Medical Ctr., USA, [5]Univ. of Botswana School of Medicine, Princess Marina Hospital, Botswana.*

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