BIOMED

OSA Biomedical Topical Meetings and Tabletop Exhibit

April 14-17, 2004

Fontainebleau Hilton Resort and Towers
Miami Beach, Florida

Three collocated meetings:

Advances in Optical Imaging and Photon Migration (AOIPM)

Biomedical Optical Spectroscopy and Diagnostics (BOSD)

Optical Techniques in Neuroscience (OTN)

Including Special Sessions on:
BIO-OPTICS IN MOLECULAR IMAGING & DRUG DISCOVERY

and

Educational Lectures

The organizers of the Biomedical Topical Meetings would like to acknowledge the generous support of the following:

- Air Force Office of Scientific Research
- ART Advanced Research Technologies
- GE Healthcare
- IMRA
- InLight Solutions
- J&J
- National Institutes of Health
- NIRx Medical Technologies, LLC
- Pfizer
- Siemens Medical
- Society of Molecular Imaging

- Visen Medical
- Xenogen Corporation

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About Biomed

April 14-17, 2004

The Biomedical Optics meeting brings together three key meetings in the field and attracts leading experts. With over 350 attendees, this meeting affords attendees the opportunity to interact one-on-one with presenters. Multiple poster sessions allow for lively discussions about the latest research.

Advances in Optical Imaging and Photon Migration (AOIPM)

Scope

The recent emergence of biomedical optics as an intense and productive area of applied research has benefited from the interactions of scientists and engineers from a variety of disciplines, including optical physics, electrical engineering, mathematical modeling, physiology and computer science. The 2004 AOIPM meeting is intended as a primary forum for researchers within this diverse community to present and discuss the latest developments in optical imaging techniques for medical diagnostics and recent progress in the study of photon migration in human tissue. Topics cover new and evolving methods and instrumentation, theoretical and numerical modeling, and clinical and biomedical applications. A broad range of techniques will be covered, such as surface imaging, subsurface sensing and tomography. The meeting will also include sessions on new developments in the understanding and modeling of photon migration, and the development of image reconstruction algorithms. The program will include invited papers covering an expanding range of clinical applications, such as imaging of breast, brain, muscle, skin, the gastrointestinal tract and ophthalmology. This meeting, which represents the sixth in a series held every two years in Florida, has become the leading conference for presenting new developments in this field.

Topics

- Novel optical diagnostic techniques and instruments
- Optical tomography and transillumination of tissues
- Reconstruction algorithms for optical tomography
- Theory and modeling of light transport in tissue
- Time-of-flight and frequency domain systems
- Fluorescent lifetime imaging
- Confocal imaging and microscopy
- Optical coherence tomography
- 3D optical imaging of the brain
- Optical topography of brain function and evoked response
- Optical mammography

- Optical biopsy
- Optical imaging with contrast agents
- Photoacoustic imaging and acousto-optic interactions

Biomedical Optical Spectroscopy Imaging, & Diagnostics (BOSD)

Scope

The design of novel probes revealing the wealth of biochemical and structural information contained in optical signatures re-emitted from tissues offers new frontiers in the engineering of biomedical spectroscopy and diagnostics. Developments in fluorescence, phosphorescence, Raman, elastic scattering, reflectance and nonlinear spectroscopies in tissues continue to fuel advances in diagnostic capability. Recent advances include noninvasive analysis of tissue biochemistry and composition, in situ spectroscopic optical biopsy for disease detection and characterization, and novel methods of optical histopathology utilizing confocal, nonlinear and near-field scanning microscopy. Innovations in optical assays promise to complement radionucleotide approaches. The objective and scope of this topical meeting will be to highlight these and other frontiers of biomedical optical engineering that are directed towards new screening and diagnostic procedures in the clinic and through joint sessions with the AOIPM meeting, to explore the applications of multi-spectral imaging to cells and tissues.

Topics

- Reflectance spectroscopy of cells and tissues
- Fluorescence spectroscopy of cells and tissues
- Raman and infrared spectroscopy of cells and tissues
- Models of light scattering from cells and organelles or of light transport in tissue
- Polarized light imaging and spectroscopy of cells and tissues
- Instrumentation for spectroscopic tissue characterization
- Light Scattering properties of cells and organelles
- Models to interpret tissue spectral data
- Exogenous contrast agents for spectral diagnosis
- Application of cellular and molecular probes to tissues
- Advances in optical histopathology utilizing confocal, non-linear and near-field microscopy
- Advances in cytometry

- Time-resolved and frequency-domain spectroscopy in medicine
- Blood gas and constituent monitoring
- In vivo tissue perfusion monitoring
- Chemometrics
- Extension of spectroscopic diagnostics to imaging modalities
- Clinical Applications

Optical Techniques in Neuroscience (OTN)

Scope

This meeting will review the state of the art of optical techniques in neuroscience and will identify remaining problem areas, technological requirements and gaps in understanding. The cross-fertilization of neuroscientists, optical scientists, engineers, physicists and mathematicians should create an exciting educational atmosphere, stimulating discussion about new research directions and collaborations. Research presented will consider optical imaging of brain physiology/function on scales ranging from dendritic spines to the whole brain, and on temporal scales from sub-millisecond to seconds. The coupling between optical responses and physiological, biochemical, hemodynamic and biophysical components of neural activation will also be discussed.

Topics

Cerebral (patho)-physiology

- Mapping of brain activity
- Neurovascular coupling
- Spreading depression
- Plasticity
- Epileptic activity

Optical approaches

- Microscopic measurements: Confocal, Two-photon and optical coherence microscopy
- Intrinsic signals of brain:
    - Slow intrinsic signals
    - Fast intrinsic signal
- Near Infrared Spectroscopy and Diffusive Optical Imaging

- Development of optical contrast agents, including: voltage, temperature, calcium, and pH sensitive dyes
- Signal processing techniques, Photon migration algorithms

Invited Speakers

AOIPM

Multi-wavelength time-resolved optical mammography, Paola Taroni, *Politecnico di Milano, Italy* **ThB3**

Near-infrared tomography as a model-based imaging modality, Keith Paulsen, *Dartmouth Col., USA* **FB1**

Monitoring and imaging, Yutaka Yamashita, *Hamamatsu Photonics K. K., Japan* **WD3**

Non invasive optical biopsy using ultrahigh resolution optical coherence tomography, Wolfgang Drexler, *Univ. of Vienna, Austria* **SE1**

Ultrahigh resolution imaging using optical coherence tomography, James Fujimoto, *Massachusetts Inst. of Tech., USA* **FD1**

BOSD

Transport theory for light propagation in biological tissues, Arnold Kim, *Stanford Univ., USA***SD4**

To be announced, David Benaron, *Stanford Univ., USA* **ThC1**

Differential pathlength spectroscopy: A novel technique to determine the local optical properties of tissue in vivo, Arjen Amelink, *University Hospital Rotterdam, The Netherlands* **FG1**

Detecting pre-cancerous cells using angle-resolved low coherence interferometry, Adam Wax, *Duke Univ., USA* **SF1**

Nonlinear optical microscopy of tumors, Edward Brown, *Massachusetts General Hosp., USA* **FA2**

Optical molecular imaging for early detection of cancer, Rebecca Richards-Kortum, *Univ. of Texas at Austin, USA* **SB1**

Joint AOIPM and BOSD

In vivo microscopy and cytometry, applications in vascular biology, Charles Lin, *Massachusetts General Hosp., Wellman Lab. of Photomedicine, USA* **FA1**

High-resolution photoacoustic tomography, Lihong Wang, *Texas A&M Univ., USA* **WA2**

OTN

Functional optical coherence tomography of neurophysiology, Stephen Boppart, *Univ. of Illinois Urbana-Cham., USA* **FC1**

Exploring neurophysiology using diffuse optical imaging, Maria Angela Franceschini, *Harvard Medical School, USA* **WA1**

Second harmonic imaging microscopy, Leslie M. Loew, *Univ. of Connecticut Health Center, USA* **ThE1**

To be announced, Brian MacVicar, *Univ. of British Columbia, Canada* **FC4**

Biophysics, Brian Salzberg, *Univ. of Pennsylvania, USA* **WE1**

The mapping of olfactory functions in the Drosophila brain with calcium imaging, Jing W. Wang, *Columbia Univ., USA* **FE1**

Siemens Plenary Session

Monitoring enzymatic function and drug efficacy in vivo using novel fluorescence probes, Ching Tung, *Massachusetts General Hospital/Harvard Medical School, USA*. **WG1**

Spectral imaging for bio-molecular research and drug discovery, Dan Farkas, *Cedars Sinai Medical Ctr., USA*. **WG2**

GE Healthcare Joint Session

Non-invasive visible light imaging in drug discovery and development: A view from an industrial perspective, Peter Lassota, Novartis Pharmaceuticals Corp, USA. **ThA1**

Molecular and functional dissection of tumors by intravital microscopy, Dai Fukumura, *Steele Lab. Harvard/MGH, USA*. **ThA2**

Quantum dots as probes in biological imaging, Charlie Hotz, *Quantum Dot Corp, USA*. **ThA3**

NIR optical imaging of integrins and matrix metalloproteinases, Chun Li, *U.T. M.D. Anderson Cancer Ctr., USA*. **ThA4**

Microspectroscopic imaging of pharmaceutical products, Neil Lewis, *Spectral Dimensions, Inc, USA*. **ThA5**

Fluorescence Imaging, sponsored by the National Institutes of Health

Small animal fluorescence imaging at the National Institutes of Health, Amir H. Gandjbakhche, *NIH, USA*. **SA1**

Molecular Imaging & Drug Discovery Industry Roll-Out

In vivo optical imaging of disease progression with a protease sensing activatable probe, Dean Falb, *VisEn Medical, USA* **ThG3**

Applications of time-domain optical imaging in physiology and drug discovery, Laura McIntosh, *Advance Res. Tech., Canada* **ThG2**

Instrumentation and methods for steady-state optical imaging in small animals, Brad Rice, *Xenogen, USA*, **ThG4**

Bio-optics in drug discovery, Steve Williams, *Pfizer, USA* **ThG1**

Educational Lectures

As biomedical optical methods continue to advance and to address an ever increasing variety of applications, it becomes important to provide tutorial lectures to introduce those new to the field to the basics of different biomedical optical methods. There will be 4 tutorial lectures for conference attendees to provide a basic introduction to:

1. Tissue Optics,
2. Diffuse Optical Imaging,
3. Fluorescence Spectroscopy and Imaging, and
4. Optical Coherence Tomography

These education lectures are included with the conference registration fee and will be approximately 1/2 hour in length.

Special Sessions on Bio-Optics in Molecular Imaging & Drug Discovery

Revolutionary advances in bio-optical technologies have allowed for a large arsenal of novel optical methods and tools for biomedical research. With the completion of several genome sequences, the next crucial step is to understand the function of gene products and their role in the development of disease. Likewise, one of the most highly sought after capabilities has thus become the noninvasive detection and visualization of specific molecular targets, pathways and physiologic effects in vivo. Partnering novel optical methods with exciting new methodologies to impart absorption, scattering, fluorescence and bioluminescence contrast could allow for unprecedented insights in tissue function at the microscopic and macroscopic level. This paradigm shift in optical methodology could revolutionize drug discovery by translating traditional in-vitro biomedical research to in-vivo practice. Small animal imaging and clinical applications will be considered as they go hand-in-hand with evaluating efficient treatments.

These special sessions aim to bring together world leaders in molecular imaging, bio-optics and drug discovery in an open forum where revolutionary technologies and approaches can interface with applications. This highlight is organized by Drs. David Lester, *Pfizer Inc.,* and Vasilis Ntziachristos, *Harvard/MGH,* as a two-day event featuring a plenary session, a joint session and an industry rollout.

Tissue Optics

This tutorial will cover the following topics:

- Properties of Light
- Light-Matter Interactions

- Optical Absorption
- Biological Absorbers (Chromophores)
- Optical Scattering
- Biological Scatterers
- Tissue Optical Properties and Light Propogation

Diffuse Optical Imaging

This tutorial will provide an introduction to techniques for reconstructing images from light transmitted through highly scattering media.

Topics covered will include:

- Photon propogation models
- The forward problem in diffuse optical imaging
- The inverse problem - scattering theory approach
- The inverse problem - optimisation approach
- Numerical Techniques
- Bayesian Methods

Fluorescence Spectroscopy and Imaging

This tutorial will provide an overview of clinical applications of fluorescence spectroscopy and imaging for detection of disease. The talk will discuss a practical, hands-on approach to building instrumentation for in vivo fluorescence spectroscopy, design of fiber optic probes for such measurements, biochemical basis of data interpretation and developing and testing classification algorithms.

List of Exhibitors

- B&W Tek, Inc.
- Boston Electronics
- CRI
- FemtoLasers, Inc.
- GE Healthcare
- Hamamatsu
- Laser Focus World
- Micron Optics
- Newport Corporation
- NIM Inc.
- NIRx Medical Technologies
- NP Photonics
- Ocean Optics
- PennWell - Biophotonics International
- PicoQuant
- SENSOVATION
- Spectra-Physics
- TimeBandwidth
- Xenogen

Agenda of Sessions

On This Page:

Wednesday, April 14, 2004

Time	Event/Location
7:30 am - 8:00 am	Educational Lecture *Brittany/Champagne*
8:00 am - 8:30 am	Educational Lecture *Brittany/Champagne*
8:30 a.m. - 10:30 a.m.	**WA**, Frontiers in Diffuse Optical Imaging *Brittany/Champagne*
10:30 a.m. - 11:00 a.m.	Break
11:00 a.m. - 1:00 p.m.	**WB**, Advances in Diffuse Optical Theory *Brittany/Champagne*
11:00 a.m. - 1:00 p.m.	**WC**, Clinical Applications *Monaco*
1:00 p.m. - 2:30 p.m.	Coffee Break/Exhibit Time
2:30 p.m. - 4:30 p.m.	**WD**, Advances in Diffuse Optical Instrumentation *Brittany/Champagne*
2:30 p.m. - 4:30 p.m.	**WE**, Biophysics and Physiology of Functional Neuroimaging *Monaco*
4:30 p.m. - 6:30 p.m.	**WF**, Coffee Break/Exhibits/Poster Session/Reception *Burgundy*
6:30 p.m. - 8:00 p.m.	**WG**, OSA Highlight: Molecular Imaging and Drug Discovery: SIEMENS Plenary Session *Brittany/Champagne*

Thursday, April 15, 2004

Time	Event/Location
7:30 am - 8:00 am	Educational Lecture *Brittany/Champagne*
8:00 am - 8:30 am	Educational Lecture *Brittany/Champagne*
8:30 a.m. - 10:35 a.m.	**ThA**, OSA Highlight: Molecular Imaging and Drug Discovery: GE Healthcare Joint Session *Brittany/Champagne*
10:35 a.m. - 11:00 a.m.	Coffee Break/Exhibit Time
11:00 a.m. - 1:00 p.m.	**ThB**, Breast Imaging *Brittany/Champagne*
11:00 a.m. - 1:00 p.m.	**ThC**, Fluorescence, sponsored by the National Institutes of Health *Monaco*
1:00 p.m. - 2:30 p.m.	Break
2:30 p.m. - 4:00 p.m.	**ThD**, Advances in Theoretical Methods for Optical Imaging *Brittany/Champagne*
2:30 p.m. - 4:00 p.m.	**ThE**, Instrumentation and Technology in the Neurosciences *Monaco*
4:00 p.m. - 5:30 p.m.	**ThF**, Poster Session II/Coffee Break/Exhibit Time *Burgundy*
5:30 p.m. - 7:30 p.m.	**ThG**, Industry Roll-Out *Brittany/Champagne*

Friday, April 16, 2004

Time	Event/Location
8:00 a.m. - 10:00 a.m.	**FA**, Frontiers in Spectral Microscopy *Brittany/Champagne*
10:00 a.m. - 10:30 a.m.	Coffee Break/Exhibit Time
10:30 a.m. - 12:45 p.m.	**FB**, Clinical Applications of Optical Tomography *Brittany/Champagne*
10:30 a.m. - 12:30 p.m.	**FC**, Functional Imaging Techniques *Monaco*
12:30 p.m. - 2:00 p.m.	Break

2:00 p.m. - 4:00 p.m.	**FD**, OCT: Clinical *Brittany/Champagne*
2:00 p.m. - 4:00 p.m.	**FE**, Functional Imaging Applications *Monaco*
4:00 p.m. - 4:30 p.m.	Coffee Break/Exhibit Time
4:30 p.m. - 6:00 p.m.	**FF**, Microscopy *Brittany/Champagne*
4:30 p.m. - 6:00 p.m.	**FG**, Cancer *Monaco*
6:00 p.m. - 7:30 p.m.	**FH**, Poster Session III/Happy Hour *Burgundy*

Saturday, April 17, 2004

Time	Event/Location
8:00 a.m. - 10:00 a.m.	**SA**, Fluorescence Imaging *Brittany/Champagne*
8:00 a.m. - 10:00 a.m.	**SB**, Contrast Agents and Multiphoton Microscopy *Monaco*
10:00 a.m. - 10:30 a.m.	Break
10:30 a.m. - 12:30 p.m.	**SC**, OCT: Spectral Domain *Brittany/Champagne*
10:30 a.m. - 12:30 p.m.	**SD**, Basic Studies Towards Cancer Diagnosis *Monaco*
12:30 p.m. - 2:00 p.m.	Break
2:00 p.m. - 4:00 p.m.	**SE**, OCT: New Technology I *Brittany/Champagne*
2:00 p.m. - 4:00 p.m.	**SF**, Novel Scattering Techniques *Monaco*
4:00 p.m. - 4:30 p.m.	Break
4:30 p.m. - 6:00 p.m.	**SG**, OCT: New Technology II *Brittany/Champagne*
4:30 p.m. - 6:00 p.m.	**SH**, Hemodynamics *Monaco*

Wednesday, April 14, 2004

Brittany/Champs Elysées
8:30 a.m.–10:30 a.m.
WA • Frontiers in Diffuse Optical Imaging
David Boas[1], Jeremy C. Hebden[2]; [1]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, USA, [2]University College London, UK, Presiders

WA1 • 8:30 a.m. (Invited)
Exploring neurophysiology using diffuse optical imaging, *Maria Angela Franceschini; Massachusetts General Hospital, USA.* This talk addresses diffuse optical imaging and what it can tell us about the healthy brain. Comparisons with fMRI, EEG, and MEG measurements will be presented, and the macroscopic origin of optical signals will be discussed.

WA2 • 9:00 a.m. (Invited)
High-resolution photoacoustic tomography, *Lihong V. Wang; Texas A&M Univ, USA.* Photoacoustic tomography combines the contrast advantage inherent in optical properties and the resolution advantage of ultrasound. Consequently, it overcomes both the resolution disadvantage of diffuse optical tomography and the contrast and speckle disadvantages of ultrasonography.

WA3 • 9:30 a.m.
Non-contact fluorescence molecular tomography (FMT) of small animals, *Ralf B. Schulz[1], Jorge Ripoll[2], Doreen Yessayan[3], Vasilis Ntziachristos[3]; [1]German Cancer Res. Ctr. (DKFZ), Germany, [2]Inst. for Electronic Structure and Laser, Foundation for Res. and Technology–Hellas, Greece, [3]Lab. for Bio-optics and Molecular Imaging, Ctr. for Molecular Imaging Res., Mass General Hospital & Harvard Medical School, USA.* We describe the implementation of non-contact measurements for obtaining tomographic reconstructions of targeted fluorochromes within phantoms and in-vivo. This new approach can enable unprecedented experimental simplicity and better quality imaging performance compared to conventional systems.

WA4 • 9:45 a.m.
Diffuse optical spectroscopy and magnetic resonance imaging of breast tissue, *Natasha S. Shah[1], Dulcy Wolverton[2], Catherine Klifa[2], Jessica Gibbs[2], Albert E. Cerussi[1], Nola Hylton[2], Bruce J. Tromberg[1]; [1]Beckman Laser Inst., USA, [2]Univ. of California, San Francisco, USA.* Quantitative diffuse optical spectroscopic (DOS) measurements of healthy and diseased breast were correlated with high-resolution contrast-enhanced magnetic resonance images (MRI). The results show DOS-derived physiological information is complementary to anatomic information provided by MRI.

WA5 • 10:00 a.m.
Physiological variation in vascular reactivity of breast tissue over the menstrual cycledemonstrated by optical tomography, *Michael S. Katz[1], Rosemarie E. Hardin[1], Nelson A. Franco[1], Alessandro D. Smeraldi[2], David P. Klemer[3], Christoph H. Schmitz[3], Harry L. Graber[3], Randall L. Barbour[3]; [1]Deparment of Surgery, SUNY Downstate Medical Ctr., USA, [2]Deparment of Vascular Surgery, Staten Island Univ. Hospital, USA, [3]Deparment of Pathology, SUNY Downstate Medical Ctr., USA.* Using optical tomography we demonstrate that breast physiology changes over the 28 day menstrual cycle. This can be demonstrated by the vasculature's compliance and degree of heterogeneity in response to simple manipulations (e.g, Valsalva maneuver).

WA6 • 10:15 a.m.
Benign versus malignant breast masses: Optical differentiation with US localization, *Quing Zhu[1], Edward Cronin[2], Scott Hurtzman[3], NanGuang Chen[1], Minming Huang[1], Chen Xu[1]; [1]Univ. of Connecticut, USA, [2]Hartford Hospital, USA, [3]Univ. of Connecticut Health Ctr., USA.* A group of 5 invasive carcinomas and 16 benign lesions have shown that malignant cancers present more than two-fold greater total hemoglobin concentration than benign lesions. Optical tomography provides much higher specificity than Doppler US.

Brittany/Champs Elysées
11:00 a.m.–1:00 p.m.
WB • Advances in Diffuse Optical Theory
Hamid Dehghani; Thayer School of Engineering, USA, Presider

WB1 • 11:00 a.m.
Modeling photon density waves with the equation of radiative transfer, *Gassan S. Abdoulaev[1], Kui Ren[2], Guillaume Bal[2], Andreas H. Hielscher[3]; [1]Dept. of Biomedical Engineering, Columbia Univ., USA, [2]Dept. of Applied Physics and Applied Mathematics, Columbia Univ., USA, [3]Dept.s of Biomedical Engineering and Radiology, Columbia Univ., USA.* We present an algorithm that provides frequency-domain solution of the equation of radiative transfer (ERT) for heterogeneous media of arbitrary shape. Two numerical simulations are presented.

WB2 • 11:15 a.m.
Artifact reduction in CW transmission diffuse optical tomography, *Kijoon Lee, Regine Choe, Alper Corlu, Soren D. Konecky, Turgut Durduran, Arjun G. Yodh; Univ. of Pennsylvania, USA.* Three dimensional image reconstruction from diffuse optical tomography suffers from unwanted high-frequency image noise. We show how a customized mesh and proper preprocessing steps can lead to artifact reduction and quantification improvement in reconstructed images.

WB3 • 11:30 a.m.
Effect of image reconstruction bias upon spectroscopy-based quantification of chromophores in near-infrared tomography, *Subhadra Srinivasan, Brian W. Pogue, Hamid Dehghani, Shudong Jiang, Xiaomei Song, Keith D. Paulsen; Dartmouth Coll., USA.* Accuracy of chromophore concentrations in near-infrared tomography is affected by negative bias in the recovery of absorption coefficients and availability of limited wavelengths. The effect of these factors has been studied with suitable error models.

WB4 • 11:45 a.m.
Optimum wavelengths in continuous-wave multi-spectral diffuse optical tomography, *Alper Corlu[1], Turgut Durduran[1], Regine Choe[1], Kijoon Lee[1], Martin Schweiger[2], Elizabeth M. C. Hillman[2], Simon R. Arridge[2], Arjun G. Yodh[1]; [1]Univ. of Pennsylvania, USA, [2]Univ. Coll. London, UK.* We derive conditions for unique and simultaneous recovery of chromophore concentrations and scatterering coefficients in multi-spectral CW DOT. We demonstrate a methodology for choosing optimum wavelengths, which gives superior separation of absorption and scatterering chromophores.

WB5 • 12:00 p.m.
Reconstructing chromospheres concentration images directly by continuous-wave diffuse optical tomography, *Ang Li, Quan Zhang, Joseph P. Culver, David A. Boas; MGH, Harvard Medical School, USA.* Present an algorithm to reconstruct chromophores concentration images directly,which imposes prior spectral information into the image reconstruction that results improvement in the image CNR. Demonstrate this improvement with simulations and a dynamic blood phantom experiment.

WB6 • 12:15 p.m.
Three-dimensional fluorescent tomography in presence of absorption: Study of the normalized Born approximation, *Antoine P. Soubret, Jorge Ripoll, Doreen Yessayan, Vasilis Ntziachristos; MGH-CMIR, USA.* We study the influence of absorption in three-dimensional fluorescent tomographic reconstruction. We show that the normalization used on the data is very important and that the Born ratio gives surprisingly accurate result.

WB7 • 12:30 p.m.
Adaptive finite element methods for forward modeling in fluorescence enhanced frequency domain optical tomography, *Amit Joshi[1], Alan Thompson[1], Eva M. Sevick-Muraca[1], Wolfgang Bangerth[2]; [1]Photon Migration Labs., Texas A & M Univ., USA, [2]Ctr. for Subsurface Modeling, ICES, Univ. of Texas, USA.* An adaptive finite element scheme for forward modeling in fluorescence optical tomography is implemented and the simulation results are compared with experimental data obtained from a tissue phantom by an area-illumination and area-detection scheme.

WB8 • 12:45 p.m.
Fluorescence Molecular Tomography using quantitative photonic and photo-acoustic measurements, *Jorge Ripoll[1], Vasilis Ntziachristos[2]; [1]IESL - FORTH, Greece, [2]LBMI - CMIR - MGH, USA.* We present an expression for the photo-acoustic contribution of an optical point source in a diffusive and absorbing medium that can be used to combine photoacustic with Fluorescence Tomography, yielding high-resolution molecular specific 3D reconstructions.

Monaco
11:00 a.m.–1:00 p.m.
WC • Clinical Applications
Andrew J. Berger; The Institute of Optics, USA, Presider

WC1 • 11:00 a.m.
Optical spectroscopy to diagnose Alzheimer's disease in vivo, *Eugene B. Hanlon[1], Donald F. Siwek[1], Ann C. McKee[1], Neil W. Kowall[1], Hui Fang[2], Edward I. Vitkin[2], Lev T. Perelman[2]; [1]Dept. of Veterans Affairs, USA, [2]Harvard Medical School/Beth Israel Deaconess Medical Ctr., USA.* Neurodegenerative pathologies such as Alzheimer's disease present protein aggregates that scatter light. We are developing techniques to detect their characteristic spectra in vivo as a basis for definitive, non-invasive diagnosis and for monitoring experimental therapeutics.

WC2 • 11:15 a.m.
Use of fluorescence and near-infrared spectroscopies for noninvasive measurement of skin-collagen Advanced Glycation Endproducts: a feasibility study, *Edward L. Hull[1], Marwood N. Ediger[1], Amelia H. T. Unione[1], Elizabeth K. Deemer[2], Maxcy L. Stroman[2], John W. Baynes[2]; [1]InLight Solutions, USA, [2]Univ. of South Carolina, USA.* A porcine dermis model was used to assess the potential for noninvasive spectroscopic quantitation of skin-collagen Advanced Glycation Endproducts (AGEs). Results indicate that noninvasive measurements of skin fluorescence should be useful for diabetes screening.

WC3 • 11:30 a.m.
Identification of vulnerable atherosclerotic plaque by analysis of time-varying laser speckle patterns, *Seemantini K. Nadkarni, Brett E. Bouma, Tina Helg, Milan Singh Minsky, Raymond Chan, Jason Motz, Guillermo J. Tearney; Harvard Medical School and the Wellman Ctr. for Photomedicine, Massachusetts General Hospital, USA.* We describe laser speckle analysis for atherosclerotic plaque characterization and fibrous cap thickness estimation. Speckle analysis had a high sensitivity and specificity for detecting vulnerable atherosclerotic plaque, even in the presence of physiological motion.

WC4 • 11:45 a.m.
Hyperspectral imaging of functional patterns for disease assessment and treatment monitoring, *David W. Hattery[1], Moinuddin Hassan[1], Stavros Demos[2], Karen Aleman[1], Richard Little[1], Robert Yarchoan[1], Amir Gandjbakhche1; [1]NIH, USA, [2]Lawrence Livermore Natl. Lab, USA.* We have designed and built a six-band multi-spectral NIR imaging system used in clinical testing on cancer patients. From our layered tissue model, we create blood volume and blood oxygenation images for patient treatment monitoring.

WC5 • 12:00 p.m.
Prediction of treatment efficacy by blood flow responses to PDT in RIF tumors, *Guoqiang Yu, Turgut Durduran, Chao Zhou, Mary Putt, Arjun G. Yodh, Theresa M. Busch; Univ. of Pennsylvania, USA.* A diffuse correlation spectroscopy is used to non-invasively measure in vivo blood flow responses to PDT in RIF tumors. The treatment efficacy significantly correlates with the flow responses during and after PDT.

WC6 • 12:15 p.m.
Rapid in-vivo measurement of optical and physiological properties in human intraperitoneal tissues before and after photodynamic therapy, *Hsing-Wen Wang, Timothy C. Zhu, James Metz, Mary E. Putt, Douglas L. Fraker, Andreea Dimofte, IV, Jeremy Miles, Eli Glastein, Steve M. Hahn, Arjun G. Yodh; Univ.*

of Pennsylvania, USA. We have measured tissue optical properties during a Phase II clinical trial to treat peritoneal carcinomatosis. Physiological properties before and after PDT will be reported.

WC7 • 12:30 p.m.

Interactive system for interstitial photodynamic therapy, *Ann Johansson[1], Marcelo Soto Thompson[1], Thomas Johansson[1], Stefan Andersson-Engels[1], Sune Svanberg[1], Katarina Svanberg[2], Niels Bendsoe[3]; [1]Lund Inst. of Technology, Sweden, [2]Dept. of Oncology, Sweden, [3]Dept. of Dermatology, Sweden.* An interactive system for interstitial PDT using δ-aminolevulinic acid and multiple fibres for light delivery has been developed. Interactive control is achieved by measuring light fluence distribution, sensitizer concentration and oxygenation level throughout the tissue.

WC8 • 12:45 p.m.

Optical spectroscopy for guiding thermotherapies of tumors, *Wei-Chiang Lin[1], Josh T. Beckha.m[1], Dipen Parekh[2], S. Duke Herrell[2], Christopher R. Anderson[3], Ravi S. Chari[3], Anita Mahadevan-Jansen[1]; [1]Dept. of Biomedical Engineering, Vanderbilt Univ., USA, [2]Dept. of Urologic Surgery, Vanderbilt Univ. Medical Ctr., USA, [3]Liver Transplant Progra.m, Vanderbilt Univ. Medical Ctr., USA.* Dynamics of fluorescence/diffuse reflectance characteristics and temperature of liver and kidney tissue undergoing radio-frequency ablation were studied in vivo. The results demonstrate the sensitivity and effectiveness of the optical-based method for tissue thermal damage assessment.

Brittany/Champs Elysées

2:30 p.m.–4:30 p.m.

WD • Advances in Diffuse Optical Instrumentation

Joseph P. Culver; Washington University School of Medicine, USA, Presider

WD1 • 2:30 p.m.

Fluorescence lifetime imaging by multi-detector TCSPC, *Wolfgang Becker[1], Axel Bergmann[1], Giovanni Biscotti[1], Christoph Biskup[2]; [1]Becker & Hickl GmbH, Germany, [2]Inst. of Physiology II, Germany.* The paper describes a high-efficiency time-correlated single photon counting (TCSPC) technique for picosecond resolution multi-wavelength lifetime imaging in two-photon or confocal laser scanning microscopes and other scanning systems.

WD2 • 2:45 p.m.

A quantitative time-domain optical imager for small animals in vivo fluorescence studies, *Pascal Gallant, Alexandre Belenkov, Guobin Ma, Frederic Lesage, Yong Wang, David Hall, Laura McIntosh; ART-Advanced Res. Technologies Inc, Canada.* ART as developed a time-domain optical molecular imager that recovers size, position and concentration of fluorescent inclusions embedded in turbid media within 15-30% accuracy. Fluorescent lifetime also gives the capability to discriminate different fluorescent sources.

WD3 • 3:00 p.m. (Invited)

Time-resolved spectroscopy system for tissue monitoring and imaging, *Yutaka Yamashita, D. Yamashita, T. Yamanaka, T. Suzuki, E. Ohmae, Y. Ueda, M. Oda; Hamamatsu Photonics K.K, Japan.* A near infrared multi-channel time-resolved spectroscopy system has been developed. This system acquires the data with 0.2sec sampling time at 16 points, simultaneously. Absorption change can be determined within 3 % accuracy.

WD4 • 3:30 p.m.

Design and initial testing of system for simultaneous bilateral dynamic optical tomographic mammography, *Randall L. Barbour[2,1], Christoph H. Schmitz[1], David P. Klemer[1], Yaling Pei[2], Harry L. Graber[1]; [1]SUNY Downstate Medical Ctr., USA, [2]NIRx Medical Technologies LLC, USA.* The sensitivity of our previously published methods for breast cancer detection with dynamic optical tomography now has been significantly augmented, via the use of a measuring head that permits simultaneous bilateral data collection.

WD5 • 3:45 p.m.

Development of a system for simultaneous MRI and Near-infrared diffuse tomography to diagnose breast cancer, *Ben A. Brooksby, Shudong Jiang, Gordon Ehret, Hamid Dehghani, Brian W. Pogue, Keith D. Paulsen; Dartmouth Coll., USA.* A multi-spectral, frequency-domain near infrared tomography system has been constructed and evaluated. Measurements of light transmission through female breast can be acquired simultaneously with MRI scans.

WD6 • 4:00 p.m.
Optical tomography system based on second-differential spectroscopy for small animal brain study, *Heng Xu[1], Hamid Dehghani[1], Brian W. Pogue[1], Keith D. Paulsen[1], Roger Springett[2], Jeff F. Dunn[2]; [1]Thayer school of Engineering, Dartmouth Coll., USA, [2]Dept. of Radiology, Dartmouth Medical School, USA.* 8-Channel broadband spectroscopy and tomography CCD system was designed and frequency domain reconstruction was applied to get both absorption and scattering images at two wavelengths based on the second-differential spectroscopy analysis of CW data.

WD7 • 4:15 p.m.
Performance assessment of photon migration instruments: the Medphot protocol, *A. Pifferi[1], A. Torricelli[1], A. Bassi[1], P. Taroni[1], R. Cubeddu[1], H. Wabnitz[2], D. Grosenick[2], M. Möller[2], R. Macdonald[2], J. Swartling[3], T. Svensson[3], S. Andersson-Engels[3], R.L.P. van Veen[4], H.J.C.M. Sterenborg[4], J.-M. Tualle[5], E. Tinet[5], S. Avrillier[5], M. Whelan[6], H. Stamm[6]; [1]Politecnico di Milano, Italy, [2]Physikalisch-Technische Bundesanstalt, Germany, [3]Lund Inst. of Technology, Sweden, [4]Erasmus Medical Ctr. Rotterdam, Netherlands, [5]Univ. Paris 13, France, [6]European Commission Joint Res. Ctr., Italy.* We propose a protocol for the performance assessment of photon migration instruments based on accuracy, linearity, uncertainty, stability and reproducibility. This protocol was applied to 9 instruments using a set of 32 solid phantoms.

Monaco
2:30 p.m.–4:30 p.m.
WE • Biophysics and Physiology of Functional Neuroimaging
John George; Los Alamos National Laboratory, USA, Presider

WE1 • 2:30 p.m. (Invited)
Biophysics, *Brian M. Salzberg; Univ. of Pennsylvania, USA.*

WE2 • 3:00 p.m.
Concurrent optical imaging spectroscopy, laser Doppler flowmetry and magnetic resonance imaging in the investigation of the relative intra and extra vascular contributions to the BOLD signal, *John E. Mayhew, J. Berwick, A. Kennerley, J. Martindale, N. Papadakis, Y. Zheng; Univ. of Sheffield, UK.* The BOLD MRI signal is a confound of intra vascular and extra vascular effects. We describe experiments in which we investigate the contribution of the intra vascular and extra vascular effects in an animal model.

WE3 • 3:20:00 p.m.
Rapid oxygen uptake in mitochondria in functional activation, *Britton Chance, S. Nioka, C. Li; Univ. of Pennsylvania, USA.* A novel concept in functional imaging is the NIR measure of fast oxygen extraction from capillary bed hemoglobin by mitochondrial activation in brain and muscle.

WE4 • 3:40:00 p.m.
Diffuse optical measurements of oxygen metabolism in human brain during sensorimotor stimulus, *Turgut Durduran, Guoqiang Yu, Mark G. Burnett, Chao Zhou, John A. Detre, Joel H. Greenberg, Arjun G. Yodh; Univ. of Pennsylvania, USA.* Combined diffuse optical and correlation spectroscopies were used to simultaneously measure hemoglobin concentrations and bloodflow changes due to sensorimotor stimulus of human brain. Brain CMRO2 is calculated for the first time using all optical methods.

WE5 • 3:55:00 p.m.
Fast optical responses in isolated nerves, *David Rector; Washington State Univ, USA.* To record optical correlates of fast electrical neural activation, we are developing improved contrast techniques for these small signals. Progressive elimination of non-specific light improves fast optical signals for neural recording by 100 fold.

WE6 • 4:15 p.m.
Neural interferometry: first non-contact measurements of action potential-induced nerve swelling, *Christopher M. Fang-Yen[1], Mark Chu[1], H. Sebastian Seung[1,2], Kamran Badizadegan[1,3], Ramachandra Dasari[1], Michael S. Feld[1]; [1]MIT, USA, [2]Howard Hughes Medical Inst., USA, [3]Massachusetts General Hospital, USA.* A novel heterodyne dual-beam interferometer is used to perform non-contact measurements of swelling displacements in a lobster nerve bundle during the action potential. Displacements are ~1-8 nm in amplitude and ~10 ms in duration.

Burgundy
4:30 p.m.–6:30 p.m.
WF • Coffee Break/Poster Session/Reception

WF1 • 4:30 p.m.
Volumetric diffuse optical tomography of brain activity in rat, *Joseph P. Culver[1], Andrew M. Siegel[2], Jonathan J. Stott[2], David A. Boas[2]; [1]Dept. of Radiology, Washington Univ. School of Medicine, USA, [2]Martinos Ctr., Massachusetts General Hospital, Harvard Medical School, USA.* We present three-dimensional diffuse optical tomography (DOT) of the hemodynamic response to forepaw stimulation in a rat. DOT results agree with previous fMRI studies and demonstrate feasibility of volumetrically imaging brain activity.

WF2 • 4:30 p.m.
Depth of arterial oscillation resolved with NIRS time and frequency domain, *George Themelis, Juliette Selb, Sonal Thaker, Jonathan J. Stott, Anna Custo, David A. Boas, Maria-Angela Franceschini; Athinoula A. Martinos Ctr., Massachusetts General Hospital, USA.* We present measurements of the heartbeat obtained on human foreheads, using frequency domain and time domain systems. Preliminary results indicate that we are able to measure signals of the heartbeat originated from intracranial layers (brain).

WF3 • 4:30 p.m.
Improved localization of evoked hemodynamic response in diffuse optical functional imaging using a spatial subspace approach, *Yiheng Zhang[1], Dana H. Brooks[1], Maria Angela Franceschini[2], David A. Boas[2]; [1]Northeastern Univ., USA, [2]Massachusetts General Hospital, USA.* We use a spatial subspace approach to identify and reduce the interference signals in diffuse optical functinal imaging and obtain a more localized response and improved maps of correlation coefficients.

WF4 • 4:30 p.m.
Calculation of task-evoked changes in the cerebral metabolic rate of oxygen consumption from simultaneous ASL-BOLD fMRI and Diffuse Optical Imaging, *Theodore J. Huppert[1,2], Rick Hoge[2], Maria Angela Franceschini[3,2], David Boas[1,2]; [1]Harvard Univ., USA, [2]Massachusetts General Hospital, USA, [3]Tufts Univ., USA.* Here we report how changes in physiological parameters such as relative cerebral blood flow, volume and oxygen metabolic rate can be calculated directly from multi-modality measurements via ASL-BOLD MRI and diffuse-optical imaging.

WF5 • 4:30 p.m.
Noninvasive monitoring of cerebral blood oxygenation with optoacoustic technique: An in vivo study in sheep, *Yuriy Y. Petrov, Donald S. Prough, Manfred Klasing, Donald J. Deyo, Rinat O. Esenaliev; Univ. of Texas Medical Branch, USA.* The optoacoustic technique was tested in vivo for noninvasive monitoring of cerebral blood oxygenation. Linear correlation of optoacoustic signals with actual blood oxygenation in the superior sagittal sinus in sheep was demonstrated.

WF6 • 4:30 p.m.
Changes in cerebral total haemoglobin volume and cytochrome oxidase redox state during deep apnoeas in patients with obstructive sleep apnoea, *Ilias Tachtsidis[1], Chris E. Cooper[2], Anne D. McGown[3], Himender Makker[3], David T. Delpy[1], Clare E. Elwell[1]; [1]Univ. Coll. London, UK, [2]Univ. of Essex, UK, [3]Middlesex Hospital, UK.* Near infrared spectroscopy was used to measure changes in cerebral

haemoglobin and cytochrome concentration in obstructive sleep apnoea. During deep apnoeas, two different patterns in the changes in these signals can be seen.

WF7 • 4:30 p.m.
Using near-infrared spectroscopy to measure the changes in cerebral blood flow and oxygen metabolism following hypoxia ischemia in newborn piglets, *Keith St. Lawrence[1,2], Derek W. Brown[1,2], Ken M. Tichauer[1,2], Jennifer Hadway[1,2], Ting-Yim Lee[2,1]; [1]Lawson Health Res. Inst., Canada, [2]Robarts Res. Inst., Canada.* Hypoxia-ischemia is a major cause of brain injury in newborns. Near-infrared spectroscopy can be used to measure cerebral oxygen consumption, which can be used as an early predictor of delayed brain injury.

WF8 • 4:30 p.m.
Multi-channel near-infrared spectroscopy on the human forehead during hypo- and hypercapnia, *Tommi Noponen[1], Markku Paloheimo[2], Pekka Meriläinen[3], Timo Kajava[3], Kalle Kotilahti[1], Ilkka Nissilä[1], Toivo Katila[1]; [1]Helsinki Univ. of Technology and Helsinki Brain Res. Ctr., Finland, [2]Dept. of Anesthesia and Intensive Care Unit, Eye Hospital, Helsinki Univ. Central Hospital, Finland, [3]Helsinki Univ. of Technology, Finland.* Cerebral blood flow and oxygenation changes during different levels of hypo- and hypercapnia were successfully monitored on the human forehead using a multi-channel frequency-domain near-infrared spectroscopy. Optical signals correlate well with simultaneously recorded gas measurements.

WF9 • 4:30 p.m.
Single trial hemodynamic response estimation in event related fNIR spectroscopy, *Meltem Izzetoglu, Scott Bunce, Banu Onaral; Drexel Univ., USA.* This study examines single trial hemodynamic response estimation in event-related fNIR spectroscopy. In a working memory task, the estimates of single trial hemodynamic responses in dorsolateral prefrontal cortex are compared across subjects.

WF10 • 4:30 p.m.
Evidence of cognitive activity in functional near infrared spectroscopy signal, *Ceyhun Burak Akgül, Bülent Sankur, Ata Akin; Bogazici Univ., Turkey.* In this work, we show that functional near infrared spectroscopy signals exhibit periodicities that match the jittered periodicity of the stimuli sequence that is used in a target categorization experiment.

WF11 • 4:30 p.m.
Optode positioning in time-resolved neurological near-infrared imaging, *Bruno Montcel, Murielle Torregrossa, Patrick Poulet; Institut de Physique Biologique, France.* An MCP-PMT–, TCSPC–based apparatus is described and used for NIR imaging in neurology. Optode positioning on the scalp is investigated with the help of MRI-based models and diffusion theory FEM simulations.

WF12 • 4:30 p.m.
The effect of CCD exposure time on the sensitivity of laser speckle contrast imaging of blood flow, *Shuai Yuan, David A. Boas, Andrew K. Dunn; Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital, USA.* We investigated effects of camera exposure time on the sensitivity and signal to noise ratio of laser speckle contrast imaging for measurements of relative blood flow changes during functional activation.

WF13 • 4:30 p.m.
Magnitude of the intrinsic optical brain imaging signal reflects neural function, *David G. Jones, Kathryn M. Murphy; McMaster Univ., Canada.* We sought to assess whether the magnitude of the intrinsic optical imaging signal in rat visual cortex is related to the underlying response properties of visual cortical receptive fields and to perceptual function.

WF14 • 4:30 p.m.
Practical approach of light propagation analysis in the adult head model by finite element method, *Tatsuya Koyama, Atsushi Iwasaki, Yosuke Ogoshi, Eiji Okada; Dept. of Electronics and Electrical Engineering, Keio Univ., Japan.* The light propagation in the head model with low-scattering CSF layer is

analysed by the FEM. The error is less than 8 % when transport scattering coefficient of the CSF is greater than 0.2 mm^{-1}.

WF15 • 4:30 p.m.
Cross talk between oxy- and deoxy-haemoglobin in brain activity measurement by near-infrared spectroscopy, *Nobuhiro Okui, Eiji Okada; Dept. of Electronics and Electrical Engineering, Keio Univ., Japan.* We investigated the cross-talk between concentration changes in oxy- and deoxy-haemoglobin in the measurement of brain activity. The optimal wavelength range with 830 nm to minimise the cross talk is from 690 to 750 nm.

WF16 • 4:30 p.m.
Investigation of breast tumor hemodynamics using tumor vascular phantoms and FEM simulations, *Jae G. Kim[1], Hanli Liu[2]; [1]Univ. of Texas Southwestern Medical Ctr. at Dallas, USA, [2]Univ. of Texas at Arlington, USA.* We have developed dynamic tumor vascular phantoms and utilized the finite element method to investigate the bi-phasic behavior of oxyhemoglobin concentration increase that were observed in vivo from rat breast tumors during carbogen inhalation.

WF17 • 4:30 p.m.
Diffuse time-resolved reflectance and transmittance measurements of the female breast using different interfiber distances in the region 610 – 1040 nm, *Johannes Swartling[1], Antonio Pifferi[1], Ekaterine Chikoidze[1], Alessandro Torricelli[1], Paola Taroni[1], Rinaldo Cubeddu[1], Stefan Andersson-Engels[2]; [1]Dipartimento di Fisica, INFM Politecnico di Milano, Italy, [2]Dept. of Physics, Lund Inst. of Technology, Sweden.* Absorption and scattering spectra were measured. A large intersubject variation is seen, correlating with the water-lipid content. Variations due to geometry and tissue heterogeneity are seen, but are small compared to the intersubject variation.

WF18 • 4:30 p.m.
Clinical results from a 32-channel time resolved system used to image the breast, *Tara D. Yates, Jeremy C. Hebden, Adam P. Gibson, Nicholas L. Everdell, David T. Delpy, Simon R. Arridge, Michael Douek, Wayne Chicken; Univ. Coll. London, UK.* Studies on volunteers are being performed to evaluate three-dimensional time-resolved optical tomography as a means of detecting and specifying breast disease. Two acquisition geometries have been assessed and the images obtained are presented.

WF19 • 4:30 p.m.
A multi-spectral three-dimensional diffuse optical mammography system, *Changqing Li, Hongzhi Zhao, Huabei Jiang; Clemson Univ., USA.* We have developed a compact, multi-spectral, three-dimensional photodiode-based diffuse optical tomography system for breast imaging. 2D & 3D phantom experiments are used to evaluate the system. Initial clinical results from this third-generation system are reported.

WF20 • 4:30 p.m.
Dual mesh reconstruction method with depth correction for near infrared diffusive light imaging with a priori ultrasound information, *Minming Huang, Quing Zhu; Univ. of Connecticut, USA.* A dual-mesh reconstruction method with depth correction for NIR diffused wave imaging has been demonstrated using phantoms and clinical cancer cases. With the depth correction, more uniform absorption maps across different layers can be obtained.

WF21 • 4:30 p.m.
Imaging skin histology through parametric mapping, *Ela Claridge; The Univ. of Birmingham UK.* A novel computational approach to diagnostic imaging of the epithelial tissues is presented. Histologically meaningful parameteric maps are inferred from image colours using a physics-based model of skin colouration. The maps aid melanoma diagnosis.

WF22 • 4:30 p.m.
Measurement of API concentration in pharmaceutical powder blends using frequency domain photon migration, *Tianshu Pan, Eva M. Sevick-Muraca; Photon Migration Labs., USA.* Experiments and

theory demonstrate that measurement precision in discrete, non-continuum media such as tissue or a powder bed, depends upon the concentration of the studied absorber as well as the volume sampled by migrating photons.

WF23 • 4:30 p.m.
Early-photon tomographic imaging with 360-degree sample rotation, *Gordon M. Turner[1], Giannis Zacharakis[1], Jorge Ripoll[1,2], Vasilis Ntziachristos[1]; [1]MGH, CMIR, USA, [2]FORTH-ISL, Greece.* An early photon detection multi-angle projection, high spatial sampling system has been developed to fully exploit the advantages of time-resolved methods in imaging diffuse media and offer measurements of maximum information content.

WF24 • 4:30 p.m.
Simulated and experimental separation and characterization of absorptive inhomogeneities embedded in turbid media, *Min Xu, Mohammad AL-Rubaiee, Wei Cai, Swapan K. Gayen, Robert R. Alfano; Inst. for Ultrafast Spectroscopy and Lasers, USA.* Independent component analysis of the scattered wave is proposed as the preprocessor to characterization of absorptive inhomogeneities embedded in turbid media. Reconstruction results with simulated and experimental data will be presented for multiple embedded objects.

WF25 • 4:30 p.m.
Imaging small absorbing and scattering objects in turbid media using diffuse optical tomography structurally guided by reconstructive ultrasound tomography, *Hongzhi Zhao, Xuejun Gu, Huabei Jiang; Clemson Univ., USA.* We report on an imaging technique that combines near-infrared diffuse optical tomography and reconstructive ultrasound tomography. We also experimentally demonstrate that a 2mm size target embedded in a 5cm diameter background can be reconstructed quantitatively.

WF26 • 4:30 p.m.
Simultaneous reconstruction of absorption and scattering maps with ultrasound localization: reflection geometry, *Minming Huang, Quing Zhu; Univ. of Connecticut, USA.* We report simultaneous reconstruction of absorption and scattering heterogeneities using a modified Tikhonov regularization method based on finite element method. The priori information from the co-registered ultrasound images is incorporated by different regularization factors.

WF27 • 4:30 p.m.
Effect of angular distribution of outgoing flux from high-scattering region in hybrid MC-diffusion method, *Atsushi Iwasaki, Eiji Okada; Dept. of Electronics and Electrical Engineering, Keio Univ., Japan.* The DHMDM has been used to calculate the light propagation in the head model.The effect of asymmetric distribution of the surface radiance toward a low-scattering layer is investigated to improve the accuracy of the DHMDM.

WF28 • 4:30 p.m.
Dependence of the contrast on the size of scattering abnormalities, *Victor V. Chernomordik[1], Amir H. Gandjbakhche[1], Giovanni Zaccanti[2]; [1]NIH, USA, 2Dipartimento di Fisica dell'Università degli Studi di Firenze and INFM, Italy.* Relationship between the scattering contrast and inclusion size is analyzed, using Monte Carlo simulations and experimental data. It is different for increased and decreased scattering cases. A random walk model is substantiated for increased scattering.

WF29 • 4:30 p.m.
Optimization of 3D flow imaging by diffuse correlation tomography, *Chao Zhou, Turgut Durduran, Guoqiang Yu, Arjun G. Yodh; Univ. of Pennsylvania, USA.* Diffuse Correlation Tomography is optimized by using condition number analysis and L-Curve analysis. Data from larger delay times was found to improve the images. Images are reconstructed from simulated data and phantom measurements.

WF30 • 4:30 p.m.
Estimation of chest-wall induced diffusive wave distortion with the assistance of ultrasound, *Chen Xu, Quing Zhu; Electrical and Computer Engineering Dept, Univ. of Connecticut, USA.* A two-layer model is

used to estimate diffusive wave distortion caused by chest-wall underneath breast tissue. Results have shown that absorption of the chest-wall layer has more influence on measurements at distance source-detector pairs.

WF31 • 4:30 p.m.
Comparison of diffusion and transport in human head, *Anna Custo[2,1], David A. Boas[1]; [1]MGH-NMR Ctr., USA, [2]MIT-Artificial Intelligence Lab, USA.* Two well-known forward models for light propagation in adult human head are compared: Monte Carlo and Finite-Difference. The main advantage of a diffusion based method is the low computational cost at the expenses of accuracy.

WF32 • 4:30 p.m.
Accuracy in position of the activated region estimated from topographic image of brain function, *Shoko Kuroda[1], Hiroshi Kawaguchi[1], Nobuhiro Okui[1], Eiji Okada[1], Tsuyoshi Yamamoto[2]; [1]Dept. of Electronics and Electrical Engineering, Keio Univ., Japan, [2]Advanced Res. Lab., Hitachi,Ltd, Japan.* The accuracy in centre of absorber estimated from topographic image and calculated by differential method is investigated. The error in position estimated from central gravity of topographic image is smaller than that from peak position.

WF33 • 4:30 p.m.
A frequency multiplexed near infra-red topography system for imaging functional activation in the brain, *Nicholas Everdell, A. Gibson, I. Tullis, T. Vaithianathan, J. Hebden, D. Delpy; Dept. of Medical Physics, Univ. Coll. London, UK.* We have developed a novel near-infrared optical topography system that can acquire images at 10 frames per second. It uses frequency multiplexed sources, and FFT detection.

WF34 • 4:30 p.m.
Simultaneous fMRI and NIRS measurements for the study of brain function, *Angelo Sassaroli[1], F. Fabbri[1], Y. Tong[1], S. Fantini[1], B. Frederick[2], P. Renshaw[2]; [1]Tufts Univ., USA, [2]McLean Hospital, USA.* One of the main purposes of our investigation is the comparison of near infrared spectroscopy (NIRS) data with functional magnetic resonance imaging (fMRI) signals under motor, visual, and cognitive activation tasks.

WF35 • 4:30 p.m.
Time-resolved diffuse NIR-reflectance topography of the adult head during motor stimulation, *Adam Liebert[1], Heidrun Wabnitz[1], Michael Möller[1], Alfred Walter[1], Rainer Macdonald[1], Herbert Rinneberg[1], Hellmuth Obrig[2], Jens Steinbrink[1]; [1]Physikalisch-Technische Bundesanstalt, Germany, [2]Dept. of Neurology, Charité, Humboldt-Univ., Germany.* We report on a time-resolved instrument for diffuse NIR-reflectance topography of the adult head. First results will be presented of time-resolved monitoring of the motor cortex area during finger tapping.

WF36 • 4:30 p.m.
Multi-site near-infrared tomographic imaging of the brain, *David P. Klemer[1], Randall L. Barbour[1,2], Christoph H. Schmitz[2,1], Harry L. Graber[1], Yaling Pei[2], Rosemarie E. Hardin[1], Michael S. Katz[1], Nelson A. Franco[1], Alessandro G. Smeraldi[3]; [1]SUNY Downstate Medical Ctr., USA, [2]NIRx Medical Technologies LLC, USA, [3]Staten Island Univ. Hospital, USA.* Time-series analysis techniques are applied to dynamic near-infrared tomographic images of the motor and frontal cortex of the brain, based on optical data simultaneously recorded from two 3 x 5 arrays.

WF37 • 4:30 p.m.
Evaluation of peripheral vascular disease using non-invasive dynamic optical tomography, *Alessandro G. Smeraldi[1], Nelson A. Franco[2], Harry L. Graber[2], David P. Klemer[2], Rosemarie E. Hardin[2], Michael S. Katz[2], Christoph H. Schmitz[2,3], Thomas F. Panetta[1], Randall L. Barbour[3,2]; [1]Staten Island Univ. Hospital, USA, 2SUNY Downstate Medical Ctr., USA, 3NIRx Medical Technologies LLC, USA.* Using dynamic optical tomography, we observed a difference in metabolic usage of oxygen and in vascular reactivity during and after provocative tests in the limbs of healthy and diabetic patients.

WF38 • 4:30 p.m.

Dynamic optical tomographic imaging of the human forearm for quantification of the vascular bed response in diabetics and non-diabetics, *Nelson A. Franco[1], Rosemarie E. Hardin[1], David P. Klemer[1], Michael S. Katz[1], Harry L. Graber[1], Christoph H. Schmitz[1], Randall L. Barbour[1], Alessandro G. Smeraldi[2], Thomas F. Panetta[2]; [1]SUNY Downstate Medical Ctr., USA, [2]Staten Island Univ. Hospital, USA.* We demonstrate the differences in the vascular response between diabetics and nondiabetics based on dynamic optical tomographic imaging of the human forearm using simple provocations.

WF39 • 4:30 p.m.
Near infrared imaging of human prostate cancerous and normal tissues based on water absorption, *Wubao Wang, Jamal H. Ali, Manuel E. Zevallos, Robert R. Alfano; City Coll. of New York, USA.* Near-infrared imaging measurements were performed on human prostate cancerous and normal tissues. The absorption of water fingerprints in cancerous and normal tissues were studied, and used to distinguish prostate cancerous tissue from surrounding normal tissues.

WF40 • 4:30 p.m.
Evaluation of forearm muscle groups recruitment during continuous or rhythmic isometric exercise by a continuous wave near infrared spatially resolved oximeter, *Leonardo Mottola, Marco Ferrari, Valentina Quaresima; Univ. of L'Aquila, Italy.* A different pattern of the two forearm muscle recruitment was found either within each exercise or amongst exercises mode in single subjects. Muscle blood flow increased similarly after the end of both exercises.

WF41 • 4:30 p.m.
Peak time analysis of TOF data with limitation of the temporal resolution and its application for measurements on a human forearm at 1.29 micrometer, *Goro Nishimura, Mamoru Tamura; Biophysics, RIES, Hokkaido Univ, Japan.* Time-of-flight measurements on a human forearm at 1.29 micrometer was analyzed by the peak time shift with changing distance from the source position. The mean path length was about 2.7 times of the geometric distance.

WF42 • 4:30 p.m.
Qualitative and quantitative improvement of optical tomographic reconstructed images via spatial deconvolution: two-dimensional case, *Yong Xu[1,2], Harry L. Graber[1], Yaling Pei[2], Randall L. Barbour[2,1]; [1]SUNY Downstate Medical Ctr., USA, [2]NIRx Medical Technologies LLC, USA.* An accompanying report demonstrates marked enhancement of reconstructed 3D diffuse optical tomographic images, via a straightforward spatial deconvolution operation. Here, the method's performance is evaluated quantitatively; for convenience, two-dimensional test media are considered initially.

WF43 • 4:30 p.m.
Qualitative and quantitative improvement of optical tomographic reconstructed images via spatial deconvolution: three-dimensional case, *Harry L. Graber[1], Yong Xu[1,2], Yaling Pei[2], Randall L. Barbour[1,2]; [1]SUNY Downstate Medical Ctr., USA, [2]NIRx Medical Technologies LLC, USA.* A straightforward spatial deconvolution operation is used to compensate for the information-blurring property of first-order perturbation algorithms for diffuse optical tomography (DOT) image reconstruction. Applying this operation to 3D DOT images significantly improves image quality.

WF44 • 4:30 p.m.
Calibrated reconstructions of diffuse optical tomography data, *Jonathan J. Stott[1], Joseph P. Culver[2], Simon R. Arridge[3], David A. Boas[1]; [1]Massachusetts General Hospital, Ctr. for Biomedical Imaging, USA, [2]Mallinckrodt Inst. of Radiology, Washington Univ. St. Louis, USA, [3]Dept. of Computer Science, Univ. Coll. Londe, UK.* In this paper, we present a technique for calibrating optode positions and couplings while simultaneous reconstructing diffuse optical images. Using phantom data, we demonstrate that our technique significantly improves the quality of the reconstructed images.

WF45 • 4:30 p.m.
Optimizing data-type for absolute diffuse optical tomographic imaging using time-domain reflectance, *Feng Gao[1], Huijuan Zhao[1], Yukari Tanikawa[1], Yukio Yamada[2]; [1]Natl. Inst. of Advanced Industrial Science and Technology, Japan, [2]Univ. of Electro-Communications, Japan.* We discuss the

optimal choice of the working frequency pair in the reflectance-type modified generalized pulse spectrum technique algorithm for achieving absolute image reconstruction in the time-domain diffuse optical tomography.

WF46 • 4:30 p.m.
A virtual study of shape-based optical reconstruction, *Kajoli B. Krishnan[1], Meera Kuppusamy[1], Floris P. Jansen[2], Stephen J. Lomnes[2]; [1]GE Global Res., India, [2]GE Global Res., USA.* We demonstrate the use of a priori knowledge of lesion shape from ultrasound to improve quantitative accuracy of 2D optical tomography. Mean absorption in the lesion can be estimated within 20% of actual value.

WF47 • 4:30 p.m.
Linearized optical tomography using the diffusion approximation in regions with curved boundaries, *Gregory Boverman[1], Eric L. Miller[1], Jonathan J. Stott[2], David A. Boas[2]; 1Northeastern Univ., USA, [2]Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital, USA.* We show that the diffusion approximation with a zero partial-flux boundary condition accurately models photon migration in a highly scattering medium with curved boundaries. In particular, we examine optical mammography in a transmission geometry.

WF48 • 4:30 p.m.
Improve the analytical cumulant solution of the radiative transfer equation, *Wei Cai, Min Xu, Robert R. Alfano; Dept. Physics/City Coll. of City Univ. of New York, USA.* We present a new cumulant solution and separate the ballistic componet from scattered component. We compare effects to measurements by objects near source and deeply inside medium using diffusion model and radiative transfer model.

WF49 • 4:30 p.m.
Utilizing the radiative transfer equation in optical tomography, *Marko Vauhkonen, Tanja Vilhunen, Ville Kolehmainen, Jari P. Kaipio; Univ. of Kuopio, Finland.* Approaches for using the radiative transfer equation (RTE) in optical tomography are proposed. The RTE is utilized in the whole domain or only over a small area in the proximity of the sources.

WF50 • 4:30 p.m.
Diffusion equation and ray divergence near a point source, *Luis Marti-Lopez[1], Jorge Bouza-Domínguez[1], Jeremy Charles Hebden[2]; [1]Centro de Neurociencias de Cuba, Cuba, [2]Univ. Coll. London, UK.* We solve a diffusion equation with nonzero ray divergence for a time-independent point source. The solutions suggest that non-negligible ray divergence causes the failure of the standard diffusion equation near a point source.

Brittany/Champs Elysées
6:30 p.m.–8:00 p.m.
WG • OSA Highlight: Molecular Imaging and Drug Discovery: SIEMENS Plenary Session
David Lester[1], Vasilis Ntziachristos[2]; [1]Experimental Medicine, USA, [2]Massachusetts General Hospital, USA, Presider

WG1 • 6:30 p.m. (Invited)
Monitoring enzymatic function and drug efficacy in vivo using novel fluorescence probes, *Ching Tung; Massachusetts General Hospital/Harvard Medical School, USA.*

WG2 • 7:15 p.m. (Invited)
Spectral imaging for bio-molecular research and drug discovery, *Dan Farkas; Cedars Sinai Medical Ctr., USA.*

Thursday, April 15, 2004

Brittany/Champs Elysées
8:30 a.m.–10:35 a.m.
ThA • OSA Highlight: Molecular Imaging and Drug Discovery: GE Healthcare Joint Session

David Lester; Experimental Medicine, USA, Presider

ThA1 • 8:30 a.m. (Invited)
Non-invasive visible light imaging in drug discovery and development: A view from an industrial perspective, *Peter Lassota; Novartis Pharmaceuticals Corp, USA.*

ThA2 • 8:55:00 a.m. (Invited)
Molecular and functional dissection of tumors by intravital microscopy, *Dai Fukumura; Steele Lab. Harvard/MGH, USA.*

ThA3 • 9:20:00 a.m. (Invited)
Quantum dots as probes in biological imaging, *Charlie Hotz; Quantum Dot Corp, USA.*

ThA4 • 9:45 a.m. (Invited)
NIR optical imaging of integrins and matrix metalloproteinases, *Chun Li; U.T. M.D. Anderson Cancer Ctr., USA.*

ThA5 • 10:10 a.m. (Invited)
Microspectroscopic imaging of pharmaceutical products, *Neil Lewis; Spectral Dimensions, Inc, USA.*

Brittany/Champs Elysées
11:00 a.m.–1:00 p.m.
ThB • Breast Imaging
Randall Barbour; SUNY Downstate Medical Center, USA, Presider

ThB1 • 11:00 a.m.
Near-infrared scattering spectrum differences between benign and malignant breast tumors measured in vivo with diffuse tomography, *Brian Pogue[1], Shudong Jiang[1], Subhadra Srinivasan[1], Xiaomei Song[1], Hamid Dehghani[1], Keith Paulsen[1], Tor Tosteson[2], Christine Kogel[2], Sandra Soho[2], Steven P. Poplack[2]; [1]Dartmouth Coll., USA, [2]Dartmouth Medical School, USA.* Near-infrared spectral tomographic imaging was used to show that a statistically significant difference exists in the spectral scattering power and amplitude between a group of benign (n=7) and malignant (n=6) tumor tissues imaged in vivo.

ThB2 • 11:15 a.m.
Time domain optical mammography on 150 patients: hemoglobin concentration and blood oxygen saturation of breast tumours, *Dirk Grosenick[1], K. Thomas Moesta[2], Heidrun Wabnitz[1], Jörg Mucke[2], Michael Möller[1], Jana Stößel[2], Bernhard Wassermann[1], Rainer Macdonald[1], Peter Schlag[2], Herbert Rinneberg[1]; [1]Physikalisch-Technische Bundesanstalt, Germany, [2]Robert-Roessle-Klinik, Humboldt-Univ., Germany.* We recorded time-domain optical mammograms from more than 150 patients. Optical properties of breast tumors detected were estimated by employing models of photon diffusion considering the tumor as a spherical inhomogeneity.

ThB3 • 11:30 a.m. (Invited)
Multi-wavelength time-resolved optical mammography, *Paola Taroni; Dept. of Physics, Politecnico di Milano, Italy.* A clinical study involving more than 150 patients has been performed to investigate the diagnostic potential of time-resolved optical mammography at 4 wavelengths (685-985 nm). Shorter wavelengths (637-656 nm) were also tested on 43 patients.

ThB4 • 12:00 p.m.
Breast deformation in near infrared optical tomography, *Hamid Dehghani[1], Brian W. Pogue[1], Marvin M. Doyley[2], Jason Geng[3], Keith D. Paulsen[1]; [1]Thayer School of Engineering, Dartmouth Coll., USA, [2]Dept. of Radiology, Dartmouth Medical School, USA, [3]Genex Technologies Inc, USA.* In NIR tomography of the breast, good contact is needed by the fibers, resulting in breast deformation. We present a deformation model to account for the change of shape and discuss implications in image reconstruction.

ThB5 • 12:15 p.m.
Bulk hemoglobin, lipid and water content in the female breast from multi-wavelength time-resolved optical mammography, *Lorenzo Spinelli[1], Alessandro Torricelli[1], Antonio Pifferi[1], Paola Taroni[1], Rinaldo Cubeddu[1], Gian Maria Danesini[2]; [1]INFM-Dipartimento di Fisica and IFN-CNR, Politecnico di Milano, Italy, [2]Dept. di Radiologia, Casa di Cura S. Pio X, Italy.* Concentrations of oxygenated and deoxygenated hemoglobin, lipids and water in female breast are presented for 113 breasts, as a result of a clinical study on optical mammography. They correlate well with demographic parameters of subjects.

ThB6 • 12:30 p.m.
In vivo three-dimensional multi-spectral diffuse optical tomography of breast cancer, *Regine Choe, Alper Corlu, Kijoon Lee, Turgut Durduran, Britton Chance, Arjun G. Yodh; Univ. of Pennsylvania, USA.* Multi-spectral diffuse optical tomography was utilized for in vivo breast cancer imaging to reconstruct 3D map of chromophore concentrations and scattering directly from CW data. Blood volume contrast was found in the cancer region.

ThB7 • 12:45 p.m.
In vivo imaging of pressure effects in normal breast tissue with quantitative multi-spectral near-infrared tomography, *Shudong Jiang[1], Brian W. Pogue[1], Xiaomei Song[1], Subhadra Srinivasan[1], Keith D. Paulsen[1], Christine A. Kogel[2], Sandra Soho[2], Steven P. Poplack[2]; [1]Thayer School of Engineering, Dartmouth Coll., USA, [2]Dept. of Radiology, Dartmouth-Hitchcock Medical Ctr., USA.* Near-infrared tomographic images of choromphores and scatterers have been validated with phantoms and used in imaging pressure effects in normal breast tissue. Dominant changes occur in water content and scattering power under applied external pressure.

Monaco
11:00 a.m.–1:00 p.m.
ThC • Fluorescence
Stefan Andersson-Engels; Lund Inst. of Technology, Sweden, Presider

ThC1 • 11:00 a.m. (Invited)
Title to be announced,
David Benaron; Spectros Corp, USA.

ThC2 • 11:30 a.m.
Towards high-speed wide-field fluorescence lifetime imaging, *Daniel Elson[1], Jose Requejo-Isidro[1], Ian Munro[1], James McGinty[1], Christopher Dunsby[1], Mark Neil[1], Paul French[1], Kirill Volynski[1], Paul Kellett[2], Tony Dymoke-Bradshaw[3], Jonathon Hares[3]; [1]Imperial Coll. London, UK, [2]Kentech Insruments Ltd, UK, [3]Kentech Instruments Ltd, UK.* We report a time-gated wide-field video rate fluorescence lifetime imaging (FLIM) system operating up to 29Hz in both microscope and endoscope systems. Single-shot wide-field FLIM based on a novel four-channel gated intensifier is also reported.

ThC3 • 11:45 a.m.
Stokes shift emission spectroscopy of cancer and normal breast tissues, *Robert R. Alfano, Yuanlong Yang, Sandra M. Lubicz; City Coll. of New York, USA.* The Stokes-shifted emission spectra were measured for cancer and normal tissues. This approach reveals more clearly defined information on molecular activity in tissue than obtained from excitation and/or fluorescence spectroscopy for a single spectral scan.

ThC4 • 12:00 p.m.
Assessment of the detection sensitivity of bioluminescent and fluorescent reporters in small animal models, *Tamara L. Troy, Olivier Delage, Brad W. Rice; Xenogen Corporation, USA.* An absolutely calibrated imaging system that can detect the steady-state emission from bioluminescent and/or fluorescent probes located inside small animals is described. Techniques to improve in vivo detection sensitivity of fluorescent imaging are explored.

ThC5 • 12:15 p.m.

Developing 3D high-resolution imaging of pancreatic islet ß cells in genetically obese-diabetic (ob/ob) mice, *Lanlan Zhou, Xiaohong Li, Bleu Zhong, Donglan Zhang, Dana Blessington, Hui Li, Gang Zheng, Jerry Glickson, Britton Chance; Univ. of Pennsylvania, USA.* We characterize Fp, NADH and Pyro-2DG distributions of pancreatic islet ß-cells and liver cells in ob/ob mice with a cryo-imager and reconstruct high-resolution 3D-images. This helps evaluate the validity of optical studies of pancreatic tissue.

ThC6 • 12:30 p.m.
In vivo flow cytometry: A new method for monitoring circulating cancer cells, *Irene Georgakoudi, Nicolas Solban, John Novak, Tayyaba Hasan, Tayyaba Hasan, Tayyaba Hasan, Charles Lin; Wellman Labs. of Photomedicine, USA.* We present a new method for detecting fluorescently labeled circulating cells in vivo. We use this method to monitor the depletion kinetics of circulating prostate cancer cells with different metastatic potential in two different hosts.

ThC7 • 12:45 p.m.
Estimation of tissue optical properties from in vivo fluorescence measurements using an inverse analytical model, *Sung K. Chang[1], Dizem Arifler[1], Michele Follen[2], Rebecca Richards-Kortum[1]; [1]Univ. of Texas at Austin, USA, [2]MD Anderson Cancer Ctr., USA.* An analytical model was used to develop an inverse model to estimate tissue optical properties from in vivo fluorescence measurements. The inverse model estimated optical parameters from the epithelial and stromal layers from fluorescence spectra.

Brittany/Champs Elysées
2:30 p.m.–4:00 p.m.
ThD • Advances in Theoretical Methods for Optical Imaging
Andreas H. Hielscher; Columbia University, USA, Presider

ThD1 • 2:30 p.m.
Water and lipid content measurements using diffuse optical spectroscopy and MRI in emulsion phantoms, *Sean Merritt[1], Albert E. Cerussi[1], Anthony J. Durkin[1], Bruce J. Tromberg[1], Gultekin Gulsen[2], George Chiou[2], Yong Chu[2], Chengwu Deng[2], Orhan Nalciogl[2]; [1]Beckman Laser Inst., USA, [2]John Tu and Thomas Yuen Ctr. for Functional Onco-Imaging, USA.* We present a quantitative comparison of lipid and water signals obtained from broadband Diffuse Optical Spectroscopy (DOS) and Magnetic Resonance Imaging (MRI) of emulsion tissue phantoms.

ThD2 • 2:45 p.m.
Observer performance studies involving simultaneous ROC/LROC fitting on simulated NIR tomographic images, *Xiaomei Song, Brian W. Pogue, Shudong Jiang, Keith D. Paulsen, Tor D. Tosteson; Dartmouth Coll., USA.* Detection and location of objects in NIR tomographic images was performed with a simultaneous ROC/LROC analysis model with maximum-likelihood based fitting of the curves. Effects of iteration and algorithm performance significantly alter detectability of objects.

ThD3 • 3:00 p.m.
Computational calibration method for optical tomography, *Tanja Vilhunen[1], Ville Kolehmainen[1], Marko Vauhkonen[1], Antti Vanne[1], Adam Gibson[2], Martin Schweiger[2], Simon R. Arridge[2], Jari P. Kaipio[1]; [1]Univ. of Kuopio, Finland, [2]Univ. Coll. London, UK.* A computational calibration method for optical tomography is proposed. The method can be used for the estimation of unknown amplitude losses and phase shifts in the source and detector fibers.

ThD4 • 3:15 p.m.
Regularization of diffuse optical tomography images by envelope guided conjugate gradients, *Alper Corlu, Regine Choe, Turgut Durduran, Kijoon Lee, Soren D. Konecky, Arjun G. Yodh; Univ. of Pennsylvania, USA.* We have implemented a spatially variant regularization method for nonlinear conjugate gradient (CG) based DOT that optimizes the regularization parameter without the use of Tikhonov L-curve. The regularization parameter is adjusted adaptively during CG-iterations.

ThD5 • 3:30 p.m.

A diffusive light source for quantification of optical properties of superficial layers, *Sheng-Hao Tseng, Carole Hayakawa, Jerome Spanier, Bruce J. Tromberg, Anthony J. Durkin; Laser Microbeam and Medical Progra.m, Beckman Laser Inst., Univ. of California, Irvine, USA.* We present a method for performing quantitative spectroscopy of superficial tissue volumes. We have employed a two-layer model, for which the upper, high-scattering layer's optical properties are known, to recover the optical properties of phantoms.

ThD6 • 3:45 p.m.
Enhancement of early skin fibrosis structure from polarized patterns, *Alexander P. Sviridov[1,2], Victor Chernomordik[1], Moinuddin Hassan[1], Angelo Russo[1], Paul Smith[1], Amir Gandjbakhche1; [1]NIH, USA, 2Inst. for Laser and Information Technologies, RAS, Russian Federation.* The structure of fibrosis skin was enhanced using Fourier transform filtering of polarization degree pattern. The pattern scanning with Pearson correlation coefficient was used to determine the orientation and characteristic size of hidden structure.

Monaco
2:30 p.m.–4:00 p.m.
ThE • Instrumentation and Technology in the Neurosciences
Jerome Mertz; Boston Univ, USA, Presider

ThE1 • 2:30 p.m. (Invited)
Second Harmonic Imaging Microscopy, *Leslie M. Loew; Dept. of Cell Biology, USA.*

ThE2 • 3:00 p.m.
Feasibility of ultrahigh resolution optical coherence tomography for imaging brain tissue morphology and function, *Kostadinka Bizheva[1], Angelika Unterhuber[1], Boris Povazay[1], Boris Hermann[1], Harald Sattmann[1], Wolfgang Drexler[1], Herbert Reitsamer[2], Matthias Preusser[3], Herbert Budka[3], Michael Seefeldt[4], Ralf Menzel[4], Andreas Stingl[5], Tuan Le[5]; [1]Dept. of Medical Physics, Austria, [2]Dept. of Physiology, Austria, [3]Dept. of Neurology, Austria, [4]Inst. of Physics and Photonics, Germany, [5]Femtolasers Produktions, Austria.* The feasibility of ultrahigh resolution optical coherence tomography to image both healthy and pathological brain tissue morphology as well as the morphology and functional response of neuron cells is investigated.

ThE3 • 3:15 p.m.
Auto-confocal microscopy using non-linear transmitted light detection, *Thomas Pons[1], Jerome Mertz[2]; [1]Lab Neurophysiologie, ESPCI, France, [2]Dept of Biomedical Engineering, Boston Univ., USA.* We describe a novel transmission confocal laser scanning microscopy where a nonlinear crystal replaces the pinhole. Phase contrast imaging is evaluated theoretically and demonstrated in brain slices. This technique can be implemented with two-photon microscopy.

ThE4 • 3:30 p.m.
Non-linear microscope for imaging of the neural systems in live drosophila, *David Entenberg, Robert D. Roorda, Ricardo Toledo-Crow; Memorial Sloan-Kettering Cancer Ctr., USA.* A custom scanning engine is used for fast (22 frames/second, 512 x 480 pixels,115ns pixel dwell-time), non-linear optical microscopical images of neural system in d. melanogaster larvae. Design guidelines and resulting images presented.

ThE5 • 3:45 p.m.
Optical stimulation of peripheral nerve in vivo, *Jonathon D. Wells, Duco Jansen, Peter Konrad, Anita Mahadevan-Jansen; Vanderbilt Univ., USA.* A novel method of stimulation of neural tissue using pulsed, low-energy laser light is presented. Optical stimulation elicits nerve and muscle action potentials similar to responses obtained with conventional electrical stimulation. Results indicate wavelength dependence.

Burgundy
2:30 p.m.–4:00 p.m.
ThF • Poster Session II/Coffee Break

ThF1 • 4:00 p.m.
Optical transillumination spectroscopy a new physical assessment tool in preventive oncology, *Lothar Lilge[1,2], Kristina Blyschak[1], Michelle Simick[3], Brian Wilson[1,2], Robert Weersink[1]; [1]Univ. Health Network, Canada, [2]Univ. of Toronto, Canada, [3]Toronto Sunnybrook Regional Cancer Ctr., Canada.* Preventive oncology correlates risk factors with targets and provides intervention. We showed that spectroscopy can identify individuals at risk. Additionally we demonstrated the ability to montior changes in risk enabling monitoring of risk changes.

ThF2 • 4:00 p.m.
Fluorescence-lifetime based pH sensing via multiple light scattering measurement with pH-sensitive dyes immobilized in poly(ethylene glycol) microspheres, *Feng Liang, Eddy Kuwana, Eva M. Sevick-Muraca; Texas A&M Univ., USA.* The frequency-domain fluorescence lifetime measurement of a pH sensitive dye (C-SNAFL-1) immobilized into poly(ethylene glycol) hydrogels showed the ability to perform implantable and continuous pH sensing with fluorescence life in tissue-like multiply scattering solutions.

ThF3 • 4:00 p.m.
Autofluorescence spectroscopy of normal and malignant esophageal epithelium cells, *Sandrine Villette[1], Geneviève Bourg-Heckly[1], Sophie Pigaglio-Deshayes[1], Christine Vever-Bizet[1], Pierre Validire[2]; [1]Univ. Pierre et Marie Curie, France, [2]Institut Mutualiste Montsouris, France.* Autofluorescence of squamous cell carcinoma, adenocarcinoma and normal esophageal epithelial cells are compared. Spectral distribution is similar but a statistical significant difference is observed between the average intensity of the different cell types.

ThF4 • 4:00 p.m.
Estimation of absorption coefficient of the lower layer in layered turbid media with time-resolved measurement, *Chie Sato[1], Miho Shimada[1], Yukio Yamada[2], Yoko Hoshi[1]; [1]Tokyo Inst. of Psychiatry, Japan, [2]Univ. of Electro-Communications, Japan.* By dividing the temporal profiles of reflected light intensity with time-resolved measurement, we have developed a new approach to selective determination of the absorption coefficient of the lower layer in two-layered turbid media.

ThF5 • 4:00 p.m.
Optimising reflection-based pulse oximeters, *Martin J. Leahy; Univ. of Limerick, Ireland.* Reflectance pulse oximetry (PO) use is retarded by fears concerning its accuracy. A photon diffusion model together with data from desaturation of 20 volunteers is analysed to provide clues for improvement.

ThF6 • 4:00 p.m.
Raman spectroscopy for clinical detection of skin cancers, *Chad Lieber; Vanderbilt Univ., USA.* Raman spectroscopy is a promising technique for noninvasive, near-real-time diagnosis of tissue lesions. Using a custom-built handheld confocal Raman microscope, Raman spectra from a number of pathologic and normal skin tissues were measured in vivo.

ThF7 • 4:00 p.m.
Design and performance of a laser-induced-fluorescence scanner for fast, sensitive measurement of real-time PCR reactions in capillaries, *Stephen E. Moody[1], Deirdre R. Melcrum[2], Charles H. Fisher[2], Patrick Ngatchou[2], Jianchun Dong[2], David L. Cunningham[1], Mark A. Holl[2], William H. Pence[1]; [1]Orca Photonic Systems, Inc, USA, [2]Univ. of Washington, USA.* The design and performance of a fast, efficient scanner that simultaneously measures fluorescence from 48 PCR samples is presented. A glass capillary approach allows Real-time PCR with much smaller samples than measurement in microtitre plates.

ThF8 • 4:00 p.m.
Low-cost, battery operated, dual wavelength continuous wave near infrared spectroscopy device for bedside monitoring of newborn brain, *Alper Bozkurt[1], Arye Rosen[1], Harel Rosen[2], Banu Onaral[1]; [1]Drexel Univ., USA, [2]St. Peter's Univ. Hospital, USA.* We present a low-cost, battery operated, dual-

wavelength, continuous wave near infrared spectroscopy system for continuous bedside monitoring of neonatal brain. Preliminary test results on adults are provided.

ThF9 • 4:00 p.m.
Proposed advantages of using mid-IR wavelengths for morphological characterization of pre-canceroustissue using elastic-scattering spectroscopy, *Nagapratima Kunaparedddy[1], Irving J. Bigio[2], Judith R. Mourant[3]; [1]Dept. of Electrical and Computer Engineering, USA, [2]Dept. of Electrical and Computer Engineering/ Dept. of Biomedical Engineering, USA, [3]Bioscience Division, Los Alamos Natl. Lab., USA.* It is proposed that elastic-scattering spectroscopy with mid-IR wavelengths may provide increased sensitivity to nuclear sizes in dysplastic tissue and reduce diffusely scattered light. This could potentially become a useful tool for characterizing dysplastic tissue.

ThF10 • 4:00 p.m.
Pharmacokinetics model to assess the extravasation of tumor tissue by using fluorescence contrast agents, *Ping Huang, Xavier Intes, Shoko Nioka, Britton Chance; Dept. of Biochemistry and Biophysics, Univ. of Pennsylvania, USA.* The pharmacokinetics model is developed to describe the delivery of ICG injected intravenously into the human subject and can differentiate between normal tissue and tumor with large leakiness of vasculature.

ThF11 • 4:00 p.m.
Er-YAG laser treatments on dentine surface: micro-Raman spectroscopy and SEM analysis, *Maria Lepore[1], Carlo Camerlingo[2], Giovanni Maria Gaeta[3], Roberto Riccio[3], Carlo Riccio[3], Mario De Rosa[1]; [1]Dipartimento di Medicina Sperimentale, Italy, [2]CNR, Italy, [3]Dipartimento di Odontostomatologia, Italy.* This study investigates the chemical and structural modifications in laser treated dentine surface. For this purpose the effect of Er-YAG laser on human dentine surface has been investigated with micro-Raman spectroscopy and SEM microscopy.

ThF12 • 4:00 p.m.
A comparison of diagnostic fluorescence point and hyperspectral imaging spectroscopy - geometry effects, *Jenny Svensson, Gabriel Somesfalean, Ann Johansson, Stefan Andersson-Engels; Atomic Physics Dept. , Lund Inst. of Technology, Sweden.* Fluorescence spectra have been measured at different distances from a pencil-beam excitation spot using two diagnostic instruments. These spectra have been compared to calculated theoretical data with fluorescence Monte Carlo.

ThF14 • 4:00 p.m.
Localization of fluorophore depth in tissue from changes in fluorescence spectra, *Johannes Swartling[1], Daniel Bengtsson[2], Khaled Terike[2], Jenny Svensson[2], Stefan Andersson-Engels[2]; [1]Dipartimento di Fisica, INFM Politecnico di Milano, Italy, [2]Dept. of Physics, Lund Inst. of Technology, Sweden.* We present a novel method for determining the depth of a localized fluorophore in tissue, based on changes in the fluorescence spectrum, because of tissue absorption. Ratios of wavelength bands correlate with the depth.

ThF15 • 4:00 p.m.
Characteristics of fluorescence quenching by polystyrene microspheres in tissue-simulating phantoms, *Wei Zhong, Karthik Vishwanath, Mary-Ann Mycek; Univ. of Michigan, USA.* Polystyrene microspheres were previously reported to reduce fluorophore quantum yield via collisional quenching in fluorescein-based tissue-simulating phantoms. Here, we report decreases of fluorescence intensities and lifetimes of ~10-30% that are dependent on microsphere size.

ThF16 • 4:00 p.m.
Simulations of time-resolved autofluorescence decays in epithelial tissue for differing probe geometries, *Karthik Vishwanath, Mary-Ann Mycek; Univ. of Michigan, USA.* A Monte Carlo code was employed to simulate the remitted time-resolved fluorescence from bi-layered tissue models. The influence of endoscopy compatible source-detector geometries for detecting variations in epithelial layer thickness and fluorophore properties were quantified.

ThF17 • 4:00 p.m.

Spectroscopic detection of cancer using NIR imaging and hyperspectral microscopy, *Stavros G. Demos[1], Rajen Ramsamooj[2], Regina Gandour-Edwards[2], Richard Bold[2], Ralph deVere White[2]; [1]Lawrence Livermore Natl. Lab., USA, [2]UC Davis Medical School, Medical Ctr., USA.* We explore NIR autofluorescence and polarized light scattering imaging in combination with hyperspectral microscopy to detect and image various types of cancer . Fresh surgical human specimens are used and images are compared to histopathology.

ThF18 • 4:00 p.m.
Mie scattering parameter estimation in near-infrared tomographic breast imaging, *Xin Wang, Brian Pogue, Shudong Jiang, Keith Paulsen; Dartmouth Coll., USA.* The Mie-type scattering parameters were estimated from NIR tomography of breast tissue. Results show that the average particle size and the number density can be estimated from bulk tissue transport scattering measurements at discrete wavelengths.

ThF19 • 4:00 p.m.
Experimental validation of a fitting procedure for retrieving the optical properties of layered media from time-resolved reflectance measurements, *Fabrizio Martelli[1], Samuele Del Bianco[1], Giovanni Zaccanti[1], Antonio Pifferi[2], Alessandro Torricelli[2], Andrea Bassi[2], Paola Taroni[2], Rinaldo Cubeddu[2]; [1]Universita' degli Studi di Firenze, Dipartimento di Fisica, Italy, [2]Dipartimento di Fisica, Politecnico di Milano, Italy.* An experimental validation of a fitting procedure for retrieving the optical properties of layered media based on multidistance time-resolved reflectance measurements is presented.

ThF20 • 4:00 p.m.
Experimental studies of near-infrared diffuse optical tomography in turbid media: Distributed excitation source and periodical boundary conditions coefficient, *Xiaoping Liang, Huabei Jiang; Clemson Univ., USA.* We report on an improved reconstruction algorithm that considers a distributed excitation source model and periodical boundary conditions coefficient in diffuse optical tomography. The improved algorithm is tested using several sets of phantom experimental data.

ThF21 • 4:00 p.m.
Boundary element solution of the coupled fluorescence diffusion equations, *Francesco Fedele, Jeffrey P. Laible, Margaret J. Eppstein; Univ. of Vermont, USA.* The use of the boundary element method is explored as an alternative solution methodology for the coupled elliptic equations used to model generation and transport of fluorescent light in highly scattering media.

ThF22 • 4:00 p.m.
Fluorescence-enhanced optical tomography: Absorption and lifetime contrast studies, *Anuradha Godavarty1, Eva M. Sevick-Muraca2, Margaret J. Eppstein1; 1Univ. of Vermont, USA, 2Texas A&M Univ., USA.* Three-dimensional fluorescence-enhanced optical tomography on fluorescence absorption and fluorescence lifetime is demonstrated on clinically relevant phantom volumes employing a rapid data acquiring gain-modulated intensified CCD imaging system in the frequency-domain.

ThF23 • 4:00 p.m.
Two- and three-dimensional high resolution imaging of genetic expression of Luciferase, *Britton Chance, W. El-Deiry, Y. Li, L. Zhou; Univ. of Pennsylvania, USA.* The widespread acceptances of Luciferase (LUC) imagery of tumor growth and recession lacks a tomographic method – A method for localized imaging of LUC luminescence in small voxel with a temperature jump is proposed.

ThF24 • 4:00 p.m.
Improvement of transcutaneous fluorescent image by depth-dependent PSF, *Koichi Shimizu[1], Yuji Kato[1], Koji Tochio[2]; [1]Hokkaido Univ., Japan, [2]Hakuju Inst. for Health Science, Japan.* For reflection-type transcutaneous fluorescent imaging, the equation of a depth-dependent PSF was derived. The visible depth in a scattering medium became almost twice as deep using this technique. The usefulness was demonstrated in animal experiments.

ThF25 • 4:00 p.m.

Photon source localization and intensity quantification in diffuse luminescence imaging tomography, *Chaincy Kuo, Daniel G. Stearns, Brad W. Rice; Xenogen Corporation, USA.* We present localization and quantification of photon sources in tissue phantoms from a single-view image analyzed by diffuse luminescence imaging tomography. Source intensity of 8% accuracy with 1 mm spatial resolution can be achieved.

ThF26 • 4:00 p.m.
Independent modeling of fluorescence excitation and emission with the finite element method, *Ralf B. Schulz[1], Wolfgang Bangerth[2], Jörg Peter[1], Wolfhard Semmler[1]; [1]Dept. Medical Physics in Radiology, German Cancer Res. Ctr. (DKFZ), Germany, [2]Ctr. for Subsurface Modeling, Inst. for Computational Engineering and Sciences, The Univ. of Texas at Austin, USA.* Based on the diffusion equation, a parallel FEM system is proposed, describing photon propagation and fluorescence emission using appropriate boundary conditions. Iterative reconstruction methods will benefit from the speed-up due to parallelized forward model execution.

ThF27 • 4:00 p.m.
Fluorescence imaging of near infrared diffusive wave with a priori information, *Baohong Yuan, Quing Zhu; Univ. of Connecticut, USA.* In this paper, a dual-mesh imaging method is extended into fluorescent imaging. The image quality is highly dependent upon source and detector distributions, and a circular source distribution around a target region provides superior images.

ThF28 • 4:00 p.m.
Prototype time-resolved diffusive optical imaging system, *Nan Guang Chen, Quing Zhu; Univ. of Connecticut, USA.* A time-resolved diffusive optical tomography system has been implemented via a novel spread spectrum approach. The temporal resolution achieved was 2.24 ns. Improved spatial resolution with early arriving photons was experimentally demonstrated.

ThF29 • 4:00 p.m.
A digital signal processor-based detection system for optical tomography, *Joseph Lasker[1], James Masciotti[1], Christoph Schmitz[2], Mathew Shoenecker[1], Randall Barbour[3], Andreas Hielscher[1]; [1]Columbia Univ., USA, [2]NIRx Medical Technologies, USA, [3]SUNY Downstate Medical Ctr., USA.* We introduce a prototype optical tomography system that is, based on embedded digital signal processing techniques. We offer insight into circuit construction and signal conditioning to accommodate desired bandwidth, sensitivity, and temporal response.

ThF30 • 4:00 p.m.
Data integrity assessment and instrument calibration for the DYNOT imaging system, *Christoph H. Schmitz[1,2], Harry L. Graber[2], Randall L. Barbour[2,1]; [1]NIRx Medical Technologies LLC, USA, [2]SUNY Downstate Medical Ctr., USA.* We present a variety of system check procedures that assess instrument functionality and data integrity for the NIRx DYNOT imaging system. Also described is use of a phantom-based calibration protocol to account for inter-channel variations.

ThF31 • 4:00 p.m.
Complex optical assessment of hemorheologic and microcirculatory disorders by means of imaging and laser diffraction techniques, *Alexander V. Priezzhev[1], Yuri I. Gurfinkel[2], Vladimir L. Voeikov[3], Pavel Y. Demidion[2], Anastasiya Yu Tyurina1; [1]Moscow State Univ., Russian Federation, [2]Central Clinical Hospital, Russian Federation, [3]Moscow State Univ., Biology Dept., Russian Federation.* We studies correlations of parameters measured by several scattering and imaging techniques with normal subjects and patients suffering from CAD and showed high diagnostic value of the combined measurements.

ThF32 • 4:00 p.m.
Optical methods for the quantification of cutaneous edema, *Georgios Stamatas, Nikiforos Kollias; Johnson & Johnson, USA.* In vivo non-invasive methods are presented for the objective quantification of histamine-induced cutaneous edema based on hyper-spectral imaging and 3D profilometry. The measured parameters include extracellular water accumulation, hemoglobin concentration, edema height, and edema volume.

ThF33 • 4:00 p.m.
QLF and OPS investigation of drying in natural incipient caries lesions, *Claudia Mujat[1], Monique H. van der Veen[2], Jan L. Ruben[3], Aristide Dogariu[1], Jaap J. ten Bosch[3]; [1]School of Optics/CREOL, USA, [2]ACTA and Inspektor Res., Netherlands, [3]Univ. of Groningen, Netherlands.* Quantitative Light-induced Fluorescence and Optical Pathlength Spectroscopy are used to study drying effects in natural dental caries lesions, in an attempt to provide non-invasive information on the lesion surface layer porosity, thus predicting lesion activity.

ThF34 • 4:00 p.m.
Three-dimensional diffuse optical imaging of joints: System description and phantom studies, *Qizhi Zhang, Huabei Jiang; Clemson Univ., USA.* A CCD-based DOT system with 64x64 channels was developed for joint imaging. The phantom studies suggest that up to 1mm thick "cartilage" can be quantitatively resolved in terms of the shape, size and optical properties.

ThF35 • 4:00 p.m.
Tumor oxygen dynamics measured simultaneously by near-infrared spectroscopy and 19F MR EPI imaging, *Mengna Xia[1], Yueqing Gu[1], Hanli Liu[1], Vikram Kodibagkar[2], Anca Constantinescu[2], Ralph Mason[2]; [1]Univ. of Texas at Arlington, USA, [2]UT Southwestern Medical Ctr. at Dallas, USA.* We demonstrate the ability to simultaneously investigate tumor oxygen dynamics by Near-infrared spectroscopy and Fluorocarbon Relaxometry using Echo planar imaging for Dynamic Oxygen Mapping in breast tumors, with close correlations between the two techniques.

ThF36 • 4:00 p.m.
Depth localization of lesions in time-domain scanning optical mammography from off-axis measurements, *Heidrun Wabnitz[1], Dirk Grosenick[1], Michael Moeller[1], Joerg Mucke[2], Jana Stoessel[2], Bernhard Wassermann[1], Rainer Macdonald[1], K. Thomas Moesta[2], Herbert Rinneberg[1]; [1]Physikalisch-Techn. Bundesanstalt, Germany, [2]Robert-Roessle-Klinik, Charité, Germany.* The depth location of tumors is obtained from line scans recorded at various source-detector offsets taking into account the shape of the average photon trajectory. Knowledge of depth facilitates reliable estimation of tumor optical properties.

ThF37 • 4:00 p.m.
Experimental and theoretical verification of a compact device to measure optical properties from thin turbid samples, *Nazila Yavari, Jan Sörensen Dam, Stefan Andersson-Engels; Lund Inst. of Technology, Sweden.* We present a novel instrumentation for simultaneous absorption and scattering characterization of small turbid samples. The results compare very well with data obtained with an integrating sphere for well-defined samples.

ThF38 • 4:00 p.m.
Image contrast enhancement following carbogen inhalation, *Kenneth T. Kotz, Khalid Amin, Juan M. Orduna, William A. Boenig, Gregory W. Faris; SRI Intl., USA.* We have studied the dynamic changes in the optical absorption of tissues in animal studies following the inhalation of carbogen gas. Differential imaging enhanced the image contrast between normal and cancerous tissues.

ThF39 • 4:00 p.m.
Application of dynamic optical tomography for the detection of a multi-phase physiologic response to Valsalva maneuver in healthy breast tissue, *Rosemarie E. Hardin[1], David P. Klemer[1], Michael S. Katz[1], Nelson A. Franco[1], Harry L. Graber[1], Christoph H. Schmitz[1], Randall L. Barbour[1], Alessandro G. Smeraldi[2], Thomas F. Panetta[2]; [1]SUNY Downstate Medical Ctr., USA, [2]Staten Island Univ. Hospital, USA.* We demonstrate the ability of dynamic optical tomography to detect and provide mathematical models of multi-phase physiologic behavior within normal tissue in response to a Valsalva maneuver.

ThF40 • 4:00 p.m.
Perturbation theory analysis of time resolved optical mammograms in-vivo, *Bernhard Wassermann[1], Andreas Kummrow[1], Heidrun Wabnitz[1], Dirk Grosenick[1], Rainer Macdonald[1], Herbert Rinneberg[1], K. Thomas Moesta[2], Joerg Mucke[2], Jana Stoessel[2], Peter Schlag[2]; [1]Physikalisch-Technische Bundesanstalt,*

Germany, [2]Robert-Rössle-Klinik, Charité, Humboldt-Univ. Berlin, Germany. A perturbation procedure is given to analyze time-domain optical mammograms by scanning a test sphere across the image of female breast. Optical coefficients, hemoglobin concentration and blood oxygen saturation of tumors and cysts are presented.

ThF41 • 4:00 p.m.
Estimating the average breast optical properties from transmission measurements despite intrinsic tissue heterogeneity: a Monte Carlo Simulation Study, *Quan Zhang[1], Jonathan J. Stott[1], Thomas J. Brukilacchio[1], Ang Li[1], Tina Chaves[1], Anand Kumar[1], Tao Wu[2], MaryAnn Chorlton[2], Elizabeth Rafferty[2], Richard H. Moore[2], Daniel B. Kopans[2], David A. Boas[1]; [1]NMR Ctr., MGH, USA, [2]Breast Imaging Unit, MGH, USA.* To estimate the average optical properties of a heterogeneous medium, simulations show that multi-distance methods assuming homogeneous structure suffer from systematic modeling errors while single source-detector pair methods provides a more meaningful estimate.

ThF42 • 4:00 p.m.
A multi-channel scanning optical time domain mammograph, *Michael Moeller[1], Heidrun Wabnitz[1], Andreas Kummrow[1], Bernhard Wassermann[1], Rainer Macdonald[1], Herbert Rinneberg[1], Rainer Erdmann[2], K. Lauritsen[2]; [1]Physikalisch-Techn. Bundesanstalt, Germany, [2]PicoQuant GmbH, Germany.* A scanning time-resolved optical mammograph for breast cancer detection featuring four wavelengths for enhanced spectroscopic information, improved depth localisation and novel attenuation and imaging optics is presented. First in-vivo measurements are shown.

ThF43 • 4:00 p.m.
Monte Carlo simulation of light propagation in the human visual cortex, *Juha Heiskala[1], Ilkka Nissilä[2], Erkki Somersalo[3]; [1]BioMag-laboratory, Helsinki Univ. Central Hospital, Finland, [2]Lab. of Biomedical Engineering, Helsinki Univ. of Technology, Finland, [3]Inst. of Mathematics, Helsinki Univ. of Technology, Finland.* A Monte Carlo method was developed for the simulation of light propagation in arbitrary voxel-based geometry. Measurements on the visual cortex were simulated and the relative pathlengths of light in different tissue types were calculated.

ThF44 • 4:00 p.m.
Experimental measurements of scattered light from TiO2 and silica phantoms, *Khadija Tahir[1], Christopher Dainty[2]; [1]Imperial Coll., UK, [2]Natl. Univ. of Ireland, Ireland.* Measurements on phantoms shows that both μs and g individually affect the light scattering and hence we conclude that diffusion theory is an inadequate model for light scattering in tissues-like phantoms.

ThF45 • 4:00 p.m.
Image reconstruction using spatial sensitivity profilefor near-infrared topography, *Hiroshi Kawaguchi, Eiji Okada; Dept. of Electronics and Electrical Engineering, Keio Univ., Japan.* In this study, we describe that image reconstruction algorithm using spatial sensitivity profile with source and detector pairs at small intervals can effectively improve the spatial resolution of near-infrared topography.

ThF46 • 4:00 p.m.
The trade-off between spatial resolution and reconstructed image noise in diffuse reflective optical CT, *Reiko Endoh, Akifumi Suzuki, Mamiko Fujii, Kiyoshi Nakayama; Dept. of Electrical & Electronics Engineering, Sophia Univ., Japan.* We adopted a regularized MP pseudoinverse to realize the 3-dimensional reconstruction and report that the trade-off between the spatial resolution and the reconstructed image noise is essentially not affected by the voxel size.

ThF47 • 4:00 p.m.
In vivo 3D DOT imaging of hand joints: Studies on fiber optics/tissue interface, *Qizhi Zhang, Huabei Jiang; Clemson Univ., USA.* We report on in vivo studies of the influence of source/detector arrangement on 3D optical-image reconstruction of hand joints. The results suggest proper spatial layout of source/detector fibers can improve the quality of image reconstructions.

ThF48 • 4:00 p.m.

Statistics of partially coherent beams propagating through scattering media – a numerical approach, *Claudia Mujat, Aristide Dogariu; School of Optics/CREOL, USA.* The characteristics of beams with adjustable spatial coherence properties propagating through highly scattering media are studied using Monte Carlo simulations. The statistics of the intensity distribution obtained after propagation through diffusive media is correctly reproduced.

Brittany/Champs Elysées
6:30 p.m.–8:30 p.m.
ThG • Industry Roll-Out
David Benaron; Spectros Corp, USA, Presider

ThG1 • 6:30 p.m. (Invited)
Bio-optics in drug discovery, *Steve Williams; Pfizer, USA.*

ThG2 • 7:00 p.m. (Invited)
Applications of time-domain optical imaging in physiology and drug discovery, *Laura McIntosh; Advanced Res. Technologies Inc, Canada.*

ThG3 • 7:30 p.m. (Invited)
In vivo optical imaging of disease progression with a protease sensing activatable probe, *Dean Falb; VisEn Medical, USA.*

ThG4 • 8:00 p.m. (Invited)
Instrumentation and methods for steady-state optical imaging in small animals, *Brad Rice; Xenogen Corp, USA.*

Friday, April 16, 2004

Brittany/Champs Elysées
8:00 a.m.–10:00 a.m.
FA • Frontiers in Spectral Microscopy
Andrew J. Berger; The Institute of Optics, USA, Presider

FA1 • 8:00 a.m. (Invited)
In vivo microscopy and cytometry, applications in vascular biology, *Charles Lin; Wellman Labs. of Photomedicine, Massachusetts General Hospital, Harvard Medical School, USA.*

FA2 • 8:30 a.m. (Invited)
Nonlinear optical microscopy of tumors, *Edward Brown; Edwin L. Steele Lab, Massachusetts General Hospital, USA.*

FA3 • 9:00 a.m.
Multi-modality three-dimensional optical imaging of engineered tissues, *Wei Tan, Aylin Sendemir-Urkmez, Lester John Fahrner, Russell Douglas Jamison, Deborah E. Leckband, Stephen Allen Boppart; Univ. of Illinois at Urbana-Champaign, USA.* Optical coherence tomography (OCT), confocal, and multiphoton microscopy are used to nondestructively monitor in situ cell distribution and cell-matrix interaction in 3-D engineered tissues composed of chitosan scaffolds and fibroblasts transfected with GFP-tagged vinculin plasmid.

FA4 • 9:15 a.m.
In vivo fluorescence microscopy of neuronal activity in three dimensions using voltage-sensitive dyes, *Jonathan A. N. Fisher, Eugene F. Civillico, Diego Contreras, Arjun G. Yodh; Univ. of Pennsylvania, USA.* We report three-dimensional in vivo imaging of neuronal electrical activity from superficial layers of the mouse barrel cortex. The depth-dependent differential fluorescence optical sections of activity were consistent with known cortical architecture.

FA5 • 9:30 a.m.
Spectrally resolved and interferometric detection in second harmonic generation microscopy, *Siavash Yazdanfar, Lily Laiho, Peter T. C. So; MIT, USA.* We demonstrate two imaging systems for spectrally resolved and heterodyne detection in SHG microscopy of biological media. Coherent detection is achieved by mixing the SHG from a biological sample with SHG from a reference crystal.

FA6 • 9:45 a.m.
Ultra-high resolution video rate in vivo retinal imaging with spectral domain optical coherence tomography, *Johannes F. de Boer[1], Barry Cense[1], Nader Nassif[1], Andy Yun[1], Hyle Park[1], Mark Pierce[1], Brett Bouma[1], Gary Tearney[1], Teresa Chen[2]; [1]Wellman Ctr., MGH, HMS, USA, [2]Massachusetts Eye and Ear Infirmary, USA.* Ultra-high resolution images of the human retina in vivo were acquired at rates of 10.000 and 29.000 A-lines per second at a 99% duty cycle and axial resolution in the retina of 3.6 μm.

Brittany/Champs Elysées
10:30 a.m.–12:45:00 p.m.
FB • Clinical Applications of Optical Tomography
Amir H. Gandjbakhche; National Institutes of Health, USA, Presider

FB1 • 10:30 a.m. (Invited)
Near-infrared tomography as a model-based imaging modality, *Keith Paulsen; Dartmouth Coll., USA.*

FB2 • 11:00 a.m.
Clinical evaluation of an optical tomographic finger joint imaging systems, *Andreas H. Hielscher[1], Alexander K. Scheel[2], Alexander D. Klose[1], Bryte Moa-Anderson[1], Marina Backhaus[3], Uwe Netz[4,5], Gerhard A. Müller[2], Gerd R. Burmester[3], Jürgen Beuthan[5,4]; [1]Columbia Univ., USA, [2]Georg-August-Univ., Germany, [3]Charite Univ. Hospital, Germany, [4]Charite Univ. Medicine, Germany, [5]Laser and Medicine Technology GmbH, Germany.* We report on a clinical study involving measurements on 80 proximal interphalangeal joints of patients with rheumatoid arthritis. We evaluated the performance of a novel sagittal optical tomographic imager by comparing it to ultrasound imaging.

FB3 • 11:15 a.m.
Three-dimensional optical imaging of hemodynamic and oxygenation changes in the newborn infant brain, *Jeremy C. Hebden, Adam Gibson, Nick Everdell, Rozarina Md. Yusof, David T. Delpy, Simon R. Arridge, Topun Austin, Judith H. Meek, John S. Wyatt; Univ. Coll. London, UK.* Optical tomography of the brain of a mechanically ventilated infant during alterations to the ventilator settings, and on other infants during passive motor stimulus, reveal expected changes in blood content and oxygenation.

FB4 • 11:30 a.m.
Transabdominal near-infrared fetal brain oximetry, *Regine Choe[1], Turgut Durduran[1], Guoqiang Yu[1], Mark J M Nijland[2], Britton Chance[1], Arjun G. Yodh[1], Nirmala Ramanujam[3]; [1]Univ. of Pennsylvania, USA, [2]Cornell Univ., USA, [3]Univ. of Wisconsin, USA.* The feasibility of transabdominal near-infrared spectroscopy for detecting and quantifying fetal hypoxia in utero is demonstrated in a pregnant ewe model.

FB5 • 11:45 a.m.
Assessment of cerebral perfusion by time-resolved diffuse NIR-reflectance following injection of a dye-bolus, *Adam Liebert[1], Heidrun Wabnitz[1], Michael Möller[1], Rainer Macdonald[1], Herbert Rinneberg[1], Hellmuth Obrig[2], Jens Steinbrink[2], Arno Villringer[2]; [1]Physikalisch-Technische Bundesanstalt, Germany, [2]Dept. of Neurology, Charité, Humboldt-Univ., Germany.* We report on monitoring of the passage of an indocyanine green (ICG) bolus through the brain and extracerebral tissue in healthy volunteers by means of time-resolved diffuse NIR-reflectance measurements.

FB6 • 12:00 p.m.
Correlation of NIR spectroscopy with BOLD MR imaging of assessing breast tumor vascular oxygen status, *Yueqing Gu[1], Mengna Xia[1], Hanli Liu[1], Vikram Kodibagkar[2], Anca Constantinescu[2], Ralph P. Mason[2]; [1]Univ. of Texas at Arlington, USA, [2]Univ. of Texas Southwestern Medical Ctr. at Dallas, USA.* Dynamic changes of oxygenated and deoxygenated hemoglobin concentrations in response to hyperoxic

gas interventions on rat breast tumors were simultaneously investigated by near infrared spectroscopy and BOLD (blood oxygenation level dependent) contrast MR imaging.

FB7 • 12:15 p.m.
Clinical responses of head & neck tumors to radiation therapy by NIR spectroscopy, *Ulas Sunar[1], Jun Zhang2, Juan Du2, Turgut Durduran1, Chao Zhou[1], Guoqiang Yu[1], Alex Kilger[3], Harry Quon[3], Robert Lustig3, Laurie Loevner3, Shoko Nioka[2], Kambiz Pourrezaei[4], Arjun G. Yodh[1], Britton Chance[2]; [1]Dept. of Physics & Astronomy, Univ. of Pennsylvania, USA, [2]Dept. of Biochem & Biophysics, Univ. of Pennsylvania, USA, [3]Dept. of Radiation Oncology, Univ. of Pennsylvania, USA, [4]School of Biomedical Engineering, Science & Health Systems, Drexel Un, USA.* The aim is to evaluate the usefulness of NIR spectroscopy for predicting early tumor response to radiation therapy in patients with neck tumors. The results suggest a correlation between tumor oxygenation and clinical outcome.

FB8 • 12:30 p.m.
X-ray tomosynthesis and diffuse optical tomography: a multi-modality method for joint imaging, *Senthil Balaji Girimurugan; Clemson Univ, USA.* The inkling behind our approach is the implementation of a multi-modality imaging technique for osteoarthritis detection. The scheme involves the application of structure maps of high resolution X-ray images to diffuse optical tomography (DOT) reconstructions.

Monaco
10:30 a.m.–12:30 p.m.
FC • Functional Imaging Techniques
David Rector; Washington State Univ, USA, Presider

FC1 • 10:30 a.m. (Invited)
Functional optical coherence tomography of neurophysiology, *Stephen A. Boppart, Mariya Lazebnik, Claudio Vinegoni, Anupama Bowonder, Daniel L. Marks, Rhanor Gillette; Univ. of Illinois-Urbana, USA.* Functional optical coherence tomography (fOCT) is used to record optical changes that correspond to spontaneous and stimulated electrical activity in neural tissue. FOCT provides a high-resolution, real-time, non-invasive method for investigating neurophysiology.

FC2 • 11:00 a.m.
Autofluorescence imaging in the mouse cerebellar cortex in vivo, *Timothy J. Ebner, Wangcai Gao, Kenneth Reinert, Gang Chen; Dept. of Neuroscience, Univ. of Minnesota, USA.* Activity dependent intrinsic autofluorescence was studied in mouse cerebellar cortex in vivo. The properties and flavoprotein origin of this autofluorescence signal were systematically evaluated, including the unique capability of differentiating between neuronal excitation and inhibition.

FC3 • 11:15 a.m.
Improvement of depth sensitivity to cerebral hemodynamics with a time domain system, *Juliette J. Selb, Jonathan J. Stott, Maria Angela Franceschini, David A. Boas; Athinoula A. Martinos Ctr. - MGH, USA.* We use a time-domain system based on a pulsed laser and an intensified CCD camera to detect cerebral hemodynamics. We show experimentally and theoretically an improvement in the depth sensitivity over continuous wave systems.

FC4 • 11:30 a.m. (Invited)
Title to be announced, *Brian MacVicar; Univ. of British Columbia, Canada.*

FC5 • 12:00 p.m.
Laminar optical tomography of rat cortical activation: resolving depth-dependent hemodynamics from 0 to 2mm, *Elizabeth M. C. Hillman, Andrew K. Dunn, David A. Boas; Massachusetts General Hospital, USA.* A Laminar Optical Tomography system for rat cortex imaging is presented, combining Diffuse Optical Tomography reconstruction with microscopy-based instrumentation, yielding 100-200μm resolution over depths of 0 to 2.5mm. Forepaw stimulation reveals depth-dependent time-courses of activation.

FC6 • 12:15 p.m.
A new fluorometric and optical approach for tracking of intracellular calcium, blood volume and oxygenation changes in the rat brain in vivo, *Congwu Du[1], Igor Izrailtyan[2], Helene Benveniste[2]; [1]Brookhaven Natl. Lab., USA, [2]SUNY at Stony Brook, USA.* We present a new fluorometric in vivo approach to track intracellular free calcium changes directly from the cortex of the rat along with the changes in blood volume and cerebral oxygenation during ischemia.

Brittany/Champs Elysées
2:00 p.m.–4:00 p.m.
FD • OCT: Clinical
Quing Zhu; University of Connecticut, USA, Presider

FD1 • 2:00 p.m. (Invited)
Ultrahigh resolution imaging using Optical Coherence Tomography, *James G. Fujimoto, Yu Chen, Desmond Adler, Aaron Aguirre, Paul Herz, Pei-Lin Hsiung, Tony Ko, Maciej Wojtkowski; MIT, USA.* Ultrahigh resolution optical coherence tomography achieves a quantum improvement in image resolution. New light sources and novel technology implementations promise to enable widespread applications for structural and functional imaging in the laboratory and clinic.

FD2 • 2:30 p.m.
Real time monitoring of laser ablation for treatment of Barrett's Esophagus by Optical Coherence Tomography, *Brian D. Goldberg, Nicusor Iftimia, Gary Tearney, Brett Bouma; MGH, USA.* We present an integrated imaging/laser-ablation technique for treatment of Barrett's Esophagus using Optical Coherence Tomography. The technique provides real time feedback during ablation on a micron scale and provides more accurate control of treatment volume.

FD3 • 2:45 p.m.
Attenuation Measurements of Optical Coherence Tomography Signals for the Assessment of Vascular Tissue Composition, *Brian K. Courtney[1], Debra L. Stamper[2], Paul R. Herz[3], Abel L. Robertson, Jr.[1], Tony H. Ko[3], Samuel B. Adams[4], Mark J. Roberts[2], Frandics P. Chan[1], Yasuhiro Honda[1], Paul G. Yock[1], James G. Fujimoto[3], Peter J. Fitzgerald[1], Mark E. Brezinski[2]; [1]Stanford Univ. Medical Ctr., USA, [2]Brigham and Women's Hospital, USA, [3]MIT, USA, [4]Brigham and Woman's Hospital, USA.* Optical Coherence Tomography (OCT) has significant potential for assessing coronary artery disease. The OCT signal attenuation was measured in several arterial tissue types and may contribute to methods for classifying plaque composition and severity.

FD4 • 3:00 p.m.
Identification of thin-cap fibroatheroma in patients by intracoronary Optical Coherence Tomography, *Guillermo James Tearney, Ik-Kyung Jang, Briain MacNeill, Jason Bressner, Milen Shishkov, Nicusor Iftimia, Brett Bouma; Massachusetts General Hospital, USA.* We describe a recent intracoronary optical coherence tomography study conducted in a cohort of 69 patients. Our results demonstrate that thin cap-fibroatheromas are higher in patients with acute presentations of coronary artery disease.

FD5 • 3:15 p.m.
Optical Coherence Tomography of urothelial neoplasia: a multicenter study, *Felix I. Feldchtein[1,2], Rashid Iksanov[2], Elena Zagaynova[3], Natalia Gladkova[3], Ludmila Snopova[3], Olga Streltsova[4], Michael Manyak[5]; [1]Imalux, USA, [2]Inst. of Applied Physics, Russian Academy of Sciences, Russian Federation, [3]Nizhny Novgorod Medical Academy, Russian Federation, [4]Nizhny Novgorod Regional Hospital, Russian Federation, [5]George Washington Univ. Medical School, USA.*
Two clinical studies on evaluation of Optical Coherence Tomography (OCT) capabilities in urinary bladder cancer and precancer detection are reported, enrolling 70 patients. Preliminary results show good sensitivity and specificity in recognition of early neoplasia.

FD6 • 3:30 p.m.

Fine needle aspiration low coherence interferometry system for guidance in the breast biopsy procedures, *Nicusor V. Iftimia, Brian Goldberg, Brett Bouma, Martha Pitman, Aliyah Rahemtullah, Guillermo Tearney; Harvard Medical School, USA.* A method and apparatus utilizing low coherence interferometry (LCI) for guiding breast fine needle aspiration (FNA) is described. Our results demonstrate that LCI may be used for accurate differentiation of various types of breast tissue.

FD7 • 3:45 p.m.
Optical coherence tomography of breast cancer: feasibility for surgical guidance, *Jeremy S. Bredfeldt[1], Wei Luo[1], Daniel L. Marks[1], Keith W. Singletary[2], Charles L. Wisseman[3], Patricia A. Johnson[3], Stephen A. Boppart[4]; [1]Beckman Inst. for Advanced Science and Technology, Univ. of Illinois at Urbana-Champaign, USA, [2]Dept. of Food Science and Human Nutrition, Functional Foods for Health Progra.m, Univ. of Illinois at Urbana-Champaign, USA, [3]Surgical Pathology and Oncology, Carle Foundation Hospital, USA, [4]Dept. of Electrical and Computer Engineering, Beckman Inst. for Advanced Science and Technology, Bioengineering Progra.m, Coll. of Medicine, Univ. of Illinois at Urbana-Champaign, USA.* We present the use of OCT for breast cancer imaging. In situ rat mammary and excised human breast tumors were imaged. The feasibility of OCT for applications in surgical oncology of the breast is discussed.

Monaco
2:00 p.m.–4:00 p.m.
FE • Functional Imaging Applications
Arno Villringer; Dept. of Neurology, Charité, Humboldt-University, Germany, Presider

FE1 • 2:00 p.m. (Invited)
The mapping of olfactory functions in the Drosophila brain with calcium imaging, *Jing W. Wang; Columbia Univ, USA.* We have developed an imaging system that couples two-photon microscopy with the specific expression of the calcium-sensitive fluorescent protein, G-CaMP. This technique affords an opportunity to monitor activity in defined neurons throughout the fly brain.

FE2 • 2:30 p.m.
High resolution imaging of the hemodynamic and metabolic response to functional activation, *Andrew K. Dunn, Anna Devor, Anders M. Dale, David A. Boas; Massachusetts General Hospital, USA.* Stimulation induced changes in blood flow, oxy- and deoxy-hemoglobin were imaged with combination of laser speckle contrast imaging and multi-wavelength reflectance imaging. Results reveal spatial and temporal differences between forepaw and whisker stimulation.

FE3 • 2:45 p.m.
Cerebral blood flow is reduced by neuronal inhibition induced by transcranial magnetic stimulation – A none-invasive functional optical imaging study on adults, *Jens Steinbrink, Clemens Koehncke, Martin Voss, Kerstin Irlbacher, Stephanie Boden, Arno Villringer, Hellmuth Obrig, Rüdiger Wenzel, Matthias Kohl-Bareis; Charite, Germany.* In a paradigm of transcallosal inhibition elicited by transcranial magnetic stimulation in humans we observe a decrease in oxy- and an increase in deoxy-hemoglobin in the motor cortex.

FE4 • 3:00 p.m.
Spatio-temporal quantification of cerebral blood flow during forepaw stimulation of the rat using laser speckle flowmetry, *Turgut Durduran, Guoqiang Yu, Mark G. Burnett, Chao Zhou, Daisuke Furuya, John A. Detre, Joel H. Greenberg, Arjun G. Yodh; Univ. of Pennsylvania, USA.* Laser speckle flowmetry was used to characterize activation flow coupling following forepaw/hindpaw stimulation. Different activation levels and duration were investigated. Temporal response of activation area was independent of stimulus amplitude and distance from the centroid.

FE5 • 3:15 p.m.
Functional cortical brain mapping by near infrared time-resolved spectroscopy, *Alessandro Torricelli1, Antonio Pifferi1, Lorenzo Spinelli1, Rinaldo Cubeddu1, Valentina Quaresima2, Marco Ferrari2; 1INFM-Dipartimento di Fisica and IFN-CNR, Politecnico di Milano, Italy, 2Dept. of Biomedical Sciences and Technologies, Univ. of L'Aquila, Italy.* A multichannel time-resolved instrument for

functional brain imaging studies was developed and characterized. Measurements were performed on volunteers to monitor the response to stimuli following motor (finger opposition, 5 Hz) or cognitive task (word generation).

FE6 • 3:30 p.m.
Cerebral oxygenation changes in response to tactile stimulation in term neonates measured by non-invasive functional near-infrared spectroscopy, *Daniel Haensse, Peter Szabo, Jean-Claude Fauchère, Hans-Ulrich Bucher, Martin Wolf; Clinic of Neonatology, Switzerland.* Non-invasive near-infrared spectrophotometry measured the changes in cerebral oxy- and deoxyhemoglobin concentration in response to tactile stimulation in 17 neonates.

FE7 • 3:45 p.m.
Changes in oxygenation and hemodynamics in the human head assessed by frequency-domain multidistance NIRS, *Antonios Michalos; Univ. od Illinois at Urbana-Champaign, USA*. We verified that we indeed "see the brain," using near-infrared spectroscopy and the frequency-domain multi-distance approach during selective ischemia by applying a scalp tourniquet and by clamping the internal and external carotid arteries during neurosurgery.

Brittany/Champs Elysées
4:30 p.m.–6:00 p.m.
FF • Microscopy
Lihong V. Wang; Texas A&M University, USA, Presider

FF1 • 4:30 p.m.
In vivo human cellular imaging using Endomicroscope (Endoscopic micro confocal scanning microscope), *Akihiro Horii, Tianyu Xie, Kazunari Tokuda, Yoshiyuki Kumada, Atsushi Okawa, Tadashi Hirata, Takeshi Suga, Hiroki Hibino, Kenji Murakami, Yoshitaka Kamiya, Hitoshi Mizuno; Olympus Corporation, Japan.* Endomicroscope is a laser scanning microscope extremely miniaturized with micromachining technology. In vivo imaging of the cell nuclei and membrane without staining has been achieved with human oral mucosa using 3.4mm diameter flexible probe.

FF2 • 4:45 p.m.
Confocal reflectance theta line-scanner for imaging human skin in vivo, *Peter J. Dwyer[1], William J. Fox[2], Charles A. DiMarzio[1], James M. Zavislan[3], Milind Rajadhyaksha1; [1]Dept. of Electrical Engineering, Northeastern Univ., USA, [2]Lucid, Inc, USA, [3]Inst. of Optics, Univ. of Rochester, USA.* A confocal reflectance theta line-scanning microscope provides axial resolution of 2-8 μm and images nuclear, cellular and architectural detail within human skin in vivo.

FF3 • 5:00 p.m.
Light scattering spectroscopy for measuring subcellular organelles, *Hui Fang[1], Edward Vitkin[1], Mario Ollero[1], Irving Itzkan[1], Eugene Hanlon[2], Lev Perelman[1]; [1]Harvard Medical School, USA, [2]Dept. of Veterans Affairs, USA.* We report light scattering experiments using aqueous suspensions of subcellular organelles. From the observed spectra, we extract size distributions that are in very agreement with the results of electron microscopy studies.

FF4 • 5:15 p.m.
Engineering a multimodal microscope, *Daniel J. Townsend[1], Gustavo E. Herrera[1], Milind Rajadhyaksha[1,2], Charles A. DiMarzio1; [1]Northeastern Univ., USA, [2]Memorial Sloan-Kettering Cancer Ctr., USA.* A multimodal microscope combines three scanning modes (confocal reflectance, 1-photon fluorescence, 2-photon fluorescence) and two staring modes (differential interference contrast and quadrature tomography) on one common stage to provide three-dimensional images of living biological specimens.

FF5 • 5:30 p.m.
Depth-sectioned imaging and quantitative analysis in turbid media using spatially modulated illumination, *David J. Cuccia, Frederic Bevilacqua, Anthony J. Durkin, Bruce J. Tromberg; Beckman*

Laser Inst., Univ. of CA, Irvine, USA. Experiments performed on heterogeneous and homogeneous tissue-simulating phantoms demonstrate that spatially modulated illumination enables depth-resolved imaging and wide-field optical property mapping in turbid media.

FF6 • 5:45 p.m.
Dentin and enamel: Unique biological media for studying the dependence of light propagation on microstructure, *Alwin Kienle, Florian Klaus Forster, Marcel Goedecke, Raimund Hibst; Inst. of lasertechnologies in medicine and metrology, Germany.* The dependance of light progagation in dentin and enamel on their microstructures is investigated using a 4π-goniometer and a collimated transmittance apparatus. A pronounced anisotropic light scattering pattern caused from cylindric structures is found.

Monaco
4:30 p.m.–6:00 p.m.
FG • Cancer
Irving Bigio; Boston Univ, USA, Presider

FG1 • 4:30 p.m. (Invited)
Differential pathlength spectroscopy: A novel technique to determine the local optical properties of tissue in vivo, *Arjen Amelink; Photodynamic Therapy and Optical Spectroscopy Res. Programme, Univ. Hospital Rotterda.m, Netherlands.* We report on the development of a novel spectroscopic technique, Differential Pathlength Spectroscopy (DPS), to determine the local capillary blood oxygenation, tissue blood content, average microvessel diameter and reduced scattering coefficient of tissue in vivo.

FG2 • 5:00 p.m.
Calibration standards for multi-center clinical trials of fluorescence spectroscopy for in vivo diagnosis, *Nena M. Marin[1], S. K. Chang[1], R. Richards-Kortum[1], N. MacKinnon[2], C. MacAulay[2], E. N. Atkinson[3], D. Serachitopol[3], M. Follen3, D. Cox[4]; [1]Univ. of Texas at Austin, USA, [2]British Columbia Cancer Res. Ctr., Canada, [3]UT M. D. Anderson Cancer Ctr., USA, [4]Rice Univ., USA.* The analysis of standards measurements for a large clinical trial employing fluorescence spectroscopy shows that a well designed set of standards and frequent measurement should be an essential component of any optical device clinical trial.

FG3 • 5:15 p.m.
Polarization spectroscopy of early increase in blood supply in predysplastic stages of colon carcinogenesis, *Vadim Backman, Young Kim, Yang Liu, Vladimir Turzhitsky, Ramesh Wali, Hemant Roy, Michael Goldberg; Northwestern Univ., USA.* Using polarization-spectroscopy we observed, for the first time, a profound increase in subepithelial blood supply in colon carcinogenesis at a time point preceding development of adenomas and any other currently known markers of colon cancer.

FG4 • 5:30 p.m.
The spectral dependence of fiberoptic probe pressure on tissue during in vivo diffuse reflectance spectroscopy, *Alexandre Douplik[1], David Shalaby[2], Brian C. Wilson[2]; [1]Xillix Ltd, Canada, [2]Ontario Cancer Res. Inst, Canada.* The effect of fiberoptic probe pressure on tissue on the measured diffuse reflectance spectra has been evaluated, using normal skin in vivo, with both standard and imaging reflection probe geometry for the visible range.

FG5 • 5:45 p.m.
Multi-modality imaging techniques to assess angiogenesis associated with Kaposi's sarcoma, *Moinuddin Hassan, David Hattery, Robert Yarchoan, Amir Gandjbakhche; NIH (NIH), USA.* We evaluated three non invasive method, spectral imaging, thermography, and laser Doppler imaging to quantitatively assess parameters of vascularity in Kaposi's sarcoma. Measurement were obtained prior to therapy and after receiving an experimental drug.

Burgundy
4:30 p.m.–6:00 p.m.
FH • Poster Session III

FH1 • 6:00 p.m.
Experimental calibration of a new angle-resolved low coherence interferometry system, *John W. Pyhtila, Neil G. Terry, Adam Wax; Duke Univ., USA.* We describe results of calibration experiments using a new angle-resolved low coherence interferometry system. Light scattered from a polystyrene microsphere sample are compared with Mie Theory predictions to determine the size of the particles.

FH2 • 6:00 p.m.
Engineering ultra-sharp light scattering resonances using structured nanospheres for multi-label molecular imaging, *Yang Liu, Kun Chen, Guillermo A. Ameer, Vadim Backman; Northwestern Univ., USA.* We describe a new concept that utilizes multi-layered metallic nanospheres exhibiting tunable ultra-sharp resonance peaks with spectral widths as narrow as 10 nm to achieve the labeling of multiple targets simultaneously for molecular imaging.

FH3 • 6:00 p.m.
Influence of coherence length on tissue perfusion depth of measurement, *Martin J. Leahy; Univ. of Limerick, Ireland.* The major limitation of laser Doppler perfusion measurement is the lack of knowledge of the sampling depth in tissue. Coherence modulation of semiconductor lasers is presented with the aim of overcoming this limitation.

FH4 • 6:00 p.m.
Optoacoustic monitoring of total hemoglobin concentration: In vitro, and in vivo studies, *Irina Y. Petrova, Donald S. Prough, Yuriy Y. Petrov, Hans-Peter F. Brecht, Christer Svensen, Joel Olsson, Donald J. Deyo, Rinat O. Esenaliev; Univ. of Texas Medical Branch, USA.* We performed in vitro measurements in blood and pilot in vivo studies in volunteers. The results suggest that the optoacoustic technique may be used for noninvasive and continuous monitoring of total hemoglobin concentration.

FH5 • 6:00 p.m.
Subcellular sizing with polarized light spectroscopy, *Matthew A. Bartlett; Clemson Univ., USA.* We measure the size distribution of mitochondria in cervical cancer cells using polarized light spectroscopy. We extend this technique to noninvasive skin measurements to distinguish dysplastic and normal tissue based on the particle size distribution.

FH6 • 6:00 p.m.
The use of a multi-separation probe for optical diagnosis of breast cancer, *Changfang Zhu; Univ. of Wisconsin-Madison, USA.* This study explored the effects of probe geometry on UV-VIS fluorescence and diffuse reflectance measurements from malignant and non-malignant breast tissues, and the potential of utilizing this information for the detection of breast cancer.

FH7 • 6:00 p.m.
Wireless spectroscopic Compact Photonic Explorer, *Alvin Katz, Leming Wang, Q. Z. Wang, J.-C. Luo, Fanon Zeng, Gang Zhang, Manuel Zevallos, Scot Alfano, R. R. Alfano; The City Coll. of New York, USA.* A remote, spectroscopic-based Compact Photonics Explorer was designed, assembled, and tested. Spectral images were acquired with the CPE and transmitted to a remote computer.Images will be presented, demonstrating the operational principles for various biomedical applications.

FH8 • 6:00 p.m.
Optimizing the probe geometry of elastic scattering spectroscopy for the diagnosis of prostate cancer, *Ousama M. A'amar[1], Michelle S. Hirsch[2], Irving J. Bigio[1]; [1]Boston Univ., USA, [2]Brigham & Women's Hospital, Harvard Medical School, USA.* Probe geometry has a major effect on the spectra obtained by elastic scattering spectroscopy (ESS). We have experimentally tested three probe-designs in ex-vivo study to determine the potential of using ESS in prostate cancer diagnosis.

FH9 • 6:00 p.m.
Investigating cellular metabolic function using fluorescence lifetime imaging microscopy, *Mary-Ann Mycek, Wei Zhong, Paul Urayama; Univ. of Michigan, USA.* Fluorescence methods are being investigated

for non-invasive tissue diagnostics. Here, we describe how fluorescence lifetime imaging can probe metabolic function in individual living cells, using both endogenous and exogenous fluorophore lifetimes for contrast.

FH10 • 6:00 p.m.
Comparative performance analysis of time-frequency distributions for spectroscopic optical coherence tomography, *Chenyang Xu, Stephen A. Boppart; Univ. Of Illinois, USA.* Joint time-frequency distributions (TFDs) can optimize the tradeoff between spectral and spatial resolution in spectroscopic OCT. Performances by representative TFDs are compared and optimized for different spectroscopic OCT applications.

FH11 • 6:00 p.m.
Immuno-targeted gold nanoparticles as in-vivo molecular-specific contrast agents for optical detection of carcinogenesis, *Jesse S. Aaron[1], Tom Collier[1], Vivian Mack[1], Rebecca Richards-Kortum[1], Lezlee Coghlan[2], Michele Follen3, Konstantin Sokolov4; [1]Univ. of Texas at Austin, USA, [2]The Univ. of Texas M. D. Anderson Cancer Ctr., USA, [3]Ctr. for Biomedical Engineering, M.D. Anderson Cancer Ctr., USA, [4]Dept. of Imaging Physics, M.D. Anderson Cancer Ctr., USA.* We present continuing developments of immuno-targeted gold nanoparticles as reflectance-based optical contrast agents for cancer-detection in-vivo-. We demonstrate the ability to label EGFR (a hallmark for epithelial cancer) in several models of increasing biological relevance.

FH12 • 6:00 p.m.
Demonstration of droplet-based microfluidics, *Kenneth T. Kotz, Kyle A. Noble, Gregory W. Faris; SRI Intl., USA.* We have used the thermal Marangoni effect to optically manipulate small droplets. We have observed droplet fusion and subsequent rapid mixing (<30ms). We have used this technique to perform a biologically relevant, absorption-based assay.

FH13 • 6:00 p.m.
Imaging and fiber-optic probe based polarized light scattering techniques for differentiating tumorigenic and non-tumorigenic cells, *Janakiramanan Ramachandran, Tamara M. Johnson, Susan Carpenter, James P. Freyer, Judith R. Mourant; Los Alamos Natl. Lab., USA.* Fiber-optic probe based measurements are presented which can differentiate tumorigenic and non-tumorigenic cells. Progress towards an imaging system which will provide more information than the probe based system is also presented.

FH14 • 6:00 p.m.
Early mitochondrial responses to photodynamic therapy are reported by angularly resolved light scattering, *Jeremy D. Wilson, Chad E. Bigelow, David J. Calkins, Thomas H. Foster; Univ. of Rochester, USA.* Early changes in mitochondrial volume and refractive index following ALA-sensitized photodynamic therapy are reported by angularly resolved light scattering measurements of whole cells. These changes are confirmed by electron microscopy.

FH15 • 6:00 p.m.
Enzyme activity imaging with confocal fluorescence polarization microscopy, *Chad E. Bigelow, John G. Frelinger, Thomas H. Foster; Univ. of Rochester, USA.* We have developed a technique for imaging enzyme activity based on confocal fluorescence polarization microscopy. Efficacy of the technique is demonstrated in model systems and experiments are performed to test its limits in scattering systems.

FH16 • 6:00 p.m.
Low-cost, highly-adaptable, retrofitted laser scanning module for real-time reflectance and confocal fluorescence microscopy, *Derrick R. Chou, Shuping Koh, Bradley A. Bower, Adam P. Wax; Duke Univ., USA.* We present a low-cost, high-speed, retrofitted laser scanning module for microscopy. This fiber-coupled source, cage-mounted system offers a real-time imaging alternative to costly commercial systems and can be easily adapted for confocal and fluorescence applications.

FH17 • 6:00 p.m.

A molecular imaging confocal workstation for in-vivo dermal microscopy of small animals, *Ricardo Toledo-Crow, David Entenberg, Robert D. Roorda; Memorial Sloan-Kettering Cancer Ctr., USA.* A system is designed and developed for simultaneous fluorescence and reflected contrast of in-vivo confocal imaging of murine skin. The reflected light image is overlaid on the fluorescence signal to provide a meaningful histological context.

FH18 • 6:00 p.m.
Conventional and cross-polarized OCT in diagnostics of pathological conditions of the larynx, *Anna Borisovna Terent'eva[1], Andrey Vladimirovich Shakhov[1], Ludmila Borisovna Snopova[1], Natalia Victorovna Kornoukhova[2], Vladislav Antonievich Kamensky[3], Ilya Victorovich Turchin[3]; [1]Medical Academy, Russian Federation, [2]Nizhny Novgorod Regional Hospital, Russian Federation, [3]Inst. of Applied Physics of RAS, Russian Federation.* We report results of systematic clinical studies using conventional OCT and its modification cross-polarized OCT in the larynx. Conventional OCT allowed for diagnostic of various pathologies. CP OCT proved to facilitate differential diagnostics of pathologies.

FH19 • 6:00 p.m.
Imaging the microstructure of menisci using optical coherence tomography, *Debra L. Stamper, Mark J. Chilek, Lisa McLay, Samuel B. Adams, Charles Demacus, Mark E. Brezinski; Brigham & Women's Hospital, USA.* Using optical coherence tomography, changes in the polarization sensitivity of pig menisci were detected both in healthy and enzymatically degraded samples.

FH20 • 6:00 p.m.
Real time optical coherence tomography system, *Nan Guang Chen, Quing Zhu; Univ. of Connecticut, USA.* A real-time optical coherence tomography system has been developed. A sensitivity of –89 dB is available at a scanning rate of 720 Hz. Much higher speed can be readily achieved, but with lower sensitivity.

FH21 • 6:00 p.m.
Vector-based polarization analysis for optical coherence tomography, *B. Hyle Park, Mark Pierce, Barry Cense, Johannes F. de Boer; Wellman Ctr. for Photomedicine, USA.* A vector-based analysis yielding birefringence, diattenuation, and optic axis orientation is applied to images acquired with high-speed fiber-based polarization-sensitive optical coherence tomography. Data from chicken tendon and a polarizing sheet are presented and validated.

FH22 • 6:00 p.m.
Characterization of dentin and enamel by polarization sensitive optical coherence tomography, *Yueli Chen, Daqing Piao, Linda Otis, Quing Zhu; Univ. of Connecticut, USA.* We present characterization of dentin and enamel as well as dental caries using polarization sensitive optical coherence tomography (PS-OCT). The results may provide useful information for detection of dental caries in both enamel and dentin.

FH23 • 6:00 p.m.
Assessment of cutaneous wound healing using optical coherence tomography, *Michael Cobb, Yuchaun Chen, Robert A. Underwood, Rahber Ali Thariani, Marcia L. Usui, John E. Olerud, Xingde Li; Univ. of Washington, USA.* We show that OCT can monitor the cutaneous wound healing process in diabetic and normal mouse models. The migration of the epithelial layer and the formation of the Epidermal-Dermal junction can be clearly seen.

FH24 • 6:00 p.m.
Digital Fourier microscopy for imaging of biological tissue, *Andrei V. Zvyagin[1], Sergey A. Alexandrov[2], Paul Meredith[1], Tim J. McIntyre[1]; [1]Ctr. for Biophotonics and Laser Science/Physics/The Univ. of Queensland, Australia, [2]Electrical, Electronic and Computer Engineering/The Univ. of Western Australia, Australia.* A novel technique, digital Fourier microscopy, is suitable for high-sensitivity imaging of biological tissue. Combination of Fourier holography and high-resolution digital recording permits crucial flexibility in filtering to pick up scatterers of interest in tissue.

FH25 • 6:00 p.m.

Power-efficient grating-based scanning optical delay line for Optical Coherence Tomography, *Daqing Piao, Quing Zhu; Univ. of Connecticut, USA.* We present a grating-based time-domain RSOD that can achieve similar scanning performance as Fourier-domain RSOD, while provides 6dB improved power efficiency. This 6dB is equivalent to about 4.0dB SNR advantage for a typical balanced-detection OCT.

FH26 • 6:00 p.m.
Use of perturbation and differential Monte Carlo methods to solve inverse problems in heterogeneous media, *Carole K. Hayakawa, Vanitha Sankaran, Frédéric Bevilacqua, Jerome Spanier, Vasan Venugopalan; Univ. of California at Irvine, USA.* We use Monte Carlo techniques to address inverse problems in heterogeneous media. The techniques we develop are general and do not rely on specific geometries or material properties.

FH27 • 6:00 p.m.
A phantom for investigating light propagation through layered diffusive media, *Samuele Del Bianco[1], Fabrizio Martelli[1], Fabrizio Cignini[1], Giovanni Zaccanti[1], Antonio Pifferi[2], Alessandro Torricelli[2], Andrea Bassi[2], Paola Taroni[2], Rinaldo Cubeddu[2]; [1]Universita' degli Studi di Firenze, Dipartimento di Fisica, Italy, [2]Dipartimento di Fisica, Politecnico di Milano, Italy.* A phantom for investigating light propagation through layered diffusive media is described. The diffusive medium is an aqueous suspension of calibrated scatterers and absorbers and a thin membrane separates layers with different optical properties.

FH28 • 6:00 p.m.
Photometry of skin and collagenous tissue phantoms with focused linearly polarized light, *Alexander P. Sviridov[1,2], Victor Chernomordik[2], Moinuddin Hassan[2], Angelo Russo[2], Alec Eidsath[2], Paul Smith[2], Amir H. Gandjbakhche[2]; [1]Inst. for Laser and Information Technologies, RAS, Russian Federation, [2]NIH, USA.* Equi-intensity contours of photometric patterns of backscattered focused linearly polarized light were fitted with ellipses. The orientation and ratio of semi-axes lengths revealed correlation with collagen fiber orientation. Optical anisotropy parameters were measured.

FH29 • 6:00 p.m.
High resolution optical coherence tomography for dermatological applications, *Felix Spöler[1], Michael Först[1], Heinrich Kurz[1], Albrecht Bartels[2], Yvonne Marquardt[3], Jorge Frank[3], Faris Abuzahra[3]; [1]Institut für Halbleitertechnik, Germany, [2]GigaOptics GmbH, Germany, [3]Klinik für Dermatologie und Allergologie, Univ.sklinikum, Germany.* A high resolution optical coherence tomography system was set up for dermatological applications. An axial resolution of 3 μm in tissue allows visualisation of the basement membrane zone in skin equivalents.

FH30 • 6:00 p.m.
Fluorescence microscopy with simultaneous lifetime and spectral resolution, *Kristen Peterson; Southwest Sciences, Inc, USA.* We present a new detection method for confocal fluorescence microscopy that simultaneously performs fluorescence lifetime measurement in multiple spectrally resolved channels. By detecting two physical characteristics, discrimination of fluorescent labels may be improved.

FH31 • 6:00 p.m.
Influence of water content on polarization sensitive optical coherence tomographic imaging of collagen, *Debra L. Stamper, Michelle Harman, Mark Chilek, Bin Liu, Mark E. Brezinski; Brigham & Women's Hospital, USA.* Polarization sensitive optical coherence tomography (OCT) was used to evaluate the effect of water content and fiber orientation on collagen sponges. This holds promise for evaluating properties of intact tissues and synthetically engineered biological materials.

FH32 • 6:00 p.m.
Analysis of speckle reduction in Optical Coherence Tomography by path length encoded angular compounding, *Nicusor V. Iftimia, Brett Bouma, Andy Yun, Guillermo Tearney; Harvard Medical School, USA.* Angular compounding by path length encoding (ACPE), a new method for reducing speckle in OCT images is presented. ACPE images demonstrate a qualitative improvement over traditional OCT and an increased SNR.

FH33 • 6:00 p.m.
Full-field optical coherence tomography using long gradient-index lenses for internal tissues, *Yuuki Watanabe, Hirokazu Hashimoto, Mituhiko Kagesawa, Manabu Sato, Naohiro Tanno; Graduate School of Science and Engineering, Yamagata Univ., Japan.* We present an en-face image of an onion at a 200 μm depth obtained using OCT with two long gradient-index (GRIN) lenses and a CCD camera by adjusting the focal plane and coherence gate.

FH34 • 6:00 p.m.
Video-rate spectral domain optical coherence tomography, *Nader A. Nassif, Barry Cense, B. Hyle Park, Mark C. Pierce, S.h. Yun, Brett Bouma, Gary J. Tearney, Teresa C. Chen, Johannes F. de Boer; Harvard Medical School and Wellman Labs. of Photomedicine, MGH, USA.* An ultra-high SD-OCT system continuously obtained in vivo images of a human retina at a speed of 29.3 kHz. A 3-D volume of the optic nerve head was constructed from the data acquired.

FH35 • 6:00 p.m.
4-D Optical Coherence Tomography of a beating chicken embryo heart, *Michael W. Jenkins, Florence -. Rothenberg, Vladimir P. Nikolski, Igor R. Efimov, Andrew M. Rollins; Case Western Reserve Univ., USA.* We are developing Optical Coherence Tomography as a tool for studying developmental cardiology. Using a gated reconstruction technique, we have produced a 4-D representation of a beating stage 28 chicken embryo heart.

FH36 • 6:00 p.m.
MEMS-based Endoscopic Optical Coherence Tomography, *Zhenguo Wang, Tuqiang Xie, Yingtian Pan; SUNY at Stony Brook, USA.* We report design and modification of an MEMS-based endoscopic optical coherence tomography (EOCT) and applications in the imaging and diagnosis of bladder cancers. Results of normal porcine bladders and rat bladder cancers will be presented.

FH37 • 6:00 p.m.
Variable coherence tomography for measuring the pair correlation function, *Erwan Baleine, Aristide Dogariu; School of Optics/CREOL, USA.* We describe a scattering experiment using quasi-monochromatic light with variable spatial coherence for determining the pair correlation function of a quasi-homogeneous medium. The tomographic technique is implemented by recording the intensity scattered in one direction.

FH38 • 6:00 p.m.
Application of chromatic analysis for resolution improvement in optical coherence tomography (OCT), *Christopher D. Russell[1], Tim J. Bullough[2], Gordon R. Jones3, Anthony Deakin[3]; [1]Medical Laser Inst., UK, [2]Materials Science and Engineering, Univ. of Liverpool, UK, [3]Electrical Engineering and Electronics, Univ. of Liverpool, UK.* We present the application of chromatic analysis and Gaussian peak fitting for resolution improvement in optical coherence tomography (OCT). Resolution improvements are demonstrated in simulated and experimental OCT images of an air wedge and onion.

FH39 • 6:00 p.m.
3-D imaging digital holographic microscopy using spectral phase shifting, *Daesuk Kim, Bahram Javidi; Univ. of Connecticut, USA.* An acousto-optic tunable filter (AOTF) based 3-D imaging digital holographic microscopy using an equally spaced 5 arbitrary spectral phase shifting method is described. This method is expected to be applied for biological 3-D spectral imaging.

FH40 • 6:00 p.m.
Rapid phase modulation for optical coherence tomography using electro-optic phase modulator, *Xin-Cheng Yao, John George; Los Alamos Natl. Lab., USA.* Optical dispersion of an electro-optic crystal was theoretically estimated and experimentally compensated. The results show that electro-optic phase modulators can be used to implement rapid no-moving-parts phase modulation in optical coherence tomography systems.

FH41 • 6:00 p.m.

Full dispersion compensation in real-time optical coherence tomography involving a phase modulator, *Yuchuan Chen, Xingde Li; Univ. of Washington, USA.* We present analytic analyses and an experimental method to compensate the dispersion of a phase modulator in an OCT system to the third order. Optimal axial resolution offered by the light source was experimentally recovered.

FH42 • 6:00 p.m.
OCT image processing algorithm for differentiation biological tissue pathologies, *Ilya Victorovich Turchin[1], Ekaterina Alexandrovna Sergeeva[1], Lev Sergeevich Dolin[1], Natalia Mikhailovna Shakhova[1], Irina Alexandrovna Kuznetsova[2]; [1]Inst. of Applied Physics RAS, Russian Federation, [2]Regional Hospital, Russian Federation.* A possibility to distinguish between different pathologies of mucous tissue by its OCT images has been demonstrated using a novel algorithm for image processing based on a small-angle approximation of transport theory.

FH43 • 6:00 p.m.
A study on blood flow effects with Polarization Sensitive Optical Coherence Tomography, *Haitham N. Zaatari, Nate J. Kemp, Jesung Park, H. Grady Rylander, III, Thomas E. Milner; The Univ. of Texas at Austin, USA.* We study blood flow effects on polarization sensitive optical coherence tomography images and birefringence measurement. Doppler shift and absorption from blood flow through a capillary tube surrounded by birefringent collagen films are recorded and analyzed.

FH44 • 6:00 p.m.
dynaLYZE: a Matlab-based analysis package for dynamic optical tomography with the DYNOT system, *Yaling Pei[1], Harry L. Graber[2], Yong Xu[2,1], Randall L. Barbour[2,1]; [1]NIRx Medical Technologies LLC, USA, [2]SUNY Downstate Medical Ctr., USA.* dynaLYZE is a Matlab-based multifunctional analysis and visualization package accompanying the DYNOT image system, and was developed by NIRx Medical Technologies. It allows users to easily reorganize, image and interpret DYNOT time-series data sets.

FH45 • 6:00 p.m.
A new speckle removal algorithm for optical coherence tomography, *Giovanni Gregori, Carmen A. Puliafito, Robert W. Knighton; Bascom Palmer Eye Inst., USA.* A new speckle removal algorithm is shown to be very effective at enhancing the quality of optical coherence tomography (OCT) images. An analysis of its performance shows advantages over other widely used techniques.

FH46 • 6:00 p.m.
Influence of anisotropy in the depolarization ability of microsphere solutions, *Jessica C. Ramella-Roman[1], Scott A. Prahl[2], Steve L. Jacques[3]; [1]Johns Hopkins Univ., USA, [2]OMLC, USA, [3]OHSU, USA.* The influence of scattering anisotropy on polarized light transport in microsphere solutions was studied experimentally an with Monte Carlo programs. Anisotropy is an important parameter in the depolarization of light traveling through a scattering media.

FH47 • 6:00 p.m.
Quantitative tomographic birefringence imaging of fibrous tissues with polarization sensitive optical coherence tomography, *Nate J. Kemp, Jesung Park, Haitham N. Zaatari, H. Grady Rylander, III, Thomas E. Milner; Univ. of Texas at Austin, USA.* Polarization sensitive OCT has potential advantages in detecting diseases which affect the vitality of fibrous tissues. We present a nonlinear numerical algorithm to suppress speckle noise and enable accurate quantitative measurement of fibrous tissue properties.

FH48 • 6:00 p.m.
Full-color two-dimensional optical coherence tomography, *Lingfeng Yu, Myung K. Kim; Univ. of South Florida, USA.* A technique is described to obtain two-dimensional OCT images with full natural color representation. The interference image is acquired using a color camera and the three color channels are processed separately, recomposing the final image.

FH49 • 6:00 p.m.
Vascular optical coherence elastography: Assessment of conventional velocimetry applied to OCT, *Alexandra H. Chau[2,1], Raymond C. Chan[1,3], Seemantini Nadkarni[1], Nicusor Iftimia[1], Guillermo J.*

*Tearney[1,3], Brett E. Bouma[3,1]; [1]Wellman Labs. of Photomedicine, Massachusetts General Hospital, Harvard Medical School, USA, [2]Dept. of Mechanical Engineering, MIT, USA, [3]Harvard-MIT Division of Health Sciences and Technology, MIT, USA.*We assess the performance of conventional correlation-based OCT velocimetry and the impact of noise suppression and correlation block size variation.

FH50 • 6:00 p.m.
Digital Gabor holography for particle field imaging, *Christopher Mann, Myung K. Kim; Univ. of South Florida, USA.* We describe the digital Gabor holography as an effective method for particle field and cellular imaging. It has a particularly simple optical set up and acquisition procedure.

Saturday, April 17, 2004

8:00 a.m.–10:00 a.m.
SA • Fluorescence Imaging
Brian Pogue; Dartmouth College, USA, Presider

SA1 • 8:00 a.m.
Small animal fluorescence imaging at the National Institutes of Health, *Amir H. Gandjbakhche; NIH, USA.* The activities of research groups at the Intramural Res. Program of the NIH related to fluorescence imaging using endogenous and exogenous fluorescence markers in small animals will be presented and discussed.

SA2 • 8:30 a.m.
Dynamic fluorescence imaging for evaluating molecular targets of disease, *Eva M. Sevick-Muraca[1], Michael Gurfinkel[1], John C. Rasmussen[1], Shi Ke[2], Wei Wang[2], Chun Li[2]; [1]Photon Migration Labs., USA, [2]M.D. Anderson Cancer Ctr., USA.* Dynamic fluorescent intensity measurements of targeting exogenous dyes within small animal models of disease can be used in conjunction with a pharmacokinetic model to evaluate the expression of molecular markers of disease.

SA3 • 8:45 a.m.
Three-dimensional optical tomography of fluorescent proteins in the visible, *Giannis Zacharakis[1], Jorge Ripoll[1,2], Ken Ishii[1], Hirokazu Kambara[1], Yoshinaga Saeki[1], Ralph Weissleder[1], Vasilis Ntziachristos[1]; [1]MGH-CMIR, USA, [2]FORTH-IESL, Greece.* We present a new modality for three-dimensional tomographic imaging of fluorescence activity in the visible, which employed a multi-angle, multi-projection illumination scheme. Reconstruction is based on novel photon propagation models developed for visible light.

SA4 • 9:00 a.m.
MRI guided fluorescence optical tomography for small animal imaging, *Anand T.N. Kumar, Jonathan J. Stott, Quan Zhang, Young Ro Kim, David A. Boas, Andrew K. Dunn; Massachusetts General Hospital, USA.* We present 3-D reconstructions of ICG fluorescence from time domain optical measurements on a phantom model mouse, using a numerical diffusion based forward model that incorporates the complex boundaries provided by MRI images.

SA5 • 9:15 a.m.
Contrast agent enhanced fluorescence imaging for early detection of arthritis, *Bernd Ebert[1], Rainer Macdonald[1], Diethard Petzelt[1], Herbert Rinneberg[1], Tom Fischer[2], Ines Wojner[2], Dorothee von Stieglitz[2], Matthias Taupitz[2], Bernd Hamm[2], Kai Licha[3], Michael Schirner[3], Veit Krenn4; [1]Physikalisch-Technische Bundesanstalt, Germany, [2]Charité Campus Mitte, Institut für Radiologie, Germany, [3]Schering AG, Germany, [4]Charité Champus Mitte, Institut für Pathologie, Germany.* Fluorescence imaging in the near-infrared range following intravenous administration of contrast agents has been investigated as a new tool for detection of inflammatory joint diseases. Our study reveals that NIR dyes accumulate in inflammatory joints.

SA6 • 9:30 a.m.

Experimental validation of a fluorescence tomography algorithm based on the equation of radiative transfer, *Alexander D. Klose[1], Vasilis Ntziachristos[2], Andreas H. Hielscher[1]; [1]Columbia Univ. New York, USA, [2]Massachusetts General Hospital, USA.* We have developed an optical fluorescence image reconstruction algorithm that is based on the equation of radiative transfer. First image reconstruction results of a three-dimensional fluorescent source distribution in a tissue-like medium are presented.

SA7 • 9:45 a.m.
Fluorescence-enhanced optical tomography on large phantoms using dual point illumination geometry, *Anuradha Godavarty[1], Margaret J. Eppstein[1], Chaoyang Zhang[1], Eva M. Sevick-Muraca[2]; [1]Univ. of Vermont, USA, [2]Texas A&M Univ., USA.* Three-dimensional fluorescence-enhanced optical tomography is demonstrated for the first time on large phantom volumes using simultaneous dual in-phase point illuminating sources. A rapid data acquiring gain-modulated intensified CCD imaging system was employed for these studies.

Monaco
8:00 a.m.–10:00 a.m.
SB • Contrast Agents and Multiphoton Microscopy
Peter So; MIT, USA, Presider

SB1 • 8:00 a.m. (Invited)
Optical molecular imaging for early detection of cancer, *Rebecca Richards-Kortum; Univ. of Texas, USA.* We describe a comprehensive strategy to develop inexpensive, rugged and portable optical imaging systems for molecular imaging of cancer, which couples the development of optically active contrast agents with advances in functional genomics of cancer.

SB2 • 8:30 a.m.
Second harmonic generation for molecular contrast in optical coherence tomography, *Brian E. Applegate[1], Changhuei Yang[1], Andrew M. Rollins[2], Joseph A. Izatt[1]; [1]Duke Univ., USA, [2]Case Western Reserve Univ., USA.* We discuss the relative advantages of dark versus bright field approaches for achieving molecular contrast with OCT, and introduce second harmonic detection as a promising novel example of dark-field, coherence-gated microstructural imaging.

SB3 • 8:45 a.m.
Spectral triangulation molecular contrast OCT with indocyanine green as the contrast agent, *Changhuei Yang[1,2], Michael A. Choma[2], John Simon[2], Joseph Izatt[2]; [1]Caltech, USA, [2]Duke Univ., USA.* We report the use of indocyanine green (ICG), an FDA approved dye, as a contrast agent for molecular contrast optical coherence tomography (MCOCT). We introduce "spectral triangulation" as an enhancement to spectroscopic OCT.

SB4 • 9:00 a.m.
Optical and luminescence properties of upconverting chelates, *Xudong Xiao, Jeanne Haushalter, Gregory Faris; SRI Intl., USA.* Measurements of the optical absorption, intermediate state lifetime, excitation spectrum, and luminescence of different upconverting chelate compounds are presented. The influence of the chelating ligand on the luminescence properties of the lanthanide ion is studied.

SB5 • 9:15 a.m.
Integrated cancer imaging and therapy using gold nanoshells, *Christopher H. Loo, Min-Ho Lee, Leon R. Hirsch, Jennifer L. West, Naomi J. Halas, Rebekah A. Drezek; Rice Univ., USA.* Nanoshells are a class of nanomaterials that have unique optical properties achievable through systematic manipulation of design parameters. We describe the development of an integrated cancer imaging and therapy application using near-infrared gold nanoshell bioconjugates.

SB6 • 9:30 a.m.
Imaging collagen in a dermal equivalent using multi-photon microscopy, *Erin M. Gill[1], Cathy A. Ivarie[2], Jayne M. Squirrell[3], B. L. Allen-Hoffmann[4], Nirmala Ramanujam[1]; [1]Dept. of Biomedical Engineering, Univ. of Wisconsin, USA, [2]Stratatech Corporation, USA, [3]Lab. of Molecular Biology, Univ. of*

Wisconsin, USA, [4]Dept. of Pathology, Univ. of Wisconsin Medical School, USA. Nondestructive imaging of tumor models offers a new tool for cancer research. We have imaged a dermal equivalent and measured a signal decrease using collagenase. This result indicates feasibility for measuring collagen degradation during tumorigenesis.

SB7 • 9:45 a.m.
Multiphoton imaging of endogenous fluorescence in neoplastic and non-neoplastic epithelial tissues, *Melissa C. Skala, Jayne M. Squirrell, Kristin M. Vrotsos, Kevin W. Eliceiri, Nirmala Ramanuja.m, Annette Gendron-Fitzpatrick; Univ. of Wisconsin, USA.* Endogenous fluorescence offers promise for diagnosing oral cancers. This is the first study to use multiphoton imaging to characterize the spatial and depth distribution of endogenous fluorescence in neoplastic and non-neoplastic epithelial tissues.

Brittany/Champs Elysées
10:30 a.m.–12:30 p.m.
SC • OCT: Spectral Domain
Jennifer Barton; The University of Arizona, USA, Presider

SC1 • 10:30 a.m.
Optical coherence tomography with digital holographic microscopy, *Pia Massatsch, Florian Charrière, Christian Depeursinge, Sr, Pierre Marquet, Etienne Cuche; BIO-E, EPFL, Switzerland.* A new 3D imaging technique combining the advantages of digital holographic microscopy (DHM) with those of reduced coherence interferometry is described. Tomographic images (10μm thick) of epithelial cells of the porcine cornea are presented.

SC2 • 10:45 a.m.
Optical frequency domain imaging with 16 kHz A-line acquisition rate and 110 dB sensitivity, *Seok Hyun (Andy) Yun, Guillermo J. Tearney, Johannes F. de Boer, Nicusor Iftimia, Brett E. Bouma; Harvard Medical School and Wellman Labs. of Photomedicine, MGH, USA.* We demonstrate high-speed optical frequency domain imaging (OFDI) capable of acquiring 16,000 A-lines/sec with sensitivity of 110 dB over depth range of 3.8 mm, using a rapidly swept laser at 1.3 μm center wavelength.

SC3 • 11:00 a.m.
Instantaneous complex conjugate resolved spectral domain OCT using 3x3 fiber couplers, *Marinko V. Sarunic, Michael A. Choma, Changhuei Yang, Joseph A. Izatt; Duke Univ., USA.* We demonstrate removal of the complex conjugate ambiguity in spectral domain OCT approaches (including swept source OCT and Fourier-domain OCT) by the use of a novel interferometer design based on 3x3 couplers.

SC4 • 11:15 a.m.
Spectral-domain optical coherence tomography at 1.3 um wavelength with 19-kHz A-line acquisition rate, *Seok Hyun (Andy) Yun, Guillermo J. Tearney, Brett E. Bouma, Barry Cense, Nader Nassif, B. Hyle Park, Johannes F. de Boer; Harvard Medical School and Wellman Labs. of Photomedicine, MGH, USA.* We demonstrate spectral-domain optical coherence tomography (SD-OCT) with A-line acquisition rate of 19 kHz with sensitivity of >105 dB over 2-mm depth range, using InGaAs line-scan camera and broadband source at 1.31 μm wavelength.

SC5 • 11:30 a.m.
Spectral domain phase microscopy, *Michael A. Choma, Audrey K. Ellerbee, Changhuei Yang, Joseph A. Izatt; Duke Univ., USA.* We describe Spectral Domain Phase Microscopy (SDPM), a phase-sensitive functional derivative of spectral domain OCT that allows for the real-time measurement of cellular motions with sensitivities in the picometer regime.

SC6 • 11:45 a.m.
Differential spectral interferometry, *Daniel J. Kane, Kristen A. Peterson, Andrei B. Vakhtin; Southwest Sciences, Inc, USA.* Differential spectral interferometry is a straightforward modification of spectral interferometry that allows an AC data acquisition mode and results in substantial improvement of the imaging dynamic range. Applications to biological imaging will be presented.

SC7 • 12:00 p.m.
Human retinal blood flow imaging with video-rate spectral domain optical Doppler tomography, *Mark C. Pierce, Brian R. White, Nader Nassif, Barry Cense, Hyle Park, Guillermo J. Tearney, Brett E. Bouma, Teresa C. Chen, Johannes F. de Boer; Wellman Ctr. for Photomedicine, USA.* We present high-resolution images of subsurface structure and flow obtained with spectral domain optical Doppler tomography. Continuous video-rate imaging is demonstrated at 29 frames per second in the human retina in vivo.

SC8 • 12:15 p.m.
Direct bi-directional angle-insensitive flow-intensity detection in doppler Optical Coherence Tomography, *Daqing Piao, Quing Zhu; Univ. of Connecticut, USA.* A new DOCT technique that performs direct bi-directional angle-insensitive flow-intensity detection is presented. Angle-insensitive direct flow-intensity detection is achieved by stationary target rejection using self-referenced coherent demodulation. Directional information is obtained with standard I&Q; technique.

Monaco
10:30 a.m.–12:30 p.m.
SD • Basic Studies Towards Cancer Diagnosis
Nirmala Ramanujam; Univ. of Wisconsin Madison, USA, Presider

SD1 • 10:30 a.m.
Spectral fluorescence imaging for the characterization of HPV 16 transfected cells, *Antonios Papadakis[1], Amy Baldwin[2], Karl Munger[2], Irene Georgakoudi[1]; [1]Wellman Labs. of Photomedicine, Massachusetts General Hospital, USA, [2]Harvard Medical School, USA.* In this study we examine the intrinsic fluorescence properties of normal keratinocytes and HPV16 transfected keratinocytes over a range of excitation-emission wavelengths. We find significant differences in the tryptophan and NADH fluorescence of these cells.

SD2 • 10:45 a.m.
Biochemical differences between tumorigenic and non-tumorigenic cells identified by Raman spectroscopy, *Kurt W. Short, Susan Carpenter, James P. Freyer, Judith R. Mourant; Los Alamos Natl Lab, USA.* Raman spectra from tumorigenic and non-tumorigenic cells are presented. Differences are considered both by examining specific vibrational regions and using a simple fitting routine to estimate the relative amounts of biochemical components in the cells.

SD3 • 11:00 a.m.
Vibrational spectroscopy results compared to biochemical analysis in mammalian cells, *Tamara M. Johnson, Susan Carpenter, Jorge Dominguez, Kurt W. Short, Leslie Coburn, James P. Freyer, Judith R. Mourant; Los Alamos Natl. Lab., USA.* Biochemical analysis of cells in different proliferative stages was performed using IR spectrscopy. Independent biochemical analysis of glycogen oncentration gave results that are consistent with the IR reults, i.e. plateau phase cells have more glycogen.

SD4 • 11:15 a.m. (Invited)
Transport theory for light propagation in tissues, *Arnold D. Kim; Stanford Univ., USA.* We review the theory of the transport equation governing light propagation in tissues. We discuss the computation of the Green's function and its applications.

SD5 • 11:45 a.m.
Effects of epithelial nuclear size and density on elastic scattering spectroscopy: an experimental study using two-layer tissue phantoms, *James W. Tunnell, Adrien Desjardins, Sasha A. McGee, Jelena Mirkovic, Jon Nazemi, Ramachandra R. Dasari, Michael S. Feld; MIT, USA.* Elastic scattering spectroscopy (ESS) has proven useful for detection of intra-epithelial neoplasia. The size and density of epithelial nuclei distort the diffuse reflectance spectra; however, information regarding the nuclear size and density is preserved.

SD6 • 12:00 p.m.
Monte Carlo based inverse model of diffuse reflectance for determination of UV-VIS optical properties and its application to breast cancer diagnosis, *Gregory M. Palmer, Quan Liu, Nirmala Ramanuja.m, Changfang Zhu, Tara M. Breslin, Fushen Xu, Kennedy W. Gilchrist; Univ. of Wisconsin Madison, USA.* A method for extracting optical properties from diffuse reflectance spectra is applied to human breast tissue. It was found that using the physically-based model for classification of malignancy performed substantially better than an empirical model.

SD7 • 12:15 p.m.
Near infrared photon migration optic probe for improving breast core needle biopsy, *Carmalyn Lubawy, Nirmala Ramanujam; Univ. of Wisconsin, USA.* We have developed a near infrared photon migration fiber optic probe which can be inserted into bore of a breast core biopsy needle, enabling preliminary diagnosis of breast lesions before they are removed.

Brittany/Champs Elysées
2:00 p.m.–4:00 p.m.
SE • OCT: New Technology I
Joseph Izatt; Duke Univ, USA, Presider

SE1 • 2:00 p.m. (Invited)
Non invasive optical biopsy using ultrahigh resolution optical coherence tomography, *Wolfgang Drexler; Univ. of Vienna, Austria.* Advances of OCT technology are presented including application of latest laser technology achieving (sub)micrometer axial resolution from 400nm-1700nm, using adaptive optics to improve transverse resolution, and Fourier Domain OCT enabling high speed ultrahigh resolution OCT.

SE2 • 2:30 p.m.
Ultrahigh resolution optical coherence tomography using broadband superluminescent diodes, *Desmond C. Adler[1], Tony H. Ko[1], Dmitry Mamedov[2], Viatcheslav Prokhorov[2], Vladimir Shidlovski[2], Sergei Yakubovich[2], James G. Fujimoto[1]; [1]MIT, USA, [2]Superlum Diodes Ltd, Russian Federation.* In vivo OCT imaging is demonstrated using a compact, inexpensive superluminescent diode light source with 155 nm bandwidth centered at 890 nm and 4 mW output power. Resolutions of <2.3 um in tissue were obtained.

SE3 • 2:45 p.m.
Nonlinear optical contrast enhancement in OCT, *Claudio Vinegoni[1], Jeremy S. Bredfeldt[1], Dan L. Marks[1], Stephen S. Boppart[4,2,3]; [1]Beckman Inst. for Advanced Science and Technology, Univ. of Illinois at Urbana Champaign, USA, [2]Dept. of Electrical and Computer Engineering, USA, [3]Beckman Inst. for Advanced Science and Technology, Bioengineering Progra.m, Coll. of Medicine, USA, 4Univ. of Illinois at Urbana Champaign, USA.* We report on a new interferometric technique for measuring Coherent Anti-Stokes Raman Scattering and Second Harmonic Generation signals. The exploitation of these optical nonlinearities for molecular contrast enhancement in Optical Coherence Tomography is presented.

SE4 • 3:00 p.m.
Endoscopic imaging in rabbit gastrointestinal tract with high resolution Optical Coherence Tomography, *Yu Chen[1], Paul R. Herz[1], Pei-Lin Hsiung[1,] Karl Schneider[1], Kathryn Madden[1], Joseph M. Schmitt[2], Amanda Koski[2], John Goodnow[2], Christopher L. Petersen[2], James G. Fujimoto[1]; [1]MIT, USA, 2LightLab Imaging, USA.* Ultrahigh resolution endoscopic OCT using broadband Cr4+:Forsterite laser light source and linear-scanning catheter is performed in the in vivo rabbit model. Imaging of the gastrointestinal tract with < 4-um axial resolution in tissue was demonstrated.

SE5 • 3:15 p.m.
Scultpured optical fiber tips for narrow diameter optical catheters, *Milen S. Shishkov, Guillermo J. Tearney, Brett E. Bouma; MGH, USA.* We describe a narrow-diameter, monolithic fiberoptic OCT imaging probe that provides a high-quality focus, transverse to the fiber axis, with a long working distance and narrow beam waist.

SE6 • 3:30 p.m.
Miniature lateral priority scanning endoscope for real-time forward-imaging optical coherence tomography, *Xiumei Liu, Michael J. Cobb, Yuchuan Chen, Xingde Li; Dept. of Bioengineering, Univ. of Washington, USA.* We developed a new forward-imaging miniature PZT-actuated endoscope of a 2.4-mm diameter, capable of rapid lateral scanning at 2.4 kHz. Real-time OCT imaging was demonstrated using an image acquisition sequence with lateral priority scanning.

SE7 • 3:45 p.m.
All-fiber, continuous wave, Raman continuum sources for Optical Coherence Tomography, *Pei-Lin Hsiung[1], Yu Chen[1], Norihiko Nishizawa[1], Paul R. Herz[1], Tony H. Ko[1], James G. Fujimoto[1], Christian J.S. de Matos[2], Sergei V. Popov[2], James R. Taylor[2], Jes Broeng[3], Valentin P. Gapontsev[4]; 1MIT, USA, [2]Imperial Coll., UK, [3]Crystal Fiber A/S, Denmark, 4IPG Photonics, USA.* We demonstrate in vivo OCT imaging with <5 um resolution in tissue at ~1.3 um wavelength using a new compact, CW, 330 mW, 140 nm bandwidth, holey-fiber continuum light source pumped by a Yb-fiber laser.

Monaco
2:00 p.m.–4:00 p.m.
SF • Novel Scattering Techniques
Irene Georgakoudi; Wellman Laboratories of Photomedicine, USA, Presider

SF1 • 2:00 p.m. (Invited)
Detecting pre-cancerous cells using angle-resolved low coherence interferometry, *Adam Wax; Dept. of Biomedical Eng, Duke Univ, USA.* Angle-resolved low coherence interferometry is used to detect pre-cancerous basal epithelial cells in intact, unstained animal tissues via quantitative nuclear morphology measurements. Recent results are presented, demonstrating the ability to assess efficacy of chemopreventive agents.

SF2 • 2:30 p.m.
Low Coherence Spectroscopy (LCS) for depth resolved measurements of optical properties in tissue, *Maurice C. Aalders, Dirk J. Faber, Ton G. van Leeuwen; AMC Lasercentre, Netherlands.* A spectroscopic technique was developed by combining low-coherence interferometry with local absorption spectroscopy for non-invasive measurement of blood and tissue constituents. In vivo measurements on tissue and ex-vivo measurements on tissue specimens will be presented.

SF3 • 2:45 p.m.
Coherent backscattering spectroscopy: A new technique for tissue diagnosis, *Vadim Backman, Young Kim, Yang Liu, Vladimir Turzhitsky; Northwestern Univ., USA.* We report development of coherent-backscattering (CBS) spectroscopy for depth-selective tissue characterization. CBS spectroscopy is based on low-coherence broadband CBS and lifts major impediments that so far prevented a widespread use of CBS in tissue optics.

SF4 • 3:00 p.m.
Determination of VIS- NIR absorption coefficients of mammalian fat, with time- and spatially resolved diffuse reflectance and transmission spectroscopy, *Robert L.P. van Veen[1], H.J.C.M. Sterenborg[1], A. Pifferi[2], A. Torricelli[2], R. Cubeddu[2]; [1]ErasmusMC Rotterda.m, Netherlands, [2]Politecnico di Milano, Italy.* The objective is derived from the need for a reliable absorption spectrum of lipids for component analysis of in-vivo tissue spectra. Three independent measurement techniques were employed to determine the absorption coefficients of mammalian lipids.

SF5 • 3:15 p.m.
Determination of tissue optical properties with white light reflectance and an empirical/spectral light transport model, *Paulo R. Bargo[1], Scott A. Prahl[2], Steven L. Jacques[2]; [1]Johnson & Johnson Consumer Products Worldwide, USA, [2]Oregon Health & Science Univ., USA.*
An optical fiber probe was developed for endoscopic determination of tissue optical properties. Reduced scattering and absorption coefficients were determined using an empirical/spectral light transport model. The method was validated against diffusion and adding-doubling models.

SF6 • 3:30 p.m.
Novel optical technique for characterization of biomaterials, *Yang Liu, Jian Yang, Young L. Kim, Vladimir Turzhitsky, Guillermo A. Ameer, Vadim Backman; Northwestern Univ., USA.* A novel optical technique four-dimensional elastic light-scattering fingerprinting enables non-invasive, quantitative and real time characterization of biomaterials. Structural information obtained at nano-scale from solid polymers showed strong correlations with the properties measured via traditional methods.

SF7 • 3:45 p.m.
A spectrally programmable light engine for in vitro or in vivo molecular imaging and spectroscopy, *Nicholas B. MacKinnon[1], Matthieu Quatrevalet[2], Pierre Lane[1], Ulrich Stange[1], Calum MacAulay[1]; [1]BC Cancer Res. Ctr., Canada, [2]Ecole Superieure D'optique, France.* Spectrally and temporally programmable light source can be used in a wide range of medical photonics instruments in spectroscopy, microscopy and endoscopy and can create any desired spectral profile for hyperspectral, fluorescence, principal component imaging.

Brittany/Champs Elysées
4:30 p.m.–6:00 p.m.
SG • OCT: New Technology II
Johannes F. de Boer; Wellman Center, MGH, HMS, USA, Presider

SG1 • 4:30 p.m.
Fourier-domain holographic optical coherence imaging, *David D. Nolte, Kwan Jeong, Mirela Mustata, John Turek; Purdue Univ., USA.* We demonstrate the first spatial Fourier-domain holographic (FDH) optical coherence flythroughs of rat tumors and mouse eyes. FDH eliminates scattered background in the holographic reconstruction and improves signal-to-noise over previous image-domain holography of tissue.

SG2 • 4:45 p.m.
In vivo detection of exogenous contrast agents using optical coherence tomography, *Amy L. Oldenburg[1], Farah Jean-Jacques Toublan[1], Chenyang Xu[1], Wei Luo[1], Gabriel R. Najarro[1], Jillian R. Gunther[1], Kenneth L. Watkin[1], Alexander Wei[2], Kenneth S. Suslick[1], Stephen A. Boppart[1]; [1]Univ. of Illinois at Urbana-Champaign, USA, [2]Purdue Univ., USA.* Contrast enhancement for in vivo OCT is investigated using plasmon-resonant gold nanorods, protein microspheres, liposomes, and iron-oxide particles. The spectroscopic, magnetomechanical and scattering properties are explored using in vivo rat, mouse and tadpole models.

SG3 • 5:00 p.m.
Three-dimensional nonlinear algorithm to determine depth-resolved phase retardation, *Jesung Park, Nate J. Kemp, Haitham N. Zaatari, H. Grady Rylander, III, Thomas E. Milner; The Univ. of Texas at Austin, USA.* A nonlinear algorithm was developed to determine depth-resolved phase retardation. The robustness of the algorithm was verified using simulated polarization sensitive optical coherence tomography (PS-OCT) data on the Poincaré sphere.

SG4 • 5:15 p.m.
Cellular-level imaging using thermal-light full-field optical coherence tomography, *Arnaud Dubois, Kate Grieve, Gael Moneron, Claude Boccara; ESPCI, France.* We present a thermal-light full-field OCT system using a CCD camera, providing 0.7 μm × 0.9 μm resolution (axial × transverse) and 80 dB shot-noise limited detection sensitivity with 1s acquisition time per image.

SG5 • 5:30 p.m.
Microscope-integrated OCT scanner with optimized optical design, *Zhilin Hu[1], Michael V. Sivak, Jr.[2], Andrew M. Rollins[1]; [1]Case Western Reserve Univ., USA, [2]Univ. Hospitals of Cleveland, USA.* An OCT scanner was developed with optimized telecentric optics and a port for a coaxial microscope. Design criteria are provided. Beam profile measurements and in vivo OCT images demonstrate the system quality.

SG6 • 5:45 p.m.

A variational framework for tissue velocimetry in vascular optical coherence elastography, *Raymond C. Chan[1,2], Alexandra H. Chau[1,3], Seemantini Nadkarni[1], W. Clem Karl[4], Nicusor Iftimia[1], Guillermo J. Tearney[1,2], Brett E. Bouma[1,2]; [1]Wellman Ctr. for Photomedicine, Massachusetts General Hospital, Harvard Medical School, USA, [2]Harvard-MIT Division of Health Sciences and Technology, MIT, USA, [3]Dept. of Mechanical Engineering, MIT, USA, [4]Dept. of Electrical Engineering & Computer Engineering, Boston Univ, USA.* A variational approach to tissue velocimetry in optical coherence elastography (OCE) is presented. It exploits prior information about vessel wall velocities to reduce the sensitivity of conventional tracking methods to speckle decorrelation and noise.

Monaco
4:30 p.m.–6:00 p.m.
SH • Hemodynamics
Hanli Liu; University of Texas at Arlington, USA, Presider

SH1 • 4:30 p.m.
Non-invasive measurements of deep tissue hemodynamics in human skeletal muscle, *Guoqiang Yu, Turgut Durduran, Gwen Lech, Chao Zhou, Chance Britton, Arjun G. Yodh; Univ. of Pennsylvania, USA.* Two near-infrared diffuse spectroscopies were used to simultaneously measure the blood flow and oxygenation in human skeletal muscles. The hemodynamics of nine healthy-volunteers and one PVD-patient during arterial cuff-occlusion and plantar-flexion exercise were characterized.

SH2 • 4:45 p.m.
Evaluation of muscle oxygenation based on spatial-resolved broad band and time-resolved spectroscopy, *Matthias Kohl-Bareis, Oliver Rohm, Roland Gürtler; RheinAhrCampus Remagen, Germany.* The current paper assesses the reliability of spatially resolved spectroscopy (SRS) for the assessment of oxygen saturation of muscle with a broad band, multi-channel system and validates it with time-resolved spectroscopy.

SH3 • 5:00 p.m.
Quantitative in vivo monitoring of methemoglobinemia using noninvasive Diffuse Optical Spectroscopy, *Jangwoen Lee[1], Albert E. Cerussi[1], Bruce J. Tromberg[1], Naglaa El-Abaddi[2], Andrew Duke[2], Mathew Brenner[2]; [1]Beckman Laser Inst., USA, [2]Univ. of California, Irvine, Coll. of Medicine, Dept. of Pulmonary Medicine and Cardiothoracic Surgery, USA.* We present noninvasive in vivo measurements of methemoglobin (MetHb) formation and reduction in rabbits using diffuse optical spectroscopy. The absolute concentrations of MetHb, Hb-R, and Hb-O_2 were quantified during nitrite infusions and methylene blue treatment.

SH4 • 5:15 p.m.
Spectroscopic assessment of ischemic bowel, *Michael G. Sowa[1], Lorenzo Leonardi[1], Chris Riley[2], Elicia Kohlenberg[1]; [1]Inst. for Biodiagnostics, Canada, [2]Atlantic Veterinary Coll., Univ. of Prince Edward Island, Canada.* Optical reflectance spectroscopy and imaging was used to investigate regional intestinal hemodynamics in a porcine model of ischemic bowel. Sections of the small intestine were divided into control and A-V occulsion groups and monitored.

SH5 • 5:30 p.m.
Assessment of renal ischemia by optical spectroscopy, *Jason T. Fitzgerald[1], Stavros G. Demos[2], Andromachi Michalopoulou[1], Jonathan L. Pierce[1], Christoph Troppmann[1]; [1]Univ. of California, Davis Medical Ctr., USA, [2]Lawrence-Livermore Natl. Lab., USA.* There is currently no practical method for analyzing organ warm ischemic damage before transplantation. We employ optical spectroscopic methods to measure differences in warm ischemia time in rat kidneys that have been hypothermically preserved.

SH6 • 5:45 p.m.
Tumor oxygenation measured by non-insavive broadband diffuse reflectance spectroscopy predicts photodynamic therapy outcome, *Hsing-Wen Wang, Mary E. Putt, Michael J. Emanuele, Daniel B. Shin, Eli Glastein, Theresa M. Busch, Arjun G. Yodh; Univ. of Pennsylvania, USA.* Photodynamic therapy (PDT) requires oxygen to damage tumor. We demonstrated that the fractional change in tumor oxygenation,

measrued by diffuse reflectance spectroscopy, shortly after versus before PDT significantly correlates with time-to-regrowth of the same tumor.