

Optica Biophotonics Congress and Exhibit Session Guide

Disclaimer: this guide is limited to technical program with abstracts and author blocks as of 21 April. For updated and complete information with special events, reference the online schedule or mobile app.

Sunday, 26 April

08:00 -- 10:00

Room: Las Olas III

BS1A • Multiscale Neuroimaging

Presider: Ashwin Parthasarathy; Univ. of South Florida, USA

BS1A.1 • 08:00 (Invited)

Omni Oblique Plane Microscope (OmniOPM): A Modular Light-Sheet Platform for Imaging Across Scales, Duc Trung Nguyen¹, Xiaoding Wang¹, Tadamoto Isogai¹, Conor Mcfadden¹, Bingying Chen¹, Stephan Daetwyler¹, Tai Ngo¹, Bo-Jui Chang¹, Kevin Dean¹, Reto Fiolka¹; ¹*Lyda Hill Department of Bioinformatics, University of Texas Southwestern Medical Center, USA*. We present the omniOPM, a modular light-sheet for high-throughput 3D imaging. omniOPM achieves diffraction-limited resolution from subcellular to tissue scales using modular optics compatible with a wide range of objectives and immersion media, offering flexibility for diverse biological needs.

BS1A.2 • 08:30

Kilohertz in Vivo Neural Voltage Imaging With Light Field Microscopy via Physics Guided LISTA-Net Reconstruction, Renke Wang¹, Cedric Stefens¹, Lei Xun¹, Nawal Zabouri¹, Christos-Savvas Bouganis¹, Amanda J. Foust¹, Pier Luigi Dragotti¹; ¹*Imperial College London, UK*. We demonstrate 1 kHz in-vivo neuronal voltage imaging using light field microscopy. A physics-inspired deep network reconstructs artifact-suppressed volumes. Then, one high-contrast reference volume is forward-projected into light-field ROIs for fast extraction of neural activity.

BS1A.3 • 08:45

All-Optical Network-Scale Neural Imaging and Optogenetic Control at Neuronal Resolution, Hamid T. Chorsi¹, Saray Soldado-Magraner¹, Yan Jin¹, Peyman Golshani¹, Dean Buonomano¹, Daniel Aharoni¹; ¹*Univ. of California Los Angeles, USA*. We present an open-source all-optical neural microscopy platform that provides large field-of-view, single-cell imaging and patterned illumination, coupled to a closed-loop real-time analysis pipeline with synchronized hardware and a projection engine for real-time mask projection.

BS1A.4 • 09:00

Combined Polarization-Sensitive Optical Coherence Tomography and Light-Sheet Fluorescence Microscopy System for Mapping Axonal Projections in 3D, Nathan Blanke⁵, John T. Giblin¹, Chang-Ling Chung², Emine Ozen², Wenze Li³, Wei Wang⁴, Jiachen Wan⁵, Malte J. Casper², Zhuhao Wu⁴, Elizabeth Hillman³, Hui Wang⁵; ¹*Biomedical Engineering, Boston Univ., USA*; ²*Biomedical Engineering, Columbia University, USA*; ³*Imaging Sciences, St. Jude Children's Research Hospital, USA*; ⁴*Appel Alzheimer's Disease Research Inst., Feil Family Brain and Mind Research Inst., Weill Cornell Medicine, USA*; ⁵*Radiology, Massachusetts General Hospital, USA*. We have developed a novel system for simultaneous imaging of postmortem brain tissues with polarization-sensitive optical coherence tomography and light-sheet fluorescence microscopy. We demonstrate the utility of this system for 3D mapping of fiber trajectories.

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BS1A.5 • 09:15

Robotic-2p: A Robotically Actuated Microscope for Advanced Two-Photon Imaging in Freely Locomoting Mice, Pin Hao Cheng¹, Travis Beckerle¹, Deano Farinella², James Hope¹, Robert Al Khoury², Jacob Gable², Harishankar Jayakumar², Zoey Viavattine¹, Kapil Saxena¹, Aaron Kerlin², Suhasa Kodandaramaiah^{1,3}; ¹*Mechanical Engineering, Univ. of Minnesota, USA*; ²*Neuroscience, Univ. of Minnesota, USA*; ³*Biomedical Engineering, Univ. of Minnesota, USA*. We present Robotic-2P, a system enabling mice to navigate physical spaces while carrying heavy two-photon instrumentation. Utilizing a cranial exoskeleton and admittance control, this platform bridges the gap between high-resolution imaging and naturalistic behavior.

BS1A.6 • 09:30

Mapping Functional Connectivity at Multiple Spatial Scales Using a Hybrid Large Field-of-View Two-Photon and Wide-Field Microscope, Shengxuan Chen¹, Annie Bice¹, Seana Bice¹, Hunter Banks¹, Jonathan Bumstead¹, Ziyuan Li¹, Joseph Culver¹; ¹*Washington Univ. in St Louis, USA*. We developed a hybrid microscope to map both neuron-level and mesoscopic functional connectivity (FC) in mice across a 3x3mm region. Shared FC features among two spatial scales suggests mesoscopic FC emerges from neuron-level FC.

BS1A.7 • 09:45

Scanning Wide-Field Tomography for Functional Imaging of Freely-Swimming Larval Zebrafish in Vivo, Jiazhen Zhai¹, Lingjie Kong¹; ¹*Tsinghua Univ., China*. Functional imaging of freely moving biosamples is indispensable in studying natural behaviors. We propose the scanning wide-field tomography with 4.6x4.6x0.32 mm³ volume-of-view at micrometre resolutions, and demonstrate functional imaging of freely-swimming larval zebrafish in natural states.

08:00 -- 10:00

Room: Bonnet

MS1B • Novel Microscope Components and Systems

Presider: Nicholas Durr; Johns Hopkins Univ., USA

MS1B.1 • 08:00 (Invited)

MAGIC-SCAN: a Next-Generation Technology Suite for High-Speed, Direct-to-Digital Surgical Pathology, J. Quincy Brown¹; ¹*Tulane Univ., USA*. Abstract not available.

MS1B.2 • 08:30

Characterizing Waveplate Behavior of the Morpho Butterfly Wing for Polarimetric Analysis of Tissue Microstructure, Paula Kirya¹, Saaj Chattopadhyay¹, Lisa Poulidakos¹; ¹*Univ. of California San Diego, USA*. We explore the sensitivity of the Morpho butterfly wing to polarized light with color-specific polarimetric image analysis to advance applications in tissue characterization.

MS1B.3 • 08:45

Multispectral Inverse Scattering of Absorptive Samples with Multi-Slice Beam Propagation and Spectrally-Anchored Transparency Prior, Peter Wagenaar¹, Shwetadwip Chowdhury¹; ¹*Univ. of Texas at Austin, USA*. Inverse-scattering for multiple-

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scattering *and* absorptive samples is poorly conditioned and prone to incorrect convergence. For multispectral applications, we demonstrate that a transparent prior can be used to stabilize the inverse problem within absorptive spectral bands.

MS1B.4 • 09:00

Optical Phantom for Evaluating Non-Contact Confocal Corneal Microscopy

Techniques, Kenneth Marcelino¹, Jason Datta¹, Momoka Sugimura¹, Rafael Romero¹, Carmella Ocaya¹, Yongjun Kim¹, Mac Rodriguez¹, Milind M. Rajadhyaksha², Jaya Chidambaram³, DongKyun Kang¹; ¹*Univ. of Arizona, USA*; ²*Memorial Sloan Kettering Cancer Center, USA*; ³*Division of Pharmacy & Optometry, Faculty of Biology, Univ. of Manchester, UK*. We developed an optical resolution phantom that mimics human corneal curvature and refractive index. By incorporating defined nanoparticles, the phantom enables standardized resolution assessment and offers a reproducible benchmark for evaluating performance of non-contact corneal imaging systems.

MS1B.5 • 09:15

Reducing the Duration of Dynamic Light Scattering With a GRIN Lens Probe, Shubham Dawda¹, Yonglin Huang¹, Mahdi Eshaghi¹, Aseel Halwani¹, Aristide Dogariu¹; ¹*Univ. of Central Florida, USA*. Optical sensing based on dynamic intensity correlations requires time-averaging leading to prolonged measurements. We demonstrate that a GRIN lens-based optical probe increases the coherent measurement volume and reduces significantly the measurement duration.

MS1B.6 • 09:30

Three-Dimensional Fluorescence Scattering Microscopy, Zijun Gao^{1,2}, Keyi Han¹, Zhi Ling^{1,2}, Wenhao Liu¹, Shu Jia^{1,2}; ¹*The Wallace H. Coulter Department of Biomedical Engineering, Georgia Inst. of Technology, USA*; ²*Parker H. Petit Inst. for Bioengineering and Biosciences, Georgia Inst. of Technology, USA*. We leverage the scan-free feature of Fourier light field microscopy, together with robust matrix factorization techniques, to achieve 3D fluorescence imaging through scattering media with uncompromised spatial resolution and enhanced optical sectioning.

MS1B.7 • 09:45

Withdrawn

08:00 -- 10:00

Room: Las Olas I,II, V,VI

CS1C • Ophthalmic OCT I

Presider: Michael Pircher; Medizinische Universität Wien, Austria

CS1C.1 • 08:00 (Invited)

Home Optical Coherence Tomography: From Lab to Living Room, Mohan Nishant¹; ¹*Notal Vision, USA*. Home optical coherence tomography is a novel FDA cleared technology that allows utilization of optical coherence tomography (OCT) for retinal imaging by the patient in convenience of their home.

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CS1C.2 • 08:30

OCT Speckle Analysis for Objective Monitoring of Rare Retinal Diseases, Alejandra Consejo¹, Celine Sys², Elke O. Kreps²; ¹*Universidad de Zaragoza, Spain*; ²*Ghent Univ. Hospital, Belgium*. We evaluated speckle statistics from clinical OCT scans to detect microstructural changes in birdshot chorioretinopathy. Parametric and non-parametric metrics showed significant group differences. These results suggest OCT speckle analysis may support objective, widely accessible disease monitoring.

CS1C.3 • 08:45

Functional Retinal Blood-Flow Monitoring Using Spatiotemporal Optical Coherence Tomography (STOC-T), Mehdi Borjkhani¹, Lukasz Kornaszewski², Dawid Borycki¹; ¹*Polska Akademia Nauk, Poland*; ²*InCellVu S.A., Poland*. We demonstrate STOC-T for functional hemodynamic imaging of retinal macrovasculature in the human eye in vivo. Automated Frangi-based segmentation extracts vessel segments and pulsatile flow, while analysis reveals cardiac-synchronous oscillations and yields anti-correlated width–peak biomarkers.

CS1C.4 • 09:00

Visible-Light OCT-Based Quantitative Fundus Autofluorescence Imaging, Rui Zhou¹, Rong Wen², Yiwen Li², Shuliang Jiao¹; ¹*Florida International Univ., USA*; ²*Bascom Palmer Eye Inst., Univ. of Miami, USA*. We developed the FAF-A2E-equivalent system to quantify fundus autofluorescence and translate FAF intensities into the corresponding amounts of lipofuscin in the retinal pigment epithelium. This system employs visible-light OCT-based FAF imaging to acquire FAF and VIS-OCT images simultaneously.

CS1C.5 • 09:15

Multimodal Molecular Photoacoustic Microscopy, OCT, and Fluorescence Imaging for Early Diagnosis of Macular Degeneration, Phuc Nguyen¹, Yannis Paulus¹, Xueding Wang², Wei Qian³; ¹*Johns Hopkins Univ., USA*; ²*Univ. of Michigan, USA*; ³*Imra America Inc., USA*. A multimodal imaging approach combining photoacoustic microscopy, OCT, and fluorescence enables enhanced structural and molecular assessment of age-related macular degeneration in vivo, using targeted ultraminiature gold nanochains to improve lesion visualization and sensitivity in a rabbit model

CS1C.6 • 09:30 (Invited)

Withdrawn

08:00 -- 10:00

Room: Las Olas IV

OS1D • Advances in Deep Optics I

Presider: Christa Haase; Northeastern Univ., USA

OS1D.1 • 08:00 (Invited)

Advancing non-Invasive Clinical Diagnostics With Spectroscopic Imaging, Aboma Merdasa¹, Paulina Ibek¹, Michelle F. Müller¹, Magne Stridh¹, Victor Olariu², Magnus Cinthio³, Malin Malmsjö¹; ¹*Medical Faculty, Lund Univ., Sweden*; ²*Computational Science for Health & Environment, Lund Univ., Sweden*; ³*Biomedical Engineering, Lund Univ., Sweden*. We apply

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spectroscopic imaging (photoacoustic, hyperspectral, and laser speckle imaging) combined with spectral analysis and machine learning in clinical applications from skin tumor diagnostics to oculoplastic surgery for enhanced decision-making, improved diagnostic accuracy and surgical guidance.

OS1D.2 • 08:30 (Invited)

New Diffuse Optical Instrumentation and Methodologies to Enhance and Refine Diffuse Optics Contrast, Frederic Lange¹; ¹*Univ. College London, UK*. This talk will describe advances in time-domain diffuse optics to improve SNR, depth sensitivity, and quantitative accuracy. I will present instrumentation and methodological advances using novel detectors and SWIR extension, guided by a realistic simulator.

OS1D.3 • 09:00

Free-Space Interferometric Diffusing Wave Spectroscopy With an 8-bit Camera, Rabisankar Samanta^{1,3}, Wenjun Zhou², Vivek Srinivasan^{1,3}; ¹*Tech4Health Inst., NYU Langone Health, USA*; ²*College of Optical and Electronic Technology, China Jiliang Univ., China*; ³*Department of Ophthalmology, NYU Langone Health, USA*. An interferometric, free-space, speckle variance optical system is developed using an 8-bit camera. The system measures tissue hemodynamics up to a source-collector separation of 40 mm on the forearm of a Fitzpatrick VI subject.

OS1D.4 • 09:15

Dual-Wavelength Interferometric Diffusing Wave Spectroscopy with a Time-of-Flight Filter (TOF-IDWS) for Tissue Oxygenation and Perfusion Assessment, Zixiao Zhang¹, Shing-Jiuan Liu¹, Mingjun Zhao², Wenjun Zhou^{3,1}, Ao Fu¹, Soheil Ghiasi¹, Vivek Srinivasan^{2,1}, Weijian Yang¹; ¹*Univ. of California Davis, USA*; ²*New York Univ., USA*; ³*China Jiliang Univ., China*. We develop a dual-wavelength TOF-IDWS system that combines high-throughput interferometric detection of speckles, and depth filtering to measure deep-tissue blood flow and oxygen saturation, enabling sensitive, noninvasive hemodynamic monitoring through highly scattering tissue.

OS1D.5 • 09:30

Multi-Wavelength Hybrid Parallel Interferometric Near-Infrared Spectroscopy (Multi- λ Hybrid π NIRS), Marcin J. Marzejon^{1,2}, Dawid Borycki^{1,2}; ¹*Inst. of Physical Chemistry (ICPF), Poland*; ²*Parallel Interferometry and Computational Optics Group, International Centre for Translational Eye Research, Poland*. We present a multi-wavelength hybrid parallel interferometric near-infrared spectroscopy (π NIRS) system combining swept-source interferometry and high-speed camera detection. The platform enhances photon throughput and enables sub-second TOF-resolved oxygenation and blood-flow sensing in vivo.

OS1D.6 • 09:45

Enabling Time-Domain Diffuse Optics Experiments With a Single-Photon Camera System Based on Superconducting Nanowires, Amin Fakhree¹, Adrian van Eik¹, Katyayani Seal¹, Antonio Guardiani¹, Andreas Fognini¹, Martin Caldarola¹; ¹*Single Quantum B.V., Netherlands*. We developed a 100-channel SNSPD system for diffuse optics, featuring a 10 x 10 independently addressed array with > 55% detection efficiency at 1064 nm, < 100 CPS dark-

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count rate and < 100 ps timing jitter.

08:00 -- 10:00

Room: Rio Vista

TS1E • Neuro-monitoring & Cerebral Hemodynamics

Presider: Adam Eggebrecht; Washington Univ. in St Louis, USA

TS1E.1 • 08:00 (Invited)

Interaction Between Cerebral Metabolism, Respiration, and Hypoxia, Jana M.

Kainerstorfer¹; ¹*Carnegie Mellon Univ., USA*. The metabolic rate of oxygen is typically calculated assuming arterial to venous volume fractions staying constant. This assumption is invalid during prolonged apneas and even naturally occurring respiration. Here we propose a method to account for these fluctuations.

TS1E.2 • 08:30

Multi-Modal Neuromonitoring With Diffuse Optics and EEG for Early Detection of Brain Injury in Adults on Venous-Arterial Extracorporeal Membrane Oxygenation, Chloe T. Zhang¹,

Ashley Proctor¹, Prashant Waiba¹, Ryan Chen¹, Irfaan Dar³, Thomas Johnson⁴, David R. Busch², Mark Marinescu⁵, Olga Selioutski³, Yang Gu⁵, Imad Khan⁶, Regine Choe¹; ¹*Univ. of Rochester, USA*; ²*Univ. of Texas Southwestern Medical Center, USA*; ³*Stony Brook Univ., USA*; ⁴*Upstate Medical Univ., USA*; ⁵*Univ. of Rochester Medical Center, USA*; ⁶*Univ. of California, Irvine, USA*. We developed a noninvasive diffuse optical–EEG neuromonitoring system for patients undergoing extracorporeal membrane oxygenation, providing continuous bedside assessment of cerebral autoregulation and early detection of evolving brain injury.

TS1E.3 • 08:45

Age- and Position-Dependence of Differential Pathlength Factor (DPF) Across Human Head Measured by TD-NIRS, Caterina Amendola¹, Marta Zanoletti^{2,1}, Giacomo Giacalone⁵,

Luisa Roveri⁵, Alessandro Lia¹, Lorenzo Spinelli³, Alessandro Torricelli^{1,3}, Davide Contini^{1,4}; ¹*Politecnico di Milano, Italy*; ²*The Inst. of Photonic Sciences, ICFO, Castelldefels, Spain, Spain*; ³*Consiglio Nazionale delle Ricerche (CNR), Italy*; ⁴*Fondazione IRCCS Ca'Granda Ospedale Maggiore Policlinico Milano, Italy*; ⁵*San Raffaele Scientific Inst., Italy*. DPF was quantified across scalp positions and wavelengths in volunteers aged 20–90. Distinct age- and site-dependent trends emerged, with strong inter-subject variability, highlighting the need for individualized DPF estimation for accurate quantitative NIRS.

TS1E.4 • 09:00

Broadband Near-Infrared Spectroscopy for Monitoring Changes in Brain Water Content After Treatment for Cerebral Edema, Vidisha Goyal^{1,2}, LaBeausha Harris¹, Michael D.

Arrington¹, Jada Oriahi¹, Giovani G. Martins¹, Tisha Boodoram¹, Yueh-Chi Wu², Shasha Bai³, Owen B Samuels⁴, Prem A Kandiah⁴, Ofer Sadan⁴, Erin Buckley^{2,3}; ¹*Emory Univ., USA*; ²*Wallace H. Coulter Department of Biomedical Engineering, Georgia Inst. of Technology, USA*; ³*Department of Pediatrics, School of Medicine, Emory Univ., USA*; ⁴*Department of Neurology and Neurosurgery, Division of Neurocritical Care, Emory Univ. Hospital and Emory School of Medicine, USA*. Broadband near infrared spectroscopy was used to detect decreases in brain water content due to hyperosmolar therapy in patients with cerebral edema for the first

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time. These decreases correlated with clinical measures of improved edema.

TS1E.5 • 09:15

Towards Assessing Consciousness Using Time Domain Diffuse Correlation

Spectroscopy, Ulas Sunar¹; ¹*SUNY Stony Brook, USA*. We used time-domain (TD)DCS to assess cerebral blood flow and low-frequency oscillations across consciousness states. Data from healthy subjects and patients demonstrate TDDCS as a noninvasive tool for probing residual neurovascular function and detecting consciousness.

TS1E.6 • 09:30

Diffuse Correlation Spectroscopy Measured Cerebral Blood Flow Response to Treatment After Subarachnoid Hemorrhage Associated With Outcome

Yueh-Chi Wu¹, Eashani Sathialingam¹, Tisha Boodooram¹, Kyle R. Cowdrick¹, Tara Urner¹, Vidisha Goyal¹, LaBeausha Harris¹, Shasha Bai², Feras Akbik³, Owen B Samuels³, Prem A Kandiah³, Ofer Sadan³, Erin Buckley^{1,2}; ¹*Wallace H. Coulter Department of Biomedical Engineering, Emory Univ., USA*; ²*Department of Pediatrics, School of Medicine, Emory Univ., USA*; ³*Division of Neurocritical Care, Department of Neurology and Neurosurgery, Emory Univ. School of Medicine, USA*. Diffuse correlation spectroscopy (DCS) was used to noninvasively monitor real-time microvascular cerebral blood flow responses to treatment with intrathecal nicardipine following subarachnoid hemorrhage. Increases in blood flow were correlated with positive functional outcome.

TS1E.7 • 09:45

Portable Speckle Contrast Optical Spectroscopy for Cerebral Blood Flow Assessment in Children With Sickle Cell Disease: a Feasibility Study in Uganda

Anurag Paul Ovi¹, Linh Luong¹, Dal Hyung Kim², Sangsun Choi³, Isaac Birungi⁴, Akello Leah Joan⁵, Akemo Betty⁵, Elubu Joseph⁵, Ariong Nespole⁶, Sarah Asio⁶, Ruth Namazzi⁷, Phillip Kasirye^{7,8}, Seung Yup Lee^{1,9}; ¹*Kennesaw State Univ., USA*; ²*Department of Mechanical Engineering, Kennesaw State Univ., USA*; ³*School of Communication and Media, Kennesaw State Univ., USA*; ⁴*Department of Information Technology, Kumi Univ., Uganda*; ⁵*Global Health Uganda, Uganda*; ⁶*Atatur General Hospital, Uganda*; ⁷*Department of Pediatrics and Child Health, Makerere Univ. College of Health Sciences, Uganda*; ⁸*Sickle Cell Clinic, Mulago National Referral Hospital, Uganda*; ⁹*Wallace H. Coulter Department of Biomedical Engineering, Emory Univ./Georgia Inst. of Technology, USA*. We have developed a dual distance portable speckle contrast optical spectroscopy (SCOS) system with fiber-camera coupling sensitive to cerebral hemodynamic abnormalities in sickle cell disease children to meet an unmet clinical need in sub-Saharan Africa.

10:30 -- 12:00

Room: Las Olas I,II, V,VI

JS2A • Joint Plenary I

President: Jonathan Liu, Stanford University, USA

JS2A.1 • 10:30 (Plenary)

From Cells to Surgery: Deep Learning Microscopy for Precision Oncology, Rebecca Richards-Kortum¹; ¹*Rice Univ., USA*. Deep-learning-enabled microscopy overcomes optical

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limits of conventional imaging by rapidly generating large-scale, slide-free cellular and vascular maps at high resolution, enabling early point-of-care cancer detection and intraoperative margin assessment in resource-limited settings.

JS2A.2 • 11:15 (Plenary)

Color and Multicontrast Multiphoton Imaging of Brain and Scattering Tissue, Emmanuel Beaurepaire¹; ¹*École Polytechnique, France*. Multiphoton imaging is popular for tissue studies due to its capability to maintain subcellular resolution in scattering samples. It also enables multiparametric imaging when combining wavelengths, polarization and nonlinear responses. The talk will discuss advances in high-information content microscopy.

13:30 -- 15:30

Room: Las Olas III

BS3A • Clinical Applications I

Presider: Silvina Ferradal; Indiana Univ., USA

BS3A.1 • 13:30 (Invited)

Neurometabolic Optical Monitoring During Pediatric Extracorporeal Life Support, Tiffany Ko¹; ¹*Children's Hospital of Philadelphia, USA*. Abstract not available.

BS3A.2 • 14:00

Comparison of Frequency-Domain and Continuous-Wave Diffuse Optical Techniques in Children with Single-Ventricle Congenital Heart Disease, Hongting Zhao¹, Caitlyn Davis¹, Darci Anderson¹, Briston Bayle¹, Alexis Schulz¹, Nicolina Ranieri¹, Joseph B. Majeski², Rodrigo M. Forti¹, Tiffany Ko¹, Arjun Yodh², Brian White¹, Wesley Baker¹, Jennifer Lynch¹; ¹*Children's Hospital of Philadelphia, USA*; ²*Univ. of Pennsylvania, USA*. Frequency domain and continuous wave optical spectroscopy metrics of cerebral tissue oxygen saturation were compared to invasive measurements of venous oxygen saturation in children with congenital heart defects. Frequency-domain measurements were more accurate than continuous-wave measurements.

BS3A.3 • 14:15

Continuous Optical Monitoring of Cerebral Hemodynamics and Neuroinflammation During Pediatric ECMO, Nikhitha Mule¹, Margherita Tabet¹, Annabel McAtee², Bill Zhang¹, Chasity Custer³, Ethan L Sanford^{1,3}, Jayesh Sharma¹, Aliya Abioye¹, Sylvine Ineza¹, Kareena N Nair¹, Deepa Sirsi⁴, Sumit Singh⁵, Jadwiga T Turchan-Cholewo², Domenico Mercurio², DaiWai M Olson⁴, Karabi Nandy⁶, Rajesh Nandy⁷, Michael C Morriss⁵, Lakshmi Raman³, Ann M Stowe², David R. Busch^{1,8}; ¹*Anesthesiology & Pain Management, UT Southwestern Medical Center, USA*; ²*Departments of Neurology and Neuroscience, Univ. of Kentucky College of Medicine, USA*; ³*Pediatrics, Univ. of Texas Southwestern Medical Center, USA*; ⁴*Neurology, Univ. of Texas Southwestern Medical Center, USA*; ⁵*Radiology, Univ. of Texas Southwestern Medical Center, USA*; ⁶*O'Donnell School of Public Health, Univ. of Texas Southwestern Medical Center, USA*; ⁷*College of Public Health, Univ. of North Texas Health Science Center Fort Worth, USA*; ⁸*Neurology, Biomedical Engineering, Peter O'Donnell Jr. Brain Inst., Univ. of Texas Southwestern Medical Center, USA*. This study uses diffuse correlation and time-domain diffuse optical spectroscopy to measure cerebral blood flow and oxygenation, together with biomarker

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assays, with the goal of identifying periods of heightened neurologic vulnerability during ECMO.

BS3A.4 • 14:30

Diffuse Optical Spectroscopies for Monitoring Hemodynamic Changes in the Brain

During Acute Pain Episodes, Tisha S. Boodoram¹, Rawan Korman², Dunia Hatabah², Jada Oriahi¹, Rowan Brothers¹, Seung Yup Lee^{1,3}, Kristin Wubben¹, Michael D. Arrington¹, LaBeausha Harris¹, Kirshma Khemani^{4,5}, Clinton Joiner^{4,5}, Beatrice Gee^{4,5}, Claudia R. Morris^{2,4}, Erin Buckley^{1,2}; ¹*Georgia Tech & Emory School of Medicine, USA*; ²*Department of Pediatrics, Emory Univ., USA*; ³*Department of Electrical and Computer Engineering, Kennesaw State Univ., USA*; ⁴*Department of Pediatrics, Children's Healthcare of Atlanta and Emory Univ., USA*; ⁵*Aflac Cancer and Blood Disorders Center, Children's Healthcare of Atlanta, USA*. We use diffuse optical spectroscopies to quantify changes in the brain during acute pain episodes in children with sickle cell disease (SCD). The results indicate decreased cerebral hemodynamics that are correlated with pain severity.

BS3A.5 • 14:45

Using Advanced Diffuse Optical Spectroscopies to Investigate the Link Between Fetal and Postnatal Cerebral Hemodynamics,

Caitlyn Davis^{1,2}, Nicolina Ranieri^{1,3}, Anita Szwest¹, Kristina Heye¹, Marin Jacobwitz¹, Susan Nicolson¹, Tiffany Ko¹, Rodrigo M. Forti¹, Wesley Baker¹, Arjun Yodh⁴, Daniel Licht¹, Jennifer Lynch^{1,2}; ¹*Children's Hospital of Philadelphia, USA*; ²*Bioengineering, Univ. of Pennsylvania, USA*; ³*Biomedical Engineering, Science and Health Systems, Drexel Univ., USA*; ⁴*Physics and Astronomy, Univ. of Pennsylvania, USA*. Diffuse optical spectroscopies measured cerebral oxygenation, oxygen extraction, and blood flow in neonates with congenital heart disease, revealing that lower fetal cerebral vascular resistance predicts greater postnatal oxygen extraction and risk for white matter injury.

BS3A.6 • 15:00

Correlation Between Resting-State Diffuse Correlation Spectroscopy and Transcranial Doppler Ultrasound and the Effect of Hematocrit in Pediatric Sickle Cell Disease,

Giovani G. Martins¹, Rowan Brothers¹, Tisha Boodoram¹, Jada Oriahi¹, Tara Urner¹, LaBeausha Harris¹, Mariam Akbar¹, Shasha Bai¹, Beatrice Gee¹, Clinton Joiner¹, Amy Tang¹, Clark Brown², Erin Buckley^{1,3}; ¹*Emory Univ., USA*; ²*Illixor Therapeutics, USA*; ³*Children's Healthcare of Atlanta, USA*. Diffuse correlation spectroscopy resting-state cerebral blood flow index correlates with transcranial Doppler ultrasound velocities in the anterior cerebral artery in children with sickle cell disease ($r=0.76$, $p<0.001$). Correction for hematocrit did not strengthen this relationship.

BS3A.7 • 15:15

Assessing Low-Frequency Power Asymmetry in Pediatric Patients on Extracorporeal Membrane Oxygenation Using High-Density Diffuse Optical Tomography,

Sung Min Park¹, Sophia McMorrow¹, Da Eun Jung¹, Kaitlyn Hersch¹, Emma Speh¹, Evan Daniels-Day¹, Tessa George¹, Chloe Sobolewski¹, Dalin Yang¹, Kristin Guilliams¹, Ahmed S. Said¹, Adam T. Eggebrecht¹; ¹*Washington Univ. in St Louis, USA*. We demonstrate the feasibility of using high-density diffuse optical tomography (HD- DOT) for bedside longitudinal neuromonitoring of pediatric ECMO patients, highlighting its potential for detecting changes in brain activity via asymmetry of low-frequency power (LFP).

13:30 -- 15:30

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Room: Bonnet

MS3B • Panel Discussion on In Vivo Microscopy for Clinical Applications

Presider: DongKyun Kang; Univ of Arizona, Coll of Opt Sciences, USA

MS3B.1 • 13:30 (Invited)

Label-Free Multimodal Optical Microscopy for Real-Time Multiscale Imaging of AI-Detected Rare Events and in-Vivo Pathology, Stephen A. Boppart¹; ¹*Univ of Illinois at Urbana-Champaign, USA*. Compromises are made in microscopy between high-resolution fields-of-view versus lower resolution larger area coverage. Rare dynamic (sub)cellular events are therefore often missed. This multiscale problem is addressed with real-time AI-based screening for *in vivo* pathology.

MS3B.2 • 14:00 (Invited)

Developing Optical Biomarkers to Quantify the Efficacy of Therapeutic Agents, Linh M. Vuong¹, Danny F. Xie², Belen Torrado², Alexander VALLMITJANA LEES², Amanda Durkin², Hira Rizwi¹, Matthew Far-Hadian², Bernard Choi², Mihaela Balu², Anand K. Ganesan¹; ¹*Dermatology, Univ. of California, Irvine, USA*; ²*Beckman Laser Inst., Univ. of California, Irvine, USA*. Here we integrate multi-photon microscopy and 3D vessel tracing to compare anti-vascular drug efficacy. We then leverage knowledge gained from vascular imaging biomarker discovery to develop bedside-imaging methods that could quantify cancer immunotherapy responses.

MS3B.3 • 14:30 (Invited)

Reflectance Confocal Microscopy-Guided Diagnosis and Management of Skin Lesions at the Bedside: Past is Prologue, Milind M. Rajadhyaksha¹; ¹*Memorial Sloan Kettering Cancer Center, USA*. Reflectance confocal microscopy-guided management of skin lesions continues to advance into routine practice. Wider adoption remains to be enabled with lower cost and easier-to-use device configuration and with machine learning-assisted clinician capabilities in image reading.

13:30 -- 15:30

Room: Las Olas I, II, V, VI

CS3C • Dynamic / Full-Field OCT

Presider: Martin Villiger; Wellman Center for Photomedicine, USA

CS3C.1 • 13:30 (Invited)

Pushing the Limits of Dynamic Full-Field Optical Coherence Microscopy, Egidijus Auksorius¹, Erikas Tarvydas^{1,2}, Austėja Treciokaite¹; ¹*Ctr for Physical Sciences & Technology, Lithuania*; ²*Faculty of Medicine, Vilnius Univ., Lithuania*. Dynamic full-field OCM is a label-free live-cell imaging technique exploiting interferometric temporal fluctuations to generate fluorescence-like contrast. Using high-NA (1.25) objectives and a bright laser-based white-light source, we achieve deep imaging (100µm) and ~270 nm lateral resolution in fresh mouse tissues.

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CS3C.2 • 14:00

Coherence- and Sampling-Ratio–Guided FFOCT Achieving 60× Depth-of-Focus Extension, Yue Zhu¹, Boyu Chen¹, Penghui Wang¹, Shizhuo Pang¹, Yuan Zhou²; ¹*Nanjing Univ of Science and Technology, China*; ²*Department of General Surgery, Sir Run Run Shaw Hospital, China*. A coherence- and sampling-ratio–guided FFOCT framework applied to optical coherence control with computational refocusing, enabling stable phase recovery and achieving submicron resolution with a 60× depth-of-focus extension using four-frame, no-averaging acquisition for deep high-NA imaging.

CS3C.3 • 14:15

Towards Objective IVF Embryo Selection: Evaluating Dynamic OCM Biomarkers for Blastocyst Assessment, Yunqin Zhao¹, Saanjali Majmundar¹, Jacob Stoebner¹, Audrey E. Bowden¹; ¹*Vanderbilt Univ., USA*. We present initial results on the use of dynamic OCM for objective blastocyst assessment. Power spectral bandwidth showed a mild correlation with cell count but lacked statistical significance, motivating the search for robust biomarkers.

CS3C.4 • 14:30

Phase-Sensitive Dynamic Micro Optical Coherence Tomography (D μ OCT) for Label-Free Neuroimaging, Hinnerk Schulz-Hildebrandt^{1,2}, Michelle Yue^{1,2}, Milana Kendrisic^{1,2}, Jintek Im^{1,2}, Erica Villareyna-Lopez², Guillermo J. Tearney^{1,2}; ¹*Harvard Medical School, USA*; ²*Wellman Center for Photomedicine, Massachusetts General Hospital, USA*. Dynamic micro-optical coherence tomography (D μ OCT) enables high-resolution, label-free imaging of brain tissue by capturing intrinsic ATP-dependent intracellular motion. We show that D μ OCT can visualize metabolic dynamics and microstructure across large areas in adult mouse brain slices.

CS3C.5 • 14:45

Image-Based Assessment of Tumor Spheroid by Computationally-Augmented Dynamic Optical Coherence Tomography, Yoshiaki Yasuno¹, Rion Morishita¹, Ibrahim A. El-Sadek^{1,2}, Yusong Liu¹, Yuping Zheng¹, Rameesa Rafi¹, Chettanat Padungatthakij^{1,3}, Shuichi Makita¹, Prathan Buranasiri³, Atsuko Furukawa⁴, Satoshi Matsusaka⁴; ¹*Computational Optics Group, Univ. of Tsukuba, Japan*; ²*Department of Physics, Faculty of Science, Damietta Univ., Egypt*; ³*Department of Physics, School of Science, King Mongkut's Inst. of Technology Ladkrabang, Thailand*; ⁴*Inst. of Medicine, Univ. of Tsukuba, Japan*. We present comprehensive dynamic OCT imaging of spheroid. Here (1) > 4-day time-lapse, (2) cellular activity differentiation, and (3) high-speed DOCT imaging are enabled by (1) an incubation-chamber-integrated OCT, (2) multi-dynamics OCT, and (3) deep-learning based image generation.

CS3C.6 • 15:00 (Invited)

Dynamic Full-Field Optical Coherence Microscopy of Living Mouse Oocytes and Early Embryos, Seweryn Morawiec², Anna Ajduk¹, Brendan F. Kennedy^{2,3}, Maciej Szkulmowski²; ¹*Department of Embryology, Faculty of Biology, Univ. of Warsaw, Poland*; ²*Inst. of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus Univ. in Torun, Poland*; ³*BRITeLab, Harry Perkins Inst. of Medical Research, The Univ. of Western Australia, Australia*. We present full-field optical coherence microscopy (FF-OCM) for high-resolution label-free imaging of living mouse oocytes and preimplantation embryos. The method visualizes subcellular components, cytoplasm motion, nuclear dynamics, and mitochondrial activity as

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potential quantitative biomarkers of developmental competence.

13:30 -- 15:30

Room: Las Olas IV

OS3D • Novel Algorithm for Deep Optics

Presider: Chulhong Kim; Pohang Univ of Science & Technology, South Korea

OS3D.1 • 13:30 (Invited)

Inverse-Scattering for Centimeter-Scale Label-Free Imaging, Shwetadwip

Chowdhury¹; ¹*Univ. of Texas at Austin, USA*. We develop computational inverse-scattering methods for volumetric, label-free bioimaging in multiple-scattering samples. In this work, we present recent advances that extend our prior approach to centimeter-scale imaging using a simple on-chip sensor, while requiring only minimal modifications to the underlying inverse-scattering framework.

OS3D.2 • 14:00

Multi-Layer Self-Calibrated Algorithm for Transabdominal Fetal Pulse Oximetry, Jingyi

Wu¹, Martin P. Debreczeny², Nevan C. Hanumara³, Neil Ray², Baptiste Jayet⁴, Stefan Andersson-Engels^{4,5}, Jana M. Kainerstorfer^{1,6}; ¹*Department of Biomedical Engineering, Carnegie Mellon Univ., USA*; ²*Raydiant Oximetry, Inc., USA*; ³*Department of Mechanical Engineering, Massachusetts Inst. of Technology, USA*; ⁴*Biophotonics@Tyndall, Tyndall National Institution, Ireland*; ⁵*School of Physics, Univ. College Cork, Ireland*; ⁶*Neuroscience Inst., Carnegie Mellon Univ., USA*. We developed a multi-layer self-calibrated algorithm for transabdominal fetal pulse oximetry. Validated in simulations and sheep experiment, it accurately estimates fetal saturation without empirical calibration, overcoming limitations of conventional single-layer models in complex geometries.

OS3D.3 • 14:15

μMCX -- Modern, Easy-to-Adapt, Hardware-Accelerated 3D Monte Carlo Photon Simulator in 800 Lines of Code, Qianqian Fang¹; ¹*Northeastern Univ., USA*. We announce μMCX – a

miniaturized, easy-to-read, easy-to-modify, and graphics processing unit (GPU)-accelerated 3D Monte Carlo (MC) simulator implemented with 800 lines of code, excellently suited for education and building new MC algorithms with-out performance compromises.

OS3D.4 • 14:30

A Hybrid Analytical--Neural Network Framework for Tissue Optical Property Recovery for Single-Fiber Reflectance Spectroscopy, Md Nafiz Hannan¹, Timothy M. Baran¹; ¹*Univ. of Rochester, USA*. We developed a hybrid analytical–neural network framework for extracting

tissue optical properties from single-fiber reflectance spectroscopy, combining a physics-based model with a neural network surrogate to achieve improved photon pathlength modeling and prediction accuracy.

OS3D.5 • 14:45

Redbird: a Compact and Versatile Toolbox for Forward and Inverse Modeling for Diffuse Optical Imaging, Edward Xu¹, Qianqian Fang¹; ¹*Northeastern Univ., USA*. We present Redbird,

a feature-rich, intuitive-to-use, and open-source toolbox for diffuse optics imaging forward and

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inverse modeling. Redbird further integrates seamlessly with the Monte Carlo eXtreme (MCX) suite while extending MCX with image reconstruction capabilities.

OS3D.6 • 15:00

Physics-Informed Neural Network for Mapping Vascular and Tissue Dynamics Using Laser Speckle Contrast Imaging, Shuying Li^{1,3}, Rockwell Tang², Will Donovan¹, Victoria Krepulec¹, David Boas^{2,4}, Lei Tian^{2,4}, Xiaojun Cheng²; ¹*Department of Chemical, Paper, and Biomedical Engineering, Miami Univ. - Oxford, USA*; ²*Department of Biomedical Engineering, Boston Univ., USA*; ³*Department of Computer Science and Software Engineering, Miami Univ. - Oxford, USA*; ⁴*Department of Electrical Engineering, Boston Univ., USA*. We present a physics-informed neural network that reconstructs vascular and tissue dynamics from LSCI. Validated in in vivo mouse stroke models, the method matches conventional curve fitting while reducing computation time from hours to seconds.

OS3D.7 • 15:15

Principal-Curvature-Informed Mesh-Based Monte Carlo for Accurate Photon Transport Modeling Across Curved Boundaries, Fan-Yu Yen¹, Qianqian Fang¹; ¹*Northeastern Univ., USA*. We introduce a curvature-informed mesh-based Monte Carlo (MMC) method that reduces geometric discretization error at curved surfaces by correcting surface normals using principal curvature during ray tracing, greatly enhancing MMC in modeling transparent optical components such as lenses.

13:30 -- 15:30

Room: Rio Vista

TS3E • Vascular Response & Muscle Oximetry

Presider: Sri Rama Pranav Kumar Lanka; Tyndall National Inst., Italy

TS3E.1 • 13:30 (Invited)

Is Spatial fNIRS the Next Step Towards Mapping Peripheral Tissue Oxygenation and Flow Dynamics?, Anuradha Godavarty¹; ¹*Florida International Univ., USA*. An innovative approach of spatial fNIRS and its varied clinical applications to map microcirculatory responses in the peripheries as tissue oxygenation changes or flow dynamics is described.

TS3E.2 • 14:00

Muscle Hemodynamics Assessment in Athletes Using TD-NIRS and DCS During Arterial Occlusion, Caterina Amendola¹, Letizia Contini¹, Marco Nabacino¹, Rebecca Re^{1,2}, Davide Contini^{1,3}, Marco Orsenigo⁴, Alessandro Torricelli^{1,2}; ¹*Politecnico di Milano, Italy*; ²*Consiglio Nazionale delle Ricerche, Italy*; ³*Fondazione IRCCS Ca'Granda Ospedale Maggiore Policlinico Milano, Italy*; ⁴*ULTRA Strength, Italy*. TD-NIRS and DCS quantified muscle oxygenation and blood-flow dynamics in sprinters before and after training. Desaturation slopes and hyperemic areas increased post-exercise, distinguishing training load and supporting noninvasive, athlete-specific monitoring for personalized training optimization.

TS3E.3 • 14:15

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Correction of Adipose Tissue Effects in Time-Domain NIRS Muscle Measurements, Marco Nabacino¹, Caterina Amendola¹, Letizia Contini¹, Davide Contini¹, Rebecca Re^{1,2}, Lorenzo Spinelli², Alessandro Torricelli^{1,2}; ¹*Politecnico di Milano, Italy*; ²*Istituto di Fotonica e Nanotecnologie, Consiglio Nazionale delle Ricerche, Italy*. We propose a Monte Carlo simulation-based correction of adipose tissue effects for single-distance time-domain NIRS measurements on skeletal muscle, enabling estimation of hemodynamic parameters for adipose tissue thicknesses up to 8 mm.

TS3E.4 • 14:30

Beyond the Surface: TD-NIRS for Bias-Resistant Brain and Muscle Oximetry, Michele Lacerenza¹, Chiara Motto¹, Mauro Buttafava¹; ¹*PIONIRS srl, Italy*. How TD-NIRS can deliver fair, quantitative oximetry in brain and muscle, reducing skin-pigmentation bias and improving access to deep cortical and muscle hemodynamics beyond scalp and adipose layers in both clinical and exercise-science settings. Enabling robust translation of optical biomarkers.

TS3E.5 • 14:45

Assess Clinical Outcome of Revascularization in Critical Limb Ischemic Subjects Using Spatio-Temporal NIRS Imaging, Aasma Dahal¹, Daniela Jimenez Perez¹, Alberto Fernandez Bujan², Shirel Belilty Benmergui¹, Vinod Chainani², Joshua Hutcheson¹, Anuradha Godavarty¹; ¹*Florida International Univ., USA*; ²*MVM Heart, Vein and Vascular Centers, USA*. Peripheral hemodynamic imaging using spatio-temporal NIRS technique can objectively assess the clinical outcome of revascularization procedures in critical limb ischemic (CLI) subjects. Studies also showed that CLI subjects had diminished perfusion compared to control subjects.

TS3E.6 • 15:00

Characterizing Peripheral Vascular Response to Cold Provocation via Dynamic NIRS and Thermal Imaging, Shivam Shukla¹, Aaron Teijeiro¹, Himaddri Shakhar Roy¹, Aasma Dahal¹, Karla Vasquez¹, Anuradha Godavarty¹; ¹*Florida International Univ., USA*. Peripheral vascular responses reflect microvascular health. Integrating dynamic near-infrared spectroscopy with thermal imaging during cold provocation captures real-time vascular behavior, enabling noninvasive detection of dysfunction and improved assessment of microcirculations.

TS3E.7 • 15:15

Advancing Peripheral Oxygen Saturation (SpO₂) Measurement Accuracy Using Biophysics-Informed Machine Learning Techniques to Mitigate Racial Disparities, Clement Nana Yaw Adjei Appiah Anokye^{1,2}, Roy Shidhartho³, Elsie E. Kaufmann², Godfrey A. Mills², Sossena Wood³, Shiraz Issahaku²; ¹*Ghana Health Service, Ghana*; ²*Biomedical Engineering, Univ. of Ghana, Ghana*; ³*Biomedical Engineering, Carnegie Mellon Univ. (, USA*. Racial disparities in pulse oximetry in Ghana is addressed by integrating biophysics-informed machine learning models that incorporate objective skin tone metrics. Using experimental SpO₂ datasets, neural networks achieved >86% accuracy, with improved performance for darker skin tones.

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16:00 -- 17:30

Room: Las Olas III

BS4A • Functional Brain Imaging in Humans I

Presider: Danushka Bandara; Fairfield Univ., USA

BS4A.1 • 16:00 (Invited)

From Bench to Bedside: Ongoing Development of a Multi-Parameter Optical Neuromonitor Based on Time-Resolved Interferometric Optical Sensing, Robert

Cooper¹; ¹*CoMind Technologies, UK*. Non-invasive, continuous monitoring of cerebral blood flow holds significant clinical potential. At CoMind, we are developing an interferometric optical neuromonitoring platform that can achieve high-fidelity pulsatile blood flow measurements at late photon times-of-flight.

BS4A.2 • 16:30

Towards Mapping Brain Function Underlying Impaired Verbal Communication in

Minimally Speaking Autistic Individuals, Ari Segel¹, Alice Sperry², Deana Crocetti², Emma Speh¹, Evan Daniels-Day¹, Kaitlyn Hersch¹, Dalin Yang¹, Morgan Barense³, Karen Chenausky⁴, Rachel Reetzke², Stewart H. Mostofsky², Adam T. Eggebrecht¹; ¹*Washington Univ. in St Louis, USA*; ²*Kennedy Krieger Inst., USA*; ³*Univ. of Toronto, Canada*; ⁴*MGH Inst. of Health Professionals, USA*. We use high-density diffuse optical tomography (HD-DOT) to investigate brain function underlying limb-motor and spoken language processing in minimally speaking autistic (MS-AUT) adult individuals and matched neurotypical controls (NT).

BS4A.3 • 16:45

Mapping Neural Correlates of Motor Observation and Imitation in School-Age Children

With and Without Autism Using HD-DOT, Dalin Yang¹, Tessa George¹, Chloe Sobolewski¹, Sophia McMorrow¹, Kelsey King¹, Evan Daniels-Day¹, Sung Min Park¹, Emma Speh¹, Ari Segel¹, Deana Crocetti², Alice Sperry², Mary B. Nebel², Bahar Tunçgenç³, Rene Vidal⁴, Natasha Marrus¹, Stewart H. Mostofsky², Adam T. Eggebrecht¹; ¹*Washington Univ. School of Medicine, USA*; ²*Kennedy Krieger Inst., USA*; ³*Nottingham Trent Univ., UK*; ⁴*Univ. of Pennsylvania, USA*. We used HD-DOT to image neural correlates in eighty-one school-age children with and without autism during motor observation and imitation, demonstrating that HD-DOT tolerates motion and successfully maps distributed brain activity during gross motor tasks.

BS4A.4 • 17:00

Activation-Prior Guided Tomographic fNIRS Bridges the Gap Between Sparse and High-Density fNIRS, Ashlyn McCann¹, Edward Xu¹, Qianqian Fang¹; ¹*Northeastern Univ., USA*. We

evaluate an activation-prior-guided DOT reconstruction algorithm across probe densities, demonstrating 3-10× and ~11× improvements in localization and contrast, enabling high-quality fNIRS imaging with sparse probes and offering a substantial improvement when high-density optodes are available.

BS4A.5 • 17:15

Participant-Specific Head Modeling Pipeline With NeuroDOT, Emma Speh¹, Ari Segel¹,

Adam T. Eggebrecht¹; ¹*Washington Univ. School of Medicine, USA*. NeuroDOT provides customizable pipelines for atlas or participant-based light modeling using any optical neuroimaging system. Atlases for various ages or head sizes and participant specific anatomy

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from MRI scans provide accuracy for light modeling.

16:00 -- 17:30

Room: Bonnet

MS4B • Label-Free Microscopy

Presider: Salvatore La Cavera III; Univ. of Nottingham, UK

MS4B.1 • 16:00 (Invited)

PRISMOS: Phasor-Resolved Imaging With Single Excitation and Multiplexed Organelle Signatures, Michelle Digman^{1,2}, Songning Zhu¹, Lorenzo Scipioni³; ¹*Univ. of California Irvine, USA*; ²*Laboratory for Fluorescence Dynamics, Beckman Laser Inst., Univ. of California Irvine, USA*; ³*Research Center In Cancer De Toulouse, France*. PRISMOS integrates phasor analysis with single-wavelength hyperspectral imaging to resolve seven organelles simultaneously in live cells. Validated in chemoresistant breast cancer, mitochondrial and lysosomal remodeling emerged as key predictors of tamoxifen resistance.

MS4B.2 • 16:30

A Standalone 3D Printed Lensless Digital Holographic Microscopy Platform for Quantitative, Label-Free Detection of Blood-Borne Diseases in Resource-Limited Settings, Charlotte Kyeremah¹, Fidelia Osei¹, Antonio Melberg¹, Aditya Paul², Manoj Duraisingh², Chandra S. Yelleswarapu¹; ¹*Univ. of Massachusetts Boston, USA*; ²*Department of Immunology and Infectious Diseases, Harvard School of Public Health,, USA*. We present a compact, 3D-printed, real-time lensless digital holographic microscope integrated with a Raspberry Pi for hologram acquisition, reconstruction, visualization, and user-friendly operation, enabling quantitative detection of blood-borne pathogens in resource-limited environments.

MS4B.3 • 16:45

Handheld Volumetric Probe for Quantitative Phase and Fluorescence Imaging of Thick Tissue, Srinidhi Bharadwaj^{1,2}, Zhenmin Li¹, Jimena Garcia-Nuno¹, Jacob Callaway¹, Lukas Clark¹, Francisco Robles¹; ¹*Biomedical Engineering, Georgia Inst. of Technology, USA*; ²*School of Medicine, Emory Univ., USA*. Multimodal systems that combine phase and fluorescence information can provide enhanced information to identify tumor. This work introduces a volumetric, handheld multimodal probe that enables phase and fluorescence imaging of *ex vivo* brain samples.

MS4B.4 • 17:00

Interferometric Reflectance Confocal Microscopy for Label-Free Dynamic Imaging, Momoka Sugimura¹, Yongjun Kim¹, Carmella Ocaya¹, Briana Guzman², Curtis Thorne², DongKyun Kang^{1,3}; ¹*James C. Wyant College of Optical Sciences, Univ. of Arizona, USA*; ²*Department of Cellular and Molecular Medicine, Univ. of Arizona, USA*; ³*Department of Biomedical Engineering, Univ. of Arizona, USA*. We developed an interferometric reflectance confocal microscope for label-free dynamic imaging of the sample. Interferometric optics along with the confocal gating allow for sensitive detection of movement of sub-resolution objects.

MS4B.5 • 17:15

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Simultaneous Label-Free Imaging of Nucleolar Dynamics and Subcellular Metabolic Shifts Across Tissue Contexts, Kunzan Liu¹, Ellen L. Kan¹, Honghao Cao¹, Jiashu Han¹, Giovanni d. Nola¹, Linda G. Griffith¹, Eliezer Calo¹, Sixian You¹; ¹*Massachusetts Inst. of Technology, USA*. We developed a label-free 3D imaging system integrated with an axial deblurring network to achieve deep and isotropic imaging, revealing dynamic correlations between metabolic states and nucleolar activities across diverse living biosystems.

16:00 -- 17:30

Room: Las Olas IV

OS4C • Fluorescence and Raman Spectroscopy

Presider: Junjie Yao; Duke Univ., USA

OS4C.1 • 16:00 (Invited)

Multimodal Metabolic Nanoscopy for Spatial Metabolic Heterogeneity, Lingyan Shi¹; ¹*Univ. of California San Diego, USA*. I will present multimodal label-free optical platforms integrating stimulated Raman scattering, multiphoton, Harmonic Generation, and fluorescence lifetime imaging for spatial metabolic heterogeneity highlighting applications to cancer, aging, and kidney disease and opportunities for quantitative, clinically translatable optical biopsy.

OS4C.2 • 16:30 (Invited)

Multidimensional Single-Molecule Spectral Dynamics Imaging, Shangguo Hou¹; ¹*Shenzhen Bay Laboratory, China*. We developed a single-molecule fluorescence spectrum dynamics microscopy, a method that can simultaneously capture both rapid 3D positional dynamics and fluorescence spectrum dynamics with enhanced spectral imaging accuracy and speed, single-molecule sensitivity, and high 3D localization precision.

OS4C.3 • 17:00

Toward Chip-on-Tip FLIm: Integrating Fast Phasor Analysis With a Miniaturized SPAD Micro-Camera, Sumedha Chanda^{1,2}, Dario Angelone^{1,2}, Robert Henderson³, Stefan Andersson-Engels^{1,4}, Sanathana Konugolu Venkata Sekar^{1,4}, Katarzyna I. Komolibus¹; ¹*Tyndall National Inst., Ireland*; ²*Department of Engineering and Food Science, Univ. College Cork, Ireland*; ³*Inst. for Integrated Micro and Nano Systems, School of Engineering, Univ. of Edinburgh, UK*; ⁴*School of Physics, Univ. College Cork, Ireland*. We demonstrate phasor-based fluorescence lifetime imaging of endogenous fluorophores using a miniaturized 3D-stacked SPAD micro-camera, validated on NADH and FAD phantoms, enabling fast, compact lifetime analysis for future chip-on-tip endoscopic applications.

OS4C.4 • 17:15

Self-Calibration of Analyte Measurements in Raman Spectra, Benjamin Braker¹; ¹*Cromia.life, USA*. We present a self-calibration method using amplitude closure among analyte measurements to remove systematic errors in Raman spectroscopy measurements of multiple analytes. We provide the method theory and experimental results showing a nine-fold reduction in measurement deviation.

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16:00 -- 17:30

Room: Rio Vista

TS4D • Pediatric Care & Neonatal Applications

Presider: Katarzyna Komolibus; Tyndall National Inst., Ireland

TS4D.1 • 16:00 (Invited)

Clinical Neonatal and Mannequin Lung Oxygen Measurements Based on Gas in Scattering Media Absorption Spectroscopy (GASMAS), Stefan Andersson-Engels¹; ¹*Tyndall National Inst., Ireland*. Abstract not available.

TS4D.2 • 16:30

Wearable Optical Monitoring of Cerebral Oxygenation in Pediatric Sickle Cell Disease in Urban and Rural Uganda, Zahra Rostampour Fathi¹, Seung Yup Lee^{1,2}, Isaac Birungi¹, Akello Leah Joan¹, Sangsun Choi¹, Akemo Betty¹, Ariong Nesp¹, Sarah Asio¹, Ruth Namazzi¹, Phillip Kasirye¹, Elubu Joseph¹; ¹*Kennesaw State Univ., USA*; ²*Department of Biomedical Engineering, Emory Univ., USA*. We have developed a dual distance portable speckle contrast optical spectroscopy (SCOS) system with fiber-camera coupling sensitive to cerebral hemodynamic abnormalities in sickle cell disease children to meet an unmet clinical need in sub-Saharan Africa.

TS4D.3 • 16:45

DIGSS: Depth Isolation via Gating and Signal Separation - a Simulation Study of Pulsatile Time-Domain NIRS, Rishad Raiyan Joarder¹, Weijian Yang¹, Vivek Srinivasan², Soheil Ghiasi¹; ¹*Electrical and Computer Engineering, Univ. of California, Davis, USA*; ²*Ophthalmology and Radiology, NYU Langone Health, USA*. Superficial interference in optical sensing masks deep-tissue dynamics. We present a signal separator feedback-based method to dynamically optimize Time-of-Flight time-gating and show sensitivity improvements across multiple measurands and tissue models in a simulated environment.

TS4D.4 • 17:00

Continuous Wave – Photon Time of Flight (CW - PToF) Hybrid Analytical Model for Estimation of Broadband Absolute Optical Properties, Muhammad D. Ghauri¹, Suraj Kumar Kothuri¹, Sri Rama Pranav Kumar Lanka¹, Stefan Andersson-Engels¹, Sanathana Konugolu Venkata Sekar¹; ¹*Tyndall National Inst., Ireland*. This study presents hybrid analytical model combining Continuous Wave & Time-of-Flight methods to enhance broadband optical property estimation. The model integrates diffuse reflectance spectroscopy with time-gated pToF to enable extraction of broadband optical properties from deeper tissue layers.

TS4D.5 • 17:15

Diffuse Reflectance Spectroscopy Integrated With Interpretable Machine Learning for Neonatal Bilirubin Prediction, Chitra R¹, Shanthi Prince¹; ¹*Department of ECE, SRM Inst. of Science and Technology, Kattankulathur, India*. In this work, we present a non-invasive method for neonatal bilirubin estimation using diffuse reflectance spectroscopic system assisted with interpretable machine learning framework.

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17:45 -- 19:15

Room: Las Olas III

BS5A • Functional Brain Imaging in Humans II

Presider: Hongting Zhao; Children's Hospital of Philadelphia, USA

BS5A.1 • 17:45 (Invited)

FNIRS for Everyone: Toward Accessible, Inclusive, and Scalable Neuroimaging, Audrey E. Bowden¹; ¹*Vanderbilt Univ., USA*. Functional near-infrared spectroscopy (fNIRS) is a portable alternative to fMRI, yet barriers in inclusiveness, usability, and scalability limit adoption. We describe advances in hairaware optode interfaces, augmented-reality-guided self-alignment, and modular multichannel systems enabling reproducible, large-scale deployment.

BS5A.2 • 18:15

Simultaneous NIRS-fMRI-EEG for Direct Measurement of Blood Volume and CSF Flow in Humans During Sleep, Adiya Rakymzhan¹, Sydney M. Bailes², Massinissa Bosli¹, Brandon Dormes¹, Oliva S. Kierul³, Joshua Levitt⁴, Nikola Otic³, Larry Padilla³, Marco Renna³, Banban Tan^{1,3}, Kuan Cheng Wu^{1,3}, Hannah Yun^{1,3}, Aaron Zeng², Maria Angela Franceschini³, Laura Lewis^{1,2}, Mitchell B. Robinson³; ¹*Research Laboratory of Electronics, Massachusetts Inst. of Technology, USA*; ²*Department of Electrical Engineering and Computer Science, Massachusetts Inst. of Technology, USA*; ³*Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, USA*; ⁴*Department of Biomedical Engineering, Boston Univ., USA*. We demonstrate simultaneous NIRS-fMRI-EEG acquisition during natural sleep in humans. NIRS successfully captured cerebral blood volume (CBV) oscillations alongside cerebrospinal fluid (CSF) flow, establishing a methodological foundation for studying brain fluid clearance mechanisms.

BS5A.3 • 18:30

Brain Oxygenation Under Microgravity and High G Forces, Stanislaw Wojtkiewicz¹, Michal Kacprzak¹, Krzysztof Kowalczyk², Dariusz Rekawik², Adam Liebert¹, Piotr Sawosz¹; ¹*Nalecz Inst. of Biocybernetics and Biomedical Engineering, Poland*; ²*The Military Inst. of Aviation Medicine, Poland*. Pocket-size cwNIRS device for real-time monitoring of cerebral oxygenation under aviation-relevant acceleration is presented. In a centrifuge, microgravity and +9G protocols revealed expected haemodynamic shifts. Compact NIRS systems can support pilot safety by indicating physiological state.

BS5A.4 • 18:45

Hemodynamic Correlates of Adaptive Motor-Cognitive Interference: an FNIRS Study of the Prefrontal Cortex, Mrinmoy Sarker Turja¹, Mary Pyfrom¹, Sean Aleman¹, Tristan Valenzuela¹, Shovan Shakya¹, Supraja Anand¹, Ashwin B. Parthasarathy¹; ¹*Univ. of South Florida, USA*. Prefrontal hemodynamics were investigated using a flexible fNIRS device during an adaptive ball-tracking game under single and dual-task conditions. Significant dissociations in HbO and HbT were revealed across difficulty levels, highlighting specific metabolic costs of cognitive interference.

BS5A.5 • 19:00

NeuroCaptain 2.0: Integrated Open-Source FNIRS Head-Gear Design Platform With Optode Visualization and Analysis in Blender, Ashlyn McCann¹, Qianqian

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Fang¹; ¹*Northeastern Univ., USA*. We extend our published NeuroCaptain platform and build an automated pipeline to map 2D optode layout to the curved head surface and produce 3D printable head-caps for neuroimaging studies, enabling streamlined headgear design, fabrication, and modeling in the interactive Blender environment.

17:45 -- 19:15

Room: Bonnet

MS5B • Non-Linear Microscopy

Presider: Shwetadwip Chowdhury; Univ. of Texas at Austin, USA

MS5B.1 • 17:45 (Invited)

AI-Augmented Optical Microscopy for Enhanced Biomedical Imaging, Fei Xia^{1,2}; ¹*Electrical Engineering and Computer Science, Univ. of California, Irvine, USA*; ²*Beckman Laser Inst. and Medical Clinic, Univ. of California, Irvine, USA*.

In this talk, we will first discuss the fundamental hardware limits of optical microscopy, then introduce our AI framework that improves speed–resolution trade-offs, along with generalizable AI models for enhanced microscopy tasks.

MS5B.2 • 18:15

Label-Free Multimodal Nonlinear Microscopy Combining Vibrational and Multiphoton Contrast for Chemical and Structural Imaging, Alejandro De La Cadena¹, Edita

Aksamitiene¹, Stephen A. Boppart¹; ¹*Univ of Illinois at Urbana-Champaign, USA*. Nonlinear label-free microscopy derives contrast from the intrinsic spectroscopic characteristics of specimens. Clinical nonlinear microscopes implement either multiphoton or vibrational contrast, severely limiting analytical capabilities. We present a strategy for coregistering both contrasts.

MS5B.3 • 18:30

Metabolic Imaging of Living Tissues Using Endogenous Autofluorescence Under Single- and Multi-Photon Excitation, Kunzan Liu¹, Sixian You¹; ¹*Massachusetts Inst. of Technology, USA*. We present a comparative analysis of metabolic imaging using NAD(P)H and FAD autofluorescence, benchmarking single- versus multi-photon excitation in depth penetration, imaging speed, and phototoxicity.

MS5B.4 • 18:45

Simulation-Guided Spectral Engineering Enables Three-Color Multiplexed Two-Photon Brain Imaging, Marvin Edelmann^{1,2}, Andreu Matamoros-Angles³, Mohsin Shafiq³, Mikhail Pergament¹, Franz Kärtner^{1,2}, Markus Glatzel³; ¹*Center for Free-Electron Laser Science CFEL, Deutsches Elektronen-Synchrotron DESY, Germany*; ²*Department of Physics, Universität Hamburg, Germany*; ³*Inst. of Neuropathology, Univ. Medical Center Hamburg-Eppendorf (UKE), Germany*. Deterministic spectral engineering in a photonic crystal fiber enables a compact multicolor two-photon microscopy platform that delivers energetic sub-115 fs pulses across the green-to-far-red window for efficient three-color imaging of multi-labeled mouse brain tissue.

MS5B.5 • 19:00

Using Mueller-Matrix Polarimetry to Improve Second Harmonic Microscopy Images of Collagen-Based Ocular Tissues, Juan M. Bueno¹, Rosa M. Martinez-Ojeda¹, Francisco J.

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Avila²; ¹Universidad de Murcia, Spain; ²Universidad de Zaragoza, Spain. A polarization-sensitive second harmonic generation (PS-SHG) microscope has been used to improve SHG images from collagen-based ocular tissues. From the elements of the corresponding Mueller matrix the best images were constructed and compared to the original ones.

17:45 -- 19:15

Room: Las Olas I, II, V, VI

CS4C • Ophthalmic OCT II and Novel Techniques

Presider: Yoshiaki Yasuno; Univ. of Tsukuba, Japan

CS4C.1 • 17:45 (Invited)

OCT in a Pill: Toward Wireless Capsule Optical Coherence Tomography Imaging, Milana Kendrisic^{1,3}, Hinnerk Schulz-Hildebrandt^{1,3}, Lindsay Ambrosino^{1,2}, Pavel Hernandez Mendoza^{1,2}, Guillermo J. Tearney^{1,3}; ¹Wellman Center for Photomedicine, USA; ²Massachusetts General Hospital, USA; ³Harvard Medical School, USA. We describe the development of a wireless capsule optical coherence tomography system, addressing constraints in size, power, synchronization, and data extraction while demonstrating imaging performance and discussing next steps toward practical untethered clinical use.

CS4C.2 • 18:15

Impact of Ocular Dynamics on Phase-Sensitive OCT: Modeling, Phantom Validation, and in Vivo Demonstration, Daniel Ruminiski⁴, Bernhard Baumann³, Karol Karnowski^{1,2}, Ireneusz Grulkowski⁴; ¹International Centre for Translational Eye Research, Poland; ²Inst. of Physical Chemistry, Polish Academy of Sciences, Poland; ³Inst. of Biomedical Physics, Medical Univ. of Innsbruck, Austria; ⁴Inst. of Physics, Nicolaus Copernicus Univ., Poland. We model how distinct eye motions and deformations generate characteristic signatures in phase-sensitive OCT. Simulations, phantom experiments, and in vivo imaging reveal motion-specific phase patterns, supporting improved interpretation of phase-resolved measurements in dynamic ocular conditions.

CS4C.3 • 18:30

Towards Optical Coherence Tomography Angiography-Based Assessment of Cutaneous Nerve Response, Lydia Haggard¹, Stine Kjeldbjerg², Trine Andresen², Christian Stevns Hansen³, Páll Karlsson⁴, Johan Røikjer^{5,2}, Lars Arendt-Nielsen^{5,2}, Carsten Dahl Mørch², Peter Andersen¹, Gavrielle Untracht¹; ¹Danmarks Tekniske Universitet, Denmark; ²Aalborg Univ., Denmark; ³Steno Diabetes Center Copenhagen, Denmark; ⁴Aarhus, Denmark; ⁵Steno Diabetes Center North, Denmark. Neuropathy is a severe complication of diabetes that is difficult to diagnose at an early stage. Optical coherence tomography angiography may provide an indirect measurement of assessing nerve function.

CS4C.4 • 18:45 (Invited)

Label-Free, Layer-Specific Imaging of Retinal Function Using Phase-Based Optoretinography, Tong Ling^{1,2}; ¹Nanyang Technological Univ., Singapore; ²Singapore Eye Research Inst., Singapore. Multilayered optoretinography based on phase-resolved optical coherence tomography (OCT) with subpixel motion correction enables non-invasive and sensitive mapping of visual responses in photoreceptors, the retinal pigment epithelium, and the

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subretinal space.

17:45 -- 19:15

Room: Las Olas IV

OS5D • Deep Optics: Challenges and Perspectives

Presider: Bin Deng; Massachusetts General Hospital, USA

OS5D.1 • 17:45 (Invited)

Engineering Hierarchical Phantoms for Multimodal Biomedical Imaging, Lucia Cavigli¹; ¹*CNR-IFAC, Italy*. Multimodal imaging and optical treatments face ethical and financial limits due to animal use. A hierarchical phantom manufacturing approach replicates features like lung porosity and skin tones, enabling cost-effective validation of imaging technologies and AI development.

OS5D.2 • 18:15

Impact of Skin Color on Peripheral Hemodynamic Changes in Response to Cold Provocation, Shivam Shukla¹, Aasma Dahal¹, Karla Vasquez¹, Aaron Teijeiro¹, Anuradha Godavarty¹; ¹*Florida International Univ., USA*. Dynamic NIRS imaging captured changes occurring in microvascular hemodynamics in response to cold provocation across subjects of varying skin colors, although the extent of hemodynamic change in oxygen saturation reduced in darker skin-colored subjects.

OS5D.3 • 18:30

Wearable Monitor for the Assessment of Tissue Water Fraction as a Marker of Edema Development, Shakeeb Habash¹, Marco Renna¹, Ailis Muldoon¹, Mitchell B. Robinson¹, Nikola Otic¹, Kuan Cheng Wu¹, Maria Angela Franceschini¹, Stefan Carp¹; ¹*Massachusetts General Hospital, USA*. Non-invasive NIRS monitoring holds the potential for reducing hospital readmission in cardiac-failure patients. We demonstrate validation measurements for a 9-wavelength LED-based device in healthy subjects. © 2025 The Authors

OS5D.4 • 18:45

Real-Time Multispectral Diffuse Optical Tomography for Simultaneous Multi-Joint Imaging in Lupus Arthritis, Lara Pinar¹, Stephen Kim¹, Andreas Hielscher¹, Moegammad A. Bardi¹; ¹*Biomedical Engineering, New York Univ., USA*. We present a real-time image reconstruction method for Diffuse Optical Tomography utilizing the SENSOR algorithm. It enables 3D visualization of hemoglobin levels and offers objective assessment of inflammation in Systemic Lupus Erythematosus patient's finger joints.

OS5D.5 • 19:00

Breath-Resolved in-Vivo Time-of-Flight Monitoring of the Adult Thorax and Multi-Distance Bi-Layer Modelling for Accurate Respiratory Gas Quantification, Sri Rama Pranav Kumar Lanka^{1,2}, Alberto Dalla Mora², Sanathana Konugolu Venkata Sekar¹, Stefan Andersson-Engels¹, Paola Taroni², Antonio Pifferi²; ¹*BioPhotonics, Tyndall National Inst., Ireland*; ²*Physics, Politecnico di Milano, Italy*. Breath-resolved, in-vivo multi distance time of flight measurements on human thorax using an SNSPD and to recover bi-layer (superficial

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thoracic and deep lung) optical properties. Synchronized biofeedback enables tracking lung properties and gas-volume variations across the breathing cycle

17:45 -- 19:15

Room: Rio Vista

TS5E • Hardware & Computational Modeling

Presider: Michele Lacerenza; PIONIRS srl, Italy

TS5E.1 • 17:45

Low Cost LiDARs for Wearable Biomedical Applications, Suraj Kumar Kothuri¹, Keela Hughes¹, Sri Rama Pranav Kumar Lanka¹, Chong Yong Shaun³, Suvam Kumar Barik¹, Lingaraju Isukapalli¹, Claudia Nunzia Guadagno², Stefan Andersson-Engels¹, Sanathana Konugolu Venkata Sekar^{1,2}; ¹*Tyndall National Inst., Ireland*; ²*BioPixS Ltd, Ireland*; ³*Univ. of Galway, Ireland*. We present for the first time, a low-cost wearable LiDAR module for wearable biomedical applications. Module's performance was assessed using MEDPHOT protocol and *In vivo* measurements were performed on human arm to track tissue oxygenation changes.

TS5E.2 • 18:00

Compact Optical System for Non-Invasive Assessment of Blood Flow and Oxygenation Through Combined Speckle Contrast and Spatially Resolved Spectroscopy, Andres Quiroga², Nikhitha Mule¹, Manish Verma², Mirko Fornasier², William Little³, Margherita Tabet¹, David R. Busch^{1,4}, Turgut Durduran^{2,5}; ¹*Anesthesiology and Pain Management, Univ. of Texas Southwestern Medical Center, USA*; ²*ICFO – Institut de Ciències Fotòniques, The Barcelona Inst. of Science and Technology, Spain*; ³*Medical School, Univ. of Texas Southwestern Medical Center, USA*; ⁴*Neurology, Biomedical Engineering, Univ. of Texas Southwestern Medical Center, USA*; ⁵*Institucio Catalana de Recerca i Estudis Avancats (ICREA), Spain*. We present a compact, affordable optical device that combines speckle contrast and spatially resolved spectroscopy for non-invasive bedside assessment of tissue blood flow and oxygenation. Tests on healthy volunteers show its potential for point-of-care use.

TS5E.3 • 18:15

NMC: Lightweight and Power-Efficient Monte Carlo Algorithm for Photon Transport in Turbid Media, Alexander V. Doronin¹; ¹*Victoria Univ. of Wellington, New Zealand*. We introduce a lightweight, power-efficient Monte Carlo framework for photon transport in turbid media. Optimized for Apple processors with integrated AI acceleration, it delivers fast, accurate simulations for real-time or embedded biomedical applications.

TS5E.4 • 18:30

Implantable Acousto-Optic Photonic Integrated Circuits for Opto-Bio Applications, Amit Sangwan¹, Jack Guida², Siddharta Ghosh², Josep M. Jornet²; ¹*SUNY Polytechnic Inst., USA*; ²*Electrical and Computer Engineering, Northeastern Univ., USA*. We present the design of an integrated photonic circuit that leverages the acousto-optic effect to control the emitted beam and dynamically steer and focus light to single-cell resolution for optogenetics and optogenomics.

TS5E.5 • 18:45

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Detection of CSF Leakage in Lumbar Spine Surgery Using Thermography, Ana Cristina Ordaz López¹, Adrian Santana², Francisco J. González³, Jorge L. Flores¹; ¹*Electro-Photonics Engineering, Univ. of Guadalajara, Mexico*; ²*Neurosurgery, Hospital Civil de Guadalajara, Mexico*; ³*Physics, Univ. of Central Florida, USA*. Cerebrospinal fluid leakage after lumbar spine surgery is a clinically severe complication. We applied thermography to detect temperature anomalies near surgical scars; colder areas indicated fistulas. Thermography proved a non-invasive, reliable tool for early detection.

TS5E.6 • 19:00

Simple and Cost-Effective High-Power Fiber Based Cylindrical Diffuser for Tracheal Stenosis Modeling, Hongjae Jung¹, Jeon Seong², Donghan Jung¹, Eunji Jeong², Jisuk Choi², SeongKeun Kwon², Yoonchan Jeong^{1,3}; ¹*Department of Electrical and Computer Engineering, Seoul National Univ., South Korea*; ²*Biomedical Research Inst., Seoul National Univ. Hospital, South Korea*; ³*ISRC & BK21Four, South Korea*. We present a simple and cost-effective fiber based cylindrical diffuser composed of a optical fiber inserted into a fused-silica capillary filled with glass beads. This structure enables efficient cylindrical light diffusion while providing strong mechanical robustness and high-power compatibility.

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Monday, 27 April

08:00 -- 10:00

Room: Las Olas III

BM1A • Clinical Applications II

Presider: Rodrigo Forti; Children's Hospital of Philadelphia, USA

BM1A.1 • 08:00 (Invited)

Depth-Enhanced Diffuse Optical Brain Monitoring: Technologies and Clinical

Applications, Mitchell B. Robinson¹; ¹*Massachusetts General Hospital, USA*. Diffuse optical methods are increasingly used to investigate cerebral hemodynamics, though are intrinsically more sensitive to superficial tissue signals. This presentation will detail recent work toward improving the depth specificity and cerebral sensitivity of these methods.

BM1A.2 • 08:30

Quantification of Cerebral Autoregulation in Neonates Undergoing the Norwood

Procedure, Nicolina Ranieri^{1,2}, Rodrigo M. Forti¹, Tiffany Ko¹, Alyssa Seeney¹, Caitlyn Davis^{1,3}, Darci Anderson¹, Briston Bayle¹, Alexis Schulz¹, Heer Patel¹, Manal Mirreh¹, Asif Padiyath¹, Lea Matthews¹, Todd Kilbaugh¹, Muhammad Nuri¹, J. William Gaynor¹, Kurtulus Izzetoglu², Wesley Baker^{1,3}, Susan Nicolson¹, Jennifer Lynch^{1,3}; ¹*Children's Hospital of Philadelphia, USA*; ²*School of Biomedical Engineering, Science and Health Systems, Drexel Univ., USA*; ³*Bioengineering, School of Engineering and Applied Science, Univ. of Pennsylvania, USA*. Diffuse correlation spectroscopy can quantify cerebral blood flow and assess autoregulation during neonatal cardiac surgery. After aortic arch reconstruction, impaired autoregulation was more likely among neonates undergoing deep hypothermic circulatory arrest than selective cerebral perfusion.

BM1A.3 • 08:45

Long-Term Continuous Monitoring of Aneurysmal Subarachnoid Hemorrhage Using

Diffuse Correlation Spectroscopy, Ailis Muldoon¹, Mitchell B. Robinson^{1,2}, Shakeeb Habash¹, John Sunwoo^{1,2}, Andrew Webb³, Eric Rosenthal^{3,2}, Maria Angela Franceschini^{1,2}, David Y. Chung^{3,2}, Stefan Carp^{1,2}; ¹*Martinos Center for Biomedical Imaging, Massachusetts General Hospital, USA*; ²*Harvard Medical School, USA*; ³*Division of Neurocritical Care, Massachusetts General Hospital, USA*. We present data from long-term continuous optical monitoring of patients with SAH. We show, that systemic blood pressure is not a suitable surrogate marker for brain blood flow and that CrCP shows agreement with ICP.

BM1A.4 • 09:00

Determining Survival in Preclinical Model of Uncontrolled Hemorrhage Using DCS and

NIRS Cerebral Measures, Danielle S. Shoshany², Patricia A. Shewokis^{3,2}, Shirel Shtraikh¹, Dean Nachman^{1,4}, Kurtulus Izzetoglu²; ¹*Faculty of Medicine, Inst. for Research in Military Medicine, The Hebrew Univ., Israel*; ²*School of Biomedical Engineering, Science and Health Systems, Drexel Univ., USA*; ³*College of Nursing and Health Professions, Drexel Univ., USA*; ⁴*The Heart Inst., Hadassah Medical Center, and the Faculty of Medicine, The Hebrew Univ., Israel*. This study investigates cerebral perfusion and oxygenation responses, measured via DCS and NIRS, in a preclinical swine model of uncontrolled hemorrhage. These findings

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suggest DCS biomarkers can distinguish between those who survive from premature death.

BM1A.5 • 09:15

Feasibility of Diffuse Correlation Spectroscopy as a Cerebral Blood Flow Monitor in Mobile Stroke Units, Shakeeb Habash¹, Saqib Shaikh³, Noah Ortiz³, Rowan Sankar³, Andre Taylor³, Sean Savitz⁴, Israel Alba³, Carla Escobar⁵, Yazan Alderazi⁶, Xn Yang³, Christopher Favilla⁷, Paisith Piriawat³, Salvador Cruz-Flores³, Gustavo J Rodriguez³, Alberto Maud³, Faheem Sheriff², Stefan Carp¹; ¹*Massachusetts General Hospital, USA*; ²*Corpus Christi Medical Center, USA*; ³*Texas Tech Univ. Health Sciences Center of El Paso, USA*; ⁴*UT Houston, USA*; ⁵*Univ. Medical Center of El Paso, USA*; ⁶*HCA Healthcare Houston, USA*; ⁷*Univ. of Pennsylvania, USA*. Diffuse Correlation Spectroscopy holds the potential for continuous non-invasive pre-hospital emergency blood flow monitoring. We demonstrate the feasibility of monitoring cerebral blood flow changes during motion in a mobile stroke unit on healthy volunteers.

BM1A.6 • 09:30 (Invited)

Light Treatment of Alzheimer's Disease, Xunbin Wei¹; ¹*Peking Univ., China*. Abstract not available.

08:00 -- 10:00

Room: Bonnet

MM1B • Advances in Clinical Microscopy

Presider: Mihaela Balu; UC Irvine Beckman Laser Inst., USA

MM1B.1 • 08:00 (Invited)

Exploring Reflectance Confocal Microscopy in the Assessment and Management of Chemotherapy-Induced Peripheral Neuropathy: a Clinical/Translational Approach, Sabrina Ramnarine^{1,2}; ¹*Guy's & St Thomas' NHS Foundation Trust, UK*; ²*King's College London, UK*. Chemotherapy-induced peripheral neuropathy (CIPN) is a challenging side effect of cancer treatment with significant acute and long-term sequelae. This presentation will explore the clinical utility of non-invasive reflectance confocal microscopy (RCM) imaging in CIPN and implications for practice.

MM1B.2 • 08:30

In Vivo Imaging of Oral Cancer at a Tertiary Cancer Hospital in India, Aditi Sahu¹, Amanjot Kaur², Isha Shinde², Prachi Terwadkar², Pratik Chandrani², Kivanc Kose¹, Pankaj Chaturvedi², Arjun Singh², Milind Rajadhyaksha¹; ¹*Memorial Sloan Kettering Cancer Center, USA*; ²*Tata Memorial Center, India*. In vivo imaging can address challenges associated with oral cancer diagnosis. We demonstrate role of reflectance confocal microscopy (RCM) in identifying features associated with normal, premalignant and cancers with high accuracy for screening and diagnosis.

MM1B.3 • 08:45

Reflectance Confocal Videomicroscopy Reveals Increased Leukocyte-Endothelial Interactions in Skin Microvasculature of Patients With Sepsis, Inga Saknite^{1,2}, Chooi Ying Sim³, X-Zavyer Smith², Dhruv Patel², Michael Pogharian², Evan Wolfe², Karina Korenika¹, Eric

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R. Tkaczyk², Julie A. Bastarache³; ¹*Univ. of Latvia, Latvia*; ²*Dermatology, Vanderbilt Univ. Medical Center, USA*; ³*Medicine, Vanderbilt Univ. Medical Center, USA*. Reflectance confocal videomicroscopy enabled noninvasive evaluation of leukocyte-endothelial interactions in the skin microvasculature at the bedside. Patients with sepsis (N=10) had higher adherent and rolling leukocyte counts than non-septic patients in the intensive care (N=8).

MM1B.4 • 09:00

PANORAMA-Enabled Liquid Biopsy for Breast Cancer Screening via Small Extracellular Vesicle Counting in Plasma, Abhay Kotnala¹, Sakib Mahmud¹, Omid Mohsen Daraei¹, Saswat Mohapatra¹, Wei-Chuan Shih¹; ¹*Department of Electrical and Computer Engineering, Univ. of Houston, USA*. We present a nanophotonic assay for high-throughput, label-free digital counting of small extracellular vesicles in plasma. Automated image analysis quantifies captured vesicles and distinguishes breast cancer from healthy controls, enabling scalable liquid-biopsy screening on microscopes.

MM1B.5 • 09:15 (Invited)

In Vivo Three-Photon Microscopy in Long Bones and Lymphoid Organs, With Connections to Mechanical Load and Resulting Mechanosensing in Immune Cells, Raluca A. Niesner¹; ¹*Freie Universität Berlin, Germany*. Abstract not available.

MM1B.6 • 09:45

Multiphoton Imaging and Correlated Spatial Transcriptomics in a Non-Interventional Clinical Study of Atopic Dermatitis, Conor L. Evans¹; ¹*Massachusetts General Hospital, USA*. Non-invasive microscopy has the potential to improve topical drug development. We employed multiphoton and confocal reflectance microscopies in healthy, atopic dermatitis, psoriasis, and vitiligo patients. Analyses show strong correlation of image-based metrics with gene expression.

08:00 -- 10:00

Room: Las Olas I, II, V, VI

CM1C • Biomechanics

Presider: Yue Zhu; Nanjing Univ of Science and Technology, China

CM1C.1 • 08:00 (Invited)

A Tale of Force and Light Part I: Development of a Multimodal Polarisation-Sensitive OCT and Raman Spectroscopy Mechanical Testing Platform for Cartilage

Characterisation, Darven Murali Tharan^{1,2}, Cushla McGoverin^{1,2}, Marco Bonesi^{1,2}, Daniel Everett^{3,2}, Sue McGlashan⁴, Ashvin Thambyah³, Frederique Vanholsbeeck^{1,2}; ¹*Department of Physics, The Univ. of Auckland, New Zealand*; ²*Dodd-Walls Centre for Photonic and Quantum Technologies, New Zealand*; ³*Department of Chemical and Materials Engineering, The Univ. of Auckland, New Zealand*; ⁴*Department of Anatomy and Medical Imaging, The Univ. of Auckland, New Zealand*. We present a non-destructive tissue dynamics testing platform combining Polarisation-Sensitive Optical Coherence Tomography, Raman spectroscopy, and mechanical compression to study cartilage under load and identify new biomechanical and biochemical biomarkers for early osteoarthritis detection.

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CM1C.2 • 08:30

Non-Destructive Assessment of Corneal Biomechanics in a Porcine Model of Keratoconus Using Optical Coherence Elastography, Sharon Shajan¹, Manmohan Singh¹, Salavat Aglyamov¹, Kirill Larin^{1,2}; ¹*Univ. of Houston, USA*; ²*Baylor College of Medicine, USA*. An enzyme-mediated approach degenerated collagen fibers in the cornea to induce keratoconus-like ectasia, and the corneal elasticity was quantified using wave-based optical coherence elastography and structure assessed by second harmonic generation imaging.

CM1C.3 • 08:45

Tracking Stiffness-Dependent Vascular Remodeling in Hydrogel-Treated Mice Wounds Using Quantified Speckle Variance Optical Coherence Tomography (qSV-OCT), Sohini Sarkar¹, Jiyeon Song², Makenzie Bushold², Michael S. Eggleston¹, Sharon Gerecht², Shreyas Shah¹; ¹*Nokia Bell Labs, USA*; ²*Duke Univ., USA*. We applied qSV-OCT to quantify vascular remodeling in hydrogel-treated mice wounds. Stiff gels supported stable vascular activity, while soft gels showed transient responses, demonstrating the potential of our non-invasive method to monitor and guide treatments.

CM1C.4 • 09:00

Functional Characterization of Cardiac Organoids Using Optical Coherence Tomography, Kechao B. Lu¹, Erin C. O’Kane¹, Wan Wang¹, Lauren Parker², Ravi Karra², Robert E. Highland III¹, David A. Miller¹, Adam Wax¹; ¹*Biomedical Engineering, Duke Univ., USA*; ²*Medicine, Duke Univ., USA*. We introduce OCT methods to characterize beating cardiac organoids, combining 4D synchronization and segmentation for chamber deformation analysis with spectroscopic OCT to map cell-type distribution and maturation influencing contractile behavior.

CM1C.5 • 09:15

Quantifying Postmortem Interval Effects on Myelin Integrity Using Polarization-Sensitive Optical Coherence Tomography and Birefringence Microscopy, Anna Novoseltseva¹, Rhiannon Robinson¹, Peter Niziolek¹, Ting Xie¹, Ankita Tiwari¹, Douglas Rosene¹, Irving Bigio¹; ¹*Boston Univ., USA*. The postmortem interval between patient death and tissue fixation unavoidably confounds human brain neuropathology studies. Birefringence microscopy validates PMI-induced myelin degradation, explaining the decreased relative retardance and increased scattering coefficient measured by PS-OCT

CM1C.6 • 09:30 (Invited)

Shear Wave Elastography Through a Helically-Scanned Catheter Using Asynchronous Optical Coherence Elastography, Ginger Schmidt^{1,2}, Eric Zou^{3,1}, Brett E. Bouma^{1,2}, Néstor Uribe-Patarroyo^{1,2}; ¹*Wellman Center for Photomedicine, USA*; ²*Health Sciences and Technology, Massachusetts Inst. of Technology, USA*; ³*Department of Electrical Engineering and Computer Science, Massachusetts Inst. of Technology, USA*. Traditional optical coherence elastography methods require phase-locked acquisitions, incompatible with catheters. Asynchronous optical coherence elastography retrieves shear waves from continuously scanned B-scans, enabling measurements through a clinically approved catheter for the first time.

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08:00 -- 10:00

Room: Las Olas IV

OM1D • Advances in Deep Optics II

Presider: Mark Niedre; Northeastern Univ., USA

OM1D.1 • 08:00 (Invited)

Advancing Optical Imaging With Akinetic Wavelength-Tuning, Hwidon Lee¹; ¹*Pusan National Univ., South Korea*. We present advances in optical imaging enabled by all-electronically controlled akinetic wavelength-tuning light sources, highlighting their impact on high-speed OCT and multi-spectral PAM. These sources provide improved stability, flexibility, and multimodal performance across diverse imaging applications.

OM1D.2 • 08:30 (Invited)

CMOS Integrated Circuits With Single-Photon Avalanche Diode (SPAD) Arrays for Time-Domain Diffuse Optics and Raman Spectroscopy, Jan Nissinen¹, Marko Pakaslahti¹, Markku Raappana¹, Jaakko Huikari¹, Tuomo Talala¹, Ilkka Nissinen¹; ¹*Circuits and Systems Research Unit, Univ. of Oulu, Finland*. SPAD arrays, multichannel time-to-digital converters and laser diode drivers fabricated in CMOS integrated circuit technologies are presented to pave the way to fabricate portable and wearable devices for time-domain diffuse optics and Raman spectroscopy applications.

OM1D.3 • 09:00

Parallel and High-Throughput Acquisition for Time-Domain Diffuse Optical Spectroscopy, Nicola Serra¹, Giulia Maffei¹, Elisabetta Avanzi¹, Alessandro Bossi¹, Valerio Gandolfi¹, Xinqiu Ye¹, Andrea Farina², Cosimo D'Andrea¹, Laura Di Sieno¹, Paola Taroni^{1,2}, Antonio Pifferi^{1,2}, Alberto Dalla Mora¹; ¹*Dipartimento di Fisica, Politecnico di Milano, Italy*; ²*Istituto di Fotonica e Nanotecnologie, Consiglio Nazionale delle Ricerche, Italy*. A novel time-domain diffuse optical system based on a 16-channel SiPM detector array and capable of fast, simultaneous spectral measurements in the range 700–950 nm was developed, characterized on phantoms and tested *in vivo*.

OM1D.4 • 09:15

Six-Wavelength Frequency-Domain Optical Tomography for Breast Cancer Diagnosis, Miguel Adrian Mireles Nunez¹, Bernhard Zimmermann², Shakeeb Habash¹, Stefan Carp¹, Bin Deng¹; ¹*Athinoula A. Martinos Center For Biomedical Imaging, Massachusetts General Hospital Harvard Medical School, USA*; ²*Department of Biomedical Engineering, Neurophotonics Center, Boston Univ., USA*. We describe the design of the third-generation optical mammography system, which integrates three-frequency demodulation and time-multiplexed illumination to achieve rapid data acquisition across a broader range of six near-infrared wavelengths for breast cancer diagnosis.

OM1D.5 • 09:30

Compact FPGA-Based Software Correlator for Real-Time Blood Flow Measurement With Diffuse Correlation Spectroscopy, Vinh-Khanh Mai¹, Vishnu Kumar Raghu¹, Tristan Valenzuela¹, Ashwin B. Parthasarathy¹; ¹*Univ. of South Florida, USA*. We present a compact Diffuse Correlation Spectroscopy system using 1-bit counters sampled at 10 MHz implemented

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on a Field Programmable Gate Array (FPGA) for real-time blood flow measurement over 16 measurement channels.

OM1D.6 • 09:45

PROMETEUS: Hybrid TD-NIRS and SCOS Instrument for Monitoring Brain Tissue Oxygenation and Blood Perfusion in Preterm Neonates, Fabio Negretti¹, Caterina Amendola¹, Sabrina Brigadoi³, Mauro Buttafava⁴, Robert Cooper⁵, Chiara Dalla Man³, Turgut Durduran⁶, Flora Faure⁵, Mirko Fornasier⁶, Alfonso Galderisi⁷, Michele Lacerenza⁴, Hadija Marchiori³, Alberto Scarpa⁸, Lorenzo Spinelli⁹, Alessandro Torricelli¹, Davide Contini^{1,2}; ¹*Politecnico di Milano, Italy*; ²*IRCCS Fondazione Ca' Granda Policlinico Milano, Italy*; ³*Univ. of Padua, Italy*; ⁴*PIONIRS srl, Italy*; ⁵*Univ. College London, UK*; ⁶*ICFO, Spain*; ⁷*Yale Univ., USA*; ⁸*Dave srl, Italy*; ⁹*IFN-CNR, Italy*. The Prometheus project seeks to enable personalized nutritional strategies for preterm infants by integrating a hybrid diffuse optics system with metabolic modeling. In this work, we introduce the optical platform developed to monitor cerebral tissue oxygenation and blood perfusion.

08:00 -- 10:00

Room: Rio Vista

TM1E • Advanced Microscopy & Flow Cytometry

Presider: Alex Walsh; Texas A&M Univ., USA

TM1E.1 • 08:00 (Invited)

Multimodal SO-FFOCT for in Vivo Diagnostic, Julie Blon¹, Emmanuel Martins Seromenho¹, Maud Legrand¹, Sybille Facca¹, Amir Nahas¹; ¹*Strasbourg Univ., France*. Full Field OCT enables 3D microscopy in scattering media such as biological tissues. We propose a single-shot FF-OCT approach acquiring images from one interferogram, enabling in vivo imaging. We present SO-FFOCT and accessible contrasts: elastography, dynamic and photothermal.

TM1E.2 • 08:30

Label-Free Multimodal Multiphoton Imaging Enables Accurate Identification of Papillary Thyroid Carcinoma, Wesley Poon^{1,2}, Rucha Dave^{1,3}, Reid Master^{1,3}, Rania Uzma^{1,4}, Ashok Veeraraghavan⁴, Hong Zhao¹, Helmi Khadra⁵, Elizabeth Jacobi⁶, Raksha Raghunathan¹, Stephen Wong^{1,2}; ¹*Department of Systems Medicine and Bioengineering, Houston Methodist Neal Cancer Center, USA*; ²*College of Medicine, Texas A&M Health Science Center, USA*; ³*School of Engineering Medicine, Texas A&M Univ., USA*; ⁴*Department of Electrical and Computer Engineering, Rice Univ., USA*; ⁵*Department of Surgery, Houston Methodist Hospital, USA*; ⁶*Department of Pathology & Genomic Medicine, Houston Methodist Hospital, USA*. Needle biopsy of suspicious thyroid nodules often causes diagnostic delays and misdiagnosis. We develop a comprehensive, multimodal, label-free multiphoton imaging framework to capture structural, metabolic, and lipidomic deviations distinguishing normal thyroid from papillary thyroid carcinoma.

TM1E.3 • 08:45

NIR-SWIR Light-Sheet Mesoscopy for 3D Drug Biodistribution and Target Engagement Mapping, Luis M. Chavez¹, Ismail Erbas¹, Isaiah Crosbourne², Saif Ragab¹, Vikas Pandey¹,

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Claudio Bruschini³, Edoardo Charbon³, Margarida Barroso², Xavier Intes¹; ¹*Rensselaer Polytechnic Inst., USA*; ²*Albany Medical College, USA*; ³*Ecole Polytechnique Fédérale de Lausanne, Switzerland*. We report on the application of a NIR-SWIR light-sheet mesoscope for 3D mapping of drug biodistribution and fluorescence lifetime in mesoscale breast cancer tumor models. Our results demonstrate our system's potential for enabling quantitative drug delivery assessments at the whole tumor level.

TM1E.4 • 09:00

Surface-Specific Mesoscopic Fluorescence Imaging via High-Spatial Frequency Structured Illumination, Saif Ragab¹, Nanxue Yuan¹, Navid Nizam², Luis Chavez¹, Vikas Pandey¹, Xavier Intes¹; ¹*Rensselaer Polytechnic Inst., USA*; ²*Biomedical Engineering, West Chester Univ., USA*. We present high-spatial-frequency structured illumination to extract surface specific contrast in mesoscopic fluorescence imaging, validated by Monte Carlo simulations and experimental conditions through m2M system with a 10-fold improvement in SBR

TM1E.5 • 09:15

Autofluorescence Lifetime Flow Cytometry for Single-Cell Metabolic Profiling of Patient T Cell Quality, Meghana Kalluri¹, Kayvan Samimi², Ojaswi Pasacche¹, Caitlyn Fardy¹, Wenxuan Zhao², Dan Pham², Amani Gillette², Peiman Hematti³, Tyce Kearn³, Nirav Shah³, Melissa Skala^{1,2}; ¹*Univ. of Wisconsin Madison, USA*; ²*Morgridge Inst. for Research, USA*; ³*Medical College of Wisconsin, USA*. Autofluorescence lifetime flow cytometry of the endogenous metabolic co-factor NAD(P)H was used to assess metabolic heterogeneity in T cells from patients with various responses to chimeric antigen receptor (CAR) T cell therapy.

TM1E.6 • 09:30

Enabling Clinical Translation of Fluorescence Lifetime Imaging (FLI): Single-Shot FLI With a Dual-Gated Camera, Vikas Pandey¹, Ismail Erbas¹, Luis M. Chavez¹, Claudio Bruschini², Edoardo Charbon², Margarida Barroso⁴, Xavier Michalet³, Xavier Intes¹; ¹*Rensselaer Polytechnic Inst., USA*; ²*Ecole Polytechnique Federale de Lausanne (EPFL), Switzerland*; ³*Department of Chemistry, Univ. of California Los Angeles, USA*; ⁴*Albany Medical College, USA*. We introduce a single-shot fluorescence lifetime imaging method that provides real-time molecular contrast for fluorescence-guided surgery. By delivering rapid, high-fidelity lifetime contrast, it supports accurate tumor delineation and seamless integration into intraoperative clinical workflows.

TM1E.7 • 09:45

Diffuse Lifetime in Vivo Flow Cytometry for Detecting Circulating Leukemia Cells, Zijian Deng¹, Tao Chen¹, Xiao Xu¹, Krishna Sharmah Gautam¹, Nicole Blasi¹, Samuel Achilefu¹; ¹*UT Southwestern Medical Center at Dallas, USA*. We proposed novel diffuse lifetime in vivo flow cytometry to identify fluorophore-labeled leukemia cells from background fluorescence within deeply embedded major blood vessels. We employed fluorescence lifetime microscopy in tissue-mimicking phantoms to demonstrate this concept.

Room: 10:30 -- 12:00
Las Olas I, II, V, VI
JM2A • Joint Plenary II

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Presider: Jonathan Liu, Stanford University, USA

JM2A.1 • 10:30 (Plenary)

Holotomography for 3D Biology and Regenerative Medicine: From Fundamental Optics to Real-World Clinical Impact, YongKeun Park¹; ¹*Korea Advanced Inst of Science & Tech, South Korea*. Holotomography enables quantitative, label-free 3D imaging of living cells and tissues. I will present recent advances in 3D imaging platforms, virtual staining with AI and emerging clinical applications, spanning digital pathology, regenerative medicine, IVF and biomanufacturing.

JM2A.2 • 11:15 (Plenary)

Generative, and Agentic AI for Biomedicine, Faisal Mahmood¹; ¹*Harvard Univ., USA*. Generative and agentic AI are transforming biomedicine. In this talk we will present advances in computational pathology, weakly supervised whole-slide learning, multimodal biomarkers, foundation models, generative copilots, and 3D pathology, and the development of a multimodal temporal patient foundation model enabling retrieval, forecasting, and interpretable clinical decision support.

13:30 -- 15:30

Room: Las Olas III

BM3A • Hemodynamic Methods and Instrumentation

Presider: Joseph Majeski; Univ. of Pennsylvania, USA

BM3A.1 • 13:30 (Invited)

Speckle-Based Techniques for Mapping Mouse and Human Brain Dynamics, Xiaojun Cheng¹; ¹*Boston Univ., USA*. We demonstrate speckle-based techniques for monitoring brain dynamics, accessing blood flow and cellular dynamics in mice, and measuring cerebral blood flow in humans using a multi-channel speckle contrast optical spectroscopy (SCOS) system.

BM3A.2 • 14:00

Wearable NIRS-EEG for at-Home Glymphatic Monitoring During Sleep, Kuan Cheng Wu¹, Olivia S. Kierul¹, Larry Padilla¹, Marco Renna¹, Nikola Otic¹, Zachary Starkweather¹, Gayathri Vijayaraghavan¹, David Salat¹, Giorgio Bonmassar¹, Shadab A. Rahman^{2,3}, Maria Angela Franceschini¹, Mitchell B. Robinson¹; ¹*Athinoula A. Martinos Center for Biomedical Imaging, Mass General Hospital, USA*; ²*Department of Medicine, Brigham and Women's Hospital, USA*; ³*Division of Sleep Medicine, Harvard Medical School, USA*. Our new NIRS/EEG device, GS-FlexNIRS+, enables at-home glymphatic system monitoring. NIRS measures hemoglobin and water fraction changes by having long wavelength LEDs, while EEG allows for sleep staging, supporting continuous, naturalistic assessment of glymphatic activity.

BM3A.3 • 14:15

A Mobile Time-Resolved Laser Speckle Contrast Imaging (TR-LSCI) System for Cerebral Blood Flow Monitoring, Mubashir Hussain¹, Peiwen Zhang¹, Faraneh Fathi¹, Mehrana Mohtasebi², Dhinesh Rajasekaran², Faezeh Akbari¹, Fatemeh Hamedi¹, Lei Chen¹, Guoqiang Yu¹; ¹*Univ. of Kentucky, USA*; ²*Biophysics Technology LLC, USA*. A mobile TR-LSCI system was developed for continuous imaging of cerebral blood flow with high spatiotemporal resolution.

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The generated depth-sensitive flow maps were validated using head-simulating phantoms and in-vivo rodent models of carotid artery ligations.

BM3A.4 • 14:30

Measuring Cortical Hemodynamics of Healthy Adults During Hypercapnic Challenge With High-Density Diffuse Optical Tomography, Da Eun Jung¹, Sung Min Park¹, Kaitlyn Hersch¹, Igor Dedkov², Heather Roberts², Kristin Williams², Adam T. Eggebrecht¹; ¹*Mallinckordt Inst. of Radiology, School of Medicine, Washington Univ. in St. Louis, USA*; ²*Department of Neurology, School of Medicine, Washington Univ. in St. Louis, USA*. We measured cortical hemodynamics of healthy adults during hypercapnic challenge using an HD-DOT system and RespirAct device. We observed differences in superficial and cortical hemodynamics across spatial and temporal dimensions.

BM3A.5 • 14:45

A Multiphase Time-Stamped Photon-Counting Approach to Sensitivity Enhancement in FD-NIRS Under Low-Light Conditions, Dongyuan Liu¹, Hongming Wang¹, Xiaomeng Wang¹, Limin Zhang¹, Feng Gao¹; ¹*Tianjin Univ., China*. This study presents a multiphase time-stamped photon-counting technique that breaks through the shot-noise limit, improving the phase sensitivity and stability of FD-NIRS and offering a high-performance, portable solution for clinical applications like functional brain imaging.

BM3A.6 • 15:00

Cluster-Based Wavelet Transform Coherence Between Cerebral Oximetry and Mean Arterial Pressure to Detect Impaired Cerebral Autoregulation After Pediatric Cardiac Arrest, Priscilla Yu¹, Binita KC², Soheila Norasteh², David R. Busch¹, Lakshmi Raman¹, Hanli Liu²; ¹*Univ. of Texas Southwestern Medical, USA*; ²*Univ. of Texas Arlington, USA*. We present a novel method to detect impaired cerebral autoregulation using cluster-based wavelet transform coherence analysis in children after cardiac arrest. Children with early impaired cerebral autoregulation were more likely to have significant neuroimaging injury.

BM3A.7 • 15:15

Multi-Wavelength Time-of-Flight-Resolved Interferometric Speckle Contrast Optical Spectroscopy (Multi- λ TOF-ISCOS), Klaudia Nowacka-Pieszak^{1,2}, Marcin Marzejon^{1,2}, Dawid Borycki^{1,2}; ¹*Inst. of Physical Chemistry (ICPF), Poland*; ²*International Centre for Translational Eye Research, Poland*. We present multi-wavelength time-of-flight-resolved interferometric speckle contrast optical spectroscopy for simultaneous, depth-sensitive measurement of blood flow and tissue oxygenation. Using an ultrafast camera and tunable laser, we enable CMRO₂ estimation and demonstrate feasibility in vivo.

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13:30 -- 15:30

Room: Bonnet

MM3B • Computational Microscopy I

Presider: Yang Liu; Univ of Illinois at Urbana-Champaign, USA

MM3B.1 • 13:30 (Invited)

Applied Computational Pathology, Eric Yang¹; ¹*Pathology, Stanford Univ. School of Medicine, USA*. Applied computational pathology merges digital pathology and AI to enhance routine diagnostic practice. This presentation covers practical AI uses across pre-analytical, analytical, and post-analytical stages, and addresses deployment challenges: slide digitization, model compatibility, and trust.

MM3B.2 • 14:00 (Invited)

The AI Revolution in 3D Computational Pathology, Andrew Song¹; ¹*Harvard Medical School, USA*. Abstract not available.

MM3B.3 • 14:30

Diffusion Model-Enabled Virtual Staining of Label-Free Tissue in Imaging Mass Spectrometry, Yijie Zhang¹, Luzhe Huang¹, Nir Pillar¹, Yuzhu Li¹, Yuhang Li¹, Lukasz Migas², Raf Van de Plas², Jeffrey Spraggins³, Aydogan Ozcan¹; ¹*Univ. of California Los Angeles, USA*; ²*TU Delft, Netherlands*; ³*Vanderbilt Univ., USA*. We present diffusion model-based virtual staining that transforms label-free imaging mass spectrometry into high-resolution histology images. This technique eliminates physical tissue staining and enables multimodal IMS-to-microscopy image co-registration, accelerating molecular histology workflows.

MM3B.4 • 14:45

3D Histopathology Enabled by Label-Free Holotomography and Deep Learning, Juyeon Park¹, Su-Jin Shin², Geon Kim¹, Hyungjoo Cho³, Dongmin Ryu³, Daewoong Ahn³, Ji Eun Heo⁴, Jean R. Clemenceau⁵, Isabel Barnfather⁵, Minji Kim⁵, Inyeop Jang⁵, Ji-Youn Song⁵, Jeong Hwan Park⁵, Hyun-seok Min³, Kwang Suk Lee², Nam Hoon Cho⁶, Tae Hyun Hwang⁵, YongKeun Park¹; ¹*Korea Advanced Inst of Science & Tech, South Korea*; ²*Gangnam Severance Hospital, South Korea*; ³*Tomocube Inc., South Korea*; ⁴*Yonsei Univ. College of Medicine, South Korea*; ⁵*Mayo Clinic, USA*. We present a holotomography-based 3D virtual H&E staining framework that converts label-free refractive-index volumes of thick cancer tissues into high-fidelity 3D histopathology, enabling subcellular microanatomical visualization beyond the limits of conventional sectioning and staining.

MM3B.5 • 15:00

Physics-Conditioned FiLM-UNet for Fast Volumetric Light-Field Reconstruction, Zhi Ling¹, Xuanwen Hua¹, Shu Jia¹; ¹*Georgia Inst. of Technology, USA*. We present a physics-conditioned, self-supervised deep learning network for Fourier light-field microscopy reconstruction, achieving robust performance across varying experimental conditions and outperforming conventional networks trained with a single PSF in accuracy and generalization.

MM3B.6 • 15:15

System- and Sample-Agnostic Isotropic 3D Microscopy by Weakly Physics-Informed, Domain-Shift-Resistant Axial Deblurring, Jiashu Han¹, Kunzan Liu¹, Keith Isaacson¹, Kristina

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Monakhova¹, Linda G. Griffith¹, Sixian You¹; ¹MIT, USA. We introduce SSAI-3D, a framework for robust isotropic 3D imaging, leveraging sample-informed self-supervised dataset and sparse fine-tuning of large pre-trained network, validated on diverse data from heterogeneous tissues with unknown blurring and noise in systems.

13:30 -- 15:30

Room: Las Olas I, II, V, VI

CM3C • Deep Tissue Imaging

Presider: Robert Zawadzki; Univ. of California Davis, USA

CM3C.1 • 13:30 (Invited)

Reflection Matrix Approach to Deep Optical Imaging: Multi-Conjugate Adaptive Focusing in Post-Processing, Alexandre Aubry¹, Victor Barolle^{2,1}, Paul Balontrade^{2,1}, João Luiz d. Pacheco¹; ¹Institut Langevin, France; ²OWLO, France. We present an OCT-based imaging setup combined with a multi-spectral reflection matrix acquisition scheme that enables depth-resolved focus optimization in biological samples through post-processing correction of wavefront aberrations and multiple scattering.

CM3C.2 • 14:00

Enhancing OCT Imaging Through Highly Scattering Media (DLS-OCT), Klaudia Nowacka-Pieszak^{1,2}, Patricio Espinoza Guevara¹, Piotr Kasprzycki^{1,2}, Karol Karnowski^{1,2}, Dawid Borycki^{1,2}; ¹Inst. of Physical Chemistry (ICHP), Poland; ²International Centre for Translational Eye Research, Poland. We demonstrate dynamic light scattering as a passive method for speckle suppression in OCT. Embedding static samples in a dynamic scattering medium enables temporal speckle decorrelation and averaging, significantly improving contrast and resolution when imaging through highly scattering tissue.

CM3C.3 • 14:15

Kramers-Kronig Based Tissue Clearing for Enhanced Penetration Depth in Optical Coherence Tomography, David A. Miller¹, Kechao B. Lu¹, Wan Wang¹, Adam Wax¹; ¹Duke Univ., USA. Optical scattering limits the penetration depth of optical imaging techniques due to refractive index mismatch between tissue components. We used Kramers-Kronig based tissue clearing approaches to suppress scattering and enhance optical coherence tomography penetration depth.

CM3C.4 • 14:30

Improving Contrast at Depth Using Spatially-Offset Optical Coherence Tomography (SO-OCT), Emi Hughes¹, Ralf Mouthaan¹, Freja Høier², Gavrielle Untracht², Peter Andersen², Kishan Dholakia^{1,3}; ¹School of Biological Sciences, The Univ. of Adelaide, Australia; ²Technical Univ. of Denmark, Denmark; ³Univ. of St Andrews, UK. Spatially offset OCT (SO-OCT) improves contrast at depth through a simple modification to a spectral domain OCT system. We achieve a tenfold CNR enhancement in phantoms and twofold improvement in ex vivo biological tissue.

CM3C.5 • 14:45 (Invited)

Spatially Offset Optical Coherence Tomography for Deep-Tissue Imaging, Gavrielle Untracht¹, Freja Høier¹, Emi Hughes², Ralf Mouthaan², Kishan Dholakia^{2,3}, Peter

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Andersen¹; ¹*Danmarks Tekniske Universitet, Denmark*; ²*The Univ. of Adelaide, Australia*; ³*Univ. of St. Andrews, UK*. Spatially offset optical coherence tomography (SO-OCT) provides improved contrast at depth in highly scattering tissues. Our results show the potential for significant improvements in imaging depth.

13:30 -- 15:30

Room: Las Olas IV

OM3D • Photonics plus Ultrasound

Presider: Lingyan Shi; Univ. of California San Diego, USA

OM3D.1 • 13:30 (Invited)

Multispectral Photoacoustic Microscopy With Wavelength-Tunable Ti:Sapphire

Laser, Changho Lee^{1,2}; ¹*Chonnam National Univ., South Korea*; ²*Hwasun Chonnam National Univ. Hospital, South Korea*. This talk presents a multispectral PAM system using a tunable Ti:Sapphire laser (735–855 nm, 20 kHz) with rapid dual-wavelength excitation and signal unmixing. This platform enables high-resolution functional imaging, allowing fast stimulated oxygen mapping and ICG-based lymphography.

OM3D.2 • 14:00 (Invited)

Quantitative Photoacoustic Computed Tomography: Challenges and Virtual Imaging Studies, Seonyeong Park¹; ¹*Bioengineering, Univ. of Illinois Urbana-Champaign, USA*.

Quantitative photoacoustic computed tomography is ill-posed because signals depend on optical properties through an unknown fluence, and are affected by system uncertainties. This talk presents virtual imaging studies using anatomically plausible stochastic phantoms to investigate these limitations.

OM3D.3 • 14:30

From Light to Sound: Deeper, Faster, and Colorful Photoacoustic Imaging in Life

Sciences, Junjie Yao¹; ¹*Duke Univ., USA*. We accelerate microscopic photoacoustic imaging (PAI) by 1000×, enabling real-time observation of biological activities. Using genetically encoded probes, we further enhance the sensitivity of PAI by 1000×, enabling reliable detection of molecular signaling pathways in deep tissues.

OM3D.4 • 14:45

Capturing Whole-Heart in Vivo Dynamics in Mice With Volumetric Photoacoustic Tomography, Sandeep Kumar Kalva^{2,1}, Cagla Özsoy^{2,3}, Daniil Nozdriukhin^{2,3}, Savannah

Tiemann^{2,3}, Lin Tang^{2,3}, Xose Luis Dean-Ben^{2,3}, Daniel Razansky^{2,3}; ¹*Department of Biosciences and Bioengineering, Indian Inst. of Technology Bombay, India*; ²*Inst. of Pharmacology and Toxicology and Inst. for Biomedical Engineering, Faculty of Medicine, Univ. of Zurich, Switzerland*; ³*Inst. for Biomedical Engineering, Department of Information Technology and Electrical Engineering, ETH Zurich, Switzerland*. High-frame-rate volumetric photoacoustic tomography with hexagonal illumination enabled noninvasive whole-heart murine imaging at 200 volumes/s. NIR-II CuS nanoagents improved full-heart coverage, penetration, quantification, and assessment of cardiac disorders and therapeutic effects.

OM3D.5 • 15:00

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Label-Free Drug Response Evaluation in Organoids via Ultraviolet Photoacoustic Microscopy, Byullee Park¹, Hyunjun Kye¹, Won Jong Yu¹, Jeesu Kim², Jong-Chan Park¹; ¹*Sungkyunkwan Univ., South Korea*; ²*Pusan National Univ., South Korea*. To overcome the lack of label-free tools for assessing drug effects in organoids, we developed ultraviolet photoacoustic microscopy, which offers high-resolution nuclear imaging and reveals drug-induced deterioration in nuclear morphology, enabling robust toxicity evaluation.

OM3D.6 • 15:15

Understanding the Sensitivity of Acousto-Optic Imaging., Akshay K. Raghuraman¹, Francesca Cali¹, Stefan Andersson-Engels^{1,2}, Baptiste Jayet¹; ¹*Biophotonics, Tyndall National Inst., Ireland*; ²*School of Physics, Univ. college Cork, Ireland*. We integrated the acousto-optic imaging(AOI) functionality into the NIRFAST package, and thereby developed a new tool to quantify AOI's imaging-sensitivity to an absorption perturbation. The influence of detection geometry on the imaging-sensitivity is also studied.

13:30 -- 15:30

Room: Rio Vista

TM3E • Oncology & Targeted Imaging

Presider: Amir Gandjbakhche; National Inst. of Health, USA

TM3E.1 • 13:30 (Invited)

Advanced Wide-Field Multispectral Mueller Polarimetric Imaging for High-Performance in-Vivo Diagnostics, Angelo Pierangelo¹; ¹*LPICM, CNRS, Ecole polytechnique, IP Paris, France*. Cutting-edge innovations in wide-field multispectral Mueller polarimetric imaging enable high-performance in-vivo diagnostics, from next-generation colposcopy probing cervical microstructure for improved precancer detection and preterm birth assessment to advanced endoscopes for imaging internal organs.

TM3E.2 • 14:00

Nanobody-Target Engagement Quantification in Vivo Using Macroscopic Fluorescence Lifetime Imaging-FRET, Nanxue Yuan¹, Catherine Sherry², Amit Verma², Saif Ragab¹, Vikas Pandey¹, Sophie Hernot³, John Williams⁴, Tynan Young⁴, Margarida Barroso², Xavier Intes¹; ¹*Center for Modelling, Simulation and Imaging in Medicine, RPI, USA*; ²*Department of Molecular and Cellular Physiology, AMC, USA*; ³*Molecular Imaging and Therapy Research Group, Vrije Universiteit Brussel, Belgium*; ⁴*Cancer Biology and Molecular Medicine, City of Hope, USA*. We evaluate NIR nanobody FRET probes for *in vivo* HER2 target engagement using Macroscopic Fluorescence Lifetime Imaging (MFLI). Compared with NIR-labeled TSM probes, nanobody probes exhibit stronger, sustained FRET, enabling improved quantification of HER2 interactions in tumor xenografts.

TM3E.3 • 14:15

Multiphoton Imaging of Multicenter Datasets to Discover Explainable Features in Rare Neuromuscular Diseases, Riccardo Scodellaro¹, Martina Mietto², Lina Tan³, Michaela Blasi^{4,5}, Hristiyan Hristov^{4,5}, Florian Jaudas^{4,5}, Eckhard Wolf^{4,5}, Anna-Kathrin Hell⁶, Jana Zschüntzsch⁷, Ferdinand Knieling³, Alessandra Ferlini², Frauke Alves^{1,8}; ¹*Translational Molecular Imaging, Max Planck Inst. for Multidisciplinary Sciences, Germany*; ²*Unit of Medical Genetics, Medical*

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Sciences, Univ. of Ferrara, Italy; ³Pediatrics and Adolescent Medicine, Friedrich-Alexander- Univ. Erlangen-Nürnberg, Germany; ⁴Chair for Molecular Animal Breeding and Biotechnology, Gene Center and Veterinary Sciences, LMU Munich, Germany; ⁵Center for Innovative Medical Models, Veterinary Sciences, LMU Munich, Germany; ⁶Trauma Surgery, Orthopaedics and Plastic Surgery, Univ. Medical Center Göttingen, Germany; ⁷Neurology, Univ. Medical Center Göttingen, Germany; ⁸Haematology and Medical Oncology Dept. & Inst. for Diagnostic and Interventional Radiology, Univ. Medical Center Göttingen, Germany. We integrated multiphoton microscopy, spatial RNA profiling, explainable AI to discover generalizable features in rare neuromuscular disorders, clinically reframing skeletal muscle microarchitecture. Validation across biopsies from heterogeneous clinical settings guarantees features reproducibility.

TM3E.4 • 14:30

An Open-top Light-Sheet Microscopy Platform With Integrated Profilometry for Rapid Intraoperative Margin Assessment, Qinghua Han^{1,2}, David Brenes², Rui Wang^{3,2}, Rauf Kareem², Helena Son³, Jonathan T. Liu^{2,1}; ¹Bioengineering, Stanford Univ., USA; ²Pathology, Stanford Univ., USA; ³Mechanical Engineering, Univ. of Washington, USA. An open-top light-sheet microscopy system with an integrated profilometer enables intraoperative margin assessment within 15 min of resection. A novel surface-tracking method images uneven tissue surfaces with >90% coverage for large breast specimens and superior image quality to frozen sections.

TM3E.5 • 14:45

A CEA-Specific NIR Probe Incorporated With Confocal Laser Endomicroscopy for Imaging of Colorectal Cancer Cells, Yiting Xu¹, Huahui Zhang¹, Bo Liang¹, Xuesong Ye^{1,2}; ¹College of Biomedical Engineering & Instrument Science, Zhejiang Univ., China; ²National Engineering Research Center of Innovation and Application of Minimally Invasive Instruments, Sir Run Run Shaw Hospital, Zhejiang Univ. School of Medicine, China. We present an *in situ* diagnostic paradigm that integrates a CEA-specific NIR probe with high-frame-rate CLE. This platform enables cellular-level diagnosis of tumor cells, promising significant utility for instant detection and surgical margin determination.

TM3E.6 • 15:00

Second Harmonic Generation Microscopy-Based Collagen Analysis in Lymph Node Metastasis of Thyroid Cancer, Rania Uzma^{2,1}, Reid Master^{2,3}, Wesley Poon^{2,4}, Helmi Khadra⁵, Elizabeth Jacobi⁶, Raksha Raghunathan², Ashok Veeraraghavan¹, Stephen Wong^{2,1}; ¹Electrical and Computer Engineering, Rice Univ., USA; ²Systems Medicine and Bioengineering, Houston Methodist Neal Cancer Center, USA; ³School of Engineering Medicine, Texas A&M Univ., USA; ⁴College of Medicine, Texas A&M Health Center, USA; ⁵Department of Surgery, Houston Methodist Hospital, USA; ⁶Department of Pathology and Genomic Medicine, Houston Methodist Hospital, USA. We used second harmonic generation microscopy to quantitatively profile collagen architecture in normal lymph tissue and metastatic thyroid cancer lymph nodes. Fourier and Hough transform-based analyses revealed distinct collagen signatures differentiating metastatic from non-metastatic regions.

TM3E.7 • 15:15

Precise Tumor Margin and Depth Estimation in Scattering Tissues Using Fluorescence Light Detection and Ranging, Ismail Erbas¹, Ferhat Demirkiran², Karthik Swaminathan³,

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Naigang Wang³, Kaoutar El Maghraoui³, Xavier Intes¹, Vikas Pandey¹; ¹*Rensselaer Polytechnic Inst., USA*; ²*Department of Computer Science, Univ. at Albany, USA*; ³*IBM T.J. Watson Research Center, USA*. We present EvidenceMoE, a physics-guided Mixture-of-Experts architecture for depth and lifetime recovery in scattering tissue. Our results show EvidenceMoE achieves sub-millimeter depth accuracy on phantoms with real-time inference capability, advancing guided surgery toward clinical translation.

15:30 -- 17:00

Atlantic Ballroom

JM4A • Joint Poster Session I

JM4A.1

Telecom-Wavelength Interferometric Near-Infrared Spectroscopy (Telecom INIRS), Marcin J. Marzejon^{1,2}, Klaudia Nowacka-Pieszak^{1,2}, Dawid Borycki^{1,2}; ¹*Inst. of Physical Chemistry (ICPF), Poland*; ²*Parallel Interferometry and Computational Optics Group, International Centre for Translational Eye Research, Poland*. We present a 1.3- μm telecom-wavelength iNIRS system that reduces scattering and slows decorrelation compared to NIR-I implementations. Phantom measurements confirm enhanced stability and sensitivity, highlighting its promise for deep-tissue, non-invasive monitoring.

JM4A.2

Accuracy of QBOLD-MRI Brain Oxygenation Maps Assessed Using Two-Photon Microscopy Angiography, Alexis Cinq-Mars¹, Ghislain Tedondje¹, Aurélie Beaudoin¹, Michèle Desjardins¹, Louis Gagnon¹; ¹*Optics, Physics and Engineering Physics, Université Laval, Canada*. Monte Carlo simulations performed over mouse Two-Photon Microscopy angiograms quantified the accuracy of three analytical qBOLD-MRI models to recover Oxygen Extraction Fraction, and revealed that all models underestimated OEF in mice.

JM4A.3

Enhancing Laser Transmittance in Ex-Vivo Porcine Skin via Thermal Optical Clearing, Ahmed H. Sheet¹, Omnia H. Abd El-Rahman Nematallah¹; ¹*Cairo Univ., Egypt*. This work demonstrates that heating porcine skin promotes thermal optical clearing (TOC), increasing 660-nm laser transmittance by 35%. This highlights TOC's potential to enhance light penetration for improved optical imaging and diagnostics.

JM4A.4

Biocompatible Optical Clearing of Skin Utilizing Lavender Nanoemulsion, Sara El-Ansary¹, Amna H. Faid¹, Omnia H. Abd El-Rahman Nematallah¹, Marwa A. Ramadan¹, Ahmed H. Sheet¹; ¹*Cairo Univ., Egypt*. Lavender oil nanoemulsion was proposed as a safe, natural, and biocompatible optical clearing agent. When applied to ex-vivo chicken skin, it greatly increased optical transmittance by 42%, indicating potential for non-invasive optical imaging and diagnostics.

JM4A.5

Unsupervised Medical-Image Dataset Categorization Using Deep-Learning-Based Latent Space Clustering, Fan-Yu Yen¹, Yiyi Liu¹, Qianqian Fang¹; ¹*Northeastern Univ., USA*. We

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present an unsupervised 3D variational autoencoder and two pretrained neural networks to organize medical image scans. Our approach clusters scans through latent space representations, detects labeling inconsistencies, and supports scalable quality control across shared neuroimaging repositories.

JM4A.6

Fluorescence Guided Surgery for IDH-Mutant Brain Tumors, Rin Yang^{1,2}, Kyle Milnes^{1,3}, Gourav Kumar¹, Kai Tao³, Gauri Malankar¹, Stephen Bowden⁴, Lei Wang^{1,3}, Summer Gibbs^{1,3}; ¹*Biomedical Engineering, Oregon Health and Science Univ., USA*; ²*School of Medicine, Oregon Health and Science Univ., USA*; ³*Knight Cancer Inst., Oregon Health and Science Univ., USA*; ⁴*Neurosurgery, Oregon Health and Science Univ., USA*. Early complete resection has been observed to largely contribute to better prognosis in patients with primary IDH-mutant brain tumors but, remains a surgical challenge due to its diffuse pathology. Here, we describe developing a technology for fluorescence guided surgery for IDH-mutant gliomas.

JM4A.7

Modified Fourier Neural Operator Enables Robust Cross-Species Pupil Dynamics Modeling for ASD Classification, Berfin Dinç^{1,2}, Frederick Bell^{2,3}, Mitul Rakholiya⁴, Macit E. Lacin², Miguel Maldonado⁵, Kemal Ozdemirli⁶, Katie Huba⁷, Thomas Frazier⁷, Ruoming Jin⁴, Murat Yildirim^{2,8}; ¹*Department of Computer Science, Cleveland State Univ., USA*; ²*Department of Neuroscience, Cleveland Clinic Research, USA*; ³*Neuroscience, Case Western Reserve Univ., USA*; ⁴*Computer Science, Kent State Univ., USA*; ⁵*Electrical Engineering, Case Western Reserve Univ., USA*; ⁶*Mechanical Engineering, Case Western Reserve Univ., USA*; ⁷*Psychology, John Carroll Univ., USA*; ⁸*Comprehensive Cancer Center, Case Western Reserve Univ., USA*. We evaluate human and mouse pupillary signals for ASD classification using a modified Fourier Neural Operator with extended spectral capacity. The model robustly learns long-range dynamics, surpassing baseline architectures and revealing translational cross-species biomarkers.

JM4A.8

Noninvasive Optical Neuromonitoring Following Delayed Umbilical Cord Clamping in a Neonate With Critical Congenital Heart Disease, Caitlyn Davis^{2,1}, Nicolina Ranieri^{1,3}, Lily Haupt¹, Susan Nicolson¹, Kristen Colletti¹, Natalie Rintoul¹, Anne Ades¹, Tiffany Ko¹, Wesley Baker¹, Elizabeth Foglia¹, Jennifer Lynch^{1,2}; ¹*Children's Hospital of Philadelphia, USA*; ²*Bioengineering, Univ. of Pennsylvania, USA*; ³*School of Biomedical Engineering, Science and Health Systems, Drexel Univ., USA*. We applied combined FD-DOS/DCS neuromonitoring after delayed cord clamping in a newborn with critical congenital heart disease, demonstrating feasible real-time measurement of cerebral blood volume, oxygenation, and metabolism during early postnatal transition. Recruitment is ongoing.

JM4A.9

Robustness of Undersampled Optical Measurements of Capillary Perfusion Index to Estimate Cerebral Blood Flow Homogeneity, Aarohi Deshpande¹, Alberto Vazquez¹; ¹*Univ. of Pittsburgh, USA*. We implemented and tested an auto-covariance based method to calculate a perfusion index for two-photon imaging data of vascular networks to evaluate the heterogeneity of brain perfusion, an emerging indicator sensitive to ischemia.

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JM4A.10

Next Generation of Ultrafast Lasers for Emerging Imaging Neuroscience

Applications, Ewa Zarnowska¹; ¹*Coherent, USA*. We present a next generation of ultrafast laser platforms for emerging neuroscience applications. These systems simplify laser integration with microscopes, support imaging with miniaturized microscopes, enable kHz-rate fluorophore detection, and deliver high-efficiency volumetric excitation.

JM4A.11

Impact of Mechanical Distortion on Optical Skin Measurements

Brandon K. Harrison Smith¹, Alexander Dumont², Leslie Johnson¹; ¹*Morgan State Univ., USA*; ²*Meta Inc, USA*. Device-induced pressure effects on diffuse reflectance in multilayer skin are quantified using finite element deformation modeling combined with mesh-based Monte Carlo light transport. Pressure-driven geometric changes produce systematic shifts in reflectance across bilirubin concentrations.

JM4A.12

Quantitative Fluorescence Imaging With SI-Traceable Units: Toward True Cross-System Comparisons

Alberto Ruiz¹, Edwin A. Robledo¹, Eammon A. Littler¹; ¹*QUEL Imaging, USA*. Fluorescence-guided imaging lacks standardized, quantitative units, limiting cross-system comparison. We introduce an SI-traceable framework that converts device counts to radiance and excitation-normalized yield, enabling reproducible, comparable imaging across fluorescence imaging devices.

JM4A.13

Programmable Microfluidic Flow Control for Point-of-Care Diagnostics on Centrifugal Lab-on-Disc Platforms

Snehan Peshin^{1,2}; ¹*UC Irvine, USA*; ²*Zoetis, USA*. This work presents a system-level flow-control strategy for centrifugal point-of-care diagnostics using passive and active microfluidic actuation. Programmable timing, reagent handling, and capillary-centrifugal modulation enable compact, automated assays without external pumps.

JM4A.14

Withdrawn

JM4A.15

Systemic Metabolic Response in Finger Microcirculation Following Facial Photodynamic Therapy With Chlorin E6: Laser Doppler Flowmetry Study

Tatiana Grishacheva¹, Natalya Podoplekina², Ekaterina Glagoleva², Nikolay Petrishev¹; ¹*Pavlov First Saint Petersburg State Medi, Russian Federation*; ²*Come Mode Medical Clinic, Russian Federation*. During photodynamic therapy (PDT) of the facial area, laser Doppler flowmetry of the finger revealed a significant increase in FAD levels. This indicates activation of cellular metabolism and a protective tissue response following therapeutic exposure.

JM4A.16

Non-Invasive Laser Interstitial Thermal Therapy Method for the Brain Utilizing Multibeam Interference

Joyce L. Liu¹; ¹*Univ. of Rochester School of Medicine and Dentistry, Univ. of Rochester Medical Center, USA*. Non-invasive laser interstitial thermal therapy is investigated theoretically based on a solid physical basis. Rigorous mathematical calculations prove that

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such a surgery can ablate the targeted object within brain tissue with sufficient depth and very high precision.

JM4A.17

Red-Laser Enhances Bioactive Phytochemicals in Tamarind Seed Germination for Antimicrobial and PDT Applications, Shaimaa Alexeree¹; ¹*Department of Laser Applications in Photochemistry and Photobiology, National Inst. of Laser Enhanced Science, Egypt*. He-Ne laser exposure (630 nm, 10 min) boosted Tamarind seed germination, biomass, protein, phenolics, and antioxidant levels. Laser-treated extracts showed stronger antimicrobial and photodynamic anticancer activity, highlighting laser bio-stimulation as a low-cost enhancer.

JM4A.18

Nanoplasmonic Malaria Biosensor: From Bulk to Local Refractive Index Sensing., Amos Kiyumbi¹; ¹*Physics, Mathematics and Informatics, Univ. of Dar Es Salaam, Tanzania, United Republic of*. Planar SPR sensors suffer from bulk noise due to long SP evanescent tails. Nanohole-array (NHA) sensors tightly confine fields, boosting surface sensitivity. FEM modeling of pLDH malaria sensing shows SiO₂-passivated Al-NHA outperforms Au-NHA SPR: LoD 1.72 ng/mL, ideal for low-cost PoC diagnostics.

JM4A.19

Non-Invasive Optical Spinal Tumor Resection Method Using Multibeam Interference, Joyce L. Liu¹; ¹*Univ. of Rochester School of Medicine and Dentistry, Univ. of Rochester Medical Center, USA*. A theoretical investigation into non-invasive spinal tumor resection is conducted based on a solid physical foundation. Rigorous calculations demonstrate that risky spinal tumor resection can be performed with high precision, resulting in a safe surgery.

JM4A.20

Dynamic Dual-Scan Multispectral Optical Imaging System for Inclusive, Label-Free Dermatological Diagnostics, Tatiana M. Cutrone¹; ¹*Univ. of Central Florida, CREOL, USA*. A compact dual-scan multispectral system adapts illumination parameters to each patient's melanin profile, improving contrast, consistency, and diagnostic accuracy across diverse skin tones. Using visible and NIR LEDs with optical filtering, it advances inclusive, label-free dermatological imaging.

JM4A.21

Monochrome Camera Based Fluorescence Spectroscopy Device for Cancer Diagnosis, Nemichand Nemichand¹, Shivam Shukla³, Rishi Kant Thakur⁴, Ravikrishnan Elangovan⁴, Asima Pradhan^{1,2}; ¹*Indian Inst. of Technology Kanpur, India*; ²*Siksha 'O' Anusandhan Deemed to be Univ., India*; ³*Department of Biomedical Engineering, Florida International Univ., USA*; ⁴*Department of Biochemical Engineering and Biotechnology, Indian Inst. of Technology Delhi, India*. We have developed a compact, portable, and automated polarized fluorescence spectroscopy device using a monochrome camera and a Raspberry Pi module. The system enables accurate spectra in comparison with a commercial spectrometer, demonstrating potential for oral and cervical cancer diagnostics.

JM4A.22

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In-Silico Simulations of Diffuse Correlation Spectroscopy Measurements of Blood Flow in Healthy and Preeclamptic Placentas in Humans, Mitchell Harrah¹, Penaz Mohammad¹, Sarah Obican¹, Ashwin B. Parthasarathy¹; ¹*Univ. of South Florida, USA*. Preeclampsia is a multisystemic disease that is rapidly growing among all pregnant populations. With this submission, we show our in-silico simulation to evaluate the feasibility of using Diffuse Correlation Spectroscopy to measure perfusion in the placenta.

JM4A.23

Optimising AI for Chemical Imaging: Benchmarking Performance Against Foundation Models for Task-Specific Applications in Histopathology, Rahul Suresh¹, Mohd Rifqi Rafsanjani¹, Karin Jirstrom², Arman Rahman³, William Gallagher³, Aidan Meade¹; ¹*Technological Univ. Dublin, Ireland*; ²*Lund Univ., Sweden*; ³*Univ. College Dublin, Ireland*. Integrating chemical imaging with AI enables all digital, label-free histopathology but faces challenges. We benchmark AI-chemical imaging models against H&E foundation models for diagnostic and prognostic tasks, analyze architectural and data limitations, and contrast performance.

JM4A.24

Toward Fluorescence Digital Twins: GPU-Accelerated Monte Carlo Simulations Validated with Multi-Parameter Solid Phantoms, Alberto Ruiz¹, Mayna H. Nguyen¹, Ethan P. LaRochelle¹; ¹*QUEL Imaging, USA*. We present MCX-ExEm, a GPU-accelerated voxel-based excitation–emission Monte Carlo model benchmarked against varied solid phantoms. The framework reproduces key fluorescence behaviors and advances digital-twin capabilities for designing and evaluating FGS imaging systems.

JM4A.25

Low Power Optogenetic Silencing of Cardiac Arrhythmia With Potassium Selective Channelrhodopsins, Nripesh Dixit¹, Sukhdev Roy¹; ¹*Dayalbagh Educational Inst., India, India*. A computational optogenetic model of HVCMs expressed with potassium-selective channelrhodopsins is presented. It is shown that WiChR enables ultra-low-irradiance action-potential suppression and stronger hyperpolarization than HcKCR1, enabling precise suppression of arrhythmogenic activity.

JM4A.26

Evaluation of a Magnetically Compressed Cutaneous Ischemia Model via ICG Distribution and Oxygen Enhanced Optoacoustic Imaging, Euitaek Yang¹, Mark D. Pagel¹; ¹*Medical Physics, Univ. of Wisconsin Madison, USA*. DCE optoacoustic imaging quantified perfusion and oxygenation changes during ischemic wound healing. ICG wash-out, hemoglobin signals, and mSO₂ revealed acute perfusion loss, transient hyperemia, and late-stage hypoxia, demonstrating sensitive vascular monitoring.

JM4A.27

NIR Active Dyes for Use in Dynamic Contrast Enhanced Optoacoustic Imaging (DCE-OAI), David A. Murphy¹, Shaunak A. Pravin¹, Avery Liddicoat¹, Mark D. Pagel¹; ¹*Univ. of Wisconsin, USA*. We evaluated near-infrared contrast agents for dynamic-contrast-enhanced optoacoustic imaging, comparing ICG, ZW800-1, and Revvity dyes in phantoms and 4T1 tumors. ZW800-1 and several Revvity probes showed overall stronger, more stable signal than

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ICG.

JM4A.29

Employing in Vivo Clearing Techniques to Improve Optoacoustic Imaging Signal Within Tumors, David A. Murphy¹, Shaunak A. Pravin¹, Avery Liddicoat¹, Mark D. Pagel¹; ¹*Univ. of Wisconsin, USA*. Topical tartrazine application reduced NIR light scattering during optoacoustic imaging. In a murine tumor model, tartrazine improved detection of indocyanine green contrast agent, improving tumor delineation. These results highlight the use of in vivo tissue clearing in improving detected signal.

JM4A.31

LumiCare: a Low-Cost Machine Learning–Based Optical Imaging Framework Integrating Skin and Sclera Features for Non-Invasive Neonatal Hyperbilirubinemia Detection, Favour O. Oni¹; ¹*Achievers Univ., Nigeria*. We present a low-cost, non-invasive optical imaging framework combining skin and sclera color features with machine learning to estimate neonatal bilirubin levels, enabling robust, accurate, and accessible jaundice screening in low-resource healthcare settings.

JM4A.33

Excitation-Dependent Fluorescence: Effects of in Vivo Environments on Probe Performance, Alberto Ruiz¹, Ethan P. LaRochelle¹, Kimberley S. Samkoe²; ¹*QUEL Imaging, USA*; ²*Dartmouth College, USA*. Excitation-dependent, anti-Kasha fluorescence behavior is observed for indocyanine green in biologically relevant environments, but not in simple solvents. These findings highlight the need to consider excitation-dependent shifts when evaluating and designing FGS fluorophores and systems.

JM4A.34

Multimodal EEG and Cerebral Blood Flow Features for Bedside Classification of Consciousness in Neurocritical Care, Ulas Sunar¹; ¹*SUNY Stony Brook, USA*. Multimodal EEG and CBF features improve bedside classification of consciousness in brain injured patients. Machine learning using EEG and low frequency CBF oscillations achieved 0.86 AUC. Noninvasive DCS showed consistent performance with invasive probes.

JM4A.35

Analysis of Epiretinal Membranes Through Multiphoton Imaging Microscopy, Juan M. Bueno¹, Xavier Valldeperas²; ¹*Universidad de Murcia, Spain*; ²*Universitat Autònoma de Barcelona, Spain*. Multiphoton microscopy images have been used to explore non-stained human epiretinal membranes (ERMs). Objective parameters based on nonlinear signals are able to quantify differences between the two main ERM categories.

JM4A.36

Optogenetic Mapping of Embryonic Cardiac Pacemaker Cells, Guzel Musina^{2,1}, Nanbing Jade Li-Villareal¹, Deirdre Scully³, Andrew L. Lopez², Irina V. Larina¹; ¹*Integrative Physiology, Baylor College of Medicine, USA*; ²*Biomedical Engineering, Univ. of Houston, USA*; ³*Reproductive Biology, Case Western Reserve Univ., USA*. We present an optogenetic platform enabling real-time mapping of mouse embryonic cardiac pacemakers, providing a

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unique tool for studying early conduction development.

JM4A.38

Withdrawn

JM4A.39

Optical Surface Annotation With Photoactivable Dyes for Precise Co-Registration

Between Virtual Pathology Surface Imaging and Histopathology, Lauren E. Boudreaux¹, Ivan Bozic¹, Guang Li¹, Janarthanan Jayawickramarajah², J. Quincy Brown¹; ¹*Tulane Univ., USA*; ²*Southern Methodist Univ., USA*. Photoactivatable dyes enable real-time, image-guided marking of suspicious regions during virtual pathology surface imaging. Selective activation provides visible fiducials for targeted sampling, enabling co-registration between fresh-tissue virtual pathology and downstream histological validation.

JM4A.40

Single-Shot Deep-Learning-Based Phase Imaging of Dense Biological Samples, Maria Cywinska¹, Wiktor Forjasz¹, Wojciech Ogonowski¹, Julianna Winnik¹, Azeem Ahmad², Balpreet Ahluwalia²; ¹*Inst. of Micromechanics and Photonics, Warsaw Univ. of Technology, Poland*; ²*Department of Physics and Technology, The Arctic Univ. of Norway, Norway*. DeepQuadrature enables adaptive single-shot phase demodulation for dense biological samples. Compared with the Hilbert Spiral Transform, it preserves fine structural detail under complex fringe geometry and suggests practical mitigation strategies for challenging local variations.

JM4A.41

Laser Speckle Rheological Microscopy (SHEAR) Mapping of Poly(Ethylene Glycol)

Diacrylate (PEGDA) Gels, Kaitlin Moquin¹, Janie Wu¹, Zeinab Hajjarian¹; ¹*Univ. of Massachusetts Lowell, USA*. Photo-cross-linkable hydrogels are increasingly used in bone tissue regeneration. We used laser speckle rheological microscopy (SHEAR) to characterize the viscoelastic properties of poly(ethylene glycol) diacrylate (PEGDA) hydrogels towards optimizing the function of engineered biomimetic scaffolds.

JM4A.42

Analyzing Phenotypic Diversity in Leukocytes Undergoing Trafficking and its Effect on

Host Immunity, Sanah Sanduja², Anthony Santella¹, Miguel Cordova¹, Ethan Krug¹, Milind Rajadhyaksha¹, Aditi Sahu¹; ¹*Memorial Sloan Kettering Cancer Center, USA*; ²*Univ. of Rochester, USA*. This study examines leukocyte trafficking cellular populations using in-vivo imaging, TrackMate feature extraction, and correlation with patient outcomes. Biologically significant patterns suggest that specific phenotypical groups and trafficking behavior may correlate with patient immune states.

JM4A.43

High-Throughput Quantitative Phase Imaging of Sickle Cell Disease Utilizing a Portable,

Compact System, Connor S. Nieh¹, Cindy Chen¹, Adam Wax¹; ¹*Duke Univ., USA*. We demonstrate the use of high-throughput quantitative phase imaging for analyzing biophysical markers of sickle cell disease. Utilizing a novel self-reflective interferometric chip, we enable

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sickle cell characterization in a low-cost system with clinical implications.

JM4A.44

3D EasySTED Illumination Design Enabling Simplified Beam Alignment, Jiyeon Chung¹, Ilkyu Park¹, Dong-Ryoung Lee¹; ¹*Soongsil Univ., South Korea*. We present a method to simplify 3D easySTED nanoscopy alignment by coupling the excitation and depletion beams into a fiber and independently modifying each wavelength's polarization, simulating 3D intensity and comparing with conventional STED.

JM4A.45

Label-Free 3D Lipid Droplet Analysis in Hepatic Organoids Using Holotomography, Jimin Cho¹, ChulMin Oh¹, Juyeon Park¹, Hyejin Kim², Hoyeon Lee², Jaehyeok Lee², Sumin Lee², YongKeun Park^{1,2}; ¹*Korea Advanced Inst of Science & Tech, South Korea*; ²*Tomocube Inc., South Korea*. Label-free holotomography with adaptive segmentation enables quantitative, live 3D lipid droplet analysis in hepatic organoids, revealing fatty acid-specific accumulation dynamics and spatial remodeling without fluorescent labels, while providing depth-resolved tracking of lipid metabolism.

JM4A.46

Artifact-Free Label-Free 4D Morphology Tracking of Organoids Using Holotomography via Bandpass-Filtered Structural Reconstruction, ChulMin Oh^{1,3}, Jimin Cho^{3,2}, Juyeon Park^{1,3}, Hoyeon Lee⁴, YongKeun Park^{1,4}; ¹*Department of Physics, Korea Advanced Inst. of Science and Technology (KAIST), South Korea*; ²*Graduate School of Stem Cell and Regenerative Biology, KAIST, South Korea*; ³*KAIST Inst. for Health Science and Technology, KAIST, South Korea*; ⁴*Tomocube Inc, South Korea*. We present a computational method that suppresses missing-cone artifacts in holotomography by extracting mid-frequency refractive index information, enabling artifact-free 3D morphology and robust static and time-lapse analysis of organoid systems.

JM4A.37

Coherent Emission From dye-Infused Biological Structures, Nathan J. Dawson¹, Hengzhou Liu¹, Michael Crescimanno², Anthony Fiorito¹, David R. Sheffield¹; ¹*Florida Polytechnic Univ., USA*; ²*Youngstown State Univ., USA*. Amplified spontaneous emission and laser emission were observed in naturally occurring photonic structures in teleost fish and avian tissues when gain was introduced, which reveals intrinsic optical feedback mechanisms.

JM4A.47

Staining-Free Visualization of Cell Boundaries for Accurate Binning of Gene Expression in Spatial Transcriptomics, Sio Fong Cheong¹, Tin Kin Zhong¹, Chien-Miao Liu¹, Xiaoxia Chen², Youyuan Chen², Zhiming Zhang², Tzu-Ming Liu²; ¹*Pui Ching Middle School Macau, China*; ²*Univ. of Macau, China*. Stain-free boundary visualization in LysM-Cre mT/mG tissues enables boundary-aware binning for ultra-dense spatial transcriptomics, improving UMI total counts and expressed number of genes. This approach facilitates accurate spatial annotation of cells in spatial transcriptomics. © 2025 The Authors

JM4A.48

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Analytical H&E-to-DAPI Conversion Achieves Deep- Learning-Level Performance on the HEMIT Dataset, Berfin Dinç^{2,3}, Resul Ozbilgic¹, Omer Dinc^{2,4}, Mihriban Karaayvaz¹, Murat Yildirim^{2,5}; ¹*Department of Cancer Sciences, Cleveland Clinic, USA*; ²*Department of Neuroscience, Cleveland Clinic Research, USA*; ³*Department of Computer Science, Cleveland State Univ., USA*; ⁴*Department of Biomedical and Chemical Engineering, Cleveland State Univ., USA*; ⁵*Cleveland Clinic Research, Department of Biomedical Engineering, USA*. We present a training-free H&E-to-DAPI translation method based on analytical color deconvolution and robust normalization. On the HEMIT dataset, it achieves mean SSIM 0.81, PSNR 29.0 dB, and MSE 0.00149, comparable to recent approaches.

JM4A.49

Unsupervised Cross-Stain Translation Between H&E and Collagen I Histology Using CycleGAN, Berfin Dinç^{2,1}, Resul Ozbilgic³, Omer Dinc^{2,4}, Hannah Gilmore⁵, Mihriban Karaayvaz³, Murat Yildirim^{2,6}; ¹*Department of Computer Science, Cleveland State Univ., USA*; ²*Department of Neuroscience, Cleveland Clinic Research, USA*; ³*Department of Cancer Sciences, Cleveland Clinic Research, USA*; ⁴*Department of Biomedical and Chemical Engineering, Cleveland State Univ., USA*; ⁵*Department of Pathology, Cleveland Clinic Research, USA*; ⁶*Department of Biomedical Engineering, Cleveland Clinic Research, USA*. We investigate unsupervised stain translation between H&E and Collagen I breast histology using CycleGAN. By training on epithelial-enriched, non-overlapping patches, the model captures stain-dependent appearance while maintaining underlying tissue structure.

JM4A.50

Enabling Advances in High-Speed Photon Counting With Silicon Photomultiplier Technology: New Opportunities in Time-Resolved Biophotonics Sensing, Ozzy Mermut¹, William J. Pietro¹, Coral Hillel¹, Seyed Masoumi Lari¹, Kevin Diamond², Christopher J. Barrett^{3,1}; ¹*York Univ., Canada*; ²*Physics and Astronomy, McMaster, Canada*; ³*Chemistry, McGill Univ., Canada*. The design and construction of a platform miniaturized silicon photomultiplier-based, photon counting sensor device, York U PCS-121, is discussed for biophotonics time-resolved measurements in the field and use in molecular photo-switch biosensor applications.

JM4A.51 • 15:30

Impaired Phosphate Trafficking in Malignant Human Bone- Fourier Transform Infrared Micro-Spectroscopy Based Study, KARTIKEYA BHARTI², Narendra N. Singh², Pranab J. Talukdar¹, POOJA LAHIRI¹, BASUDEV LAHIRI¹; ¹*Indian Inst. of Technology Kharagpur, India*; ²*ORAL PATHOLOGY, MICROBIOLOGY AND FORENSIC ODONTOLOGY, Rajendra Inst. of Medical Sciences, India*. In this study human bone with malignancy was analyzed for biomolecular changes. We have summarized the changes across mid-IR range 1000 cm⁻¹ to 3500 cm⁻¹. Phosphate, lipid and collagen alteration was appreciated. We used unprocessed (raw) human bone samples of directly under FTIR micro-spectroscope

JM4A.52 • 15:30

Development of a Custom Objective Lens for Confocal Microscopy of Skin With Thick Stratum Corneum, Carmella Ocaya¹, Momoka Sugimura¹, Sabrina Ramnarine^{3,4}, Milind M. Rajadhyaksha⁵, DongKyun Kang^{1,2}; ¹*James C. Wyant College of Optical Sciences, Univ. of*

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Arizona, USA; ²Department of Biomedical Engineering, Univ. of Arizona, USA; ³Guy's and St Thomas' NHS Foundation Trust, UK; ⁴Life Sciences and Medicine, King's College London, UK; ⁵Memorial Sloan Kettering Cancer Center, Weill Cornell School of Medicine, USA. We designed a custom objective lens optimized for confocal imaging of skin with thick stratum corneum. The objective lens is designed to work with an immersion index of 1.51 and provides cellular resolution over an increased field of view of 1 mm.

JM4A.53 • 15:30

Development of a Probe-Based Light Sheet Microscope, Yongjun Kim¹, Momoka Sugimura¹, Brooke Liang^{3,5}, Michelle Khan⁴, Eric Yang⁵, Dongkyun Kang^{1,2}; ¹James C. Wyant College of Optical Sciences, Univ. of Arizona, USA; ²Department of Biomedical Engineering, Univ. of Arizona, USA; ³Department of Pathology, Univ. of Colorado Anschutz Medical Campus, USA; ⁴Department of Obstetrics and Gynecology, Stanford Univ. School of Medicine, USA; ⁵Department of Pathology, Stanford Univ. School of Medicine, USA. This work describes the current development of a probe-based light sheet microscope (pLSM) for future *in vivo* imaging of anal lesions. The paper presents optical design of the pLSM prototype and preliminary results of evaluating detection path performance.

JM4A.54 • 15:30

Wavelet Transform Coherence Between Cerebral Oximetry and Mean Arterial Pressure for Cerebral Autoregulation: Demonstration and Application, Binita KC¹, Priscilla Yu², Soheila Norasteh¹, Hanli Liu¹; ¹Univ. of Texas at Arlington, USA; ²Univ. of Texas Southwestern Medical Center at Dallas, USA. We developed and demonstrated a time-resolved, multi-scale (i.e., multi-frequency) wavelet coherence framework to quantify scale-dependent coherence between cerebral oximetry and mean arterial pressure in pediatric cardiac arrest patients. This approach enables physiologically informed early discrimination of brain injury in this population.

JM4A.55 • 15:30

Neurophysiological Modeling of Cerebrovascular–Cerebrospinal Fluid Coupling Measured by Broadband Near-Infrared Spectroscopy: Mechanisms and Applications, Fatemeh Tavakoli¹, Fiza Saeed¹, Hanli Liu¹; ¹Univ. of Texas at Arlington, USA. We propose neurophysiological models of cerebrovascular-cerebrospinal fluid (CSF) coupling measured by broadband near-infrared spectroscopy for two applications. Results demonstrate stronger inverse vascular-CSF coupling with aging and Alzheimer's disease, and hierarchical metabolic-vascular-CSF reorganization after transcranial photobiomodulation.

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Tuesday, 28 April

08:00 -- 10:00

Room: Las Olas III

BT1A • Metabolism & Structural Imaging

Presider: Alberto Vazquez; Univ. of Pittsburgh, USA

BT1A.1 • 08:00 (Invited)

Live Cell Fluorescent Imaging for Pyruvate & Lactate, Lauren Qiu¹, Tamanna Verma¹, Takahiro Sasaki¹, Masayuki Yazawa¹; ¹*Columbia Univ., USA*. We will report our new method and resource for live cell fluorescent imaging of pyruvate and lactate to provide a new insight into cellular metabolism in various cells including neural progenitor and neuron.

BT1A.2 • 08:30

Forward and Inverse Light Scattering in Thick Biological Samples Using the Pupil Phase Series, Herve Hugonnet¹, ChulMin Oh¹, Juyeon Park¹, YongKeun Park¹; ¹*Korea Advanced Inst of Science & Tech, South Korea*. The pupil phase series (PPS) is a new multiple-scattering simulation algorithm achieving high speed and accuracy in the non-paraxial regime. PPS was integrated into an inverse solver and used to suppress multiple-scattering artifacts in Holotomography.

BT1A.3 • 08:45

Differences in Cerebral Metabolic Rate of Oxygen Consumption in Excitatory and Inhibitory Neurons Elucidated by Optogenetics in Awake Mice, Andrew E. Toader^{2,1}, Adiya Rakymzhan³, Mitsuhiro Fukuda¹, Alberto Vazquez¹; ¹*Univ. of Pittsburgh, USA*; ²*Lake Erie College of Medicine, USA*; ³*Bioengineering, MIT, USA*. This study used optogenetics and oxygen-sensitive optical imaging to activate targeted neuronal subpopulations. We found large changes in CBF and CMRO2 in excitatory neurons and disproportionately larger changes in CBF from inhibitory neurons (mostly explained by somatostatin-expressing neurons).

BT1A.4 • 09:00

Absolute Quantification of Cytochrome-c-Oxidase Redox State in Human Brain Tissue Using Broadband Continuous-Wave Near-Infrared Spectroscopy, Fatemeh Tavakoli¹, Xinlong Wang¹, Hanli Liu¹; ¹*UTA, USA*. We demonstrate a broadband continuous-wave near-infrared spectroscopy method that quantifies absolute cytochrome-c-oxidase and other tissue components. Diffusion and Monte Carlo simulations recovered parameters with <10% error, and in vivo forehead data produced physiologically consistent results.

BT1A.5 • 09:15

Understanding Remodeling of the Tunica Adventitia in Anterior Cerebral Arteries With Respect to Age Using Quantitative Birefringence Microscopy, Mikayla Bradsby¹, Luca Dipple¹, Jorge Rivera¹, Ashley Tai¹, Samuel Halvorsen¹, Alec Candib¹, Anna Novoseltseva¹, Ting Xie¹, Joe Zaia¹, Thor Stein¹, Katherine Zhang¹, Irving Bigio¹; ¹*Boston Univ., USA*. In this study we use birefringence microscopy to examine the remodeling of anterior cerebral arteries as a function of aging and find an increase in relative retardance of the tunica adventitia with respect to age.

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BT1A.6 • 09:30

Imaging Mueller Polarimetry: a New Perspective on Intra-Operative Brain Tumor Visualization

Tatiana Novikova^{1,2}, Sooyong Chae¹, Théotim Lucas¹, Omar Rodriguez-Nunez³, Eléa Gros⁴, Theoni Maragou⁴, Richard McKinley⁴, Philippe Schucht³; ¹*LPICM, CNRS, Ecole polytechnique, IP Paris, France*; ²*Biomedical Engineering, Florida International Univ., USA*; ³*Neurosurgery, Inselspital, Switzerland*; ⁴*Univ. of Bern, Switzerland*. Real-time brain tumor delineation remains a major neurosurgical challenge. We present a compact fast wide-field imaging Mueller polarimetric system that enables label-free intraoperative tumor delineation and fiber-tract visualization by revealing optical anisotropy of tumorless brain white matter.

08:00 -- 10:00

Room: Bonnet

MT1B • Emerging Microscopy Applications in Life Sciences

Presider: Aditi Sahu; Memorial Sloan Kettering Cancer Center, USA

MT1B.1 • 08:00 (Invited)

Fluorescence-Lifetime Optical Electrophysiology in Contracting Cardiomyocytes, Marie-Caroline Muellenbroich¹; ¹*Univ. of Glasgow, UK*. We present high-speed fluorescence lifetime-intensity imaging for motion-robust, calibrated mapping of voltage and calcium in contracting cardiomyocytes, using a gated SPAD camera to achieve 200 fps, revealing spatial heterogeneity and late-phase repolarization dynamics.

MT1B.2 • 08:30

A Unified Platform for Multiscale Quantitative Phase Imaging, Hongqiang Ma¹, Chaojie Zhang¹, Shengwei Chen¹, Phuong Nguyen¹, Shuyuan Zheng¹, Yang Liu^{1,2}; ¹*Department of Bioengineering, Univ of Illinois at Urbana-Champaign, USA*; ²*Department of Electrical and Computer Engineering, Univ. of Illinois Urbana-Champaign, USA*. We present a unified multiscale quantitative phase imaging framework based on a bright-field microscopy configuration, where illumination and detection NA and field of view are optimized for mesoscale high-resolution label-free tissue pathology, long-term live-cell imaging, and 3D tissue imaging.

MT1B.3 • 08:45

Broadband Stimulated Raman Scattering for Virtual Histopathology and High-Speed Microplastics Detection, Eric Fantuzzi², Federica Padelli², Tiago Azevedo³, Rebeca Martinez Vazquez⁵, Alessandra Nardini⁵, Gabriele Di Noia², Federico Monti², Sara Pizzurro², Matteo Corti², Mujeeb Rahman^{2,1}, Andrea Ragni², Chris Tomy³, Moe Vali³, Renzo Vanna⁵, Anna Muehlig⁴, Orlando Guntinas Lichius⁴, Andrea Ferrari^{3,2}, Pietro Liò³, francesco crisafi², Giulio Cerullo^{1,2}; ¹*Politecnico di Milano, Italy*; ²*Cambridge Raman Imaging srl, Italy*; ³*Univ. of Cambridge, UK*; ⁴*Jena Univ. Hospital, Germany*; ⁵*Consiglio Nazionale delle Ricerche, Italy*. We present a broadband stimulated Raman scattering platform for virtual histopathology and rapid microplastics detection. Single shot CH range hyperspectral imaging enables label-free diagnostics and high speed polymer identification in complex biological matrices.

MT1B.4 • 09:00

Withdrawn

Optica Biophotonics Congress and Exhibit Session Guide

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MT1B.5 • 09:15

A Custom Three-Photon Microscope for Intravital Imaging of Axolotl Regeneration, Kelvin Amakye^{1,2}, Nicole Calder³, Samantha Finkbeiner³, Jackson Griffiths³, Hari Paudel⁴, James Monaghan³, Christa Haase^{1,2}; ¹*Bioengineering, Northeastern Univ., USA*; ²*Physics, Northeastern Univ., USA*; ³*Biology, Northeastern Univ., USA*; ⁴*Apple, USA*. We report the first application of three-photon microscopy to axolotl. A custom system achieves increased imaging depth, resolves regeneration, and enables, for the first time, identification of Leydig cells using third-harmonic generation contrast.

MT1B.6 • 09:30

Confocal Mueller Matrix Polarimetry in Thick Turbid Media and Polarization Monte-Carlo, Ajmal Ajmal¹, Amanda Sanchez¹, Andres J. Rodriguez¹, Pedro Lopez¹, Jessica C. Ramella-Roman¹; ¹*Florida International Univ., USA*. Depth-resolved Mueller Matrix polarimetry combined with nonlinear microscopy enables quantitative assessment of polarization properties in turbid media. Using phantoms, tissues, and Monte Carlo modeling, we analyze depth-dependent polarization properties and contributions from anisotropic structure.

MT1B.7 • 09:45

Deep Brain Mesoscale Calcium Imaging in Freely

Behaving Mice, Ibrahim Oladepo¹, Dylan Flink¹, Kapil Saxena¹, Suhasa Kodandaramaiah¹, Arif Hamid¹; ¹*Univ. of Minnesota Twin Cities, USA*. We present a miniaturized, head-mounted fluorescence microscope with a long working distance of 13.45 mm and a field of view of 2.17 x 2.2 mm² for imaging widefield calcium dynamics of the dorsal striatum in freely behaving mice.

MT1B.8 • 09:45

Unsupervised Multi-Animal Tracking With Spatiotemporal Transformers for Quantitative Neuroethology, Yixin Li^{2,1}, Xinyang Li²; ¹*College of Future Information Technology, Fudan Univ., China*; ²*College of AI, Tsinghua Univ., China*. Accurate multi-animal tracking under occlusion is essential for quantitative neuroethology. UDMT learns without labels using forward-backward cycle consistency and a spatiotemporal transformer. Combined with a head-mounted miniscope, we link locomotion with neural calcium activity.

08:00 -- 10:00

Room: Las Olas I, II, V, VI

CT1C • AI & Computational OCT

Presider: Audrey Bowden; Vanderbilt Univ., USA

CT1C.1 • 08:00 (Invited)

Advances in Clinical Care Driven by OCT Image Guided AI, Adam M. Dubis¹; ¹*Univ. of Utah, UK*. AI-enabled medical support in ophthalmology has taken OCT imaging to a new level of diagnostic integrity and consistency, strengthening both disease detection and treatment decision-making. This presentation reviews current advances in AI-driven OCT analysis and outlines future directions.

CT1C.2 • 08:30

Optica Biophotonics Congress and Exhibit Session Guide

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Compressed Sensing 3-D OCT Reconstruction via Hybrid TV-Wavelet

Optimization, Zhuoya Shi¹, Diego M. Cho¹, Christine P. Hendon¹; ¹*Columbia Univ., USA*. We present a compressed sensing 3-D reconstruction pipeline that mitigates quality loss in undersampled optical coherence tomography volumes, improving structural recovery under sub-Nyquist acquisition and enabling accelerated OCT imaging.

CT1C.3 • 08:45

Monitoring Tissue Remodeling in Hydrogel-Treated Mice Wounds Using OCT and Deep Learning, Michael S. Crouch¹, Jiyeon Song², Nicole Hanson², Makenzie Bushold², Michael S. Eggleston¹, Sharon Gerecht², Shreyas Shah¹; ¹*Nokia Bell Labs, USA*; ²*Duke Univ., USA*. We developed a deep learning-based 3D OCT segmentation framework to quantify *in vivo* tissue remodeling. This platform revealed how hydrogel stiffness affects wound regeneration, providing an objective approach to evaluate healing and guide therapies.

CT1C.4 • 09:00

AI-Based Spatiotemporal Prediction of Vitreomacular Traction Progression Using Longitudinal 3D OCT Data, Akshay Raman¹, Jędrzej Golebka¹, Ye Tian¹, Nancy Liddle¹, Xinxin Fang¹, Royce W.S. Chen¹, Kaveri Thakoor¹; ¹*Columbia Univ., USA*. We propose a spatiotemporal AI model to predict Vitreomacular Traction (VMT) progression in longitudinal 3D OCT. Via a hybrid 3D-CNN backbone and a GRU encoder, our AI captures temporal dynamics, achieving 0.863 AUC. Grad-CAMs attend to the vitreoretinal interface, a clinically-valid VMT feature.

CT1C.5 • 09:15

Full-Eye-Length OCT and Machine Learning to Assess the Geometry of Accommodating Eyes, Keerthana Soman¹, Muhammad Usman³, Raul U. Arpal¹, Grzegorz Gondek¹, Daniel Ruminski¹, Karol Karnowski², Jacek Ruminski³, Ireneusz Grulkowski¹; ¹*Nicolaus Copernicus Univ., Poland*; ²*Polish Academy of Sciences, Poland*; ³*Gdansk Univ. of Technology, Poland*. The study characterizes accommodation-induced morphological changes in the human crystalline lens using full-eye-length OCT, combined with machine learning–assisted analysis enabling an automated and accurate segmentation of ocular surfaces, along with a detailed assessment of OSD zones.

CT1C.6 • 09:30 (Invited)

Artificial Intelligence in Quasi-Static and Wave-Based Optical Coherence Elastography, Manmohan Singh¹, Achuth Nair¹, Christian Zevallos-Delgado¹, Salavat Aglyamov¹, Kirill Larin¹; ¹*Univ. of Houston, USA*. Applications of artificial intelligence (AI) in elastography have been significantly limited. Here, we discuss the development and applications of AI in optical coherence elastography in both quasi-static and dynamic wave-based applications.

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08:00 -- 10:00

Room: Las Olas IV

OT1D • Diffuse Correlation and Laser Speckle Techniques

Presider: To Be Announced

OT1D.1 • 08:00

Evaluation of Remote Effects of Manipulative Therapy on Muscle Blood Flow Using DCS, Yukino Takahashi⁵, Yasuhiro Matsuda², Mikie Nakabayasi^{1,3}, Masashi Ichinose⁴, Yumie Ono⁶; ¹*Faculty of Engineering, Niigata Univ., Japan*; ²*Department of Judo Therapy, School of Health and Medical Sciences, Nippon Sport Science Univ., Japan*; ³*Inst. for Research Administration, Niigata Univ., Japan*; ⁴*Human Interactive Physiology Laboratory, School of Business Administration, Meiji Univ., Japan*; ⁵*Graduate School of Science and Technology, Meiji Univ., Japan*; ⁶*Department of Electronics and Bioinformatics, School of Science and Technology, Meiji Univ., Japan*. This study used diffuse correlation spectroscopy to examine whether manipulative therapy applied to an adjacent area indirectly alters muscle blood flow. The untreated muscle showed a transient rise during intervention, indicating an indirect hemodynamic effect.

OT1D.2 • 08:15

Evaluation of the Deep Tissue Blood Flow Detection Capability of Speckle Contrast Optical Spectroscopy, Shuta Hashimoto¹, Tomoya Yamamoto¹, Nisan Ozana², Vika Tarle², Masashi Ichinose³, Yumie Ono⁴; ¹*Graduate School of Science and Technology, Meiji Univ., Japan*; ²*Faculty of Engineering and Inst. of Nanotechnology and Advanced Materials, Bar-Ilan Univ., Israel*; ³*Human Integrative Physiology Laboratory, School of Business Administration, Meiji Univ., Japan*; ⁴*Department of Electronics and Bioinformatics, School of Science and Technology, Meiji Univ., Japan*. We validated detection depth of tissue blood flow using speckle contrast optical spectroscopy. Although a stronger influence from superficial layers was suggested, its demonstrated depth sensitivity was comparable to that of diffuse correlation spectroscopy.

OT1D.3 • 08:30

Speckle Contrast Optical Spectroscopy Measurements of Blood Pressure in Hypertensive Subjects, Ariane B. Garrett¹, Ana I. Perez¹, John Forman², David Boas¹, Darren M. Roblyer¹; ¹*Boston Univ., USA*; ²*Boston Medical Center, USA*. We present the first speckle contrast optical spectroscopy measurements of blood pressure in a hypertensive population. Blood pressure prediction results will be presented and compared with previous measurements in healthy subjects.

OT1D.4 • 08:45

Inter-Frame Mutual Information-Based Diffuse Correlation Spectroscopy (DCS) for Continuous Cerebral Blood Flow Monitoring, Yongjian Liu¹, Zhe Li¹, Yiwen Wang¹, Ting Hu¹, Zhonghua Sun¹, Pengyu Liu¹, Jinchao Feng¹, Kebin Jia¹; ¹*Beijing Univ. of Technology, China*. An inter-frame mutual information-based DCS (IFMI-DCS) method is proposed in this work. IFMI-DCS derives cerebral blood flow (CBF) by quantifying the degree of information overlap between inter-frame images. This method provides a novel approach for CBF monitoring with wearable integration potential.

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OT1D.5 • 09:00

Estimating Blood Flow Dynamics from Parallelized Diffuse Correlation Spectroscopy Measurements Using a Stochastic Differential Equation Approach, Melissa Wu¹, Roarke Horstmeyer¹; ¹*Duke Univ., USA*. Current methods to extract blood flow dynamics in diffuse correlation spectroscopy are computationally expensive and can yield non-ideal results when implemented with SPAD arrays. We explore how a stochastic differential equation framework can improve blood flow extraction from SPAD array setups.

OT1D.6 • 09:15

Parameter Optimization for Wearable and Fiber-Less Speckle Contrast Optical Spectroscopy, Ana I. Perez¹, Ariane B. Garrett¹, Bernhard Zimmermann¹, David Boas¹, Darren M. Roblyer¹; ¹*Boston Univ., USA*. We present the development of a wearable SCOS device for the purpose of ambulatory blood pressure monitoring. We detail parameter and hardware optimization to achieve a maximum signal-to-noise ratio of blood flow index.

OT1D.7 • 09:30

Vibration and Motion Induced Noise in Speckle Contrast Measurements Employing Multimode Fibers, Joseph B. Majeski¹, Yining Wang², Ahmet Erdogan², Yuanyuan Hua², Rodrigo M. Forti³, Hongting Zhao³, Kenneth Abramson¹, Wesley Baker³, Robert Henderson², Arjun Yodh¹; ¹*Univ. of Pennsylvania, USA*; ²*Univ. of Edinburgh, UK*; ³*Neurology, Children's Hospital of Philadelphia, USA*. We employ speckle contrast optical spectroscopy and a single-photon avalanche diode array to investigate noise introduced via multimode fiber motion. Both low frequency motion akin to human movement and high frequency noise representing vibration are considered.

OT1D.8 • 09:45

3D Printed Tumor Perfusion Phantom for Validation of Integrated Diffuse Correlation Tomography and Ultrasound Imaging System for Breast Cancer Therapy, Prashant Waiba¹, Fan Feng¹, Chloe T. Zhang¹, Hong F. Zhang¹, Stephen A. McAleavey¹, Regine Choe¹; ¹*Univ. of Rochester, USA*. We present tissue phantoms with a 3D-printed tumor perfusion model for the validation of integrated diffuse correlation tomography and ultrasound shear wave elastography imaging. These techniques in combination can be used for efficacy prediction of neoadjuvant breast cancer therapy.

08:00 -- 10:00

Room: Rio Vista

TT1E • Dermatology & Internal Diagnostics

Presider: Stanislaw Wojtkiewicz; IBBE PAS, Poland

TT1E.1 • 08:00 (Invited)

A Tale of Force and Light Part II: How Optical Coherence Tomography and Raman Spectroscopy, Combined With Mechanical Testing, Reveal the Dynamic Behaviour of Healthy and Diseased Articular Cartilage, Frederique Vanholsbeeck^{3,2}, Darven Murali Tharan^{1,2}, Daniel Everett^{1,2}, Sue McGlashan⁴, Marco Bonesi^{3,2}, Cushla McGoverin^{3,2}, Ashvin Thambyah¹; ¹*Department of Chemical and Materials Engineering, Univ. of Auckland, New Zealand*; ²*Dodd-Walls Centre for Photonic and Quantum Technologies, New*

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Zealand; ³*Department of Physics, Univ. of Auckland, New Zealand*; ⁴*Department of Anatomy and Medical Imaging, Univ. of Auckland, New Zealand*. We present a multimodal platform combining PS-OCT, Raman spectroscopy, and mechanical testing to study cartilage under load, uncovering structural and biochemical mechanisms underlying osteoarthritis progression and enabling early detection, diagnosis, and evaluation of regenerative therapies.

TT1E.2 • 08:30

Spatial Frequency Domain Imaging (SFDI) for the Assessment of Skin Involvement in Scleroderma, Aarohi M. Mehendale¹, Mahsa Parsanasab², Adhithi Ramasubramanian¹, Kavon Karrobi¹, Hung Vo³, Vasan Venugopalan², Andreea Bujor³, Darren M. Roblyer¹; ¹*Biomedical Engineering, Boston Univ., USA*; ²*Chemical and Biomolecular Engineering, Univ. of California, Irvine, USA*; ³*Boston Univ. School of Medicine, USA*. Using clinical SFDI measurements and Monte-Carlo simulations, we show that R_d at 0.2 mm^{-1} and 851 nm is sensitive to Scleroderma skin involvement. We also present the design and testing of a new handheld system for broad clinical translation.

TT1E.3 • 08:45

AI-Assisted Prediction of Burn Wound Healing Using Terahertz Time-Domain Spectral Imaging: First in-Human Study, Arash Karimi¹, Erica Heller¹, Zachery B. Harris¹, Deborah Le Blanc¹, Maria Taylor¹, Steven Sandoval¹, M. Hassan Arbab¹; ¹*SUNY Stony Brook, USA*. We present results from the first clinical study of burn diagnosis using a handheld terahertz spectroscopic imaging device. Leveraging physics-based AI models, we predict the healing rate of burns with 90% accuracy, compared to approximately 60% accuracy achieved by current clinical assessments.

TT1E.4 • 09:00

Terahertz Time-Domain Spectral (THz-TDS) Imaging for the Diagnosis of Skin Burns Post Enzymatic Debridement, Erica Heller¹, Zachery B. Harris¹, Arash Karimi¹, Rachel Bonn¹, Shi Fu¹, Huiting Luo¹, Miriam Rafailovich¹, Adam J. Singer¹, Steven Sandoval¹, M. Hassan Arbab¹; ¹*Stony Brook Univ., USA*. THz-TDS is a promising imaging technique for the diagnosis of burn depth. We demonstrate 100% accuracy in predicting the wound healing outcome within 14 days after enzymatic debridement treatment in a preliminary porcine model and pilot human studies.

TT1E.5 • 09:15

Precision Medicine for the Delineation of Basal Cell Carcinoma Using Unsupervised Machine Learning, Paulina Ibek¹, Alexander Degener¹, Magne Stridh¹, Marcus Tegnér¹, Patrik Edén¹, Victor Olariu¹, Malin Malmsjö¹, Aboma Merdasa¹; ¹*Lunds Universitet, Sweden*. We present a hyperspectral imaging pipeline using unsupervised machine learning to delineate basal cell carcinoma. It achieves 0.25–0.29 mm error in 20 human samples, showing that non-invasive HSI can provide accurate preoperative tumor boundaries.

TT1E.6 • 09:30

Dual-Channel Confocal Laser Endomicroscopy for the Detection of Early Inflammatory Bowel Disease, Huahui Zhang¹, Yiting Xu¹, Bo Liang¹, Congcong Zhou², Xuesong Ye^{1,2}; ¹*College of Biomedical Engineering and Instrument Science, Zhejiang Univ., China*; ²*National Engineering Research Center of Innovation and Application of Minimally*

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Invasive Instruments, Sir Run Run Shaw Hospital, Zhejiang Univ. School of Medicine, China. We demonstrate simultaneous *in vivo* monitoring of vascular and epithelial barriers using dual-channel confocal laser endomicroscopy. Results confirm that small-molecule vascular leakage occurs while the epithelium remains intact, offering a novel functional metric for early IBD staging.

TT1E.7 • 09:45

Capsule Endoscopy With Blue Green Imaging for Early Detection of Barrett's Esophagus, Cheima Hicheri¹, Alex Kortum¹, Jennifer Carns¹, Sharmila Anandasabapathy², Rebecca Richards-Kortum¹; ¹*Rice Univ., USA*; ²*Baylor college of Medicine, USA*. Scancap, a cost-effective, tethered capsule endoscope for BE screening, uses a 360° rotating mirror and Blue-Green illumination for enhanced microvasculature visibility. It successfully visualizes BE-characteristics in ex-vivo specimens, addressing the need for early EAC detection.

10:30 -- 12:00

Room: Las Olas III

BT2A • Widefield Optical Imaging

Presider: Nikhitha Mule; UT Southwestern Medical Center, USA

BT2A.1 • 10:30 (Invited)

Optical Mapping of Brain Function in Mice From Circuits to Behaviors, Adam Q. Bauer¹; ¹*Washington Univ. in St Louis, USA*. We leveraged optical neuroimaging and light-based motor mapping in mice to demonstrate a large degree of convergence between the topographies and hierarchies of functional brain network architecture and cortical maps of ethologically-relevant behaviors.

BT2A.2 • 11:00

Neurovascular Effects of Seizure and Cortical Spreading Depolarization Imaged With Widefield Optical Imaging, Alyssa Palmucci^{1,2}, Humberto Mestre-Payne^{1,2}, Hayden Fisher^{1,2}, Ethan Goldberg^{1,2}, Brian White^{1,2}; ¹*The Children's Hospital of Philadelphia, USA*; ²*The Perelman School of Medicine at The Univ. of Pennsylvania, USA*. Neurovascular coupling variation in cortical spreading depolarization may be a key to understanding the origin of neurologic injury. We imaged mice with widefield optical imaging through seizure induction, cortical spreading depolarization, and eventual respiratory arrest.

BT2A.3 • 11:15

Maintaining Spatial Autocorrelation During Imputation of Missing Neuroimaging Data, Yiyan Hao¹, Ofer Harel², Simon N. Vandekar³, Russell T. Shinohara⁴, Brian White^{5,6}; ¹*Department of Bioengineering, Univ. of Pennsylvania, USA*; ²*Department of Statistics, Univ. of Connecticut, USA*; ³*Department of Biostatistics, Vanderbilt Univ., USA*; ⁴*Department of Biostatistics, Epidemiology and Informatics, Perelman School of Medicine, Univ. of Pennsylvania, USA*; ⁵*Division of Pediatric Cardiology, The Children's Hospital of Philadelphia, USA*; ⁶*Department of Pediatrics, Perelman School of Medicine, Univ. of Pennsylvania, USA*. Incomplete data affects all neuroimaging techniques. Multiple imputation is a powerful statistical technique; however, we must ensure that the imputed data matches properties of the

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true data. Here, we evaluate spatial autocorrelation in imputed datasets.

BT2A.4 • 11:30

Independent Component Analysis Denoising Improves Reliability of Widefield Optical Imaging Functional Connectivity, Arash Asadian¹, Diego Derman¹, Brian White², Silvina Ferradal¹; ¹*Indiana Univ., USA*; ²*Children's Hospital of Philadelphia, USA*. We introduce a subject-level independent component analysis (ICA) denoising method for widefield optical imaging (WOI) that removes high-kurtosis artifacts, boosts within/between-subject similarity and subject identification from connectivity maps, and preserves group-level connectivity patterns.

10:30 -- 12:00

Room: Bonnet

MT2B • Computational Microscopy II

Presider: Ki Hean Kim; Pohang Univ of Science & Technology, South Korea

MT2B.2 • 11:00

Optimal Low-Signal Image Denoising via Binomial-Split Self-Supervised Learning, Hongqiang Ma¹, Chaojie Zhang¹, Yang Liu¹; ¹*Univ of Illinois at Urbana-Champaign, USA*. We introduce a self-supervised denoising method that uses statistically grounded binomial photon splitting to generate independent noisy pairs from a single image. It preserves fine structures, improves SNR, and enables robust low-light imaging across fluorescence and label-free imaging modalities.

MT2B.3 • 11:15

FLIM_{PSR}: a Pixel Super-Resolution Approach for Fluorescence Lifetime Imaging Using Deep Learning, Paloma Casteleiro Costa², Parnian Ghapandarkashani², Xuhui Liu¹, Alexander Chenn², Ary Portes², Laura Marcu¹, Aydogan Ozcan²; ¹*Univ. of California, Davis, USA*; ²*Univ. of California, Los Angeles, USA*. We present a pixel super-resolution framework for multi-channel fluorescence lifetime imaging microscopy (FLIM) that achieves fivefold spatial resolution enhancement, revealing fine structural features from undersampled data and supporting faster and hardware-flexible FLIM for clinical translation.

MT2B.4 • 11:30

Frequency Coherence Score: a Robust Image Quality Metric for Autofocus in Multimodal Microscopy, Hongqiang Ma¹, Chaojie Zhang¹, Shuyuan Zheng¹, Yang Liu^{1,2}; ¹*Bioengineering, Univ. of Illinois Urbana-Champaign, USA*; ²*Electrical and Computer Engineering, Univ. of Illinois Urbana-Champaign, USA*. The Frequency Coherence Score is a computationally efficient autofocus metric that measures frequency coherence from a single frame. It provides robust focus detection across multiple modalities and outperforms conventional sharpness measures under noise, intensity variation.

MT2B.5 • 11:45

Multislice Computational Modeling for Birefringence Microscope Imaging Simulations, Ting Xie¹, Anna Novoseltseva¹, Tong y. Li¹, Irving Bigio¹; ¹*Boston Univ., USA*. Birefringence microscopy provides rapid structural imaging of myelin, yet struggles with analyzing complex fiber geometries. We develop simBRM, a computational model that

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simulates mix myelin fiber structures, enabling precise interpretation of birefringence microscopy measurements.

10:30 -- 12:00

Room: Las Olas IV

OT2D • Deep Optics: Clinical Applications

Presider: Sergio Fantini; Tufts Univ., USA and Manojit Pramanik; Iowa State Univ., USA

OT2D.1 • 10:30 (Invited)

Multimodal Photoacoustic Ultrasound Imaging: From Bench to Bedside and Products, Chulhong Kim¹; ¹*chulhong@postech.ac.kr Pohang Univ of Science & Technology, South Korea.* (1) multiscale and multiparametric trans-energy imaging systems, (2) novel deep-learning powered image processing, (3) recent clinical study results in pathology, endocrinology, oncology, cardiology, dermatology, and radiology, (4) label-free ultrafast ultrasound Doppler imaging, and (5) efforts to commercialization.

OT2D.2 • 11:00

Side-Viewing Near-Infrared Spectroscopy for Depth-Sensitive Mapping of Ventricular Epicardial Ablation Lesions, Danyang Cheng¹, Jonah A. Majumder², Haiqiu Yang¹, Kenneth Laurita^{3,4}, Andrew M. Rollins⁴, Deepak Saluja⁵, Christine P. Hendon¹; ¹*Department of Electrical Engineering, Columbia Univ., USA;* ²*Department of Biomedical Engineering, Columbia Univ., USA;* ³*Department of Medicine, Cardiology Division, MetroHealth Hospital, USA;* ⁴*Department of Biomedical Engineering, Case Western Reserve Univ., USA;* ⁵*Department of Medicine, Cardiology Division, Columbia Univ. Vagelos College of Physicians and Surgeons, USA.* A side-viewing, multi-detector NIRS probe enables depth-sensitive mapping of epicardial radiofrequency ablation lesions. In 11 porcine hearts, SDS-specific spectral indices identified lesion regions and showed depth-dependent signatures across 1-6 mm source-detector separations.

OT2D.3 • 11:15

Developing Diffuse Optical Tomography for Peri-Arrest Monitoring in Piglets, Amit Subhash¹, Diego Derman¹, Hayden Fisher², S. Ananya Paladugu², Aidan Crozier², Tiffany Ko², Brian White², Silvina Ferradal¹; ¹*Indiana Univ., USA;* ²*Children's Hospital of Philadelphia, Afghanistan.* We developed a first-in-large-animal diffuse optical tomography (DOT) system to identify biomarkers of neurologic recovery in a piglet cardiac arrest model, designed a custom head cap, and validated the system's cortical sensitivity.

OT2D.4 • 11:30

Comparing Systemic and Cerebral Blood Flow During Controlled Hemorrhage and Resuscitation, Christian Crouzet¹, Danny F. Xie¹, Nicole Wakida¹, Tanya Burney¹, David Mukai¹, Michelle Khine¹, Bernard Choi¹; ¹*Univ. of California Irvine, USA.* Blood flow monitoring during hemorrhage may provide early markers of decompensation. We measured arterial blood pressure and systemic and cerebral blood flow during hemorrhage and resuscitation and showed that these measures closely track one another.

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OT2D.5 • 11:45

Prompt-Efficient Dual-Target Adaptation of SAM for Ultrasound Needle Tracking and Tumor Segmentation

Jahid Hasan¹, Praveenbalaji Rajendran², Cai Ying¹, Manojit Pramanik¹; ¹Iowa State Univ., USA; ²Emory Univ., USA. We introduce a prompt-efficient SAM-based multi-task method that simultaneously detects ultrasound-guided (US) needles and breast tumor segmentation using photoacoustic (PA) ground truth. This unified framework enables generalization to unseen data with a single bounding-box prompt.

10:30 -- 12:00

Room: Rio Vista

TT2E • Ocular Imaging & Reconstructions

Presider: Sanathana Konugolu Venkata Sekar; Tyndall National Inst., Ireland

TT2E.1 • 10:30

Real-Time Fisheye Doppler Holography for Ultra Wide-Field Choroidal and Retinal Blood-Flow Imaging, maxime Boy Arnould², yann fischer², zacharie auray², Michael Atlan^{1,2}; ¹CNRS, France; ²ESPCI, France. We report a simple, clinically compatible upgrade to real-time Doppler holography that enables live, ultra wide-field mapping of choroidal blood flow in undilated patients within a few second exam. This platform supports a path toward functional, quantitative choroidal biomarkers.

TT2E.2 • 10:45

A Trimodal Ocular Imaging System for Structure and Permeability Mapping in

Vivo, Yeachan Lee¹, Maomao Chen², Phuc Nguyen¹, Meltem Yashar¹, Felipe Barandiaran¹, Yannis Paulus¹; ¹Johns Hopkins Univ., USA; ²Univ. of Michigan, USA. We present a trimodal ocular imaging platform integrating optical coherence tomography, photoacoustic, and fluorescence microscopy to co-register structural and permeability data, resolving rabbit retinal neovascularization and enabling vascular bio-phenotyping for diagnostic applications.

TT2E.3 • 11:00

Beat-Resolved Retinal Flow and Shear Under Moderate IOP Elevation Using Rigid-Wall Womersley Inversion of Doppler Holography

David Gouyoumdjian², Lancelot Doucet², Yann Fischer², Zacharie Auray², Michael Atlan^{1,2}; ¹CNRS, France; ²ESPCI, France. Ultrafast retinal Doppler holography combined with rigid-wall Womersley inversion can quantify flow, wall shear, and pressure-gradient harmonics variations. During transient IOP elevation, arterial pulsatile flow and shear doubled, while the per-length impedance of vessel segments changed modestly.

TT2E.4 • 11:15

3D Carotid Artery Reconstructions Using Non-Invasive Diffuse Optical

Tomography, Nisha Maheshwari^{1,2}, Stephen Kim^{1,3}, Alessandro Marone¹, Lokesh Sharma^{1,2}, Andreas Hielscher¹; ¹Biomedical Engineering, New York Univ., USA; ²CaroRhythm, Inc., USA; ³Radiology, New York Univ. Grossman School of Medicine, USA. Data collected using a non-invasive diffuse optical tomography system were used to reconstruct images of the carotid arteries of two healthy subjects. Comparison to carotid Doppler ultrasound indicated a depth and spatial resolution of ± 2 mm.

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TT2E.5 • 11:30

A Metasurface Biosensor Platform for Multiplex Molecular Profiling Assay, Yubin Xiong¹, Po-Sheng Huang², Mu Ku Chen¹, Pin Chieh Wu², Lip Ket Chin³; ¹*Department of Electrical Engineering, City Univ. of Hong Kong, Hong Kong*; ²*Department of Photonics, National Cheng Kung Univ., Taiwan*; ³*Department of Electrical and Electronic Engineering, The Hong Kong Polytechnic Univ., Hong Kong*. We propose a metasurface biosensor platform that utilizes the plasmon-enhancement and chemifluorescence amplification for point-of-care molecular profiling of liquid biopsies. This assay provides a precise method for detecting biomarkers, thereby facilitating accurate diagnosis and monitoring.

TT2E.6 • 11:45

Fluorescence Structural Overlap and Depth Fidelity Loss From Physiological Eye Motion During Human in-Vivo Two Photon Retinal Imaging, Atul K. Dubey¹, Raphael Francis L. Aguas¹, Andrew W. Browne¹; ¹*Univ. of California Irvine, USA*. Physiological eye motion during human in-vivo two-photon retinal imaging causes focal plane shifts that create overlap and fidelity loss in structural fluorescence. Using simultaneous SLO-2PEF acquisition, we quantify motion-linked distortions, raising depth-fidelity concern during imaging sessions.

14:00 -- 15:30

Room: Las Olas III

BT3A • Deep Brain Imaging

Presider: Brian White, Children's Hospital of Philadelphia, USA

BT3A.1 • 14:00 (Invited)

FOCUS: Intensity-Based Scattering Correction for Deep Brain Imaging, Yi Xue¹; ¹*Univ. of California Davis, USA*. We developed Fourier-domain intensity coupling for scattering correction (FOCUS) as an active scattering correction approach for two-photon microscopy based on spatial intensity modulation rather than wavefront shaping. FOCUS achieves over 1 mm imaging depth in the intact mouse brain *in vivo*.

BT3A.2 • 14:30

In-Vivo Imaging of the Mouse Brain With Aberration Corrected Spatial Coherence Tomography, Herve Hugonnet¹, ChulMin Oh¹, Jieun Choi¹, Pilhan Kim¹, YongKeun Park¹; ¹*Korea Advanced Inst of Science & Tech, South Korea*. We propose spatial coherence tomography, a spatially modulated reflection holotomography with aberration correction capability. We apply our new microscope to in-vivo imaging of the mouse brain.

BT3A.3 • 14:45

Wide-Based NIRS Illumination for Enhanced Depth Sensitivity, revival shechter^{1,2}, Nathaniel Rein^{3,4}, Evgeny Tszin^{4,2}, Mordekhay Medvedovsky^{3,4}, Michal Balberg^{1,2}; ¹*faculty of engineering, Holon Inst. of Technology, Israel*; ²*NELC- Neuro ElectroLight Center, The Joint Research Center of Hadassah Medical Organization and Holon Inst. of Technology, Israel*; ³*Department of Neurology and Agnes Ginges Center for Human Neurogenetics, Hadassah Medical Organization, Israel*; ⁴*Faculty of Medicine, Hebrew Univ. of Jerusalem, Israel*. This study introduces a novel fNIRS setup with deeper tissue penetration, based on wide based optodes. We present results in a brain mimicking phantom and propose a wearable cap for future clinical

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study.

BT3A.4 • 15:00

Functional Perfusion Imaging Enabled by Long Wavelength, Interferometric Diffuse Correlation Spectroscopy, Mitchell B. Robinson¹, Bin Deng¹, Ailis Muldoon¹, Shakeeb Habash¹, Maria Angela Franceschini¹, Stefan Carp¹; ¹*Massachusetts General Hospital, USA*. Recent advances in interferometric diffuse correlation spectroscopy (iDCS) have enabled high signal-to-noise ratio, multi-channel perfusion imagers to be built. Here we demonstrate the use of long-wavelength multichannel iDCS for functional brain imaging.

BT3A.5 • 15:15

Integrated Diffuse Speckle Contrast Spectroscopy at 1064 nm for Deep-Tissue Blood Flow Monitoring, Sean Aleman¹, Nahidul Bhuiyan¹, Arnold Estrada², Ashwin B. Parthasarathy¹; ¹*Univ. of South Florida, USA*; ²*SPKL LLC, USA*. We present a wearable integrated Diffuse Speckle Contrast Spectroscopy (iDSCS) system, that uses photodiode speckle-variance integration, realized at 1064 nm for deep-tissue blood flow measurement in tissue.

14:00 -- 15:30

Room: Bonnet

MT3B • Novel Contrast, Multi-Modal Microscopy

Presider: Rosario Porrás-Aguilar; Univ of North Carolina at Charlotte, USA

MT3B.1 • 14:00 (Invited)

Practical Mid-Infrared Spectroscopic Imaging for Chemical Histopathology, Rohit Bhargava¹; ¹*Univ of Illinois at Urbana-Champaign, USA*. Pathology has traditionally involved assessing morphology using optical microscopy of stained tissue. Here, we report practical and fast mid-infrared imaging technology to record the chemical composition of each pixel. We then apply AI workflows to determine disease and stain tissue without dyes.

MT3B.2 • 14:30

Correlative Multimodal Label-Free and Immunofluorescence Imaging of Alzheimer's Disease Hallmarks, Kideog Bae^{1,2}, Aniwat Juhong¹, Edita Aksamitiene¹, Zhongtian Yang^{1,3}, Kayvan Tehrani¹, Stephen A. Boppart^{1,2}; ¹*Beckman Inst. for Advanced Science and Technology, Univ. of Illinois at Urbana Champaign, USA*; ²*NSF Science and Technology Center for Quantitative Cell Biology, Univ. of Illinois at Urbana Champaign, USA*; ³*Department of Bioengineering, Univ. of Illinois at Urbana Champaign, USA*. We integrate nonlinear optical microscopy with immunofluorescence to expand imaging in the Alzheimer's mouse hippocampus. Myelin, lipid halos and plaque's internal structures are visualized; immunostained images overlaid to mark glial cells, which density peaks near plaques, declining with distance.

MT3B.3 • 14:45

High-Resolution Sidestream Darkfield Microscopy for Visualizing Individual Melanocytic Cells in 3D, Rafael Romero¹, Carmella Ocaya¹, Yongjun Kim¹, Delaney Stratton¹, Momoka Sugimura¹, Kenneth Marcelino¹, Clara Curiel-Lewandrowski¹, DongKyun Kang¹; ¹*Univ. of Arizona, USA*. We present a high-resolution sidestream darkfield microscope (HR-SDF) for *in*

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vivo evaluation of melanocytic lesions. Volumetric imaging with a high numerical aperture objective enables visualization of melanocytic cells across imaging depths.

MT3B.4 • 15:00

Longitudinal Multimodal PAM, OCT, and Fluorescence Imaging Tracking of hiPSC-RPE Transplantation in Large Animals With Neurological Degeneration, Phuc Nguyen¹, Wei Qian², Abigail T. Fahim³, Xueding Wang³, Yannis Paulus¹; ¹*Wimer Eye Inst., Johns Hopkins Univ. School of Medicine, USA*; ²*Imra America Inc., USA*; ³*Ophthalmology and Visual Sciences, Univ. of Michigan, USA*. We present a multimodal optical imaging platform for *in vivo* tracking of subretinally transplanted hiPSC-RPE stem cells in a rabbit model. The approach combines photoacoustic microscopy, optical coherence tomography, and fluorescence imaging, enhanced with gold nanochains, to monitor cell migration.

MT3B.5 • 15:15

Tailored Speckle Illumination Microscopy With Enhanced Sectioning and Image Quality, SeungYun Han¹, KyeoReh Lee¹, Young Seo Kim², Chuan Li³, Nicholas Bender⁴, Kabish Wisal⁵, Taeyun Ku², Jerome Mertz³, Hui Cao¹; ¹*Department of Applied Physics, Yale Univ., USA*; ²*Graduate School of Medical Science and Engineering, KAIST, South Korea*; ³*Department of Electrical & Computer Engineering, Boston Univ., USA*; ⁴*School of Applied & Engineering Physics, Cornell Univ., USA*; ⁵*Department of Physics, Yale Univ., USA*. We tailor intensity statistics of illumination speckles for linear fluorescence microscopy. Three-dimensional tailored speckles provide axial sectioning comparable to confocal and structured illumination, and are robust to optical aberrations and scattering in vascular imaging.

14:00 -- 15:30

Room: Rio Vista

JT3C • Joint Panel Discussion (OCT, OT&S and Translational)

This panel discussion will examine the expanding role of artificial intelligence (AI) across the biophotonics research spectrum, from basic discovery science to translational and clinical applications. Panelists will highlight how AI is being used to analyze complex biological data, generate new hypotheses and accelerate the translation of fundamental findings into practical tools and therapies. The discussion will also address key challenges, including data integration, model interpretability, reproducibility and ethical considerations and will emphasize the importance of interdisciplinary collaboration. Overall, the panel will underscore AI's potential to enhance biophotonics research at multiple levels while highlighting the need for responsible and rigorous implementation and standardization. This panel discussion is a joint event by the Clinical and Translational Biophotonics, Optical Coherence Tomography and Optical Tomography and Spectroscopy Topicals. Please note this panel is part of the technical program and accessible to full technical registrants only.

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15:30 -- 17:00

Atlantic Ballroom

JT4A • Joint Poster Session II

JT4A.1

Scattering-Based Light Sheet Microscopy Imaging of Fresh Intraoperative "Frozen Section" Specimens: a Pilot Study, Brooke Liang^{1,2}, Jingwei Zhao³, Yongjun Kim⁴, DongKyun Kang^{3,4}, Eric Yang¹; ¹*Pathology, Stanford Univ., USA*; ²*Pathology, Univ. of Colorado, USA*; ³*Wyant College of Optical Sciences, Univ. of Arizona, USA*; ⁴*Department of Biomedical Engineering, Univ. of Arizona, USA*. Microscopic evaluation of intraoperative specimens may be improved by rapid, non-destructive imaging techniques. Here, we explore the use of scattering-based light sheet microscopy (sLSM) on a variety of fresh surgical specimens.

JT4A.2

Analytical and Experimental Determination of Optical Redox Ratio Estimation Error, Evan Sharafuddin¹, Hong Hu¹, Janet E. Sorrells¹; ¹*Washington Univ. in St Louis, USA*. The optical redox ratio (ORR) has been used to study diverse biological systems and mechanisms. Here, we provide an analytical solution for estimated ORR variance and verify it using both simulated and experimental data.

JT4A.3

Characterizing Spectral Responses of Sick Cell Hemoglobin to Oxygen-Affinity Modulation Under Hypoxia, Justin F. Fan¹, Robert Highland¹, Adam Wax¹; ¹*Duke Univ., USA*. We examine hemoglobin spectral responses to various deoxygenating and oxygen-affinity modulating agents, focusing on Q-band time-varying changes in sickled hemoglobin. This analysis uniquely allows for novel standardization of in-vitro oxidative modulating agents in oxygen-dependent conditions.

JT4A.4

Optimization of UV-Excitable, Fluorescent Staining Protocol for Ex Vivo Tissue Imaging, Bakai Sheyitov^{1,2}, Pavel B. Tsitovich², Huayu Hou¹, Jimin Wu³, Sahar Sadeghi¹, Ashok Veeraraghavan³, Konstantin Sokolov², Rebecca Richards-Kortum^{1,3}; ¹*Bioengineering, Rice Univ., USA*; ²*Imaging Physics, The Univ. of Texas MD Anderson Cancer Center, USA*; ³*Electrical Engineering, Rice Univ., USA*. Intra-operative oral and breast tumor margin assessment with a novel UV-surface excitation microscope requires an established fluorescent staining protocol. Dyes were evaluated for spectral, photophysical, and tissue-labeling properties to identify optimal staining formulation.

JT4A.5

Photon-Number Distributions of Ultra-Low-Light, Mahshid Zoghi¹, Aristide Dogariu¹; ¹*CREOL, Univ. of Central Florida, USA*. We developed a statistical approach that compensates for Bernoulli thinning and independent dark-noise in ultra-low photon counting measurements, recovering Poisson statistics of attenuated laser fields and revealing statistical evolution in ultra-weak, non-stationary emission from cancer cells.

JT4A.6

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Label-Free Imaging of Conjunctival Goblet Cells in Mice, Noseong Park¹, Suil Jeon¹, Ki Hean Kim¹; ¹*Pohang Univ of Science & Technology, South Korea*. Quantitative oblique back-illumination microscopy (qOBM) enables label-free, high-contrast imaging of conjunctival goblet cells in mice. Validated against fluorescence and histology, qOBM provides rapid, non-contact assessment relevant for ocular surface research and diagnostics.

JT4A.7

Fractional Laser Treatment for Articular Cartilage Repair, Tyler Iorizzo^{1,2}, Kate Mallory¹, James Childs², Ilya Yaroslavsky², Gregory Altshuler², Anna Yaroslavsky¹; ¹*Advanced Biophotonics Laboratory at Univ. of Massachusetts Lowell, USA*; ²*IPG Medical, USA*. Quantitative fluorescence microscopy and Nuclear Magnetic Resonance (NMR) spectroscopy were utilized for elucidating and comparing the effects of fractional laser treatment and mechanical puncturing on cartilage.

JT4A.8

Withdrawn

JT4A.9

Real Time Speckle Suppression in 4D-OCT Using Inverse Eulerian Magnification, Andrei Perez¹; ¹*Photomedicine Labs, Canada*. We propose Inverse Eulerian Video Magnification to denoise time-resolved OCT. Using temporal frequencies to suppress speckle while preserving flow, it achieves 300% better ENL at 3ms/frame than gold standards, enabling real-time clinical applications.

JT4A.10

Estimating the Operating Range of OCT Speckle Digital Phantoms for Light Source Parameters, Maria M. Miazdzyk¹, D. Robert Iskander¹; ¹*Politechnika Wroclawska, Poland*. Digital OCT phantoms can serve to estimate tissue optical parameters in-vivo. This study aimed to estimate the operating range for input central wavelength and spectral width of light source for a Monte Carlo based OCT digital phantom simulation, by analyzing speckle statistics.

JT4A.11

Compressive Subsampling and Volumetric Inpainting for Rapid Intraoperative OCT Assessment of Donor Organs, Bornface M. Mutembe^{1,2}, Feng Yan², Qinggong Tang², Yuye Ling¹; ¹*School of Electrical and Computer Engineering, the Univ. of Oklahoma, USA*; ²*Stephenson School of Biomedical Engineering, the Univ. of Oklahoma, USA*. Nyquist-sampled OCT acquisition limits rapid imaging of donor organs. We propose lateral compressive subsampling and reconstruct the final OCT volumes by integrating reconstructions obtained from complementary planes (en-face and B-scan).

JT4A.12

A-Scan Resolution Enhancement in OCT Based on Spectral Splitting and Multi-Camera Detection, Pascual Sevillano^{1,2}, Julia Peña², Iñigo Salinas², Carlos Heras², Alejandra Consejo^{1,2}; ¹*Universidad de Zaragoza, Spain*; ²*Instituto Universitario de Investigación en Ingeniería de Aragón (I3A), Spain*. A hardware-based split-spectrum dual-camera method enhances SD-OCT axial resolution by combining complementary VIS and NIR bands into an

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extended-bandwidth interferogram. The approach requires no modifications and achieves 1 μm resolution with negligible computational cost.

JT4A.13

Integration of Polarization Sensitivity Into Full-Field Optical Coherence

Tomography, Michele G. D'Aquino¹, Ajmal Ajmal¹, Tananant Boonya-ananta¹, Andres J. Rodriguez¹, Jessica C. Ramella-Roman¹; ¹*Florida International Univ., USA*. This work explores the integration of polarization sensitivity into a Full-Field Optical Coherence Tomography device to determine if the added polarization contrast can improve depth-resolved visualizations of birefringent tissue.

JT4A.14

How Excitation Frequency Affects Rayleigh Wave Frequency in Optical

Elastography, Jinjun Xia¹; ¹*Lawrence Technological Univ., USA*. We studied how the frequency of the excitation radiation force affects the frequency of the excited Rayleigh wave propagating along the surface of soft biological tissue mimicking phantoms in optical elastography.

JT4A.15

Axial Structured Illumination Tomography (ASIT): a 3D Label-Free Phase Imaging

Technique, Nishant Goyal¹, Kedar Khare¹; ¹*Indian Inst. of Technology Delhi, India*. This work shows that on-axis structured illumination(s) with sparsity-driven reconstruction enables cross-talk-free 3D refractive index imaging, presenting the core idea and a complete practical guideline for building such a system without conventional multi-angle illumination(s).

JT4A.16

Investigating the Potential to Estimate CSF Thickness on Children Using High-Density Diffuse Optical Tomography

, Yutian Qin¹, Sung Min Park¹, Adam T. Eggebrecht¹; ¹*Washington Univ. in St Louis, USA*. We simulated and analyzed how the cerebrospinal fluid thickness affects the light fall-off curves using high-density diffuse optical tomography in children. Our results show that HD-DOT can potentially estimate CSF thickness both globally and focally.

JT4A.17

Longitudinal Performance of Three-Wavelength Optical Sensors for Extracorporeal

Settings in an Ovine Model, Osama M. Elgabori¹, Kelly R. Strong¹, Ander D. Gallastegi¹, Ryuji Nakamura¹, William B. Scammon¹, Keith E. Cook¹, Jana M. Kainerstorfer^{1,2}; ¹*Biomedical Engineering, Carnegie Mellon Univ., USA*; ²*Neuroscience Inst., Carnegie Mellon Univ., USA*. We describe the calibration of 3-wavelength optical sensors measuring hemoglobin concentration and oxygen saturation in whole blood for ECMO settings. We examine their performance through 30-day in-vivo sheep studies.

JT4A.18

Developing a Low-Cost, Miniaturized Frequency-Domain Near-Infrared Spectroscopy

System Using Software-Defined Radios (SDRs), Kai-Ting Ting¹, Miguel Mireles¹, Edward Xu¹, Qianqian Fang^{1,2}; ¹*Bioengineering, Northeastern Univ., USA*; ²*Electrical and Computer Engineering, Northeastern Univ., USA*. We present a framework for building low-cost miniaturized frequency-domain near-infrared spectroscopy systems using off-the-shelf software-

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defined radios (SDRs). The platform supports programmable modulation frequencies and is easily expandable for additional channels.

JT4A.19

Automated Baseline Correction Evaluation Score for Raman Spectroscopy, Simone Innocente^{1,2}, Andrea Visentin^{2,3}, Stefan Andersson-Engels^{1,4}, Katarzyna I. Komolibus¹, Rekha Gautam¹; ¹*Biophotonics@Tyndall, Tyndall National Inst., Ireland*; ²*School of Computer Science and Information Technology, UCC, Ireland*; ³*Insight Centre for Data Analytics, UCC, Ireland*; ⁴*School of Physics, Univ. College Cork, Ireland*. Raman spectroscopy requires reliable baseline correction, but visual assessment is subjective and slow. The IS-Score automatically evaluates correction quality using spectral properties, identifying poor fits, matching expert judgments, and improving consistency for large clinical datasets.

JT4A.20

FNIRS Artifact Removal Using Selective Mode Suppression, Dmitry Patashov², Yakir Menahem³, Yoshinari Kameda¹, Dmitry Goldstein³, Michal Balberg³; ¹*Univ. of Tsukuba, Japan*; ²*Waseda Univ., Japan*; ³*Holon Inst. of Technology, Israel*. Selective mode suppression is an algorithm that decomposes signals into intrinsic modes, examines each mode for presence of an artifact, and locally suppresses the artifact only within the affected modes. This procedure reduces the distortion of the information while removing the artifact effects.

JT4A.21

Evaluating the Impact of Skin Pigmentation on Diffuse Optical Spectroscopy (DOS) Techniques, Karen Huang², Caitlyn Davis¹, Kenneth Abramson², Nicolina Ranieri^{3,4}, Joseph B. Majeski², Jennifer Lynch¹, Rodrigo M. Forti⁵; ¹*Department of Bioengineering, Univ. of Pennsylvania, USA*; ²*School of Arts and Sciences, Univ. of Pennsylvania, USA*; ³*Department of Anesthesia and Critical Care, Children's Hospital of Philadelphia, USA*; ⁴*School of Biomedical Engineering, Drexel Univ., USA*; ⁵*Division of Neurology, Children's Hospital of Philadelphia, USA*. Skin phantoms comprising of biologically relevant melanin levels were developed to assess whether pigmentation affects diffuse optical spectroscopy. Preliminary phantom testing suggested that darker skin tones significantly impact accuracy of recovered absorption and reduced scattering coefficients.

JT4A.22

Entangled Exploration of Human Lung Epithelial Cancer Cells by Optical Self-Diffraction, Carlos Torres-Torres¹, Blanca E. García-Pérez¹, Jhovani Bornacelli²; ¹*Instituto Politécnico Nacional, Mexico*; ²*Universidad Autónoma del Estado de Hidalgo, Mexico*. Vectorial self-diffraction generated by a multi-wave mixing in A549 cells in monolayer form is employed to analyze entangled multi-spatial-optical fields. Quantum correlations can potentially modify nonlinear transmittance controlled by multiphotonic effects in the samples.

JT4A.23

Intraoperative Diffuse Optical Tomography Using a Camera-Based System for Small-Animal Imaging, Xuejun Hong¹, Gultekin Gulsen¹, Farouk Nouizi¹; ¹*Univ. of California Irvine, USA*. We developed a multi-wavelength intensified CCD-based diffuse optical tomography system to recover 3D, spatially resolved tissue oxygenation in small-animal models, particularly

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rabbits. The system is designed to monitor therapy outcomes in the liver.

JT4A.24

Inactivation of Pathogens With Short Pulses Using Metamaterial Manipulation in Decontamination Areas, Nicolae A. Enaki¹; ¹*Inst. of Applied Physics, Moldova State Univ., Moldova (the Republic of)*. Combined absorption of ultraviolet C and infrared radiation pulses was achieved in pathogen decontamination equipment. A substantial increase in the inactivation rate of the fungal solution flowing through the rotating channels of the quartz metamaterial was observed.

JT4A.25

Linear-Scan Mapping of Optical Property Changes in Microwave-Ablated Ex Vivo Liver, Alessandro Bossi¹, Andrea L. Pacheco Tobo¹, Chiara Licursi¹, Paola Saccomandi¹, Antonio Pifferi¹; ¹*Politecnico di Milano, Italy*. Spatially resolved broadband time-domain optical measurements in *ex vivo* liver reveal strong variations in absorption and scattering across the microwave ablation zones, demonstrating that optical properties provide clear markers of local thermal damage.

JT4A.26

Enhancing Dual-Wavelength GASMAS Quantification Using Photon Time-of-Flight Spectroscopy, Sri Rama Pranav Kumar Lanka¹, Stefan Andersson-Engels¹, Sanathana Konugolu Venkata Sekar¹; ¹*Tyndall National Inst., Italy*. Gas in Scattering Media Absorption Spectroscopy (GASMAS) enables non-invasive sensing of free gas within turbid materials. We propose a Perturbative Attenuation to Absorption (PAA) analysis that improves quantitative oxygen retrieval compared to the conventional path length-invariant method.

JT4A.27

Phantom and in-Vivo DCS and TD-DCS Measurements With Compact 1064 nm Laser, Tommaso Palo¹, Lisa K. Frisk², Alessandro Bossi¹, Ilaria Bargigia¹, Laura Di Sieno¹, Alberto Dalla Mora¹, Turgut Durduran², Antonio Pifferi¹; ¹*Politecnico di Milano, France*; ²*ICFO, Spain*. We studied a 1064 nm laser source with a small linewidth and short pulses for DCS and TD-DCS experiments. After measurements on phantoms and in-vivo, we concluded it is sufficiently precise and accurate enough for further study.

JT4A.28

Hardware-Accelerated Implicit Mesh-Based Monte Carlo for Simulating Light Transport Inside Complex Anatomical Structures, Aiden Lewis¹, Qianqian Fang¹; ¹*Northeastern Univ., USA*. We present a hardware-accelerated implicit mesh-based Monte Carlo simulator that accurately propagates photons across large numbers of analytically defined 3D inclusions inside complex tissues. This approach yields a 7×–30× speedup compared to 128-threaded simulations using central processing units.

JT4A.29

Peripheral Hemodynamic Changes in Control Subjects Using Spatio-Temporal NIRS, Daniela Jimenez Perez¹, Aasma Dahal¹, Shirel Belilty Benmergui¹, Joshua Hutcheson¹, Anuradha Godavarty¹; ¹*Florida International Univ., USA*. Peripheral hemodynamic changes from the foot's plantar surface were determined using spatio-temporal NIRS imaging in control

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subjects. A distinct change in hemodynamic and diffuse reflectance-based parameters was observed in response to a leg-elevation paradigm.

JT4A.30

A Modified ResNet-Based Algorithm for Bioluminescence Tomography Applications in Small Animal Imaging, Zifeng Huang¹, Yuqi Xia¹, Gultekin Gulsen¹, Farouk Nouizi¹; ¹*Univ. of California Irvine, USA*. We implemented a CNN-based algorithm to reconstruct 3D Bioluminescence tomography images of mice. The algorithm uses a modified ResNet algorithm trained on a database generated using our finite element method-based simulator on a mouse-like geometry.

JT4A.31

Speckle Contrast Optical Spectroscopy for Microcirculatory Assessment in a Hemorrhagic Shock Model, Tomoya Yamamoto¹, Koki Kurono¹, Kenta Oba², Hiroki Matsushita², Shuta Hashimoto¹, Mei Mochizuki¹, Keita Saku², Masashi Ichinose³, Yumie Ono⁴; ¹*Graduate School of Science and Technology, Meiji Univ., Japan*; ²*Department of Cardiovascular Dynamics, National Cerebral and Cardiovascular Center, Japan*; ³*Human Integrative Physiology Laboratory, School of Business Administration, Meiji Univ., Japan*; ⁴*Department of Electronics and Bioinformatics, School of Science and Technology, Meiji Univ., Japan*. Peripheral tissue blood flow in a canine model of hemorrhagic shock was monitored using speckle contrast optical spectroscopy. Both nonpulsatile and pulsatile changes reflected tissue hemodynamics, highlighting its potential as a noninvasive microcirculation monitor.

JT4A.32

Spectrum of Singlet Oxygen Raman Photogeneration Efficiency in Distilled Water, Aristides Marcano Olaizola¹, Sonia Wabukoya¹, Walique Richardson¹; ¹*Delaware State Univ., USA*. We report on excitation spectra of the efficiency of singlet oxygen generated using the Raman method. Spectral maxima are observed for several pump wavelengths in the region 400-700 nm, demonstrating the effect's resonant character.

JT4A.33

Validation of Tissue Curvature Correction Models in NIRS via Phantom Studies, Himaddri Shakhar Roy¹, Jhoan Gonzales¹, Shivam Shukla¹, Anuradha Godavarty¹; ¹*Florida International Univ., USA*. Recently tissue curvature correction models for our smartphone-based NIRS imaging were developed and validated via Monte-Carlo simulation studies. Herein, these curvature correction models are validated on curved phantoms towards wound imaging studies in the future.

JT4A.34

Rapid 3D Optical Property Tomography via Deep Neural Networks Trained on Spatial Frequency Domain Data, Augusto A. Fernandes¹, Felipe M. Rodrigues¹, Adamo Monte¹; ¹*Universidade Federal de Uberlândia, Brazil*. A feedforward neural network trained on diffusion-theory reflectance profiles replaces Monte Carlo lookup tables in SFDI, enabling real-time inversion. Depth is physically retrieved from multi-frequency absorption attenuation, yielding wide-field 3D biodistribution maps.

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JT4A.35

In Vivo Evaluation of Dermis Optical Properties Using Time-Domain Diffuse Optical Spectroscopy, Alessandro Bossi¹, Emma Lacagnina², Giulia Nieri², Marianna Locatelli², Laura Oggionni², Malak Ouaiem², Antonio Pifferi¹, Paola Saccomandi²; ¹*Department of Physics, Politecnico di Milano, Italy*; ²*Department of Mechanical Engineering, Politecnico di Milano, Italy*. We present preliminary in vivo characterization of dermal optical properties using Time-Domain Diffuse Optical Spectroscopy (TD-DOS). TD-DOS overcomes limitations due to pigmentation and enables evaluation of dermal hydration and hemoglobin concentrations, demonstrating adequate depth sensitivity.

JT4A.36

Camera-Free NIR-II Fluorescence Molecular Tomography via Single-Pixel Spatial Frequency Domain Imaging, Wenxing Bai², Dongyuan Liu^{2,1}, Feng Gao^{2,1}; ¹*State Key Laboratory of Precision Measurement Technology and Instruments, China*; ²*School of Precision Instrument and Optoelectronics Engineering, China*. We demonstrate a camera-free NIR-II fluorescence tomography platform using single-pixel spatial frequency domain imaging. NIR-II structured excitation and SPAD-based compressive detection enable millimeter-scale shallow separability and depth-dependent localization in tissue-mimicking phantoms.

JT4A.37

Investigation of Individual Variability in Time-Resolved Near-Infrared Spectroscopy Tissue Optical Coefficients, Mei Mochizuki¹, Mikie Nakabayasi^{2,3}, Koki Kurono¹, Dai Okushima⁴, Shunsaku Koga⁵, Masashi Ichinose⁶, Yumie Ono⁷; ¹*Graduate School of Science and Technology, Meiji Univ., Japan*; ²*Faculty of Engineering, Niigata Univ., Japan*; ³*Inst. for Research Administration, Niigata Univ., Japan*; ⁴*Department of Information and Management Systems Engineering, Nagaoka Univ. of Technology, Japan*; ⁵*Faculty of Design, Kobe Design Univ., Japan*; ⁶*Human Integrative Physiology Laboratory, School of Business Administration, Meiji Univ., Japan*; ⁷*Department of Electronics and Bioinformatics, School of Science and Technology, Meiji Univ., Japan*. We quantified forearm optical coefficients at a 3-cm source-detector distance using time-resolved near-infrared spectroscopy. Results suggest the need to account for adipose thickness and sex variability to improve hemodynamic quantification in diffuse correlation spectroscopy.

JT4A.38

Deep-Learning-Based Denoising of DCS Autocorrelation Curves for Improved Blood Flow Estimation, Marco Nabacino¹, Caterina Amendola¹, Davide Contini¹, Rebecca Re^{1,2}, Lorenzo Spinelli², Alessandro Torricelli^{1,2}; ¹*Politecnico di Milano, Italy*; ²*Istituto di Fotonica e Nanotecnologie, Consiglio Nazionale delle Ricerche, Italy*. We propose a deep-learning-based denoising method for Diffuse Correlation Spectroscopy (DCS) autocorrelation curves. The approach preserves curve shapes, improves signal-to-noise ratio, and enhances blood flow estimation, enabling post-processing integration with standard DCS analysis pipelines.

JT4A.39

Deep Learning Assisted Label-Free Microscopy for Morphodynamics Based Rapid Cytotoxicity Testing, Md Saimun Alam¹, Somaiyeh Khoubafarin¹, Aniruddha Ray¹; ¹*Univ. of Toledo, USA*. We present a automated method of predicting cell death mechanism using phase and scattering-based microscopy coupled with deep learning, achieving ~98% accuracy. This

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approach delivers real-time insights into cellular responses for cytotoxicity testing, which we apply for anti-cancer drug screening.

JT4A.40

A Regularization Penalty Based on Laguerre-Gaussian Hilbert Transform for Artifact-Free Image Reconstruction, Muskan Kularia¹, Kedar Khare¹; ¹*Optics and Photonics Centre, Indian Inst. of Technology Delhi, India*. We propose a Laguerre–Gaussian Hilbert transform-based penalty that overcomes the directional bias common in traditional gradient-based penalties like total variation and eliminates the corresponding grid-like artifacts enabling higher fidelity reconstructions for inverse imaging tasks.

JT4A.41

A new Generation of Tunable Femtosecond OPOs for Neuroscience and Biomedical Imaging, Lukas Kontenis¹, Giedrius Martynaitis¹, Zygintas Dabulis¹, Christian Wilms¹, Mantvydas Mikulis¹; ¹*Light Conversion, Ltd., Lithuania*. Femtosecond lasers tunable in the 650 – 1300 nm range are the workhorses of multiphoton imaging with Yb-based optical parametric oscillators being the technology of choice. We present a new family of industrial-design tunable Yb OPOs from Light Conversion and report their key performance metrics.

JT4A.42

Withdrawn

JT4A.43

Hybrid Multilayer SPR Biosensor for Cancer Biomarker (CEA) Detection, Maymona Binte Juwel¹, Md. Al Amin Islam Utshob¹, Khandakar M. Ishtiaq¹; ¹*Ahsanullah Univ. of Science & Tech, Bangladesh*. We demonstrate an improved surface plasmon resonance biosensor based on CaF₂/PbTiO₃/Ag/ZnO/MoS₂ layers for highly sensitive, label free carcinoembryonic antigen detection and evaluates its performance with that of traditional sensors, demonstrating significant improvement in detection capability.

JT4A.44

Performance Disparities in Very Deep Super-Resolution Learning for Malignant Versus Benign Breast Histopathological Images, Tugba N. Bozkurt¹, Gokhan Ertas¹; ¹*Yeditepe Universitesi, Turkey*. VDSR networks enhance breast histopathological image resolution, but performance is significantly higher for malignant than benign lesions, necessitating optimization. Prospective studies on VDSR based segmentation and classification pipelines will support scalable AI-assisted pathology.

JT4A.45

Spectral LED Irradiation Modulates Growth, Pigment Biosynthesis, and Antimicrobial Activity in *Scenedesmus* sp., Shaimaa Alexeree¹; ¹*Department of Laser Applications in Photochemistry and Photobiology, National Inst. of Laser Enhanced Science, Egypt*. LED red, blue, and mixed light boosted *Scenedesmus* sp. growth, pigments, antioxidants, and antibacterial activity. Mixed light gave the highest pigments, blue enhanced antioxidant power, and red showed the strongest antibacterial effect—supporting biophotonic production of high-value metabolites.

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JT4A.46

Optics as a Relational Science: From Light–Matter Interaction to Emergent Perception Across Scales, Esan M. Adegunloye^{2,1}; ¹*Yenching academy of interdisciplinary, Peking Univ., China*; ²*Global visionary academia innovators department, Univ. of Lagos, Nigeria*. Optics unifies geometrical, physical, and quantum perspectives to explain how light enables coherent perception across scales. Advances in biophotonics and photonic sensing reveal optics as a relational infrastructure shaping how physical and living systems sense, adapt, and organize.

JT4A.47

A High-Performance Urine Glucose Biosensor for Hyperglycemia Patients, Abror Jawad^{1,2}, Al Hadith Moon², Md. Sultan Mahmud¹, Md. Shamim Anower³; ¹*Bangladesh Univ. of Business & Tech, Bangladesh*; ²*Electrical & Electronic Engineering, Rajshahi Univ. of Engineering & Technology, Bangladesh*; ³*Mechatronics Engineering, Univ. of South Australia, Australia*. A hybrid SPR biosensor for urine glucose sensing is analyzed using the TMM method. The Kretschmann design uses a CaF₂ prism with Ag (47 nm) and KTaO₃ (1 nm) layers. At 10 g/dL glucose, sensitivity reaches 552.5 deg/RIU, enabling medical diagnostics and point-of-care testing. and diabetes monitoring.

JT4A.48 • 15:30

Phase Detection in SD-OCT for Flow Imaging Using in Situ Ultrasonically Sculpted Optical Waveguides, Lloyd Lobo¹, Junze Liu², Hang Yang², Yasin Karimi¹, B. Hyle Park², Maysam Chamanzar¹; ¹*Electrical and Computer Engineering, Carnegie Mellon Univ., USA*; ²*Department of Bioengineering, Univ. of California Riverside, USA*. We address the resolution versus focal depth tradeoff in phase sensitive SD-OCT by developing ultrasonically enhanced OCT (ue-OCT). Our experimental results demonstrate that ue-OCT is phase stable and measure flow changes in a tissue phantom.

JT4A.49 • 15:30

Polarization-Sensitive OCT for Quantitative Characterization of Biofilm Thickness and Interface Roughness, Ran Zhang¹, Mitra Mirsalehi¹, Patrick Mirindi¹, Sara E. Beck¹, Chris Zhou¹, Shuo Tang¹; ¹*Univ. of British Columbia, Canada*. Polarization-sensitive OCT quantifies biofilm thickness and interface roughness, revealing differences in attachment morphology between substrates and supporting interface roughness as a complementary structural metric.

JT4A.50 • 15:30

Asymptotic Resonance Framework for Inverse Design of Multilayer Nanoparticle Contrast Agents in Biomedical Optical Imaging, TAOUFIK MEKLACHI¹; ¹*SSET, Pennsylvania State Univ.-Harrisburg, USA*. We present resonance formulas and effective medium framework for multilayer high-contrast nanostructures, enabling inverse design of composite optical contrast agents with prescribed linear and nonlinear response relevant to biomedical imaging, biosensing, and differential detection.

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Wednesday, 29 April

08:00 -- 10:00

Room: Las Olas III

BW1A • Functional Imaging of Neural Activity

Presider: Amanda Foust; Imperial College London, UK

BW1A.1 • 08:00 (Invited)

Probing Neurovascular Coupling Using Combined Optical and Electrophysiological Techniques, Philip O'Herron¹, Kun Xie¹, Dalchand Ahirwar¹, Olubukola Ojo¹; ¹*Augusta Univ., USA*. This study uses optogenetics to block neurovascular coupling in a mouse model. Then, using optical imaging and electrophysiology, we determine how neuronal response properties and cellular metabolic processes are affected by this alteration.

BW1A.2 • 08:30

Withdrawn

BW1A.3 • 08:45

Disentangling Hemodynamic Contamination From Neural Calcium Signals in Mesoscale Widefield Imaging Using Dual Wavelength Regression, Tenesha Connor^{1,2}, Murat Yildirim¹; ¹*Cleveland Clinic Foundation, USA*; ²*Biomedical & Chemical Engineering, Cleveland State Univ., USA*. Dual wavelength widefield imaging with Allen Atlas based regression isolates neural calcium dynamics from hemodynamic artifacts. Indicator and region dependent contamination were quantified and show with different analysis hemodynamic subtraction mechanisms significantly alter cortex metrics.

BW1A.4 • 09:00

Withdrawn

BW1A.5 • 09:15

Mapping Resting State Cortical Neural Networks to Hemodynamics Using High-Speed Voltage Imaging, Lisa M. Meyer-Baese¹, Dieter Jaeger², Shella Keilholz¹; ¹*Georgia Inst. of Technology & Emory, USA*; ²*Emory, USA*. To characterize spontaneous cortical network organization wide-field voltage and hemodynamic imaging were represented through CAPs. CAPs recapitulated functional connectivity. Mutual information revealed weak but consistent broadband voltage–hemodynamic coupling without strong frequency specificity.

BW1A.6 • 09:30

Optimization of Spatial and Temporal Sampling Resolution for Optophysiology in Large-Scale two-Photon Calcium Imaging, Dian Chen¹; ¹*John Hopkins, USA*. We evaluate automated optical physiology performance across spatial and temporal sampling in mouse cortex with the goal of optimizing multiphoton microscope design. Spatial sampling ($\leq 3 \mu\text{m}$) critically determines accuracy, while temporal sampling shows greater tolerance.

BW1A.7 • 09:45

Inducing Non-Pulsatile Cerebral Blood Flow With an Optogenetic Control Loop, William B. Scammon², Jana M. Kainerstorfer^{2,3}, Alberto Vazquez^{1,4}; ¹*Radiology, Univ. of Pittsburgh*,

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USA; ²Biomedical Engineering, Carnegie Mellon Univ., USA; ³Neuroscience Inst., Carnegie Mellon Univ., USA; ⁴Bioengineering, Univ. of Pittsburgh, USA. We present a novel method for damping the pulsatile component of cerebral blood flow in optogenetic mice using a control system that modulates arterial tone.

08:00 -- 10:00

Room: Bonnet

MW1B • Computational Microscopy III

Presider: Janet Sorrells; Washington Univ. in St Louis, USA

MW1B.1 • 08:00 (Invited)

High-Throughput Virtual Staining With Computational Microscopy, Seung Ah Lee¹; ¹Seoul National Univ., South Korea. Abstract not available.

MW1B.2 • 08:30

Universal Adversarial Microscopic Perturbations Reveal Transferable Vulnerabilities in Pathology Foundation Models, Yuntian Wang¹, Xilin Yang¹, Che-Yung Shen¹, Nir Pillar², Aydogan Ozcan¹; ¹Univ. of California Los Angeles, USA; ²Hadassah Hebrew Univ. Medical Center, Israel. We introduce a universal adversarial perturbation framework exposing vulnerabilities in pathology foundation models. A single optimized microscopic pattern severely disrupts feature representations across unseen black-box models, highlighting security risks in digital pathology and microscopy.

MW1B.3 • 08:45

Automated Diagnosis of Barrett's Esophageal Neoplasia on High-Resolution Microendoscopy, Karthik Goli¹, Johnathan Jia², Richard Schwarz¹, Jennifer Carns¹, Sonia Singh², Josiah Shin², Alex Kortum¹, Adrianna Maliga², Sharmila Anandasabapathy³, Hyun-Hwan Jeong², Mimi Tan², Rebecca Richards-Kortum¹; ¹Rice Univ., USA; ²Baylor College of Medicine, USA; ³The Univ. of British Columbia, Canada. High-resolution microendoscopy (HRME) paired with AI algorithms can be used to provide a real-time in vivo diagnosis of neoplasia in Barrett's esophagus. ConvNeXt with an attention module is able to achieve 95% accuracy and 0.96 AUC-ROC for diagnostic classification of HRME images.

MW1B.4 • 09:00

MAD: Self-Supervised Image Embeddings Encode Molecular Information at Single-Cell Resolution, Jiashu Han¹, Kunzan Liu¹, Yeojin Kim², Saurabh Sinha², Sixian You¹; ¹MIT, USA; ²Georgia Tech, USA. We introduce MAD, a microenvironment-aware self-supervised pretraining framework that learns single-cell embeddings from complementary cell-centric and morphology-based views, enabling broad applicability across diverse biological downstream tasks.

MW1B.5 • 09:15

Manifold Alignment for Label-Free Cell Phenotyping in Multimodal Microscopy, Amir Reza Vazifeh¹, Jason Fleischer¹; ¹Princeton Univ., USA. We show that manifold-aligned neighbor embedding enables label-free phenotyping of live and dead cells from multimodal microscopy

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images. Without fluorescent labels or supervised training, MANE provides an interpretable low-dimensional representation that can guide biological discovery.

MW1B.6 • 09:30

Optical Features of Invasive Potential in Human Lung Cancer Cells Revealed by Label-Free Multimodal Nonlinear Optical Microscopy and Machine Learning, Tien D. Lai^{2,1}, Jindou Shi^{2,1}, Edita Aksamitiene², Stephen A. Boppart^{2,1}; ¹*Electrical and Computer Engineering, Univ. of Illinois, Urbana Champaign, USA*; ²*Beckman Inst. for Advanced Science and Technology, USA*. We introduce a machine learning-assisted label-free optical microscopy method for the detection of epithelial-mesenchymal transition-related features. Our developed single-cell analysis pipeline analyzes multimodal nonlinear images of human lung cancer A549 cells treated with TGF- β 1.

MW1B.7 • 09:45

Virtual Inking of Surgical Resection Margins via a Pathology Foundation Model, Xilin Yang¹, Musa Aydin¹, Yuhong Lu¹, Sahar Selcuk¹, Bijie Bai¹, Yijie Zhang¹, Andrew Birkeland², Katjana Ehrlich², Julien Bec², Laura Marcu², Nir Pillar¹, Aydogan Ozcan¹; ¹*Univ. of California Los Angeles, USA*; ²*Univ. of California, Davis, USA*. We present a virtual inking network that localizes electrocautery-defined resection margins on hematoxylin and eosin whole-slide microscopy images using a foundation model encoder and a classifier, producing ink-free margin maps, standardizing distance-to-margin assessment.

08:00 -- 10:00

Room: Las Olas IV

OW1C • Novel Method for Oximetry

Presider: Caterina Amendola; Politecnico di Milano, Italy

OW1C.1 • 08:00 (Invited)

What's Next for Quantitative Tissue Oximetry? Clinical Accuracy, Standardization, and Hybrid Approaches., Michele Lacerenza¹; ¹*PIONIRS srl, Italy*. Where are we now, and what does the future hold for TD-NIRS? Advances in quantitative oximetry: standardized acquisition/analysis, hybrid TD-NIRS with broadband, SCOS and DCS for cytOx and flow, and improved sensitivity to cortical and deep muscle layers, in clinics and beyond.

OW1C.2 • 08:30

Exploring the Feasibility of 1064 nm for Time Domain NIRS Tissue Oximetry, Tommaso Palo¹, Li Xingmin², Nicola Serra¹, Alessandro Bossi¹, Frederic Lange², Lisa K. Frisk³, Alberto Dalla Mora¹, Antonio Pifferi¹, Turgut Durduran³, Ilias Tachtsidis², Laura Di Sieno¹; ¹*Politecnico di Milano, France*; ²*Univ. College London, UK*; ³*ICFO, Spain*. We carried out oximetry measurements on 11 subjects rotating through a set of 8 wavelengths including 1064 nm. We found that 1064 nm works very well, having high SNR and low water-related error.

OW1C.3 • 08:45

Dual-Ratio Optical Imaging of the Human Finger for Person-Specific Pulse-Oximetry, Giles P. Blaney¹, Jodee Frias¹, Angelo Sassaroli¹, Sergio Fantini¹; ¹*Tufts Univ., USA*. We present a high-density diffuse optical imaging array for dual-ratio imaging of the

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human finger. This method enables person-specific pulse-oximetry by minimizing sensitivity to superficial tissue and recovering pulsatile hemodynamic phasors in deep tissue.

OW1C.4 • 09:00

Dual-Slope Frequency-Domain FNIRS Data Interpreted With two- and Three-Layer Models, Jodee S. Frias¹, Giles P. Blaney¹, Angelo Sassaroli¹, Sergio Fantini¹; ¹*Tufts Univ., USA*. Monte Carlo simulations in three-layer media (incorporating a cerebrospinal fluid layer) reproduce experimental *in vivo* absorption changes measured on the human occipital lobe with dual-slope frequency-domain near-infrared spectroscopy during visual stimulation.

OW1C.5 • 09:15

Wavelength Sensitivity Analysis in Multilayer Maternal-Fetus Model for Transabdominal Pulse Oximetry, Katarzyna I. Komolibus¹, Baptiste Jayet¹, Martin P. Debreczeny², Lane E. Breshears², Paul Stetson², Stefan Andersson-Engels^{1,3}; ¹*Tyndall National Inst., Ireland*; ²*Raydiant Oximetry, USA*; ³*School of Physics, Univ. College Cork, Ireland*. We evaluate wavelength selection for transabdominal fetal pulse oximetry using a multilayer spherical maternal–fetal model. Seventeen physiological and optical parameters are varied to quantify robustness, sensitivity, and anatomical dependence of the ratio-of-ratios method.

OW1C.6 • 09:30

Scattering-Insensitive Estimation of Tissue Oxygen Saturation via Spatial Slope Ratios in CW-NIRS, Martin Goessweiner¹, Jingyi Wu¹, Angelo Sassaroli², Jana M. Kainerstorfer¹; ¹*Carnegie Mellon Univ., USA*; ²*Department of Biomedical Engineering, Tufts Univ., USA*. We propose a scattering-insensitive CW-NIRS method for estimating tissue oxygen saturation from a spatially resolved ratio-of-ratios between steady-state and pulsatile signals. Simulations validate the framework, while breath-hold experiments highlight feasibility and challenges with noise.

OW1C.7 • 09:45

Near-Infrared Investigation and Oxygenation Dependence During Thermal Denaturation of Hemoglobin, Alessandro Bossi¹, Paola Saccomandi¹, Antonio Pifferi¹; ¹*Politecnico di Milano, Italy*. Hemoglobin's thermal denaturation depends on oxygenation. The absorption coefficient of treated blood phantoms reveals hypoxia-specific peaks at 770–870 nm, highlighting oxygenation as a key factor in thermally induced spectral changes.

08:00 -- 10:00

Room: Rio Vista

TW1D • Clinical AI & Point-of-Care

Presider: Davide Contini; Politecnico di Milano, Italy

TW1D.1 • 08:00

Multimodal Deep-Learning Colposcopy System for Point-of-Care Cervical Cancer Diagnosis in Low-Resource Settings, Yingxin Liu¹, Yajur Maker¹, Karthik Goli¹, Júlio C. Possati-Resende², Márcio Antoniazzi², Bruno d. Fonseca², Alex Kortum¹, Jennifer Carns¹, Richard Schwarz¹, Iara V. Santana³, Flávia F. Barbin³, Kathleen M. Schmeler⁴, Mila P. Salcedo^{4,5}, Rebecca Richards-Kortum¹; ¹*Department of Bioengineering, Rice Univ.,*

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USA; ²Department of Prevention, Barretos Cancer Hospital, Brazil; ³Department of Pathology, Barretos Cancer Hospital, Brazil; ⁴Department of Gynecologic Oncology and Reproductive Medicine, The Univ. of Texas MD Anderson Cancer Center, USA; ⁵Department of Obstetrics and Gynecology, Federal Univ. of Health Sciences of Porto Alegre (UFCSPA)/Santa Casa Hospital of Porto Alegre, Brazil. In a 386-patient study in Brazil targeting cervical cancer diagnosis barriers in LMICs, a portable multimodal mobile colposcope with deep-learning was deployed, achieving 0.93 sensitivity and 0.56 specificity, demonstrating strong potential.

TW1D.2 • 08:15

Withdrawn

TW1D.3 • 08:30

Photodynamic Therapy of Murine Breast Tumor Model Using Wireless Light-Emitting Implant, Ana Flavia Borges de Almeida Barreto¹, Hailey S. Sanders¹, Catherine G. Price¹, Daena Talavera¹, Sunghoon Rho¹, Bradley D. Smith¹, Thomas D. O'Sullivan¹; ¹Univ. of Notre Dame, USA. We present a preclinical study that demonstrates that deep photodynamic therapy using a minimally-invasive wireless light-emitting implant with orally-administered 5-ALA can reduce tumor volume in an aggressive triple-negative model of breast cancer.

TW1D.4 • 08:45

Stain-Free Malaria Detection Using Hyperspectral Microscopy, Michelle F. Müller^{1,2}, Olof Neumann^{1,2}, Kristina E. Persson^{3,4}, Muyideen Tijani³, Philippe Grellier⁵, Jérémie T. Zoueu⁶, Malin Malmsjö^{1,2}, Aboma Merdasa^{1,2}; ¹Clinical Center for Spectral and Acoustic Imaging, Department of Clinical Sciences, Lund Univ., Sweden; ²Department of Ophthalmology, Skåne Univ. Hospital, Sweden; ³Division of Clinical Chemistry and Pharmacology, Department of Laboratory Medicine, Lund Univ., Sweden; ⁴Department of Clinical Chemistry, Skåne Univ. Hospital, Sweden; ⁵UMR 7245 Molécules de Communication et Adaptation des Micro-organismes, Muséum National d'Histoire Naturelle, France; ⁶Institut National Polytechnique Félix Houphouët-Boigny de Yamoussoukro, Côte d'Ivoire. This work presents a portable push-broom hyperspectral microscope enabling stain-free malaria detection, distinguishing healthy and infected cells within minutes, and demonstrating broad diagnostic potential, including histopathology, to reduce reliance on subjective clinical interpretation.

TW1D.5 • 09:00

Temporal Dynamics of Ultra-Weak Photon Emission Reveals Cellular Respiratory Bursts, Mahshid Zoghi¹, Carolyn Dang², Annette R Khaled², Aristide Dogariu¹; ¹CREOL, Univ. of Central Florida, USA; ²Burnett School of Biomedical Sciences, Univ. of Central Florida, USA. Time-resolved ultra-weak photon emission measurements from PMA-stimulated THP-1 cells reveal intermittent intensity bursts during differentiation, with clear dose dependence and coincidence non-Poissonian photon statistics reflecting dynamic oxidative activity.

TW1D.6 • 09:15

Side Viewing Endoscopic Photon Time-of-Flight System for Monitoring Chemotherapy Response, Hasti Yavari¹, Suraj Kumar Kothuri¹, Sri Rama Pranav Kumar Lanka¹, Stefan Andersson-Engels¹, Sanathana Konugolu Venkata Sekar^{1,2}; ¹Tyndall National Inst., Ireland; ²BioPixS Limited, Ireland. We present compact side-viewing endoscopic platform that integrates a micro-camera with time-of-flight spectroscopy in a 4 mm catheter-compatible form

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factor. System performance was validated using MEDPHOT phantoms along with invivo studies on human volunteers to assess accuracy & depth sensitivity.

TW1D.7 • 09:30

RGB-to-Hyperspectral Reconstruction for Cutaneous Chronic Graft-Versus-Host Disease, Mayaank Pillai¹, Ruijing E. Han¹, Inga Saknite², Eric R. Tkaczyk², Audrey E. Bowden¹; ¹*Vanderbilt Univ., USA*; ²*Department of Dermatology, Vanderbilt Univ. Medical Center, USA*. We show the ability to generate realistic RGB images from hyperspectral images of chronic graft-versus-host disease and evaluate RGB-to-hyperspectral reconstruction on them. Our method achieves 8% spectral RMSE and recovers hemoglobin and melanin chromophore signals.

TW1D.8 • 09:45

Treatment Monitoring in the Joint Manifestations of Systemic Lupus Erythematosus Using Diffuse Optical Tomography, Moegammad A. Bardien¹, Lara Pinar¹, Alessandro Marone¹, Alberto Nordmann Gomes², Leila Khalili², Stephen K. Suh², Wei Tang², Stephen Kim^{1,3}, Anca Askanase², Andreas Hielscher¹; ¹*Department of Biomedical Engineering, New York Univ., USA*; ²*Department of Medicine – Rheumatology, Columbia Univ., USA*; ³*Department of Medicine – Department of Radiology, New York Univ., USA*. We developed a wearable near-infrared system for objective monitoring of treatment for SLE arthritis. Preliminary results from two patients show significant post-treatment hemodynamic shifts demonstrating the system's potential for real-time therapeutic assessment.

13:30 -- 15:00

Room: Las Olas III

BW2A • Analysis Algorithms and Frameworks for Neuroimaging

Presider: Wesley Baker; Children's Hospital of Philadelphia, USA

BW2A.1 • 13:30

Auto-BIDSify: an LLM-First Automated Neuroimaging Data Standardization Framework, Yiyi Liu¹, Qianqian Fang¹; ¹*Northeastern Univ., USA*. Auto-BIDSify is a large-language-model driven neuroimaging data standardization framework that integrates semantic reasoning with rule-based execution to automatically format heterogeneous neuroimaging files into Brain Imaging Data Structure (BIDS) datasets, facilitating neuroimaging data sharing.

BW2A.2 • 13:45

Deep Learning for Hemoglobin Estimation in Two-Layer Head Model From Time- and Frequency-Domain NIRS: a Monte Carlo Simulation Study, Haiyang Tang¹, Yiqing Hu¹, Hanli Liu¹; ¹*Biomedical Engineering, Univ. of Texas at Arlington, USA*. We developed a deep learning model that facilitates successful recovery of oxyhemoglobin and deoxyhemoglobin concentrations with errors of <5% for time-domain NIRS and <8% for frequency-domain NIRS simulation data in a two-layer head model

BW2A.3 • 14:00

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NeuroJSON.io 2.0 – a Modern, Scalable, Standardized Neuroimaging Data Repository and Sharing Portal, Tzu-Yun Fan¹, Fan-Yu Yen¹, Qianqian Fang¹; ¹*Department of Bioengineering, Northeastern Univ., USA*. NeuroJSON.io 2.0 is a redesigned neuroimaging data sharing portal based on modern web architectures, featuring an intuitive user interface, cross-database metadata search, large-language-model-based data summaries, and in-browser data preview, ideally suited for sharing complex scientific datasets.

BW2A.4 • 14:15

Deep-Learning-Accelerated Myelin Defect Detection With RGB Circular-Polarized Birefringence Microscopy, Anna Novoseltseva¹, Arjun Chandra¹, Alexander Gray¹, Shuying Li¹, Mikayla Bradsby¹, Irving Bigio¹; ¹*Boston Univ., USA*. We developed a human-in-the-loop deep learning system, combining RGB circular-polarized birefringence microscopy with YOLOv8, achieving 14-fold analysis acceleration for myelin defect detection in neurodegenerative tissues.

BW2A.5 • 14:30

Subject-Specific Monte Carlo Modelling for Optical Neuromonitoring and Neuroimaging in Mice, Jiaxiuxiu Zhang¹, Alyssa Palmucci², Hayden Fisher², Rodrigo M. Forti^{2,1}, Brian White^{2,1}; ¹*Univ. of Pennsylvania, USA*; ²*Children's Hospital of Philadelphia, USA*. We developed a pipeline that integrates subject-specific CT mouse head models with Monte Carlo simulations to more accurately model photon propagation for optical neuromonitoring and imaging. This approach enables more precise spectroscopic and widefield optical measurements in preclinical studies.

BW2A.6 • 14:45

Variability in Cerebral Autoregulation in Children With Acute Heart Failure Transitioned From Venous Extracorporeal Membrane Oxygenation (VA-ECMO) to Ventricular Assist Device (VAD), Aidan Crozier^{1,2}, Celia Gagnon³, Elizabeth Malick⁴, Alexis Schulz⁵, Alyssa Seeney⁵, Briston Bayle⁵, Darci Anderson⁵, Pilar Anton-Martin⁶, Jamie Weller⁶, Benjamin Kozyak⁶, Maryam Naim⁶, Katsuhide Maeda⁸, Susan Nicolson⁷, Todd Kilbaugh¹, Jennifer Lynch⁷, Tiffany Ko¹; ¹*Department of Anesthesiology and Critical Care Medicine, Children's Hospital of Philadelphia, USA*; ²*School of Biomedical Engineering Science and Health Systems, Drexel Univ., USA*; ³*Department of Cardiovascular Perfusion, Children's Hospital of Philadelphia, USA*; ⁴*ECMO Center, Children's Hospital of Philadelphia, USA*; ⁵*Division of Neurology, Children's Hospital of Philadelphia, USA*; ⁶*Cardiac Center, Children's Hospital of Philadelphia, USA*; ⁷*Division of Cardiothoracic Anesthesiology, Children's Hospital of Philadelphia, USA*; ⁸*Division of Cardiothoracic Surgery, Children's Hospital of Philadelphia, USA*. We report on an exploratory assessment of cerebral hemodynamics and autoregulatory impairment using non-invasive diffuse optical monitoring during extracorporeal membrane oxygenation and transition to the Berlin Heart EXCOR ventricular assist device in 3 pediatric patients.

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13:30 -- 15:00

Room: Bonnet

MW2B • Super-Resolution Microscopy

Presider: Jessica Ramella-Roman; Florida International Univ., USA

MW2B.1 • 13:30 (Invited)

Multimodal Pathology-Spatial Omics Fusion for High-Dimensional Cell-Pixel Barcoded Biomarker Discovery, Ahmet F. Coskun¹; ¹*Georgia Inst. of Technology, USA*. mPathOmics envisions a unified synthesis of multicolor pathology, multiplexed imaging, and spatial omics for high-dimensional biomarker discovery. This seamless integration powers cell-pixel barcoding and machine learning to quantify and predict tissue taxonomy, inflammation, and fibrosis.

MW2B.2 • 14:00

Integrating Fresh Surface and Cross-Sectional Slice Imaging With SIM for Prostate Tumor Margin Detection, Ivan Bozic¹, Gabriel Kobza¹, Lauren E. Boudreaux¹, Dylan Lucia¹, Emily Ribando-Gros¹, Kimber Ashman¹, John Ruhsam¹, Sharon Fox², Louis S. Krane³, Brian Summa¹, J. Quincy Brown¹; ¹*Tulane Univ., USA*; ²*Pathology, Southeast Louisiana Veterans Health Care System, USA*; ³*Urology, Southeast Louisiana Veterans Health Care System, USA*. Structured illumination microscopy was used to acquire paired surface and cross-sectional fluorescence images of fresh prostatectomies, co-register to H&E slides, and improve pathologist interpretation. Initial results show feasible imaging, anatomical mapping, and promising diagnostic integration.

MW2B.3 • 14:15

LFC-Plus: Simultaneous Multicolor Volume Cytometry for High-Throughput Single-Cell Analysis, Zhi Ling¹, Wenhao Liu¹, Kyungduck Yoon¹, Zijun Gao¹, Keyi Han¹, Shu Jia¹; ¹*Georgia Inst. of Technology, USA*. We present LFC-plus, a next-generation light-field cytometry platform that enables multiparametric, simultaneous multi-color, and volumetric single-cell analysis with ultra-high throughput and large volumetric capability at subcellular resolution.

MW2B.4 • 14:30

Nanobody Probes Avoid Antibody-Induced Receptor Aggregation to Enable FRET-Based Measurement of HER2 Dimerization in Live Cells, Catherine Sherry¹, Nanxue Yuan², Amit Verma¹, Saif Ragab², Sophie Hernot³, John Williams⁴, Tynan Young⁴, Xavier Intes², Margarida Barroso¹; ¹*Albany Medical College, USA*; ²*Center for Modeling, Simulation, and Imaging in Medicine, Rensselaer Polytechnic Inst., USA*; ³*Vrije Universiteit Brussel, Belgium*; ⁴*City of Hope, USA*. HER2 dimerization affects cytotoxicity of HER2-targeted therapies. FRET is a powerful method to quantify HER2 dimerization, but antibody probes perturb HER2 interactions. Here, we utilize nanobody-based FRET to quantify native HER2 dimerization in live cells.

MW2B.5 • 14:45

Sequential Single-Fluorophore STORM for Highly Multiplexed Nanoscale Protein Mapping, Shuyuan Zheng¹, Shengwei Chen¹, Hongqiang Ma¹, Yang Liu¹; ¹*Univ. of Illinois champaign urbana, USA*. Highly multiplexed super-resolution imaging remains challenging. We present a streamlined sequential multiplexed super-resolution imaging approach using only a single fluorophore, eliminating chromatic aberration and dye incompatibility with standard STORM systems and commercially available antibodies

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13:30 -- 15:00

Room: Las Olas IV

OW2C • Advances in Deep Optics III

Presider: Byullee Park; Sungkyunkwan Univ., South Korea

OW2C.1 • 13:30 (Invited)

High Throughput Fourier Light Field Imaging of 3D Biological Dynamics, Clare Cook^{1,2}, Melody Young¹, Julia S. Foust¹, Martin Bohlen¹, Sheila Patek¹, Roarke Horstmeyer¹; ¹*Duke Univ., USA*; ²*Biomedical Engineering, Johns Hopkins Univ., USA*. We present the optical and algorithmic design of two related high-throughput Fourier light field imaging systems: the first optimized for spatial throughput (>0.5 GP/frame), and the second for temporal throughput (up to megahertz frame rates).

OW2C.2 • 14:00

Optical Characterization of Healthy, Metastatic, and Aggressive Prostate Cells Using Coherence-Gated DLS, Jose Guzman-Sepulveda¹, Josue Alejandro Perales-Hernandez¹, Aristide Dogariu²; ¹*Cinvestav Monterrey, Center for Research and Advanced Studies, Mexico*; ²*CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA*. Measurements of intracellular dynamics with coherence-gated dynamic light scattering enables passive, noninvasive, contact-less distinction between healthy and cancerous prostate cells with low and high metastatic potential based on their biomechanical properties under physiological conditions.

OW2C.3 • 14:15

Mapping Corneal Hydration Gradients Using a Fast Terahertz Spectroscopic Scanner, Zachery Harris¹, Robert Honkanen¹, M. Hassan Arbab¹; ¹*SUNY at Stony Brook, USA*. We demonstrate a fast terahertz (THz) imaging system for corneal water content measurement in 1-2 seconds. Using corneal phantoms and ex vivo eyeballs, we show that THz spectroscopy data correlates well with sample hydration ($R^2 = 0.94$).

OW2C.4 • 14:30

In Vivo Diagnosis of Frostbite Depth Using Terahertz Time-Domain Spectroscopy, Erica Heller¹, Zachery B. Harris¹, Arash Karimi¹, Shi Fu¹, Huiting Luo¹, Miriam Rafailovich¹, Adam J. Singer¹, M. Hassan Arbab¹; ¹*Stony Brook Univ., USA*. Early diagnosis of the depth of frostbite wounds is critical to improving patient outcomes. Using machine learning, terahertz imaging can separate healthy, shallow, and deep frostbite injuries with AUC-ROCs of 0.96, 0.90, and 0.86 in a porcine model.

OW2C.5 • 14:45

Low-Cost and Wide-Field Single Snapshot Imaging of Optical Properties Using Binary Masks for Photodynamic Therapy Treatment Plannings and Monitoring, Zihao Li¹, Zihan Zheng¹, Timothy M. Baran¹; ¹*Univ. of Rochester, USA*. We developed a low-cost, wide-field Single Snapshot Imaging of Optical Properties system using binary masks, aberration-corrected projection, 3D-printed optomechanics, and Raspberry Pi camera for optical property mapping to support photodynamic therapy treatment planning and monitoring.

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13:30 -- 15:00

Room: Rio Vista

TW2D • System Performance & Validation

Presider: Caterina Amendola; Politecnico di Milano, Italy

TW2D.1 • 13:30

Optical Phantoms to Mimic the Optical Changes of Thermal Damage in Bovine

Organs, Andrea L. Pacheco Tobo¹, Alessandro Bossi¹, Chiara Licursi¹, Antonio Pifferi¹, Paola Saccomandi¹; ¹*Politecnico di Milano, Italy*. We fabricated optical phantoms replicating the ablation zones in ex vivo organs treated with microwave. Reduced scattering and absorption coefficients were tailored to specific wavelengths which can distinguish the tissue in central, peripheral and unablated zones.

TW2D.2 • 13:45

A New Methodology for Characterizing Medical Laparoscope Fluorescence Imaging

Performance With 3D-Printed Phantoms, Edwin A. Robledo¹, Wilson Adams¹, Ethan P. LaRoche¹, Alberto Ruiz¹; ¹*QUEL Imaging, USA*. There is a lack of standardized methods for comparing NIR fluorescence laparoscopes. Reference targets were used to measure the optical throughput, distortion, and depth of field for three laparoscopes. Results demonstrate performance differences and highlight need for standardized benchmarking.

TW2D.3 • 14:00

Characterizing Fluorescence Uniformity and Distortion of Near-Infrared Fluorescence-Guided Imaging Systems

, Alberto Ruiz², Emmanuel A. Mannoh², Edwin A. Robledo², Samuel S. Streeter¹, Ethan P. LaRoche²; ¹*Dartmouth College, USA*; ²*QUEL Imaging, USA*. Non-uniform fluorescence and geometric distortion remain unstandardized yet critical FGS performance metrics. We present a fluorescence phantom and analysis toolkit enabling their simultaneous measurement, revealing device-specific variation and when flat-field correction helps, or biases, imaging.

TW2D.4 • 14:15

Exploring Breathing Through Time Resolved Near Infrared Spectroscopy

, Scott Pesenti¹, Kenneth Pesenti², Francesca Policastro³, Michele Lacerenza⁴, Davide Contini^{5,6}, Lorenzo Spinelli¹, Alessandro Torricelli⁵, Sergio Ghirardo³; ¹*Istituto di Fotonica e Nanotecnologie, Consiglio Nazionale delle Ricerche, Italy*; ²*Department of Surgical Medical and Health Sciences, Univ. of Trieste, Italy*; ³*Univ. Clinical Department of Medical, Surgical, and Health Sciences; Complex Operative Unit of Pediatric Clinic of the Inst. for Maternal and Child Health, IRCCS 'Burlo Garofolo', Italy*; ⁴*PIONIRS srl, Italy*; ⁵*Dipartimento di Fisica, Politecnico di Milano, Italy*; ⁶*Ospedale Maggiore Policlinico Milano, Fondazione IRCCS Ca'Granda, Italy*. We present an observational pilot study on healthy subjects, investigating fatigue of the accessory respiratory muscles during inspiratory and expiratory stress through time resolved - near-infrared spectroscopy. Reviewing the potential and limitations of its clinical applications.

TW2D.5 • 14:30

Towards Scalable Deep Tissue Blood Flow Measurement Using a Fiber Coupled SPAD

Camera for Diffuse Correlation Spectroscopy, Christopher M. Moore¹, Ulas Sunar¹; ¹*SUNY Stony Brook, USA*. We present a SPAD camera based DCS system with FPGA enabled real-

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time multispeckle autocorrelation. Dual separation phantom and human studies show robust blood-flow tracking up to 3.25 cm and improved SNR, supporting scalable deep tissue DCS with parallel single photon detection.

TW2D.6 • 14:45

Differentiate Healing and Non-Healing Diabetic Foot Ulcers Using a Smartphone-Based NIRS Device, Himaddri Shakhar Roy¹, Karla Vasquez¹, Gabriela E. Beraja², Charles Policard¹, Aliette Espinosa², Jason Levine², Jose A. Jaller², Jose A. Jaller², Robert Scott Kirsner², Anuradha Godavarty¹; ¹*Florida International Univ., USA*; ²*Univ. of Miami, USA*. A smartphone-based NIRS device is used to assess healing status of diabetic foot ulcers (DFUs). A difference in oxygen saturation contrast between the wound and its surroundings was observed across healing and non-healing DFU cases.

15:30 -- 17:00

Las Olas I, II, V, VI

JW3A • Joint Postdeadline Presentations

Presider: To Be Announced

JW3A.1 • 15:30

Early Detection and Monitoring of Neurodegenerative Disease via in-Vivo Non-Invasive Imaging of Neurovascular Dynamics in Retina, Katie Duncan¹, Ikbal Sencan Egilmez¹, Zara Husain¹; ¹*Washington Univ. in St Louis, USA*. Effective AD therapy requires early detection, yet methods are limited. Identifying brain hypoperfusion via retinal microcirculation offers a translatable early biomarker. With in vivo 2PM/PLIM we quantify brain & retinal oxygenation to map neurovascular function in healthy vs diseased aging.

JW3A.2 • 15:45

Wavefront Neural Representation for Field-Dependent Aberration Correction in Volumetric Microscopy, Linh Hoang², Zhongqiang Li¹, Dominique Meyer², Xiankun Lu², Ji Yi^{2,1}; ¹*Johns Hopkins Univ School of Medicine, USA*; ²*Biomedical Engineering, Johns Hopkins Univ., USA*. Our self-supervised algorithm predicts field-dependent aberrations and reconstructs 3D samples without additional hardware. Tested on OPM mouse brain and AOSLO retina images, it triples resolution and doubles SNR across mm-scale, revealing originally obscured sample structures.

JW3A.3 • 16:00

Characterisation of Root Wall Stiffness Under Compacted Soil Conditions by Phonon Microscopy, Fernando Perez-Cota¹, Salvatore La Cavera III¹, Bipin Pandey¹; ¹*Univ. of Nottingham, UK*. We have applied Phonon Microscopy for the study of the mechanical properties of plant root cells. In doing so, we have observed the changes in cell wall mechanical properties in compacted and non-compacted conditions.

JW3A.4 • 16:15

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The Merits of Optoacoustic Mesoscopy in Dermatology and Cardiometabolic Health, Vasilis Ntziachristos^{1,2}; ¹*Technische Universität München, Germany*; ²*Helmholtz Munich, Germany*. We present progress with Raster-Scan Optoacoustic Mesoscopy (RSOM) utilizing ultra-bandwidth detection reaching ~100MHz, in particular for resolving the melanoma depth in humans and using the skin as a window to cardiometabolic disease.

JW3A.5 • 16:30

Optical Monitoring of Calf Muscle Blood Flow and Oxygenation During Passive Simulated Jogging in Patients With Mitochondrial Disease, Zaha Shahdad^{1,2}, Rodrigo M. Forti², Joseph B. Majeski¹, Daniel McGinn², Jean Flickinger², Vernon E. Anderson², Marni Falk², Vinay M. Nadkarni², Arjun Yodh¹, Wesley Baker², Harry Ischiropoulos², Jose Adams³, Zarazuela Zolkipli-Cunningham², Tiffany Ko²; ¹*Univ. of Pennsylvania, USA*; ²*Children's Hospital of Philadelphia, USA*; ³*Mount Sinai Medical Center, USA*. We present a study using continuous diffuse optical monitoring to evaluate hemodynamic and metabolic changes of the calf muscle during passive simulated jogging in patients with primary mitochondrial disease and in healthy controls.

JW3A.6 • 16:45

In Vivo Assessment of Cerebrospinal Fluid Dynamics Using Photoacoustic Imaging, Seongwook Choi¹, Jiwoong Kim¹, Hyunseo Jeon¹, Yejin Lee², Gyeongju Lim², Won-Min Ju², Kyuwan Kim², Dong Soo Lee¹, Yun-Sang Lee², Jae Sung Lee², Gi Jeong Cheon², Yoori Choi², Chulhong Kim¹; ¹*POSTECH, South Korea*; ²*Seoul National Univ., South Korea*. We present an in vivo assessment of cerebrospinal fluid dynamics using photoacoustic imaging with ICG. Our results demonstrate high-resolution, brain to whole-body visualization of CSF flow, offering powerful tool for investigating neurodegenerative disease.