UC DAVIS HEALTH | Department of Neurological Surgery

NATIONAL CENTER NCIBT INTERVENTIONAL BIOPHOTONIC TECHNOLOGIES

Sponsored by: NIH NIBIB | UC DAVIS OFFICE OF RESEARCH

2024 Interventional Biophotonics Week

Symposium and Summer School | July 22-26

At Genome and Biomedical Sciences Facility (UC Davis campus)
and UC Davis Medical Center (Sacramento)

Keynote speakers:

Stephen Boppart, M.D., Ph.D.
University of Illinois Urbana-Champaign

Daniel Elson, Ph.D.
Imperial College London

Jana Kainerstorfer, Ph.D.
Carnegie Mellon University

Adam Yala, Ph.D.
UC Berkeley and UCSF

Jürgen Popp, Ph.D.
Friedric Schiller University Jena and Leibniz Institute of Photonic Technology

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UC Davis and UC Davis Health

Griffith Harsh M.D., M.B.A
Deputy Director and Co-Leader of Training & Dissemination, NCIBT; Professor of Neurological Surgery, University of California, Davis.

Randy Carney, Ph.D.
Co-Leader of Training & Dissemination, NCIBT; Associate Professor of Biomedical Engineering, University of California, Davis.

Laura Marcu Ph.D.
Director of NCIBT; Professor of Biomedical Engineering and Neurological Surgery, University of California, Davis.

Dear Participants,

We are delighted to welcome you to the inaugural UC Davis Biophotonics Week of the National Center for Interventional Biophotonics Technologies!

The NCIBT is a national center for research and development, clinical testing, and dissemination of optical biomedical imaging. It was funded in 2022 by a 5-year grant from the National Institute of Biomedical Imaging and Bioengineering (NIBIB) of the National Institute of Health (NIH), with institutional support from UC Davis's Office of Research, College of Engineering, and School of Medicine.

Headquartered at the University of California, Davis, NCIBT is a consortium of over 40 scientists and clinicians from research institutions distributed throughout the United States and Europe.

Our scientists are predominantly scientists and engineers seeking to develop novel technological approaches to optical imaging of biological tissues that will eventually be of clinical value. Our clinicians are predominantly surgeons and medical intensivists eager to help the engineers identify shortcomings and develop and test novel solutions in the clinical application of optical imaging.

Specifically, we are advancing two optical technologies developed at UC Davis—interventional fluorescence lifetime imaging (iFLIM) and interferometric Diffuse Optical Spectroscopy (iDOS)—and combine them with an AI-deep learning platform in a novel paradigm of real-time guidance of decision making during medical and surgical procedures.

The imaging devices we are developing will address important challenges such as the definition of tumor boundaries during surgery and non-invasive monitoring of brain blood flow and oxygenation after stroke.

The Center also supports the clinical testing of the new technologies developed as well as the education and training of additional investigators and clinical users.

This week's Biophotonics Workshop is a fundamental component of that education and training. It consists of a two-day Scientific Symposium, led by well-recognized experts in the fields of optimal imaging as Keynote Speakers, Lecturers, and Panelists, followed by a three-day Biophotonics Summer School in which engineering students and postdoctoral scholars will learn from additional didactic sessions, group discussions, laboratory demonstrations, introductions to clinical environments, and hands-on training with NCIBT instruments. We hope to provide opportunities for both learning and establishing professional friendships beneficial to the careers of our participants.

Thank you for joining us for what we anticipate will be an educational and enjoyable week. Please do not hesitate to contact any of us or our staff is we can do anything to make your week more productive or enjoyable.

Sincerely,
Laura Marcu, Griff Harsh, and Randy Carney

Index

Welcome to UC Davis

UC Davis is the home of the Aggies – go-getters, change makers, and problem solvers who make their mark at one of the top public universities in the United States.

Since we first opened in 1908, we've been known for standout academics, sustainability and Aggie Pride as well as valuing the Northern California lifestyle. These themes are woven into our 100-plus-year history and our reputation for solving problems related to food, health, the environment, and society.

Our 5,300-acre campus borders the city of Davis, a vibrant college town of about 68,000 people living in Yolo County. The state capital is 20 minutes away, and world-class destinations such as the San Francisco Bay Area, Lake Tahoe and the Napa Valley are within a two-hour drive.

College of Engineering

The UC Davis College of Engineering creates a sustainable world through socially responsible engineering. By connecting people and technology, we solve the world's most pressing problems and create the next generation of engineering leaders and entrepreneurs. Our faculty, students, staff, and partners collaborate to design a better tomorrow and make a positive difference in the world. It's in everything we do.

Taking our college to the next level means amplifying our strengths to become outstanding leaders in the engineering challenges we address, the education we provide and the community we create.

Today's world demands next-level engineering solutions for our most challenging problems, from climate change to pandemic response. The UC Davis College of Engineering is already making great contributions in each of our departments and our interdisciplinary efforts.

Next Level means advancing beyond where we already excel to focusing our resources and collaborations on bold new solutions to society's most complex problems. It means preparing and inspiring the next generation of engineers to be agile thinkers who carry with them the commitment to engineer a better future. And it means doing so in a diverse, harmonious community.

UC Davis Health and UC Davis Medical Center

UC Davis Medical Center serves a 65,000-square-mile area that includes 33 counties and 6 million residents across Northern and Central California. The 646-bed acute-care teaching hospital is the main clinical site of a $1.7 billion UC Davis Health system. UC Davis typically admits approximately 30,000 patients per year and handles more than 900,000 visits. The medical center's emergency room sees more than 200 patients per day on average.

In its 2023-2024 survey, U.S. News & World Report ranked UC Davis Medical Center as one of the nation's best hospitals in nine adult medical specialties, including ear, nose and throat; cardiology and heart surgery; pulmonology and lung surgery; geriatrics; neurology and neurosurgery; diabetes and endocrinology; cancer; and obstetrics and gynecology. We also ranked as high performing in sixteen adult procedures and conditions. We were recognized as the No. 1 hospital in the Sacramento area, and among the top 10 in California.

UC Davis Medical Center has also earned the nation's highest form of recognition for nursing excellence: Magnet® recognition from the American Nurses Credentialing Center. Less than 10 percent of U.S. hospitals typically achieve this designation from the world's largest and most prominent nurse credentialing organization – and as of the time of this writing, UC Davis is the only hospital in Sacramento to carry it.

Host Bios

Griffith R Harsh IV, M.A., M.D., M.B.A.

Dr. Harsh is Professor of Neurological Surgery at the University of California, Davis and Deputy Director and Leader of the Technology Training and Dissemination Program of the National Center for Interventional Biophotonics Technologies (NCIBT). Dr. Harsh graduated ***summa cum laude*** from Harvard College, earned a master's degree from Oxford University as a Rhodes Scholar, completed his MD degree at Harvard, and earned an MBA degree from Boston University. After residency at UCSF, he joined its faculty and developed its radiosurgery program before returning to Harvard where he directed MGH's Brain Tumor Center. He subsequently moved to Stanford, where he was Residency Program Director, Vice Chair for Education, Associate Dean for Post-graduate Medical Education and Director of Stanford's Center for Continuing Medical Education.

As Chair of the Department of Neurosurgery at UC Davis, he led rapid expansion of faculty, clinical programs, the residency, and research funding while greatly improving financial performance. He also served as Chair of the Council of Department Chairs and Center Directors, representing the faculty on the Health System's Clinical Leadership Team, the Executive Board of the Medical Group, and, as chair or member, on the committees on Medical System Strategy, Program Development, Operations, Funds Flow, and Accountability. His national leadership roles have included Chair of the Neurosurgery Residency Review Committee of the ACGME and the Neurosurgery Research and Education Foundation, Presidency of the American Academy of Neurological Surgery and the Neurosurgical Society of America, and Vice Presidency of the Society of Neurological Surgeons whose Career Service Award he received in 2022. Dr. Harsh's clinical practice focuses on the surgical and radiosurgical treatment of tumors of the brain and pituitary gland, and his research studies the molecular mechanisms of tumor development. He is author or co-author of 240 scientific articles and book chapters and editor or co-editor of four texts. He is currently Principal Investigator (MPI) of an NINDS R25 grant for resident training in research and of the NIBIB P41 grant supporting the NCIBT.

Randy Carney, Ph.D.

Randy Carney is an Associate Professor of Biomedical Engineering at the University of California, Davis. He received his B.S. in Chemistry in 2008 from the University of Arkansas. His M.S. at Massachusetts Institute of Technology (MIT) in 2010 and PhD from EPFL in 2013 focused on the impact of nanoscale surface structure in the organic ligand coating of metal nanoparticles on cell penetration. He continued his studies as a postdoctoral fellow at UC Davis in the fields of biophotonics characterization of extracellular vesicles (EVs). His group currently engineers platforms to examine the use of EVs as next-generation cancer biomarkers and therapeutics, particularly using Raman spectroscopy and surface-enhanced Raman spectroscopy (SERS). He is the co-lead of the training and dissemination (TTD) arm of the National Center for Interventional Biophotonics Technologies (NCIBT).

Laura Marcu, Ph.D.

Laura Marcu is a Professor of Biomedical Engineering and Neurological Surgery at the University of California, Davis. She received her Ph.D. in biomedical engineering in 1998 from the University of Southern California, Los Angeles. She is the founding director of the recently established (2022) NIH-NIBIB P41 Center – the National Center for Interventional Biophotonic Technologies at UC Davis. Since 2007 she has served as co-director of the Comprehensive Cancer Center - Biomedical Technology Program, at the UC Davis Medical Center. Her research interest is in biomedical optics, with a particular focus on research for the development of optical techniques for tissue diagnostics including applications in surgical oncology, interventional cardiology, and tissue engineering. She has published a book as well as over 240 co-authored publications. Currently, she is a member of the Editorial Board for the Journal of Biophotonics and the Translational Biophotonics, and Associate Editor for Optica. She is a Fellow of AAAS, AIMBE, BMES, OSA, SPIE, and NAI.

Keynote Speaker Bios

Stephen Boppart, M.D., Ph.D.

Stephen Boppart is a Professor and Grainger Distinguished Chair in Engineering at the University of Illinois Urbana-Champaign (UIUC) with appointments in the Departments of Electrical and Computer Engineering, Bioengineering, and the Carle Illinois College of Medicine. His Biophotonics Imaging Laboratory is focused on developing novel optical biomedical diagnostic and imaging technologies and translating these into clinical applications. Prof. Boppart received his Ph.D. in Medical and Electrical Engineering from MIT, his M.D. from Harvard Medical School, and specialty training in Internal Medicine. He has published over 450 invited and contributed publications, delivered over 1000 invited and contributed presentations, and has over 55 patents related to optical biomedical imaging technology. He was recognized by MIT Technology Review magazine as one of the Top 100 Young Innovators for his development of medical imaging technology, and received the international Hans Sigrist Prize in the field of Diagnostic Laser Medicine, the IEEE Technical Achievement Award, and the SPIE Biophotonics Technology Innovator Award, among others. Prof. Boppart has co-founded five start-up companies to commercialize and disseminate his optical technologies and was elected a member of the National Academy of Inventors. He is a Fellow of AAAS, IEEE, OSA, SPIE, AIMBE, BMES, and IAMBE. He is currently Director of the GSK Center for Optical Molecular Imaging, supported by an academic-clinical-industry partnership with GlaxoSmithKline. In support of a national NIH Biomedical Technology Research Resource, Prof. Boppart is directing the NIBIB P41 Center for Label-free Imaging and Multiscale Biophotonics (CLIMB). Prof. Boppart has been a strong advocate for the integration of engineering, technology, and medicine to advance human health and our healthcare systems. He played an active role in the initiation, visioning, launch, and growth of the new engineering-based Carle Illinois College of Medicine at the University of Illinois Urbana-Champaign, and is currently serving as the Director for the University's Interdisciplinary Health Sciences Institute.

Daniel Elson, PhD

Daniel Elson is a Professor at the Hamlyn Centre for Robotic Surgery, Department of Surgery and Cancer, and the Institute of Global Health Innovation, Imperial College, London. His group develops and clinically translates optical and photonics technologies for surgical endoscopic sensing and imaging applications, to provide minimally invasive diagnostic guidance and to characterize different disease states during intervention. Current technologies under investigation include multispectral, polarization-resolved, and fluorescence sensing/imaging, supported by computer vision and robotic guidance techniques. These devices are finding applications in minimally invasive surgery and are being actively evaluated in the operating theatre. This research has been funded by the ERC, EPSRC, MRC, Innovate UK, CRUK, Brain Tumour Research, Wellcome Trust, and the NIHR, and has included collaborations with industrial partners such as Karl Storz, Covidien, Lightpoint Medical, Cymtec, and Intuitive Surgical.

Jana Kainerstorfer, Ph.D.

Jana Kainerstorfer is Associate Professor of Biomedical Engineering at Carnegie Mellon University and holds courtesy appointments in the Neuroscience Institute and Electrical & Computer Engineering. Her research develops noninvasive optical imaging methods for disease detection and treatment monitoring, with emphasis on diffuse optical imaging. It focuses on clinical translation of optical methods for monitoring cerebral perfusion and tools for assessing cerebral health in traumatic brain injury. Other applications of diffuse optics include fetal health monitoring and brain imaging in marine mammals. She serves on program committees at national and international conferences (including SPIE Photonics West and OSA Topical Meetings) and was Conference Chair for OSA Biophotonics Congress: Optical Tomography and Spectroscopy in 2022 and the Photonics West: Clinical and Translational Neurophotonics sub-conference. She is associate editor for the Journal of Biomedical Optics (SPIE) and a senior member of OPTICA.

Adam Yala, Ph.D.

Adam Yala is an assistant professor of Computational Precision Health, Statistics, and Computer Science at UC Berkeley and UCSF. His research focuses on developing machine learning methods for personalized medicine and translating them into clinical care. His previous research has focused on two areas: 1) predicting future cancer risk, and 2) designing personalized screening policies. Adam's tools underly multiple prospective trials and his research has been featured in the Washington Post, New York Times, STAT, Boston Globe, and Wired. Prof Yala obtained his BS, MEng, and PhD in Computer Science from MIT where he was a member of MIT Jameel Clinic and MIT CSAIL.

Jürgen Popp, Ph.D.

Juergen Popp holds a chair for Physical Chemistry at the Friedrich-Schiller University Jena, Germany. Since 2006 he is also the scientific director of the Leibniz Institute of Photonic Technology, Jena. Juergen Popp is a world leading expert in Biophotonic / optical health technology research covering the complete range from photonic basic research towards translation into clinically applicable methods. He has published more than 990 journal papers, has been named as an inventor on 15 patents and has given more than 200 invited talks on national and international conferences (among them more than 50 keynote/plenary lectures). He received several awards like e.g. the 2016 Pittsburgh Spectroscopy Award, the Kaiser-Friedrich-Forschungspreis 2018, the third price of the Berthold Leibinger Innovationspreis in 2019 or in 2022 he became part of The Photonics100. He has two honorary doctorate degrees: 2012 from Babes-Bolyai University in Cluj-Napoca, Romania and 2023 from the University at Albany – State University of New York (USA).

Invited Speakers & Lecturers Bios

Alba Alfonso Garcia, Ph.D.

Dr. Alba Alfonso-Garcia is an Assistant Professor in the Department of Biomedical Engineering at University of California, Davis. She received her Ph.D. in Biomedical Engineering from University of California, Irvine before joining UC Davis for her postdoctoral training. Dr. Alfonso-Garcia's research in the field of biophotonics focuses on developing label-free spectroscopy and imaging solutions to address unmet needs in biomedical research and clinical practice including disease detection, therapy monitoring, and surgical guidance. She currently investigates live tissue fluorescence signatures to identify intrinsic biomarkers of brain tumor and gastrointestinal disease. She is a member of Optica and vice-chair of the Tissue Imaging and Spectroscopy Technical Group and a member of The International Society for Optics and Photonics (SPIE).

Marco Arrigoni, Ph.D.

Marco Arrigoni has over 35 years of experience in the laser industry, most of them working at Coherent in various roles from engineering to foreign subsidiaries management, business management and – more recently - strategic marketing for the scientific research and life science market segments. In 2023 he Joined Lithuanian femtosecond laser company Light Conversion as head of strategic marketing. Marco is a frequent presenter at BIOS and other conferences and has authored several articles in sector publications.

Wesley Baker, Ph.D.

Dr. Baker is a translational physicist with expertise in developing diffuse optical techniques to non-invasively measure biological tissues. His overarching research goal is the development and validation of new brain monitoring devices that can be used for precision medicine to reduce brain injury in vulnerable pediatric populations. A major part of his current research effort is focused on developing non-invasive optical approaches for measuring intracranial pressure (ICP) and cerebral perfusion, which are useful prognostics of brain injury. Based on his recent work, he was awarded the Functional Near-infrared Spectroscopy Society's Young Investigator award. He is currently the PI of external grants awarded by the National Institutes of Health, the Department of Defense, and the American Heart Association, and co-PI on an internal Frontier program at the Children's Hospital of Philadelphia, entitled "Biomedical optical devices to monitor cerebral health."

Julien Bec, Ph.D.

After an early career as an R&D engineer in the automotive industry (active chassis systems, emissions control), Julien Bec joined the UC Davis Biomedical Engineering department working on the design, fabrication, and evaluation of biomedical imaging systems in the nuclear and optical imaging fields. As the Marcu Laboratory director of engineering, his current activity is focused on the development and clinical validation of fluorescence lifetime instrumentation for cardiovascular and oncology applications. He is supervising hardware and software developments and contributes to clinical study design, development of data analysis methods, and compliance activities.

Andrew Birkeland, M.D.

Dr. Birkeland is a head and neck cancer surgeon-scientist. He is an Associate Professor at the University of California, Davis in the Department of Otolaryngology-Head and Neck Surgery. His research interests center on clinical indicators, translational technologies, and biomarkers to improve, better predict and stratify head and neck cancer patient outcomes.

Orin Bloch, MD

Dr. Orin Bloch is a Professor of Neurological Surgery and the Director of Neurosurgical Oncology at the University of California Davis. He specializes in the neurosurgical management of patients with benign and malignant brain tumors. His surgical expertise includes awake and asleep mapping for eloquent tumors, minimally invasive brain tumor surgery, stereotactic laser ablation for tumors, and stereotactic radiosurgery. He is also the co-director of the Biomedical Technology Program and the disease team leader for Neuro-oncology at the UC Davis Comprehensive Cancer Center. Dr. Bloch directs the UC Davis Brain Tumor Immunotherapy Laboratory funded by support from NIH/NCI and industry. His laboratory studies mechanisms of immune resistance in patients with brain malignancies to identify new targets to enhance immune responses.

Farzad Fereiduoni, Ph.D.

Dr. Fereidouni is an Adjunct Assistant Professor of Pathology and Laboratory Medicine at the University of California at Davis. He earned his Ph.D. in Biophysics from Utrecht University in the Netherlands. As an experimental physicist, he possesses expertise in the development of imaging instrumentation. His research focuses on developing advanced microscopy techniques for tissue diagnostics, with applications in pathology, intraoperative surgery, and point-of-care diagnosis.

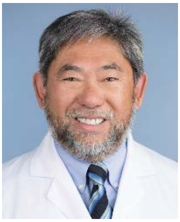
Dr. Fereidouni is a member of several professional organizations, including the United States and Canadian Academy of Pathology (USCAP), the Biomedical Engineering Society (BMES), the Optical Society of America (OSA), and the International Society for Optics and Photonics (SPIE).

In addition to his academic roles, Dr. Fereidouni is the Chief Technology Officer (CTO) and co-founder of Histolix, a company focused on advancing tissue imaging and diagnostics.

Soheil Ghiasi, PhD

I am interested in design methodologies for embedded and cyberphysical systems (CPS). In my research, I aim to build systems that can monitor, predict, and influence application-specific processes, including those in the physical world and/or involving humans. More specifically, my research work deals with system-level modeling, analysis, synthesis, and optimization of embedded systems, programmable execution platforms (e.g., processors, DSPs, GPUs, and FPGAs), and tools for automating the design process. The area focuses on system-level and human-integration challenges and offers an interesting blend of theory and practice: real-world applications give rise to research problems, for which solutions are developed using a combination of analytical and experimental (data-driven) techniques. Our team is always on the lookout for emerging applications of societal significance, which can benefit from advances in technology. While the specific application focus may change from time to time, we are presently focused on human health and wellness as the target domain. In particular, we are currently working on transabdominal fetal oximetry, wearable bladder volume sensing, data analytics & machine intelligence for health.

Herman Hedriana, M.D.



Dr. Hedriana is Professor of Clinical Obstetrics and Gynecology and the director of Maternal Fetal Medicine at the University of California Davis, Department of OB/GYN at the UC Davis Health with an appointment of Professor of Clinical OB/GYN. He received his MD from the Far Eastern University - Nicanor Reyes Medical Foundation Institute of Medicine, Manila, Philippines. He completed his residency training in OB/GYN at the College of Physicians and Surgeons of Columbia University at Harlem Hospital Center and his fellowship training in Maternal Fetal Medicine at the University of California San Diego. His areas of interest include prenatal diagnosis/screening, perinatal safety initiatives, prenatal diagnosis (including first trimester screening and amniocentesis), fetal ultrasound and management of labor. In his interest for non-invasive screening in Obstetrics, he was the lead on developing the non-invasive assessment of twins using fetal cell-free DNA in maternal plasma and is currently working in translating the use of transcutaneous fetal oximetry developed by Soheil Ghiasi' s team at the Laboratory for Embedded and Programmable Systems (LEPS) into clinical application. Dr. Hedriana is board certified in Obstetrics/Gynecology and Maternal Fetal Medicine. M. He is a fellow of the American College of Obstetrics and Gynecology, the Society of Maternal Fetal Medicine, Society of Reproductive Investigation, and the Pacific Coast Obstetrical and Gynecological Society. He was recently added to the Editorial Board of the American Journal of Obstetrics and Gynecology – Global Reports.

Saif Islam, Ph.D.

M. Saif Islam received his B.Sc. Degree in Physics from Middle East Technical University, an M.S. in Physics from Bilkent University, and a Ph.D. degree in Electrical Engineering from UCLA in 2001. He worked for JDS Uniphase Corp and HP Labs before joining the University of California, Davis in 2004, where he is a Professor in the Electrical and Computer Engineering Department and the Director of the Center for Information Technology Research in the Interest of Society (CITRIS) at UC Davis. His research focuses on integrating low-dimensional and nanostructured materials into conventional semiconductor integrated circuits and systems for applications in ultrafast optoelectronics, communication, quantum sensing, AI-enabled imaging, and energy harvesting. Dr. Islam authored or co-authored more than 300 scientific papers, organized 36 conferences as a chair/co-chair, and holds 42 patents as an inventor/co-inventor.

Prof. Islam received the NSF CAREER Award, Outstanding Junior, Outstanding Research Faculty Award of UC Davis Engineering, IEEE Professor of the Year, and UC Davis Academic Senate Distinguished Teaching Award. He is a fellow of the AAAS, Optica, SPIE, IEEE, and National Academy of Inventors (NAI).

Farouc Jaffer, M.D., Ph.D.

Dr Jaffer is Associate Professor of Medicine, Harvard Medical School; and Director of Coronary Intervention, the Chronic Total Occlusion Percutaneous Coronary Intervention (CTO PCI) Program, and CTO/CHIP Fellowship Program at Massachusetts General Hospital. Dr. Jaffer graduated from Stanford University (1990, BS with distinction in Mathematical and Computational Sciences) and received his Doctor of Medicine and Doctor of Philosophy in Biophysics (M.D. and Ph.D.) from the University of Pennsylvania School of Medicine in 1996. He was a Howard Hughes Medical Institute-NIH Research Scholar from 1993-1995. Dr. Jaffer completed a residency in internal medicine at the Brigham and Women's Hospital (1999) and went on to a fellowship in Cardiovascular Medicine at Massachusetts General Hospital (1999-2001). Dr. Jaffer completed a postdoctoral research fellowship in the Center for Molecular Imaging Research at MGH, directed by Professor Ralph Weissleder, M.D. Ph.D., followed by a fellowship year in Interventional Cardiology at Mass General Hospital (2002).

In 2003, Dr. Jaffer joined the MGH Cardiology Division as a faculty member and Attending Interventional Cardiologist. In 2006, he was promoted to Assistant Professor of Medicine at Harvard Medical School. In 2007, Dr. Jaffer was appointed as a Principal Investigator in the Cardiovascular Research Center at MGH. In 2012, he was promoted to Associate Professor of Medicine at Harvard Medical School. In 2013, he was elected to the American Society for Clinical Investigation. Dr. Jaffer's main area of research interest is in developing translational molecular imaging approaches to investigate inflammation in vascular biology in living subjects. His laboratory has partnered with leading engineering groups to develop translatable intravascular near-infrared fluorescence (NIRF) molecular imaging approaches and has performed the first human studies of intracoronary OCT-NIRF imaging of CAD. In venous thrombosis, his laboratory has shown the importance of timely restoration of blood flow to reduce the post-thrombotic syndrome and has developed new inflammation imaging to predict impaired DVT resolution. He has published extensively in peer-reviewed basic, translational, and clinical journals with over 250 Pubmed articles. His laboratory is supported by R01 grants from the National Institutes of Health with specific funding to perform the first NIRF-OCT molecular inflammation imaging studies in CAD patients. Clinically, Dr. Jaffer focuses on CTO and CHIP PCI, utilizing advanced methods including retrograde PCI, mechanical circulatory support, and first-in-US real time CT-x-ray fusion to guide CTO PCI. He is the MGH PI for a number of clinical trials and is part of the International PROGRESS CTO PCI registry.

Ross Keyashian, M.Sc., M.B.A.

Ross Keyashian earned a bachelor's degree in electrical engineering from UC Davis in 2004, a master's degree in physics from San Diego State University, and an MBA from the University of Texas, He is now working towards his Doctorate in Physics at Texas Christian University under Prof. Karol Gryczynsk. His research focuses on macro-fluorescence lifetime imaging instrumentation. Ross has been in the photonic instrumentation industry for over 20 years in mostly Sales & Business Development roles. He is currently the North American Fluorescence Imaging Product Manager at Horiba Instruments.

Kim Jinhwan, Ph.D.

Dr. Jinhwan Kim is an Assistant Professor in the Department of Biomedical Engineering, College of Engineering, and the Department of Surgery, School of Medicine at the University of California, Davis. As one of the Principal Investigators in the Center for Surgical Bioengineering, he directs the Laboratory for Cell Nanoengineering. His research centers on the integration of nanotechnology, cell engineering, and bioimaging to augment and optimize cell therapies, including immunotherapy and stem cell therapy. His group investigates augmentation of endogenous functional/therapeutic cells (e.g., stem cells, T cells, NK cells) with foreign and biocompatible nanoparticles. They use non-invasive and real-time imaging systems, including ultrasound and photoacoustic imaging, to assess the efficacy of these therapies, in an attempt to understanding their therapeutic mechanisms. The goal is to improve control over cell therapies, thereby enhancing their efficacy and facilitating their successful translation into clinical practices.

Richard Levenson, M.D.

Richard Levenson, MD, FCAP, is Professor and Vice Chair for Strategic Technologies, Department of Pathology and Laboratory Medicine at the University of California, Davis. He received his MD at the University of Michigan and pathology training at Washington University, followed by a cancer research fellowship at Univ. of Rochester and faculty positions at Duke and Carnegie Mellon. He then joined Cambridge Research & Instrumentation, Inc., becoming VP of Research before assuming his present position at UC Davis. He helped develop multispectral microscopy and small-animal imaging systems, birefringence microscopy, multiplexed ion-beam imaging (MIBI), and slide-free as well as enhanced-content microscopy approaches and is an inventor on some 15 patents. Since joining UC Davis, he has co-founded two start-up companies. He is the section editor for Archives of Pathology and is on the editorial board of Lab. Invest. and AJP. Regrettably, he also taught pigeons histopathology and radiology. He is a recipient of the 2018 UC Davis Chancellor's Innovator of the Year award and is a Fellow of SPIE.

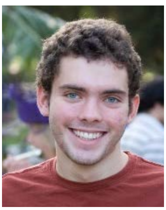
Ryan Martin, M.D.

Dr. Ryan Martin is an Associate Professor of Neurological Surgery and Neurology at UC Davis and serves as the Neurocritical Care Fellowship Director. His clinical interests are related to acute brain injury from a variety of different pathologies, including traumatic brain injury (TBI), subarachnoid hemorrhage, stroke, and seizures. In addition to working in the ICU, he manages an outpatient multidisciplinary TBI clinic. His research interests focus on outcomes following TBI. He is currently funded by CDMRP to use PET imaging to investigate the relationship between neuro-inflammation and post-traumatic epilepsy.

Aydogan Ozcan, M.S., Ph.D.

Dr. Aydogan Ozcan is a Chancellor's Professor and the Volgenau Chair for Engineering Innovation at UCLA and an HHMI Professor with the Howard Hughes Medical Institute. He is also the Associate Director of the California NanoSystems Institute. Dr. Ozcan is elected Fellow of the National Academy of Inventors and holds >75 issued patents in microscopy, holography, computational imaging, sensing, mobile diagnostics, nonlinear optics and fiber-optics, and is also the author of one book and the co-author of >1000 peer-reviewed publications in leading scientific journals/conferences. Dr. Ozcan received major awards, including the Presidential Early Career Award for Scientists and Engineers, International Commission for Optics Prize, Dennis Gabor Award, Joseph Fraunhofer Award & Robert M. Burley Prize, Biophotonics Technology Innovator Award, Rahmi Koc Science Medal, NSF CAREER Award, NIH Director's New Innovator Award, National Geographic Emerging Explorer Award, and MIT's TR35 Award for his contributions to computational imaging, sensing and diagnostics.

Julian Panetta, Ph.D.



Julian Panetta is an Assistant Professor of Computer Science at the University of California, Davis. His research interests lie primarily in the domain of physical simulation, numerical optimization, geometry processing, and inverse design for digital fabrication. He develops efficient multiscale computational techniques for designing physical objects that meet functional goals and respect manufacturing constraints. Before joining UC Davis, he was a post-doc at EPFL in Switzerland. He received his PhD in computer science from NYU's Courant Institute in 2017 and his BS in computer science from Caltech in 2010.

Jinyi Qi, Ph.D.

Jinyi Qi is a Professor of Biomedical Engineering at the University of California, Davis. He received his Ph.D. degree in Electrical Engineering from the University of Southern California in 1998. Dr. Qi served as the Interim Chair of the Department of Biomedical Engineering at UC Davis from 2015 to 2016. He is an elected Fellow of the American Institute for Medical and Biological Engineering (AIMBE) and the Institute of Electrical and Electronics Engineers (IEEE). Currently, he serves as an Associate Editor for the IEEE Transactions on Medical Imaging and the IEEE Transactions on Radiation and Plasma Medical Science. His research focuses on developing advanced signal and image processing techniques for molecular imaging and image guidance.

Jonathan Sorger, Ph.D.

Jonathan Sorger is Vice President, Research at Intuitive, maker of the da Vinci Surgical Systems where he has been responsible for new robotic procedure & platform exploration, initial forays into image guidance technologies which has led to the 3D Models augmented reality product as well as taking three novel optical imaging agents to IND filing and clinical studies. Prior to Intuitive, Sorger worked at Varian Medical Systems, helping to integrate molecular medicine with Varian's radiation oncology platforms. Before Varian, he worked at Stanford University, helping to set up and teach in the newly formed Department of Bioengineering. Jonathan holds a PhD in biomedical engineering as well as an MBA from Johns Hopkins, and attended the University of California, San Diego. He particularly enjoys performing due diligence for investors, and helping small companies when he can.

Jeffrey Southard, M.D.

Dr Jeffrey Southard is a Professor of Medicine/Cardiology at the UC Davis Medical Center. He received his MD from Georgetown University in Washington, DC, and completed his Cardiology and interventional cardiology training at UC Davis. He is the Founding Director of the transcatheter aortic valve replacement (TAVR) program at UC Davis and Shasta Regional Medical Center where he performs additional valve replacement procedures. He is the medical director of the cardiac cath and EP labs at UC Davis and has research interests in structural heart procedures, vascular imaging by way of optimal coherence tomography, and the treatment of patients with hypertrophic cardiomyopathy. He is or has been the principal investigator for many research trials relating to new or emerging TAVR technologies, imaging catheters, and therapeutics related to his field of interest. He is a fellow in the American College of Cardiology and the Society for Cardiovascular Angiography and Interventions and has been practicing at UC Davis since 2003.

Vivek Srinivasan, Ph.D.

Dr. Srinivasan is an Associate Professor of Ophthalmology and Radiology at NYU Grossman School of Medicine, as well as Biomedical Engineering at NYU Tandon School of Engineering. His group invents new light-based technologies for in vivo imaging and sensing of the brain and eye. The Srinivasan Group develops and applies these technologies both to understand fundamental disease processes in experimental models and to detect these changes earlier in humans. The group puts theory into action by actively collaborating with clinicians and other scientists to address pressing needs in the diagnosis of disease in the eye (glaucoma, age-related macular degeneration) and brain (Alzheimer's disease, traumatic brain injury).

Thomas Strohmer, M.S., Ph.D.

Thomas Strohmer is Professor of Mathematics at the University of California, Davis. His research interests are in data science, AI, applied harmonic analysis, signal- and image processing, and mathematics of information. He got his Ph.D. in Mathematics from the University of Vienna. He was the Erwin-Schroedinger fellow in the Department of Statistics at Stanford University in 1997 before joining the University of California, Davis in 1998. His awards include the 2013 IEEE Signal Processing Society Best Paper Award, the 2014 SIAM Outstanding Paper Prize, and the 2014 SIAM Digest Award. Dr. Strohmer is on the editorial board of several journals. He also serves as a consultant to industry in the areas of data science, AI, and signal- and image processing.

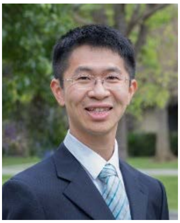
Bogdan Valcu

Bogdan Valcu is Clinical Affairs Director, Novalis Circle Director, and Business Development Director at Brainlab. In Romania, he earned degrees in neuroscience, physics, and mathematics. As a consultant at the Harvard-Smithsonian Center for Astrophysics, he developed novel algorithms to acquire and analyze data from the Ultraviolet Coronagraph Spectrometer (UVCS) instrument on NASA's Solar and Heliospheric Observatory (SOHO) satellite, which were subsequently used at NASA's Goddard Spaceflight Center. He has been a guest researcher at the NIH Office of Extramural Research and a visiting scientist at the University of California San Francisco. He collaborates with a worldwide network of clinicians to advance neurosurgery and radiosurgery and disseminate best clinical practices. As industry sponsor, Valcu has led a US national registry of radiosurgery and served as liaison to the Neuro Point Alliance of the AANS and the American Society for Radiation Oncology (ASTRO). With extensive expertise in applied physics and medical fields and reporting directly to the company's CEO, Valcu seeks company focus on improving patient outcomes.

Yi Xue, M.S., Ph.D.

Dr. Xue is an Assistant Professor in the Department of Biomedical Engineering at the University of California. She received her M.S. and Ph.D. in Mechanical Engineering at MIT, and her B.S. in Optical Engineering at Zhejiang University, China. She leads the Computational Optics for Biomedical Imaging (COBI) lab and is affiliated with the UC Davis Center for Neuroengineering and Medicine. Her research interests include multiphoton microscopy and multimodal imaging. She is a member of the Program Committee for the SPIE Photonics West Adaptive Optics and Wavefront Control for Biological System IX conference, a committee member of the Optics and the Brain Technical Program at the OPTICA Biophotonics Congress 2024, and co-chair of the Computational Cameras and Displays Workshop at the IEEE Conference on Computer Vision and Pattern Recognition (CVPR). Dr. Xue has received several awards including the Weill Neurohub Fellowship and the JenLab Young Investigator Award.

Weijian Yang, Ph.D.



Dr. Weijian Yang is an associate professor in the Department of Electrical and Computer Engineering at the University of California, Davis. He received his Ph.D. degree in electrical engineering at the University of California, Berkeley, CA, USA, in 2013. His research interests lie at the intersection of electrical engineering, biomedical engineering, and neuroscience. He is interested in optical microscopy, biophotonics, integrated optics, optoelectronics, neuroengineering, and using advanced technologies to study the functional organization and plasticity of neural circuits. He is a recipient of the Career Awards at the Scientific Interface from Burroughs Wellcome Fund in 2016, and the NSF Early Career Award in 2019. He is a finalist in the Science-PINS Prize for Neuromodulation in 2021.

Arjun Yodh, Ph.D.

Arjun G. Yodh is the James M. Skinner Professor of Science and Chair of the Department of Physics and Astronomy at the University of Pennsylvania. He was Director (2009-2020) of Penn's Materials Science and Engineering Center (NSF-MRSEC). Yodh's research studies soft materials such as colloids and liquid crystals and biophotonics, especially functional imaging and monitoring of living tissues with diffuse light. Much involves optics, including diffuse optics and spectroscopy, optical microscopy and micromanipulation, nonlinear optics, and light scattering. He was awarded the 2021 Feld Biophotonics Prize of the Optical Society of America (now Optica) and the 2024 Penn Provost Award for Distinguished PhD Teaching and Mentoring. In addition to mentoring more than one hundred PhD students and post-doctoral associates, Yodh has made significant contributions to education, outreach and diversity at the University of Pennsylvania broadly defined, for example leading partnerships with the University of Puerto Rico and research experience programs for undergraduates and high school students/teachers. Yodh graduated from Cornell University (1981) with a B.Sc. in Applied & Engineering Physics. He obtained his Ph.D. from Harvard (1986) under the guidance of Tom Mossberg and then spent two years at AT&T Bell Laboratories as a post-doc working with Steven Chu and Harry Tom. Yodh joined the faculty at Penn in 1988, where he has remained for his entire career.

Mingjun Zhao, Ph.D.

Mingjun Zhao received her BE degree and PhD in biomedical engineering from Tianjin University, China in 2012 and the University of Kentucky in 2019, respectively. She is a research scientist in Dr. Vivek Srinivasan's lab at New York University Langone Health. Her current research interests include technical development of interferometric diffuse optics, applications in human brain measurements, and clinical translations.

Participant Bios

Alex Adams, Ph.D.

Specializing in translational data science within the field of fluorescence spectroscopy, Alex is developing computational tools to interpret disease signatures from spectroscopy data. Her doctoral thesis, "Hidden in Plain Light: High-Resolution Time-Resolved Fluorescence Modelling of Lung Cancer," explored how computational models could enhance biological understanding of lung cancer FLIM signatures. Alex is a postdoctoral researcher in Fluorescence Lifetime Imaging in the Marcu Group at UC Davis, having started in July 2024. She recently completed her PhD in Precision Medicine from The University of Edinburgh, Scotland. Alex also holds an MRes in Cellular and Molecular Biology (2019) and a BSc in Bioscience and Business Management (2018) from The University of Birmingham, England.

Abstract: Variation in tissue autofluorescence originates from structural, metabolic, and environmental differences between fluorophores of cancerous and non-cancerous tissue. However, challenges from fluorescence data collection still remain, including the overlapping spectra of individual fluorophores and in the heterogeneity of tissue fluorescence itself.

Fluorescence lifetime (FL), independent of absolute intensity and unique to specific fluorophores, overcomes some limitations. In addition, innovations in detector technology have seen point-based fluorescence lifetime devices accepted onto clinical studies. Further innovations in detector technology may see clinical devices transition from a few detector channels to many hundreds, thus providing extremely data-rich tissue profiles. To understand these complex signatures, and allow accurate and rapid intra-operative information, sophisticated algorithms that fully interrogate these signatures are required.

From one excitation wavelength range, a limited number of endogenous fluorophores can be excited. These will undoubtedly be overlapping in emission spectra. Additionally, given the complexity of the biological environment and its influence on autofluorescence, we propose unmixing fluorophores with overlapping signatures simultaneously in both the spectral and temporal domain. This will allow further investigation of the changes of individual tissue fluorophores such as NADH, elastin and FAD. This will provide highly detailed, instantaneous clinical fluorescence information with enhanced specificity.

We first present, Multichannel Fluorescence Lifetime Estimation, MuFLE, a novel approach to analyse fluorescence lifetime devices which can capture the fluorescence lifetime and intensity spectrum simultaneously. We show MuFLE to simultaneously un-mix simulated fluorophores with overlapping emission spectra and where their total emission is present, extract their specific peaks. Next, we show ex vivo lung tissue

analysed with MuFLE to differentiate into 3 components. We then show the FL of these MuFLE un-mixed components to match the same tissue when analysed using an alternative benchtop FLIM confocal setup. Finally, we show from biological staining, the un-mixed signatures originate from either elastin or from cellular components of ex vivo lung tissue.

Santosh Aparanji, Ph.D.

Santosh Aparanji is a 3rd year-postdoctoral researcher at Vivek Srinivasan lab at NYU Langone Health, whose research focus is on interferometric diffuse optics (iDWS), comprising hardware and software development, for blood flow monitoring. Santosh obtained a PhD in Nanotechnology with a specialisation in Nonlinear Photonics and Laser Physics from the Centre for Nanoscience and Engineering, Indian Institute of Science, Bangalore in 2021. Equipped with an arsenal of laser-building skills and a stronghold in optics, Santosh uses this knowledge to advance the optical technologies in interferometric diffusing wave spectroscopy. He has built an iDWS system for collaboration with UPenn in a simultaneous comparison of different state of the art diffuse optics technologies for blood flow (traditional APD-based DCS, SCOS and iDWS).

Title: Interferometric Diffuse Optics for Imaging and Monitoring of Human Tissues

Abstract: In this work, we present the technology of interferometric diffuse optics for monitoring of blood flow in human tissues. The concept of interferometric diffuse optics (iDO) is presented and shown to have advantages over conventional diffuse optics, namely in terms of SNR, massive parallelisation, time-of-flight resolution, and estimation of BFI along with hemoglobin concentrations. We present the different facets of interferometric diffuse optics, such as CW iDO, iDO with time-of-flight filtering to binarily choose late or early photon paths, and iDO with time-of-flight resolution (iNIRS). Forearm occlusion, mental arithmetic for brain monitoring, forehead hemodynamics imaging and blood saturation estimation during isometric exercise are presented to validate the unique features and capabilities of iDO.

Paloma Casteleiro Costa, M.S., Ph.D.

Dr. Paloma Casteleiro Costa is a postdoctoral fellow in the Ozcan Research Laboratory at UCLA and her work is mostly centered on computational multimodal microscopy applied to virtual staining. She received her Ph.D. from the Georgia Institute of Technology in 2023. Her dissertation research was focused on label-free tomographic microscopy for in-vivo biomedical applications. Dr. Casteleiro Costa is now focusing her work on studying the capabilities and limitations of deep learning-based virtual staining approaches applied to various digital pathology problems.

Abstract: The classification of Human Epidermal Growth Factor Receptor 2 (HER2) expression levels in breast cancer is critical in the management and treatment of this disease. This poster presents our research on the implementation of digital pathology techniques for HER2 classification, highlighting the transformative benefits of this technology. Digital pathology offers the capability of virtual staining, which eliminates the need for physical staining processes and reduces variability in slide preparation. Furthermore, automated classification algorithms enhance diagnostic accuracy by providing consistent and objective assessments of HER2 status. Additionally, our platform facilitates online training for pathologists, promoting standardization and improving interobserver agreement. The integration of digital pathology in HER2 classification not only streamlines workflows but also significantly contributes to more reliable and reproducible diagnostic outcomes, ultimately enhancing patient care.

Katjana Ehrlich, Ph.D.

Dr. Katjana Ehrlich is a Postdoctoral Researcher in Biomedical Engineering at the University of California, Davis. She earned her Ph.D. in physics from Heriot-Watt University in Edinburgh, Scotland, UK.

With a solid foundation in optical physics and experience in working with optical fibers for telescope integration, Dr. Ehrlich's Ph.D. research focused on the use of time-resolved photon detection for lung disease diagnostics. She developed fiber-based sensing platforms for fluorescence and Raman spectroscopy.

Following her Ph.D., she has worked in medical device design and integration, developing fiber-optic imaging and sensing platforms that combine modalities such as fluorescence lifetime spectroscopy, Raman spectroscopy, OCT, and optical laser ablation. She has also contributed to guiding these technologies through regulatory pathways in clinical settings.

Her current research interests include the clinical translation of fluorescence lifetime imaging for head and neck surgery applications and exploring this data using machine learning techniques.

Yifei Gu

Yifei Gu is a first-year Ph.D. student in Biomedical Engineering at the University of California, Davis, specializing in Raman Spectroscopy and machine learning for cancer diagnosis under the supervision of Professor Randy Carney. She earned her M.S. in Biophysics from McGill University in 2021 and her B.S. in Nanoscience from the University of Waterloo in 2019.

Before starting her Ph.D., Yifei worked as a specialist in Leslie Lab at the University of British Columbia, where she contributed to the development of a high-throughput single-particle imaging technique utilizing microfluidics to study nanoparticles for RNA therapeutics delivery. Yifei is currently automating a high-throughput Raman imaging system, developing robust pre-trained encoders for Raman spectra with large volumes of unlabeled data.

Abstract: Raman spectroscopy-based liquid biopsy platforms leverage circulating biomolecules in biofluids to detect and monitor various health conditions, such as cancers, providing a non-invasive optical diagnosis method. Raman spectroscopy characterizes sample components through their intrinsic Raman fingerprints without requiring any molecular labels, positioning it as a powerful point-of-care diagnoses tool. However, Raman scattering is inherently weak, leading to low signal intensity. Interpreting Raman spectra from biological samples is challenging due to overlapping peaks from mixed biomolecules, and fluorescence background, cosmic rays, and instrument noise can further obscure the signal. Extensive preprocessing is typically required to extract the true Raman signal.

Initial success has been achieved using machine learning models to classify different cancer stages and types based on Raman spectra. Nevertheless, variances in Raman systems, lack of standardized preprocessing protocols, and small patient cohorts lead to models underperforming when applied to spectra measured with different instruments or different cancer types, limiting their clinical utility.

Our goal is to develop a robust Raman spectra encoder that eliminates the need for preprocessing steps and can be fine-tuned for tasks such as classifying cancer stages, identifying cancer types, forecasting cancer recurrence, and recommending personalized treatment plans. To achieve this, we employ a Siamese-based self-supervised contrastive learning model trained on a large amount of unlabeled spectral data. The learning structure incorporates data augmentation techniques to enlarge the training sample size and simulate variations commonly encountered in different measurement conditions. By creating diverse augmented samples, the model learns to identify consistent patterns within the Raman spectra, enhancing its ability to generalize across different instruments and sample types. Preliminary data from head and neck cancer patients indicate that our approach can effectively capture the intrinsic features of Raman spectra, paving the way for reliable and widespread clinical applications.

Elizabeth Hale

Elizabeth Hale is a first year Ph.D. student in Biomedical Engineering at the University of California, Davis with a D.E. in Biotechnology. She received her B.S. in Biomedical Engineering with a Biomolecular Emphasis from the University of Mississippi in 2022 and worked as a research technician and core research facility manager at the University of Mississippi before perusing her graduate degree at UC Davis. She is a NIEHS training fellow focusing on characterization of pollutant adsorbed nanoplastics (PANs) via laser tweezers Raman spectroscopy (LTRS), specifically using LTRS to characterize the adsorption kinetics of pollutants onto the surface of nanoplastics and their prevalence in the environment. She is also investigating PAN toxicity at the lung-blood-brain axis via enhanced dark-field hyperspectral imaging (EDF/HSI).

Abstract: Nanoplastics result from environmental degradation of plastic, a ubiquitous material in our society, which plagues our earth with an estimated 8.3 billion metric tons. Recent studies have revealed concerning levels of microplastics in the environment, drinking water, food products, and humans. Atmospheric particulate matter less than 2.5 µm (PM2.5) is a chemical soup of carcinogens, and nanoplastics are an understudied component due to our limited characterization abilities because of their small size. Molecular interactions in these atmospheric soups may lead to the formation of defined composite particles, that we term pollutant-adsorbed nanoplastics, or PANs, whose characteristics and toxicities differ significantly from those of their individual components. The complex heterogeneity of PANs in our environment demands nanoscale-single particle characterization methods to understand their prevalence and impacts on human health. We present LTRS and EDF/HSI single particle characterization of PANs and their toxicity at the lung-blood-brain axis compared to their individual counterparts.

Qing He, M.S., Ph.D.

Qing He is a postdoc researcher specializing in the field of spectroscopy, focusing on developing robust diagnostic tools for early cancer detection. She is currently conducting her postdoctoral research at the University of California Davis, where she applies Raman spectroscopy (Raman) and surface-enhanced Raman spectroscopy (SERS) to liquid biopsy for cancer diagnosis. She holds a Ph.D. in Agricultural and Biosystems Engineering and an M.S. in Mechanical Engineering from Iowa State University, and a B.S. in Hydrology and Hydropower Engineering from Wuhan University, China. Qing He's research centers on bioengineering ultra-bright SERS nanotags for extracellular vesicle (EV) multiplexing, and demonstrates the potential of these technologies in early cancer detection. Her innovative approach addresses the 'black box' nature of machine learning (ML) algorithms in liquid biopsy by integrating ML-enabled SERS profiling of EVs with a novel Raman tag labeling assay specific to ovarian cancer biomarkers.

Title: Enhancing Ovarian Cancer Diagnostics: Integrating Raman Tag Labeling with ML-Enabled SERS of Extracellular Vesicles for Improved Transparency and Precision

Abstract: Liquid biopsy utilizing machine learning (ML)-enabled surface-enhanced Raman scattering (SERS) of extracellular vesicles (EVs) presents significant potential in the realm of cancer screening due to its inherent advantages, including minimal invasion, early detection, high throughput, and cost-effectiveness. However, its widespread clinical adoption is hampered by the opaque 'black box' nature of ML algorithms. In this study, we aimed to enhance transparency and trust by amalgamating ML-enabled SERS profiling of EVs by using a novel Raman tag labeling assay specific to ovarian cancer EV biomarkers

(CA-125, CA-19-9, HE4). Results underscored that Raman tags, linked to cancer biomarkers, significantly enhanced the interpretability of the SERS data. Notably, SERS outperformed ELISA of the same markers, and SERS spectra from cancer-afflicted patients showed a pronounced Raman tag signal of corresponding cancer biomarkers, in contrast to the subtler signals in the control groups. Further, integrating the Raman tag signature data enhanced the classification accuracy, sensitivity, and specificity across all nine ML models evaluated. Among them, the support vector machine (SVM) model stood out, achieving an exemplary performance with accuracy, sensitivity, and specificity rates all reaching up to 95%. This research underscores the potential of combining Raman tags with ML-enabled SERS to offer a more transparent, effective, and precise approach to ovarian cancer diagnosis.

Tan Hua

Tan Hua is a post-baccalaureate student working as an Assistant Specialist in the UC Davis Division of Head and Neck Surgery at the Department of Otolaryngology. He received a Bachelor of Science at UC Davis in Neurobiology, Physiology, & Behavior while also pursuing a double minor in Sociology and Public Health. His research focuses on Fluorescence Lifetime Imaging (FLIm) and image-guided surgery to improve minimally invasive surgical treatments and outcomes for patients with head and neck cancer. In addition to working under primary surgeon Dr. Andrew Birkeland, Tan also assists in head & neck cancer organoid research through administration of medications and IR photodynamic laser therapy for Dr. Yuanpei Li in the Department of Biochemistry and Molecular Medicine and in utilizing Raman spectrometry via specimen collection and processing in surgical care under Dr. Randy Carney of the Department of Biomedical Engineering.

Jocelyn Jensen

Jocelyn Jensen recently graduated from the University of Washington, where she received a Bachelor of Science in Bioengineering and a Minor in Art History. At the University of Washington, she worked in research regarding rapid point-of-care breast cancer diagnostics using core needle biopsies and MUSE (Microscopy with UV Surface Excitation) microscopes. Jocelyn will join the Fereidouni Lab, currently in the Department of Pathology and Laboratory Medicine at UC Davis Health, to research novel imaging approaches and pathology applications of FIBI (Fluorescence Imitating Brightfield Imaging).

Title: GigaFIBI; rapid, large-format histology-resolution imaging for Intraoperative assessment of breast lumpectomy margins.

Abstract: More than 280,000 women in the United States are diagnosed with breast cancer each year. The majority of these women qualify for breast conserving surgery (BCS), which is also known as a lumpectomy or partial mastectomy. Despite advances in preoperative imaging, the positive surgical margin rate remains significant, with residual tumor present in 5-40% in published reports. The current standard of care for pathology

examination of lumpectomy provides only post-procedural guidance which results in re-excision of the surgical margins in search of residual carcinoma at a substantial cost both in terms of anxiety and morbidity associated with additional surgery, as well as the actual costs to the health care system.

We have developed FIBI (Fluorescence Imitating Brightfield Imaging), a technology which produce digital images from fresh tissue, within minutes that closely, resemble standard histology. Based on our FIBI technology, we plan to develop GigaFIBI, a novel histology-grade imaging approach for margin evaluation of fresh breast lumpectomy specimens providing surgical guidance in an intraoperative setting. Diagnostic-quality microscopic images using GigaFIBI methodology obtained from large (up to 100 x 100 mm2) tissue surfaces can be available within 7 minutes of fresh tissue grossing.

GigaFIBI can provide sensitive and specific lumpectomy margin assessment feasible for intraoperative surgical guidance. This has potential to dramatically reduce the rates of final positive margins requiring additional surgery, with the accompanying morbidity, psychosocial risk, and personal/health care system costs.

Willy Ju

Willy is a Staff Research Associate in the Department of Pathology and Lab Medicine at UC Davis Health (Fereidouni Lab). He received his bachelor's degree at UC Berkeley in Molecular and Cell Biology with an immunology emphasis in 2019. He is currently working on Dual-mode emission and transmission microscopy (DUET) and its applications in basic science research and medical diagnostics. Other projects include the development of novel histopathology staining and imaging approaches and rapid tissue diagnostics in the context of breast cancer tumor margin detection using fluorescence imitating brightfield imaging microscopy (FIBI).

Title: Collagen and Elastin as Biomarkers for Studying Disease: Utilizing DUET Imaging

Abstract: Collagen and elastin are prominent components in both normal and abnormal tissues, and their presence and distribution are significant for fibrosis-, cardiovascular- and cancer-related processes. Collagen quantification in the context of fibrosis, often associated with irreparable organ injury, can predict the disease severity and patient prognosis. In cardiovascular research, elastin signatures can be an important factor in better understanding coronary artery disease processes. In cancer care, identifying elastin from patient biopsies can play a significant role in aiding pathologists in their clinical workflow to identify vascular invasion of cancer cells. Traditional methods to quantify collagen and elastin vary in accuracy, cost, and ease of use. Using DUET microscopy on H&E slides, high-resolution collagen and elastin mapping is possible without added staining steps or expensive optical instrumentation. Here, we demonstrate DUET's approach in chronic kidney disease (CKD), coronary artery disease (CAD), and in identifying vascular elastin in colon cancers.

Yucheng Li, M.S.

Yucheng (Steven) Li is a second-year PhD student in the Biomedical Engineering Department at the University of California, Davis. His research focuses on deep tissue imaging and multimodal imaging based on two-photon fluorescence imaging and computational methods. He received an M.S. in Electrical Engineering from the University of California, Santa Cruz, in 2019 and a B.S. in Microelectronics from Nankai University, Tianjin, China, in 2016. He is currently working on the development of a multimodal imaging system to reconstruct the 3D fluorescence and refractive index distribution of labeled and non-labeled biological specimens from fluorescence images. He is also developing and evolving an active scattering corrections method aiming to image deep into the tissue in real-time in a large volume without heavy computation.

Title: Scattering Correction through Fourier-Domain Open-Channel Coupling in Two-Photon Microscopy

Abstract: Light penetration depth in biological tissue is limited by tissue scattering. There is an urgent need for scattering compensation in vivo focusing and imaging, particularly challenging in photon-starved scenarios without access to the transmission side of the scattering tissue. Here, we introduce a two-photon microscopy system with Fourier domain open-channel coupling for scattering correction (2P-FOCUS). 2P-FOCUS corrects scattering by utilizing the non-linearity of multiple-beam interference and two-photon excitation, eliminating the need for a guide star, iterative optimization, or measuring transmission or reflection matrices. We demonstrate that 2P-FOCUS significantly enhances two-photon fluorescence signals by several tens of folds when focusing through a bone sample, compared to cases without scattering compensation at equivalent excitation power. We also show that 2P-FOCUS can correct scattering over large volumes by imaging neurons and cerebral blood vessels within a 230×230×500 µm3 volume in the mouse brain ex vivo. 2P-FOCUS could serve as a powerful tool for deep tissue imaging in bulky organisms or live animals.

Ben Mattison

Ben is a 4th year PhD candidate in Biomedical Engineering at UC Davis focusing on biophotonics and neuroscience. Prior to UC Davis, he received his undergraduate degree in Engineering Physics from the University of British Columbia and worked at an orthodontic medical device startup developing optical instrumentation and simulations to inform device design and clinical study direction. His current research at UC Davis is working with Prof. Weijian Yang to develop novel miniaturized two-photon microscopes for high-speed in vivo functional imaging of neural activity in mice during freely moving and natural behaviors.

Abstract: Miniaturized two-photon microscopes (2P Miniscopes) are powerful optical tools that can enable high-resolution structural imaging of morphology and/or functional recording of physiological dynamics in biological applications where large bench-top microscopes are too cumbersome. 2P Miniscopes are constrained by size and weight requirements which may limit performance compared to bench-top options. Additionally, two-photon imaging can be relatively slow since it requires mechanically raster scanning of a small laser excitation spot over a given field-of-view (FOV) to generate each image frame. We present a 2P Miniscope that performs high-speed imaging of neural activity at cellular resolution in freely moving mice. Rather than exciting the sample with a diffraction-limited spot, we shape the beam into an ellipse (~1 μm short axis, 5-10 μm long axis) to match the morphology of the physiological targets, the neuronal cell bodies (10-15 μm diameter). This reduces the number of rows required for a single scanning FOV, thus increasing the imaging frame rate for a given scanner speed. We incorporated an electrically tunable lens to adjust the imaging depth dynamically. Using our 2P Miniscope, we performed volumetric calcium imaging in a mouse visual cortex transfected with GCaMP calcium indicators (5 planes, 400 μm diameter FOV per plane, 432 simultaneously recorded neurons). Compared to the point-by-point scanning approach, we achieved a ~5× increase in imaging speed. Our 2P Miniscope will be important to study large-scale neuronal circuits during natural mouse behaviors.

Rebecca Mayer

Bec Mayer is a 4th year PhD student studying cancer detection using Raman Spectroscopy in the Biomedical Engineering department at the University of California, Davis. She received her B.S. degree from the Georgia Institute of Technology in Biomedical Engineering in 2021. Her current research focuses on the optimization of methods used to collect Raman measurements in order to automate the process and reduce the need for an expert user. The goal for this research is to work towards the reduction to clinical practice of Raman cancer detection.

Abstract: There are many limitations to current cancer diagnostic methods. Tissue biopsies are invasive and expensive, there is no generalized imaging technique for all cancers, and liquid biopsies, such as ones that quantify ctDNA, are not effective for early-stage diagnosis. Later stage diagnoses, and therefore delayed treatment, correlate to a much lower survival rate and a poorer prognosis than early stages. Raman spectroscopy has the ability to detect cancer in a wide range of tumor types by identifying subtle increases in cancer associated metabolites released into circulating biofluids during early tumor development. The underlying measurement is a simple, label-free optical measurement that can be automated to eliminate the need for expert user involvement, thus providing a high throughput assay that could be applied to large populations for serial monitoring and surveillance. I investigated many preanalytical variables that affect the quality of Raman biofluid measurements using plasma and saliva samples from patients with head and neck cancer with the goal to streamline the sample testing process by decreasing sample acquisition time, increasing repeatability, and eliminating the requirement for human intervention. One main variable is the effect of Marangoni and

capillary flow that cause sample droplets to dry with non-homogenous composition across their area, causing spatially correlated spectral changes. This study has the potential to provide a large-scale, widely available cancer detection method that is simple to use, provides highly sensitive results, and ultimately set the stage for biomarker clinical trials to validate that the proposed test improves patient outcomes.

Carl Messerschmidt, M.S.

Carl Messerschmidt is a PhD student at the Leibniz Institute of Photonic Technology and the Friedrich-Schiller University in Jena, Germany. His focus is the development of nonlinear spectroscopic imaging modalities utilizing broadband coherent Raman scattering (CRS). He received an M.Sc. degree in Physics specializing in solid-state physics and photonics in 2023 from the Technical University of Dresden, Germany. His B.Sc. degree in Physics he received from the Albert-Ludwig-University of Freiburg, Germany in 2020. His current research focuses particularly on the comparison of broadband CARS and broadband SRS and utilizing these techniques in custom-developed setups for various applications.

Abstract: Nonlinear spectroscopic imaging techniques, such as Coherent Anti-Stokes Raman Scattering (CARS), have emerged as powerful tools for biomedical research, supporting medical diagnostics and therapy. Broadband CARS (BCARS) plays a promising role in the field since it enables label-free and chemically specific imaging at subcellular resolution of a broad vibrational spectrum at high speed.

We present a BCARS setup based on a chirped pulse amplification laser and white light generation in a bulk crystal for BCARS spectroscopy. We showcase measurements of various samples, e.g. subcellular components, cell cultures, solvents, and complex human tissue samples. The imaginary part of the BCARS spectrum corresponds to the spontaneous Raman spectrum. It is reconstructed through a phase retrieval algorithm based on the Kramers-Kronig relations. Machine learning algorithms are employed to further explore the information content of the extensive spectral data cubes.

With that, we can access the characteristics of the vibrational spectra of the (bio-) chemical compositions, allowing the differentiation of tissue types, the observation of differences in metabolism, the tracking of lipids or the monitoring of processes such as drug delivery. The achievable imaging speed due to the coherent process sets the stage for time-resolved imaging in situ and live imaging in vivo making specific contrast, e.g. digital staining, accessible in the clinical environment.

Abraham Morales

Abraham Morales is a fourth-year undergraduate student pursuing a bachelor's degree in molecular and medical microbiology. He is attending the University of California, Davis, and is to graduate in the Spring of 2025. He is currently a student researcher in Dr. Stephanie Goldshmidt's lab. The lab focuses on work relating to oral cancer, with one project using FLIm technology to test its effectiveness in diagnosing oral squamous cell carcinoma.

Hannah O'Toole

Hannah O'Toole is a rising fifth-year Ph.D. candidate with a Designated Emphasis in Biophotonics and Biomedical Imaging in the Biomedical Engineering Department at the University of California, Davis. She completed her B.S. in Biomedical Engineering at UC Davis in 2020 and has been working with Prof. Randy Carney since 2019, for both undergraduate and now doctoral research. Hannah's work focuses on the development of nanoscale biosensors and the characterization of extracellular vesicles (EVs) for biomarker detection across a variety of indications, including cancers and sepsis. Utilizing spontaneous and surface-enhanced Raman spectroscopy (SERS), paired with machine learning, she aims to delineate disease versus healthy biomarkers, for rapid, sensitive, and specific detection.

Abstract: Sepsis following burn trauma is a global complication with high mortality, with ~60% of burn patient deaths resulting from infectious complications. Sepsis diagnosis is complicated by confounding clinical manifestations of the burn injury, and current biomarkers lack the sensitivity and specificity required for prompt treatment. There is a strong rationale to assess circulating extracellular vesicles (EVs) from patient liquid biopsy as biomarkers of sepsis due to their release by pathogens from bacterial biofilms and roles in subsequent immune response. Spontaneous Raman spectroscopy characterization of patient plasma derived EVs for rapid, sensitive, and specific detection of sepsis in burn patients, achieving 97.5% sensitivity and 90.0% specificity. Furthermore, spectral differences between septic and non-septic burn patient EVs were traced to specific glycoconjugates of bacterial strains associated with sepsis morbidity. This work illustrates the application of EVs as biomarkers in clinical burn trauma care, and establishes Raman analysis as a fast, label-free method to specifically identify features of bacterial EVs relevant to infection amongst the host background.

Xiangping Ouyang

Abstract: Optical coherence microscopy (OCM) imaging of the Drosophila melanogaster (fruit fly) heart tube has enabled the non-invasive characterization of fly heart physiology in vivo. OCM generates large volumes of data, making it necessary to automate image analysis. Deep-learning-based neural network models have been developed to improve the efficiency of fly heart image segmentation. However, image artifacts caused by sample motion or reflections reduce the accuracy of the analysis. To improve the precision and efficiency of image data analysis, we developed an Attention LSTM U-Net model (FlyNet3.0), which incorporates an attention learning mechanism to track the beating fly heart in OCM images. The new model has improved the intersection over union (IOU) compared to FlyNet2.0+with reflection artifacts from 86% to 89% and with movement from 81% to 89%. We also extended the capabilities of OCM analysis through the introduction of an automated, in vivo heart wall thickness measurement method, which has been validated on a Drosophila model of cardiac hypertrophy. This work will enable the comprehensive, non-invasive characterization of fly heart physiology in a high throughput manner[1].

[1]Xiangping Ouyang, Abigail Matt, Fei Wang, Elena Gracheva, Ekaterina Migunova, Saathvika Rajamani, Edward B. Dubrovsky, and Chao Zhou, "Attention LSTM U-Net model for Drosophila melanogaster heart tube segmentation in optical coherence microscopy images," Biomed. Opt. Express 15, 3639-3653 (2024)

Joshua Pace

Josh Pace is a fourth-year graduate student pursing his Ph.D. in Bioengineering with a focus in biomedical optics at Northeastern University in Boston, Massachusetts. He received a B.S. Degree in Biomedical Engineering from the University of Arizona in 2019. His research is focusing on the fluorescent detection of circulating tumor cells directly in the blood of mice. Utilizing custom built diffuse in vivo flow cytometry optical setups, he is exploring the uptake of clinical stage fluorescent molecular targeted contrast agents by a variety of different cancer types. With the end goal of using this technology in humans, he hopes to give doctors more information about the presence of these cells in the blood of cancer patients.

Sricharan Pusarla

I am Sricharan Pusarla, a high schooler from Folsom High school interested in the field of bio-engineering.

Iris Rivas

Iris Rivas is a Junior Specialist II at the UC Davis School of Veterinary Medicine Teaching Hospital. Iris obtained her Bachelor of Science in Animal Biology from UC Davis in 2022 and will be applying to veterinary school this year. Iris is a lab manager and technician with Dr. Goldschmidt on the first canine clinical trial that uses exogenous 5-ALA to detect oral cancer at the Veterinary Medicine Teaching Hospital. The Goldschmidt Comparative Oncology Lab detects oral cancer using fluorescent lifetime imaging (FLIm) in several cancer types and have successfully managed to mimic this phenomena in vitro. Iris hopes to explore the possibilities of using fluorescence imaging to advance the treatment of dogs with cancer.

Pegah Safavi, M.Eng.

Pegah Safavi is a Ph.D. candidate in Biomedical Engineering at the University of Kentucky, working under the guidance of Professor Guoqiang Yu. Her research focuses on developing innovative wearable fiber-free optical sensors for continuous cerebral monitoring. Pegah's work has earned recognition, including the Third Place Award in the 2023 Spring "1-Minute Poster Pitch Competition" at the University of Kentucky and the 2024 Lighthouse Beacon Foundation Graduate Fellow award. She holds an M.Sc. in Medical Radiation Engineering from Islamic Azad University (Science and Research Branch) of Iran, obtained in 2017, and a B.Sc. in the same field from the same institution, completed in 2014. Pegah is currently engaged in two significant projects: the development of a wearable fiber-free optical sensor for continuous cerebral monitoring during treadmill exercise in young, aged, and AD mice, and a novel study on noninvasive and continuous monitoring of cerebral blood flow responses to intermittent hypoxia in neonatal rats using diffuse speckle contrast flowmetry (DSCF). Her skill set includes expertise in biomedical optics, 3D printing, programming in C# and MATLAB, and experience with various imaging modalities. Pegah's research aims to advance non-invasive medical devices for cerebrovascular disease monitoring, with potential applications in various neurological conditions across different age groups.

Abstract: Intermittent hypoxia (IH) may result in hypoxic/ischemic stresses on the brains of preterm neonates. To address the need for wearable techniques for continuous monitoring of cerebral blood flow (CBF) variations during IH, we developed a novel diffuse speckle contrast flowmetry (DSCF) technique capable of noninvasive CBF monitoring. A controlled experiment utilizing neonatal rats, selected for neurophysiological similarities to human neonates, evaluated DSCF system efficacy in assessing cerebral hemodynamic variations during induced IH. A miniaturized DSCF probe was developed consisting of a small laser diode as a focused-point source for deep tissue penetration and a tiny NanEye camera for detecting spatial fluctuations of diffuse laser speckles resulting from red blood cell motions in the brain (i.e., CBF). The DSCF probe was attached gently to the scalp of rat pups (3-5 days old) under 1% Isoflurane anesthesia. Rat pups in the IH group (n = 4) received repetitive transient hypoxia-hyperoxia challenges (10 cycles of 2-minute 8% O2 in N2 and 2-minute 100% O2) daily for 3 days, while the sham group (n = 3) underwent a 13-minute normoxic baseline monitoring for 3 days. The sham group showed small CBF variations over 3 days (0.79% ± 0.91%, 3.41% ± 6.20%, 4.52% ± 7.27%). Conversely, the IH group showed large increases in CBF during hypoxia and small decreases during hyperoxia in each IH cycle. Overall, the IH group showed remarkable CBF increases immediately after the completion of 10 IH cycles compared to the baseline (13.67% ± 7.55%, 24.53% ± 12.42%, 15.14% ± 12.47%). Recent DSCF device advancements achieve a 17.5 mm penetration depth, suitable for human neonates. Future studies propose neonatal piglet models, bridging rat-to-human translation. Piglets' similarities in head size, brain development, and injury responses to human neonates will facilitate DSCF technique validation for monitoring cerebral hemodynamics during IH.

Rabinsakar Samanta, M.Sc., Ph.D.

Dr. Rabisankar Samanta is a postdoctoral fellow at the Neurophotonics Lab, headed by Prof. Vivek Srinivasan, at the NYU Grossman School of Medicine, NY, USA, starting in Feb 2024. Prior to this position, he obtained an integrated M.Sc- Ph.D degree in Physics from Tata Institute of Fundamental Research, Mumbai, India in January 2024. His doctoral thesis concentrated on several aspects of light transport and control in second-order nonlinear scattering media. He completed his undergraduate studies in Physics at Midnapore College (Autonomous), W.B., India. Currently, in Prof. Srinivasan's Lab, his research focuses on the non-invasive monitoring of blood flow in the brain and other areas. To accomplish this, he is developing different low-cost imaging modalities utilizing interferometric diffuse optics techniques.

Dena Sayrafi

Dena Sayrafi received her BS degree in Biomedical Engineering from the University of California, Davis in 2023. Following her graduation, she has been working as a Junior Specialist in the Department of Pathology and Laboratory Medicine at UC Davis Health under the supervision of Dr. Farzad Fereidouni. She has actively contributed to research projects focused on developing imaging instrumentation and intraoperative guidance approaches, directly applicable to pathology and patient care. Dena is particularly interested in biophotonics and the clinical application of label-free fluorescence lifetime imaging and plans to pursue a PhD to further her research. She is motivated by the desire to impact patient care by developing innovations for disease prevention, diagnosis, and treatment, and aims to ensure that these technologies and strategies are adopted in geographically and economically diverse healthcare settings worldwide.

Title: ROSE+: Rapid Adequacy and Diagnostic Determinations for Core-Needle Biopsy Specimens Using FIBI-Enabled Sample-Sparing Slide-Free Histology.

Abstract: Histological diagnoses obtained through minimally invasive biopsies are critical to providing timely and accurate diagnoses in oncologic and infectious diseases. However, these procedures pose risks of damaging tissue or blood vessels and inadequate tissue sampling, occurring in over 20% of cases. Traditional histopathology, the gold standard for diagnosing these biopsies, proves impractical due to the significant time and care required. These factors may result in the need for repeat biopsies and delays in diagnosis, impacting patient care, increasing healthcare costs, and heightening patient anxiety. There is a need for a real-time diagnostic approach for needle-based biopsy procedures of patients with suspected cancer to enhance both diagnostic yields and adequacy confirmation. Fluorescence Imitating Brightfield Imaging (FIBI) is a technique that bypasses formalin fixation and paraffin embedding (FFPE) processes by capturing images of the surface of non-sectioned, freshly excised specimens, providing histology-grade images within minutes. This novel process addresses concerns of cost, time, and sample adequacy and is suitable for downstream immunohistochemistry, sequencing, or other molecular analyses. FIBI has demonstrated significant promise in facilitating accurate diagnoses, showcasing clinical concordance rates of 97% when compared to standard slide-based diagnoses. Our study aims to optimize tissue processing, staining, and handling by evaluating approximately 100 needle biopsy specimens of soft tissue lesions. We anticipate observing the non-inferiority of FIBI images compared to standard FFPE and sectioned H&E images and the superiority of FIBI over diagnoses made through cytological touch prep or concurrent fine-needle aspirations.

Constanze Schultz, M.S.

Constanze is currently a doctoral student at the Leibniz Institute of Photonic Technology in Jena (Germany). Her research focuses on the application of vibrational tags for the elucidation of biological processes in simple organisms such as cells, algae, and nematodes. She previously obtained a bachelor's degree in chemistry with a synthetic organic focus from the University of Jena (Germany) in 2018. For her graduate studies in chemistry, she transitioned to the University of Calgary (Canada) as an exchange student and completed her degree in Jena (Germany) with her master's thesis on "Spatio-temporal imaging of small molecules in complex biological matrices" in the group of Dr. Juergen Popp in physical chemistry in 2020.

Abstract: Minimally invasive tracking of molecules in natural environments is a demanding task when elucidating biological processes. Typically applied localization techniques are diverse and include e.g. fluorescence, radionuclide, mass spectroscopy, or vibrational imaging. However, for small molecules (<1000 g mol^{-1}) intrinsic characteristic traceable features (ideally orthogonal to the enclosing matrix) are often lacking. In vivo and in vitro imaging further demand a selective, sensitive, unambiguous, and nondestructive identification of molecules. This not only limits the choice of an imaging technique but also of a suitable mimetic or external molecular probe due to size restrictions. Here, we show the potential of spontaneous and coherent Raman spectroscopy combined with a triple bond tag concept for resolving biological issues in simple systems, such as cells and nematodes. Triple bond tags feature several benefits, including the retainment of faithful biological behavior, rapid on-site data evaluation, and tunability of scattering cross-section and spectral position in the case of tailor-made tags. As a result, vibrational imaging can effectively complement conventional fluorescence gold standards. Coherent nonlinear techniques further expand the scope of available vibrational methods, providing fast imaging for time-critical demands and large-area screening.

Hidenori Tanaka, Ph.D.

Hidenori Tanaka is a visiting assistant professor at Eben Rosenthal lab at Vanderbilt University Medical Center, whose research interest is on intra-tumor and inter-tumor heterogeneity of molecular target drug distribution and intra-operative surgical imaging using fluorescence-labeled molecular target drug. He has over 10 years of experience as a board-certified otorhinolaryngologist in Japan. After receiving PhD from Osaka University, Japan, in 2021 for his research on circulating tumor DNA, he joined the Rosenthal lab in 2023. The Rosenthal lab has conducted clinical trials using fluorescence-labeled targeted drugs against EGFR for intraoperative tumor imaging for head and neck cancer patients, and he tries to identify the barriers to drug delivery in vivo by analyzing these clinical specimens.

Andrew Tharp, Ph.D.

Andrew (Andy) Thrapp finished his PhD at the Applied Optics Group, University of Kent, UK in 2021. He is currently a researcher in the Tearney Lab at Massachusetts General Hospital and Harvard Medical School. His primary interests are endoscopic applications of multi-modal optical coherence tomography. He is working on technical improvements to cardiovascular near-infrared fluorescence (NIRF) OCT to detect active macrophages, a byproduct of inflammation. He is focused on the technical improvements necessary to realize the clinical benefit of new agents. One component is a technique for real time intravascular unmixing, and a second is high throughput fluorescence probes and associated rotary junction. He is also working on a multi-modal optical coherence tomography capsule designed to better identify pre-cancerous tissue likely to progress. The capsule uses optical coherence tomography along with 12 unique optical signatures from endogenous tissue to detect known risk correlates. He also is pursuing fluorescence OCT in a clinical setting, in a first study, he is using a fluorescent slurry and more conventional capsule to detect dysplasia, and the second, he is participating in a cardiovascular study to investigate near infrared autofluorescence (NIRAF) as a risk progression tool.

Title: Depth-in-color enface encoding enables automated colon polyp classification of optical coherence tomography image ex-vivo: A feasibility study

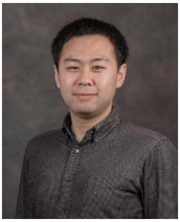
Abstract: Optical coherence tomography (OCT) enables depth-resolved cross-sectional imaging of tissue structure. If accurate for diagnosing polyp types, OCT could be used to implement ASGE's PIVI "diagnose-and-leave" strategies for lower colon hyperplastic polyps or "resect-and-discard" for diminutive polyps. Automatic classification of lesions from OCT images is still under investigation. Key limitations of prior efforts include limited sensitivity to depth dependent pathological differences, a relatively low number of samples, and the exclusion of sessile serrated adenomas and polyps (SSA/P).

We imaged polyps from 300 patients with an OCT system immediately after excision. With knowledge of the histopathology, en face projections and scattering maps were labeled by a pathologist as "No Malignant Potential" including hyperplastic polyps and polypoid mucosa seen endoscopically, and "Malignant Potential" including adenomas and SSA/P. Two convolutional neural networks were trained using depth-in-color enface projections, with the following encoding: surface (Red), mid (Green), and deep (Blue). One network used slices, the other summed from the surface to the final depth. The two networks were then fused in a support vector machine which output a predicted class.

A preliminary receiver operating characteristic (ROC) analysis showed a prospective area under-the-curve (AUC) of 0.88 with an accuracy of 86%. The model performed with a sensitivity of 95% (85-100%, 95% CI), specificity of 73% (59-87%), a positive predictive value of 84% (75-94%) and a negative predictive value of 90% (82-98%).

Our findings show that if these diagnostic accuracies hold in vivo, then automatic classification of polyp types by OCT should meet ASGE PIVI thresholds for "diagnose and leave" and "resect and discard" strategies.

Nimu Yuan, Ph.D.



Nimu Yuan is a postdoctoral scholar at Qi Lab in Biomedical Engineering at the University of California, Davis, specializing in CT imaging and radiomics. He completed his Ph.D. in Biomedical Engineering, where his research focused on deep learning-based low-dose CT image denoising approaches. His current research encompasses advancing deep learning-based techniques for enhancing low-dose and sparse-view CT images, and radiomics-based surgical guidance and survival prediction. Nimu's work has been published in various prestigious journals, and he holds several patents related to CT imaging technology.

Abstract: Early detection and accurate diagnosis of lymph node metastasis (LNM) in head and neck cancer (HNC) are crucial for enhancing patient prognosis and survival rates. Current imaging methods have limitations, necessitating new evaluation of new diagnostic techniques. This study investigates the potential of combining pre-operative CT and intra-operative fluorescence lifetime imaging (FLIm) to enhance LNM prediction in HNC using primary tumor signatures. CT and FLIm data were collected from 46 HNC patients. A total of 42 FLIm features and 924 CT radiomic features were extracted from the primary tumor site and fused. An SVM model with a radial basis function kernel was trained to predict LNM. Hyperparameter tuning was conducted using a 10-fold nested cross-validation. Prediction performance was evaluated using balanced accuracy (bACC) and area under the ROC curve (AUC). The model leveraging combined CT and FLIm features demonstrated improved testing accuracy over the CT-only and FLIm-only models. Feature selection identified that a subset of 10 FLIm and 10 CT features provided optimal predictive capability. Feature contribution analysis identified high-pass and low-pass wavelet-filtered CT images as well as Laguerre coefficients from FLIm, as key predictors. Combining CT and FLIm of the primary tumor improves the prediction of HNC LNM than using either modality alone. This study underscores the potential of combining pre-operative radiomics with intra-operative FLIm for more accurate LNM prediction in HNC, offering promise for enhancing patient outcomes.

Mingjun Zhao, Ph.D.

Mingjun Zhao received her BE degree and PhD in biomedical engineering from Tianjin University, China in 2012 and the University of Kentucky in 2019, respectively. She is a research scientist in Dr. Vivek Srinivasan's lab at New York University Langone Health. Her current research interests include the technical development of interferometric diffuse optics, applications in human brain measurements, and clinical translations.

Title: Interferometric Diffuse Optics for Imaging and Monitoring of Human Tissues

Abstract: In this work, we present the technology of interferometric diffuse optics for monitoring of blood flow in human tissues. The concept of interferometric diffuse optics (iDO) is presented and shown to have advantages over conventional diffuse optics, namely in terms of SNR, massive parallelisation, time-of-flight resolution, and estimation of BFI along with hemoglobin concentrations. We present the different facets of interferometric diffuse optics, such as CW iDO, iDO with time-of-flight filtering to binarily choose late or early photon paths, and iDO with time-of-flight resolution (iNIRS). Forearm occlusion, mental arithmetic for brain monitoring, forehead hemodynamics imaging and blood saturation estimation during isometric exercise are presented to validate the unique features and capabilities of iDO.

Lei Zhou

Lei Zhou is a first-year graduate student. Her doctoral research focuses on PET-related image processing, primarily using deep learning and machine learning algorithms. She completed her undergraduate studies on the Internet of Things at Central South University and her master's degree in computer science and engineering at Nanjing University. Her research primarily focuses on the recognition of head and neck cancers and lymph nodes based on PET-CT images, and she is also interested in multimodal data such as Fluorescence Lifetime Imaging Microscopy (FLIm).

Xiangnan Zhou, Ph.D.

Dr. Xiangnan Zhou is a Postdoctoral Scholar in the Department of Biomedical Engineering at the University of California at Davis. He received his Ph.D. in biomedical engineering from the University of California at Davis. His research interest is in biomedical optics, with a particular focus on fluorescence lifetime imaging and optical coherence tomography for the development of optical techniques for clinical applications in surgical oncology and interventional cardiology. He is a member of The Optical Society of America (OSA) and SPIE, the international society for optics and photonics.

Organizing Team

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Venue Information

Genome & Biomedical Sciences Facility
451 Health Sciences Drive
Auditorium Room 1005
Davis, CA 95616
Map

UC Davis Health Campus
The UCD Pavilion
1419 H Street
Sacramento, CA 95814
Map

Aggie Square
Stockton Blvd & Second Ave
Sacramento, CA 95817
More info

Lake Tahoe
Things to do in Lake Tahoe

Code of Conduct

Harassment, bullying, and retaliation create divisive and exclusionary environments. The science and engineering ecosystem thrives on a diversity of ideas, perspectives, and talents, so therefore must be free of these types of behaviors. Providing a professional and safe conference environment, as well as raising awareness of harassing behaviors, are priorities for Optica and SPIE. Both organizations are determined to eliminate harassment in any form at their respective events.

Harassment

Consists of unwanted, unwelcomed, and uninvited behavior that demeans, threatens, or offends another.

Report Harassment or Unethical Behavior

- Laura Marcu: lmarcu@ucdavis.edu
- Griff Harsh: gharsh@ucdavis.edu
- Randy Carney: rcarney@ucdavis.edu

Parking & Transportation

Parking

There are parking lots to the west and east of the GBSF building. Information about campus parking is available from the Transportation And Parking Services (TAPS) website, or call 530-752-TAPS (8277).

Please note that a valid UC Davis permit is required to park on campus; at this time, daily parking types and rates for students, employees, and visitors are available. You can purchase a parking permit online from TAPS or via the ParkMobile app.

Visitor permits may be purchased for $12.00 per day from permit dispensing machines or by using the ParkMobile app. There is also limited metered parking directly in from of the GBSF building. More information about visitor parking at UC Davis can be found online at TAPS.

For parking on campus, you could purchase a daily permit through the AMP Park application. Paid permits are required Monday through Friday, from 7:00 am to 10:00 pm.

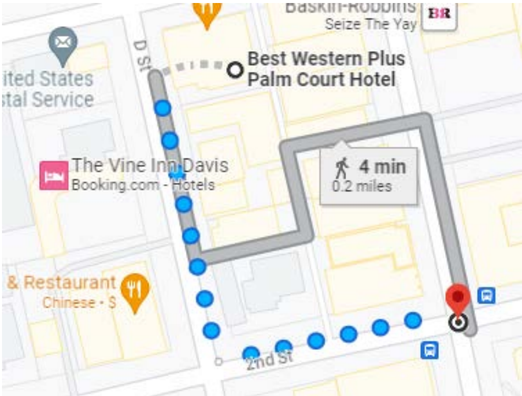
Traveling beyond Davis

Unitrans

Unitrans is operated in partnership by the Associated Students of UC Davis (ASUCD) and the City of Davis, and provides public transportation service to the entire city with over 40 buses on 15 routes, carrying over 3 million passengers a year. For routes, fares, and schedules, visit the Unitrans website, or call 752-BUSS (2877).

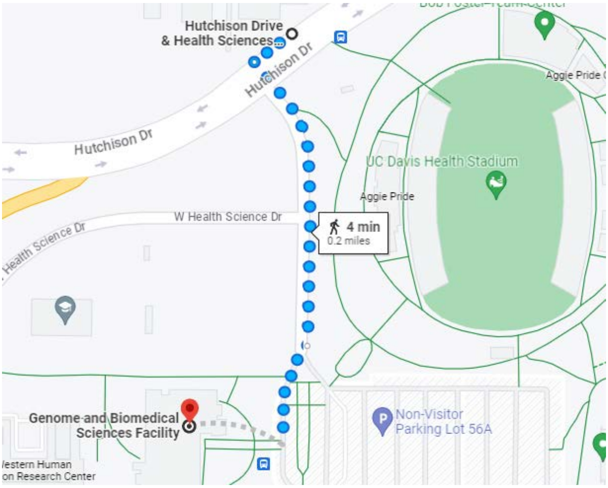
Transportation instructions: Bus runs every hour. Please make sure to arrive at the bus stop on time.

- Board A line bus at 2nd and E street at 7:30am (ask for transfer ticket)
- Get off at Silo Terminal (last stop) 7:50am



- Board V line at Silo Terminal at 7:55am
- Get off Hutchison/Health Science at 7:58am

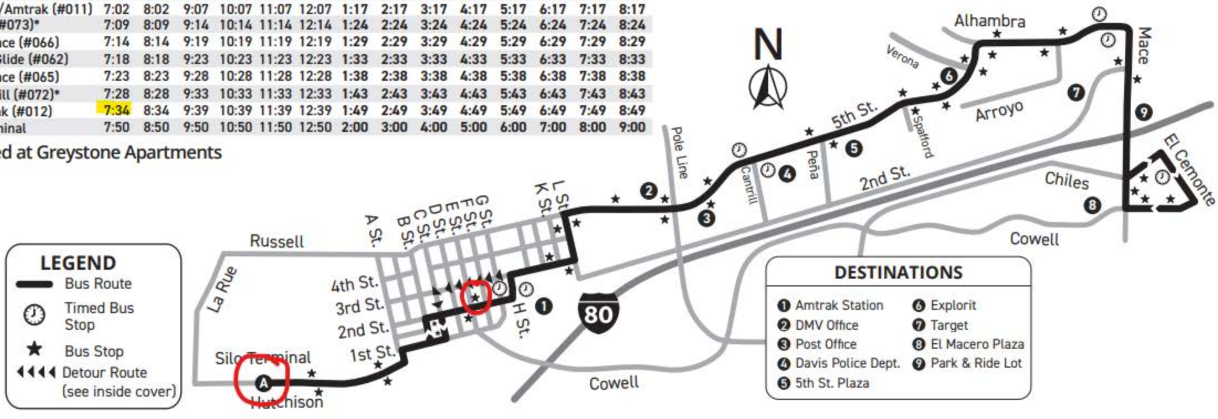
- Walk towards Health Sci drive.


Hutchison Drive
& Health Sciences...
Hutchison Dr
Hutchison Dr
W Health Science Dr
UC Davis Health Stadium
Aggie Pride
4 min
0.2 miles
Genome and Biomedical
Sciences Facility
Non-Visitor
Parking Lot 56A

Summer Service (No Break Service)

Depart Silo Terminal (#258)	6:55	7:55	9:00	10:00	11:00	12:00	1:10	2:10	3:10	4:10	5:10	6:10	7:10	8:10
H St. @ 2nd St./Amtrak (#011)	7:02	8:02	9:07	10:07	11:07	12:07	1:17	2:17	3:17	4:17	5:17	6:17	7:17	8:17
5th @ Cantrill (#073)*	7:09	8:09	9:14	10:14	11:14	12:14	1:24	2:24	3:24	4:24	5:24	6:24	7:24	8:24
Alhambra @ Mace (#066)	7:14	8:14	9:19	10:19	11:19	12:19	1:29	2:29	3:29	4:29	5:29	6:29	7:29	8:29
El Cemonte @ Glide (#062)	7:18	8:18	9:23	10:23	11:23	12:23	1:33	2:33	3:33	4:33	5:33	6:33	7:33	8:33
Alhambra @ Mace (#065)	7:23	8:23	9:28	10:28	11:28	12:28	1:38	2:38	3:38	4:38	5:38	6:38	7:38	8:38
5th St. @ Cantrill (#072)*	7:28	8:28	9:33	10:33	11:33	12:33	1:43	2:43	3:43	4:43	5:43	6:43	7:43	8:43
H @ 2nd/Amtrak (#012)	7:34	8:34	9:39	10:39	11:39	12:39	1:49	2:49	3:49	4:49	5:49	6:49	7:49	8:49
Arrive Silo Terminal	7:50	8:50	9:50	10:50	11:50	12:50	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00

*Stop located at Greystone Apartments



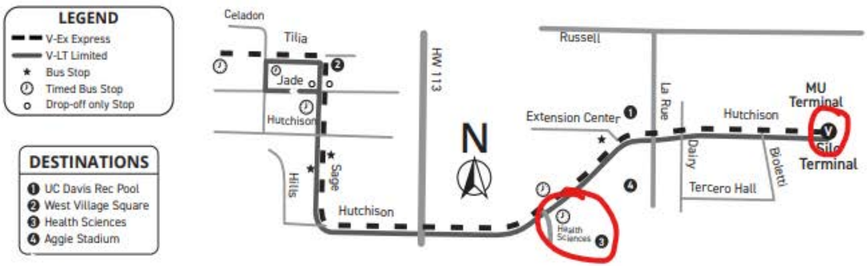
A Line — Amtrak / 5th Street / Alhambra — Silo Terminal

Summer

Depart Silo (#256)	6:55	7:25	7:55	8:25	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:40	1:10	1:40	2:10	2:40	3:10	3:40	4:10	4:40	5:10	5:40	6:10	6:40	7:10	7:40	8:10
Hutchison @ Health Sci. (#361)	6:58	7:28	7:58	8:28	9:03	9:33	10:03	10:33	11:03	11:33	12:03	12:43	1:13	1:43	2:13	2:43	3:13	3:43	4:13	4:43	5:13	5:43	6:13	6:43	7:13	7:43	8:13
The Green/2080 Tilia (#305)	7:02	7:32	8:02	8:32	9:07	9:37	10:07	10:37	11:07	11:37	12:07	12:47	1:17	1:47	2:17	2:47	3:17	3:47	4:17	4:47	5:17	5:47	6:17	6:47	7:17	7:47	8:17
West Village Sq. (SB) (#289)	7:05	7:35	8:05	8:35	9:10	9:40	10:10	10:40	11:10	11:40	12:10	12:50	1:20	1:50	2:20	2:50	3:20	3:50	4:20	4:50	5:20	5:50	6:20	6:50	7:20	7:50	8:20
Hutchison @ Health Sci. (#240)	7:08	7:38	8:08	8:38	9:13	9:43	10:13	10:43	11:13	11:43	12:13	12:53	1:23	1:53	2:23	2:53	3:23	3:53	4:23	4:53	5:23	5:53	6:23	6:53	7:23	7:53	8:23
Due Silo Terminal	7:15	7:50	8:15	8:50	9:20	9:50	10:20	10:50	11:20	11:50	12:20	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30

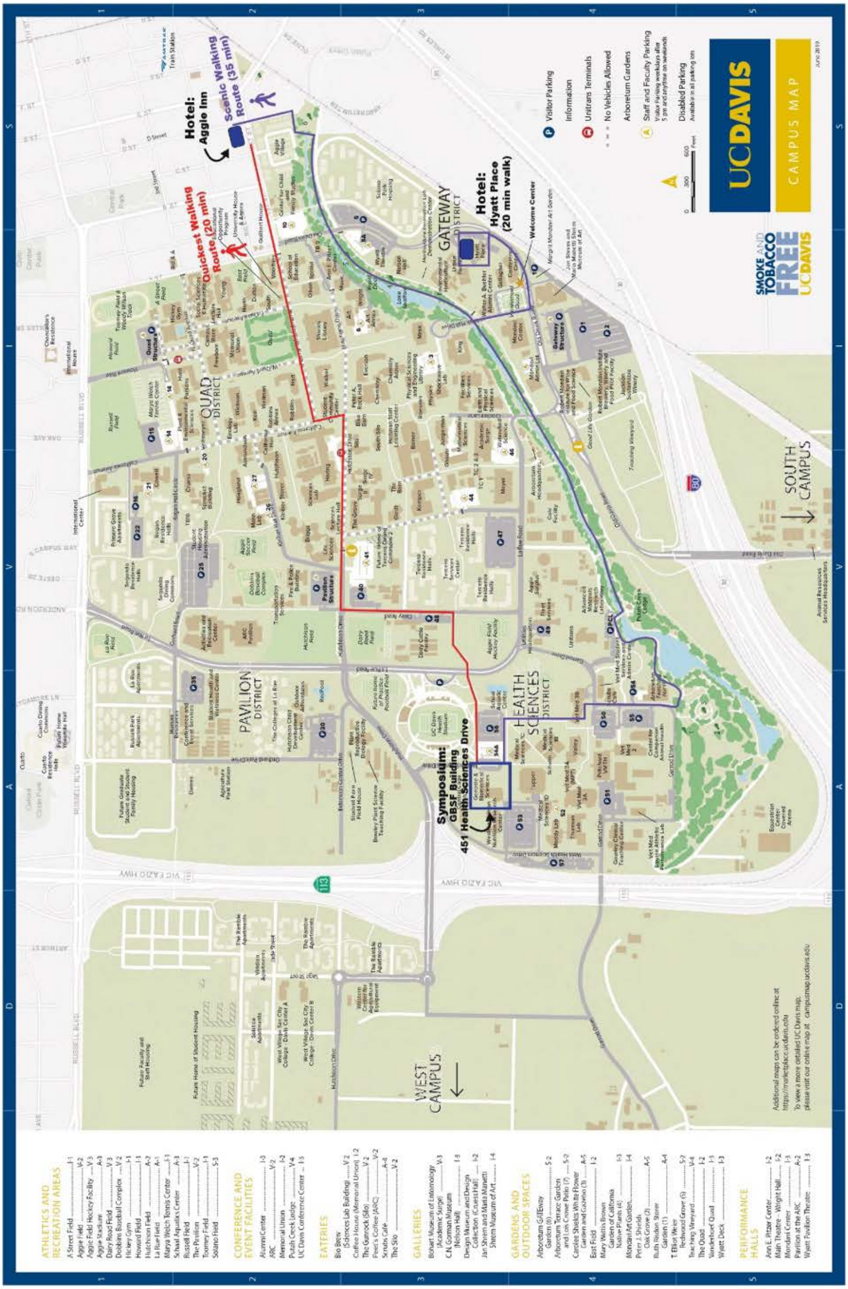
After 8:10pm, see U line schedule.

*** For Break, Summer Night, and Weekend Service, see U line schedule.*



V Line — West Village — Silo Terminal

Walking directions



Consent to be Recorded

At this event, photos and videos may be recorded.

By attending this event, you may be included in these photos and videos.

Your attendance at this event grants your permission to be in these photos or videos, which may be used for educational, archival, social media, and website purposes.

Things to do in Davis & Beyond

Get to know Davis

Between our campus and our college town, you'll find something new to do every day in Davis. You can choose from dozens of farm-to-fork restaurants and weekly events and attractions. You'll also find museums, a 100-acre arboretum, an arcade, bowling alley, and so much more.

Davis is a city located fifteen minutes away from Sacramento, CA and is the largest city in Yolo County. Davis was founded in 1868 after the installation of a railroad depot. The city's original name was "Davisville," in honor of a local farmer, Jerome C. Davis. This reference to agriculture is a common theme running throughout the history of Davis. In 1908, Davis became home to the University of California's University Farm. The Farm eventually earned the title of University of California, Davis. While the modern city core is quite urbanized, the surrounding lands are still used for farming today.

Davis, CA is also known for being extremely bike-friendly. Miles of bike lanes criss-cross town and the 12-mile Davis Bike Loops is a popular route that offers views of major parts of the city. The United States Bicycling Hall of Fame is also located in downtown to commemorate the city's dedication to cycling infrastructure and culture.

For more information, visit the official city website or the community wiki.

Aggie Square

Aggie Square is where university, industry and community come together to create opportunities for everyone. This planned innovation district on UC Davis' Sacramento campus will be home to research programs, private industry partners, classrooms, student housing, and public-facing programs that engage local communities and entrepreneurs. The first phase of construction began in 2022. This phase includes two buildings designed for science, technology and engineering, a classroom building dedicated to lifelong learning, and a building designated for housing and programs that focus on food and health.

Aggie Square will create a unique live/learn/work/play environment to foster collaboration and creativity. Entrepreneurs, companies and workers can thrive in our technology campus that values inclusion and creates chance encounters among creative people.

The campus will feature state-of-the-art research facilities, modern office and mixed-use space, world-class amenities and a dynamic, thriving community. Aggie Square will create new public space with welcoming, accessible entry points that connects the university with its neighboring communities.

Aggie Square will create new public space with welcoming, accessible entry points that connects the university with its neighboring communities.

The entrepreneurial partnerships we forge at Aggie Square will advance human health, enrich lifelong learning, enhance emerging technologies, support student and community development and set the stage for future collaborations.

Mondavi Center

The Robert and Margrit Mondavi Center for the Performing Arts is a performing arts venue located on the UC Davis campus in unincorporated Yolo County, California. It is named for arts patron and vineyard operator Robert Mondavi, who donated $10 million to help with the building costs, and who also helped finance The Robert Mondavi Institute for Wine and Food Science on the same campus. The current annual operating budget is approximately $7.3 million, 58% of which comes from earned income.

Mondavi Center opened on October 3, 2002, for the UC Davis Symphony Orchestra and today serves as a venue for musical concerts, theater, dance, lecturers and other entertainers.[1] The façade is a large glass paneled lobby that is surrounded by sandstone that also lines the interior walls.

The Mondavi Center explores the full range of the performing arts, from the traditional to the innovative, and from diverse cultures and disciplines through presentation, education, public service, and research. As part of the UC Davis mission as a land grant university, the Mondavi Center provides outstanding cultural programming, support for the University's academic departments, and a professional laboratory to train students in the performing arts.

The Mondavi Center is committed to maintaining state-of-the art, world-class performance facilities and providing the highest quality experience for both artists and audiences. Our mandate is to maintain a balance between our regional responsibility, fiscal responsibility, artistic integrity, and the educational mission of the University of California.

Manetti Shrem Museum

Born of a distinctive legacy, the Manetti Shrem Museum is committed to the interdisciplinary experimentation that makes UC Davis a leading university. The museum's dedication to impactful education is evident in every aspect, from programming to architecture.

On November 13, 2016, the museum opened as a fulfillment of UC Davis' rich legacy of education and innovation.

The museum has taken shape because of the incredible support of the UC Davis community. We owe deep gratitude to Jan Shrem and Maria Manetti Shrem, Margrit Mondavi, and all of our supporters for making this vision a reality.

With the same passion for experimentation that first brought prominence to the arts at UC Davis, the Manetti Shrem Museum cultivates transformational art experiences to inspire new thinking and the open exchange of ideas.

Serving both the public and our university community with a dynamic artistic program, the museum presents exhibitions and events that advance students' understanding of their place in the world; connects to faculty teaching and research; and creates a lively forum for community engagement and creative practice.

Old Sacramento & Downtown

Water Front District

Old Sacramento Waterfront is a unique 28-acre National Historic Landmark District and State Historic Park that lives in homage to California's beginning with the Gold Rush of 1849. The district is located along the beautiful Sacramento River. Bustling with activity, it is alive with shopping, dining, entertainment, historical attractions, and world-renowned museums set within the time of the California Gold Rush and the Transcontinental Railroad.

Old Sacramento Waterfront features dozens of recreated or restored buildings from the Gold Rush era. Wooden sidewalks, horse-drawn carriages, and living history characters provide a glimpse into 19h-century life.

Downtown Sacramento

Downtown Sacramento has grown and changed remarkably over the past 20 years, burgeoning into a 24-hour urban center that offers fine dining, unique boutique shopping, hotels, entertainment, events and cultural festivities. On any given night, you can enjoy a theater performance, a fine dining experience at one of the more than 150 restaurants, or dance the night away at one of the newly renovated lounges. Downtown is the central hub and heartbeat of Sacramento.

San Francisco

Grab your coat and a handful of glitter, and enter a wonderland of fog and fabulousness. So long, inhibitions; hello, San Francisco!

San Francisco, officially City and County of San Francisco and colloquially known by its initialism SF, is a city in, and the cultural, commercial, and financial center of, Northern California. San Francisco succeeds in winning over visitors immediately and without any special effort. The city of the lovers, the mild Mediterranean beauty immersed in pastel colors attracts with bridges, cable cars, hills and Victorian wooden houses, Alcatraz and Fisherman's Wharf, Chinatown and enormous beaches in the north. You know all these films and TV series that have taken advantage of the great scenery of the city. Many visitors come back because they can't – and certainly don't want to - escape this flair. San Francis- co is one of the cosmopolitan cities whose embedding in a magnificent natural landscape creates a fantastic overall picture. Many cities to which this applies do not exist in this world - the City an der Bay is definitely one of them.

The North Californian city already experienced its first great boom in the 18th century, at the time of the great gold rush. In the 1960s, the San Francisco hippie movement left a lasting mark on the city. San Francisco's most famous landmark is the Golden Gate Bridge. But what would San Francisco be without its lively neighborhoods? One of the most famous districts is Chinatown. With around 80,000 inhabitants, it is one of the largest Chinese neighborhoods outside China.

The cultural diversity that San Francisco has to offer is also reflected in its cuisine: in addition to ethnic cuisine, there is a colorful cross-section of California cuisine. First-class wines from the region are served with it.

Exploratorium

The Exploratorium isn't just a museum; it's an ongoing exploration of science, art and human perception—a vast collection of online experiences that feed your curiosity. The Exploratorium is a hands-on museum for science, art and human perception. It is dedicated to experimentation, discovery and play. Visitors of all ages can explore the more than 650 exhibits indoors and outdoors, groping to better understand the world. The Tactile Dome offers visitors the opportunity to go on an interactive journey in complete darkness, relying solely on their sense of touch. There is also a museum shop and two places where food is offered. The Exploratorium is located at Pier 15 on Embarcadero in San Francisco, between Pier 39 and the Ferry Building.

Lake Tahoe

Lake Tahoe (‘the lake’) is a large freshwater lake in the Sierra Nevada of the United States. Lying at 6,225 ft (1,897 m), it straddles the state line between California and Nevada, west of Carson City. Lake Tahoe is the largest alpine lake in North America. Its depth is 1,645 ft (501 m), making it the second deepest in the United States after Crater Lake in Oregon.

The lake was formed about two million years ago as part of the Lake Tahoe Basin, with the modern extent being shaped during the ice ages. It is known for the clarity of its water and the panorama of surrounding mountains on all sides. The area surrounding the lake is also referred to as Lake Tahoe, or simply Tahoe. More than 75% of the lake’s watershed is national forest land, comprising the Lake Tahoe Basin Management Unit of the United States Forest Service.

Lake Tahoe is a major tourist attraction in both Nevada and California. It is home to winter sports, summer outdoor recreation, and scenery enjoyed throughout the year. Snow and ski resorts are a significant part of the area’s economy and reputation. The Nevada side also offers several lakeside casino resorts, with highways providing year-round access to the entire area.