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Imaging with Artificial Intelligence for Identifying Optical Biosignatures of Disease using Simultaneous Label-free Auto-fluorescence Multi-harmonic (SLAM) Microscopy

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Abstract

Label-free intravital optical imaging and imaging of fresh, unstained, resected tissue specimens, offers a wealth of new biosignatures for revealing the true colors of cancer and diagnosing neurodegenerative changes. Using new optical source technology and nonlinear optics to generate new excitation wavelengths and manipulate the light stimulus in new ways, Simultaneous Label-free Auto-fluorescence Multi-harmonic (SLAM) microscopy can achieve fast simultaneous visualization of the rich intrinsic molecular and metabolic features within tissues. Quantitative machine/deep learning analyses of these multi-dimensional datasets can be used to identify selective diagnostic biosignatures for disease. Specifically, extracellular vesicles (EVs) in carcinogenesis and plaque composition in Alzheimer's disease were analyzed via their optical signatures and spatial distributions. Analysis showed that EVs from the tumor microenvironment and variations in amyloid-beta plaques have unique optical signatures, in comparison to those vesicles and tissues from healthy subjects. The clinical demonstration of these optical biomedical imaging technologies offers new paradigms for point-of-procedure diagnosis and guidance.

Bio

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, the Carle Illinois College of Medicine, and the Beckman Institute for Advanced Science and Technology. 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. 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 served as Executive Associate Dean and Chief Diversity Officer. Currently he is serving as the Interim Director for the university's Interdisciplinary Health Sciences Institute, and as the Illinois Co-Chair of the Mayo Clinic & Illinois Alliance for Technology-Based Healthcare. He is also leading the Chancellor's charge to develop a new cross-campus model for research and education in technology-inspired health innovation**.**

Host: Prof. Meng Cui

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