

Santosh Kumar Paidi, Ph.D.

University of California, Berkeley, California; Email: santosh175@gmail.com; Web: <https://santoshpaidi.com>



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Research Interests

Recent advances in optical microscopy and imaging have allowed us to understand the structural and molecular underpinnings of disease and improve human health. However, multimodal optical methods that allow simultaneous three-dimensional mapping of multiple disease biomarkers deep inside the tissues of living animals are urgently needed. My research program at the interface of optics, engineering and medicine seeks to fill these gaps through research in three interconnected foci. First, we will build advanced optical technologies based on multimodal integration of multiphoton microscopy, label-free optical spectroscopy, and adaptive optics to image biological specimen deeper, faster, and with higher sensitivity and specificity in vivo. Second, we will employ in vitro organ-on-chip models and patient-derived xenograft models (where tumors are grown in mice using patient-derived live cancer tissue) to develop chemical imaging methods for personalized monitoring of disease progression and prediction of metastatic outcomes based on optical signatures. Third, my lab will employ the in vivo imaging methods for ocular imaging in preclinical models of cataract formation to understand the biological mechanisms of age-related changes in the ocular lenses. Together, these studies will establish robust optical biomarkers of cancer and help in the translation of the technologies for applications in personalized medicine, beyond the initial diagnosis of primary cancers. In addition, the tangential biomedical applications, such as those in ocular biology, will catalyze wider adoption of multimodal optical methods as routine bioanalytical instruments for basic sciences.

Education

Postdoc, **University of California, Berkeley**, 2023. Advisors: Prof. Na Ji and Prof. Xiaohua Gong
Ph.D. in Mechanical Engineering, **Johns Hopkins University**, 2020. Advisor: Prof. Ishan Barman
B.Tech. in Mechanical Engineering, **Indian Institute of Technology Bombay**, 2014.

Selected Publications

1. Paidi SK, et al. "Adaptive optical two-photon fluorescence microscopy probes cellular organization of ocular lenses in vivo", **Investigative Ophthalmology and Visual Science**, 64(20), **2023**.
2. Paidi SK, et al. "Raman spectroscopy reveals phenotype switches in breast cancer metastasis", **Theranostics**, 12(12), 5351-63, **2022**. (Journal back cover)
3. Paidi SK, et al. "Raman spectroscopy and machine learning reveals early tumor microenvironmental changes induced by immunotherapy", **Cancer Research**, 81(22), 5745-55, **2021**.
4. Paidi SK, et al. "Label-free Raman spectroscopy reveals tumor microenvironmental signatures of radiation resistance", **Cancer Research**, 79(8), 2054-64, **2019**.
5. Paidi SK, et al. "Label-free Raman spectroscopy detects stromal adaptations in pre-metastatic lungs primed by breast cancer", **Cancer Research**, 77(2), 247-56, **2017**.

Selected Awards/Honors

1. Frederick Bettelheim Award by **National Foundation for Eye Research**, 2022
2. AACR Scholar-in-Training Award by **American Association for Cancer Research**, 2022
3. Barbara Stull Graduate Student Award by **Society of Applied Spectroscopy**, 2019
4. SLAS Graduate Education Fellowship Grant by **Society for Laboratory Automation and Screening**, 2018
5. SPIE Optics and Photonics Education Scholarship by **SPIE**, 2018
6. Tomas A. Hirschfeld Scholar Award by **FACSS**, 2017
7. Undergraduate Research Award by **IIT Bombay**, 2013

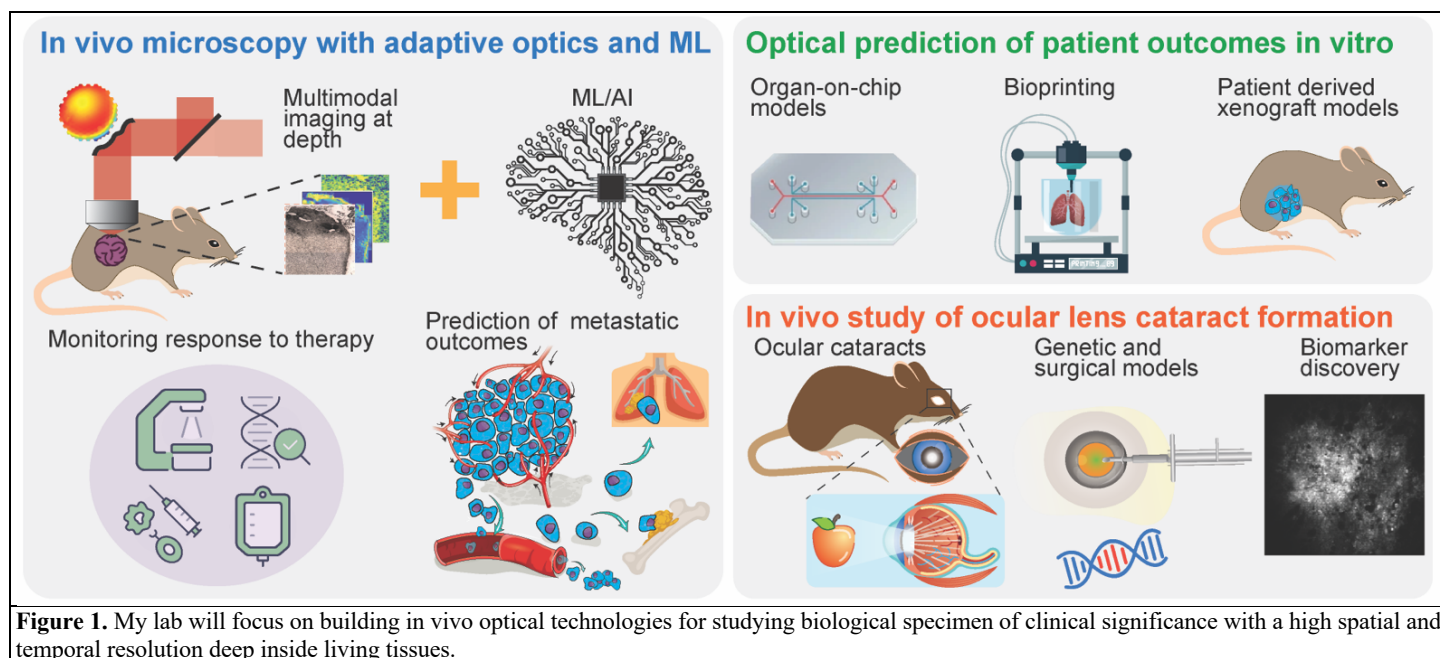
Teaching Interests and Experience

1. Course Instructor for Introduction to Biomedical Optics at JHU, Fall 2019
2. Course Instructor for Quantitative Spectroscopy and Imaging in Biology and Medicine at JHU, Fall 2018
3. Completed the requirements of Johns Hopkins Teaching Academy program 2019
4. Teaching Assistant for courses at JHU, 2016, 2017, 2018, and 2019

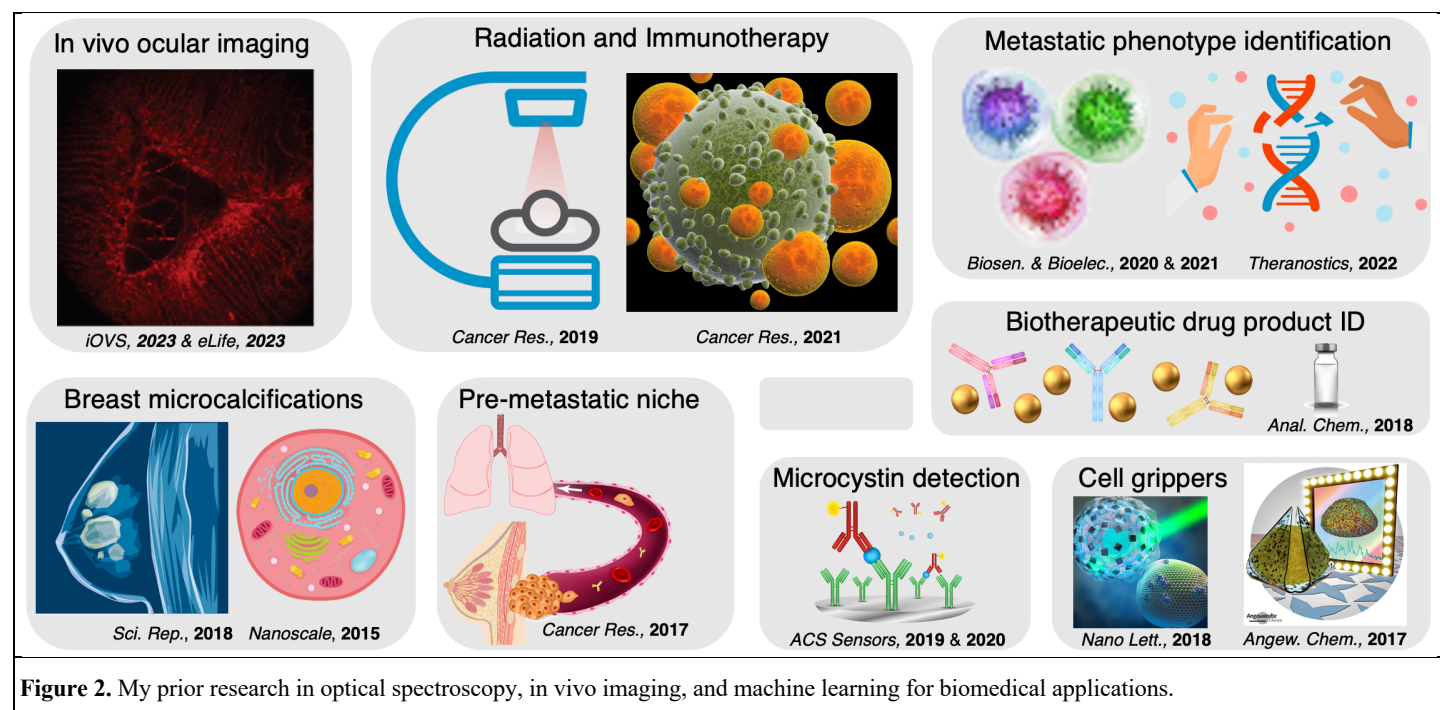
Outreach Interests and Experience

1. Mentor for SLAS-NOBCCHE Scholarship, 2022
2. Whiting School of Engineering representative on Homewood Graduate Board at JHU, 2018 - 2020
3. Elected Advocacy Chair for Graduate Representative Organization at JHU, 2018
4. Ad-hoc reviewer for 10+ journals and topical session chair at multiple conferences

Some early research directions of my independent research program are summarized in the following schematic (**Fig. 1**):



My broad graduate and postdoctoral training in mechanical engineering, optical spectroscopy and in vivo microscopy has provided me with unique opportunities to develop optical technologies and apply them for important problems in cancer and ocular biology (Fig. 2). My work has resulted in over 25 publications (including 9 as first-author) in high impact journals and received accolades from a wide spectrum of organizations such as SPIE, SAS, SLAS and Coblentz Society. My research activities have also facilitated the training of several graduate and undergraduate students, with the latter publishing first-author manuscripts in peer-reviewed journals (Biosen. & Bioelec., ACS Sensors) and currently undertaking medical training at top medical schools (UPenn, VCU). The diversity of my graduate and postdoctoral research is summarized below (**Fig.2**):



My talks at BMES 2023:

Imaging Cells, Molecules, Genomes, Tissues and Organs

Two photon microscopy and adaptive optics elucidates in vivo cellular organization of ocular lens

Friday, Oct 13: 8:30 – 8:45 AM, Location: 338

Optical, Spectroscopy and Microscopy II

Raman spectroscopy reveals phenotype switches in breast cancer metastasis

Friday, Oct 13: 2:30 – 2:45 PM, Location: 339