

AbstractID: 11897 Title: Breast Cancer Applications of Optical Imaging Biomarkers measured with Diffuse Optical Spectroscopic Imaging

Optical imaging biomarkers measured by Diffuse Optical Spectroscopic Imaging (DOSI) provide unique physiological profiles of tissue biochemistry that may be useful in breast cancer for detecting/characterizing lesions and evaluating tumor response to therapy.

Imaging technologies have long played an important role in oncology, covering early detection, therapeutic planning, and remission management. Imaging biomarkers, such as tumor volume, are being considered as surrogate endpoints in place of traditional endpoints such as morbidity and mortality. Yet there is a need and a desire to see more. Spectral information content is often added to increase information content, and thus improve tumor detection and classification. For example, dual energy mammography can improve the visibility of microcalcifications. The capabilities of Magnetic Resonance Imaging (MRI) can also be augmented through the inclusion of spectroscopy (MRS). MRS applied to breast cancer has yielded some promising results, namely via the detection of choline, which may distinguish between benign and malignant as well as signal early changes in tumors responding to neoadjuvant chemotherapy.

Optical imaging offers a new class of imaging biomarkers, although their clinical significance has yet to be firmly established. These “optical imaging biomarkers” emerge from modeling specific near-infrared (NIR) molecular absorption signatures, which may be surrogate markers for traditional molecular biomarkers of disease from processes such as angiogenesis, apoptosis, and proliferation. Optical imaging in the 1980’s generated lots of enthusiasm but fell short of expectations. By modeling the physics of light transport, improving technology, and increasing spectroscopic information content, the past limitations of optical imaging can be overcome. Modern optical imaging such as DOSI can measure tumor total hemoglobin, in both oxygenated and deoxygenated states. By increasing spectral bandwidth, new optical imaging biomarkers emerge. Tissue water, in various biochemical states, and bulk lipids, have also been used to identify and even stage malignant lesions. Deoxy-hemoglobin and water have predicted final pathological response of breast cancer patients treated with neoadjuvant chemotherapy in pilot studies, in similar fashion to choline. Novel NIR spectroscopic signatures that are unique to cancer have been discovered, and may also distinguish between benign and malignant lesions.

Our long-term goal is to develop the concept of optical imaging biomarkers for the prevention, detection, and treatment of malignancy, particularly in breast cancer. Through novel technological and analytical methods, we are developing DOSI as the optical analogue to MRS/MRI, yet DOSI will have significantly reduced barriers for access. DOSI can be made highly portable, and may find use in the doctor’s office setting, or even in the field.

### **Conflict of Interest Statement**

While the authors have not received any funds or assistance from companies for this research, authors hold patents on technologies that are being licensed by companies. The University of California Irvine Conflict of Interest Committee reviewed these interests and considered them acceptable and do not interfere with research integrity.

### **Learning Objectives**

1. Learn the physical basis for Diffuse Optical Spectroscopic Imaging
2. Learn how increasing spectroscopic bandwidth improves tissue characterization
3. Learn how Diffuse Optical Spectroscopic Imaging may be useful in breast cancer applications