Clinical feasibility of co-registered opto-acoustic and ultrasonic imaging for differentiation of breast tumors

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Principles of Opto-Acoustic Imaging

- Optical imaging provides high contrast BUT low resolution, and does not permit deep imaging.

- Ultrasound provides high resolution, BUT low contrast and provides neither quantitative molecular or functional images.

- **Solution**: Opto-acoustics (OA) provides high contrast with molecular specificity, quantitative information, and high resolution in the depth of tissue.

Optical Absorption as a Function of Laser Wavelength

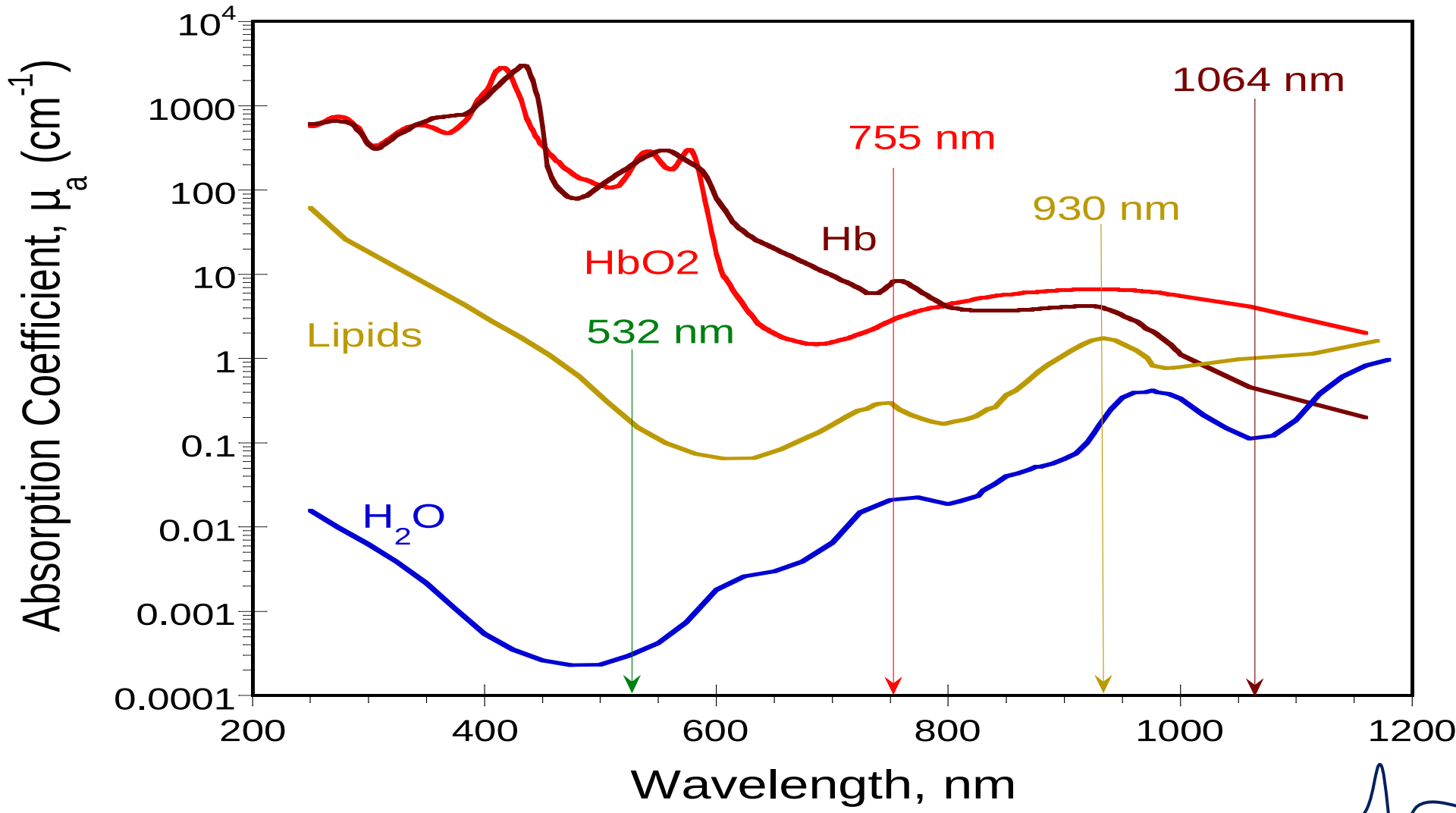
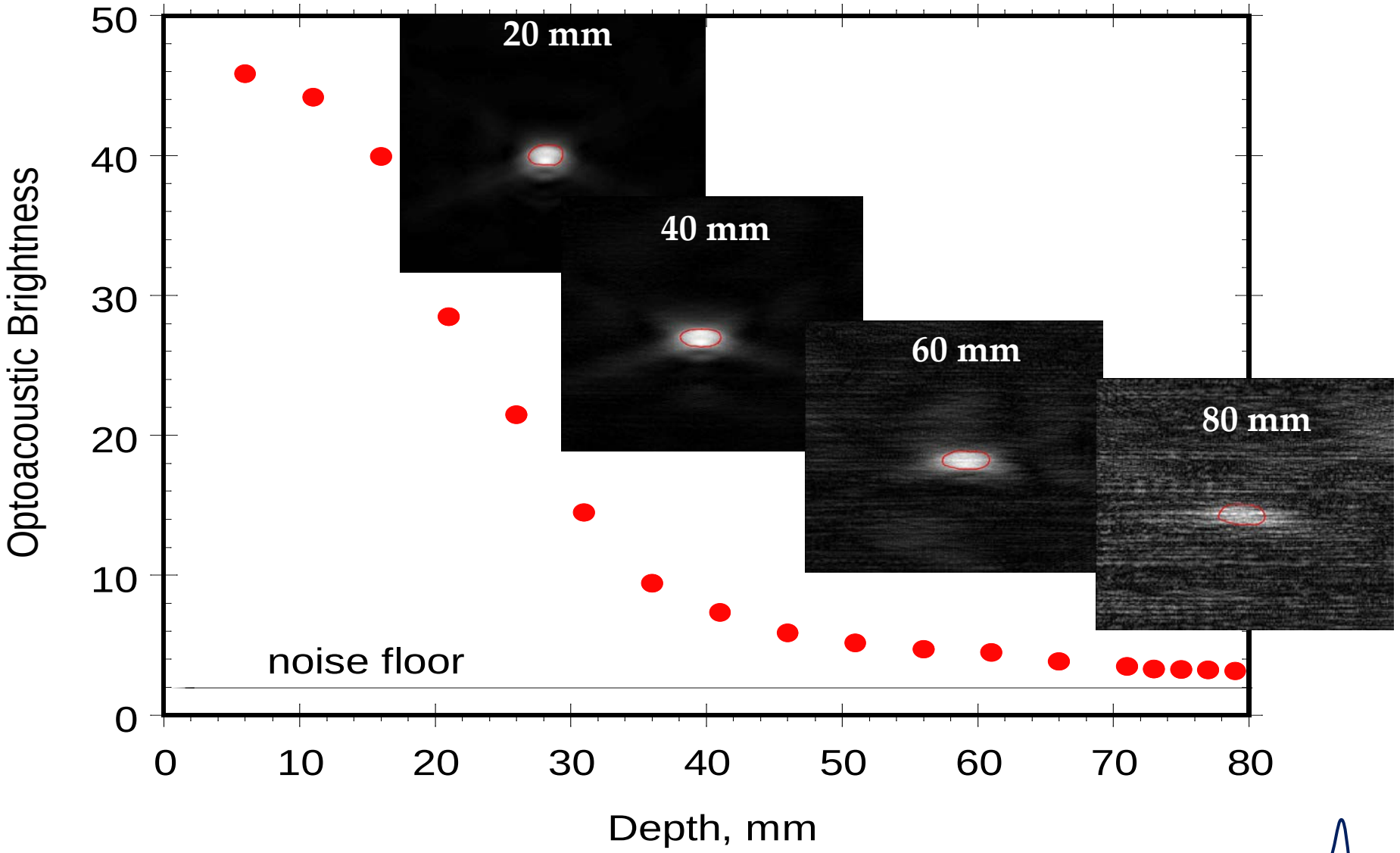
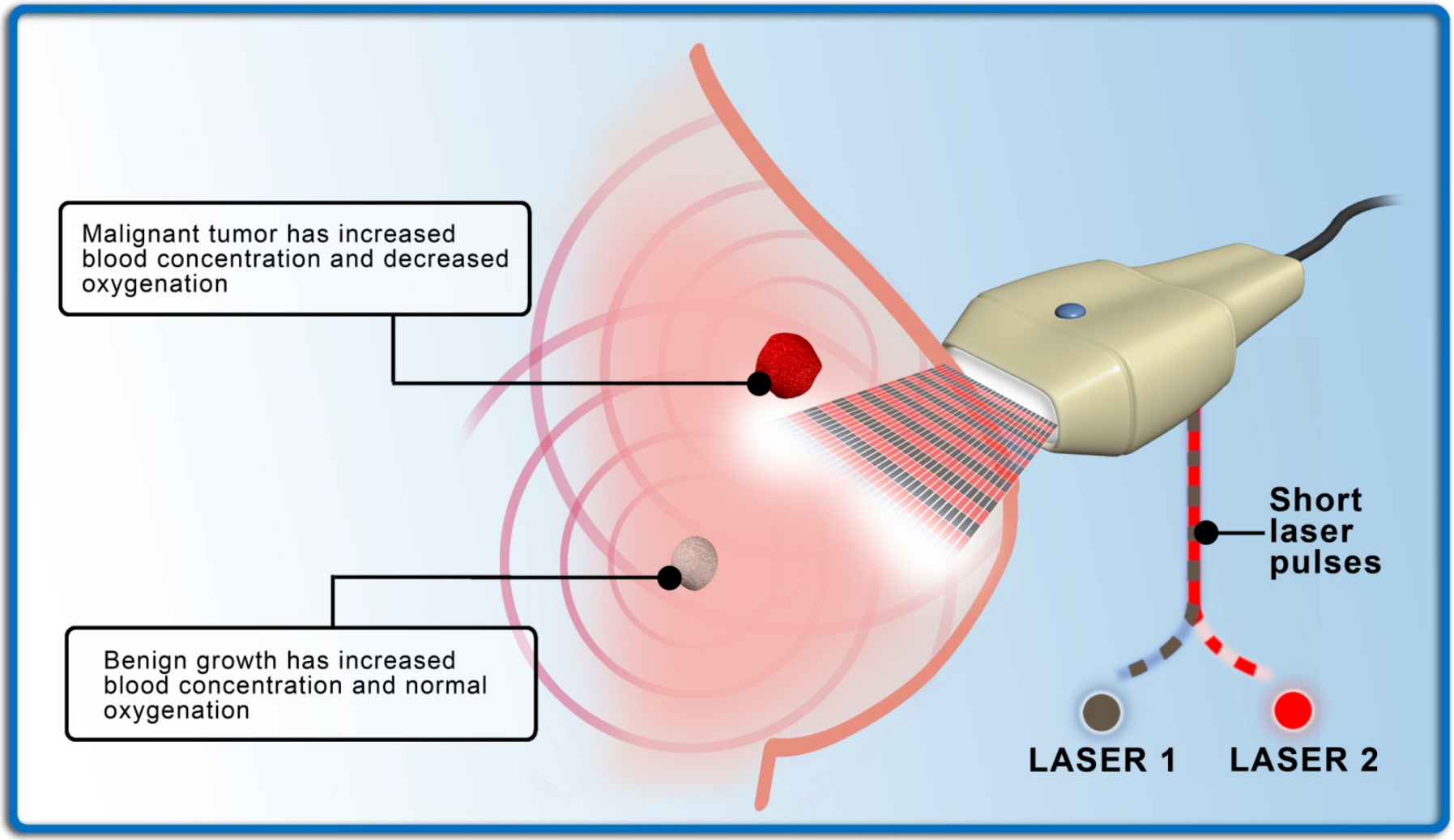


Image Contrast *versus* Depth



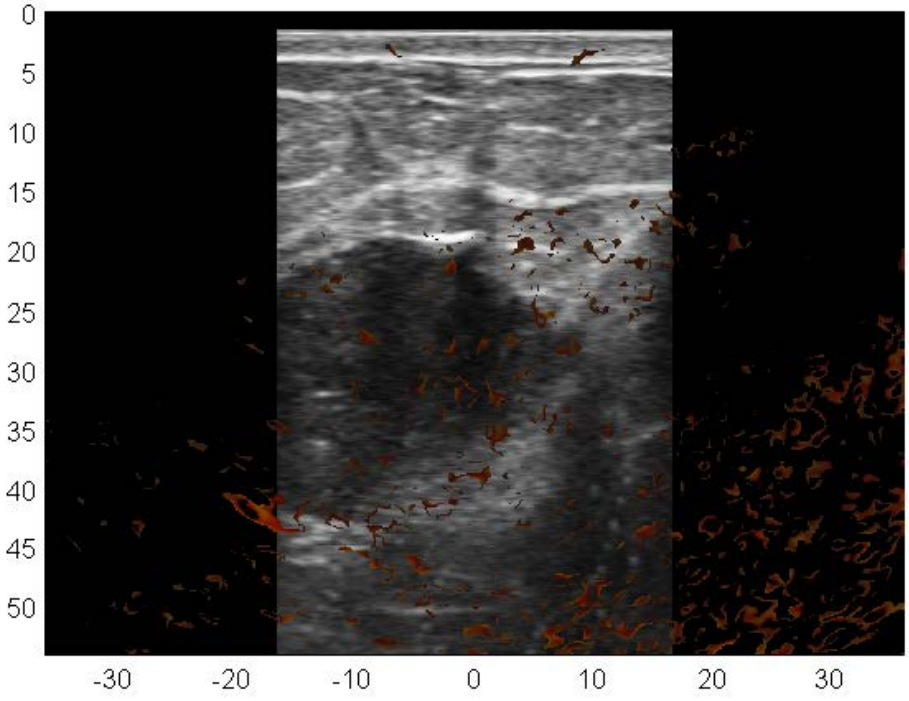
The Imagio™ System
— The Combination of OA and US —



Co-registered US & OA Images

Fibroepithelial benign lesion (most likely a phyllodes tumor)

Red indicates deoxygenated hemoglobin



Imagio™ Ultrasound with Opto-acoustic Co-registration

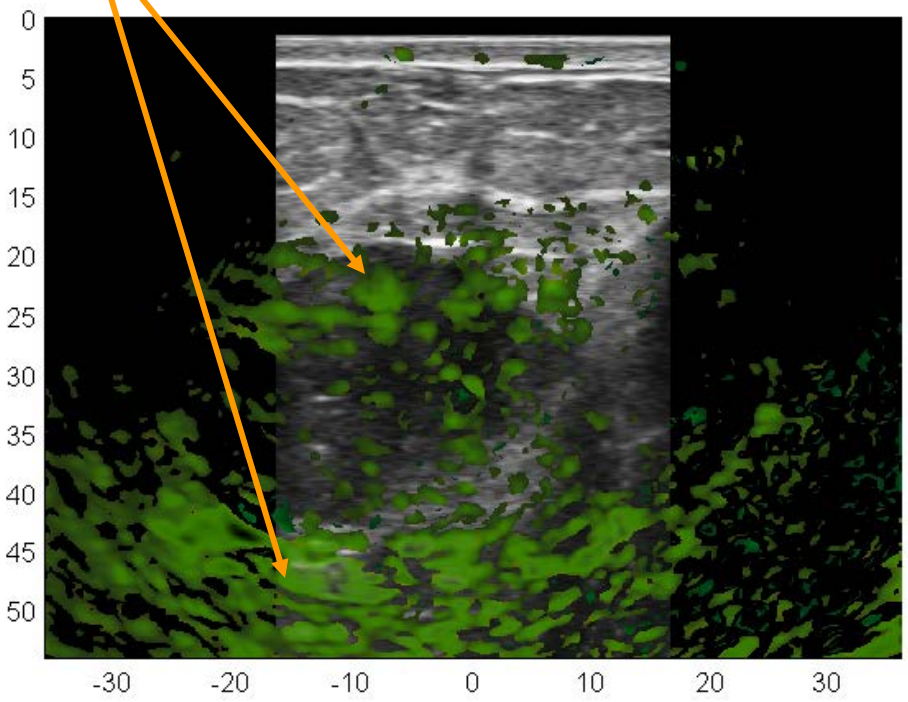
CTRC Diagnostic Ultrasound Image

49 YO patient with new 6cm mass, superior at 1.4cm, inferior at 4.0cm, in right breast

Co-registered US & OA Images

Fibroepithelial benign lesion (most likely a phyllodes tumor)

Green indicates oxygenated hemoglobin



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CTRC Diagnostic Ultrasound Image

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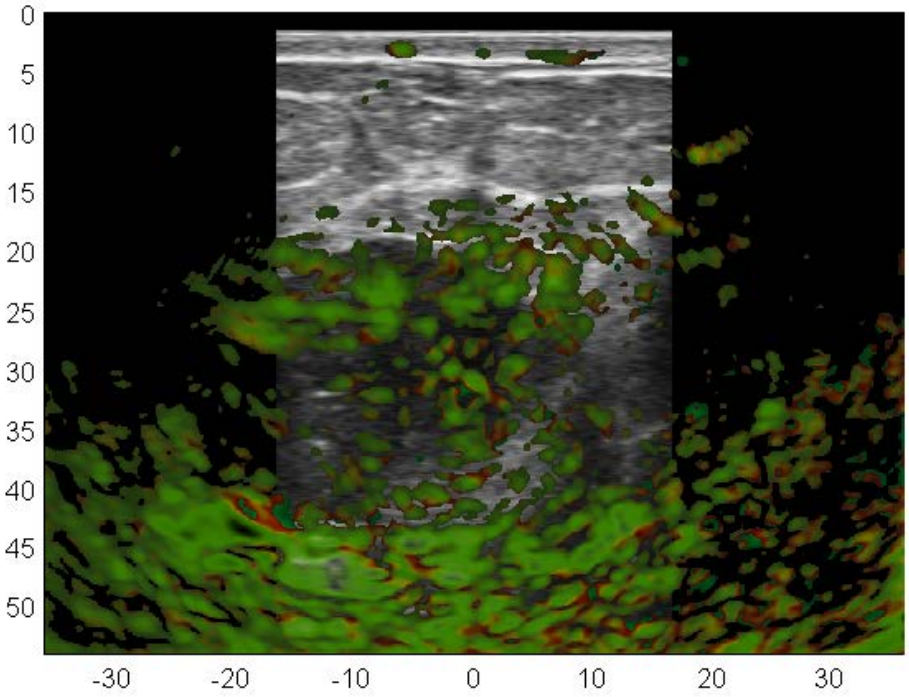
Co-registered US & OA Images

Fibroepithelial benign lesion (most likely a phyllodes tumor)

Combined images reveals benign tumor



Imagio™ Ultrasound with Opto-acoustic Co-registration

CTRC Diagnostic Ultrasound Image

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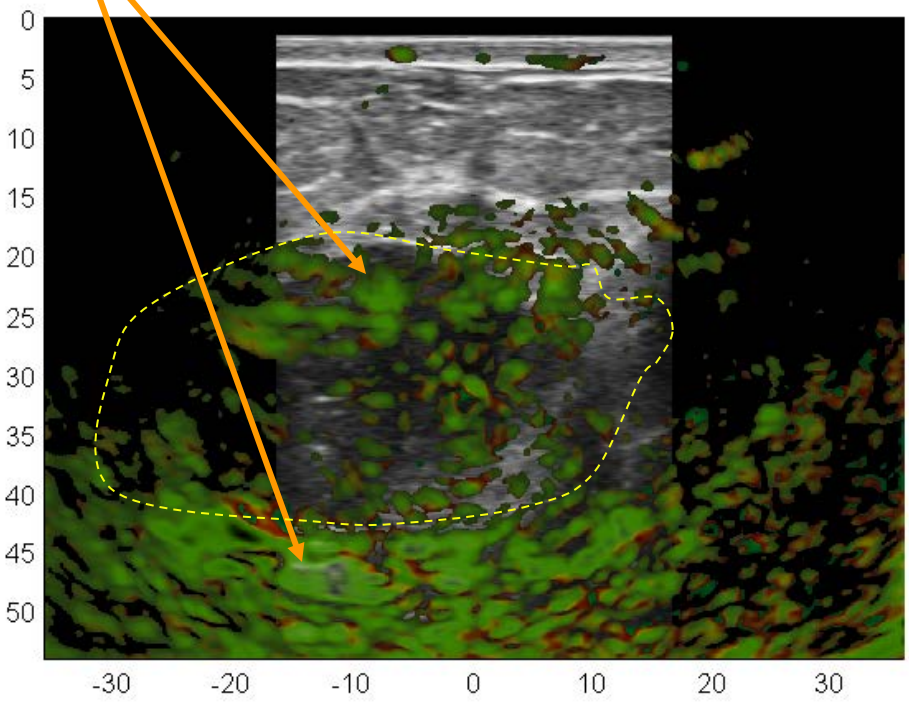
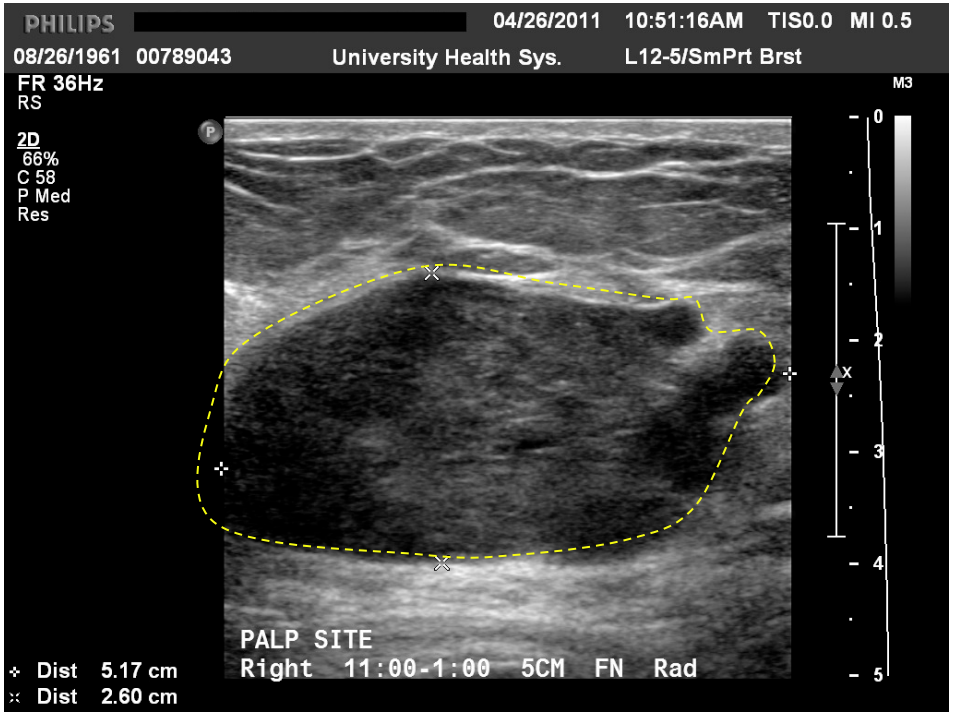
Co-registered US & OA Images

Fibroepithelial benign lesion (most likely a phyllodes tumor)

Note peak oxygenated areas in benign tumor



Imagio™ Ultrasound with Opto-acoustic Co-registration

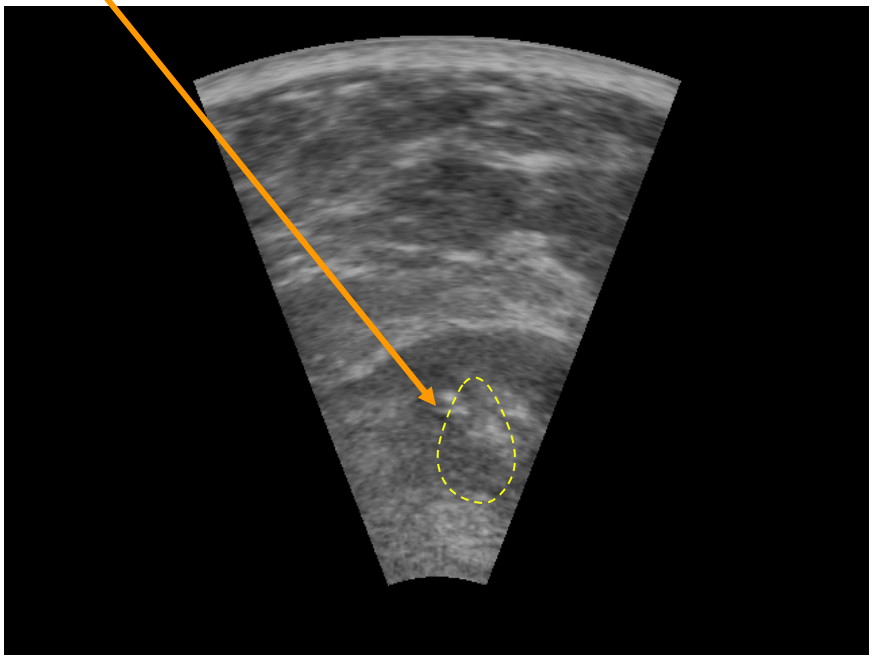


CTRC Diagnostic Ultrasound Image

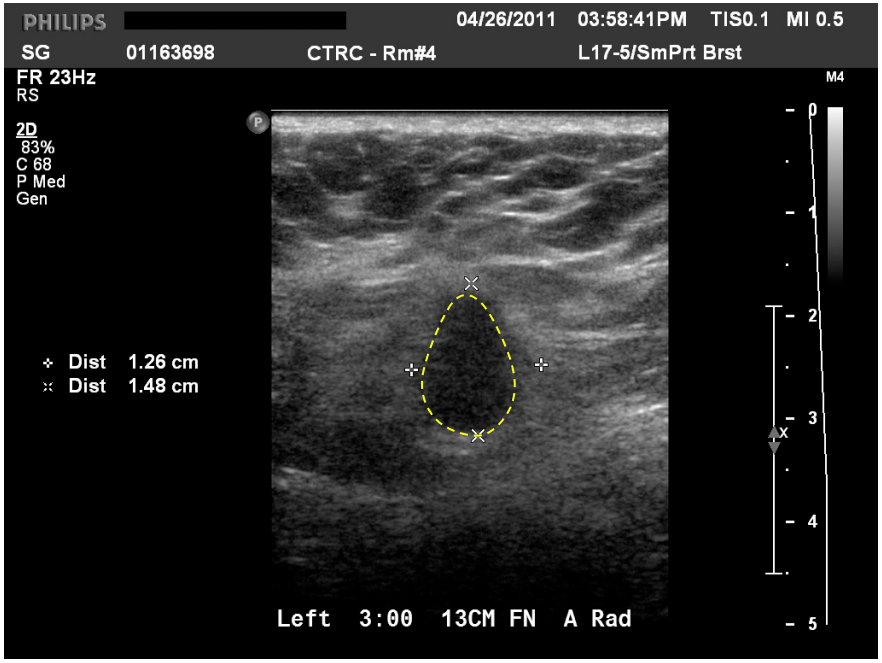
49 YO patient with new 6cm mass, superior at 1.4cm, inferior at 4.0cm, in right breast

Co-registered US & OA Images
Invasive Ductal Carcinoma

Tumor Location



Imagio™ Ultrasound Showing Region of Lesion

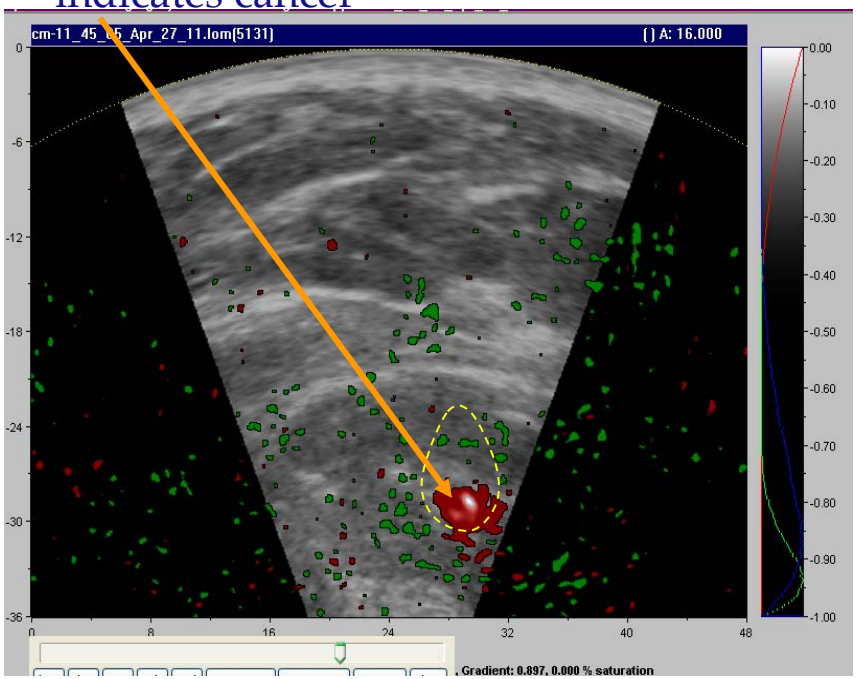


CTRC Diagnostic Ultrasound Image

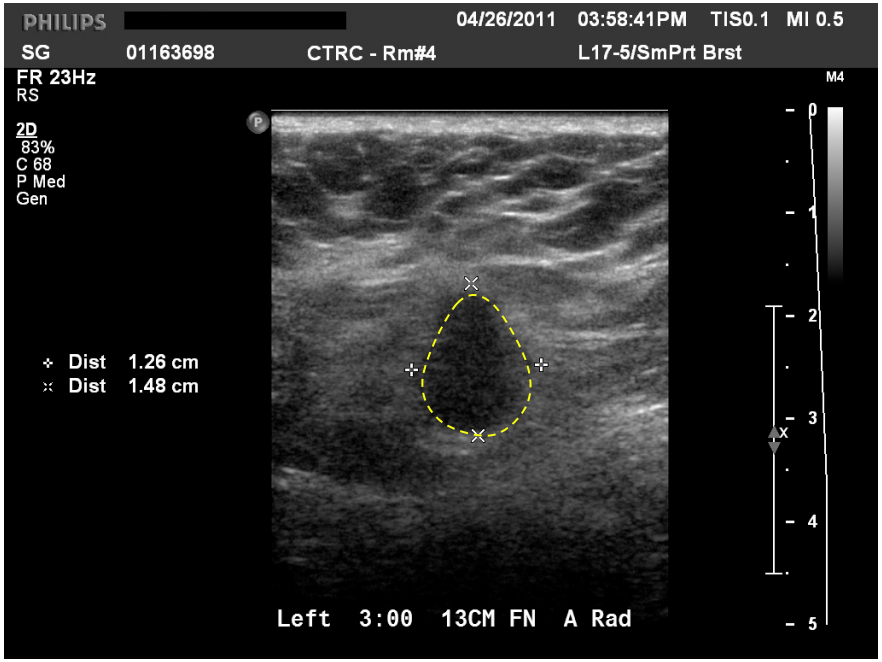
46 YO patient with new 1.5cm mass, superior at 1.7cm, inferior at 3.2 cm, in left breast.

Co-registered US & OA Images
Invasive Ductal Carcinoma

Note peak de-oxygenated area in tumor indicates cancer



Imagio™ Ultrasound with Opto-acoustic [S02] Overlay



CTRC Diagnostic Ultrasound Image

46 YO patient with new 1.5cm mass, superior at 1.7cm, inferior at 3.2 cm, in left breast.

RESULTS and CONCLUSION
OA Imaging as an Emerging Technology

RESULTS

- 6 tumors identified by mammography and ultrasound as suspicious for malignancy; 3 were confirmed malignant by biopsy.
- 2 out of 3 histologically benign tumors were differentiated as benign with opto-acoustics.
- 3 of 3 carcinomas were correctly identified by opto-acoustics.

Opto-acoustics correctly diagnosed 5 of the 6 lesions.

CONCLUSION

- Opto-acoustic imaging provides additional diagnostic information based on angiogenesis and blood oxygen saturation.
- These data are being used to formulate a multi-center trial.

Acknowledgement

- Dr. Martin Sandler, Radiology, Vanderbilt University