

Synthetic Structural Imaging (SSI): A New Ultrasound Method for Tracking Breast Cancer Morphology

Alan A. Winder and Bahram Jadidian
J&W Medical LLC

Robert Muratore
Quantum Now LLC

39th Annual Symposium of the Ultrasonic Industry Association
Cambridge MA USA
2010 Apr 14

Introduction: A Clinical Need for 3-D Imaging

Oncology: monitoring of tumor and lesion sizes

Primary & neoadjuvant therapies

HITU ablation →

Chemotherapy

Radiation therapy

Localized cancer

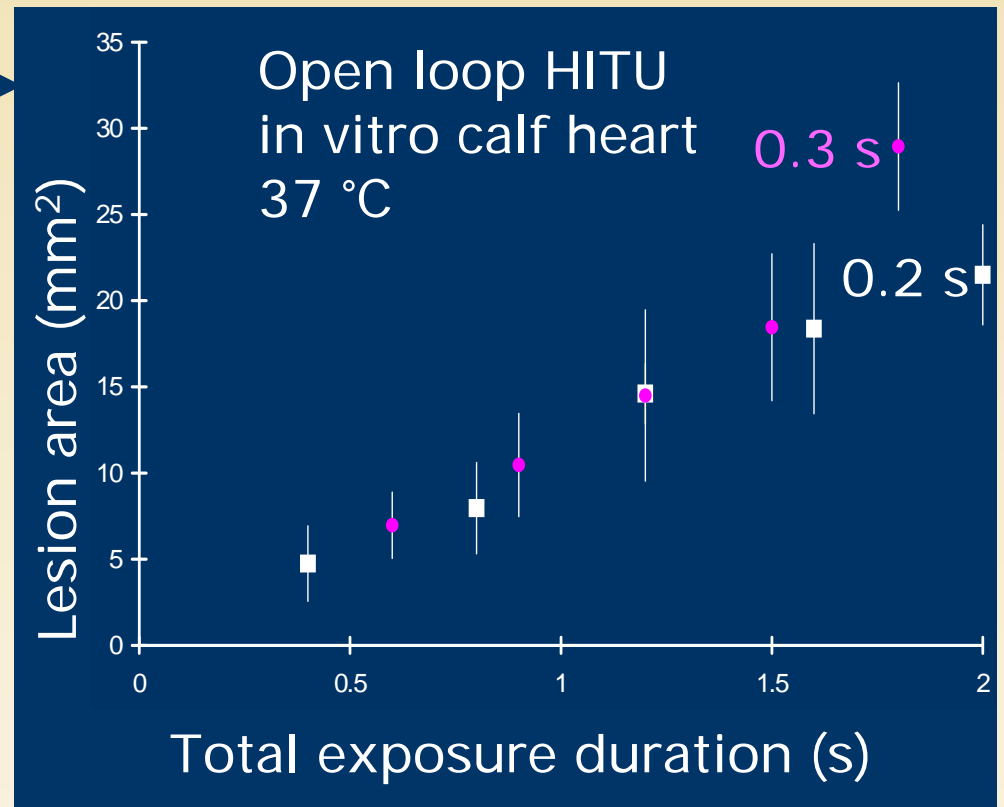
Breast cancer

Prostate cancer

Developmental studies

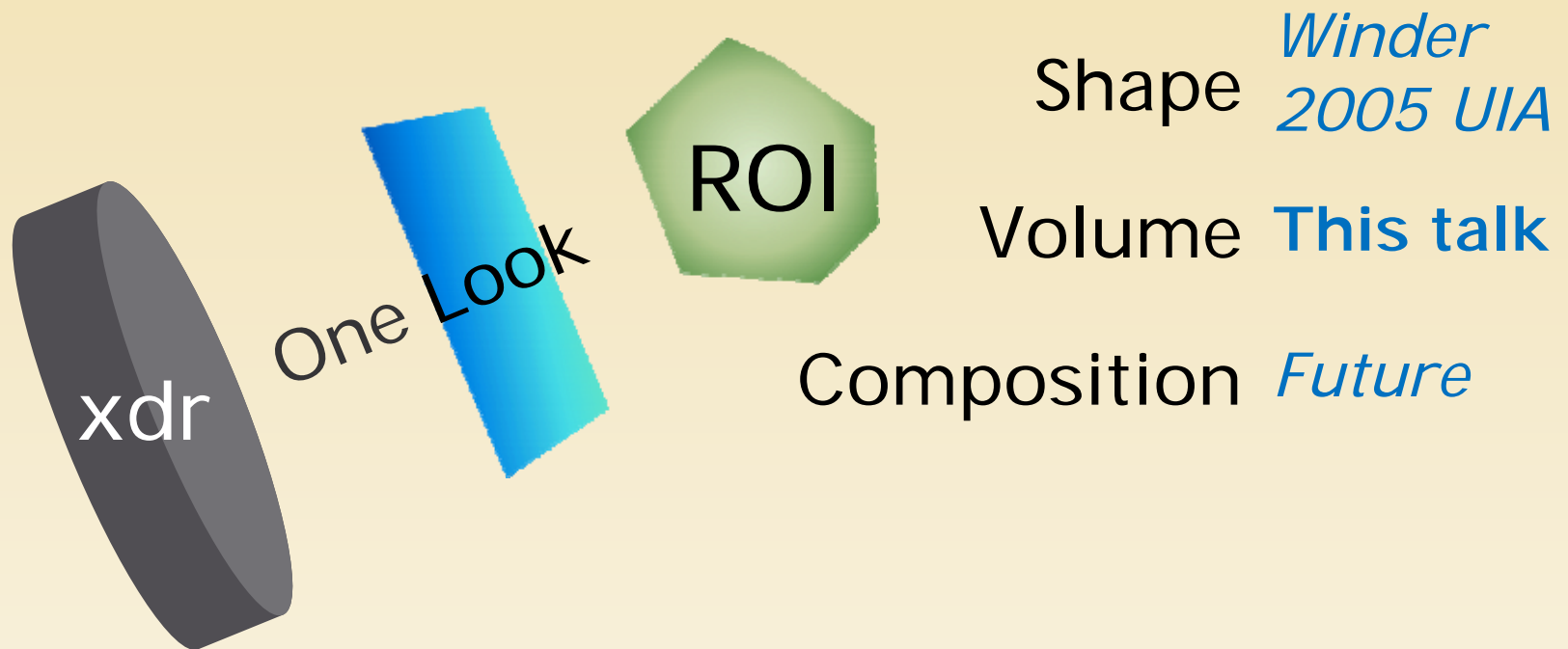
Total fetal volume

Organ development



Muratore 2006 AIUM

An Ideal for 3-D Imaging: Everything at a Glance



3D and 4D ultrasound, MRI, & CT are expensive and cumbersome.

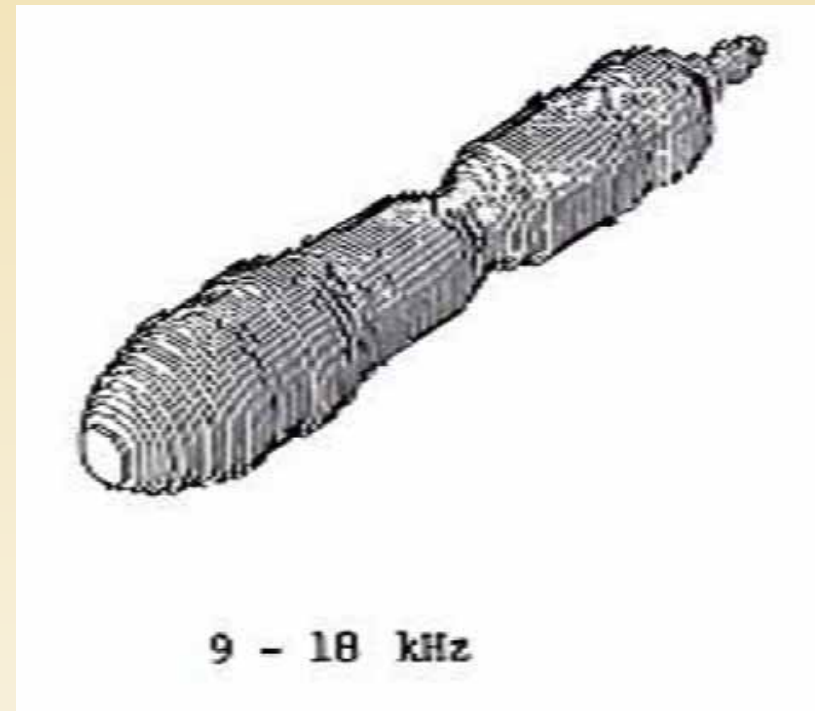
Synthetic Structural Imaging (SSI)

SSI works !

RADAR: aircraft ID



SONAR: torpedo &
submarine model ID



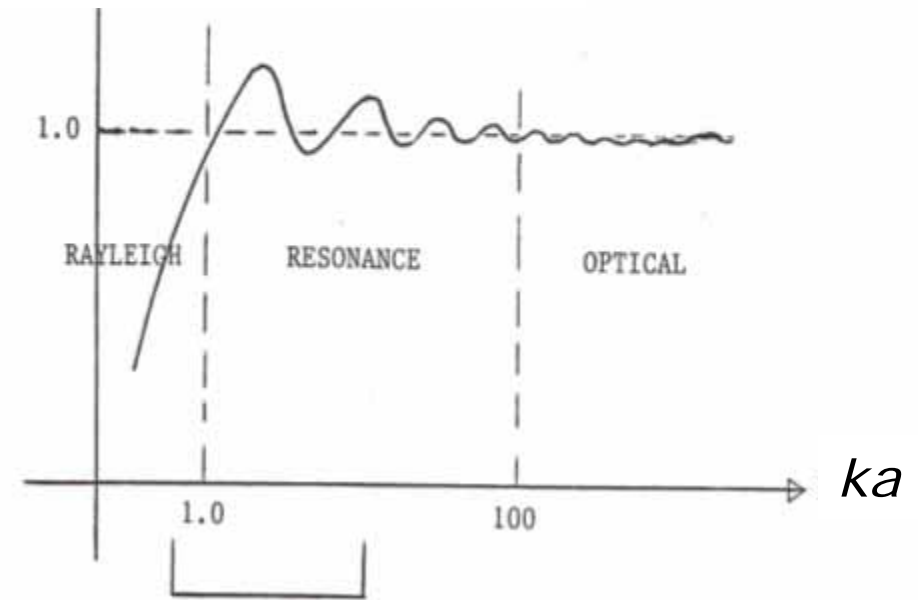
*One Look SONAR
Winder 2005 UIA*

Goal

Adapt SSI:

- clinically relevant ka regime
- scattering medium
- convenient frequencies

acoustic target
backscattered response



-Winder 2003

US Patent 6 585 647

assigned to J & W Medical

info from low frequencies

- shape
- volume
- composition

Methods: Experimental Setup

Panametrics 5900PR
Pulser/Receiver

LeCroy 9354TM
500 MHz Oscilloscope

Data Acquisition
Computer



V301

V314

0.5 MHz

1 MHz

US coupling gel

$c = 1640 \text{ m/s}$ 28%

$c = 1534 \text{ m/s}$ 10%

Porcine gel

Calipers

height

diameter

Images courtesy of manufacturers

Transducer Characteristics

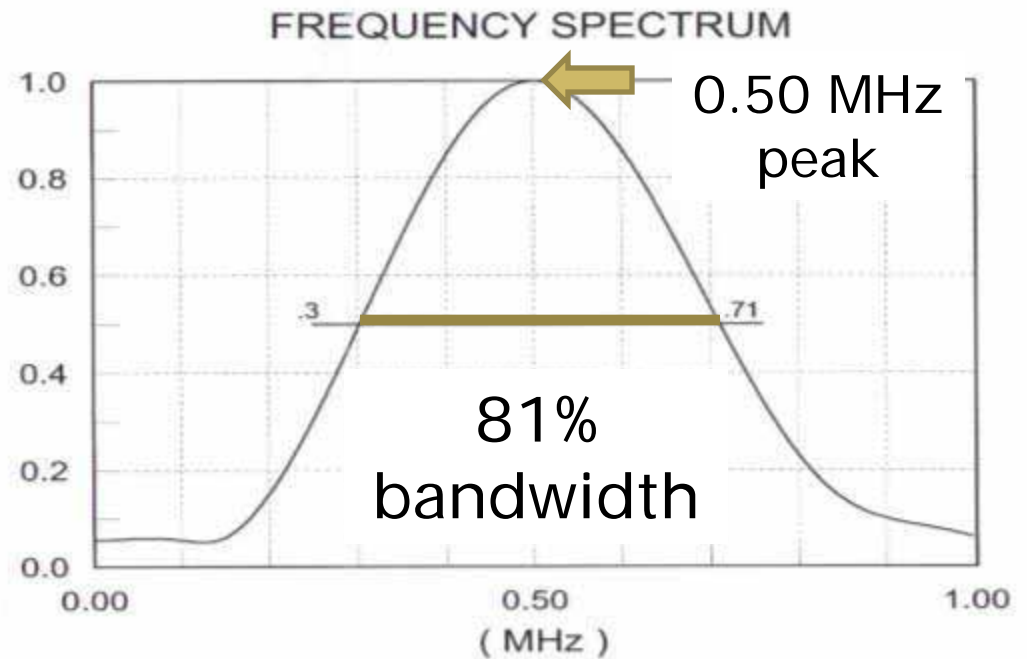
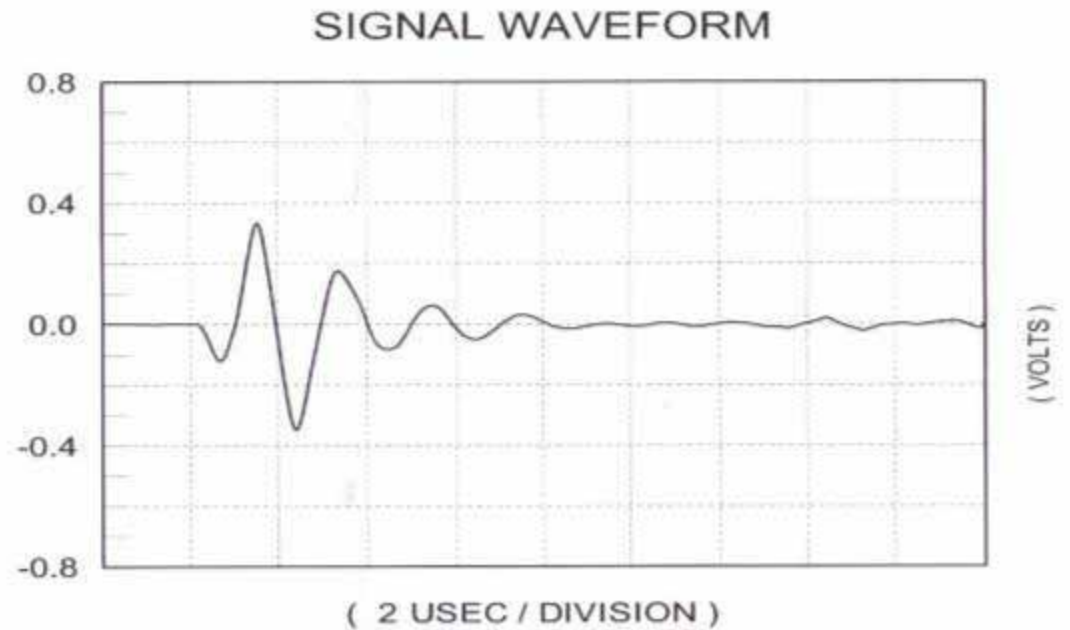
Panametrics
Videoscan V301



f/1.5

37.0 mm
focal length

~ 5 - 6 mm
-6 dB width



manufacturer's data  PANAMETRICS-NDT™

Transducer Characteristics

Panametrics
Videoscan V314

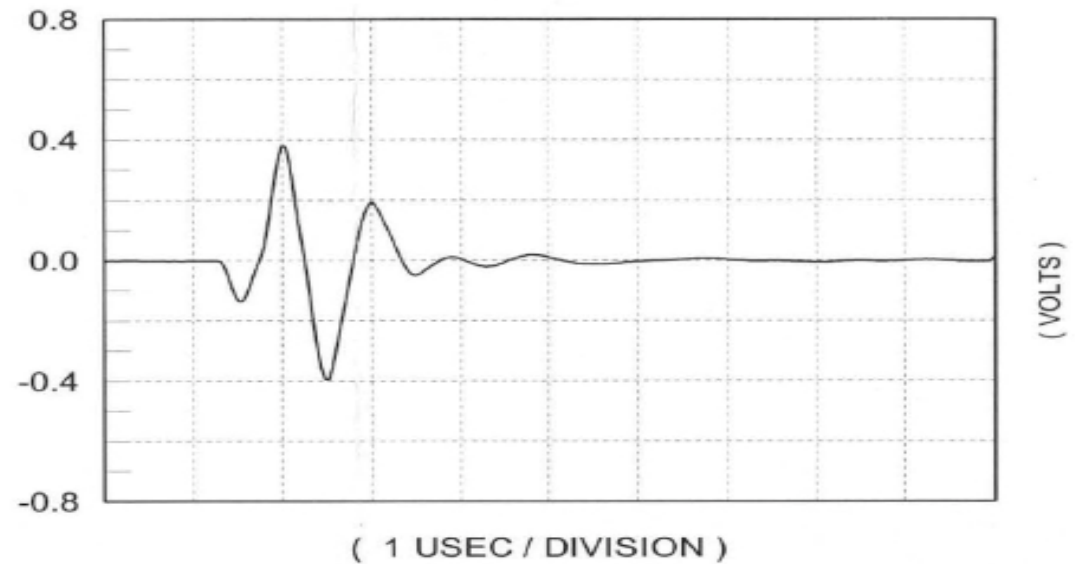


f/1.9

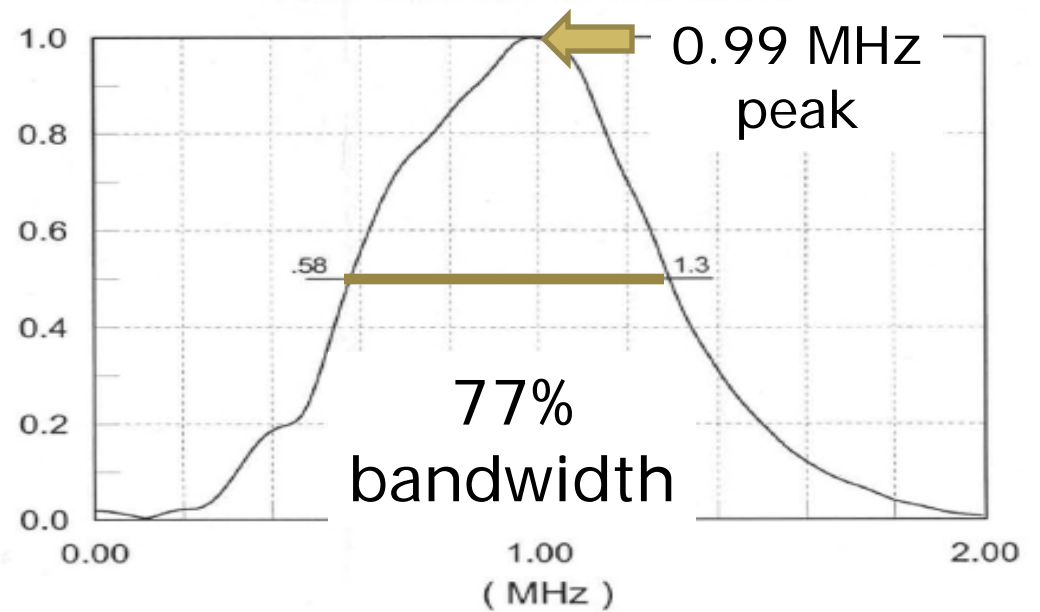
36.2 mm
focal length

~ 3 - 4 mm
-6 dB width

SIGNAL WAVEFORM



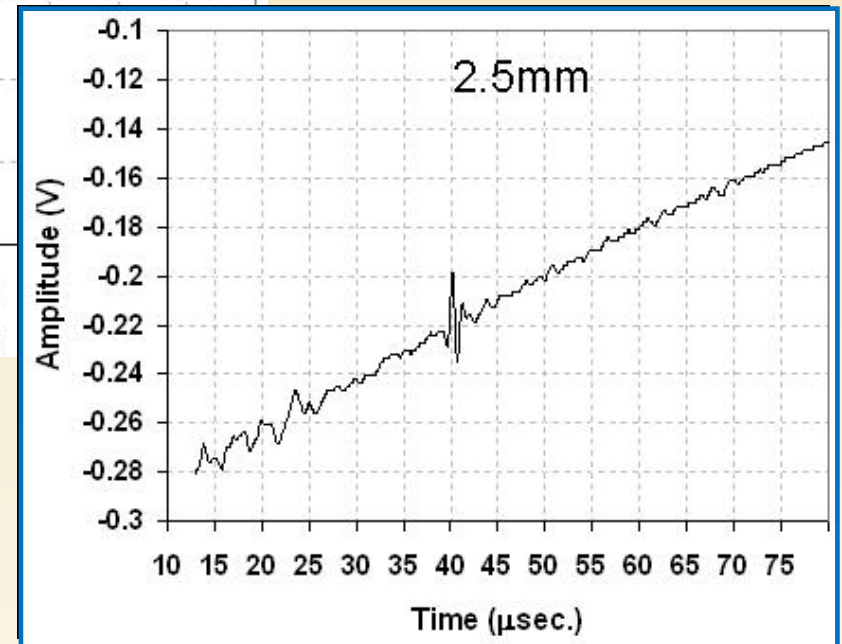
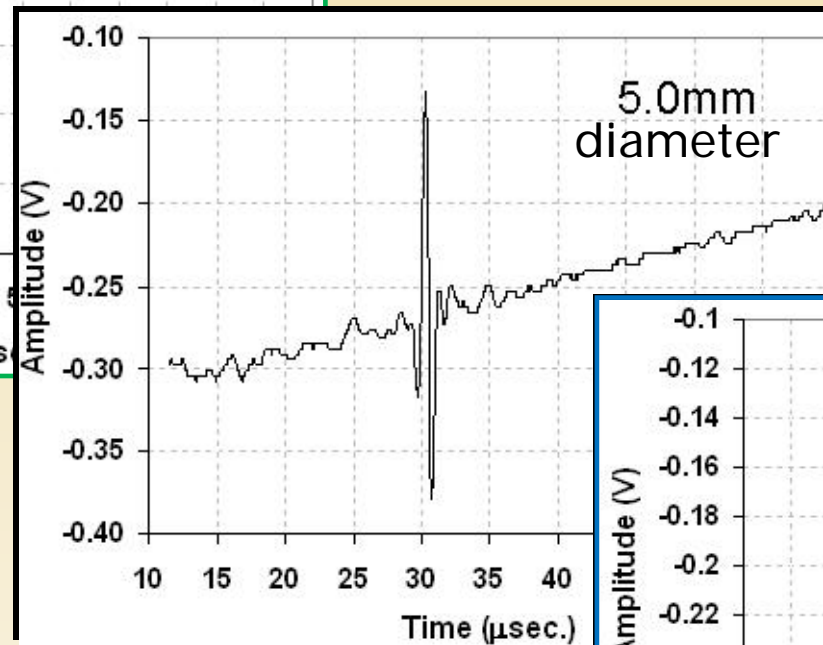
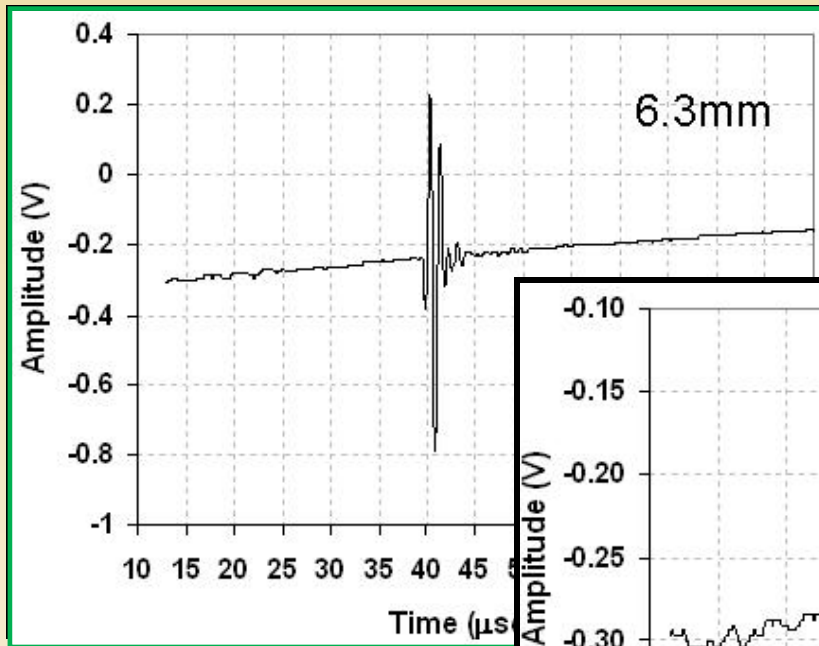
FREQUENCY SPECTRUM



manufacturer's data  PANAMETRICS-NDT™

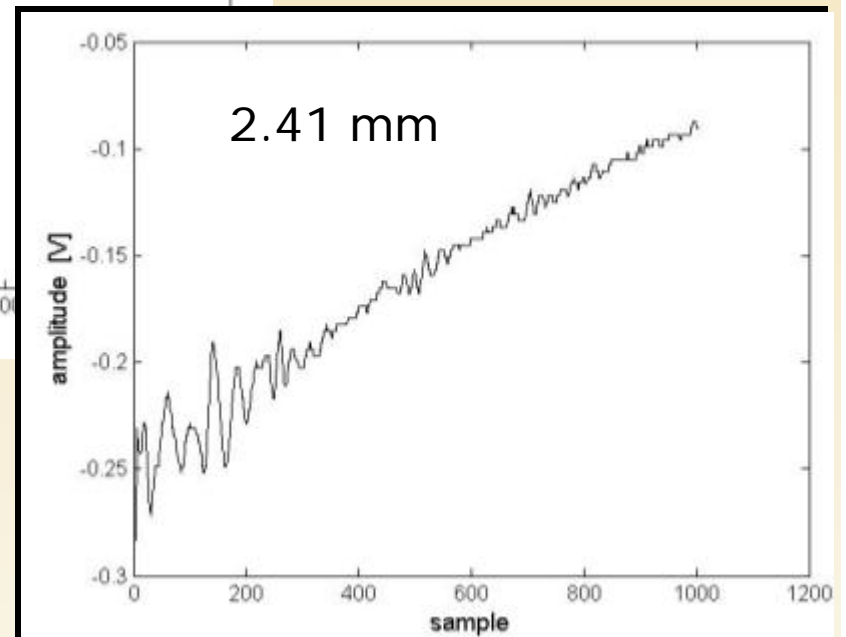
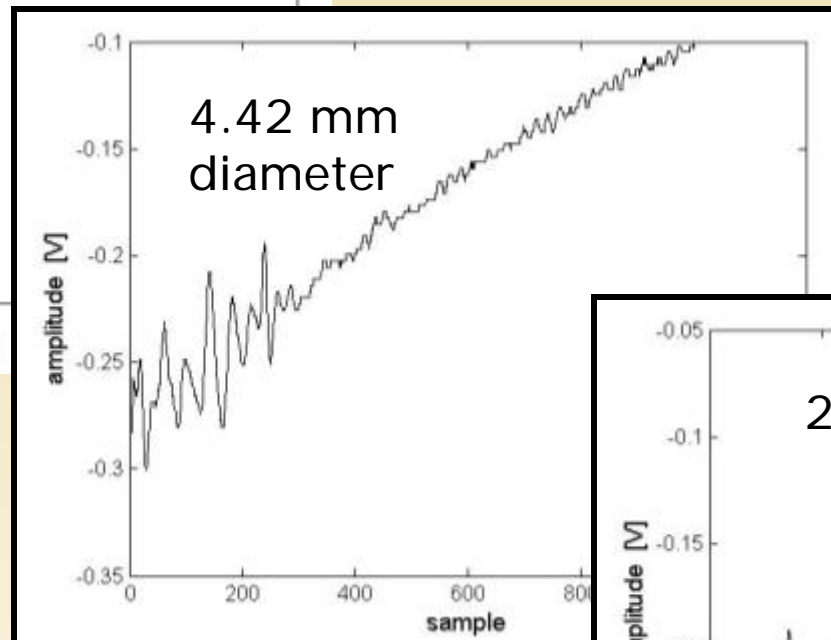
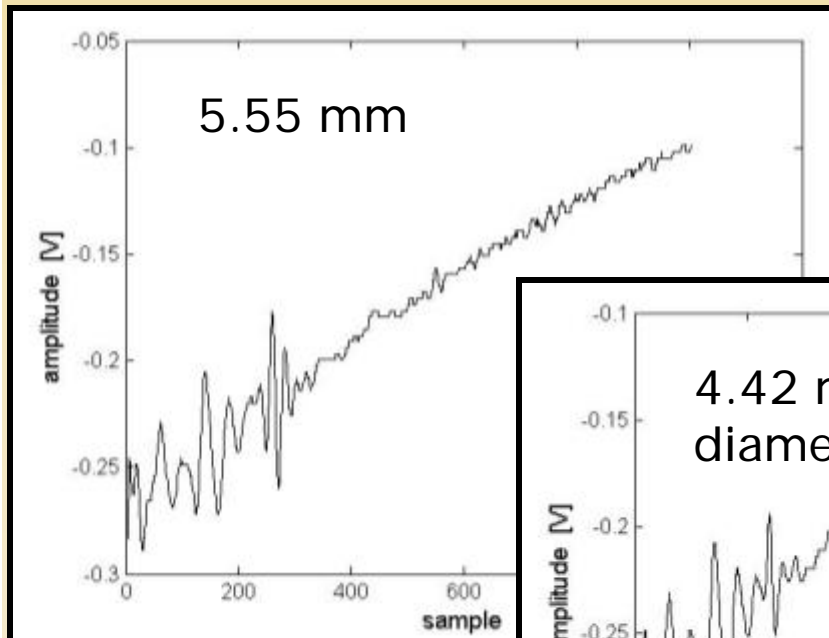
Results: Acoustic Burst Echo Responses

0.99 MHz

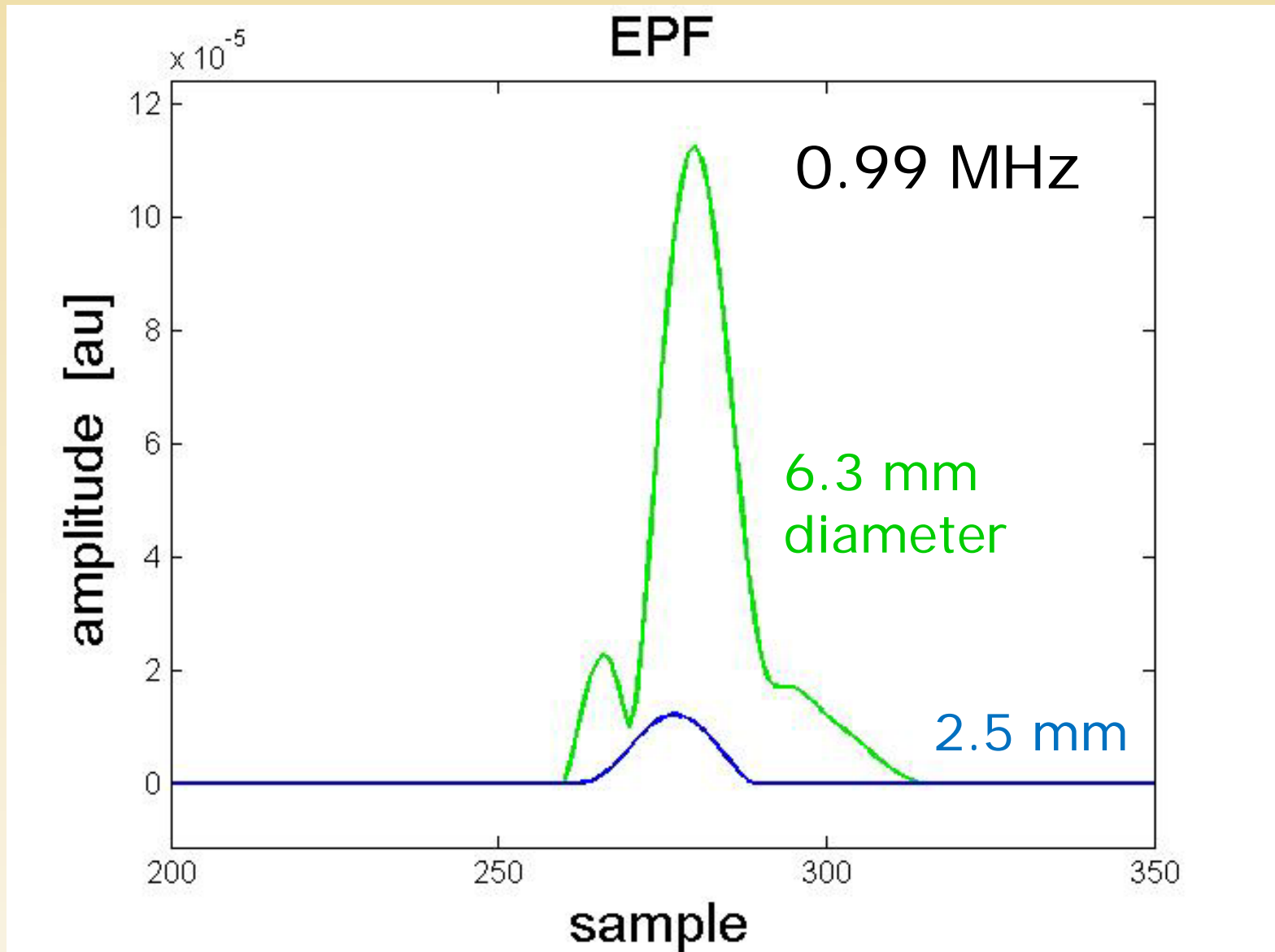


Results: Acoustic Burst Echo Responses

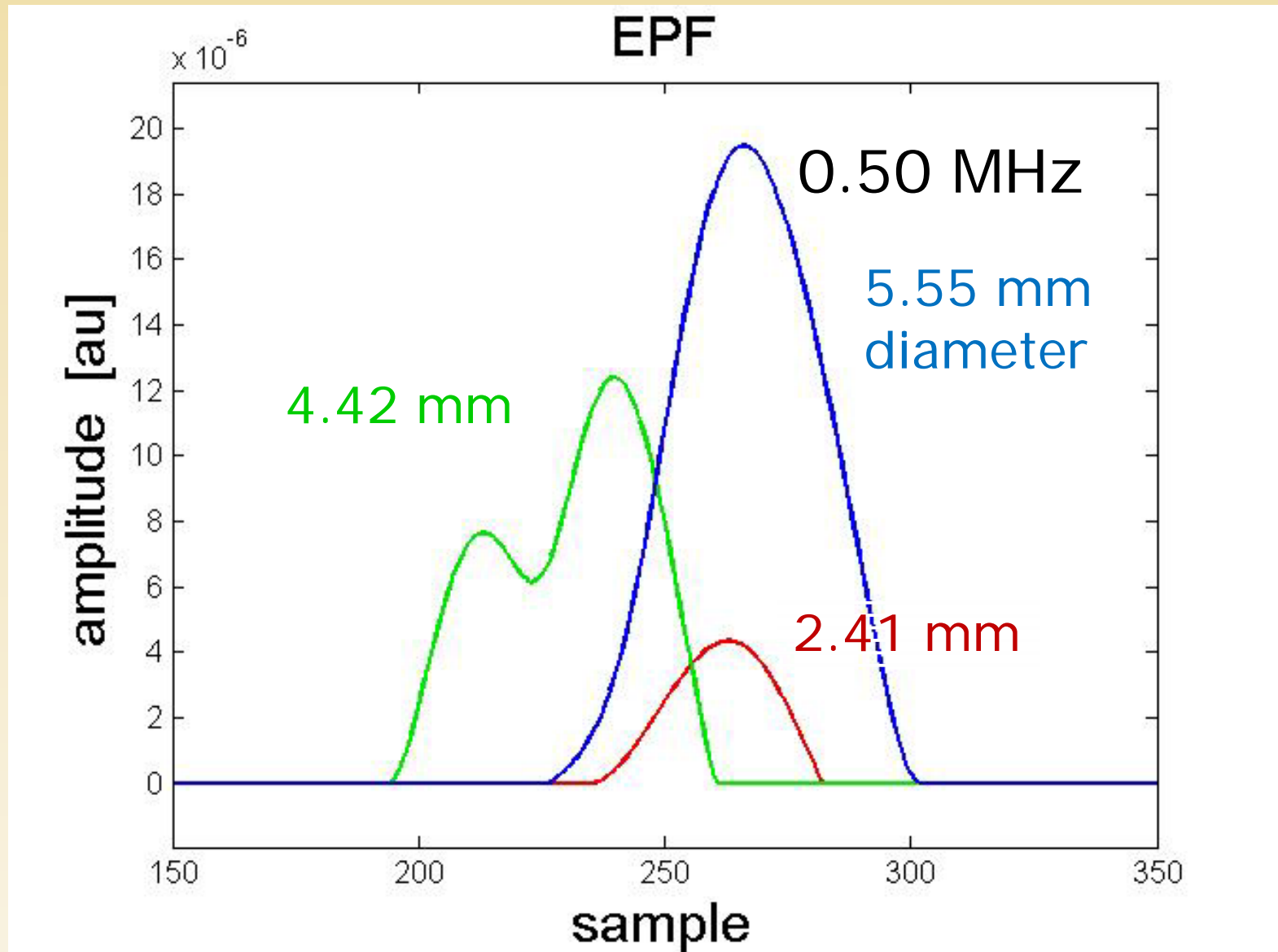
0.50 MHz



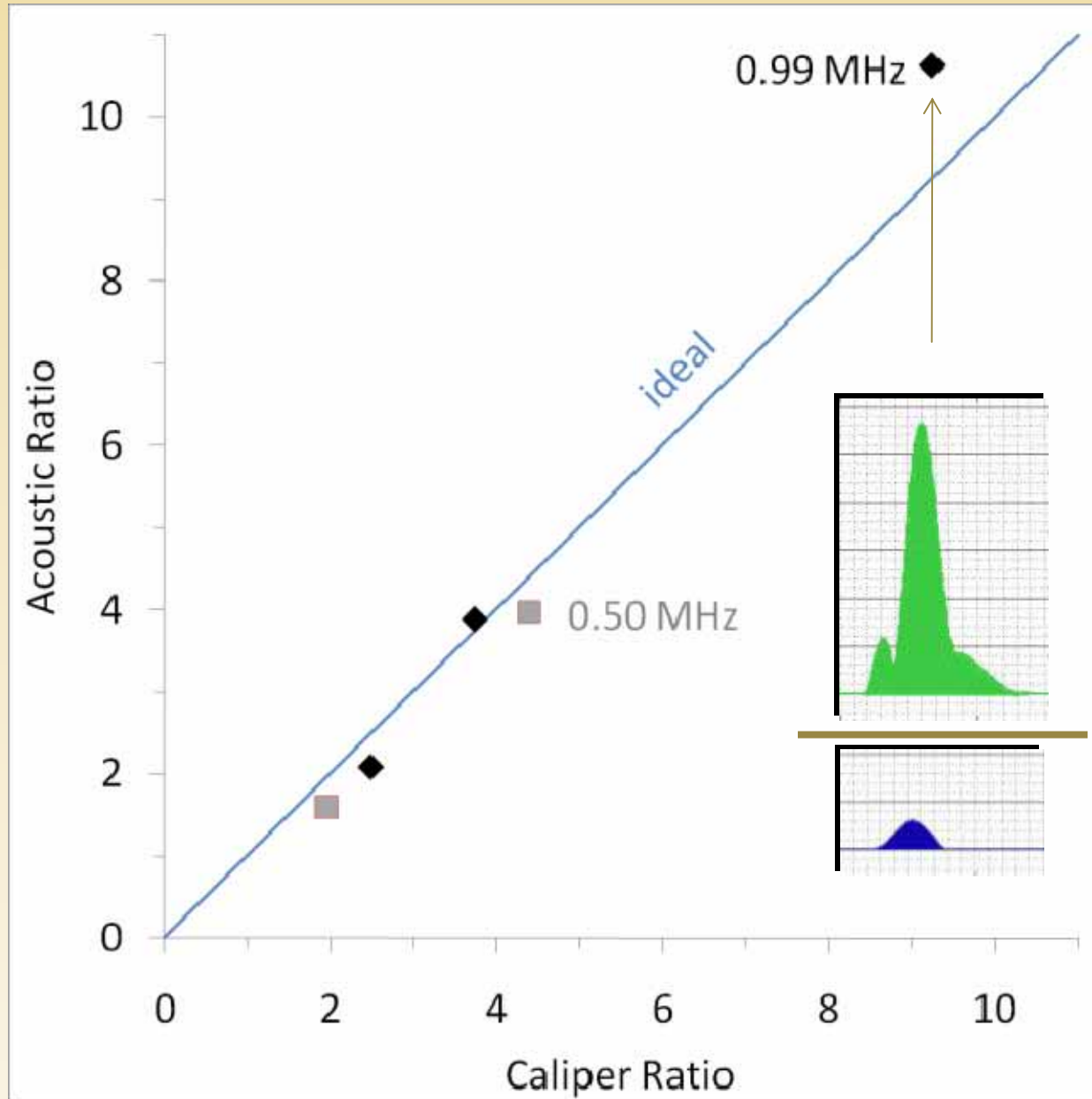
Experimental Profile Functions



Experimental Profile Functions



Estimated Volumes



Conclusions

- SSI effectively estimates biological phantom volumes.
- Accurate volume estimate requires appropriate matching of transducer excitation & ka .

Future Work

- Apply ultrasound SSI to real biological targets:
 - Breast
 - Fetus
 - Prostate

Acknowledgments

U.S. DoD - Breast Cancer Research Program

Concept Award: BC076704

Period: 2008 Sep 15 / 2009 Oct 14

Thomas Jefferson University *Philadelphia PA USA*

Freeport Public Schools *Freeport NY USA*

Thank you !