Architecture of Quality Imaging

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Architecture of Quality Imaging

Agile Acoustic Architecture

E-Series and XDclear Transducers

Acquisition Technologies

Post-Acquisition Technologies

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Agile Acoustic Architecture

Agile Acoustic Architecture

Designed to help meet the challenges of healthcare

Increasing obesity

Aging population

More difficult-to-image patients

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Agile Acoustic Architecture

powerful
fast
adaptable
dynamic
intuitive

LOGIQ* 700 Good images.

LOGIQ 9 Great images.

LOGIQ E9 XDclear Extraordinary images.

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*Trademark of the General Electric Company

Agile Acoustic Architecture

LOGIQ ultrasound systems prior to Agile Acoustic Architecture

Rigid assumptions about how sound interacts with the body

Agile Acoustic Architecture

Flexible clinically based mathematical models of the body

Dynamically helps optimize image acquisition for many body types

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Agile Acoustic Architecture

Generation of power

- Miniaturization technology
- Ultra fast communication
- Platform for future innovations

Class of intelligence

- Distributed intelligence
- Dynamic models of anatomy & physics

Level of performance

- Penetration … large/difficult patient imaging
- Image Uniformity
  - High frequency at depth
- Few keystrokes needed –"plopable"

The New LOGIQ E9 with XDclear

The biggest thing to happen to the LOGIQ E9 since the LOGIQ E9

Today

2008

- ✓ Extraordinary images
  - *Platform architecture*
- ✓ Easy workflow
  - *Raw data, Ergonomics, Scan Assistant*
- ✓ Expert tools
  - *Real time fusion with Volume Navigation*

+ Stunning penetration & resolution
  - *-XDclear transducer architecture*
+ Direct hemodynamic visualization
  - *-Innovative B-Flow* technology*
+ New workflow tools
  - *-Compare Assistant for prior exams*
  - *-Breast & Thyroid Productivity Packages*
+ Auto-registration for CT fusion
+ Platform enhancements
  - *-Faster, more powerful computer*
  - *-Easy speed of sound adjustment*
  - *-New fully adjustable monitor*

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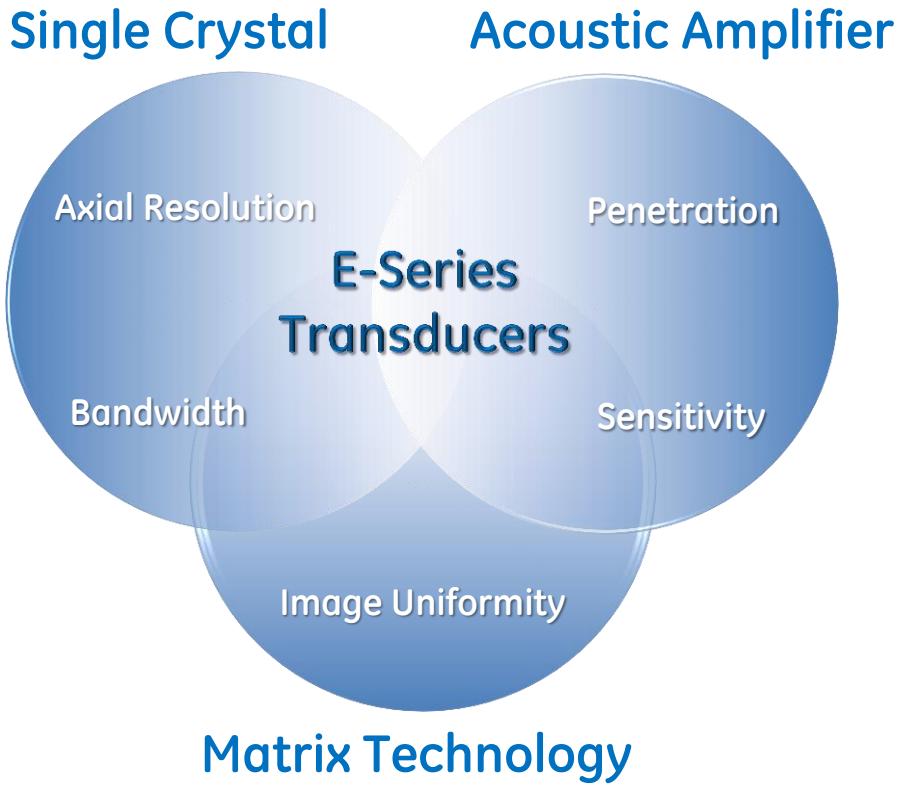
E-Series Transducers

E-Series Transducers

Designed for Agile Acoustic Architecture

Ergonomic

Wide range of applications

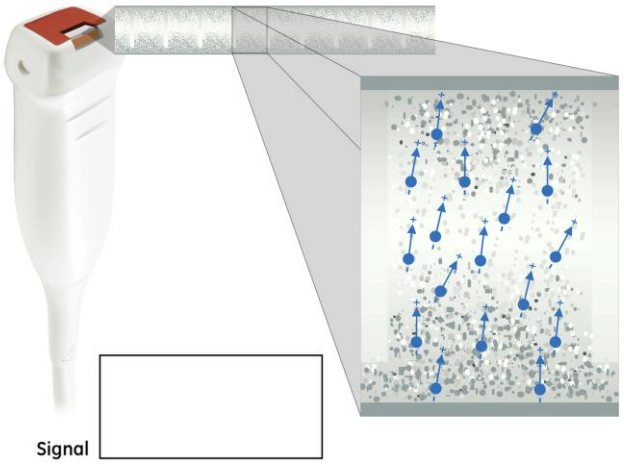


E-Series Transducers

Single crystal technology

GE Traditional PZT Technology

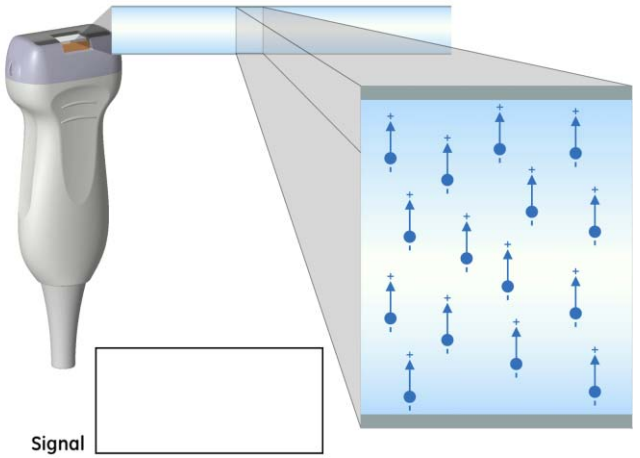
The variations of polarization in PZT affect its piezoelectric properties and signal to noise ratio



The electric dipoles of PZT are randomly oriented introducing signal noise

GE Single Crystal Technology

A single crystal material exhibits fewer poling variations than those made from multiple crystals



Single Crystal exhibits enhanced dipole alignment

Using GE's Single Crystal Technology helps to:

- Enhance bandwidth
- Enhance signal-to-noise ratio
- Enhance axial resolution and penetration

compared to GE's traditional PZT

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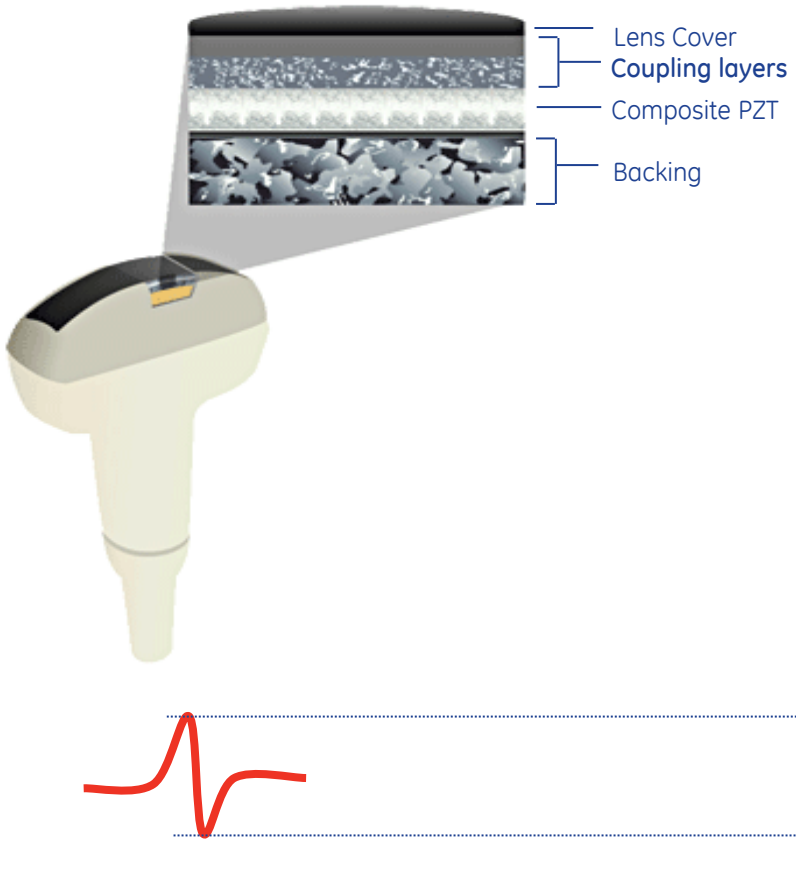
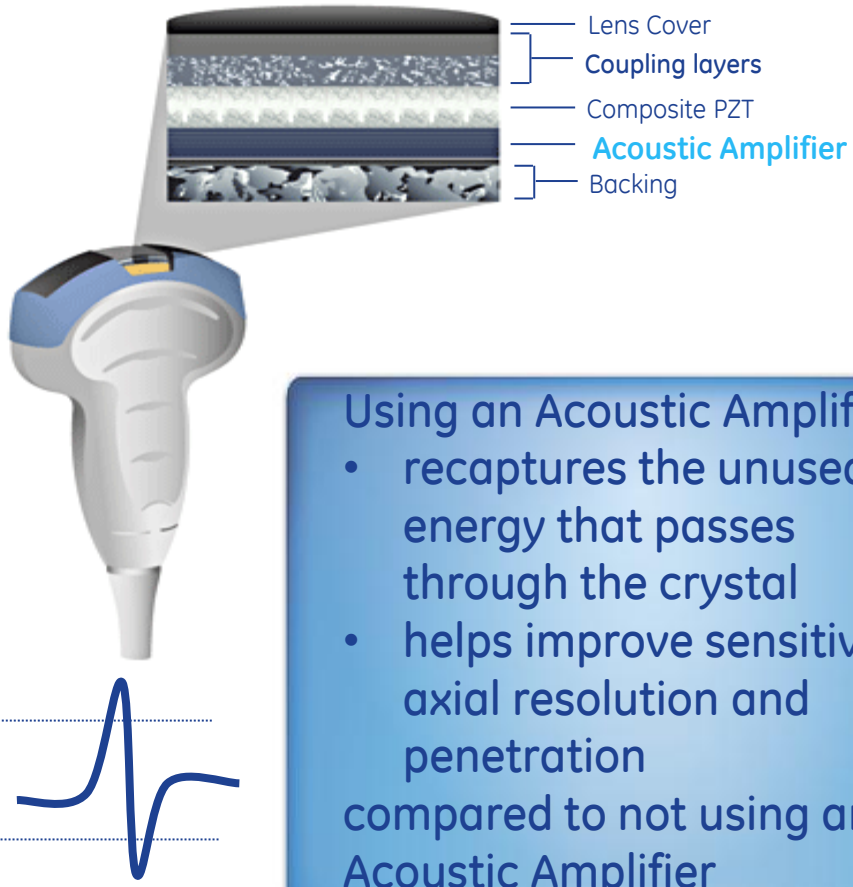
E-Series Transducers

Acoustic amplifier technology

GE Traditional Technology



GE Acoustic Amplifier Technology



Using an Acoustic Amplifier:

- recaptures the unused energy that passes through the crystal
- helps improve sensitivity, axial resolution and penetration

compared to not using an Acoustic Amplifier

E-Series Transducers

Matrix array technology

Matrix arrays provide multiple rows of crystals

Multiple rows allow focusing in the near, mid and far field

GE's 11L

GE's ML6-15-D

ML6-15-D has more uniform elevation slice thickness than the 11L

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E-Series Transducers
ML6-15-D Focal Zones

Focal zone above 2 cm

- Only center row used
- Narrow slice thickness for small vessels and cystic clarity

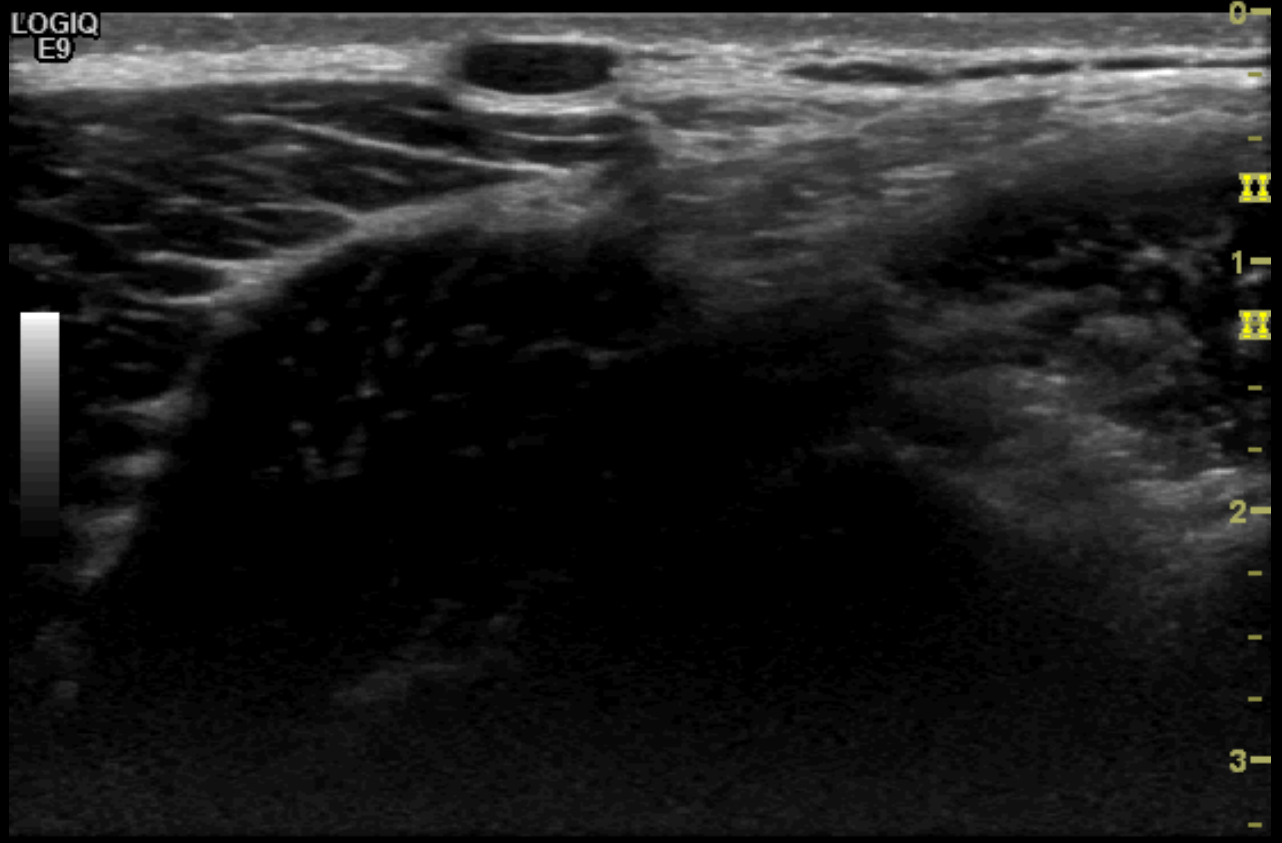
Focal zone below 2 – 2.5 cm

- All rows turned on
- Provides penetration, reduces far field noise

Models are set to use multiple zones spaced widely to ensure that appropriate number of rows are used

E-Series Transducers

ML6-15-D Focal Zones



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E-Series Transducers

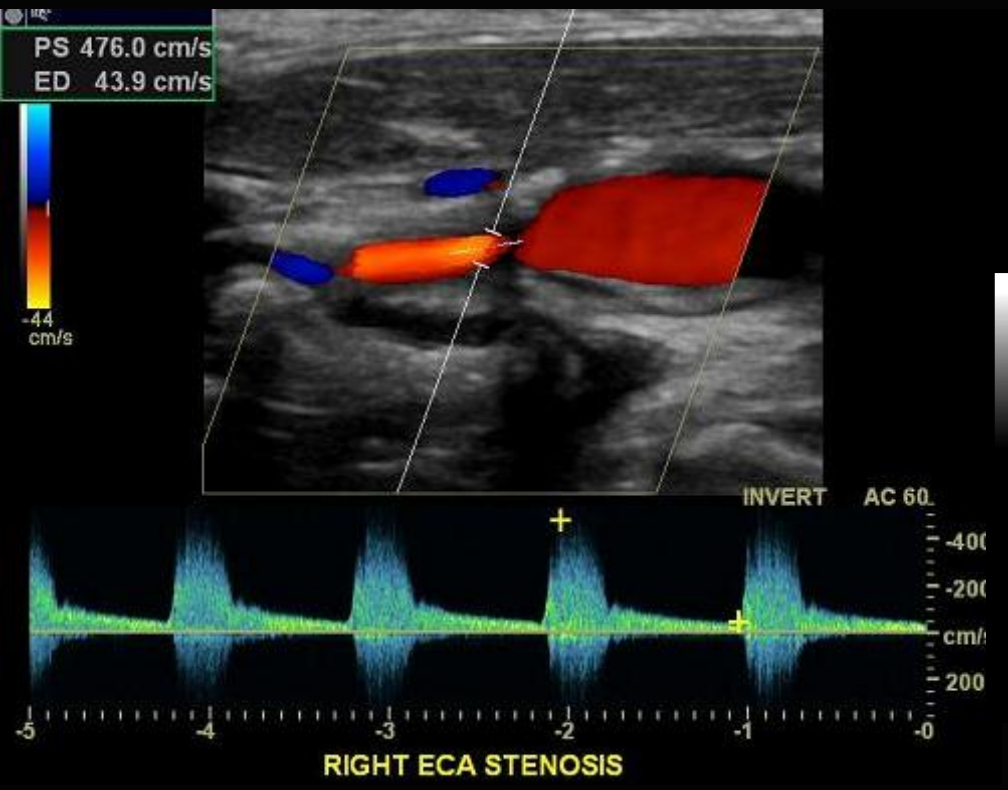
9L-D

- Vascular Probe for Carotid, Arterial and Venous
- Complements Curved array probes in Abdomen, Pediatrics and Obstetrics
- Uses all elements to provide enhanced penetration and resolution at depth

E-Series Transducers

9L-D Vascular

OB - 16 weeks



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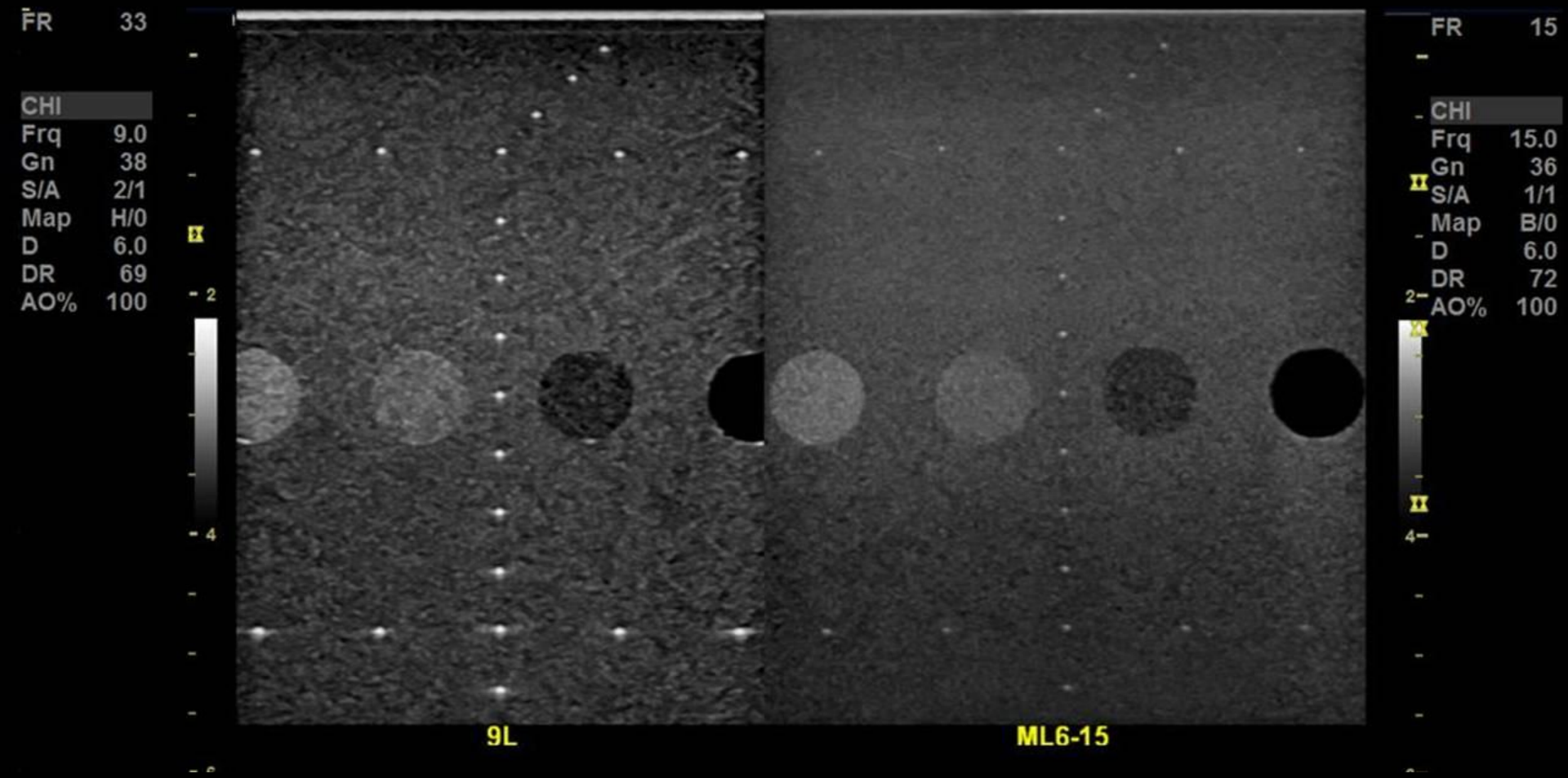
E-Series Transducers

9L-D / ML6-15-D



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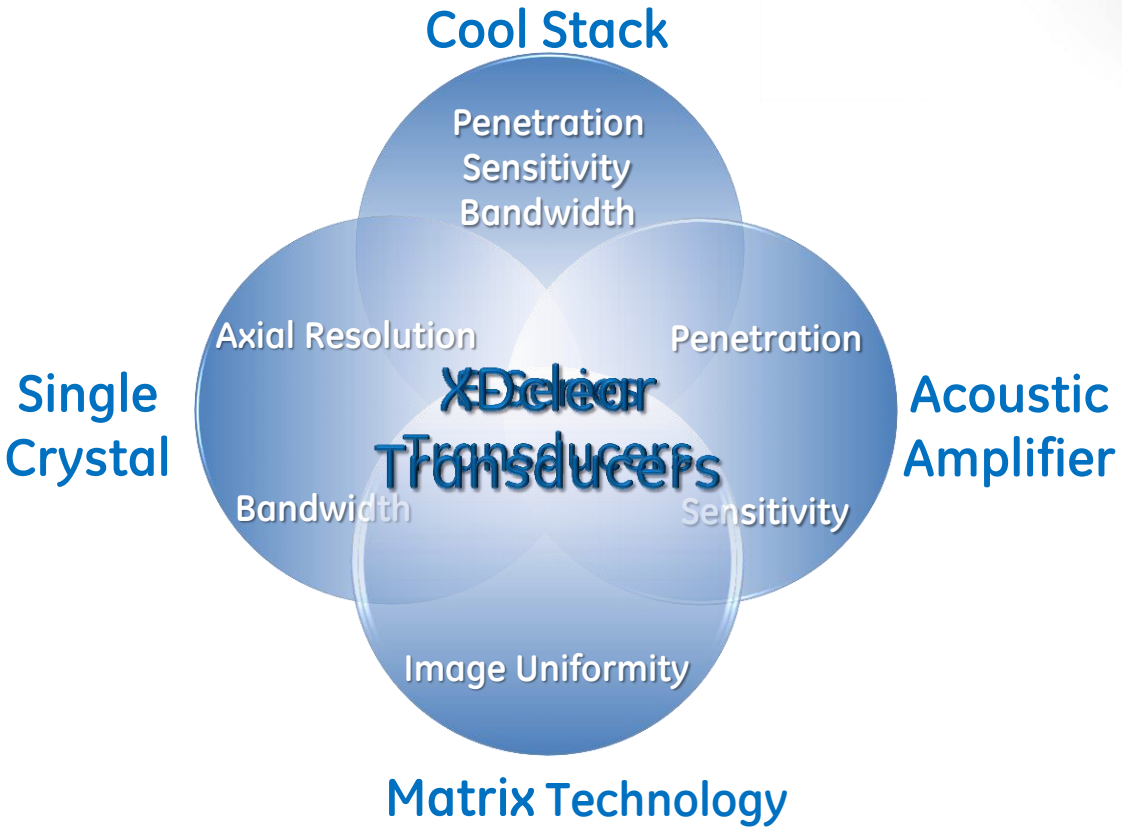
E-Series Transducers

XDclear transducers



XDclear Transducers

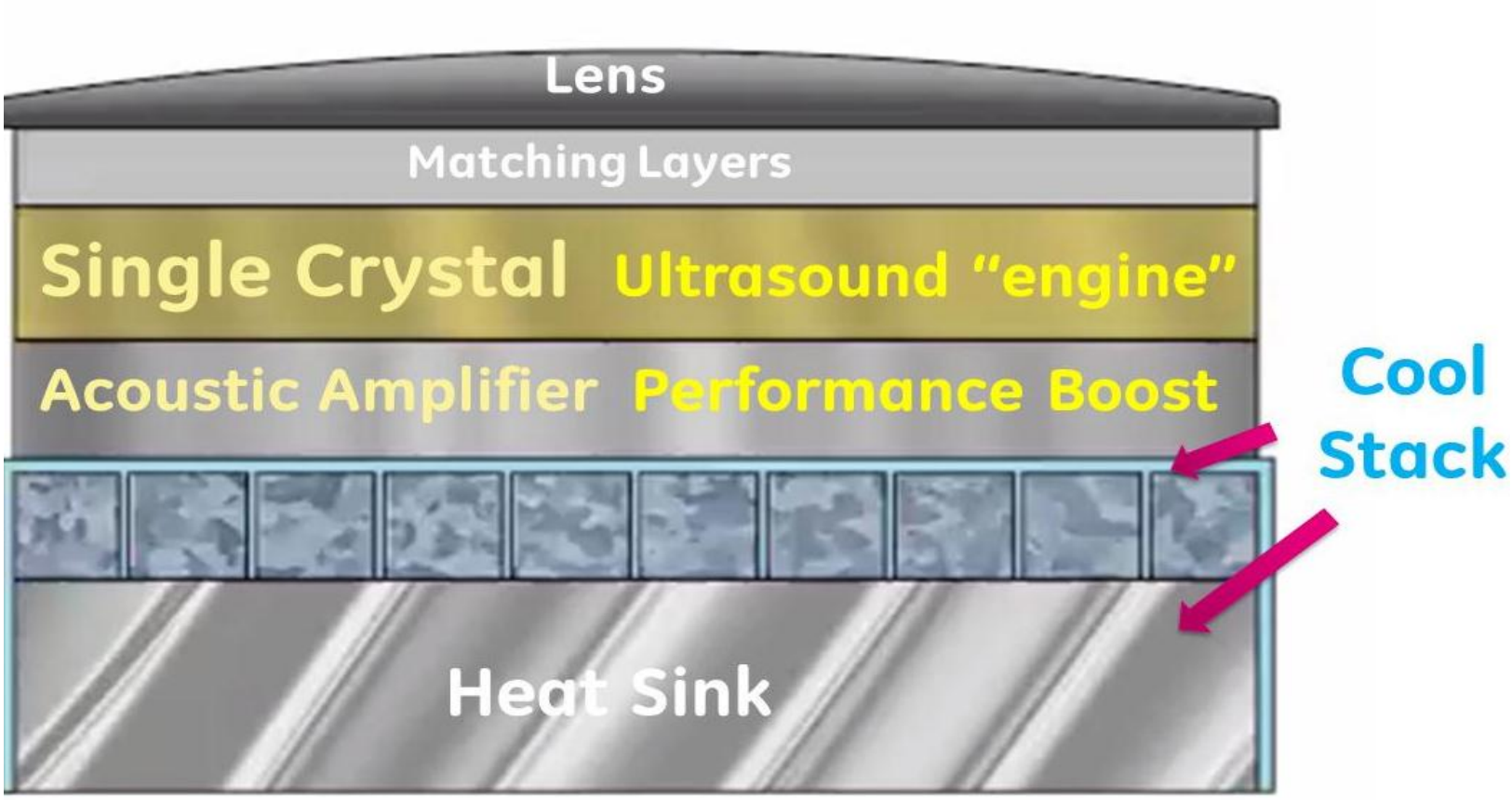
XDclear technology differentiates these probes from all others in GE's history

XDclear is a tuned and efficient combination of three major probe technologies:

- Single Crystal
- Acoustic Amplifier
- Cool Stack

XDclear Transducers

XDclear - 3 combined GE technologies



XDclear Transducers
What are the Benefits?

Technology benefits

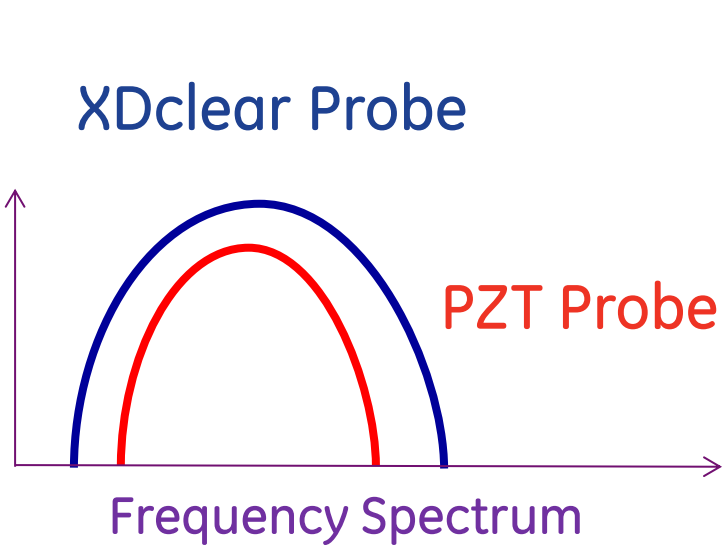
- Helps increase sensitivity
- Helps increase bandwidth

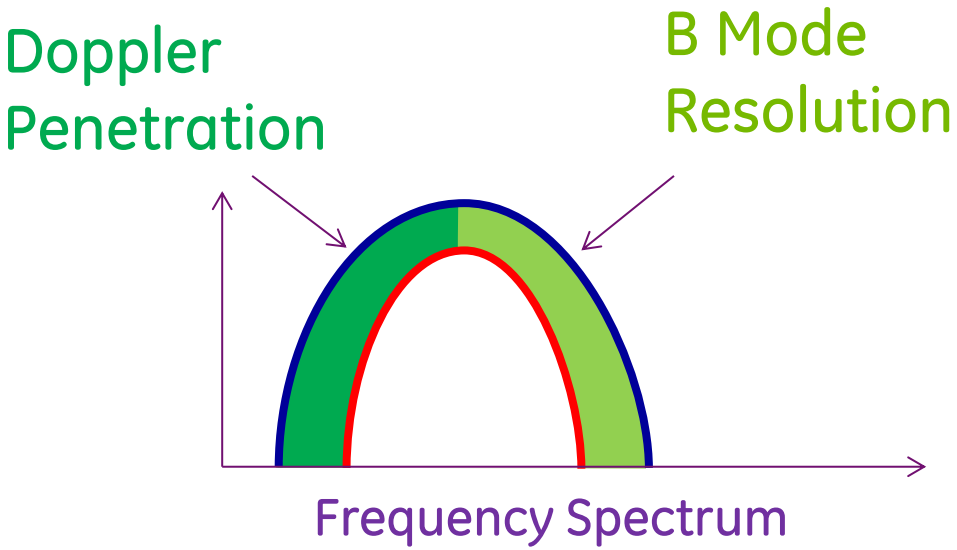
Translate to clinical benefits

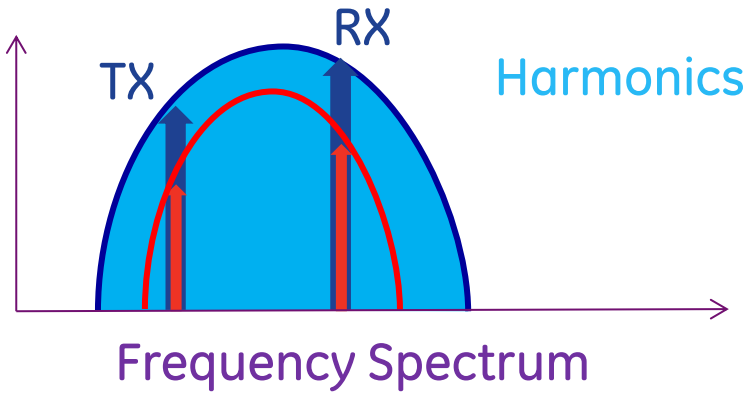
- Helps increase penetration
- Helps improve imaging in every mode

XDclear Transducers

How does bandwidth translate to imaging?

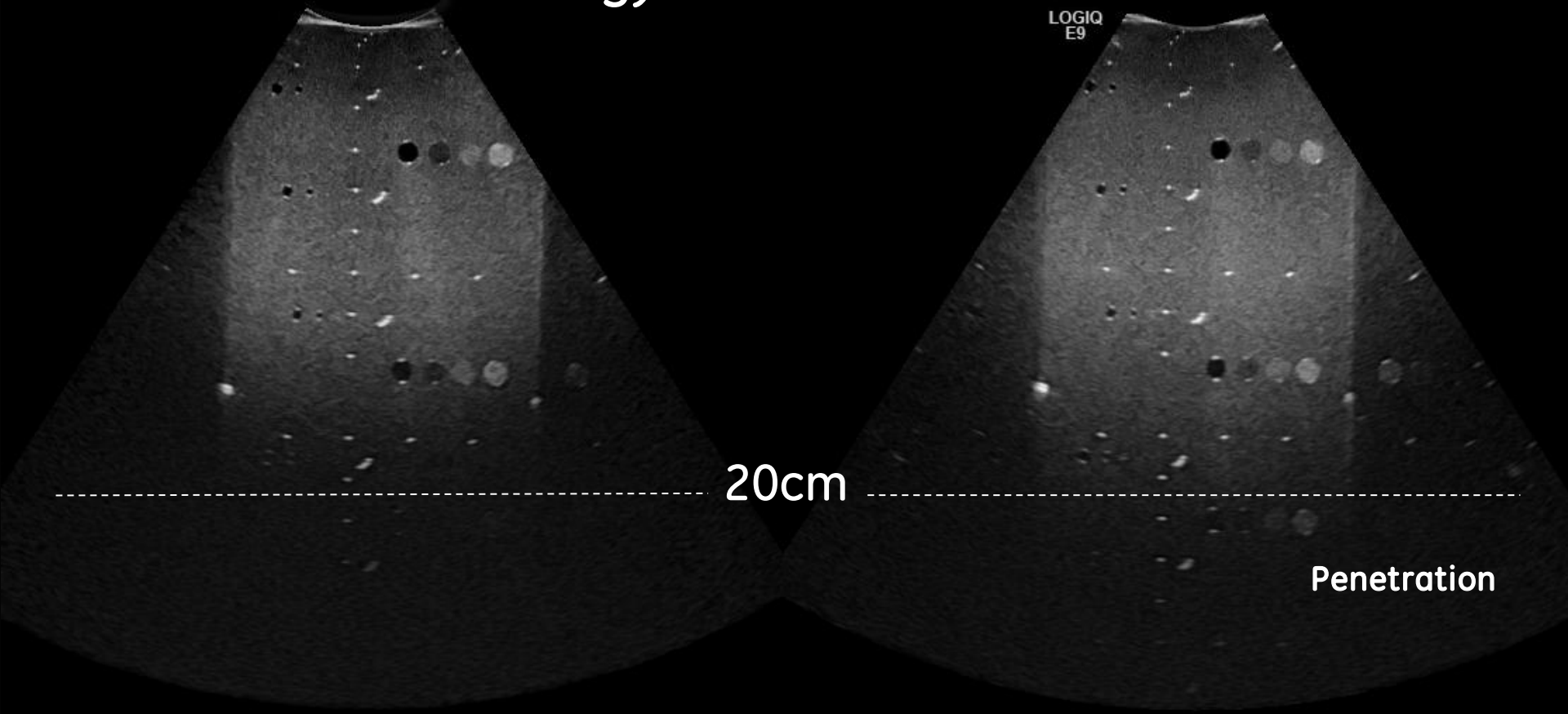






XDclear Transducers

Transducer technology evolution



Traditional†

XDclear

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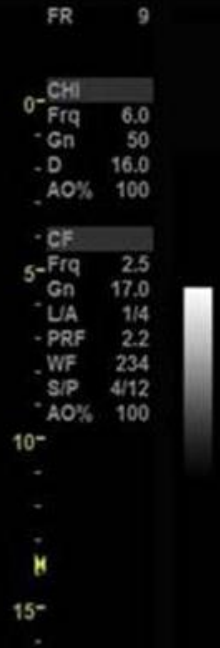
†Prior GE transducer technology

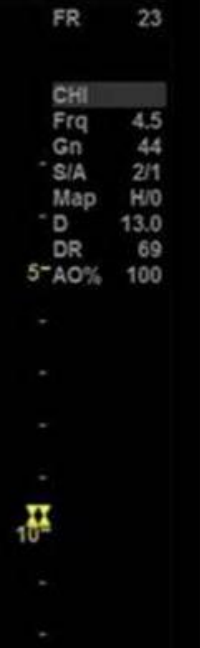
XDclear Transducers

C2-9-D intended uses

Pediatric, Small Adults, and OB imaging

Helps fill the gap between the C1-6-D and the 9L-D





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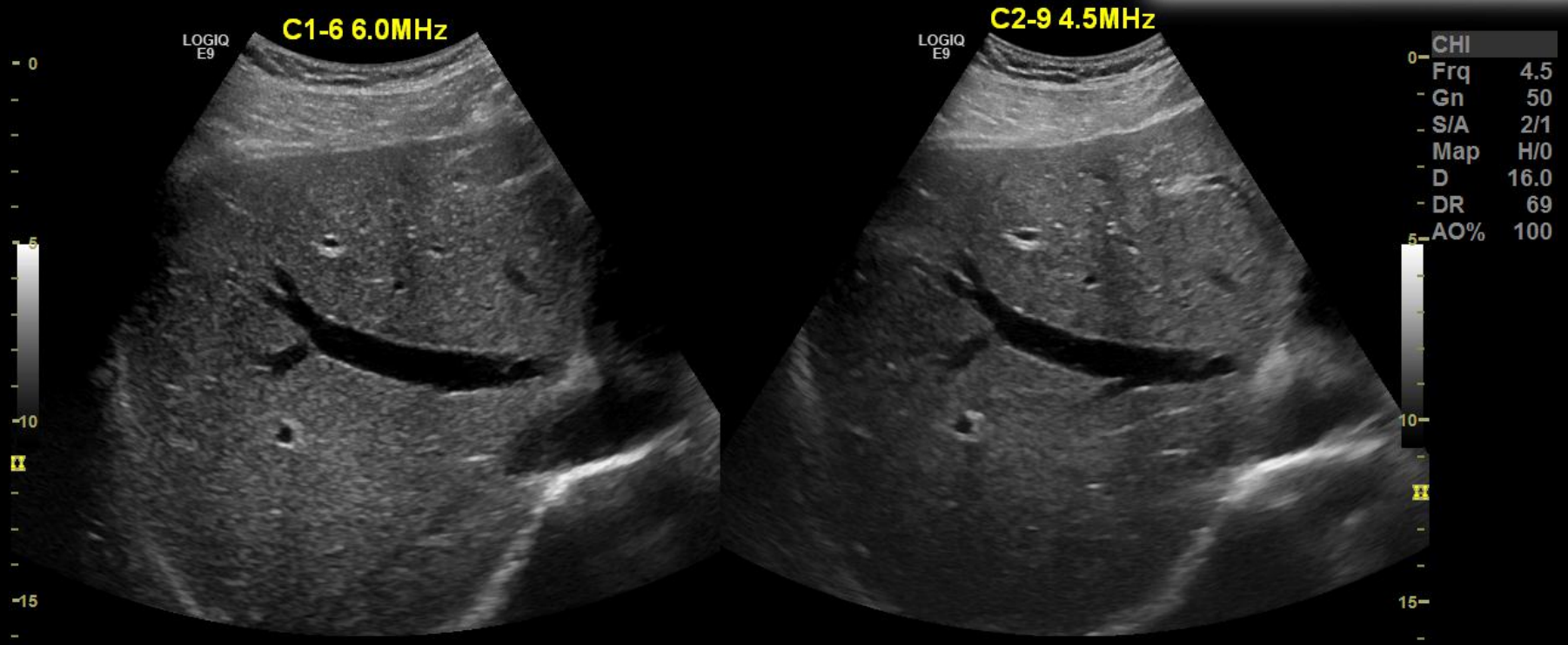
XDclear Transducers
C1-6-D / C2-9-D



C2-9-D helps improve resolution

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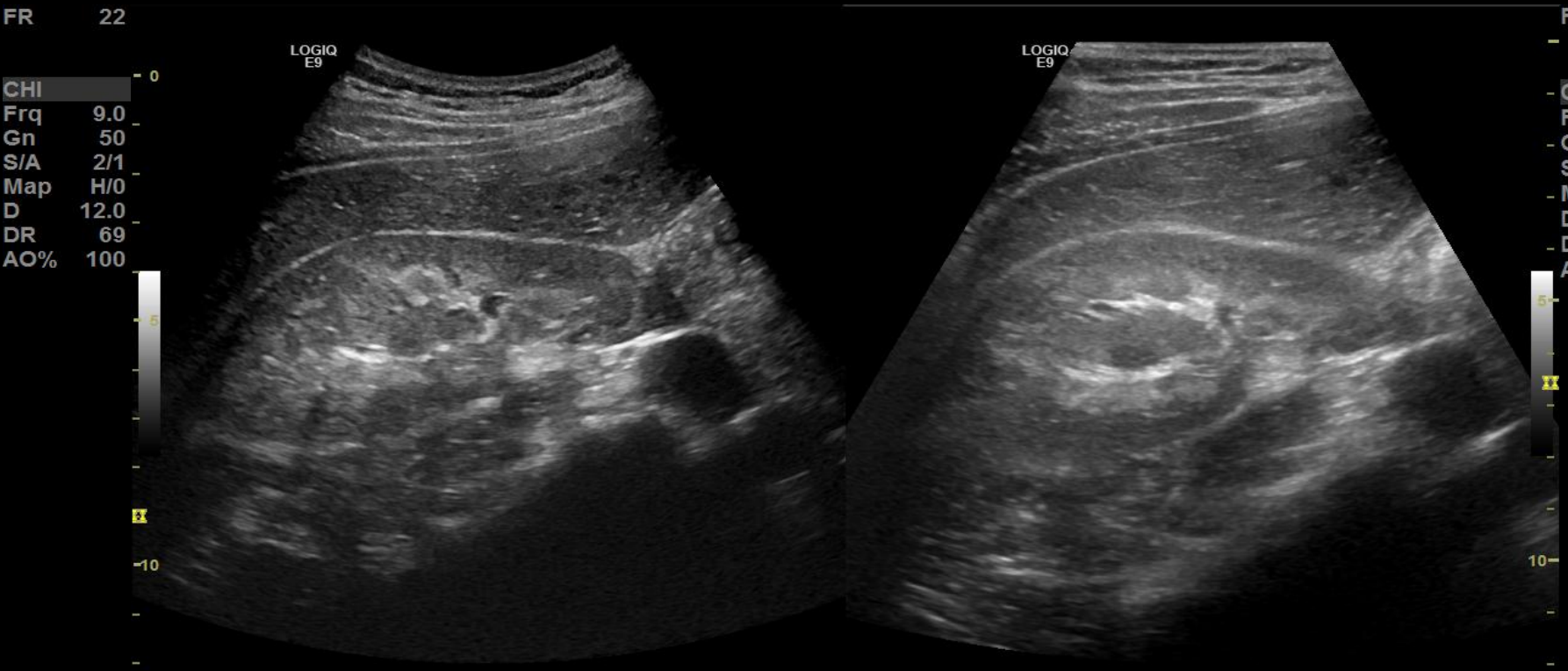
XDclear Transducers

9L-D / C2-9-D



9L-D helps improve resolution

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Acquisition Technologies

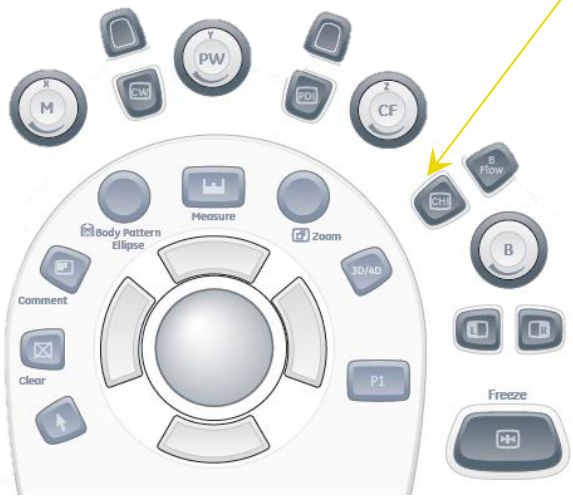
- Harmonics
- B-Flow
- CrossXBeam*
- Speed of Sound
- Virtual Convex
- LOGIQView*

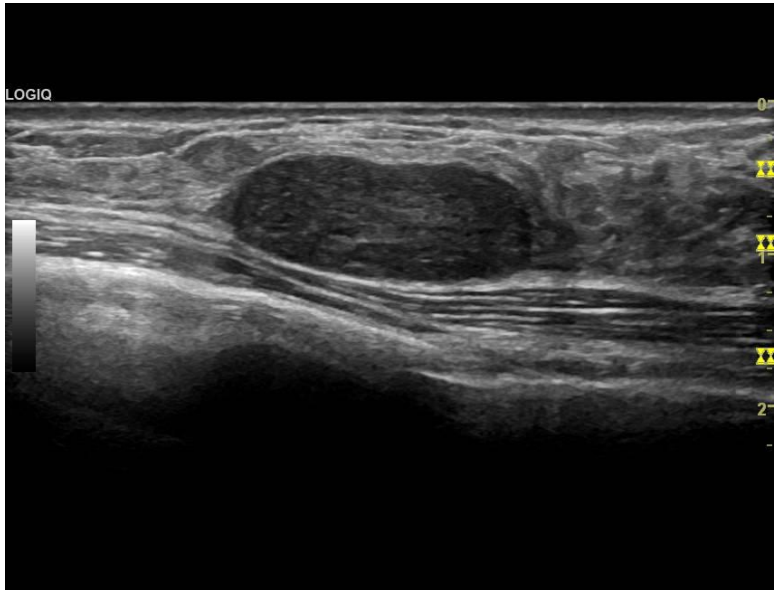
Acquisition Technologies
Coded Harmonic Imaging

Directly addresses fundamental ultrasound limitations (penetration/resolution)

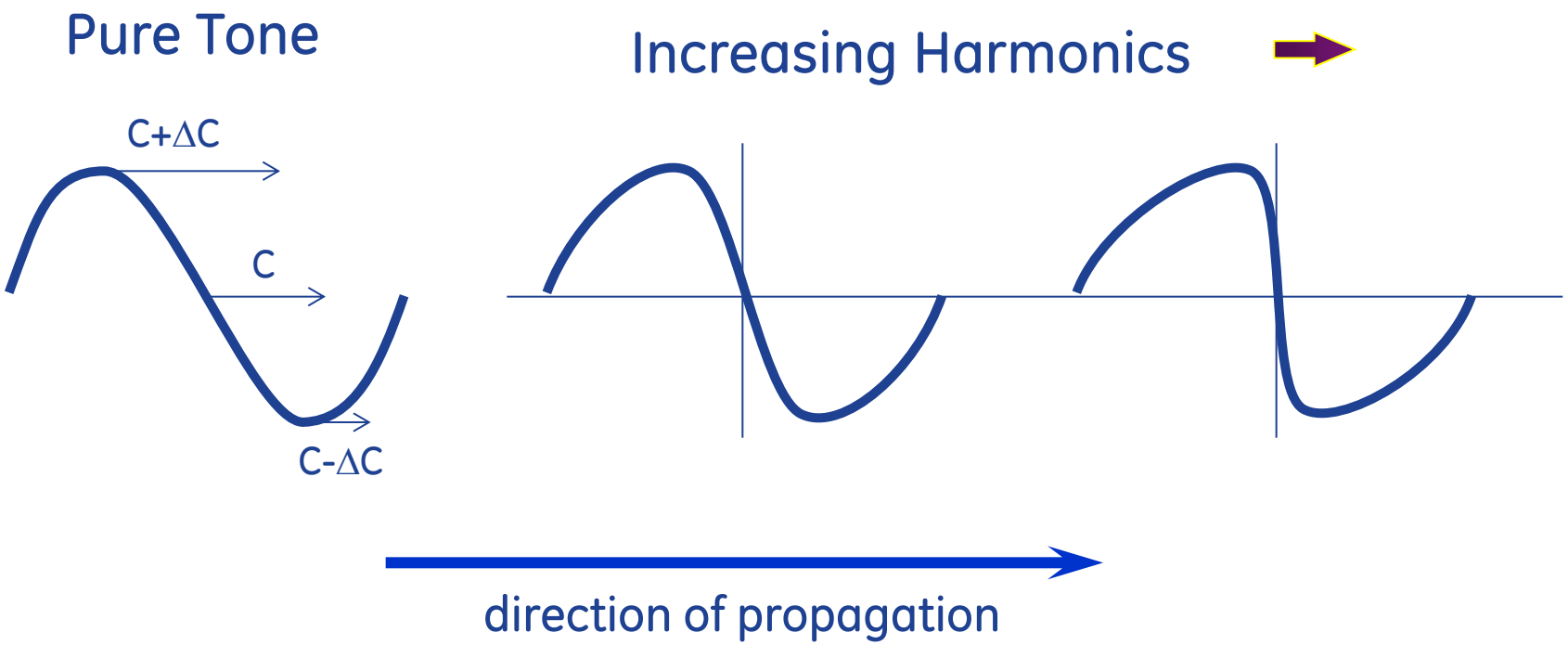
Helps improve signal to noise ratio

Helps reduce noise





Acquisition Technologies
Harmonics – Sound Wave Distortion



Acquisition Technologies
Harmonics

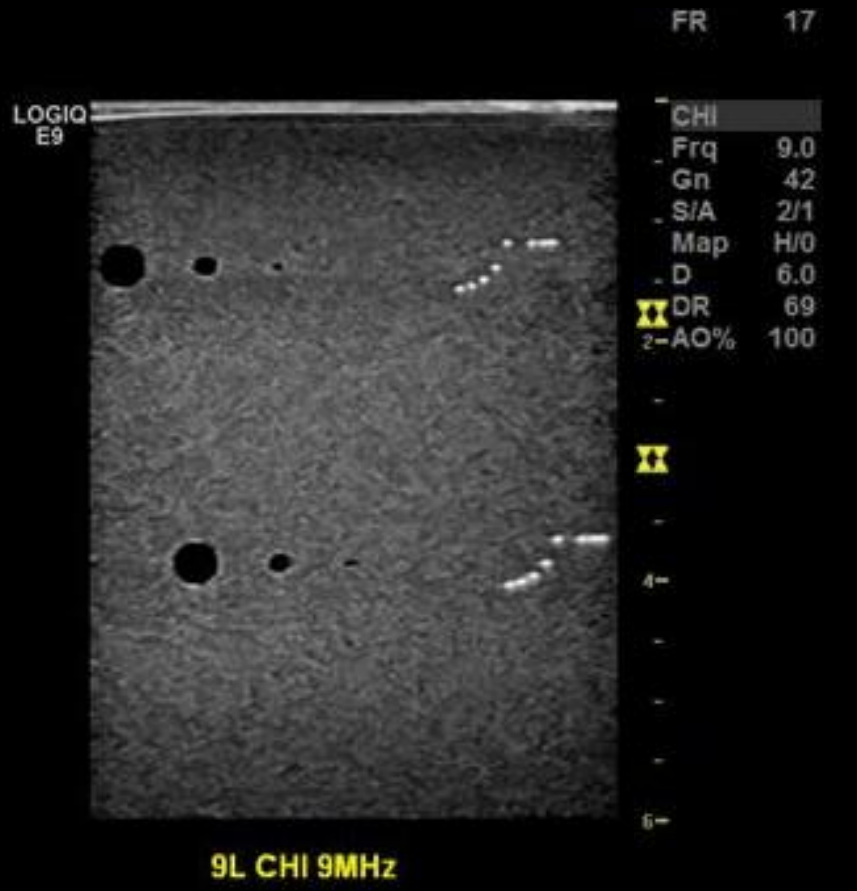
A 3.0 MHz signal that would produce maximum penetration will return a Harmonics frequency of 6.0 MHz

This returning high frequency signal only has to travel one direction (back to the probe)

The displayed image now benefits from the attributes of high frequency and a one-way travel effect

Acquisition Technologies

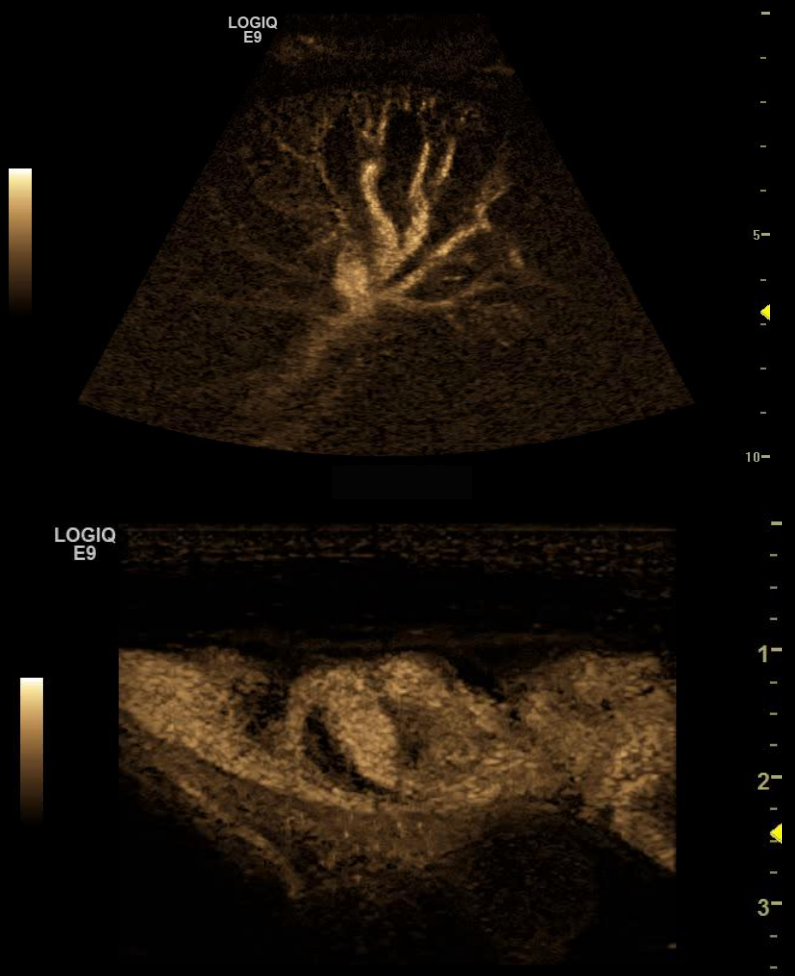
9L-D with and without harmonics



imagination at work

Acquisition Technologies
B-Flow

- Spatial resolution similar to 2D
- Temporal resolution closer to true hemodynamics of blood flow
- No ROI, bleeding or color on brights
- No Doppler Effect or angle dependency



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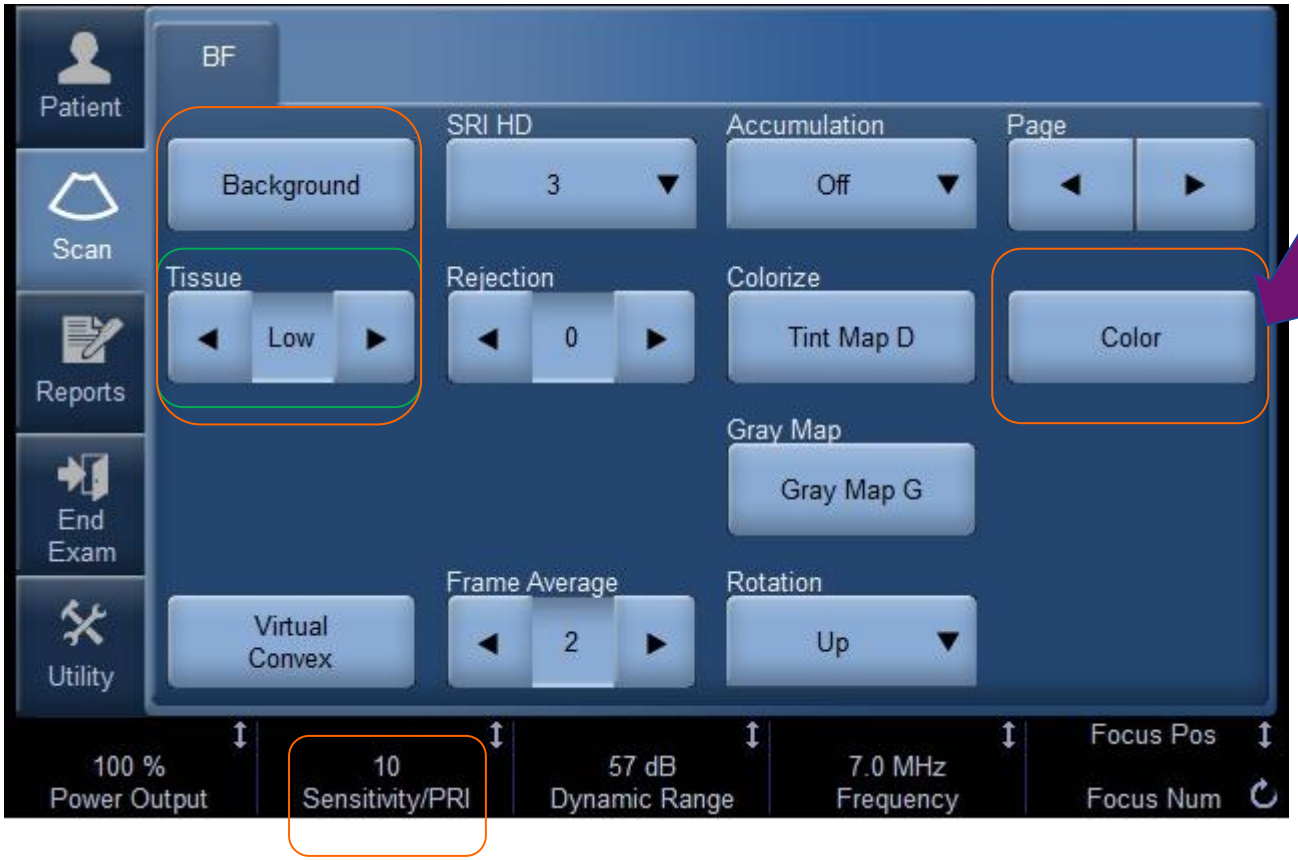
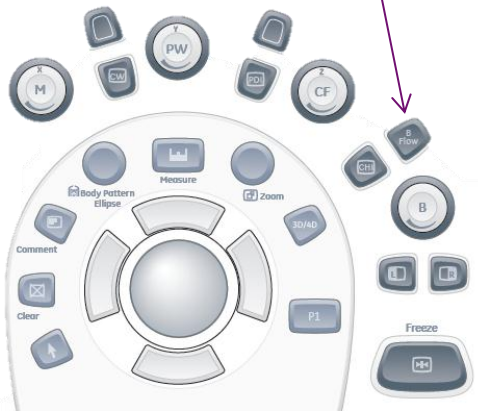
Acquisition Technologies
B-Flow user interface



B-Flow
B-Flow Color
switch



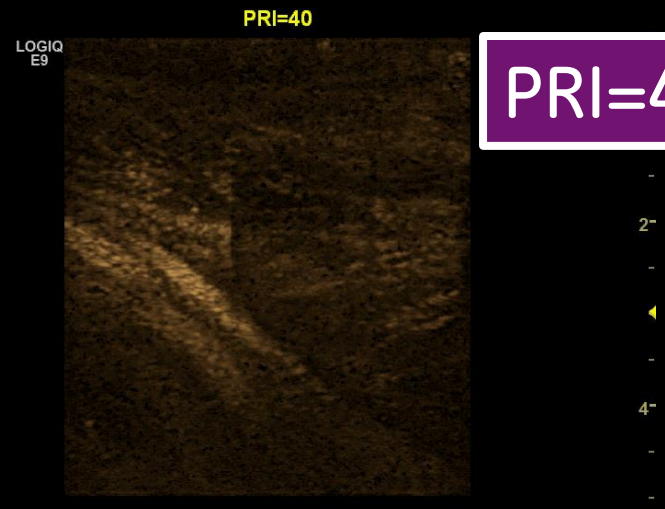
Supported Probes: C1-6-D, 9L-D, ML6-15-D, L8-18i-D

Acquisition Technologies

Pulse repetition interval

PRI=6

PRI=22



PRI=40

↑ for small vessels or slow flow states

↓ for high flow states or to reduce flash

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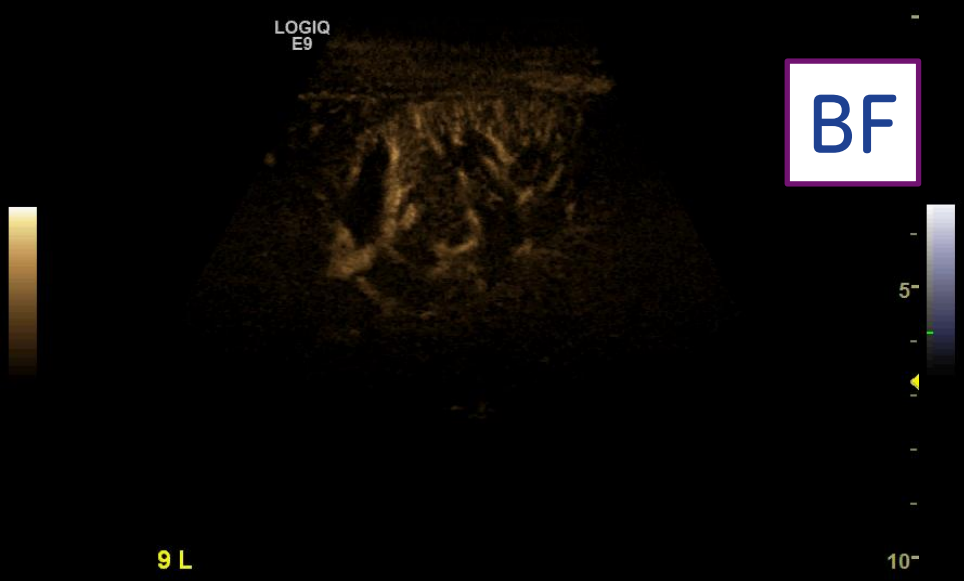
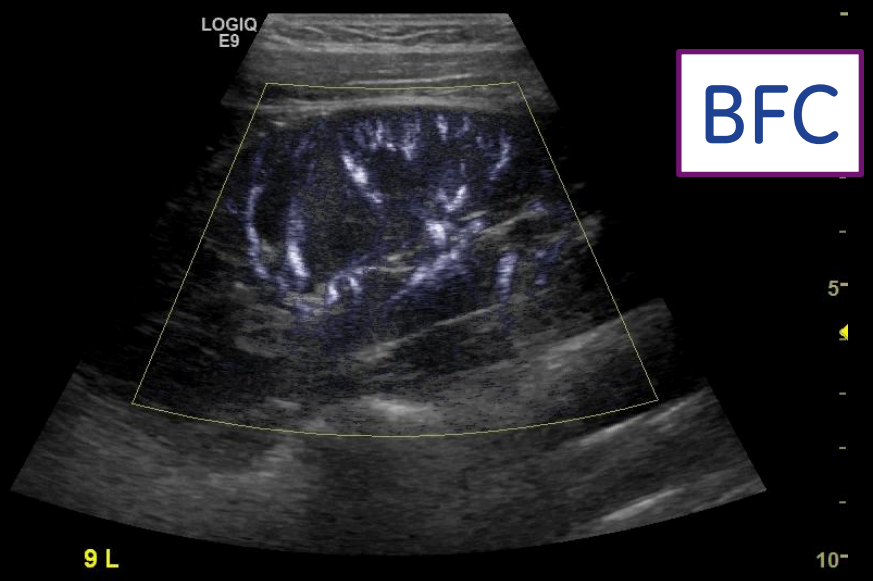
Acquisition Technologies
Wideband PDI using Codes

Compared to PDI, B-Flow Color
- Helps improve spatial resolution
- Helps improve temporal resolution



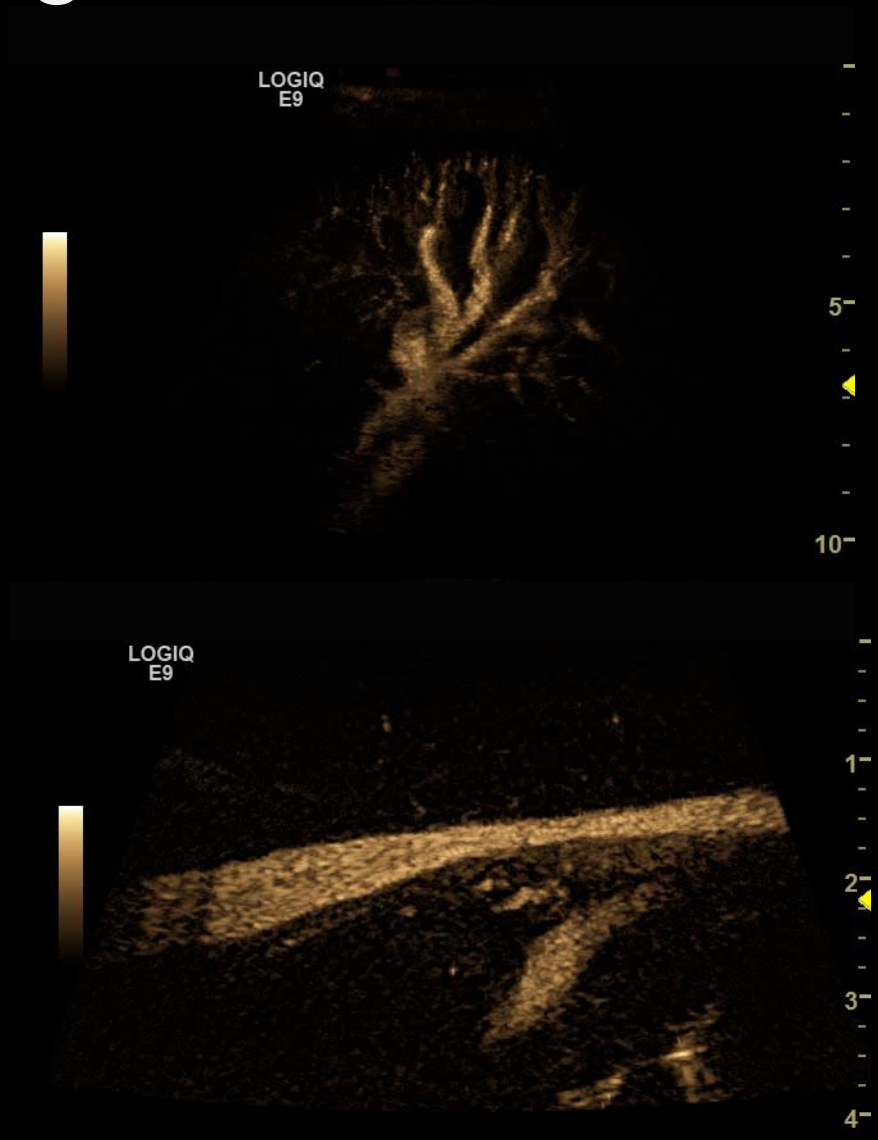


imagination at work

Acquisition Technologies

B-Flow summary

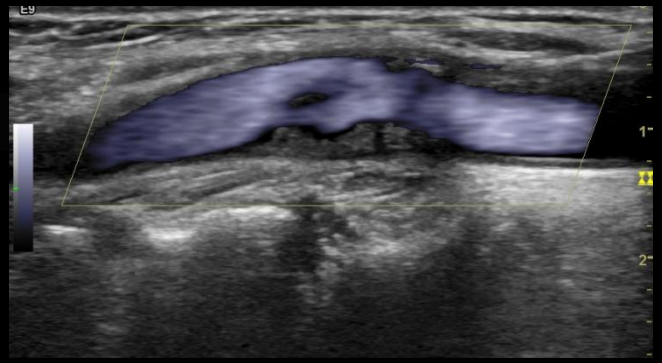
- Clinical Advantages
  - Increased Sensitivity as compared to PDI
  - No ROI needed
  - True hemodynamics
  - No angle dependence
- Clinical Uses
  - High grade stenosis
  - Soft Plaque
  - Perfusion, small vessel identification
  - Early thrombus/DVT
- Challenges
  - Background tissue not easily visualized
  - Flash artifact from tissue motion
  - Penetration limits



imagination at work

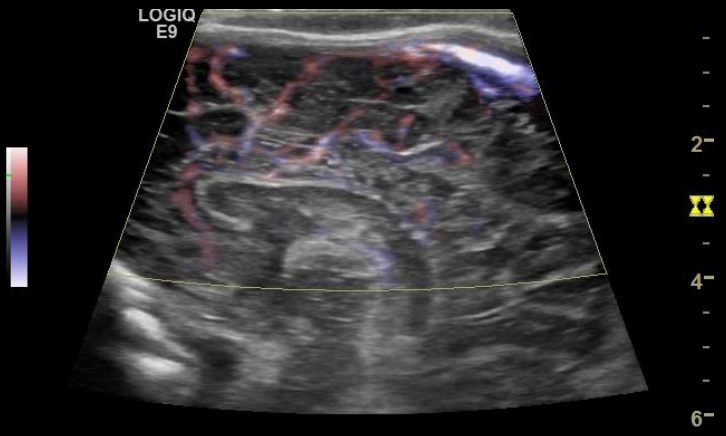
"All above comparisons are to LOGIQ E9 BT11"

Acquisition Technologies
B-Flow Color summary



- Clinical Advantages
  - Dynamic Flow appearance
  - High Frame rate
  - Clear Background tissue with vessel hemodynamics
- Clinical Uses
  - High Grade stenosis
  - Soft Plaque
  - Early Thrombus formation
  - Aneurysm
  - Access graft
  - Perfusion in Placenta, Spleen, and Kidney

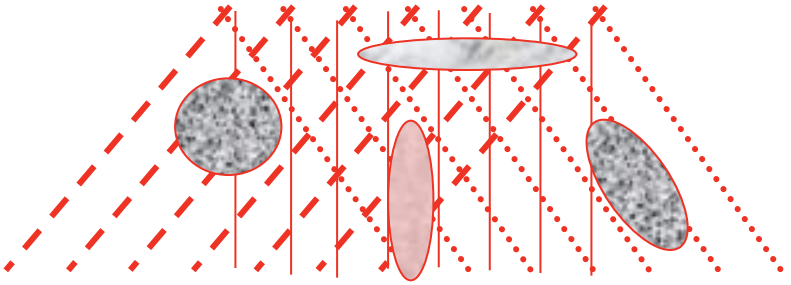
Challenges
- Tissue vibration,
- Penetration Limits
- ROI angle, BFC is less angle dependent than PDI or CF



imagination at work

"All above comparisons are to LOGIQ E9 BT11"

Acquisition Technologies
CrossXBeam

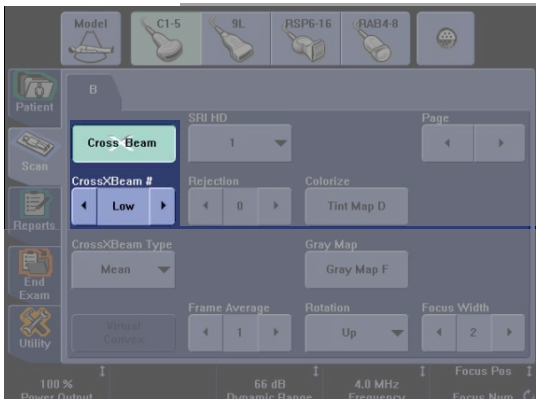


What it is:

Multiple co-planar images from different angles combined into a single image in real time

Why it works:

Successive frames help average out noise and smooth borders



Acquisition Technologies
CrossXBeam

Results:

Helps improve Border definition

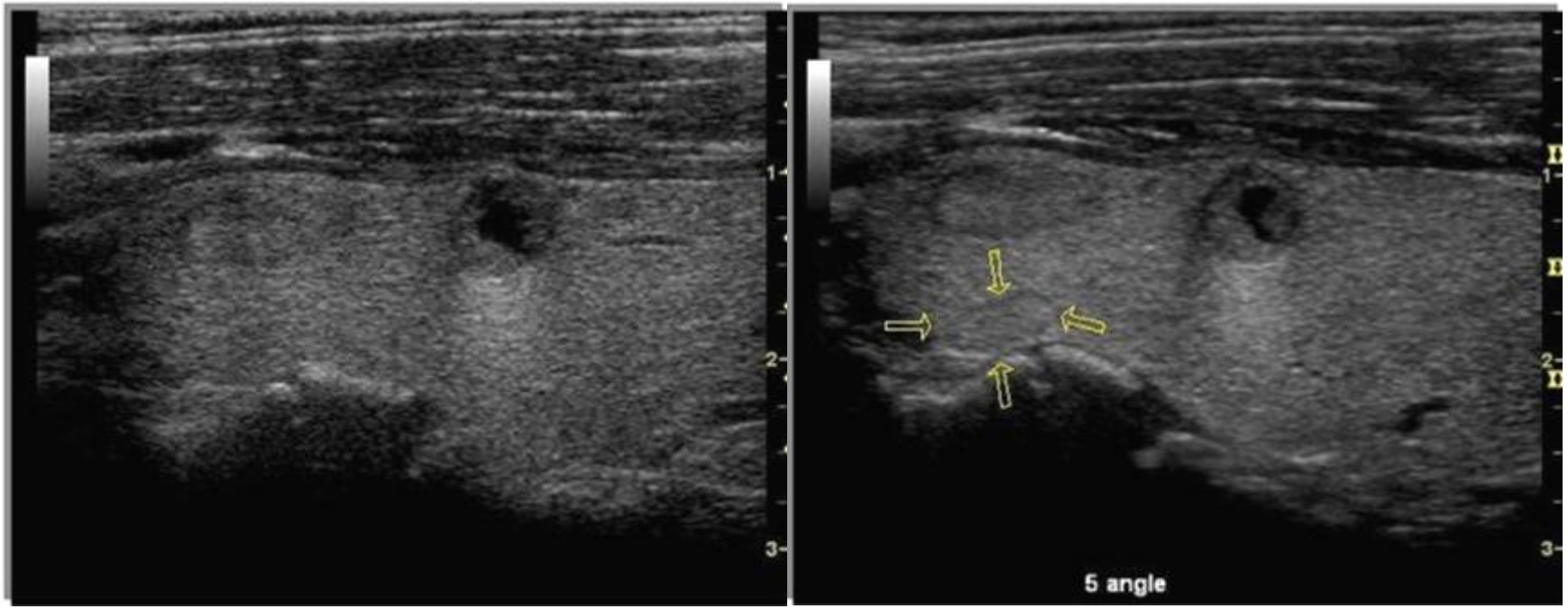
Helps improve Contrast resolution

Helps reduce Angular dependence of border or edge

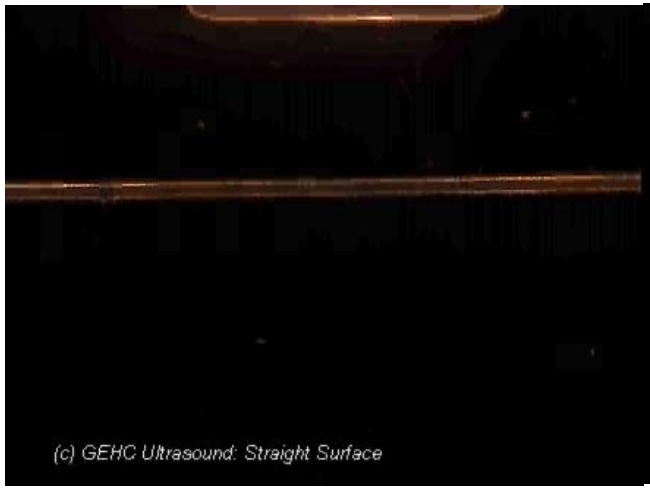
Helps reduce Speckle / Clutter

Helps increase visualization of biopsy needles

Acquisition Technologies
CrossXBeam – Benefits

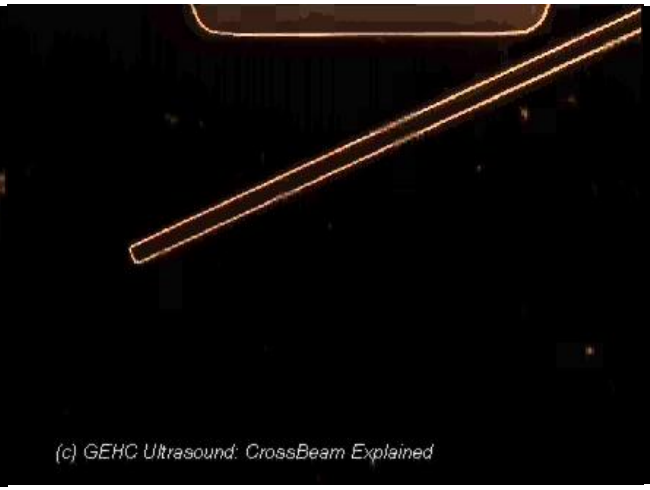


Acquisition Technologies
CrossXBeam – Visualizing Transmit



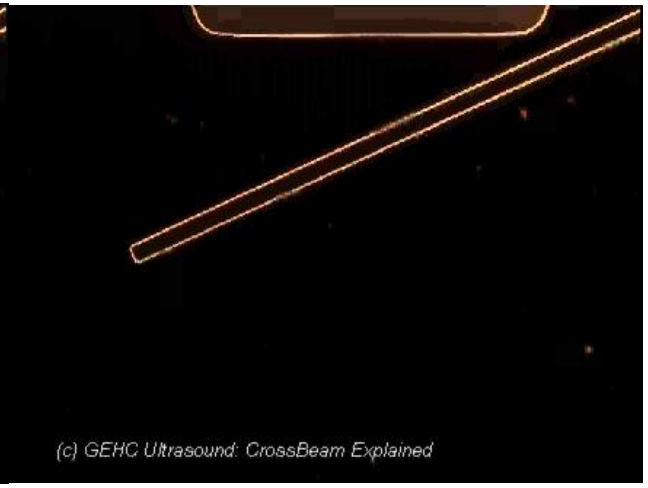
Straight Fire on
straight structure

Echo Reaches
probe



Straight Fire on
Angled structure

Echo Misses
probe



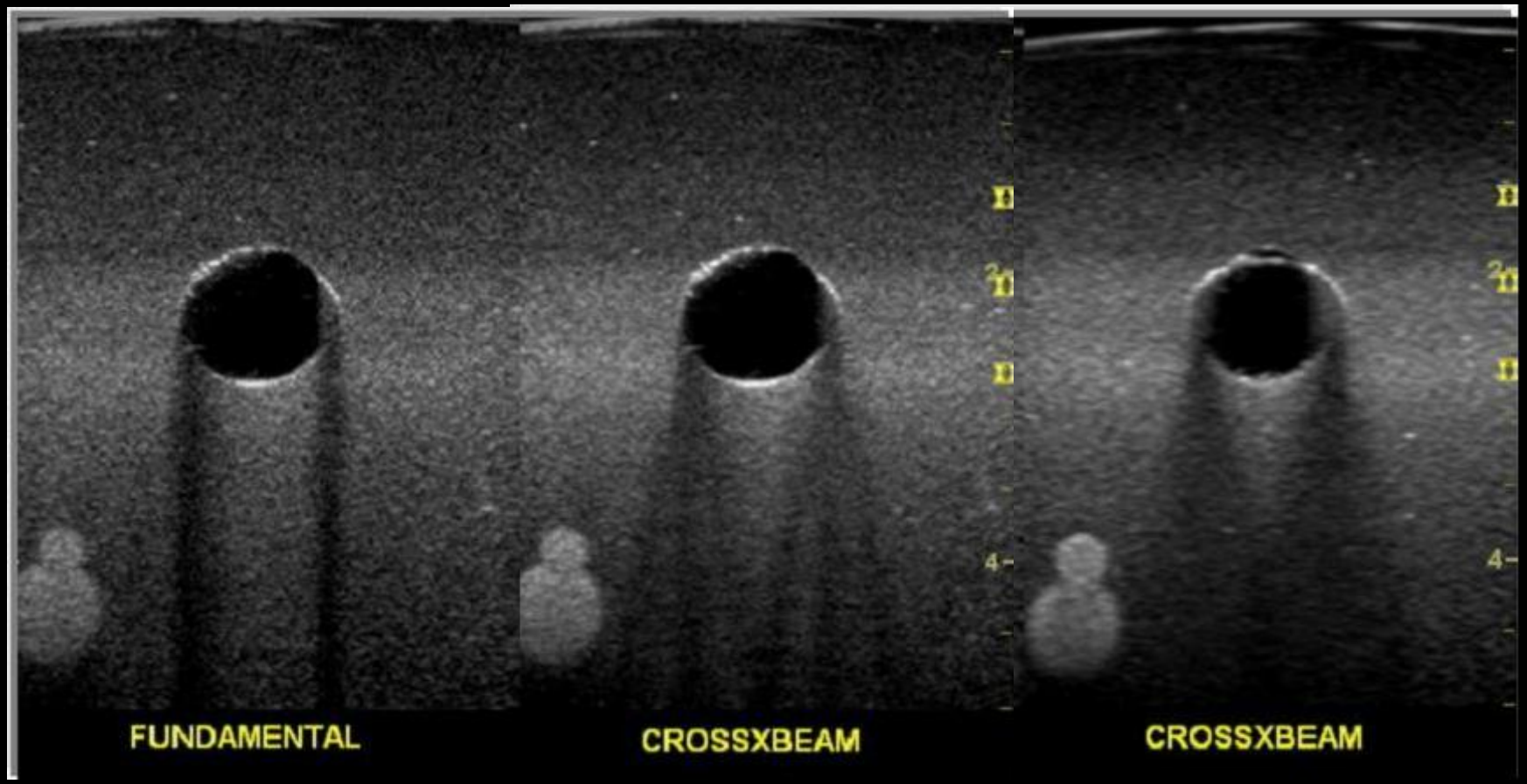
Angled Fire on
Angled structure

Echo Reaches
probe

Acquisition Technologies

CrossXBeam

off | 3 angles | 7 angles



imagination at work

Acquisition Technologies
Speed of Sound

What it is:

An additional control to help optimize image resolution

In applications where tissue types are diverse, it allows the user to choose settings that are well suited for that particular patient

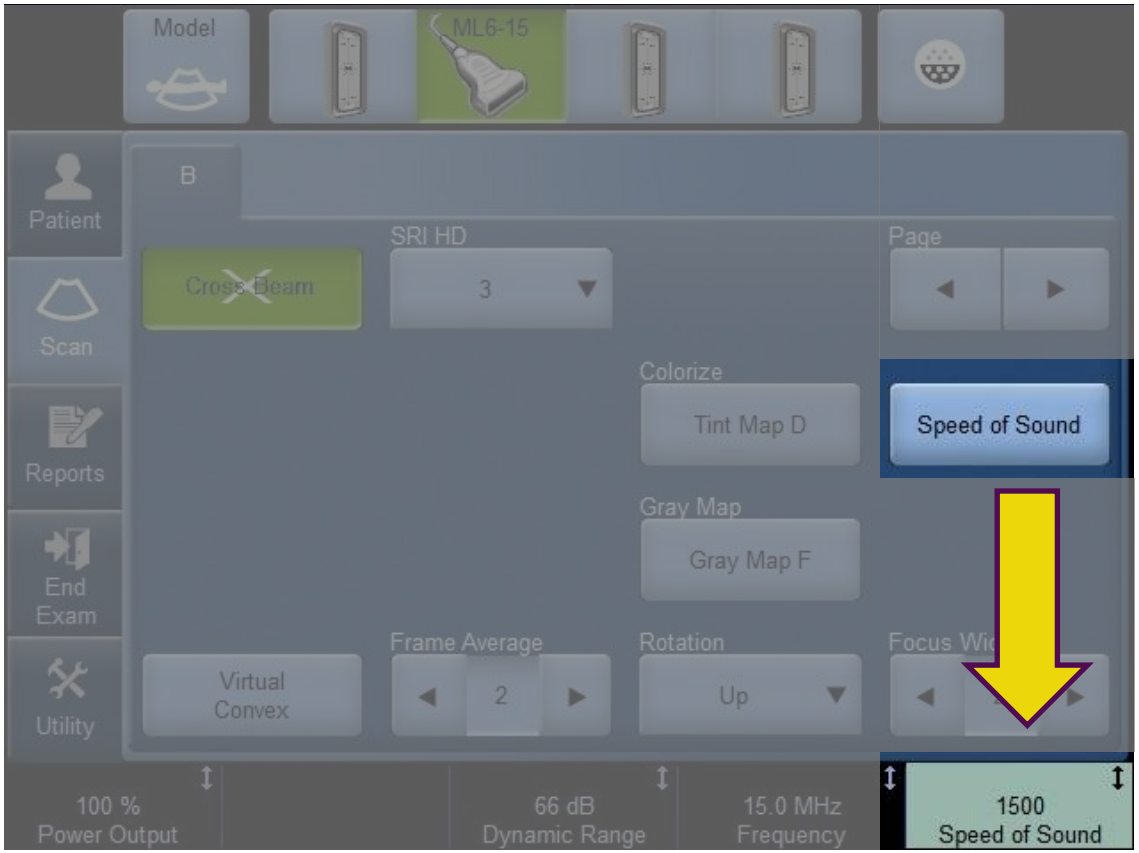
Clinical impacts:

Adjusting the speed of sound can help improve:

- Resolution
  - A sharp image, especially in breast
- Signal-to-Noise
  - Adjustable focusing helps improve SNR

Acquisition Technologies
Speed of Sound Applications

- Breast
- Abdomen
- Abdomen 2
- Renal



Acquisition Technologies

Speed of Sound breast example

1420 m/s has enhanced contrast & resolution in this case

imagination at work

Acquisition Technologies
Speed of Sound

Breast

Useful to help handle a variety of breast types

Fatty tissue tends to image better at low speed of sound

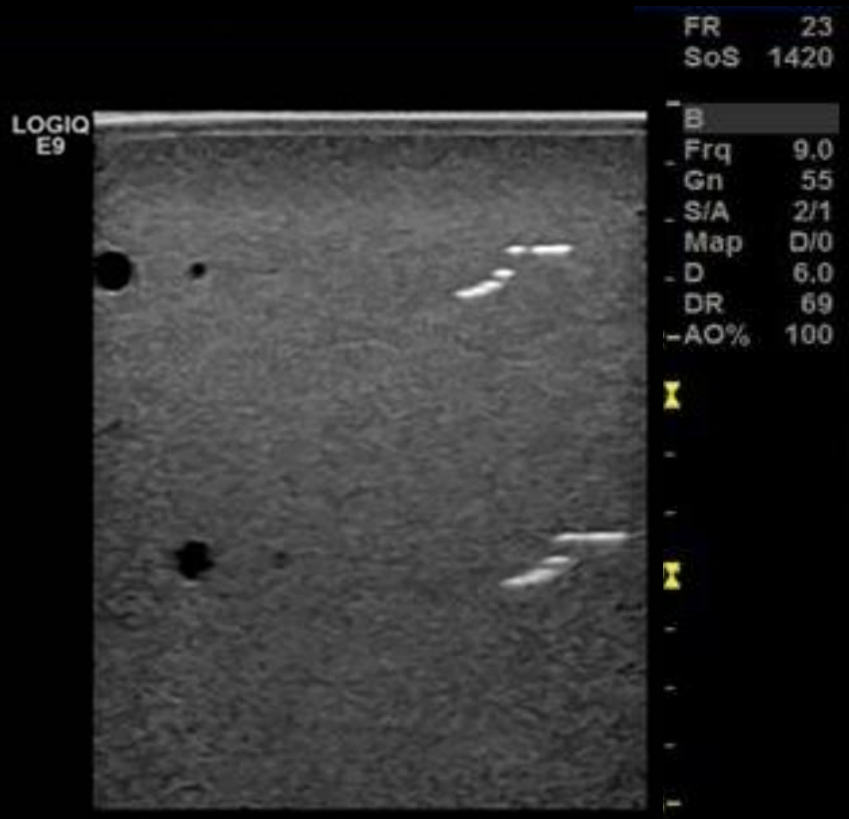
Dense tissue tends to image better close to 1500/1540

Default is 1500

Liver

Available, but unlikely to offer significant benefit

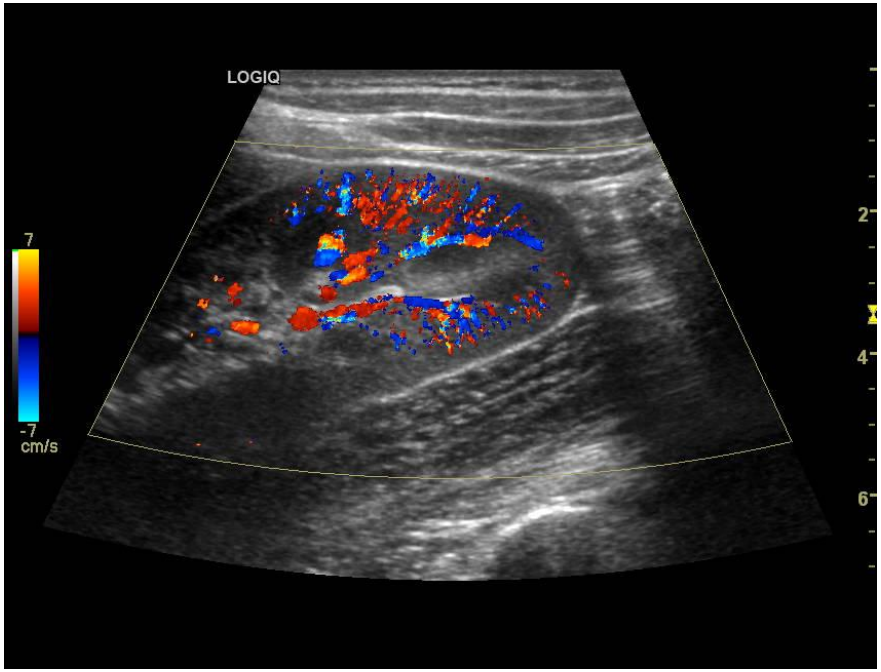
Acquisition Technologies
Speed of Sound



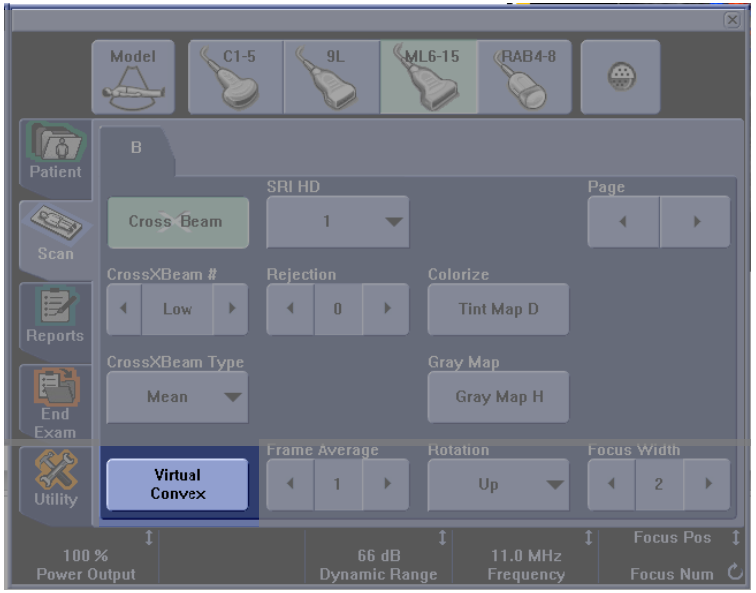
imagination at work

Acquisition Technologies
Virtual Convex

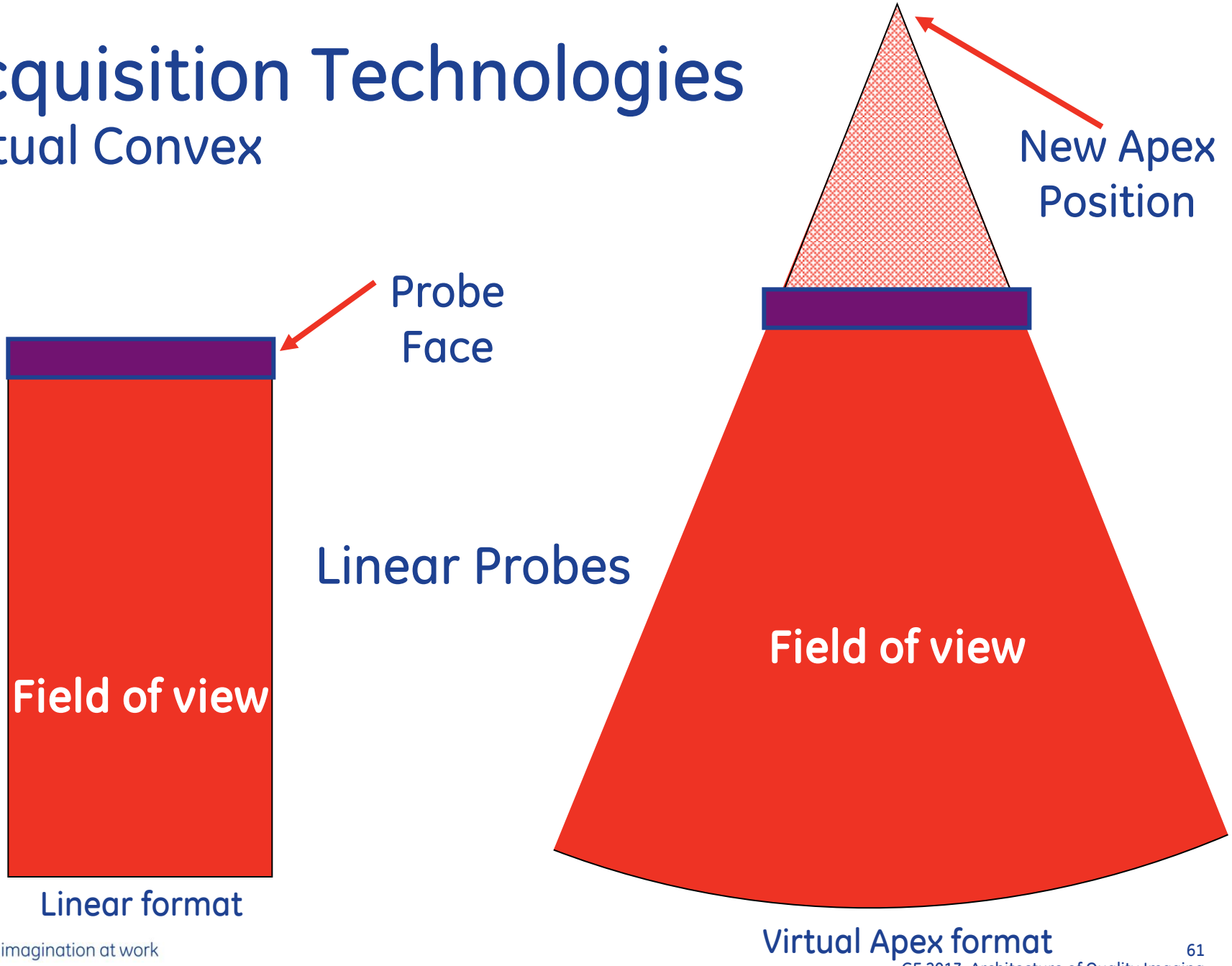
Expands the field of view of linear array probes



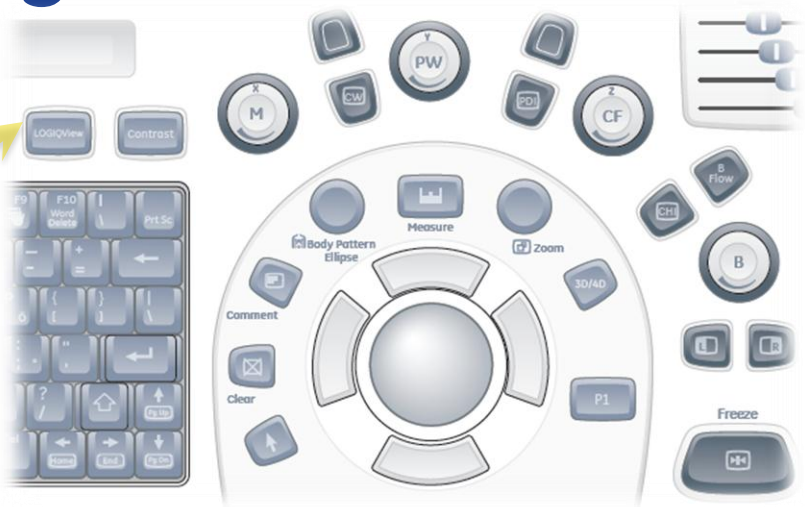
Available on the B mode tab for linear array transducers



Acquisition Technologies
Virtual Convex



Acquisition Technologies
LOGIQView

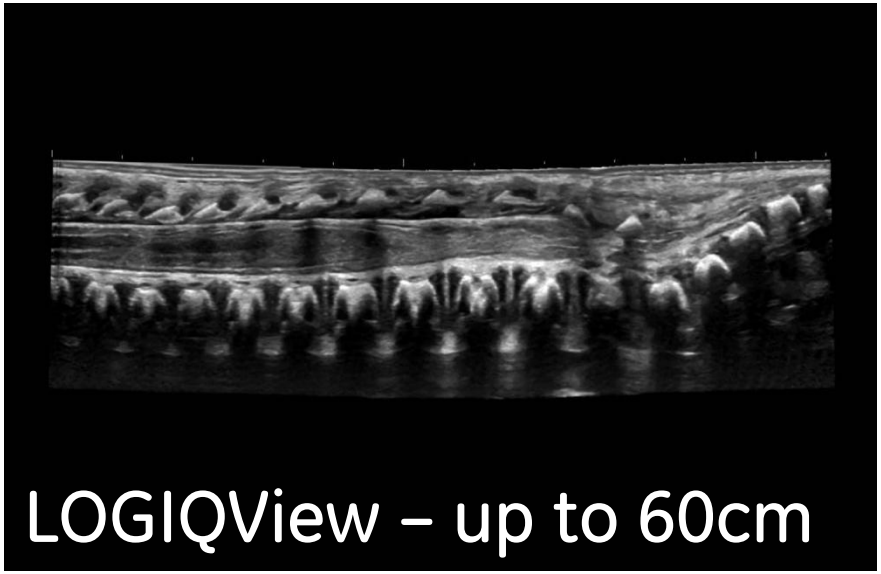


What is it?

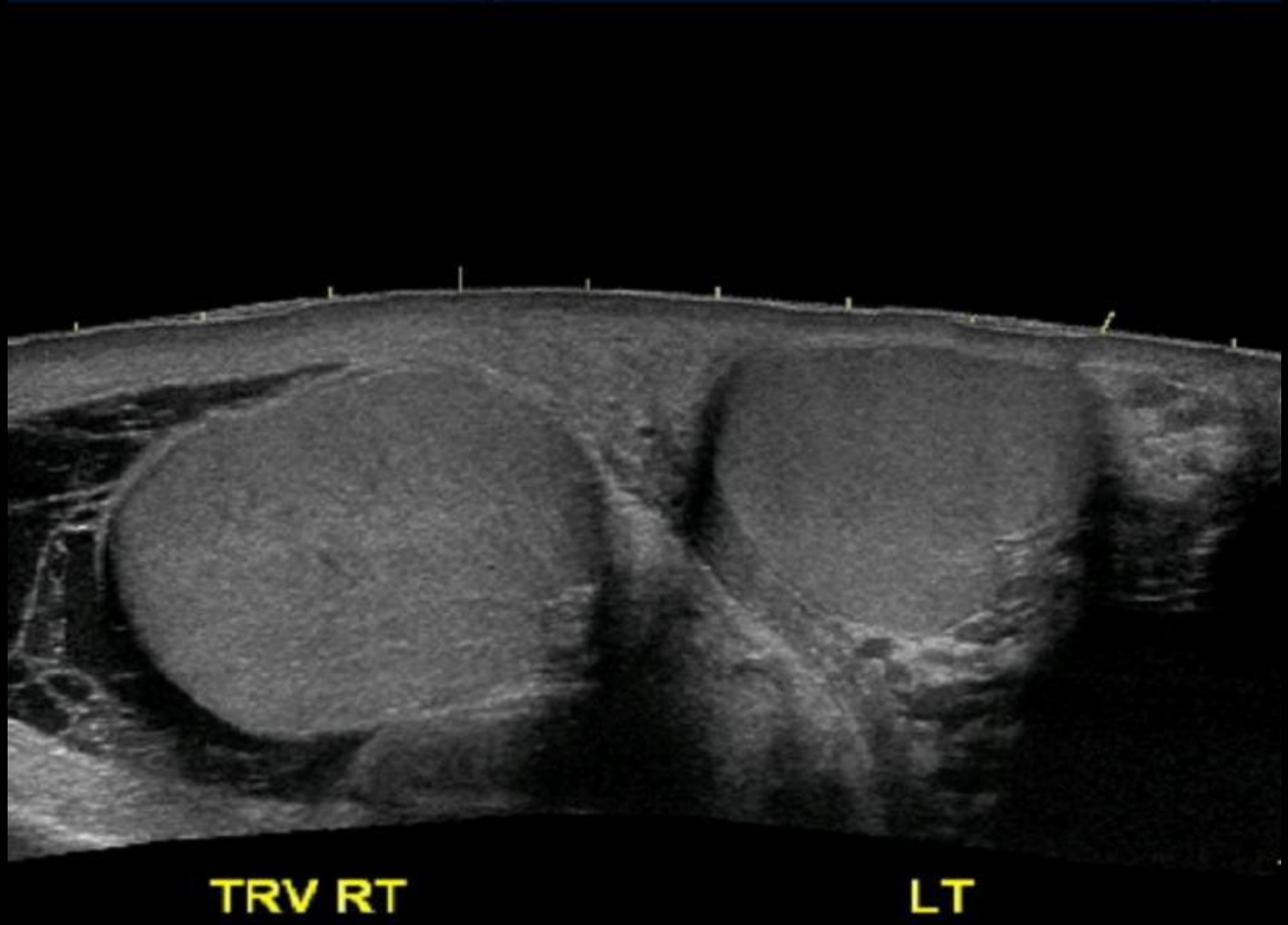
- Move the probe along the anatomy and create an image with a large field of view

Benefits

- Enhanced demonstration of anatomical relationships
- Ability to measure large structures



imagination at work



Post-Acquisition Technologies

Raw Data

Speckle Reduction Imaging

Post-Acquisition Technologies

Raw Data

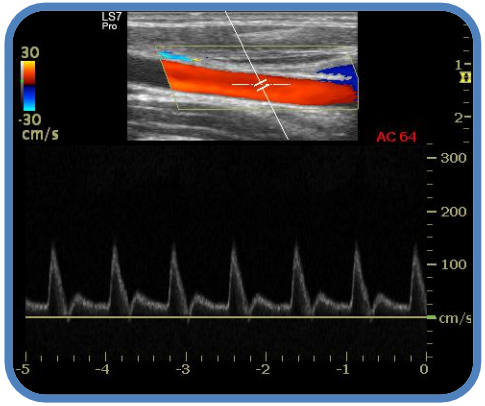
Raw data capture enables you to build a thorough exam while helping reduce scan time. This **proprietary raw data format** from GE Healthcare captures data earlier in the image processing chain enabling users to make changes to the data during or even after the exam has ended.

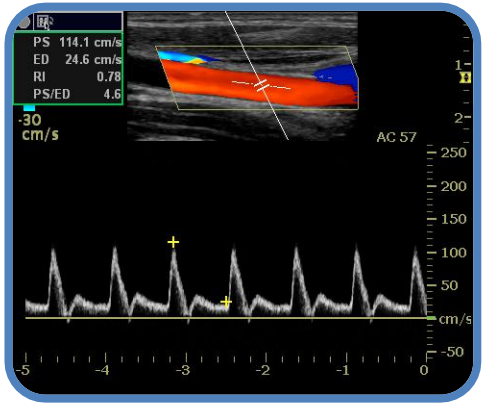
imagination at work

Post-Acquisition Technologies

Raw Data

Original Acoustic Data are stored before Scan Converting in a GE "Raw" Format to be easily accessed and re-processed any time after the exam completion.





Highlights:

Helps optimize sub-optimal studies.

Measurements can be re-done and reports regenerated

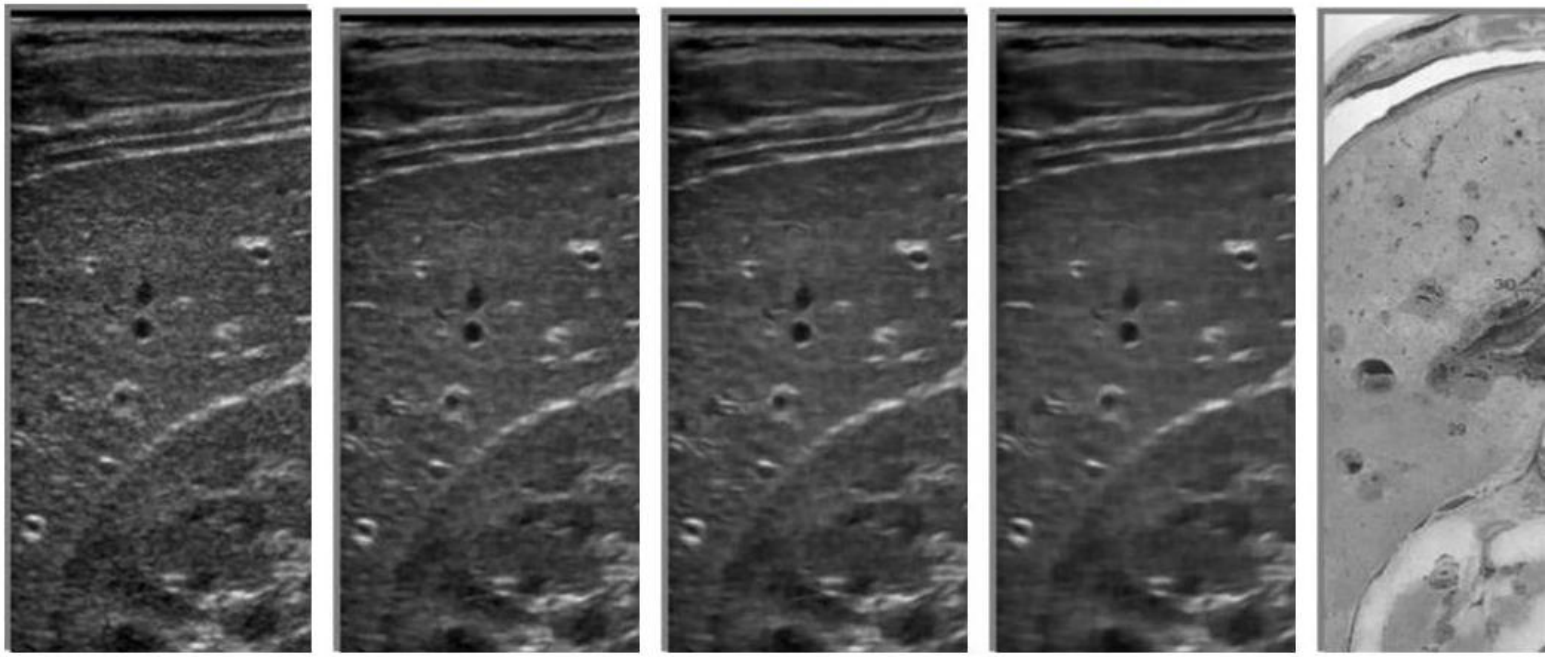
Imaging control parameters can be changed, such as:

- B-Mode: Gain, DR, Zoom, SRI…
- CFM: Gain, Threshold, DualView, DR…
- PW: Baseline, Invert, Angle, DR, Gain…

Post-Acquisition Technologies
Speckle reduction imaging

Adaptive, real-time software algorithm

min ⟵ ⟶ max



GE imagination at work

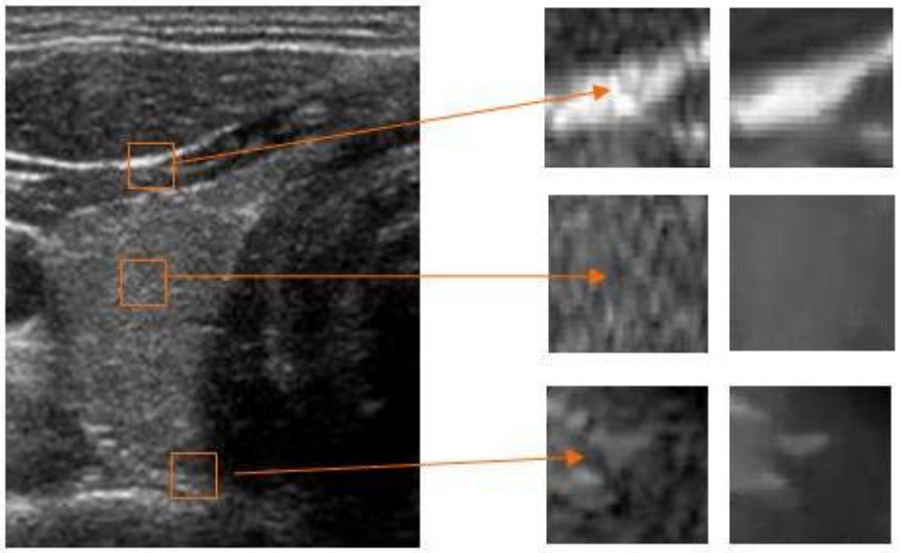
Post-Acquisition Technologies
Speckle reduction imaging

Adaptive, real-time software algorithm

Preserves borders where echogenicity differences occur

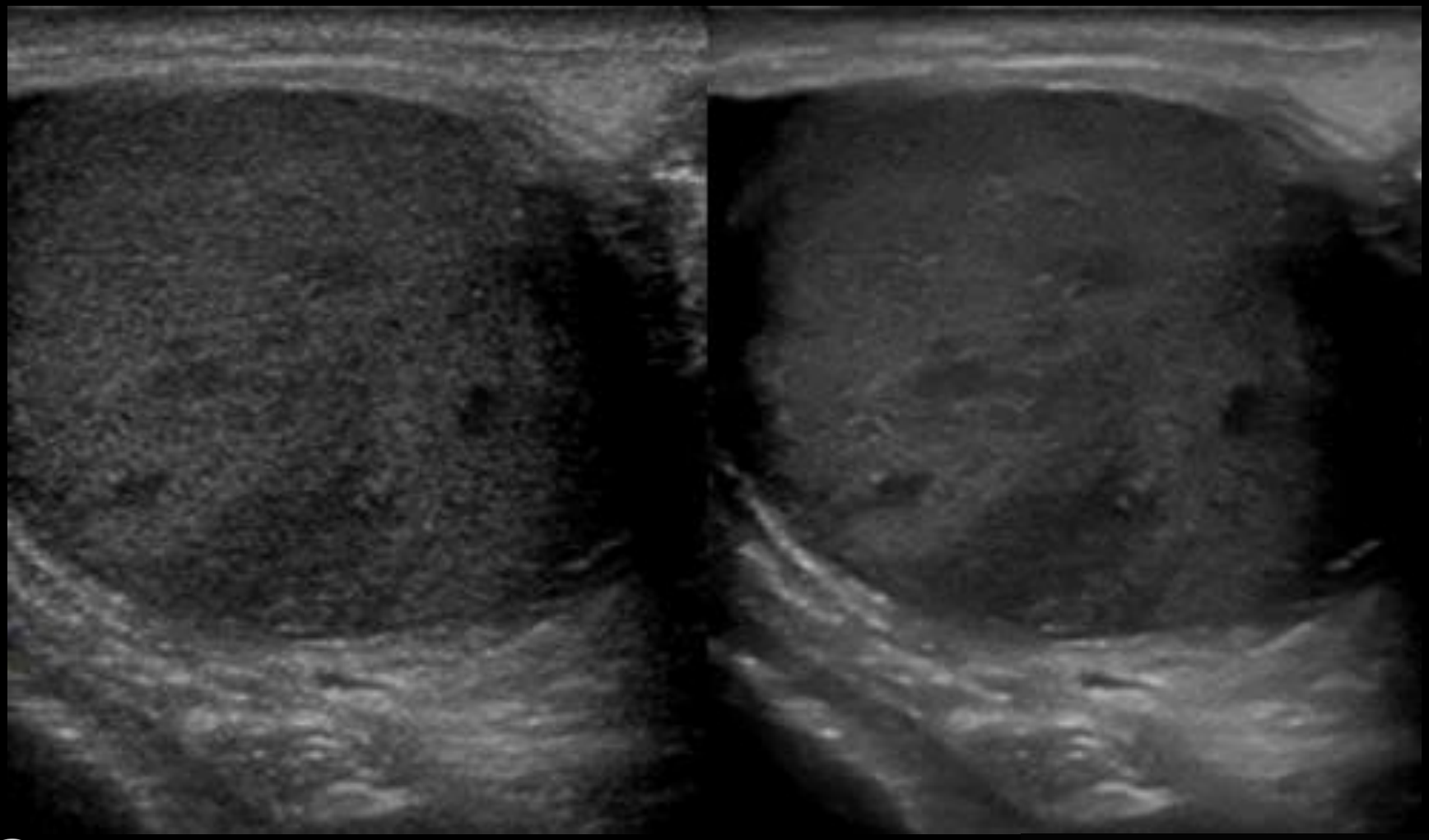
Smoothes the image where there is no border or edge

Algorithm does not create structures but rather allows user to see the underlying anatomy



Post-Acquisition Technologies

Speckle reduction imaging



imagination at work

Architecture of Quality Imaging

Thank You!

imagination at work