Lesson 06:
Pulse-echo Imaging and Display Modes

This lesson contains 22 slides plus 15 multiple-choice questions.

Accompanying text for the slides in this lesson can be found on pages 26 through 32 in the textbook:
ULTRASOUND IMAGING AND INSTRUMENTATION
now this is a diagram of a pulse-echo imaging system. it shows the flow of information from the beam former to the transducer to the timing, then to the receiver, and finally to the image storage, display, and record. it includes stages like rectification, amplification, compensation, demodulation, compression, rejection, scan conversion, preprocessing, postprocessing, and magnification. the diagram also shows the flow of voltage and sound.
TRANSDUCER EXCITATION AND OUTPUT POWER
TIMING

PRF

>1000 Hz
RECEIVER

BEAM FORMER ➔ TRANSUDCER ➔ RECEIVER ➔ IMAGE STORAGE ➔ DISPLAY ➔ RECORD

TGC
GAIN
MASTER GAIN
OVERALL GAIN
TIME GAIN COMPENSATION
TGC

INCORRECT SETTINGS
DYNAMIC RANGE

- BEAM FORMER
- TIMING
- IMAGE STORAGE
- DISPLAY
- RECORD
- TRANSUDCER
- RECEIVER

DYNAMIC RANGE

- COMPRESSION
- LOG COMPRESSION
- COMPRESS
DYNAMIC RANGE

50 dB

30 dB
NOISE REDUCTION
REJECT

BEFORE REJECT

AFTER REJECT

low-level echoes (noise)

anechoic
NOISE REDUCTION

• Frame averaging (persistence)
• Frequency compounding
• Spatial compounding
A wave whose frequency is a whole-number multiple of that of another
DISPLAY MODES

A-mode (A-scan)  B-mode  M-mode (TM-mode)

SKIN →

DEPTH ↓

TIME →
2D & M-mode

B-SCAN (2-D)

M-MODE
B-scan
B-scanner
PATIENT-ORIENTED B-SCAN PLANES

1 - Sagittal (longitudinal)
2 - Coronal
3 - Transverse (axial)
ORGAN-ORIENTED B-SCAN PLANES

1 - Short axis
2 - Long axis
3 - Apical, four-chamber
B-SCAN WITH A-SCAN

OPHTHALMIC IMAGE
OBSTETRICAL IMAGES

2D

3D
Answers to the following FIFTEEN practice questions were derived from material in the textbook:
Question 1

Which of the following controls is part of the receiver in a pulse-echo ultrasound system?

- BRIGHTNESS
- XMTR PWR
- RES
- TGC
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- BRIGHTNESS
- XMTR PWR
- RES
- TGC
What is measured to determine the sensitivity of an ultrasound system?

- duty factor
- strongest echoes that are received
- weakest echoes that are received
- bandwidth
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- duty factor
- strongest echoes that are received
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- bandwidth
What occurs if the **OVERALL GAIN** is decreased?

- only the brightness of the near echoes will decrease
- the energy to the patient is decreased
- the brightness of all echoes will decrease equally
- only the brightness of the far echoes will decrease
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- only the brightness of the near echoes will decrease
- the energy to the patient is decreased
- the brightness of all echoes will decrease equally
- only the brightness of the far echoes will decrease
What should a sonographer do if the ultrasound system displays only the echoes from strong reflectors and nothing else?

- decrease the output power
- increase the overall gain
- decrease the slope of the TGC
- adjust the far gain
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- decrease the output power
- increase the overall gain
- decrease the slope of the TGC
- adjust the far gain
What is the name of the control that is used to suppress unwanted, low level echoes or background information?

- TGC
- DYNAMIC RANGE
- REJECT
- WRITE MAGNIFICATION
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Question 6

How might electrical interference appear in an image?

- shadowing behind a poorly attenuating structure
- low-level echoes within a cyst
- enhancement behind a highly reflective structure
- a loss of axial resolution
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Question 7

Which receiver dynamic range provides the best opportunity for the display of a wide range of gray shades?

- 60 dB
- 9 dB
- 3 dB
- 0 dB
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Why is compression used in the receiver of an ultrasound system?

- to reduce the range of signal amplitudes
- to increase the range of signal amplitudes
- to reduce the sound energy entering the patient
- to increase the sound energy entering the patient
Why is compression used in the receiver of an ultrasound system?

- to reduce the range of signal amplitudes
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- to reduce the sound energy entering the patient
- to increase the sound energy entering the patient
What is the function of the **OUTPUT** control in a pulse-echo ultrasound system?

- control the amount of amplification in the receiver
- vary the dynamic range in the receiver
- vary the beamformer’s voltage to the transducer
- correct poor axial resolution
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Question 10

What will not be affected by the **OUTPUT** control in a pulse-echo system?

- excitation voltage that is applied to the transducer
- frequency of the sound that leaves the transducer
- energy that enters the patient
- amount of energy leaving a transducer
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- excitation voltage that is applied to the transducer
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- energy that enters the patient
- amount of energy leaving a transducer
From a safety standpoint, which one of the following methods is best?

- Low transmitter output and high receiver gain
- High near gain and low far gain
- High reject and high transmitter output
- High transmitter output and low receiver gain
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- Low transmitter output and high receiver gain
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- High reject and high transmitter output
- High transmitter output and low receiver gain
What does the dynamic range of the receiver of an ultrasound system refer to?

- range of echo signal frequencies that can be processed without distortion
- speed with which the receiver recovers following the excitation pulse to the transducer
- depth range in tissue over which moving echoes can be received
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Which of the following results in an increased acoustic exposure to the patient?

- application of reject
- increase in the television monitor brightness
- increase in the beamformer voltage to the transducer
- increase in the overall gain
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Which of the following is an amplitude-modulated display, based on the amplitude of received echoes?

- A mode
- B mode
- B scan
- M mode
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Why are A-mode echoes higher when the gain of a pulse-echo system is increased?

- the amount of emitted sound increases
- the amount of reflected sound increases
- amplification in the receiver increases
- amplification in the receiver decreases
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END OF LESSON 06

For information on the accompanying textbook, visit the Website:

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