



Course title: Application of Ultrasound in Diagnostic Imaging

Topic: Ultrasound Basics

1. _____ is measured in Hertz (Hz) and denotes the oscillation count per second.
(A): frequency
(B): velocity
(C): intensity
(D): wavelength
2. _____ involves a change in direction of the sound wave.
(A): Refraction
(B): Absorption
(C): Diffraction
(D): Attenuation
3. _____ functions as a generator and a detector of ultrasonic waves.
(A): Ultrasound transducer
(B): TFT
(C): Ionizing chamber
(D): Gradient coil
4. _____ are generated by systematically combining a multitude of A-mode (1-D) scans into a single 2-D image.
(A): Amplitude mode images
(B): B-mode images
(C): M-mode images
(D): Grayscale images
5. Which of the following modality **does not** use ionizing radiation?
(A): Radiography
(B): Ultrasound
(C): Computed Tomography
(D): Mammography

Topic: Strategies for Hardware Reduction on the Design of Portable Ultrasound Imaging Systems

6. The _____ have demonstrated to be an effective method for minimizing the size of the ultrasonic imaging systems and accelerating the image acquisition processes.
(A): PACS machines
(B): Step-up transformers
(C): Synthetic Aperture techniques (SAFT)
(D): none of the above
7. Conventional SAFT techniques are based on the sequential activation in emission and reception of every _____.
(A): transducer element
(B): ionizing chamber
(C): CR cassette
(D): none of the above
8. Once all _____ have been stored in memory, a beamforming process is applied in a post-processing stage in order to focus the image dynamically in emission and reception, obtaining the maximum quality at each image pixel.
(A): radiation signals
(B): radionuclides
(C): magnetic waves
(D): acoustic signals

9. Which of the following is an inconvenience of conventional SAFT techniques?

- (A): Artifacts
- (B): Low contrast
- (C): Medium penetration
- (D): all of the above

10. In total Focusing Method (TFM) each array element is sequentially used as a single emitter and all array elements are used as receivers.

- (A): True
- (B): False

11. A hardware reduction in ultrasonic imaging systems involves which of the following aspect?

- (A): Optimization of the acquisition strategies to achieve the completeness of the coarray with a minimum number of hardware elements
- (B): Use of pulse compression techniques to overcome the reduced capability of penetration when emission is limited to one element
- (C): Development of GPGPU1 parallel beamforming techniques to achieve real time imaging
- (D): all of the above

12. The ultrasonic imaging systems based on the pulse/echo aperture model is known as _____.

- (A): fluoroscopy
- (B): coarray
- (C): subtraction
- (D): none of the above

13. Coarray analysis identifies which emitter-receiver combination completes each of its elements.

- (A): True
- (B): False

14. 2R-SAFT technique has some particular advantages that make it very useful for ultrasonic imaging systems that uses only one element to transmit and _____ elements to receive.

- (A): one
- (B): two
- (C): three
- (D): four

15. Which of the following can help to improve the dynamic range and SNR, in order to achieve an image quality comparable to that of Total Focusing Method?

- (A): use of ionizing chamber
- (B): applying 3D construction software
- (C): pulse coding based on Golay codes
- (D): none of the above

16. Golay complementary pairs have been widely used for transducer excitation because the sum of its auto-correlation function has a main peak and zero side-lobes.

- (A): True
- (B): False

17. One of the major drawbacks of Golay codes is that _____ shots are needed for each emitting element in order to complete both A and B codes respectively.

- (A): two
- (B): three
- (C): four
- (D): five

18. The general ultrasonic imaging systems are composed by which of the following parts?

- (A): The array or probe
- (B): Acquisition subsystem
- (C): Image generation subsystem
- (D): all of the above

19. All the acquisition process is managed by a hardware control system which is located in a _____.

- (A): transducer
- (B): field-programmable gate array (FPGA)
- (C): imaging screen
- (D): anode tube

20. Now the software imaging system requires a smaller memory and an additional decoding stage, where the complete set of signals is deconvolved, generating a $2N - 8$ data set.

- (A): True
- (B): False

21. All time-domain imaging algorithms are based on the principle of _____.

- (A): inverse square law
- (B): line focus
- (C): delay-and-sum beamforming
- (D): Ohm's law

22. The final step in the ultrasonic generation process is to obtain the _____ which contribute to a given spatial point.

- (A): accumulated sum of all the signals samples
- (B): patient radiation dose
- (C): total occupational exposure
- (D): 3D software data

Topic: Speckle Noise Reduction in Medical Ultrasound Images

23. Which of the following are shortcomings of ultrasound imaging in medical diagnosis?

- (A): acquisition noise from the equipment
- (B): ambient noise from the environment
- (C): presence of background tissue, other organs, body fat, and breathing motion
- (D): all of the above

24. Ultrasound is a sound wave with a frequency that exceeds 20 kHz.

- (A): True
- (B): False

25. Ultrasound technique is mainly based on measuring the _____ transmitted back from a medium when sending an ultrasound wave to it.

- (A): scattered radiation
- (B): echoes
- (C): radionuclides emission
- (D): magnetic signals

26. In the echo impulse ultrasound technique, the ultrasound wave interacts with tissue and some of the transmitted energy returns to the _____ to be detected by the instrument.

- (A): ionizing chamber
- (B): transducer
- (C): anode
- (D): cathode

27. Which of the following superficial structures are imaged at a higher frequency (7- 18 MHz)?

- (A): muscles and tendons
- (B): testes and breast
- (C): neonatal brain
- (D): all of the above

28. Deeper structures such as liver and kidney are imaged at a lower frequency 1-6 MHz with lower axial and lateral resolution but greater penetration.

- (A): True
- (B): False

29. The usefulness of ultrasound imaging is degraded by the presence of signal dependent noise known as _____.
- (A): quantum mottle
 - (B): thermal motion
 - (C): speckle
 - (D): reconstruction kernel
30. Speckle noise is an inherent property of medical ultrasound imaging and because of this noise the _____ and _____ contrast become reduced, which effects the diagnostic value of this imaging modality.
- (A): occupational dose
 - (B): background radiation
 - (C): image resolution
 - (D): source to image distance (SID)
31. In ultrasound images, the noise content is multiplicative and _____.
- (A): non-systematic
 - (B): non-Gaussian
 - (C): radiopaque
 - (D): transferable
32. Which of the following statistical parameters are used for image quality assessment in ultrasound?
- (A): Signal to Noise Ratio (SNR)
 - (B): Correlation Coefficient (CC)
 - (C): Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR)
 - (D): all of the above
33. The _____ compares the level of desired signal to the level of background noise.
- (A): histogram
 - (B): signal to noise ratio
 - (C): H and D chart
 - (D): stochastic curve
34. *Correlation Coefficient* represents the strength and direction of a linear relationship between two variates.
- (A): True
 - (B): False
35. Speckle reducing filters are originated from the _____.
- (A): aluminum filters
 - (B): lead based collimators
 - (C): synthetic aperture radar community
 - (D): none of the above
36. The spatial filter acts on an image by smoothing it; that is, it reduces the intensity variation between adjacent _____.
- (A): radio coils
 - (B): ionizing chambers
 - (C): pixels
 - (D): matrix
37. The main disadvantage of Lee filter is that, it tends to ignore speckle noise in the area closest to _____.
- (A): edges and lines
 - (B): centers
 - (C): deep tissues
 - (D): superficial structures
38. The primary goal of speckle reduction is to remove the speckle without losing much detail contained in an image.
- (A): True
 - (B): False

39. Wavelet transforms are classified into which of the following?

- (A): continuous wavelet transform (CWT)
- (B): discrete wavelet transform
- (C): signal to noise ratio (SNR)
- (D): both A and B

40. Gaussian probability density is often used in _____.

- (A): histograms
- (B): image filtering
- (C): shadow shielding
- (D): 3D software

41. Usually, medical ultrasound images are affected by the mixed noise, which is the combination of speckle noise and Gaussian noise.

- (A): True
- (B): False

Topic: 3D Ultrasound Imaging in Image-Guided Intervention

42. Today, image-guided procedures make use of _____ to provide real-time three-dimensional (3D) information of the anatomy of the patient being treated.

- (A): film-based systems
- (B): analog based systems
- (C): computer-based systems
- (D): none of the above

43. Today, the majority of US-based diagnostic and interventional procedures are still performed using _____.

- (A): digital 3D system
- (B): virtual 4D reality system
- (C): conventional 2D imaging
- (D): none of the above

44. Which of the following are benefits of 3D ultrasound imaging?

- (A): Freely manipulating the conventional US transducer during the interventional procedures
- (B): Provides accurate lesion volume measurements
- (C): Optimal viewing of the pathology and guiding the interventional procedure
- (D): all of the above

45. Mechanical 3D US systems make use of mechanisms using motors to translate, tilt, or rotate a conventional 2D US transducer.

- (A): True
- (B): False

46. Since the scanning geometry in mechanical 3D US systems is predefined and precisely controlled by a _____, the relative position and orientation of the acquired 2D US images are known accurately and precisely.

- (A): step-down transformer
- (B): mechanical motorized system
- (C): automated exposure switch
- (D): none of the above

47. Which of the following approach has been used in the development of mechanical 3D US scanning systems?

- (A): integrated 3D US transducers with the scanning mechanism within the transducer housing
- (B): external mechanical fixtures that hold the housing of a conventional 2D US transducers
- (C): air gap technique with low radiation exposure
- (D): both A and B

48. Most US system manufacturers offer integrated 3D US transducers that are based on a mechanically-swept transducer or "wobbler".

- (A): True
- (B): False

49. Digital 2D US images that are generated while the 1D US array is wobbled, which are used in the 3D US _____.
- (A): data processing
 - (B): histograms
 - (C): image reconstruction
 - (D): none of the above
50. Many interventional 3D US-guided interventional systems are currently using _____ for mechanical 3D scanning since researchers typically do not get access to the control of the US system for development of novel interventional systems.
- (A): internal fixtures
 - (B): TFT system
 - (C): external fixtures
 - (D): none of the above
51. The resolution in the 3D US image will degrade in the axial direction away from the transducer due to the _____ in the lateral and elevational directions of the acquired 2D US images.
- (A): patient movement
 - (B): increasing US beam spread
 - (C): pathology
 - (D): anatomical density
52. Since the acquired 2D images used to generate a 3D image are arranged as a fan, the distance between the acquired US images decreases with increasing axial distance.
- (A): True
 - (B): False
53. The _____ of the transducer as it is being scanned is adjusted to obtain 2D images with an appropriate spatial interval for generating high quality 3D images.
- (A): velocity
 - (B): shape
 - (C): size
 - (D): none of the above
54. Endo-cavity transducers using an end-firing approach are typically used for _____.
- (A): gall stone diagnosis
 - (B): fetal age predictor
 - (C): pregnancy due date
 - (D): prostate biopsy
55. For scanning systems used for 3D US-guided prostate biopsy, the end-firing transducer is rotated by at least 360° about a fixed axis that perpendicularly bisects the transducer array.
- (A): True
 - (B): False
56. 3D rotational scanning with an end-firing transducer is most sensitive to the _____ of the transducer and patient since the axis of rotation is in the center of the 3D US image.
- (A): speed
 - (B): intensity
 - (C): motion
 - (D): size
57. For interventional applications such as 3D US-guided prostate biopsy or brachytherapy, the rotational scanning mechanism is typically supported by a _____ to reduce motion.
- (A): ionizing chamber
 - (B): stabilization apparatus
 - (C): temporary collimators
 - (D): lead shielding
58. The most successful free-hand 3D US scanning approach used in interventional procedures makes use of magnetic field sensors, as well as applications such as echocardiography, obstetrics, and vascular imaging.
- (A): True

(B): False

59. _____ is the fifth most common diagnosed malignancy and the third most frequent cause of cancer related deaths worldwide.

- (A): Hepatocellular carcinoma (HCC)
- (B): Lung cancer
- (C): Ovarian cancer
- (D): Prostate malignancies

60. The _____ is the second most common site of metastatic cancer arising in other organs.

- (A): uterus
- (B): spleen
- (C): rectum
- (D): liver

61. Microwave energy-induced tissue heating by near-field probes is emerging as a common _____ of liver tumors.

- (A): chemotherapy
- (B): radiation therapy
- (C): thermal treatment
- (D): acupuncture treatment

62. The use of 3D US-guidance for focal liver tumor ablation is based on which of the following facts?

- (A): showing of the features of liver masses and the hepatic vasculature more clearly
- (B): allowing guidance of the ablation probes to the target more accurately
- (C): permitting more accurate monitoring of the ablation zone during the procedure and at follow up
- (D): all of the above

63. Worldwide, prostate cancer is the second leading cause of death due to cancer in men.

- (A): True
- (B): False

64. Prostate _____ is the only definitive diagnostic modality capable of confirming malignancy, and is now always performed with trans-rectal ultrasound (TRUS) guidance.

- (A): Computed tomography
- (B): needle biopsy
- (C): MRI
- (D): Radiography

65. TRUS biopsies are now performed with a thin, _____ gauge needle mounted on a spring-loaded gun connected to the TRUS probe, forcing the needle to stay in the imaging plane.

- (A): 14
- (B): 15
- (C): 16
- (D): 18

66. To perform a 3D US-guided prostate biopsy, the end-firing US transducer is mounted onto the _____ such that the tip of the probe is initially set to the RCM point of the tracker linkage.

- (A): display monitor
- (B): exposure console
- (C): tracking assembly
- (D): cathode assembly

Topic: Ultrasound-Based Guidance and Therapy

67. Ultrasound has emerged as one of the main modalities for medical imaging in healthcare, the main reason being its ability to image soft tissue, blood flow, organ function and physiology with considerably improved image quality.

- (A): True
- (B): False

68. In medical imaging, the ultrasound frequencies are usually between 2 and 40 MHz, with the highest frequencies currently used in _____.

- (A): musculoskeletal disorders
- (B): intravascular ultrasound (IVUS)
- (C): sport injuries
- (D): pregnancy checkups

69. The generation of an ultrasound image is based on transmission of _____ and receiving the echoes that have been reflected from tissue boundaries or scattered from smaller objects.

- (A): ionizing radiation
- (B): radionuclides
- (C): magnetic waves
- (D): sound pulses

70. Ultrasound arrays today are mostly based on piezoelectric materials.

- (A): True
- (B): False

71. The concept of ultrasound imaging of tissue strain or elasticity is often referred to as ultrasound elastography and the corresponding 2D images are frequently called _____.

- (A): electrograms
- (B): cardiograms
- (C): elastograms
- (D): encephalograms

72. Stiff tissue responds differently to the vibrations than softer tissue, and can therefore be distinguished in the real-time images.

- (A): True
- (B): False

73. In Supersonic Shear Imaging (SSI) the _____ is used to generate low-frequency shear waves (50-500 Hz) remotely in the tissue.

- (A): contrast agent
- (B): acoustic radiation force
- (C): scattered radiation
- (D): none of the above

74. Nonlinear terms in the tissue elasticity are responsible for the fact that the tissue becomes stiffer during _____ and softer during expansion.

- (A): rarefaction
- (B): compression
- (C): release
- (D): decompression

75. Ultrasound contrast agents are made as a suspension of gas microbubbles encapsulated in thin stabilizing shells made from _____.

- (A): iodine or barium
- (B): iron or calcium
- (C): gadolinium
- (D): lipid or albumin

76. Commercially available ultrasound contrast bubbles are stable and small enough to enable transpulmonary passage and the blood half-life is typically in the range of _____.

- (A): 1-10 minutes
- (B): 35-45 minutes
- (C): 60-90 minutes
- (D): 4-5 hours

77. The traditional way of getting real-time access to ultrasound frames is to connect the analog output (e.g., composite video, S-video) of the ultrasound scanner to a frame-grabbing card on the _____.

- (A): display monitor
- (B): control panel

- (C): navigation computer
- (D): none of the above

78. When the link between the ultrasound scanner and navigation system is digital, ultrasound data at different stages in the processing chain on the scanner can be transferred.

- (A): True
- (B): False

79. Which of the following tracking technologies are the most widely used in ultrasound?

- (A): mechanical
- (B): optical or electromagnetic
- (C): acoustical
- (D): none of the above

80. After streaming ultrasound data into the navigation software and tracking the ultrasound probe, _____ is needed in order to integrate the image stream with the tracking stream since it is the main error source.

- (A): calibration
- (B): disorganization
- (C): disarrangement
- (D): none of the above

81. Which of the following method can be used to reconstruct all the 2D frames into a regular 3D volume in ultrasound imaging?

- (A): Voxel-based
- (B): Pixel-based
- (C): Function based
- (D): all of the above

82. _____ is the process of transforming an image into the coordinate system of a patient, or another image.

- (A): One-rack system
- (B): PercuNav system
- (C): Registration
- (D): none of the above

83. Intensity based registration of ultrasound images can also be used to track the motion of an organ of interest.

- (A): True
- (B): False

84. The clarity and contrast of structure boundaries depend heavily on their orientation relative to the sound wave and the _____ of the surrounding tissues.

- (A): chemical makeup
- (B): acoustic properties
- (C): fat content
- (D): none of the above

85. _____ means extracting a 2D plane from the 3D data and can further be classified according to how the 2D slice data are generated and how this information is displayed.

- (A): Direct volume rendering
- (B): Geometric surface rendering
- (C): Slicing
- (D): none of the above

86. The simplest form of ultrasound guidance is placement of a _____ inside a target using freehand 2D ultrasound imaging.

- (A): radionuclide
- (B): needle
- (C): bio marker
- (D): contrast material

87. Neuronavigation is the term used to describe the use of computer-assisted methods to guide or navigate instruments within the confinements of the _____ during surgery.

- (A): liver
- (B): heart
- (C): lungs
- (D): skull or spinal column

88. The echocardiography is a useful tool in which of the following?

- (A): evaluation of cardiovascular anomalies in fetuses and newborns
- (B): assessment of aortic stenosis and evaluation of the function of the valves
- (C): examination of the flow and function after heart attacks
- (D): all of the above

Topic: Ultrasound Empowered Trauma Management

89. _____ has been one of the first essentials of the clinical examination that can be found in almost every medical textbook.

- (A): Insurance claim
- (B): Follow up
- (C): Observation
- (D): Treatment plan

90. The placement of the piezoelectric crystals on the probe is in the same direction, and this will create only one row of sound that is interpreted by the operator in the plane of axial, coronal, or sagittal images.

- (A): True
- (B): False

91. The probe is available in which of the following type?

- (A): High-frequency Linear
- (B): Low-frequency Convex
- (C): Phased-Array (Echo)/low-frequency probe
- (D): all of the above

92. Which of the following are the most reflective media that sound waves cannot penetrate them and may reflect through making an acoustic shadow phenomenon?

- (A): musculature and fat
- (B): air and bone
- (C): internal solid organs
- (D): water and liquid

93. Though the low-frequency probes are used for surface study, their wave cannot penetrate deep into the body.

- (A): True
- (B): False

94. For assessing the larynx and its cartilages, put the linear probe with the indicator pointing to the patient's _____ on the anterior cervical mid-line.

- (A): feet
- (B): diaphragm
- (C): head
- (D): pelvis

95. Which of the following protocol is used to assess the pneumothorax and hemothorax in trauma patients?

- (A): Extended-Focused Assessment Sonography for Trauma(E-FAST)
- (B): Abdominal Sonography for Trauma (FAST)
- (C): Deep Peritoneal Lavage (DPL)
- (D): none of the above

96. Which of the following ultrasound protocol is used for critical-care and hypotensive patients?

- (A): Code Blue
- (B): Rapid Ultrasound for Shock and Hemorrhage (RUSH)
- (C): Abdominal Sonography for Trauma (FAST)
- (D): none of the above

Topic: Breaking Through the Speed Barrier — Advancements in High-Speed Imaging

97. _____ invented the very first sonar type listening device in 1906 as a way of detecting icebergs.

- (A): Wilhelm Roentgen
- (B): Nicolay Tesla
- (C): Godfrey Hounsfield
- (D): Lewis Nixon

98. For medical Imaging, the dynamic range of signals could be of the order of order of _____dB covering both backscattered signals from tissues and specular reflections.

- (A): 10
- (B): 30
- (C): 50
- (D): 100

99. The simplest form of ultrasonic visualization is what is known as the _____.

- (A): A-scan
- (B): B-scan
- (C): C-scan
- (D): D-scan

100. In late _____'s, the techniques for generating 3-D images from a collection of 2-D images have been demonstrated.

- (A): 1890
- (B): 1980
- (C): 1990
- (D): 2000

101. Which of the following echo enhancement techniques can improve sensitivity, penetration and contrast are now been widely used in ultrasound imaging?

- (A): Coded Excitation (CE)
- (B): Digitally Encoded Ultrasound (DEU)
- (C): Air- gap imaging
- (D): both A and B

102. Once an ultrasonic pulse illuminated the object medium, the acoustic signals intercepted by the receiving array is retransmitted into the image medium through the acoustic focusing system after conditioning and boosting signal power using signal conditioning hardware (SC).

- (A): True
- (B): False

Topic: Advances in Breast Ultrasound

103. Ultrasound became an accepted method as an adjunct to _____ for further analysis of equivocal breast lesions.

- (A): computed tomography
- (B): digital fluoroscopy
- (C): MRI
- (D): mammography

104. Breast ultrasound is a dynamic (live) examination, the diagnostic procedure is performed by scanning systematically the whole breast in perpendicular planes.

- (A): True
- (B): False

105. Which of the following is a disadvantage of breast ultrasound?

- (A): dependency on the expertise of the physician and on the used technology
- (B): does not produce an image of the whole breast
- (C): provides real-time images
- (D): Both A and B