

Medical Imaging Systems



INTRODUCTION

- ▶ We have seen many methods of measuring biomedical parameters but those methods do not produce any visual images of internal structures of the human body.
- ▶ let us discuss the imaging techniques like ultrasonic imaging, X-ray techniques, radiography, CT scan and MRI.



ULTRASONIC IMAGING SYSTEMS

- ▶ The application of ultrasound in medical diagnosis is imaging of the internal organs or the internal structures of the body.
- ▶ Ultrasonic image provides valuable information regarding the size, location, displacement or velocity of a selected structure inside the body.
- ▶ There is no need to do any surgery or radiation to get the image.
- ▶ The change in density of an organ due to tumours can be identified using this imaging technique.
- ▶ This imaging technique replaces many risky and traumatic clinical procedures.
- ▶ In general, imaging systems generally use the pulsed ultrasound or pulsed Doppler mode



- ▶ Ultrasonography or diagnostic sonography is an ultrasonic sound based imaging technique which is used to get images of subcutaneous human body structures like muscles, joints, tendons and internal organs.
- ▶ Obstetric sonography is used for imaging foetus during pregnancy.



Basics of Ultrasonic Waves

- ▶ Ultrasonic waves are sound waves but its frequency range is above audible range (>20 kHz).
- ▶ These have the same physical properties as audible sound and are preferred **because of the following reasons:**
- ▶ 1. Ultrasonic waves are directional and the ultrasonic beams can be obtained with little spreading. In other words, focusing of ultrasonic waves will be simple.
- ▶ 2. It can be used where audible frequency can not be used.



- ▶ 3. The wavelengths used to investigate small structures should be of the same order, hence it can be used to investigate the very small dimensional defects. Its wavelength is shorter, hence it can be used to investigate the properties of very small internal structures.
- ▶ 4. Ultrasonic wave clearly reveals the dynamic information than any other sophisticated method.
- ▶ 5. Ultrasonic waves can be transmitted in different modes.
- ▶ They are longitudinal, transverse or shear. For the purpose of medical imaging, longitudinal waves alone can be used since it can be propagated in all types of medium like liquid, solid and gases.



Types of Ultrasonic Imaging

- ▶ Ultrasound imaging can be operated in three modes depending upon the applications.
- ▶ **These are:**
- ▶ (i) A scan imaging
- ▶ (ii) B scan imaging
- ▶ (iii) M scan imaging

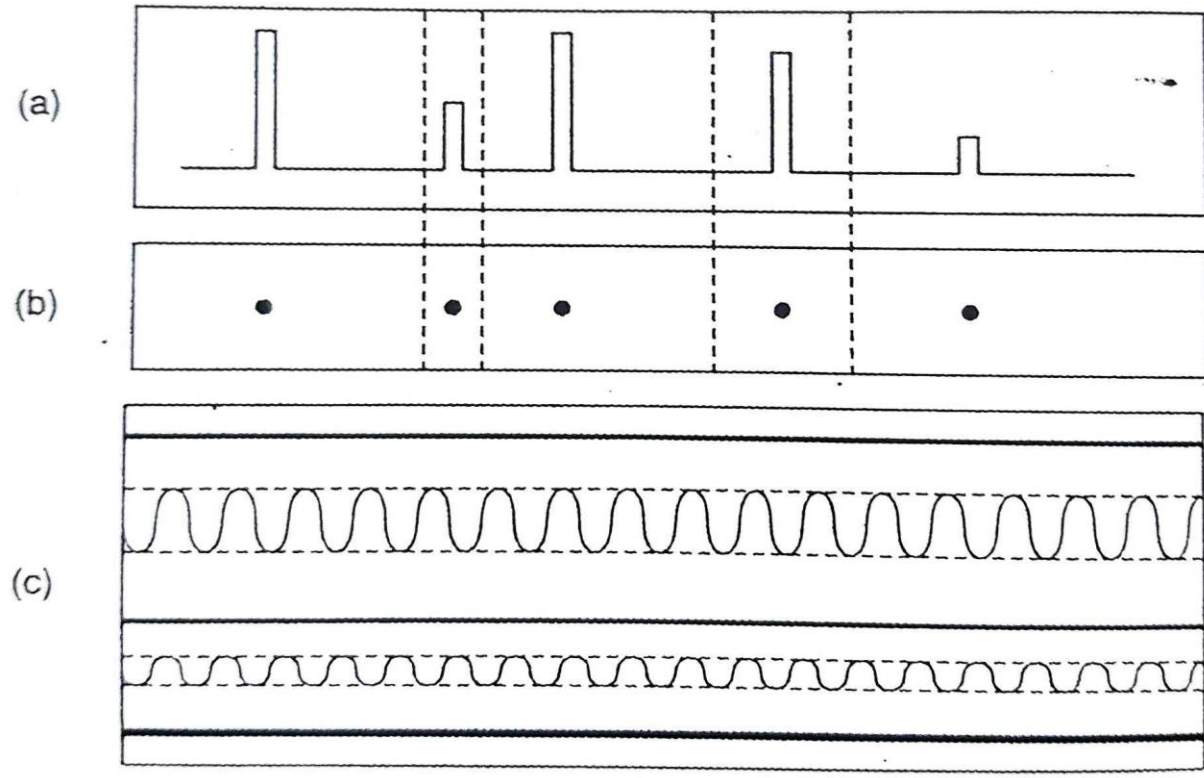


A scan imaging

- ▶ This method is the simplest among other methods.
- ▶ The transmitted signals and echo signals are applied to the Y plates of the CRT so that they are displayed as vertical deflections on screen as shown in Figure 9.2.
- ▶ The vertical sweep is calibrated in units of distance and provide vertical deflections in various ranges depending upon the distance of the interface.
- ▶ generally the transducer is kept stationary so that any displacement of echoes will result due to movement of targets.
- ▶ Echo encephalogram is a typical example of A scan display.



Figure 9.2 Ultrasonic imaging (a) A-scan echoes, (b) B-scan echoes, (c) M-scan echoes



B scan imaging

- ▶ If A scan echoes are rotated electronically 90° towards the viewer, the echoes can be viewed along the horizontal axis as bright and dim dots which depend upon the strength of depth as shown in Figure 9.2(b).
- ▶ The distance between the bright and dim dots represents the depth of the tissue and brightness of the dots represents the strength of the echoes.
- ▶ In other words, the brightness represent the nature of tissue



M scan imaging

- ▶ if the echoes are obtained from a moving structure, then the B scan image for that moving structure will be oscillating.
- ▶ This type of image display is known as M scan display.
- ▶ A typical M scan display is shown in Figure 9.2(c).

