MECHANICAL IMAGING TRANSDUCERS

Mechanical imaging transducers are used to visualize and display the location of impedance discontinuities in a medium through which a short ultrasonic pulse is made to propagate. This method of echo location is known as the pulse-echo technique.

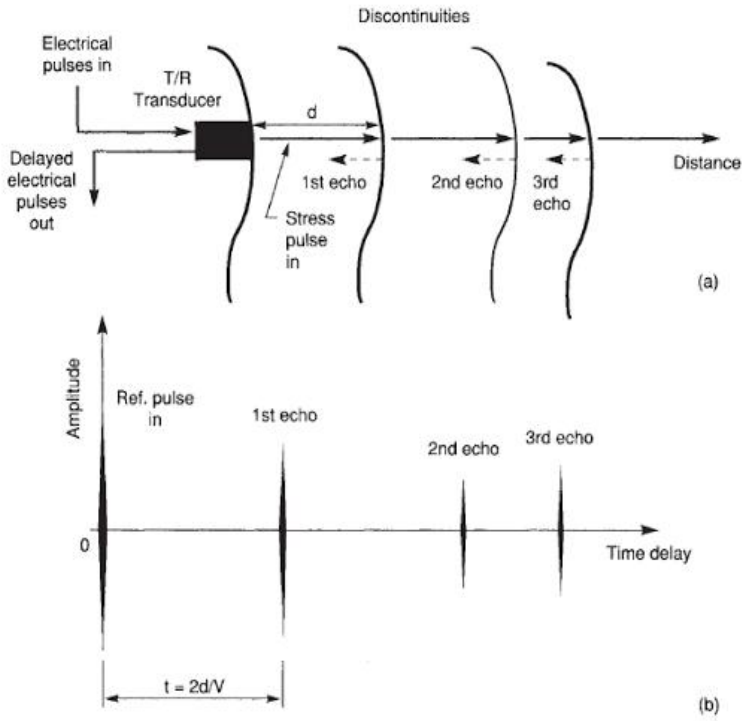

Fig 5.22 The fundamental basis of the pulse-echo technique used in NDT and medical imaging.

Figure 5.22 illustrates the fundamental basis for the pulse-echo technique.

An ultrasonic transmit/receive (T/R) transducer is excited by an electrical pulse, and a corresponding stress pulse propagates into the medium. This stress pulse travels with a velocity V, and it encounters an acoustic impedance discontinuity at a distance d. At this discontinuity, some of the pulse energy is reflected back, and the remaining pulse energy propagates farther into the medium.

The first reflected pulse travels back to the same transducer, and since the T/R transducer is bidirectional, it registers the arrival of that pulse by generating an electrical signal at its output. This represents the transduction mechanism in the pulseecho mode. The total distance traveled by the initial pulse is 2d. Assuming that the velocity V is constant, the total round-trip time t is 2d/V. Now, t can be determined from an oscilloscope display, and consequently the distance d of the discontinuity from the transducer face is Vt/2. Other discontinuities can also be located in this manner.

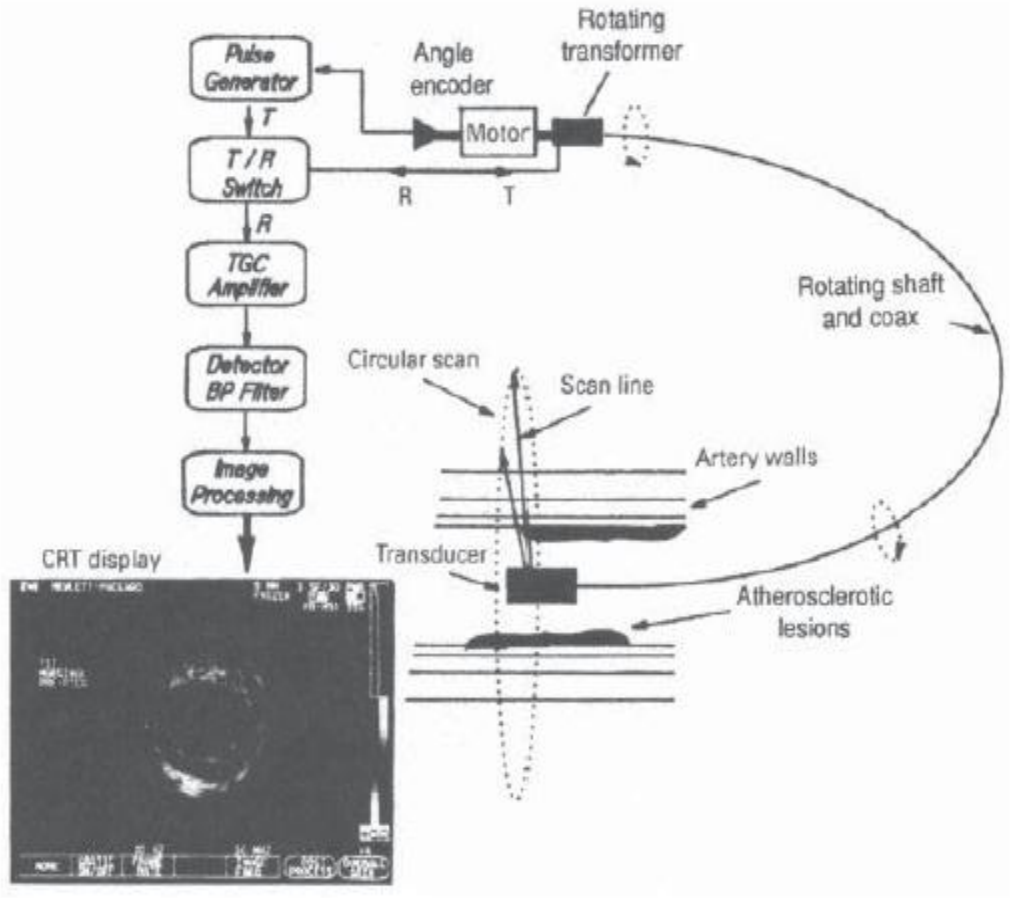

Figure 5.23 Intravascular imaging transducer and processing circuits used to image the inside wall of an artery.

Figure 5.23 shows the cross section of a blood vessel,50 which could very well represent a cylindrical structure like a cladded metal pipe. In the center is a small single-element transducer which rotates when driven by a flexible shaft connected to a motor. In medical practice, the flexible shaft and transducer reside inside a catheter, which is a polyethylene tubing.

The catheter is not shown, for clarity. The space around the transducer is filled with an acoustic coupling fluid. The catheter(Sonicath*) is inserted into the blood vessel by * Sonicath is a trademark of Boston Scientific Corporation. making a small incision and is then advanced to the desired location.

When the transducer is excited, the ultrasonic stress pulse propagates through the fluid, catheter wall, and surrounding blood to reach the linings of the artery wall including the intima, media, and adventitia.47

For a given direction, the transducer sends an ultrasonic pulse toward the artery walls and remains in that position long enough to receive all the echoes from the impedance discontinuities. The transducer then rotates, points in another direction, and receives all the echoes. The process is repeated for a 360° circular scan. All the echoes are stored in memory. The image processing circuitry then uses these signals to modulate the intensity of a CRT which displays the cross-sectional image of the blood vessel as shown in Fig. 5.23.

Source: http://mediatoget.blogspot.in/2012/06/mechanical-imaging-transducers.html