

Physics of Ultrasound

Third lecture

Interaction of Ultrasound with Matter

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Third Stage

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1. Introduction

In order to use ultrasound for either diagnostic or therapeutic purposes, a beam of ultrasound must be directed into the tissues of the subject over a selected area of interest. The ultrasonic energy will then interact with the tissues along its path. The interaction processes are influenced by the characteristics of the ultrasound wave, as well as the physical properties of the tissues through which the beam passes.

2. Acoustic impedance

- ✚ Different materials respond differently to interrogation by ultrasound, depending on the extent to which their medium particles will resist change due to mechanical disturbance.
- ✚ This medium property is referred to as the characteristic acoustic impedance of a medium.
- ✚ It is a measure of the resistance of the particles of the medium to mechanical vibrations.
- ✚ This resistance increases in proportion to the density of the medium, and the velocity of ultrasound in the medium.
- ✚ Acoustic impedance, Z , may be defined as the product of medium density and ultrasound velocity in the medium.

$$Z = \text{density} \times \text{velocity}$$

3. Acoustic boundaries

Positions within tissue where the values of acoustic impedance change are very important in ultrasound interactions. These positions are called acoustic boundaries, or tissue interfaces.