

1. This image mode is called B-mode.

2. wavelength = speed of sound / frequency

$$\text{Fat: } \frac{1450 \text{ m/s}}{5 \text{ MHz}} = 0.29 \text{ mm}$$

$$\text{Muscle: } \frac{1581 \text{ m/s}}{5 \text{ MHz}} = 0.3162 \text{ mm}$$

3. Fat acoustic impedance is Z1 and muscle is Z2

$$\text{PRC} = \frac{Z_2 - Z_1}{Z_2 + Z_1} = \frac{1.70 \frac{\text{kg}}{\text{m}^2 \text{s}} - 1.38 \text{ kg/m}^2 \text{s}}{1.70 \frac{\text{kg}}{\text{m}^2 \text{s}} + 1.38 \text{ kg/m}^2 \text{s}} = \frac{0.32}{3.08} = 0.104$$

$$\text{PTC} = \frac{2 * Z_2}{Z_2 + Z_1} = \frac{2 * 1.70 \frac{\text{kg}}{\text{m}^2 \text{s}}}{1.70 \frac{\text{kg}}{\text{m}^2 \text{s}} + 1.38 \text{ kg/m}^2 \text{s}} = \frac{3.4}{3.08} = 1.104$$

4. average speed of sound = (SOS in fat x thickness of fat + SOS in muscle x thickness of muscle) / total thickness

$$= \frac{1450 \frac{\text{m}}{\text{s}} * 0.01 \text{ m} + 1581 \frac{\text{m}}{\text{s}} * 0.03 \text{ m}}{0.04 \text{ m}} \\ = 1,548.25 \text{ m/s}$$

Round trip time = 2 x depth / speed of sound

$$= 2 * 0.040 \text{ m} / 1,548.25 \text{ m/s}$$

$$= 0.000052 \text{ s}$$

$$= 0.052 \text{ ms}$$

5. # of scan lines = FOV width / scan line interval = 35 mm / 0.25 mm = 140

$$\text{time per scan line} = \text{round trip time} * 2 = 0.000052 \text{ s} * 2 = 0.000104 \text{ s} = 0.104 \text{ ms}$$

$$\text{total scan time} = (\# \text{ of scan lines} * \text{time per scan line})$$

$$= 140 * 0.000104 \text{ s}$$

$$= 0.01456 \text{ s}$$

$$= 14.56 \text{ ms}$$

6. frame rate = 1 / (time per scan line) = 1 / 0.000104 s = 9,615 frames per second

7. attenuation coefficient of fat = 0.63 dB/cm

$$\text{attenuation (dB)} = 2 * \text{attenuation coefficient} * \text{round trip distance} * \text{frequency}$$

$$= 2 * 0.63 \text{ dB/cm} * 2 \text{ cm} * 5 \text{ MHz}$$

$$= 12.6 \text{ dB}$$