

24 Pulse-echo imaging – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
pulse-echo	脉冲回波	_____
reflected	反射	_____
coupling gel	耦合剂	_____

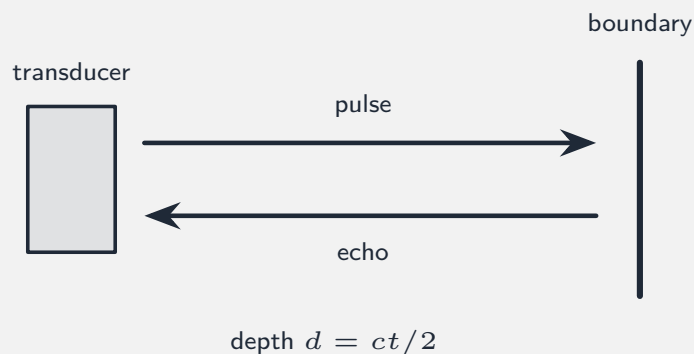
Recall

Ultrasound lets us see inside the body without surgery, using reflected pulses.

New ideas

Read these first. Each idea has a short worked example. Then do the Practice.

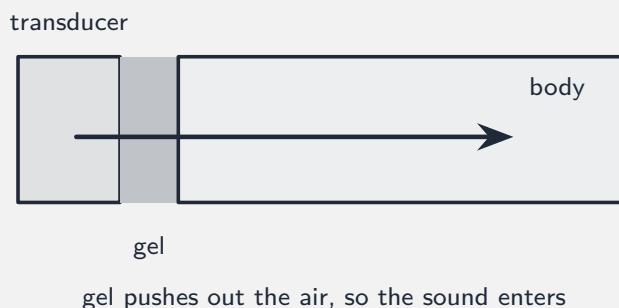
■ 1 Pulse-echo imaging



In **pulse-echo** 脉冲回波 imaging, the transducer sends a short pulse; part is **re-
flected** 反射 at each boundary. The time delay gives the depth: $d = ct/2$ (there and back).

Worked example. An echo returns after $t = 1.0 \times 10^{-4}$ s. With the speed of ultrasound in tissue $c = 1500 \text{ m s}^{-1}$: $d = ct/2 = (1500)(1.0 \times 10^{-4})/2 = 0.075 \text{ m}$ —the boundary is 7.5 cm deep.

■ 2 Coupling gel



A **coupling gel** 耦合剂 is put between the transducer and skin. Without it, almost all the ultrasound would reflect off the air and never enter the body.

Worked example. A thin layer of air between the probe and skin would bounce nearly all the ultrasound straight back. The gel fills that gap, so the pulse passes smoothly into the body.

Watch out: divide the time by 2 because the pulse travels to the boundary *and* back. Use the speed of sound in *tissue* (about 1500 m s^{-1}), not in air.

Practice

Try these in order.

24.1 In *pulse-echo* imaging, what is sent into the body? [1]

24.2 What happens to the pulse at a tissue boundary? [1]

24.3 Write the formula for the depth from the echo time. [1]

24.4 Why is the time divided by 2 in $d = ct/2$? [1]

24.5 An echo returns after 8.0×10^{-5} s. The speed in tissue is 1500 m s^{-1} . Find the depth of the boundary. [2]

24.6 Why is *coupling gel* used? [1]

24.7 Challenge. Ultrasound is used to image a baby in the womb, but X-rays are not. Explain why ultrasound is the safer choice. [2]
