Ultrasound Measurement

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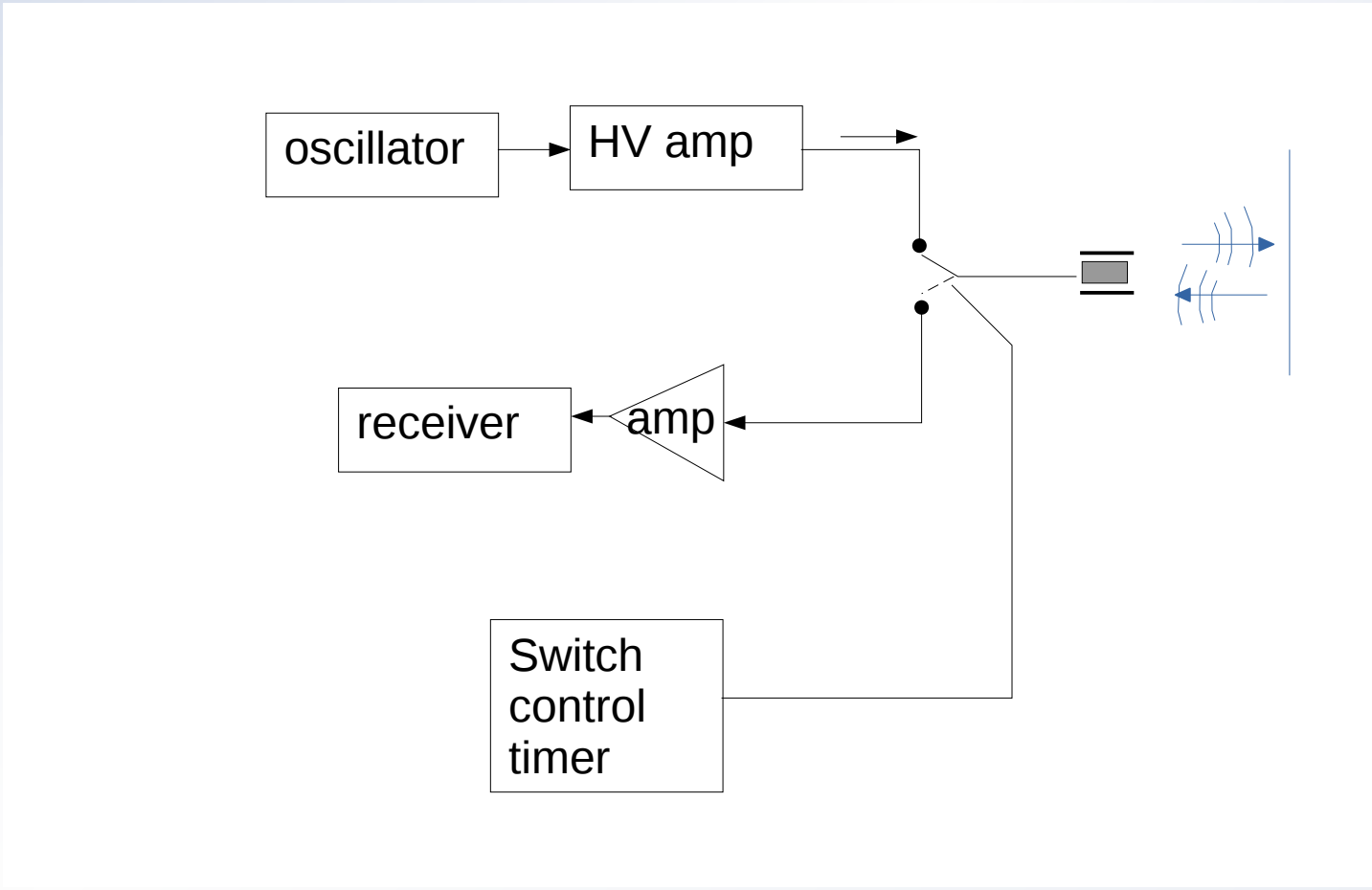
Lecture - Outline

- Piezoelectric as sensors and actuators
- Applications

Ultrasound Reflection Measurement



Ultrasound Instruments

- Time of echo:

$$\tau = 2\frac{d}{c}$$

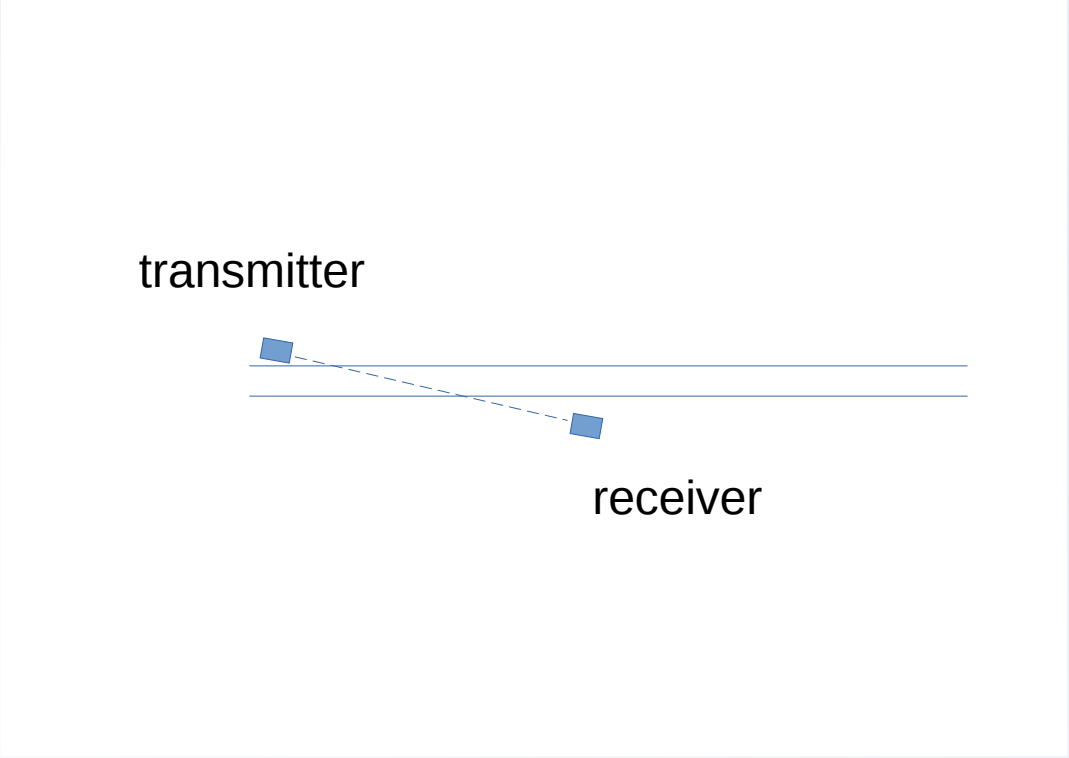
- Attenuation:

$$\frac{I_r}{I_o} = e^{-\mu(2d)}$$

- Automatic depth dependent gain compensation

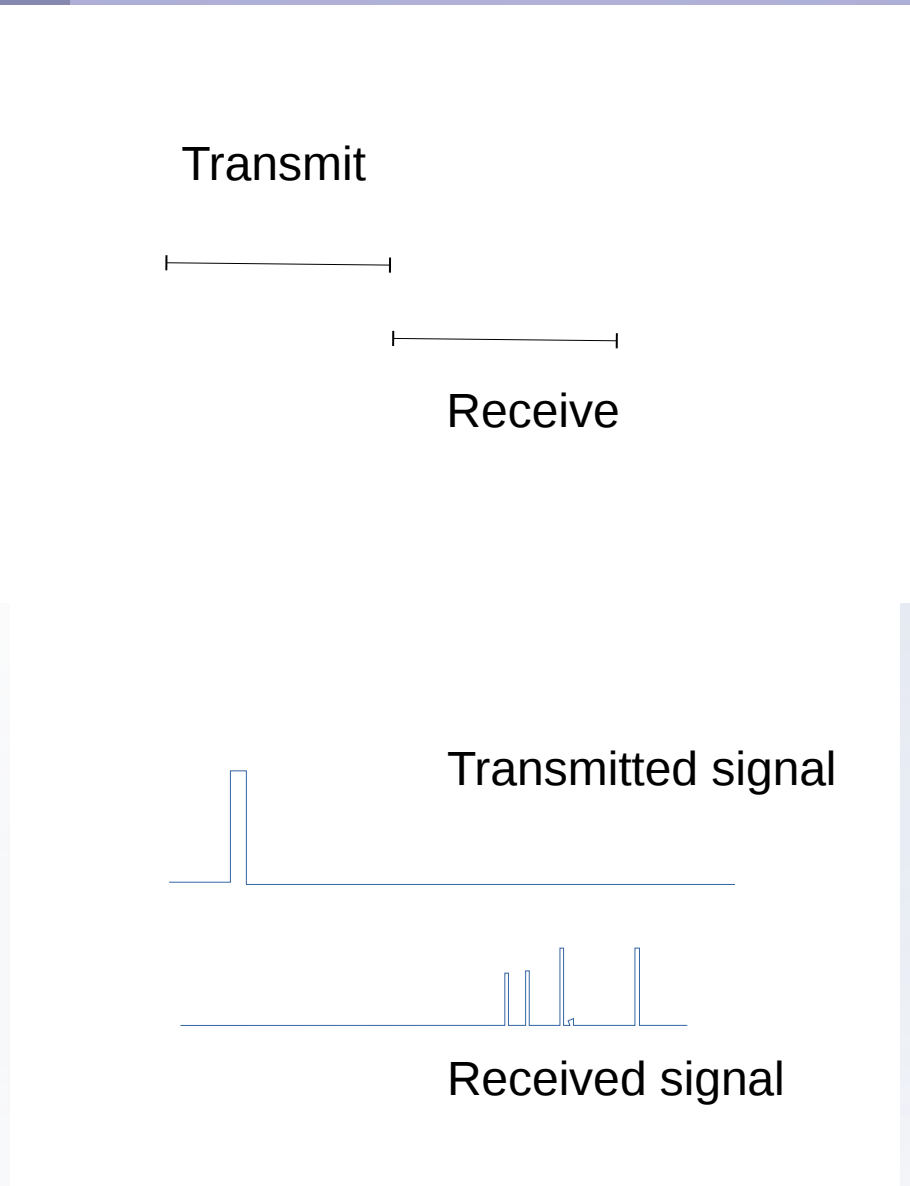
Flow measurement

- Transit time =
  distance / (effective velocity in medium)



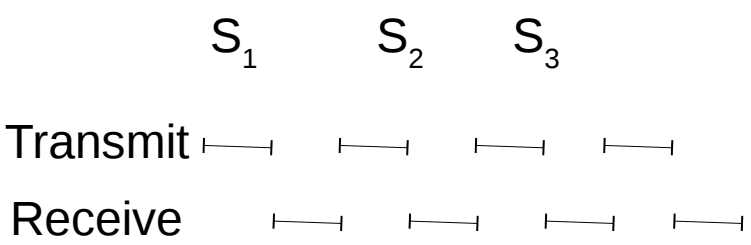
A-scan

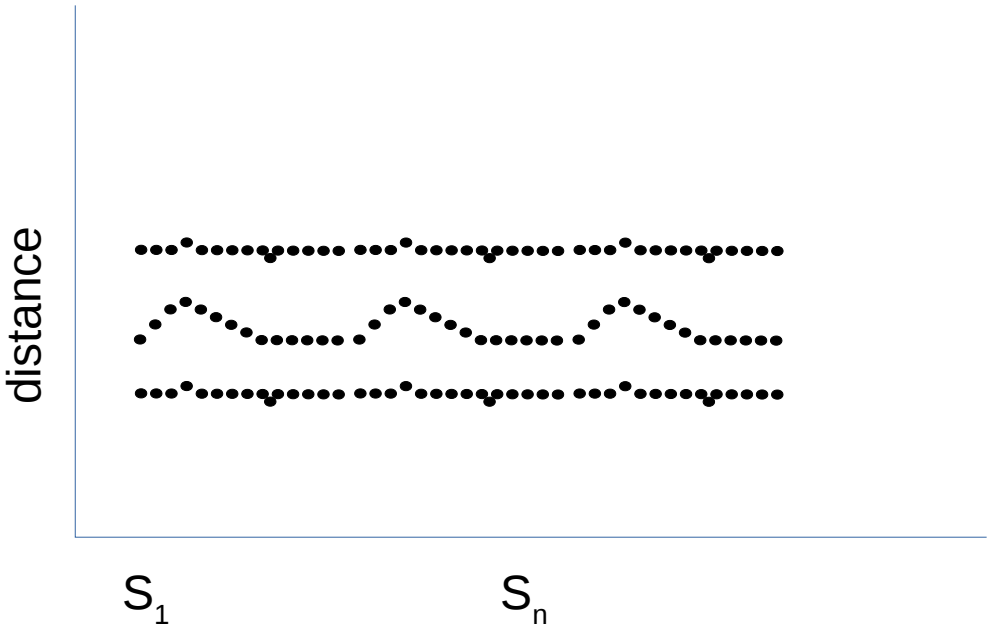
- Plot time of reflected waves
- Depth dependent gain compensation is applied
- Calculate distance of every reflecting boundary



M-scan

- Repeated transmit-receive cycles
- Plot calculated distance for each cycle





B-scan

- Move position of the transducer
- Calculate depth o multiple reflection
- Plot depth as inte on a 2D spatial di

Doppler shift

- Source frequency f_o
- Source-target velocity u
- Propagation in medium with velocity c
- Dopplet shift f_d

$$\frac{f_d}{f_o} = \frac{u}{c}$$

Doppler flowmetry

- Ultrasound
  - Doppler measurement of motion

Doppler imaging

End of Lecture