Faculty of Engineering
Department of Biomedical Engineering

06
Sensors-1

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BME 312
Biomedical Instrumentation II

Transducer

A device which converts one form of energy to another

When input is a physical quantity and output electrical → Sensor

When input is electrical and output a physical quantity → Actuator

Commonly Detectable Phenomena

- Biological
- Chemical
- Electric
- Electromagnetic

Common Conversion Methods

- Physical
- Chemical

Biological

Capacitive Type Pressure Transducer

Measurement with strain gauge, or How sensors work?

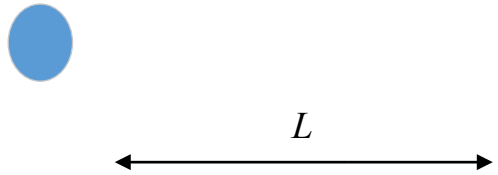
$R_S = 120\ \Omega$
No tension

$R_S > 120\ \Omega$
Tension

$R_S < 120\ \Omega$
Compression

Resistance of strain gauge

To calculate the resistance of strain gauge is similar to calculation of resistance of (round) wire.



$$F_0 = 0$$
$$\Delta L = 0$$
$$\Delta A = 0$$

Wheatstone bridge

Quarter bridge

Half bridge

Full bridge

Temperature compensation

Strain Gauge Example

A strain gauge with a gauge factor K of 1.666 is placed on a compressor tank. The gauge has an initial resistance of 120Ω and it is connected to the given Wheatstone Bridge circuit. And output of Wheatstone Bridge circuit is connected to an instrumentation amplifier with a positive gain of 61. When the tank is empty the amplifier is balanced and the output is 0 volt.

a) When the tank is filled with almost full with gas the output voltage of instrumentation amplifier is 4V. Calculate the amount of stretching (strain) of strain gauge.

b) Calculate the output voltage of instrumentation amplifier when the gauge is stretch of 2.5%.

Capacitive Transducer

The capacitance of a parallel plate capacitor is given by

$$C = \frac{kA\varepsilon_0}{d}(Farads)$$

where

k	= dielectric constant
A	= the area of the plate, in m^2
ε_o	= 8.854×10^{-12} F/m
d	= the plate placing in m