

BME 200

Lesson 6 - Bioinstrumentation

Sep 10, 2020

By the end of the lecture students should be able to:

- Identify voltage sources, current sources, and resistors in a circuit diagram
- Use Ohm's law to calculate one of voltage, current, resistance given the other two
- Use Kirchoff's Current Law to solve for voltage and current in a circuit
- Use Kirchoff's Voltage Law to solve for voltage and current in a circuit

I. Introduction

A. Bioinstrumentation: measuring quantities from the body (or from biological systems)

# Bioinstrumentation

## Coursework

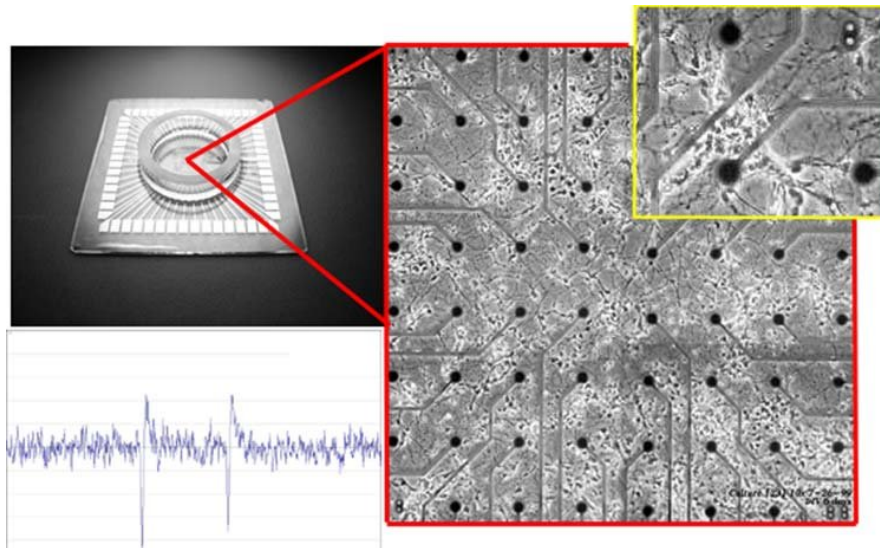
- Circuits
- Instrumentation
- Signal Processing

## BME Area

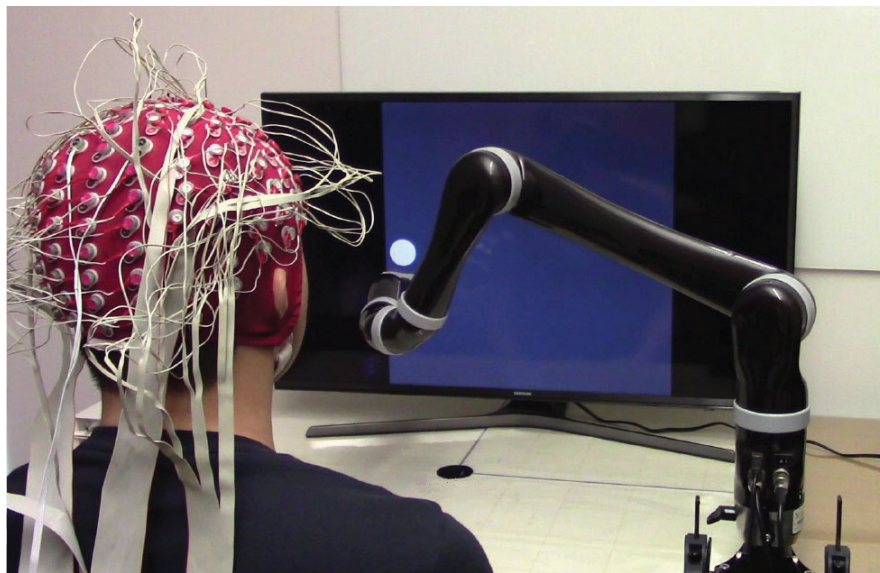
- Systems

## B. Examples of bioinstrumentation

### 1. Research



<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0003355>



Edelman, Bradley J., et al. "Noninvasive neuroimaging enhances continuous neural tracking for robotic device control." *Science robotics* 4.31 (2019).

## 2. Industry

# Industry

**Established industry:** yes

### Areas

- Medical devices
- Sensors

# Companies

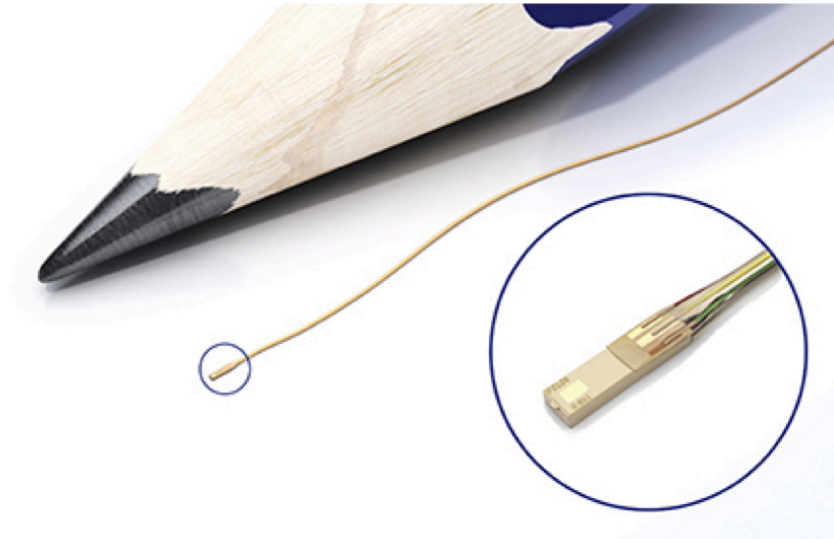
- Medtronic
- St. Jude Medical
- Baxter
- Abbot Labs
- Apple



Sacral nerve stimulation for treating incontinence  
[http://www.totalhealth.co.uk/sites/default/files/articles/medtronic\\_0.jpg](http://www.totalhealth.co.uk/sites/default/files/articles/medtronic_0.jpg)



<https://www.mobihealthnews.com/content/senseonics-gets-fda-clearance-everSense-will-sell-implantable-glucose-monitor-directly-us>



[https://www.si-micro.com/fileadmin/00\\_smi\\_relaunch/products/Minimally\\_Invasive\\_Sensor/IntraSense\\_miniature\\_connected\\_MEMS\\_pressure\\_sensor.jpg](https://www.si-micro.com/fileadmin/00_smi_relaunch/products/Minimally_Invasive_Sensor/IntraSense_miniature_connected_MEMS_pressure_sensor.jpg)



Seetharama Bhat, P. S., et al. "Giant coronary-pulmonary fistula with pulmonary atresia, ventricular septal defect, and coronary anomaly: a case report and review of literature." *Ann Pediatr Cardiol* 7 (2014): 142-144.

## II. Overview of Measurement Systems

### A. Sensor

1. Usually a *transducer*; transduces a measurement to an electrical signal

### B. Instrumentation

### C. Output

## III. Circuit analysis

### A. Parts

### B. Nodes

1. A point at which two or more elements have a common connection
2. An element has a node at each end
3. Example:

4. Student Example:

C. Ohm's Law

1.  $\Delta V = IR$ 
  - a) Note the  $\Delta V$  it's important
2. What does this mean?
  - a) If I know the current and resistance, I can figure out the voltage
  - b) If I know the voltage and resistance I can figure out the current
  - c) If I know the voltage and current I can figure out the resistance
3. All elements have a voltage drop and a current

D. Kirchhoff's Current Law

1. The algebraic sum of currents entering a node is zero (**IN = OUT**)
2. Example

### 3. Student example

#### E. Kirchhoff's Voltage Law

1. The algebraic sum of voltages around a closed path (loop) is zero
2. Start with whatever the battery gives you, and you lose a little as you go around
3. Example



#### 4. Student example