Biosignal

- Definition
- Origin
- Classification

Definition

- A signal is a function that “conveys information about the behavior or attributes of some phenomenon”.
- Bio-signal is “any biological quantity or magnitude exhibiting variation in time or variation in space is potentially a signal that provides information on the status of a biological system”.
- Example: ECG,EEG,EMG,MRI,CT,PET, Medical Ultrasound, ENG, ERG, EOG, EGG etc.

Bio-potential	Frequency Range	Signal Amplitude	Electrode
ECG	0.05-150 Hz	0.1-5 mV	Surface
EMG	25-5000 Hz	0.1-100 mV	Surface, needle
EEG	0.1-100 Hz	0.025-0.1 mV	Surface
Action Potential of neuron	0-10 KHz	50-100 mV	needle

Origin(1)

Bio-electric Signals

- Bioelectrical signals are very low amplitude and low frequency electrical signals that can be measured from biological beings, for example, humans.
- Generated by nerve and muscle cells as a result of electrochemical changes within and between cells.
- Can be measured with intracellular or extracellular electrodes.
- **Examples**: ECG, EGG, EEG, and EMG are results of the Bioelectric signals taken from the human body.
- Bioelectric Signals are probably the most important biosignal

Origin(2)

Bio-magnetic Signals

- Different organs (heart, lungs & brain) generate weak magnetic fields
- Measured from specific physiological activity that is linked to an accompanying electric field from a specific tissue or organ
- Uses very precise magnetic sensors or SQUID magnetometers (Superconducting Quantum Interference Device)
- Example: Magnetic field in the head when listening music

  Magnetoencephalography (MEG) - monitor magnetic activity from the brain

  Magnetoneurography (MNG) – monitor peripheral nerves

  Magnetogastrography (MGG) – monitor gastrointestinal tract

  Magnetocardiography (MCG) – monitor the heart

Origin(3)

Bio-chemical Signals

- Contain information about changes in concentration of various chemical agents in the body
- Example: Oxygen concentration determination
- Determine levels of glucose, lactate, and metabolites
- Provides information about the function of various physiological systems

Origin(4)

Bio-mechanical Signals

- Produced by the mechanical functions of biological signals such as: motion, displacement, tension, force, pressure, and flow
- Example: Blood pressure measurement

  Cardiac output measurement

Origin(5)

Bio-acoustic Signals

- Are special subset of biomechanical signals that involve vibrations (motion)
- Respiratory system, joints, and muscles generate distinct bio-acoustic signals
- Often measured at the skin using acoustic transducers such as microphones and accelerometers
- Examples: Biological sounds, such as lung sounds, heart sounds, bowel sounds, and joint sounds, flow of blood in the heart or through vessels, the flow an air in the lungs and airways, in the joints and in the digestive tract etc.

Origin(6)

Bio-optical Signals

- Bio-optical signals are the result of the optical functions of the biological systems, occurring naturally or induced by the measurement.
- Generated by the optical, or light-induced, attributes of biological systems
- May occur naturally or signals can be introduced to measure a biological parameter using an external light medium
- Example: human skin tissue

Origin(7)

Thermal biosignal

- Continuous or discrete carry information about the temperature of the body core or temperature distribution on the surface.
- The temperature measurement reflects physical and biochemical processes proceeded in the organism. The measurement is usually performed by a contact method using a variety of thermometers.

Classification(1)

Classification by existence:

- **Permanent biosignal:** They can exist without an artificial trigger and are available at any time. The source for those biosignals is already inside the body. An electrocardiographic signal.
- **Induced biosignal:** These biosignals are artificially triggered or induced and last only during the time of excitation. It means that when the artificial induction is over the induced biosignal decays with a time constant determined by the body properties.

Classification(2)

Classification by origin

- **Magnetic biosignals:** These signals include motion and displacement signals, pressure and tension and flow signals, and others.
- **Optic biosignals:** are the result of optical functions of the biologic system, occurring naturally or induced by the measurement (Blood oxygenation)
- **Acoustic biosignals:** Many physiological phenomena create noise like the flow of blood in the heart or through blood vessels also the flow or air through the airways creates acoustic sounds.
- **Chemical biosignals:** Reflect the chemical composition and its temporal changes in body solids, liquids, and gases. Examples are measuring the concentration of various ions and vicinity of a cell by means of specific ion electrodes
- **Thermal Biosignals:** Temperature measurement shows physical and biochemical processes proceeded in the organism. (Heat loss, heat absorption)