Biomaterials and Medical Applications

Editorial

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Medical Devices and Instrumentation

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Editorial

Bioinstrumentation or Biomedical Instrumentation is an application of biomedical engineering, which focuses on the devices and mechanics used to measure, evaluate, and treat biological systems. Bioinstrumentation has revolutionized the medical field, and has made treating patients much easier.

The focus of research in medical devices and instrumentation is to conceptualize, design, fabricate, and validate novel therapeutic and diagnostic tools. This includes a vast range of medical devices ranging from invasive, implantable devices for chemical, optical, and electrical interfacing, wearable patches for vital signs and health monitoring, and non-contact magnetic stimulation and imaging tools.

Researchers at the intersection of biomedical engineering and chemistry, materials, electrical engineering, and mechanical engineering use detailed computational models and laboratory experiments to analyze the interactions between medical devices and the human body at cellular, tissue, and organ scales. Research in this field also tackles challenges related to power, data transmission or on-board data handling. These efforts involve foundational, translational and clinical studies, and often require close interaction with regulatory agencies to enable the next generation of medical instruments. The articles in The Encyclopedia of Medical Devices and Instrumentation focus on what is currently useful or is likely to be useful in future medicine. They answer the question, "What are the branches of medicine and how does technology assist each of them?" Articles focus on the practice of medicine that is assisted by devices, rather than including, for example, the use of drugs to treat disease. The title is the only resource on the market dealing with the subject in encyclopedic detail.

1. Bio potential electrodes

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode– skin interface, half cell potential, impedance, polarization effects of electrode – nonpolarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

2. Electrode configurations

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG, ERG and EOG – unipolar and bipolar mode.

3. Bio amplifier

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.

4. Measurement of non-electrical parameter

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

5. Bio-chemical measurement

Biochemical sensors - pH, pO2 and pCo2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyser (simplified schematic description)

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