Photoplethysmography (PPG)

Photoplethysmography (PPG) is a simple optical technique used to detect volumetric changes in blood in peripheral circulation. It is a low cost and non-invasive method that makes measurements at the surface of the skin. The technique provides valuable information related to our cardiovascular system.

Principle of PPG

PPG makes uses of low-intensity infrared (IR) light. When light travels through biological tissues it is absorbed by bones, skin pigments and both venous and arterial blood. Since light is more strongly absorbed by blood than the surrounding tissues, the changes in blood flow can be detected by PPG sensors as changes in the intensity of light. The voltage signal from PPG is proportional to the quantity of blood flowing through the blood vessels. Even small changes in blood volume can be detected using this method, though it cannot be used to quantify the amount of blood.

A PPG signal has several components including volumetric changes in arterial blood which is associated with cardiac activity, variations in venous blood volume which modulates the PPG signal, a DC component showing the tissues' optical property and subtle energy changes in the body. Some major factors affecting the recordings from the PPG are site of measurement and the contact force between the site and the sensor. Blood flow variations mostly occur in the arteries and not in the veins. The PPG Waveform

PPG shows the blood flow changes as a waveform with the help of a bar or a graph. The waveform has an alternating current (AC) component and a direct current (DC) component.

The AC component corresponds to variations in blood volume in synchronization with the heartbeat. The DC component arises from the optical signals reflected or transmitted by the tissues and is determined by the tissue structure as well as venous and arterial blood volumes.

The DC component shows minor changes with respiration. The basic frequency of the AC component varies with the heart rate and is superimposed on the DC baseline.

Uses of PPG

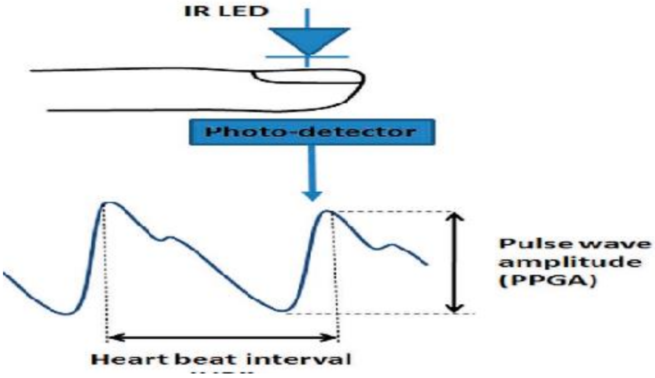
Medical devices based on PPG technology are widely used in various applications

- Clinical physiological monitoring
- Blood oxygen saturation
- Blood pressure
- Cardiac output
- Heart rate
- Respiration
- Vascular assessment
- Arterial disease
- Arterial compliance and ageing
- Venous assessment

Wearable Devices

Using this technology, wearable pulse rate monitors have been developed. These low-cost and small devices have high-intensity green light-emitting diodes (LEDs) and photodetectors that help reliable monitoring of the pulse rate in a non-invasive manner.

These devices have a sensor that monitors minor variations in the intensity of light transmitted through or reflected from the tissue. These intensity changes are associated with changes in blood flow through the tissue and provide vital cardiovascular information such as the pulse rate.



Body plethysmography

Body plethysmography is a simple, painless test that takes lung volume measurements. Lung volume is the amount of air you inhale and exhale. The test involves sitting in an airtight booth and blowing into a mouthpiece while a computer records measurement. Body plethysmography helps diagnose respiratory diseases with similar symptoms, including asthma, pulmonary firosis, and chronic obstructive pulmonary disease (COPD). Body plethysmography is only one method used to diagnose and manage respiratory diseases. Discuss all your testing options with your doctor to understand which tests are best for you. Resistance also may be used to determine the response of obstructed patients to bronchodilator medications.

Why is body plethysmography used?

Body plethysmography is the most accurate method and sometimes the only way to take certain lung volume measurements. Lung volu e is the amount of air you breathe in and out of your lungs. There are many kinds of lung volume measurements, which are measured using various pulmonary function tests, such as spirometry.

Body plethysmography can diagnose respiratory diseases earlier than spirometry. It also helps your doctor determine if your symptoms are due to a restrictive or an obstructive disease.

How is body plethysmography performed?

Body plethysmography will be performed in a hospital pulmonary function lab or sometimes in a pulmonologist's office. Lung volume measurements take as little as three minutes, but the entire procedure will take about 20 to 30 minutes.

Proper breathing technique is imp take a bit of practice to master.

Body plethysmography generally involves these steps:

- You will loosen tight or restricti

e clothing.

- You will sit or stand inside a clear, airtight chamber or booth and spend about 45 seconds acclimating to the temperature in the booth.

- You will inhale and exhale through a mouthpiece against a closed shutter devic

to a particular

volume. Your pulmonary function technologist will instruct you to use different breathing techniques, such as panting and normal breathing.

- Your chest volume will expand and increase the pressure in the box as you bre shutter. This pressure reading determines lung volume measurements.

the against the

- Your pulmonary function tech

ologist may perform other pulmonary function tests in the

booth, such as spirometry and lung diffusion capacity.

A pulmonary function technologist usually performs body plethysmography. A pulmonary function

technologist has specialized traini accurately.

g and education to perform pulmonary function tests safely and

Risks and potential complications

Body plethysmography is a safe procedure without serious risks or complications. However, people with the following conditions may not tolerate body plethysmography:

- Claustrophobia
- Mental confusion
- Any condition requiring continuous oxygen therapy that cannot be stopped to take the test

Blood Glass Analyser

A blood gas test measures the amount of oxygen and carbon dioxide in the blood. It may also be used to determine the pH of the blood, or how acidic it is. The test is commonly known as a blood gas analysis or arterial blood gas (ABG) test.

Your red blood cells transport oxygen and carbon dioxide throughout your body. These are known as blood gases.

As blood passes through your lungs, oxygen flows into the blood while carbon dioxide flows out of the blood into the lungs. The blood gas test can determine how well your lungs are able to move oxygen into the blood and remove carbon dioxide from the blood.

Imbalances in the oxygen, carbon dioxide, and pH levels of your blood can indicate the presence of certain medical conditions. These may include:

- kidney failure
- heart failure
- uncontrolled diabetes
- hemorrhage

Why is a blood gas test done?

- chemical poisoning
- Drug overdoses
- shock

A blood gas test provides a precise measurement of the oxygen and carbon dioxide levels in your body. This can help your doctor determine how well your lungs and kidneys are working.

This is a test that is most commonly used in the hospital setting to determine the management of acutely ill patients. It doesn’t have a very significant role in the primary care setting, but may be used in a pulmonary function lab or clinic.

Your doctor may order a blood gas test if you're showing symptoms of an oxygen, carbon dioxide, or pH imbalance. The symptoms can include:

- shortness of breath
- difficulty breathing
- confusion
- nausea

A blood gas test is often ordered along with other tests, such a blood glucose test to check blood sugar levels and a creatinine blood test to evaluate kidney function.

Blood gas analysers consist of three electrodes measuring pH, PCO2, and PO2 at 37°C. From these outputs, internal computers calculate O2 saturation, base excess, bicarbonate, and other derived variables such as the compensation by the body for acid–base abnormalities. Arterial PO2 and PCO2 can be approximated using heated skin surface 'transcutaneous' electrodes, which are commonly used in premature infants and nurseries. Haemoglobin oxygen saturation, SO2%, is also directly measured by multiwavelength blood oximeters. Arterial SO2 is approximated by pulse oximeters, which detect the arterial pulsatile variations in red and infrared light penetrating a finger, ear, or other tissue,

Interpretation of blood gases and acid–base balance is briefly discussed. Figures include schema of the three electrodes, a pulse oximeter probe, an acid–based compensation diagram, and photographs of the first three-function blood gas analyser, a combined PO2PCO2 transcutaneous electrode in use on a child, and a pulse oximeter probe on a finger.