BLOOD PULSE DETECTION METHOD USING AUTOCORRELATION

A technical overview

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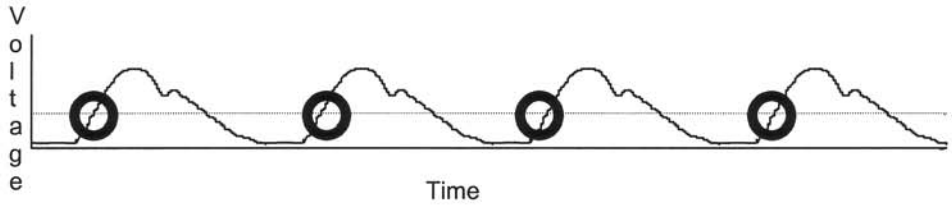
DIGITAL PULSE OXIMETRY

GENERAL THEORY OF OPERATION:

Pulse oximetry combines the principles of optical plethysmography and spectrophotometry to determine arterial oxygen saturation values. Optical plethysmography uses light absorbance technology to reproduce waveforms produced by pulsating blood. Spectrophotometry uses various wavelengths of light to perform quantitative measurements about light absorption through given substances. Using these two principles, a sensor is attached to a patient which uses two LEDs - a red (660 nm) and an infrared (940 nm) light emitting diode - to transmit light through the vascular bed to a photodetector. The difference in the intensity of transmitted light between red and infrared light is caused by the differences in the absorption of light by oxygenated (saturated) and deoxygenated (desaturated) hemoglobin. The resulting voltage difference is used to calculate the amount of oxygen saturation by comparing the value against tables contained in the pulse oximeter's memory.

TRADITIONAL PULSE DETECTION

Traditional pulse detection looks at the dynamic signal voltage outputs as pulsatile only if they surpass a predetermined threshold. The following illustration may assist in understanding this concept:

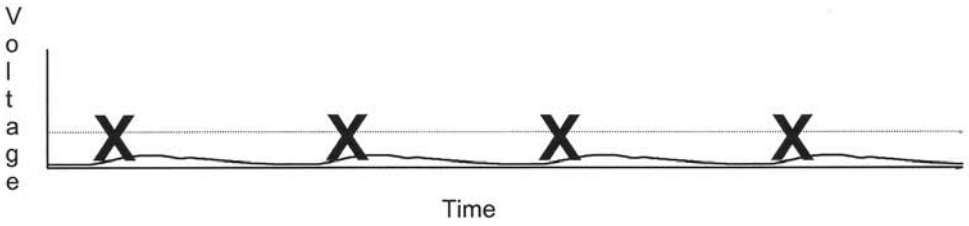


O = Point of pulse detection at which signal voltage crosses a predetermined threshold

LIMITATIONS OF TRADITIONAL PULSE DETECTION

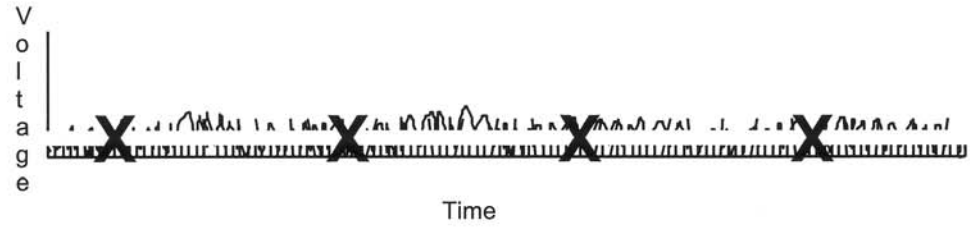
Minimal Pulse Amplitude (Low Perfusion)

Minimal pulse amplitude is encountered in patients with poor peripheral perfusion. This can result as a consequence of hypothermia, increased systemic vascular resistance, or disease states such as diabetes. The following portrays this dilemma:



X = Point of missed pulse detection

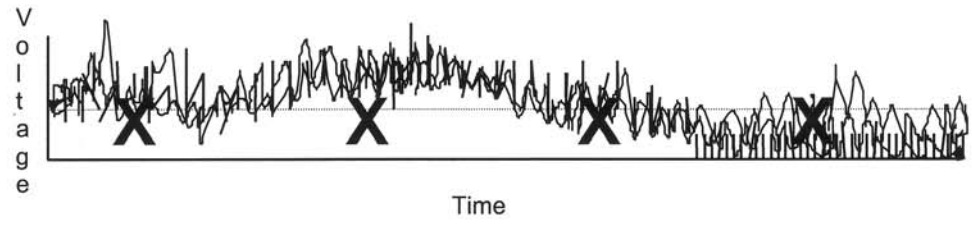
In looking at this, one may conclude a simple solution would be to lower the voltage detection threshold. Unfortunately, the issue is not that elementary. Both oximeter self-generated and environmental electrical noise are added obstacles to proper readings. With weak pulse signals, comes a complete washout (pulse signal is camouflaged within the electrical noise) of viable pulse signals. Please see the following:



X = Point of missed pulse detection

Motion Artifact

Adding to the issue of background electrical noise, motion artifact can also play a factor in pulse signal detection. The following depicts this combination shortcoming:



X = Point of missed pulse detection

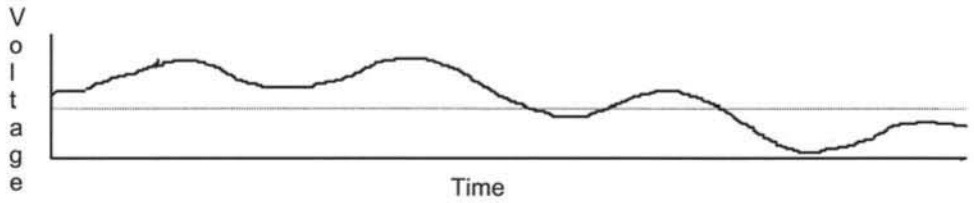
The use of algorithms which rely on voltage thresholds for pulse detection are not capable of readings on poorly perfused, kinetic patients. With this awareness, BCI International has developed a solution. This solution is possible because of refined, noise-reducing hardware to diminish electrical noise as well as a unique software algorithm which takes advantage of a digital signal

processor. This unique algorithm has been awarded a patent titled, ***Blood Pulse Detection Method Using Autocorrelation*** (patent number: 5,558,096).

A NEW PERSPECTIVE

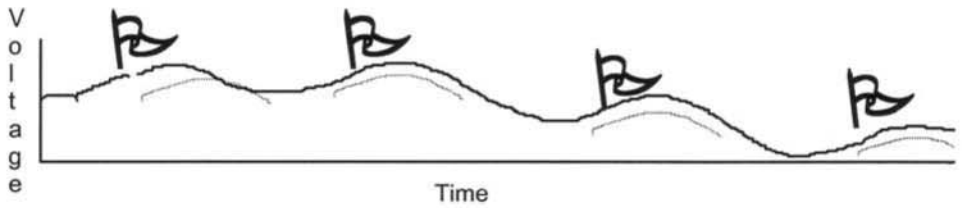
Refined Hardware

Enhanced hardware with superior insulating capability is the key to environmental and oximeter self-generated electrical noise reduction. Please see the following improved signal to noise ratio illustration:



An Patented Algorithm

Blood Pulse Detection Using Serial Autocorrelation looks at pulse oximetry data in a new way. Instead of utilizing a voltage threshold as a means to determine a pulse, BCI's latest technology analyzes a digitized signal (generated via a digital signal processing chip) in real time and compares it with previous pulse data. If similar characteristics to previous data are found, the device confirms a valid pulse. In essence, an individuals inherent pulse data is remembered and used as a template to accept or reject future pulse signals. Both SpO_2 and pulse rate determinations logically follow. The following illustrates this concept:



= Point of pulse detection with BCI's digital oximetry technology

= Retained template signal

Superior performance when used with mobile, poorly perfused individuals is a simple reason to consider the purchase of this new oximetry technology. With alarms greatly reduced, clinicians gain enhanced focus on their patients rather than a noisy, misleading monitor.