

Adaptive Filtering and Alternative Calculations Revolutionizes Pulse Oximetry Sensitivity and Specificity during Motion and Low Perfusion.

Graybeal J.M., Petterson M.T. *Proceedings of the 26th Annual International Conference of the IEEE EMBS*, 2004.

Pulse oximetry, utilizing spectrophotometric principles and normalized absorption of red and infrared light, provides vital information concerning patients' arterial oxygen saturation, pulse rate and perfusion level. Conventional pulse oximeters, incorporating conventional filters, are hampered by artifact interference from motion, electrical and ambient light and other conditions producing weak signals. Masimo introduced mathematically and physiologically based designs along with adaptive filtering and what it calls DST (Discrete Saturation Transform) as a solution to monitoring patients even during times of severe and unpredictable noise interference. This combined with 4 other alternative calculations, revolutionized pulse oximetry performance. This new technology is called Signal Extraction Pulse Oximetry or Masimo SET pulse oximetry.

Pulse oximetry utilizes basic spectrophotometric principles to determine the oxyhemoglobin concentration of the arterial blood. Two wavelengths of light (one in the red (r) frequency, 1 in the infrared frequency (ir) are used. The absorption of these wavelengths changes as each pulsation of blood occurs thereby producing the AC (pulsatile) and DC (nonpulsatile) components of the absorption waveform for each frequency. From these values an absorption ratio (R) is calculated ¹. This absorption ratio is then compared to a calibration curve for determination of arterial oxyhemoglobin saturation (SpO₂).

$$R = (ACr/DCr)/(ACir/DCir) ^1$$

Sensitivity and specificity of Signal Extraction Technology, was first tested extensively in the lab on volunteers under conditions designed to simulate varying physiology, including controlled desaturations, combined with severe patient motion, and low perfusion conditions. Conventional pulse oximeters demonstrated very low sensitivity and specificity while pulse oximeters with SET showed sensitivity and specificity of over 95% under the same conditions. Clinical testing was then performed on an extensive variety of patients in the hospital environment demonstrating similar performance, validating the significant advance resulting from the use of SET. False alarms due to motion artifact and low perfusion have been reduced from up to 90% to less than 5%.