USING IMPEDANCE PLETHYSMOGRAPHY TO MEASURE ARTERIAL PERFUSION

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Nowadays, vascular diseases have become an essential problem in the world and cost much money. Only an early recognition of the development of a vascular disease enables an optimal therapy and avoids or delays a chronic development, for example, chronic venous insufficiencies or arterial occlusive diseases. Therefore, it is very important to carry out screening examinations.

Impedance plethysmography is based on the measurement of changes in the electrical resistance (impedance) caused by blood volume changes. For this purpose a very low amount of high frequency alternating current is passed through the selected measuring segment. The measurement is possible because in comparison to other tissue, like skin, muscle or bone, blood has a much lower resistance. Therefore, blood volume variations correspond with the measurable changes of the electrical resistance (impedance).

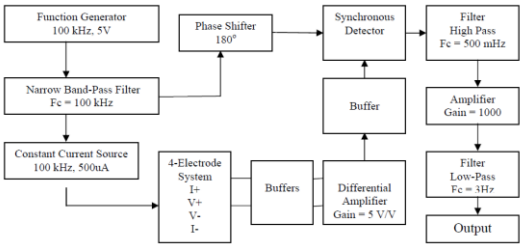

Figure 1. Block diagram for measure impedance system

The objective of this study was to develop a method for the detection of arterial blood flow, which utilized the 4-electrode sensor for the measurement of tissue impedance. The system developed, for the synchronous detection method, consisted of both analog hardware and software tools. The data acquisition hardware used during this research was the NI USB 6009. The software interface was developed in Lab View 2011. A filter selection capability was also incorporated in the interface in order to remove any unwanted signals or annoying noise.

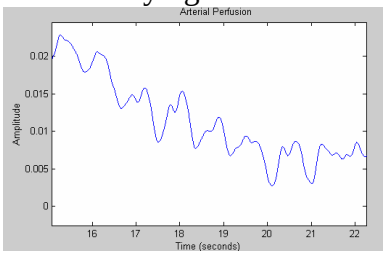

Figure 2. Impedance measured with the arm cuff inflated

Every calculation was performed as an average over 25 heart beats. All subjects had cardiac output, stroke volume and baseline of impedance (Z_0) measured during the recording session. We obtained the following values of the blood flow measurements in normal limbs: Arm: Flow/beat = 0.80–5.20 ml; Flow/minute= 90-300 ml/min; Z_0= 40-85 ohm; Leg: Flow/beat = 1.42–6.80 ml; Flow/minute= 100-440 ml/min; Z_0= 30–83 ohm.

This system can be used in the diagnosis of limb ischemia, allowing a noninvasive assessment of hemodynamic parameters.

[1] David A. Bell, *Operational Amplifiers and Linear ICs*, Oxford University Press, 2011.
[2] Cotter G., Moshkovitz Y., Kaluski E., Cohen A., Miller J. H., Goor D., Vered Z., Accurate, noninvasive continuous monitoring of cardiac output by whole-body electrical bioimpedance, *Chest*, 125, 2014, 1431-1440.