A FPGA based Measurement System for the Estimation of the Stroke Volume of the Heart by measuring Bioimpedance Changes- First Results

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Abstract—Bioimpedance is proving to be a very vital tool in analysis of various physiological parameters in the human body such as cardiac output and stroke volume of the heart, because of its non-invasiveness and real-time continuous monitoring. The conductivity curve can be obtained by introducing a small known alternating current via surface electrodes in the human body and by measuring the resultant surface voltages.

This work introduces a novel multi-frequency Bioimpedance Measurement system (BMS), which is able to accurately measure body impedances. The used measurement system is based on System on Chip (SoC) Field Programmable Gate Array (FPGA) and works in a frequency range of 10 kHz to 250 kHz. Additional to sinusoidal excitations also chirp signal excitations are possible to allow short-time broadband impedance measurements. Furthermore the system is in compliance with the IEC60601-1 safety requirements and allows excitation currents from 125 µA to 5 mA. The employed impedance demodulation is FFT based and has a temporal resolution of about 1 ms.

As pointed out by e. g. Suttner et al. [1] or Zoremba et al [2] the stroke volume of the heart can be estimated based on the heart beat induced conductivity changes of the tissue between the thorax and the neck of a subject. The measured time resolved conductivity curve is digitally processed and analyzed in Mathworks MATLAB. Estimates of the stroke volume and the cardiac output found from the first derivatives of the conductivity curves will be made. Moreover also different electrodes placements over the thorax and the extremities are tested with respect to their influence on the conductivity curves.

Keywords—Instrumentation, embedded measurement systems

REFERENCES


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