Abstract

The dissertation describes the measurement method for tissue impedance spectrometry. The new method of calculating spectrum impedance characteristics was introduced. The modulus characteristics and phase shifting are calculated from recorded waveforms of current extortion in circuit and voltage response of tested object. All extortions waveforms have constant spectral density in specified frequency band.

The proper functioning of the method was verified in series of simulations. The simulations were performed using state-space representation of the measuring circuit and tissue equivalent circuit. As extortions waveforms with: limited time sinc(t) function and modulated sinc(t) function and the impulse response of FIR filter were used. The response for each extortion was calculated and used in the new method to determine impedance spectrum.

The results of simulations were compared with analytical solution of a tissue model and the Pearson correlation coefficient was calculated. The value of the determined coefficients was approximately 0.99 for all used extortions. Analysis of the results proved correctness of measurements using the proposed measurement method.

Investigating the possibility of measuring the impedance spectrum using the new method required an equivalent electrical circuit of tissue model. The circuit was built using passive elements which values were chosen based on literature studies. The performed measurements also required a new measuring system which extended properties of a digital oscilloscope and an arbitrary generator. The system consists of high precision differential amplifiers used in measurement circuits and voltage controlled current source used in extortion circuit.

The measurements of impedance spectroscopy have been performed using the new method in comparison to frequency sweep technique. The results were compared by calculating the Pearson correlation coefficient. The value of the Pearson coefficient suggested high correlation between results of both methods. Analysis of the results showed that the impulse response of the FIR filter and the modulated $sinc(t)$ function used as extortions waveforms give the best performance. The new measurement method has also been used with a signal averaging technique, which increased the correlation between characteristics.

The final measurements were performed on a subject's arm. The measuring system has been supplied with a battery source to separate from the power grids. In order to obtain the reference characteristics the frequency sweep measurements were performed. Analysis of the results proved that the proposed method enables measurement of the impedance of tissue and determining both the impedance module and the phase shifting characteristics.

Keywords: *tissue impedance; bioimpedance spectroscopy; the impedance modulus characteristics; the phase shifting characteristics; the impulse response of FIR filter; modulated sinc(t) function.*