# Wavelet analysis of fetal ECG on the background of the mother's ECG

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*Abstract* – **The research results of uses of wavelet transforms for fetal ECG separation from the aggregated mother's and fetus's ECG are presented.**

*Keywords* – **fetal ECG, mother's ECG, wavelet transform.**

## I. INTRODUCTION

There is a necessity to register the electrocardiogram of the fetus in course of pregnancy monitoring. Today is often used as invasive - the imposition of special electrodes on the head of the fetus, as well as non-invasive - in ECG signals detected by the front wall of the abdomen pregnant, ways of recording fetal ECG. These results are suitable for analysis EKGF received non-invasive way.

## II. MAIN PART

In modern ECG data processing systems to highlight ECGF time and frequency signals analysis are most commonly used [1].

Several authors have formulated the problem of allocating ECGF as a problem of "blind source separation" - BSS. BSS-methods are algebraic methods for signal analysis of the fetus from the mixture signals [1]

The aim of this work is to select wavelet functions and parameters that would identify ECGF of aggregated ECG of fetus and mother.

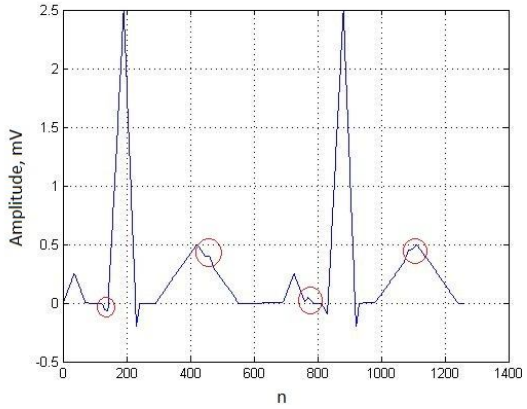


Fig.1 Aggregated ECG of mother and fetus.

In course of research a model ECG signal with known parameters was generated. This signal is an aggregated ECG of mother and fetus (fig.1). Changes, made by QRS-complex of the fetus in the mother's signal, are highlighted.

The wavelet transform is able to identify the position of the singularity ECG signal – coefficients of the wavelet transform of a smooth function are small and increase sharply when a particular, noting the location of the lines of local peak [2].

The researches were conducted with different wavelets, such as Gaussian wavelet, Haar wavelet, wavelet "Mexican hat", wavelet Meyer, Morlet wavelet, Daubechies wavelets, and others. The scale was varied s = 4 ... 64. All these results were obtained using the continuous wavelet transform defined as:

$$\gamma(\tau, s) = \int_{-\infty}^{+\infty} x(t) \frac{1}{\sqrt{s}} \psi^*\left(\frac{t-\tau}{s}\right) dt,$$

where $\tau$ represents shift, s-scale, $\psi(f)$-mother wavelet [3].

Figure 2 shows the results obtained by HAAR-wavelet.

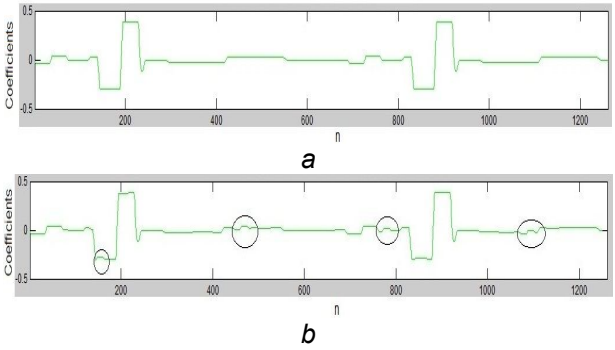


Fig.2 Coefficients Line(a-mother, b-fetus).

Areas in which change occurs due to the influence EKGF are highlighted.

## III. CONCLUSION

Among the considered wavelets the best results were obtained by applying wavelet transformation of the Haar basis. Influence of fetal ECG on the aggregated electrocardiogram is more visible at small scales, which is associated with low amplitude and high frequency EKGF against EKGM.

One promising avenue is the development of new wavelets, adapted to the task of separation mother's and fetus's ECG.

## REFERENCES

[1] *V.I. Shulgin, A.V. Tokarev* Method of recording and analysis of fetal electrocardiogram during pregnancy.

[2] *I.M. Dremin, O.V. Ivanov, V.A. Nechitailo* Wavelets and their application.

[3] *P.V. Gorbunov* Wavelet analysis of electrocardiograms.